REVISION OF THE DEEP-WATER MOLLUSCA OF THE ATLANTIC COAST OF NORTH AMERICA, WITH DESCRIPTIONS OF NEW GENERA AND SPECIES.

PART I.—BIVALVIA.

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THIS article is not intended as a review of all the known species found off our coasts. It is preliminary to a much more extensive report, in which full details of the distribution of all the species collected will be given, and for which the detailed tables have been prepared, giving every station for each species, with its position, depth, temperature, character of the bottom, etc.

Many of the larger and more prominent species were described and figured by the senior author several years ago in various papers published in the Transactions of the Connecticut Academy and elsewhere. The smaller and more difficult species were put aside at that time, for more careful study, and are now presented.

The families that are most fully treated in this article are the Ledidæ, Cuspidaridæ, Diplodontidæ, and Pectinidæ. These include a very large number of deep-sea species in every region, and their species are often very difficult to distinguish without long and patient microscopic study and direct comparison of large series of specimens from various localities.

The present article is intended to give some of the results of studies of this kind, made during several years, of the large series of specimens dredged by the United States Fish Commission off our coasts from 1871 to 1887, together with those previously dredged by the senior author in the same region.

In order to avoid, so far as possible, the uncertainty necessarily connected with mere descriptions of these forms, we have had large camera-lucida figures made, as carefully as possible, not only of the new species, but also of some of those previously described from our coast, for comparison. It is, therefore, to be hoped that future investigators may at least be able to understand the characters of the species now recognized by us, whether they agree with our determinations or not.

Although the collections studied are unusually extensive, and the number of stations represented is very large, it is noteworthy that a considerable number of species were met with but once, and sometimes only a single specimen was obtained. This indicates that many additional species of such small deep-sea shells would be discovered in the same region if additional dredgings should be made.

Our investigations have enabled us to add to the fauna nine genera, four subgenera, and about eighty species and varieties, of which about seventy are described as new species and seven as new varieties; of these, twelve species and one variety belong to the southern fauna.

The following list shows the genera in which the new species and varieties are included.[1] The new genera are printed in italic:

Martesiella, 1.
Abra, var. 1.
Macoma, 1
Montacuta, 4, var. 2.
Kelliopsis.
Cryptodon, 4, var. 1.
Axinulus, 6.
Axinopsis, 1, var. 1.
Axinodon, 1.
Leptaxinus, 1.
Cuspidaria, 8.
Cardiomya, 2.
Halonympha, 1.
Myonera, 3.
Poromya, var. 1.
Cetoconcha, 2.
Cetomya, 1.
Lyonsiella, 2.
Lyonsia, 1.
Clidiophora, 1.
Kennerlia, 1.
Periploma, 1.
Limatula, 3.
Chlamys, 2.
Hyalopecten, 1.
Camptonectes, 1.
Cyclopecten, 2.
Bathyarca, 2.
Bentharca.
Limopsis, 2.
Solemya, 1.
Nucula, 1, var. 1.
Leda, 1.
Ledella, 1, var. 1.
Adranella, 1.
Microyoldia.
Yoldiella, 11, var. 1.
Malletia, 2.
Neilonella, 1.
Tindaria, 3.

No attempt has been made to give the complete synonymy and details of the distribution. Such matters have been reserved for the final report on the collections.

Unless otherwise stated, the station numbers are those of the United States Fish Commission and the serial numbers are those of the United States National Museum.

The drawings, with few exceptions, were made by Mr. Alpheus H. Verrill, under the immediate supervision of the authors.

Peabody Museum of Yale University, New Haven, Connecticut, January 25, 1897.

[1]Owing to the long delay in the publication of this article, some of the new species and genera have been published elsewhere, so that these numbers are not now strictly correct.

Family PHOLADIDÆ.

MARTESIELLA, new subgenus.

This subgeneric name is proposed for the following species, which differs from *Martesia* in having a well-defined, elongated, median, dorsal plate, posterior to the umbos, in addition to the shield-shaped one over them.

MARTESIA (MARTESIELLA) FRAGILIS, new species.

(Plate LXXIX, fig. 10.)

Shell small, white, thin, fragile, wedge-shaped. The anterior end is very short and broadly rounded, the aperture nearly closed in our largest specimen by a pair of callous plates. The antero-dorsal margin is recurved toward the umbos, but not appressed, and forms a deep, spiral, open cavity. The valves have a very obtuse anterior emargination. A broad and moderately deep sulcus runs from the beak to the ventral margin; in front of this the surface is covered by thin concentric ribs, which curve downward at the sulcus and form a distinct angle in line with the anterior emargination and corresponding with a slight ridge on the surface; these concentric ribs are crossed by fine radiating lines, which produce fine serrations on their edges. Posterior to the sulcus the surface is marked only by irregular lines of growth, which, near it, take the form of more distinct grooves or ridges. The posterior end is prolonged, compressed, and bluntly rounded. The umbonal plate is thick, relatively large, and usually heart-shaped, with the posterior end broader and distinctly emarginate in the middle; the anterior end tapers somewhat and is blunt and angulated, or sometimes subacute. The posterior dorsal plate is long, narrow, and somewhat spatulate or clavate, and stands well in relief above the dorsal margin, with the edges free and the narrow anterior end running under the posterior end of the umbonal plate.

Length of one of the largest specimens, 7 mm.; height, 4.5 mm.; thickness, 4 mm.

Young specimens 3 or 4 mm. in length are relatively shorter and thicker than the larger ones, but even these have the anterior callous pretty well developed; the umbonal plate is usually shield-shaped, the lateral borders emarginate, in contact with the most prominent part of the umbos; the posterior border is distinctly emarginate, and the anterior end has a central point or mucro, sometimes defined by slightly concave posterior edges.

Many live specimens were found in a piece of wood floating near station 2566, N. lat. 37° 23′, W. long. 68° 8′, 1885.

Family SEMELIDÆ.

ABRA LONGICALLIS (Scacchi), variety AMERICANA, new.

(Plate LXXXIII, figs. 6, 7.)

Abra longicallis VERRILL, Trans. Conn. Acad., VI, pp. 224, 278, 1884.

Our specimens differ from the European form described and figured by G. O. Sars[1] in having the posterior lateral tooth less remote and the cartilage-pit or chondrophore longer, the antero-dorsal margin more convex, and the whole shell relatively broader.

