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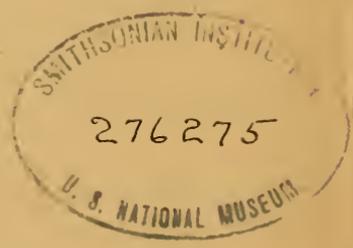
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OF

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I. SYNOPSIS OF THE PYCNOGONIDA OF NEW ENGLAND.

By EDMUND B. WILSON.*

Read, March 20th, 1878.

It is the object of this paper to present a systematic synopsis of the species of Pycnogonida occurring on the coast of New England, including also those found as far north as Halifax, based on a study of the large collection of these animals in the Peabody Museum of Yale College. My thanks are due to Professor S. I. Smith for much valuable aid, particularly in the use of his library, and to Professor Verrill, to whom I owe the opportunity of studying the group, for suggestions and other assistance. Many of the specimens were collected by the U. S. Fish Commission, and to Professor S. F. Baird, the Commissioner, I am also indebted for the use of several figures, drawn by Mr. J. H. Emerton.

In the Pycnogonida the body is composed of four apparent segments, which are expanded laterally into prominent processes to which the legs are articulated. The abdomen is rudimentary and presents no trace of segmentation, except in one or two forms, where it is bi-articulate. Upon the dorsal surface of the anterior or oculiferous segment is a prominent "oculiferous tubercle" upon which are situated the four simple eyes.

The most anterior pair of appendages, which are wanting in the family Pycnogonidæ, are in this paper regarded as antennæ. These appendages apparently correspond to the chelicerae of spiders and scorpions, the homology of which is uncertain, since they are regarded as antennæ by some writers, while others consider them post-oral, and as probably representing the mandibles. In the higher forms they are composed of three joints and are often chelate; in other genera they are two-jointed, and in *Tanystylum* become reduced to a single knob-like joint.

Below the antennæ is the proboscis or rostrum, which is often of great size; at its extremity is the triangular mouth, which is provided

* Abstract of a graduation Thesis presented to the Governing Board of the Sheffield Scientific School of Yale College, 1878.

in some species with an apparatus somewhat resembling the three denticulated jaws of a leech. The homologies of the rostrum are still uncertain; by Huxley it is regarded as representing the united chelicerae and pedipalpi, like that of the Acarina.

In many genera a pair of palpi are present, attached below the bases of the antennae at the sides of the rostrum; they are composed of five to nine joints, and sometimes are furnished with sense organs in the form of plumose hairs.

The third pair of appendages, which are wanting in the males of certain genera, have been termed "ovigerous legs," from their office of bearing the egg-masses in the female, it having been supposed, formerly, that they were never present in the male. This term is, however, inappropriate, when applied to the male appendages, and it appears preferable to term them *accessory legs*, as certain writers have done, at least until their homologies are better understood.

The legs are eight in number, and are, in many forms, remarkable for their great length; they are composed of nine joints, the terminal of which is claw-like, and, in many cases, forms with the preceding joint or propodus a subcheliform "hand." In certain genera it is armed with two movable claws articulated to its upper side near the base.

The genital openings are eight in number in all the forms which I have examined. They are on the lower side of the second joint of the leg, near the distal extremity.

The Pycnogonida, as a whole, have not been very carefully studied by systematic zoölogists. To the researches of Dohrn, Quatrefages, Zenker and others, we owe a tolerably full knowledge of their anatomy and, in some cases, of their embryology. The systematic work has, with few exceptions, been unsatisfactory, owing to the paucity of generic and specific characters, the great variation in some of the species, and the difficulty of obtaining large series of specimens. The North American forms have hitherto received little attention. Leach described an *Ammothea* from Carolina; and Stimpson another species of this genus from Puget Sound. In 1853 the latter enumerated five species in his "Invertebrata of Grand Manan," four of which were described as new. These are the only detailed descriptions hitherto published, although three or four species are mentioned, accompanied in some cases by brief notes, in papers by Professors Verrill, Smith, Packard and others. The "*Pasithoe*" described by Dr. Gould (Proc. Bost. Soc. Nat. Hist., vol. i, p. 92) is indeterminable.

The present paper is purely systematic. The synonymy is not intended to contain all the references to the species, but, as a rule, only those referring to descriptions or figures. Owing to the close general resemblance of the species and the very imperfect descriptions by many of the earlier writers, it is quite impossible to determine, from the descriptions, to what species some of the older names should be applied.

The species here described are included in the genera shown in the following table.