A very few specimens were obtained at six stations between N. lat. 39° 49′, W. long. 68° 28′ 30″, and N. lat. 36° 16′ 30″, W. long. 68° 21′, in 924 to 2,620 fathoms, 1883–1886.

Family TELLINIDÆ.

MACOMA INFLATA Dawson.

(Plates LXXVII, fig. 1; LXXXVIII, fig. 6.)

Macoma inflata (STIMPSON MSS.) DAWSON, Canadian Naturalist, VI, p. 377, 1872.—VERRILL, Trans. Conn. Acad., V, p. 568, 1882.

A number of live specimens and separate valves were obtained at six stations between N. lat. 47° 40′, W. long. 47° 35′ 30″, and N. lat. 40° 3′, W. long. 70° 31′, in 57 to 206 fathoms, 1877–1886. Murray Bay.—Dawson. Gulf of St. Lawrence.—Coll. Whiteaves.

Family PETRICOLIDÆ.

CHORISTODON ? CANCELLATUS Verrill.

(Plate XCVI, figs. 2, 3.)

Choristodon ? cancellatus VERRILL, Trans. Conn. Acad., VI, p. 435, 1885.—DALL, Bull. U. S. Nat. Mus., No. 37, p. 58, 1889.

One valve, station 2265, off Chesapeake Bay, in 70 fathoms, 1884.

Family KELLIELLIDÆ.

KELLIELLA NITIDA Verrill.

(Plates XCI, fig. 8; XCIII, fig. 10.)

Kelliella sp. VERRILL, Trans. Conn. Acad., VI, p. 279, 1884; Expl. *Albatross*, Report U. S. Com. Fish and Fisheries for 1883, p. 576, 1885.
Kelliella nitida VERRILL, Trans. Conn. Acad., VI, p. 438, 1885.

Comparatively few specimens, at seven stations between N. lat. 39° 5′ 30″, W. long. 70° 44′ 30″, and N. lat. 38° 20′, W. long. 70° 8′ 30″, in 1,525 to 2,033 fathoms, 1883–1886.

[1] Mollusca Reg. Arcticæ Norvegiæ, p. 74, pl. 6, figs. 3 *a–c;* pl. 20, fig. 4, 1878.

Family LEPTONIDÆ or ERYCINIDÆ.

KELLIA SUBORBICULARIS (Montagu).

(Plate XCIV, figs. 3, 4.)

Kellia suborbicularis H. and A. ADAMS, Genera Recent Moll., II, p. 475; III, pl. CXIV, figs. 8 *a–c*, 1858.—JEFFREYS, British Conchology, II, p. 225, pl. V, fig. 3, 1863; V, p. 179, pl. XXXII, fig. 2, 1869.—GOULD, Rep. on Invert. of Mass., Binney's ed., p. 83, fig. 394, 1870.—TRYON, Amer. Mar. Conch., p. 171, pl. 32, figs. 433, 435, 1873.—G. O. SARS, Mollusca Reg. Arcticæ Norvegiæ, p. 67, pl. 19, figs. 14 *a-b*, 1878.—JEFFREYS, Proc. Zoöl. Soc., London, p. 700, June, 1881.—SMITH, E. A., Report Voy. Challenger, Zoöl. Lamellibranchiata, XIII, p. 201, 1885.—DALL, Bull. U. S. Nat. Mus., No. 37, p. 200, pl. LXVIII, fig. 5, 1889.

One fresh specimen, Massachusetts Bay, off Salem, 1877. This species appears to be very rare on the American coast. In its hinge-characters it seems to agree closely with *Bornia* Philippi, 1836.

MONTACUTA BIDENTATA (Montagu).

(Plates XCIII, figs. 7, 8; XCIV, fig. 6.)

Mya bidentata MONTAGU, Test. Brit., p. 44, pl. XXVI, fig. 5, 1803.

Montacuta bidentata FORBES and HANLEY, Hist. Brit. Moll., II, p. 75, pl. XVIII, figs. 6, 6*a*.

Tellimya bidentata H. and A. ADAMS, Genera Recent Moll., II, p. 478; III, pl. CXV, figs. 2, 2*a*, 1858.

Montacuta bidentata JEFFREYS, British Conchology, II, p. 208, pl. V, fig. 1, 1863; V, p. 177, pl. XXXI, fig. 8, 1869.—G. O. SARS, Mollusca Reg. Arcticæ Norvegiæ, p. 69, pl. 19, figs. 17*a-b*, 1878.—JEFFREYS, Proc. Zoöl. Soc., London, p. 698, June, 1881.—VERRILL, Trans. Conn. Acad., V, p. 571, 1882.—BUSH, Trans. Conn. Acad., VI, p. 479, 1885; Expl. *Albatross*, Report U. S. Com. Fish and Fisheries for 1883, p. 590, 1885 Not *Montacuta bidentata* Gould.

Comparatively few specimens have been found in Long Island Sound and at Thimble Island (A. E. Verrill); Provincetown, Massachusetts (S. I. Smith and O. Harger); Vineyard Sound, 1875; Cape Cod Bay, 1879; off Block Island, 1880; Woods Hole, Massachusetts (Gut of Canso, and Naushon Gutters), 1882–83. From low-water to 15½ fathoms. Off Cape Hatteras, North Carolina, in 14 to 48 fathoms, 1883 and 1884.

MONTACUTA BIDENTATA (Montagu), variety TENUIS, new.

(Plate XCII, fig. 7.)

Shell similar to the typical *M. bidentata* in form and size, but relatively more elongated and more nearly elliptical, with the umbos and beaks somewhat less prominent. The surface is covered with fine and pretty regular lines of growth. The teeth in the right valve are strong, nearly equal in length and in the amount of divergence from the dorsal margin. They diverge more strongly and are thicker and more prominent, especially at the inner end, than is usual in the true *bidentata*.

Length of a medium size specimen 4.7 mm.; height, 2.6 mm.

A few separate valves, off Cape Hatteras, North Carolina, in 16 to 17 fathoms, 1884.

MONTACUTA BIDENTATA (Montagu), variety FRAGILIS, new.

(Plate XCII, fig. 8.)

Shell subelliptical, inequilateral, both ends broadly rounded, thin, fragile, covered with delicate lines of growth. The umbos are flattened; beaks but slightly prominent. The teeth in the right valve are smaller and more delicate than in the typical *bidentata*, and diverge but slightly from the dorsal margin, as in that species.