A. Antennæ present.	
a. Antennæ chelate.	
b. Palpi present.	
(1) Palpi five-jointed.	<i>Nymphon.</i>
(2) Palpi eight-jointed.	<i>Ammothea.</i>
bb. Palpi wanting.	
c. Auxiliary claws present.	
(1) Accessory legs, five-jointed.	<i>Phoxichilidium.</i>
(2) Accessory legs, nine-jointed.	<i>Pallene.</i>
cc. Auxiliary claws wanting.	
(1) Accessory legs, eleven-jointed.	<i>Pseudopallene, nov.</i>
(2) Accessory legs, six-jointed.	<i>Anoplodactylus, nov.</i>
aa. Antennæ non-chelate, palpi present.	
(1) Antennæ rudimentary, one-jointed.	<i>Tanystylum.</i>
(2) Antennæ, two-jointed.	<i>Achelia.</i>
AA. Antennæ wanting.	
Palpi wanting.	<i>Pycnogonum.</i>

The family characters, as usually given, are somewhat unsatisfactory. In Semper's arrangement the *Nymphonide* include those having chelate antennæ, the *Acheliide* those having non-chelate antennæ, and the *Pycnogonide* those having no antennæ. It seems more natural to separate from the *Nymphonide*, as thus defined, those forms in which the palpi are wanting, applying to this group the name *Pallenide*, from *Pallene*, the first described genus. This arrangement is somewhat artificial, but it is a convenient one and may, for the present, be retained.

Family I, PYCNOGONTIDE.

Pycnogonum Brünnich.

Body very stout. Antennæ and palpi wanting. Accessory legs ten-jointed, wanting in the male. Legs stout, dactylus without auxiliary claws.

Pycnogonum littorale O. Fabr.

Phalangium littorale Ström, Söndmör, p. 209, Pl. I, fig. 17, 1762.

Acarus marinus Pallas, Misc. Zool., p. 188. Pl. XIV, figs. 21–23, 1766.

Pycnogonum balænarum L., Syst. Nat., ed. XII, I., p. 1028, 1767; Chr. Fabr., Ent. Syst., vol. iv, p. 416, 1794; Latreille, Hist. Nat. des Crust. et des Insectes, Tom. vii, p. 332, 1804; Gen. Crust. et Insect., Tom. i. p. 144, 1806.

Pycnogonum littorale O. Fabr., Fauna Grönlandica. p. 233, 1780; Abilgaard in O. F. Müller, Zool. Dan., Fasc. 3, p. 68, Pl. CXIX, figs. 10–12, 1789; Milne-Edwards, Hist. Crust., vol. iii, p. 537, Pl. 41, fig. 6; Johnston, Mag. Zool. and Bot., vol. i, p. 376, Pl. XIII, figs. 1–3; Kröyer, Nat. Tidss., 1ste Bind, 2det Hæfte, p. 126; Isis, Jahrg. 1846, Heft vi, p. 442; Voy. en Scand., Laponie, etc., Crust., Pl. 38, fig. 4 a–e.; Hoek, Niederländisches Archiv für Zool., Band iii, 3tes Heft, p. 236, Pl. XV, figs. 1–3.

Pycnogonum pelagicum Stimpson, Invertebrata of Grand Manan. p. 37. 1853.

? *Pycnogonum littorale* Nicolet, in Gay, Historia fisica y politica de Chile, Zoologia, p. 308, Pl. 4, fig. 8, 1854.

Pl. I, figs. 1 a, 1 b. Pl. II, figs. 3 a, 3 b.

Body very broad. Lateral processes with scarcely any interval between them. Neck somewhat constricted, but broad and stout. Each segment has a prominent conical tubercle in the median line above, and one or two less prominent ones on each lateral process. Oculiferous tubercle prominent, broad and rounded. Eyes black, widely separated, remarkably small. Abdomen slender, decidedly clavate, truncated at the extremity. Rostrum large, slender, basal half slightly swollen, outer portion attenuated, rounded at the tip. There is a slight constriction near the middle and another near the extremity, which give it a distinctly sinuous outline.

Accessory legs very small and slender, composed of nearly equal short articulations, the first five of which are somewhat shorter than the others; the terminal joint is pointed and slightly curved; the outer joints bear a few small stout spines.

Legs very stout; the three basal joints are short and thick, the first with two obtuse prominences above; fourth about twice the second, produced at the extremity into a very prominent rounded elevation; fifth similar, but not so much produced distally; seventh joint or tarsus very short and nearly triangular; eighth (propodus) narrow, somewhat curved; dactylus nearly half as long as the propodus, very stout.

Many of the joints bear very short hairs, which are densely set on the inferior side of the tarsus and propodus. The entire surface of the animal is covered with small rounded tubercles, which give it a scabrous appearance. Color light yellowish brown to dark brown,

the legs often blackish near their extremity. Length 16 millimeters; extent 38 millimeters.*

This species has a wide range. Phillippi records it from Naples, and it appears to be common along the whole northern coast of Europe. In the Bay of Fundy it is common under stones at or near low water mark, and also in deep water. Four specimens were dredged in 1872, by Smith and Harger, in 430 fathoms, east of St. George's Bank, N. lat. $41^{\circ} 25'$; W. long. $65^{\circ} 42.3'$. It occurs in the Gulf of Maine, and on Le Have Bank, off Nova Scotia, where it was frequently found clinging to the lower side of the large actinia, *Bolocera Tuedia*, upon which it is probably parasitic. A single small specimen was dredged by the U. S. Fish Commission in 1874, in 50 fathoms, off Race Point Rock, in Long Island Sound, with young *Nymphon grossipes*. The females are less common than the males; the eggs are carried upon the accessory legs in a single large flat mass, which covers nearly the entire ventral surface of the body.

Dr. P. P. C. Hoek states in a recent paper (Niederländisches Archiv für Zoologie, Band iii, Drittes Heft. p. 244) that he found adult male specimens with accessory legs, and females in which they were completely wanting. It seems hardly credible that this observation is correct. In a large series of specimens I have been unable to find the least indication of a transition between those forms with accessory legs and those without them, among adults, though young females present all stages, as also observed by Hoek. The sperm cells may readily be mistaken for undeveloped ova, as I have observed in several other species.

Family II, ACHELIDÆ.

Tanystylum Miers.

Body broad and stout. Antennæ rudimentary, one-jointed. Palpi six-jointed. Accessory legs ten-jointed, present in both sexes. Legs stout, dactylus with auxiliary claws.

Tanystylum orbiculare, sp. nov.

?? *Pasithoe umbonata* Gould, Proc. Bost. Soc. Nat. Hist., vol. i, p. 92.

Pallene, sp., Smith in Report on the Invertebrata of Vineyard Sound, p. 250 (544).

Plate II, figures 2 *a* to 2 *f*.

Body orbicular, deeply incised between the lateral processes, which are in close contact. Oculiferous segment extremely broad, neck not evident. Oculiferous tubercle large and rounded. Eyes black.

* The length includes the rostrum and abdomen. The extent is the distance from tip to tip of the outstretched legs.

Abdomen rather large, tapering, truncated and slightly bifid at the extremity; it usually projects vertically upwards.

Rostrum very large, rounded-conical, little constricted at the base, somewhat shorter than the body.

Antennæ rudimentary, consisting of a single knob-like joint which is thinly covered with hairs.

Palpi slightly longer than the rostrum; the first, second, fourth and fifth joints are nearly equal, and about as long as broad; the third and sixth are nearly equal, and about twice the others. The outer joints are somewhat hairy, the terminal one most so.

Accessory legs about half as large in the male as in the female. In the latter the basal joint is somewhat swollen and about as long as broad. The second, fourth and fifth are nearly equal, and longer than the third; the remaining joints are short, decreasing in size to the last, which is very small. In the male the proportions are nearly the same, but the third joint is proportionally longer, and all of the others are more robust. The three outer joints are nearly globose, the terminal one minute. This joint bears, in both sexes, two spines, one of which is sometimes bifid at the tip. Other spines occur on the four preceding joints and are sometimes bifid.

Legs rather stout, sparsely hairy, the fifth and sixth joints having, above, alternate depressions and elevations producing a deeply sinuous outline; each of these elevations bears a number of hairs. The three basal joints are very stout and short; the three following are each about equal to the three basal joints united; tarsus nearly triangular, with two or three stout spines below; propodus strongly curved, with a series of stout curved spines on the lower margin, on the upper side hairy; dactylus more than half the propodus, stout and curved; auxiliary claws about half as long as the dactylus.

Color of alcoholic specimens, light yellowish brown. Length 1.5 millimeters; extent 6.4 millimeters.

The egg-masses are three or four in number and of a light yellow color. In some specimens the embryos had escaped from the eggs; they closely resemble those of *Achelia*, described on p. 8 (Pl. II, fig. 1g), and the antennæ are large and chelate.