Length, 4 mm.; height, 3 mm.

One specimen (No. 46134), station 816–17, in Narragansett Bay, in 8½ to 10 fathoms, 1880.

MONTACUTA STRIATULA, new species.

(Plate XCIII, fig. 9.)

Shell rather large, thin and somewhat hyaline, compressed, broad-elliptical with both ends well rounded, the anterior much the longer. Antero-dorsal margin nearly straight with a gradual slope; anterior end broadly and regularly rounded, its outline forming nearly the segment of a circle; ventral margin broadly and evenly convex; posterior end bluntly rounded with its dorsal margin slightly concave and sloping rapidly. Umbos not swollen; beaks acute and only a little prominent. Surface covered with fine, regular, concentric, microscopic striæ and more distant lines of growth. Interior somewhat shining with inconspicuous muscular scars. Hinge-margin thin, delicate, only slightly thickened. In the right valve there is, on each side of the beaks, a short, rather delicate, elevated, triangular tooth, terminating distally with an abrupt slope; these are nearly equal in size and length, the anterior one being slightly the shorter and more angular. They are separated by a V-shaped notch, the sides of which form nearly a right angle. In the left valve there are two thin, slightly prominent elevations, scarcely worthy the name of teeth, separated by a very wide angle under the beak.

Length of one of the largest specimens, 7 mm.; height, 6 mm.

This species is much larger than any of our other species of this genus, and may possibly prove to be identical with *M. bowmani*, described and figured by Holmes.[1] Owing, however, to the shortness of the description and small size of the figures, this question cannot be definitely decided without a careful comparison with authentic specimens.

A few separate valves were found off Cape Hatteras, North Carolina, in 15 to 48 fathoms, 1883–84.

[1] Post-pleiocene fossils of South Carolina, p. 30, pl. VII, fig. 2, 1860.

MONTACUTA OVATA Jeffreys.

(Plate XCII, figs. 9, 10.)

Tellimya ferruginosa VERRILL, Notice of Recent Add. to Mar. Invert., Pt. 3, Proc. U. S. Nat. Mus., III, p. 400, 1880.

Montacuta ovata JEFFREYS, Proc. Zoöl. Soc., London, p. 698, pl. LXI, fig. 4, June, 1881.—VERRILL, Trans. Conn. Acad., V, p. 571, 1882; VI, p. 279, 1884.

A very few specimens, at four stations, off Newport, Rhode Island, and off Marthas Vineyard, in 100 to 157 fathoms, 1880–81.

MONTACUTA TUMIDULA Jeffreys.

(Plates XCIII, fig. 6; XCIV, figs. 1, 2.)

Montacuta tumidula JEFFREYS, British Conchology, V, p. 177, pl. C, fig. 5, 1869.—G. O. SARS, Mollusca Reg. Arcticæ Norvegiæ, p. 69, pl. 19, figs. 18 *a–b*, 1878.—VERRILL, Trans. Conn. Acad., VI, pp. 225, 279, 1884; Expl. *Albatross*, Report U. S. Com. Fish and Fisheries for 1883, p. 575, 1885.

One live specimen and three valves, at three stations between N. lat. 40° 7′, W. long. 67° 54′, and N. lat. 35° 49′ 30″, W. long. 74° 34′ 45″, in 843 to 1,091 fathoms, 1883–1886.

MONTACUTA CASTA, new species.

(Plate XCIV, fig. 5.)

Shell small, compressed, oblong-ovate, with the anterior end considerably the longer and both ends about equally rounded. Beaks small, scarcely rising above the margin. Surface covered with fine, regular, microscopic, concentric striæ and distant, raised lines of growth. The antero-dorsal margin is at first a little incurved, then slightly convex; with a gradual slope; the anterior end is obtusely rounded; the ventral margin is broadly and evenly rounded; the posterior end is slightly produced and a little angulated below, in some specimens with the dorsal margin sloping more rapidly than the anterior and slightly incurved near the beaks. The hinge-margin is thin and delicate. In the right valve there are two moderately thick, rather prominent teeth; the one behind the beak is shorter than the other, with a more abrupt posterior slope; they are separated from the slightly thickened margin by a deep groove and from each other by a large notch or angle, the sides of which form an angle of about 90°. On the thickened margin there is a thin, rough, shallow ligamentary furrow both in front of and behind the beaks. In the left valve there is an elongated, thin, and not very prominent, tooth-like elevation on each side of the beak; they are nearly equal in size and separated by a very broad angle.

Length of the largest specimen, about 2.4 mm.; height, about 1.8 mm.

A few separate valves, off Cape Hatteras, North Carolina, in 14 to 17 fathoms, 1884.

MONTACUTA CUNEATA, new species.

(Plates XCI, fig. 4; XCIII, fig. 5.)

Shell small, elongated, wedge-shaped, with a much produced, narrow anterior end, and with the dorsal margins nearly straight, sloping rapidly, and forming an obtuse angle at the beaks, which are decidedly behind the middle, prominent, curved inward. Antero-dorsal margin sloping rapidly, at first nearly straight, becoming a little convex, and curving regularly into the ventral margin, thus forming a somewhat rostrated, narrow, evenly rounded anterior end; ventral margin nearly straight, sometimes with a slight incurvature opposite the beaks; posterior end bluntly rounded, with its dorsal margin nearly straight, sloping about equally with the anterior. The surface is covered with fine, concentric, rather regular lines of growth and microscopic striations. Interior somewhat shining. In the right valve there are two well-defined, prominent, thickened teeth, separated by a large, deep notch under the beak; the anterior one is the larger and is broadly triangular, with a prominent excurved tip, and is separated from the hinge-margin by a deep furrow, which runs obliquely within and below the thickened dorsal margin; the posterior one is set obliquely to the margin, from which it is separated by a well-defined groove. In the left valve there is a wide notch beneath the beak, with a rather inconspicuous, elongated, somewhat thickened anterior tooth-like projection, which continues forward as a thickened inner margin nearly to the end, and a shorter, broad, triangular posterior projection. Color cream-white, sometimes tinged with pink.

Length of the largest specimen, about 3 mm.; height, 1.5 mm.

A few specimens were found off Cape Hatteras, North Carolina, in 15 and 16 fathoms, 1883–84.

MONTACUTA TRIQUETRA, new species.

(Plate XCI, fig. 3.)