This genus, recently described by Miers from specimens collected at Kerguelen Island, is interesting from the extreme reduction of the antennæ, approaching, in this respect, those forms in which antennæ are altogether wanting. This species is not uncommon in Vineyard Sound, and occurs as far south as Virginia, where it was collected by Mr. S. F. Clark. Two specimens were found on *Botryllus Gouldii*

collected at Brooklyn, N. Y., by Prof. D. C. Eaton. It is usually found on Hydroids and Ascidians, growing on piles of wharves, and occurs down to 14 fathoms. The description of "*Pasithoe umbonata*" Gould is so imperfect as to render identification of the species impossible. What is meant by the "umbo" of a Pycnogonid is not clear to me.

Achelia Hodge.

Body broad. Antennæ small, two-jointed, not chelate. Palpi eight-jointed. Accessory legs ten-jointed, present in both sexes. Legs stout; dactylus with auxiliary claws.

Achelia spinosa Wilson.

Zetes spinosa Stimpson, Invertebrata of Grand Manan, p. 37, 1853.

? *Achelia echinata* Hodge, Ann. and Mag. Nat. Hist., 3d series, vol. xiii, No. lxxiv, p. 115, Pl. XII, figures 7-10, 1864.

Plate II, figures 1 a to 1 h.

Body nearly orbicular, deeply incised, segments not apparent. Lateral processes separated by a distinct interval. Neck distinct, but very broad. Ocniferous tubercle large and prominent, acute. Eyes ovate, black. Abdomen very long and slender, bifid at the tip.

Rostrum large, thickest in the middle and tapering to both ends, truncated at the extremity.

Antennæ not quite half the rostrum. The basal joint is about four times as long as broad, somewhat swollen near the extremity, where there are two or three tubercles, each terminated by a stout hair. Second joint rounded and knob-like, with one or two hairs.

Palpi slightly longer than the rostrum; the first, third, and four outer joints are very short, the first somewhat swollen; the second and fourth are much longer and nearly equal; all but the basal joint are hairy, the four outer ones only on the exterior margin.

Accessory legs in the female rather large. The two basal joints are short and stout, followed by three longer and more slender ones. The remaining five are much shorter, the terminal one very small and nearly globular; it bears two very large flattened denticulated spines; each of the two preceding joints has a similar spine; the outer joints are sparsely hairy, most of the hairs pointing backward. In the male this appendage is much smaller and proportionally stouter; the two basal and five distal joints are nearly as in the female, but the third, fourth and fifth are much shorter and stouter.

Legs rather long; the three basal joints are short and stout, the

second longest; the three following joints are nearly equal, each about as long as the three basal joints united; tarsus small, about one-fourth the propodus; the latter is strongly curved and armed below with a series of short stout spines; dactylus about half the propodus, stout and curved; auxiliary claws more than half the dactylus. The entire surface of the legs and body is scabrous with numerous pointed hairy tubercles often tipped with spines; the lateral processes of the body have three or four of these tubercles near the exterior margin; the largest are on the basal joints of the legs; on the other joints they are much smaller. The legs are throughout hairy and most of the hairs are borne on prominent tubercles. Color of alcoholic specimens light brown. Length 2.6 millimeters; extent 8.4 millimeters.

The egg-masses of a female specimen from Eastport, Maine, contain embryos recently escaped from the egg (Pl. II, fig. 1*g*). The antennæ of these are enormously large and strongly chelate. The basal joint bears, at its extremity, on the outer side, a long spine. The two remaining appendages consist of two basal joints and a long slender acute terminal one, bearing a spine near its middle. The body is nearly hemispherical and without trace of segmentation. Rudiments of the eyes have appeared. The rostrum is rounded-conical and much smaller than in the adult.

This species is very common northward, under stones, at low-water mark, and also down to seventeen fathoms. It has been collected at Grand Manan; Eastport; Casco Bay, &c. A single specimen was dredged by the U. S. Fish Commission, off Block Island, Aug. 30, 1874, in thirty-four fathoms, mud, which is the most southern locality observed. It is usually found on Ascidians, Hydroids, etc., on which it is probably parasitic.

There can be, I think, no doubt of the identity of this form with Stimpson's *Zetes spinosa*. It differs somewhat from Hodge's figure in the greater length of the abdomen, stouter proboscis, and less size of the oculiferous tubercle, though these differences seem scarcely sufficient to separate them as distinct species.