Shell small, covered with regular concentric grooves, scarcely compressed, somewhat triangular, with a slightly rostrated, angular posterior end, and a regularly rounded anterior one. Umbos a little swollen, beaks nearly central, pointed and a little prominent. The anterior and posterior dorsal margins form nearly a right angle; the anterior margin is slightly convex and passes gradually into the somewhat bluntly rounded anterior end; ventral margin broadly convex, becoming slightly incurved toward the posterior rostration, which is wedge-shaped, rapidly tapered, with a narrow truncate tip, defined below by a faint, radiating ridge; postero-dorsal margin is nearly straight, and slopes rapidly from the beaks. The surface is sculptured with strongly marked, smooth, rounded, concentric ridges having the upper edge smooth and recurved; these are separated by deep, regular grooves

which appear in some places to extend beneath the upper edge of the ridges; on the umbos and posterior rostrum these ridges and grooves become feeble and irregular, like lines of growth. Internally the surface is white and smooth, with the muscular scars rather strongly marked.

The hinge-margin is rather thick; in the right valve there are two strong, prominent, curved, cardinal teeth, separated by a large, somewhat oblique notch which extends upward into the beak; the posterior tooth is the narrower and more prominent, with the tip curved forward and upward; the anterior tooth is connected, just in front of the beak, by a bridge-like extension to the external margin, leaving between the tooth and the margin a deep submarginal groove; the inner edge of the hinge-margin is a little thickened to form a ridge continuous with the anterior tooth. In the left valve there is a distinct notch under the beak for the cartilage or resilium; in front of this is a prominent, tooth-like thickening of the margin of the shell, the proximal end of which becomes tooth-like, but is continuous with the rest of the hinge-margin; behind the notch there is no tooth and the margin is only a little thickened, without any special prominence.

Length, about 2 mm.; height, 1.4 mm.

Two valves, station 2307, off Cape Hatteras, North Carolina, in 43 fathoms, 1884.

TELLIMYA FERRUGINOSA (Montagu).

(Plate XC, figs. 7, 8.)

Tellimya ferruginosa H. and A. ADAMS, Genera Recent Moll., II, p. 479, 1858.
Montacuta ferruginosa JEFFREYS, British Conchology, II, p. 210, 1863; V, p. 178, pl. XXXI, fig. 9, 1869.
Tellimya ferruginosa G. O. SARS, Mollusca Reg. Arcticæ Norvegiæ, p. 70, pl. 20, figs. 1, *a–c*, 1878.—VERRILL, Trans. Conn. Acad., VI, 225, pl. XXX, fig. 13, 1884.
Montacuta ferruginosa FISCHER, Manuel de Conchyliologie, p. 1027, fig. 775, 1887.
Tellimya ferruginosa DALL, Bull. U. S. Nat. Mus., No. 37, p. 50, pl. XLV, fig. 13, 1889.

A few specimens were found at low-water at Woods Hole, Massachusetts (Gut of Canso), and Gutters of Naushon Island, 1882–83. The figure of the living animal published by Verrill in 1884 has been copied by Dall, Fischer, and others. We now give additional ones.

KELLIOPSIS, new genus.

Type.—Montacuta elevata Stimpson.

The shell, in size and form, resembles *Kellia* and *Montacuta*. In both valves there is a small, prominent, anterior tooth and a low, elongated, thickened posterior ridge, scarcely amounting to a tooth. The resilium is large and is attached to an elongated, oblique excavation on the proximal edge of the posterior tooth-like ridge, and also to a triangular pit beneath the beak; it bears a large, elongated, curved ossicle. Soft parts not observed.

This genus appears to be closely allied to *Montacuta*, but differs in not having a definite, raised, posterior tooth; in having a large, elongated posterior cartilage, bearing a large ossicle attached to a special groove along a tooth-like ridge; and in having the structure of the hinge in both valves nearly the same. In the position of the resilium it resembles *Erycina*, but the latter has two large teeth in both valves.

KELLIOPSIS ELEVATA (Stimpson).

(Plates XCIII, figs. 2-4; XCIV, figs. 7, 8.)

Montacuta bidentata GOULD, Rep. on Invert. of Mass., 1st ed., p. 59, 1841. (Not of Montagu.)

Montacuta elevata STIMPSON, Shells of New Eng., p. 16, 1851.

Cyamium elevatum H. and A. ADAMS, Genera Recent Moll., II, p. 477, 1858.

Montacuta elevata GOULD, Rep. on Invert. of Mass., Binney's ed., p. 86, fig. 396, 1870.—TRYON, Amer. Mar. Conch., p. 172, pl. XXXIII, fig. 440, 1873.—VERRILL, Report Invert. Anim. of Vineyard Sd., in 1st Rep. U. S. Fish Com., pp. 394, 688, 1874 (auth. cop., p. 418).

Tellimya elevata DALL, Bull. U. S. Nat. Mus., No. 37, p. 50, pl. LXVIII, fig. 6 (as *Montacuta elevata* Stimpson), 1889.

This rare species has been obtained at low-water mark, at Savin Rock, near New Haven, Connecticut (J. E. Todd), 1871; Wellfleet, Massachusetts (Webster), 1879; Woods Hole, Massachusetts (Gut of Canso), 1882; Naushon Island (Gutters and Sheep Pen Cove), 1882; and Narragansett Bay, in 8½ to 10 fathoms, 1880.

Family DIPLODONTIDÆ.

Ungulinidæ FISCHER; *Diplodontidæ* + *Cryptodontidæ* Dall.

CRYPTODON Turton, 1822.

Type.—Cryptodon flexuosus (Montagu).

The typical species of this genus have no distinct teeth in either valve, but the inner margin of the hinge-plate is more or less thickened or swollen in front of and behind the beaks. The ligament is posterior and lies in a long, curved furrow in the midst of the marginal thickening; where it commences at the beak it is marginal and external, but as it runs backward it recedes from the edge and becomes more or less internal and invisible from the exterior. Moreover, the posterior end of the shell has one or more distinct radial corrugations or plications to give the thin shell strength enough to resist the action of the large posterior adductor muscle which is attached directly upon the principal plication. The pedal muscle is attached to the upper plication when the latter is present. Many writers have adopted the name of *Axinus* Sowerby, 1823, for this genus; the latter name was given to a tertiary species, the structure of which is not fully determined. It may belong to a very distinct genus. Moreover, Turton's name seems to have actual priority of publication.

CRYPTODON GRANDIS Verrill.

Cryptodon grandis VERRILL, Trans. Conn. Acad., VI, p. 436, pl. XLIV, fig. 22, 1885; Expl. *Albatross*, Report U. S. Com. Fish and Fisheries for 1883, p. 575, 1885.—DALL, Bull. U. S. Nat. Mus., No. 37, p. 50, pl. XLVI, fig. 22, 1889.

Schizothærus grandis (*pars*) LOCARD, Campagne du "*Caudan*," Annales de l'Université de Lyon, p. 180, 1896.

This large and interesting species, described in detail and well figured in the first article quoted above, is a true *Cryptodon*, although very distinct from any of our other species. Therefore it seems strange that M. Locard has referred it to the very different genus, *Schizothærus* of Conrad, which belongs to the Mactridæ. He identifies without question a single valve, dredged by the *Caudan* off the coast of France, in 1,710 meters, as our species. It is, therefore, doubtful whether his specimen is congeneric with ours, for the latter certainly has no affinity with *Schizothærus*.

One live specimen and a few separate valves were dredged at three stations between N. lat. 38° 29′, W. long. 73° 9′, and N. lat. 35° 9′ 50″, W. long. 74° 57′ 40″, in 938 to 1,582 fathoms, 1883–84.

CRYPTODON INSIGNIS, new species.

(Plate XCI, figs. 1, 2.)

Cryptodon sarsii VERRILL, Proc. U. S. Nat. Mus., III, p. 399, 1880; Trans. Conn. Acad., V, p. 570, 1882.

Shell unusually large and thick for the genus, opaque white or tinged faintly with reddish internally. Outline somewhat variable, usually broad-ovate or subquadrate, usually moderately swollen, sometimes rather compressed. Umbos moderately large, not very prominent; beaks small and turned forward. Lunule cordate, rather large, pretty well defined. The radial folds and lobes are less marked than is usual in this genus. A well-marked fold or shallow undulation extends from the beak to the posterior margin, opposite the scar of the adductor muscle; anterior to this there is a broad, slightly raised ridge, extending from the umbo to the siphonal lobe of the margin; in front of this there is usually a broad faint depression of the surface which is scarcely apparent in many specimens; a posterior groove runs close to and nearly parallel with the postero-dorsal margin. The antero-dorsal margin, in the lunular region, is straight or slightly incurved; the anterior end is short, a little prominent below the lunule, and obtusely rounded; the ventral margin, is very broadly rounded, usually with a slightly more prominent lobe at or just behind the middle, with a more decided but obtuse projection (siphonal lobe) farther back where it joins the posterior margin, which is usually somewhat incurved, corresponding to the external wave-like depression, becoming convex opposite the posterior external fold; the postero-dorsal margin slopes rapidly from the beak and is sometimes broadly rounded, and at others slightly convex. The surface is covered with conspicuous, more or less irregular,

rounded, obtuse, often prominent lines of growth with a thin yellowish brown epidermis which, under the lens, is closely covered with minute granules often arranged in more or less distinct concentric lines. The posterior hinge-margin is somewhat thickened, the ligamental groove is long and curved, diverging considerably from the margin of the shell at its posterior end and extending forward under the beak. Muscular scars and pallial line in the largest specimens strongly marked; the anterior scar is considerably elongated and has a number of lobes or scallops on its inner margin.

Length of a medium-sized specimen, 27 mm.; height from siphonal lobe to beak, 27 mm.; breadth, 14 mm. Length of a larger, more ovate specimen, 32 mm.; height from siphonal lobe to beak, 35 mm.; breadth, 21 mm.

This species presents considerable variation in outline and in the degree of convexity of the valves; some are subquadrate in form, others subcordate, and others pretty well rounded, but the majority are oblong-obvate with a posterior truncation, corresponding to the broad radial groove; some of the valves are considerably inflated, but most of them are more compressed than is usual in this genus. There is also considerable variation in the prominence of the siphonal lobe and broad radial ridge, and in the size of the lines of growth, which in some specimens are quite fine and regular, and in others unevenly developed, those on the anterior part appearing almost like concentric ribs.

Many separate valves, at four stations between N. lat. 44° 54′, W. long. 59° 46′ 45″, and N. lat. 42° 19′, W. long. 69° 47½′, in 65 to 471 fathoms, 1879 and 1885.

The single valve found off Cape Cod, 1879, and identified as *Cryptodon sarsii*, proves to be the young of this species.

CRYPTODON PLICATUS Verrill.

(Plate LXXXIX, fig. 6.)

Cryptodon plicatus VERRILL, Trans. Conn. Acad., VI, pp. 437, 450, 1885.

One young live specimen and one imperfect valve of this characteristic and fragile species were found at two stations, off Marthas Vineyard, in 1,073 to 1,122 fathoms, 1884.

CRYPTODON CROULINENSIS (Jeffreys) Smith.

(Plate XC, figs. 3, 4.)

Clausina croulinensis JEFFREYS, Ann. Mag. Nat. Hist., XX, p. 19, 1847.

Axinus croulinensis JEFFREYS, Brit. Con., II, p. 250, 1864.—G. O. SARS, Mollusca Reg. Arcticæ Norvegiæ, p. 62, pl. 19, figs. 8, *a–b*, 1878.—JEFFREYS, Proc. Zoöl. Soc., London, p. 703, June, 1881.

Cryptodon croulinensis SMITH, E. A., Report Voy. *Challenger*, Zoöl. Lamellibranchiata, XIII, p. 193, 1885.

Shell small, obliquely subovate, with the beaks prominent, and the anterior end considerably the longer. The antero-dorsal margin is

nearly straight, sloping rapidly from the beak; the anterior end is distinctly produced, evenly rounded; the ventral margin is slightly but regularly convex to the lower posterior fold; the posterior end is marked by two distinct plications separated by a rather prominent ridge which, at the margin, appears as a rounded projection separating two reentrant curves; the postero-dorsal margin is convex, sloping rapidly to the upper plication. The ligamental area is relatively large, long, elliptical, defined by a distinct groove. Internally the hinge-margin is considerably thickened, especially directly under the beak, where there is a slight swelling; the posterior ligament occupies a very distinct groove, and extends forward under the tip of the beak.

Length, 3.5 mm.; height, 3.75 mm.