Family III, PALLENIDÆ.

Pallene Johnston.

Body stout. Rostrum short, rounded. Antennæ robust, three-jointed, chelate. Palpi wanting. Accessory legs nine-jointed, present in both sexes. Legs very long; dactylus with auxiliary claws.

Pallene empusa, sp. nov.

Plate III, figures 2 *a* to 2 *g*.

Body robust, smooth, distinctly segmented. Lateral processes well separated. Neck long, very slender at base. Oculiferous tubercle sub-acute, small, but prominent. Abdomen very small and short.

Rostrum nearly hemispherical, evenly rounded, smooth.

Antennæ sparingly hairy, short and stout. The opposable edges of the second and third joints are coarsely toothed, the teeth evenly rounded, so that the outline is deeply sinuous. There are about seven of these on the second joint, and many more, smaller ones, on the dactylus.

Accessory legs in the female about one-third the legs; the third joint is curved and about equal to the two basal joints united. Fourth joint considerably longer than the third, suddenly expanding at its distal extremity below; the five remaining joints are much shorter and nearly equal; the terminal one smoothly rounded at the extremity; each of the outer four joints is armed with a series of seven or eight spines; these are very broad and thin, with minute slender teeth, which do not extend to the base and are usually terminal; some of the spines are truncated, others smoothly rounded at the extremity. In the male the appendage is considerably smaller, the third and fourth joints are much shorter and stouter, and the latter is not expanded at the extremity.

Legs enormously long, over four times the length of the body, very slender near the base, much stouter distally; the first and third joints are short, the second much longer, about five times the first; the three following are much longer and very stout; the fourth is usually distended by the generative organs; tarsus very short and nearly triangular; propodus nearly straight and very slender; it is very narrow at the base, expanding to two and a half times this width, near the extremity; on the inferior side, near the base, are four or five stout spines, followed by a series of much smaller and more slender ones; dactylus slender, more than half the length of the propodus; auxiliary claws slender, two-thirds as long as the dactylus. The legs bear a few scattered stout hairs, most numerous distally. Length 1.5 millimeters; extent 13 millimeters. Color in alcohol, white.

This interesting species corresponds closely to the European *Pallene brevirostris* Johnston, but has, according to figures of that species, a much longer neck and shorter rostrum, besides differences in the

shape and armature of the propodus, etc. It is remarkable for the great size of the eggs, which appear not to be carried in masses, but are scattered over the accessory legs.

Taken by the U. S. Fish Commission, in Vineyard Sound, in 1871, on the stems of *Pennaria tiarella*; and in 1874, at Noank, Ct., in the harbor on muddy bottom. Several specimens were taken, in 1874, by Professor S. I. Smith, from tubularian hydroids growing on the bottom of an old ship, at Noank, Conn.

Pseudopallene Wilson.

Body robust; neck broad and thick; rostrum more or less acute. Antennæ three-jointed, chelate; palpi wanting; accessory legs eleven-jointed; legs stout and comparatively short, dactylus without auxiliary claws.

This genus has hitherto been confounded with *Pallene*, and some confusion has thus been caused in the diagnosis of that genus.

In *Pallene*, as described by Johnston (*Mag. Zool. and Bot.*, vol. i, p. 380) the accessory legs are nine-jointed; the neck is constricted and more or less elongated as in *Nymphon*; the rostrum is short and nearly hemispherical; and the dactylus bears two very large auxiliary claws. The presence or absence of these claws is a good generic character; they are always two in number, are movably articulated to the dactylus, and are provided with a special set of muscles by means of which they are moved. It is to be observed, also, that the peculiar spines upon the outer joints of the accessory legs in *Pallene* are very unlike those of *Pseudopallene*.

Kröyer figures three species of "Pallene" in Gaimard's *Voy. en Scand., Laponie, etc.* (*P. discoidea*, *P. intermedia* and *P. spinipes*). The first of these is undoubtedly a *Pseudopallene*, and probably also the other two, but, not having examined specimens of them, I have been unable to verify this.

Pseudopallene hispida Wilson.

American Journal of Science and Arts, vol. xv, No. 87, p. 200, 1878.

Pallene hispida Stimpson, *Invertebrata of Grand Manau*, p. 37, 1853.

Plate III, figures 1a to 1e.

Body oval, very broad, neck not constricted. Oculiferous tubercle small, rounded. Eyes ovate, light brown. Oculiferous segment half as long as the body. The second and third segments have, above,

two prominent conical tubercles, each of which is tipped by a hair. The lateral thoracic processes are very broad and are not separated by any interval; they bear, on the outer margin, two to four acute, hairy tubercles. Abdomen twice as long as broad, truncate, hairy.