The shell here referred to this species appears to agree well with the figures and descriptions given by G. O. Sars. It pretty closely resembles some varieties of *C. gouldii*. The principal differences externally are in the somewhat more produced anterior end and the longer and straighter antero-dorsal margin; the posterior plications are also less strongly developed.

Found in small numbers at about thirty stations north of Cape Cod, between N. lat. 43° 44½′, W. long. 69° 22′, and N. lat. 42° 30′, W. long. 70° 38′, in 13 to 73 fathoms, 1873–1879.

CRYPTODON CROULINENSIS (Jeffreys) Smith, variety ALTUS, new.

(Plate LXXXVIII, figs. 1, 2.)

Shell higher than long, larger than the common form. Umbos prominent, elevated and turned forward, so as to leave a rather large, conspicuous, flattened, lunular area, which is bordered externally by a slight ridge, followed by a concave depression in the surface, which forms a slight indentation in the anterior margin, and resembles the posterior plication, but is more shallow. The antero-dorsal margin in the lunular region is slightly concave, but slopes very rapidly; the anterior end is a little more produced than the posterior, but both are decidedly short; the ventral margin is pretty evenly rounded; posteriorly there are two distinct plications; the lower or larger one is moderately sunken and extends from the beak to the posterior margin, the upper one is much shorter and narrower and defines the narrow, lanceolate, ligamental area; each produces a decided indentation in the margin, that caused by the lower one being more sharply defined and shorter than the other, these are separated by a well-defined, curved, radiating ridge which extends a little below the margin; the postero-dorsal margin is strongly convex, evenly rounded, with a rapid slope; the hinge-margin is considerably thickened, especially beneath the beak, and in the right valve forms a distinctly raised tubercle.

Length, 5 mm.; height, 6 mm. Eastport, Maine, 1870.

Another specimen, from station 292, is slightly smaller. Length,

4.5 mm.; height, 5.25 mm. In this the anterior or upper plication is much less distinct than in the type, and it is therefore possible that this feature is abnormal.

CRYPTODON EQUALIS, new species.

(Plate XCI, figs. 5, 6.)

Shell of moderate size, grayish white, rather swollen, pyriform, usually a little higher than long, but sometimes the height and length are about equal. Umbos rather prominent; beaks median, conspicuously raised above the margin and curved strongly forward so as to produce a rather deep, broad, cordate, but ill-defined lunular area. Anterior and posterior ends nearly equal. The dorsal margin slopes rapidly on both sides of the beak; anteriorly, in the lunular region, it is nearly straight; the anterior end is pretty evenly rounded, forming a continuous curve with the ventral margin, which forms nearly a semicircular curve; the posterior end has one broad, shallow undulation which causes a slight incurvature in the postero-ventral margin; above this the dorsal margin is very slightly convex and forms an angle at the commencement of the fold. The ligamental area is marked by a smooth, long, lanceolate, slightly sunken portion, clearly separated by an incised line. The general surface is covered with slightly marked, more or less irregular lines of growth. The hinge-margin is moderately thickened and is essentially the same in both valves. There is a well marked swelling both before and behind the beak and a more conspicuous one immediately under it; a less conspicuous thickening, with its external edge excurved, extends along the postero-dorsal margin, in the ligamental region. Muscular and pallial scars indistinct.

Length, 5 mm.; height, 5½ mm.; thickness, 4 mm. Some specimens are somewhat larger than this.

In the large series which we have of this species there is some variation. In some cases the form is less swollen, the length is slightly in excess of the height, so that the general outline is more evenly rounded. The species is, however, notable for the equality of the anterior and posterior ends and the presence of the single slight undulation. *Cryptodon gouldii* somewhat resembles this species, but differs in being longer in proportion to its height, in its more compressed form, and in having two distinct folds or undulations. It is also closely allied to *C. flexuosus* of Europe, but is more pyriform in shape and lacks the anterior angulation noticeable in that species.

Taken at thirty-two stations, between N. lat. 47° 40′, W. long. 47° 35′ 30″, and N. lat. 37° 08′, W. long. 74° 33′, in 94 to 1,537 fathoms, 1873–1886.

CRYPTODON PLANUS, new species.

(Plate LXXXVIII, figs. 3, 4.)

Shell small, well-rounded, the length and height about equal, with the beak small, prominent, nearly central, curved strongly forward,

forming a small, sunken, heart-shaped, lunular area. Posteriorly there is only a faint, depressed undulation, which causes but a slight indentation or angulation in the margin; behind this the surface rises slightly and forms an inconspicuous ridge surrounding the ligamental area, which is long, rather narrow, and sunken, so that its margin is scarcely visible in a side view. The dorsal margin is a little convex and slopes but little, and about equally on both sides of the beak; the anterior end is well-rounded and slightly produced; the ventral margin is broadly rounded, a little produced in the middle, and nearly straight or very slightly incurved posteriorly, opposite the undulation; behind this there is a slight obtuse angulation corresponding to the ridge below the ligamental area. Surface dull grayish white. The hinge-margin is considerably thickened, especially below the beaks and lunular area, and a thickened ridge also extends backward beyond the ligamental area. There is no distinct tubercle nor tooth-like projection. The posterior ligament is unusually strong, and occupies a rather conspicuous submarginal groove which runs forward under the beak as a thin incised line.

Length, 4 mm.; height, the same.

Found in 8 to 100 fathoms, north of Cape Cod, in the Gulf of Maine, Casco Bay, Bay of Fundy, and Halifax Harbor, 1872–1885.

CRYPTODON OBSOLETUS, new species.

(Plate LXXXIX, figs. 1, 2.)

Shell small, higher than long, with the ends and ventral margin rounded. Umbos somewhat prominent and swollen; beaks curved strongly forward. Posterior plication obsolete, or nearly so, only visible in certain positions, and imperfectly defined by a faint undulation of the surface and margin. The antero-dorsal margin is slightly convex in the lunular area, and slopes rapidly to the broadly rounded anterior margin with which it forms a very slight and very obtuse angle; the whole ventral margin is well-rounded, a little produced in the middle; the postero-dorsal margin is broadly convex and ends distally in a very obtuse, rounded angle, above which there is a slight inbending of the edge. The hinge-plate is rather thick, especially posteriorly. The ligament is rather strong and considerably curved and occupies a narrow, but very distinct groove, mostly within the margin posteriorly, and extends forward under and in front of the beaks. The anterior hinge-margin is thickened and a little flexuous toward the anterior angle of the shell; the proximal end, just under the beak, is slightly thickened without forming any apparent tooth. Under the microscope, the surface is covered with rather coarse, irregular, concentric undulations, and fine, raised lines of growth, becoming smoother at each end, where there are patches of a closely adherent coating of red mud and iron oxide.

Length, 2.4 mm.; height, 2.6 mm.

Four specimens, at three stations, off Marthas Vineyard, in 100 to 390 fathoms, 1880–1885.

AXINULUS, new subgenus or genus

Type.—*Axinulus brevis*, new species.

We propose this division to include those species which agree with *Cryptodon* in the character of the hinge and ligament, but lack the plications of the shell, and have, therefore, a smaller posterior adductor muscle.

CRYPTODON (AXINULUS) BREVIS, new species

(Plate LXXXIX, figs. 7, 8.)

Shell small, short, the height exceeding the length, somewhat pyriform, with slightly prominent umbos and small subcentral beaks, which are but little prominent and turn forward. The antero- and postero-dorsal margins are about equal in length, the latter slightly more broadly rounded than the former, which is a little incurved near the beak so as to form a very slight lunular area; both ends are broadly rounded and nearly equal; the ventral margin is slightly convex and a little produced just in front of the middle; an exceedingly faint, scarcely discernible undulation runs from the beak to the posterior ventral margin. The surface is covered with very fine, close, parallel lines of growth visible only when much magnified. Grains of fine ferruginous sand or mud usually adhere closely to the surface, both anteriorly and posteriorly. The posterior ligament is well-developed and occupies a well-marked marginal groove; a small, thickened, more internal portion, situated just behind the beak, within the margin, appears to be continuous with the external ligament. The inner edge of the dorsal margin is slightly thickened, for a short distance, just in front of the beak.

Length, 2⅓ mm.; height, 2.5 mm.

Several live specimens and separate valves were found at six stations, between N. lat. 40° 16′ 50″, W. long. 67° 5′ 15″, and N. lat. 38° 22′, W. long. 70° 17′ 30″, in 984 to 1,825 fathoms, 1883–1886.

At station 2208 was found a single imperfect valve closely resembling this species but of much larger size.

Length, 5.5 mm.; height, 6.5 mm.

It is, however, much less regular in outline, having a nearly straight, rapidly sloping antero-dorsal margin, merging very abruptly into the broadly and very slightly curved and sloping anterior margin, forming a somewhat angular and little produced anterior end; ventral margin strongly convex, curving gradually into the posterior margin which slopes rapidly from the beak; postero-dorsal margin is convex but rises only a little above the outline of the distinct ridge which borders the ligamental area.

CRYPTODON (AXINULUS) INEQUALIS, new species.

(Plate XC, figs. 1, 2.)

Shell small, somewhat oblong, with the anterior end much the longer. Umbos rather prominent, beaks elevated, curved strongly forward, so as to leave a small, deep lunular area. The antero-dorsal margin is at first nearly straight, sloping but little, and is nearly parallel with the ventral margin; the anterior end is produced, broadly and evenly rounded; the ventral margin is much less rounded, with the middle portion almost straight for a short distance, toward the posterior end it is subtruncate and slightly angulated; the postero-dorsal margin is convex and slopes rapidly; a very slight depression runs from the beak to the postero-ventral margin, but is so slight as to be scarcely worthy the name of plication or fold; posterior to this there is a distinct submarginal ridge separated by a rather deep groove, from the ligamental area, which is long and narrow. The surface appears to the naked eye nearly smooth, bluish white; under the microscope it is marked by slight, raised, concentric ridges and faint undulations, which are the most regular and distinct on the umbos. In addition to these the whole surface, when highly magnified, has a fine fibrous appearance; on some parts there are remnants of a thin, pale yellowish epidermis. The hinge-margin is distinctly thickened, with a slight protuberance directly under the beak, where it is thicker than elsewhere. The posterior ligament is rather large and strong, and occupies a conspicuous groove extending from under the beak about one-third the length of the postero-dorsal margin.

Length, 4.5 mm.; height, 4.25 mm.; thickness, about 4 mm.

A few specimens have been found in 14 to 49 fathoms, at about eleven stations north of Cape Cod, in Casco Bay, and in Halifax Harbor, 1873–1879.

CRYPTODON (AXINULUS) SIMPLEX, new species.

(Plate XCII, figs. 3, 4.)

Shell small, thin, fragile, translucent bluish white, somewhat inflated, nearly circular in outline and without any posterior undulations. Beaks small, acute, slightly prominent, turned forward. Antero-dorsal margin excavated in front of the beaks and convex farther forward; anterior margin broadly and evenly rounded and, with the ventral margin, forms nearly a circular curve; the posterior margin similarly rounded, but slightly flattened in the middle; postero-dorsal margin broadly convex without any distinct angulation posteriorly. The surface is nearly smooth and somewhat glossy on the umbos; it is marked by rather indistinct, small, concentric waves or undulations and microscopic lines of growth. Interior somewhat shining. The hinge-margin is thin, delicate, and very simple, with but a very slight thickening in the region of the beak; a narrow groove for the ligament is visible just

before and behind the beaks, but there is no tooth-like prominence at any point.

Length, about 3.1 mm.; height, about 3 mm.

One imperfect specimen, station 1093, N. lat. 39° 56′, W. long. 69° 45′, in 349 fathoms, 1882.

This species is remarkable for the plainness of its surface, and the simplicity of its hinge, as it has neither radial undulations nor tooth-like projections on the hinge-margin. In form it greatly resembles *Axinopsis orbiculata*, but lacks the conspicuous concavity in the antero-dorsal margin. It has, however, a very obvious posterior ligamental furrow in the same relative position as that of other species of *Cryptodon*.

A single valve taken at Eastport, Maine, 1872, agrees closely with the type in form, but is somewhat less thin and hyaline and the beaks are a trifle more prominent. The surface has faint and rather distant concentric undulations, visible only under the microscope, being most distinct on the umbo. The microscopic striations are a little more distinct and in some lights give to the surface a fibrous or finely vermiculate appearance when highly magnified. This character, however, has been noticed in other species. The hinge-margin is a little more thickened and has a minute swelling on the inner margin just beneath the beak, scarcely worthy the name of tooth; the ligamental groove is also somewhat more strongly marked. This may prove to be a distinct species more nearly related to *Axinopsis orbiculata* from which it differs in having the antero-dorsal margin convex instead of strongly concave, and the general outline more evenly rounded, and a less evident tooth-like thickening of the hinge-margin.

Length, about 2.8 mm.; height, about 2.6 mm.

CRYPTODON (AXINULUS) PYGMÆUS, new species.

(Plate LXXXVI, figs. 3, 4.)

Shell minute, somewhat compressed, transversely ovate, inequilateral, with the anterior end the longer, and with a slightly produced posterior angulation. Surface scarcely lustrous, covered with fine lines of growth and microscopic striations, and more or less incrusted with ferruginous mud, especially posteriorly; there is barely a trace of a posterior fold. Umbos a little prominent, beaks small, slightly raised above the margin, and turned a little forward. The antero-dorsal margin is nearly straight, or sometimes slightly convex, with a slightly excavated, small, lunular area; the anterior end is broad, considerably produced, and evenly rounded; the ventral margin is broadly rounded, not at all produced, and joins the posterior margin in a small obtuse angulation, above which the dorsal margin is slightly convex and slopes rapidly from the beaks.

The inner surface is smooth with inconspicuous muscular scars.

The hinge-margin in the right valve is slightly thickened with a distinct, tooth-like prominence below and slightly in front of the center of the beak, and an inner fold-like thickening of the posterior margin to support the ligament; in front of the lunular area the margin is convex and slightly everted.

Length, about 1.6 mm.; height, about 1.4 mm.

A few live specimens were found at three stations between N. lat. 47° 40′, W. long. 47° 35′ 30″, and N. lat. 39° 54′ 30″, W. long. 70° 20′, in 206 to 499 fathoms, 1883–1886.

This species is allied to *C. ferruginosus* (Forbes), from which it differs in its distinctly produced and angulated posterior end, and longer or more produced, evenly rounded anterior end. It also has considerable resemblance in form to *C. tortuosus* Jeffreys, but that has a very lustrous surface and more vitreous texture, and moreover entirely lacks the posterior angulation.

C. subovatus of Jeffreys, seems to resemble rather closely the small specimens of this species, but that has more prominent beaks, is wedge-shaped, the antero-dorsal margin sloping pretty rapidly from the beak, instead of being nearly straight and horizontal as in our species.

CRYPTODON (AXINULUS) FERRUGINOSUS (Forbes).

(Plate LXXXVII, figs. 7, 8.)

Cryptodon ferruginosus VERRILL, Trans. Conn. Acad., V, p. 570, 1882; VI, p. 279, 1884; Expl. *Albatross*, Report U. S. Com. Fish and Fisheries for 1883, p. 575, 1885.—DALL, Bull. U. S. Nat. Mus., No. 37, p. 50, 1889.

Axinus ferruginosus LOCARD, Campagne du *Caudan*, Annales de l'Université de Lyon, p. 191, 1896.

This very common species was found at numerous stations from N. lat. 42° 47′, W. long. 61° 04′, to N. lat. 35° 12′ 10″, W. long. 74° 57′ 15″, in 125½ to 1,525 fathoms, 1880–1886.

CRYPTODON (AXINULUS) OVATUS, new species.

(Plates XCI, fig. 7; XCIII, fig. 1.)

Shell small, ovate, not swollen, with the posterior end produced and somewhat pointed, rusty brown in color and heavily incrusted with iron oxide. Umbos rather flattened; beaks small and concealed by the coating of ferruginous matter. The anterior end is well-rounded with a nearly semicircular curve; the ventral margin is broadly convex; the posterior margin is tapered and produced at the end, with the dorsal margin a little convex and sloping rapidly. The hinge-margin is a little thickened and much obscured by the incrustation. In the left valve there is a rather prominent, blunt, tooth-like swelling below the lunular area; in the right valve there is a corresponding notch and a rather wide ligamental furrow commencing beneath the beak, and running back subparallel with the dorsal margin, becoming more

internal posteriorly. Just beneath the beak is an elongated tooth-like thickening of the inner margin which consequently curves downward at this point. Muscular scars whitish, inconspicuous. The external surface, so far as visible, seems to be smoothish with irregular lines of growth.

Length, 1.6 mm.; height, 1.4 mm.

Two valves, station 949, N. lat. 40° 3′, W. long. 70° 31′, in 100 fathoms, 1881. This species is encrusted very much as *Cryptodon* (*Axinulus*) *ferruginosus*, but is quite different in its much more strongly developed hinge and ovate form.

From station 2113, N. lat. 35° 20′ 30″, W. long. 75° 19′, in 15 fathoms, there are three specimens (No. 35531) of considerably larger size which agree closely with this species and are probably identical. They are more extensively encrusted with ferruginous mud and are somewhat higher in proportion to their length; the ventral margin being slightly produced in the middle, but they have the same posterior angulation and the same evenly produced anterior end. The beaks are larger, rounded, and relatively more prominent above the margin. The hinge-margin is very thin and delicate, but does not differ essentially in other respects from the smaller specimens.

Length, 2.6 mm.; height, 2.2 mm.

AXINOPSIS ORBICULATA G. O. Sars, variety INEQUALIS, new.

(Plate XCII, figs. 5, 6.)

Axinopsis orbiculata G. O. SARS, Mollusca Reg. Arcticæ Norvegiæ, p. 63, pl. 19, figs. 11*a–d*, 1878.—VERRILL, Trans. Conn. Acad., V, p. 569, 1882.—BUSH, Proc. U. S. Nat. Mus., VI, p. 243, pl. IX, fig. 4, 1883.

The numerous specimens of this species show considerable variation in form and character of the hinge. Many specimens show the cardinal tooth and pit as described and figured by G. O. Sars; others have the hinge-margin nearly smooth or with mere rudiments of a tooth and pit. Our specimens moreover show a thin, continuous external ligament, which should be lacking according to Sars' description, but he may have overlooked it. In form many of our specimens are evenly rounded, as figured by Sars, but others have the antero-dorsal margin more concave and the anterior end somewhat produced, while the postero-dorsal margin is somewhat straighter than usual.

Specimens from the Bay of Fundy have a somewhat oblong form, with the ventral margin more nearly straight or but slightly convex, and with the anterior end distinctly produced. This form seems sufficiently distinct to receive a varietal name, and we therefore propose to call it variety *inequalis*.