Rostrum slightly hairy, acute-conical, as long as the oculiferous segment, with a constriction on each side, below, giving it the appearance of being articulated at this point. The mouth is terminal and surrounded by a rosette of filamentary processes.

Antennæ very stout and swollen, hairy, tipped with amber-color, about twice as long as the rostrum; claws of chelæ blunt and rounded; basal joints enlarged near their attachment; the second joint has, on its lower margin, a prominent rounded tubercle behind which the dactylus closes.

Accessory legs slender, eleven-jointed; the two basal joints are short, the third longer, the fourth and fifth still longer, sixth about as long as the third; the remaining joints are shorter and decrease in size to the last, which is spine-like and trifid at its extremity; the four outer joints are armed with four or five stout, smooth, curved spines.

Legs very stout, the three basal joints short and overlapping each other; fourth joint as long as the three basal ones, much distended with the ovaries in the specimen described; fifth as long as the fourth, but much more slender; sixth still longer and more slender; tarsus very short, nearly triangular; propodus tapering from the base, slightly curved, armed on the inferior margin with five or six stout curved spines; dactylus curved, acute, about two-thirds as long as the propodus.

All of the legs bear a number of prominent, conical, spiny tubercles. These are arranged in longitudinal rows on some of the joints, particularly on the fifth and sixth, which thus appear deeply serrate on the margin. The entire surface of the body is rough and more or less hairy.

Color, in alcohol, light brown. Length, 3 millimeters; legs, 7.5 millimeters; accessory legs, 3.7 millimeters.

Of this species there is but a single female specimen in the collection of the Peabody Museum, dredged by the U. S. Fish Commission in Johnson's Bay, near Eastport, Maine, in 12 fathoms, rocky bottom. Stimpson records it from deep water off Grand Manan, "on *Ascidia callosa*."

Pseudopallene discoidea Wilson.

Pallene discoidea Kröyer, Nat. Tidss., 1ste Bind, 2det Hæfte, p. 120, 1844; Voy. en Scand., Laponie, etc., Pl. 37, fig. 3a—g; Isis, Jahrg. 1846, Heft vi, p. 443.

Plate III, figures 3a to 3c.

Body oval, somewhat narrower than that of *P. hispida*, lateral processes in close contact. Abdomen pointed, slightly bifid at the tip.

Rostrum obtuse, slightly hairy, outline of sides convex.

Antennæ stout, but not so much so as in *P. hispida*; basal joint not enlarged near the base. Chelæ with the claws acute and finely serrated along the opposable margins, second joint with no tubercles on the inferior margin.

Accessory legs stout; all of the joints are short and broad, the fourth and fifth longest; terminal joint acute; the 7th, 8th, 9th and 10th joints bear each a simple spine on the upper side.

Legs nearly as in *P. hispida*, but longer and more slender, particularly in their basal portion, where the joints do not overlap.

The legs and body are armed with conical hairy tubercles arranged nearly as in the preceding species. Color light yellowish brown. Length 3 millimeters.

This species, like the preceding, is represented by a single specimen, apparently not yet adult; it was taken with *Caprella* on the tangles in 20 fathoms, rocky bottom, Eastport harbor, by the U. S. Fish Commission, Aug. 9, 1872.

This species is very similar to the last, and a larger number of specimens may show them to be identical. The two specimens described present, however, well marked differences, particularly in the shape and armature of the antennæ, the shape of the rostrum, abdomen, etc. Though not agreeing perfectly with Kröyer's figures of *P. discoidea* there can be little doubt of the identity of this species with it.

Phoxichilidium Milne Edwards.

Body slender; neck short. Rostrum cylindrical, rounded. Antennæ three-jointed, chelate. Palpi wanting. Accessory legs five-jointed, absent in the male. Legs slender; dactylus with auxiliary claws.

Phoxichilidium maxillare Stimpson.

Phoxichilidium maxillare Stimpson, Invertebrata of Grand Manan, p. 37, 1853.

Plate IV, figures 1a to 1e.

Body rather stout. Oculiferous segment twice as broad as long. Oculiferous tubercle prominent, acute. Eyes ovate, nearly white in

alcohol. Posterior segment much smaller than that preceding. Abdomen small, rounded at tip.

Rostrum rather short and stout, slightly constricted a short distance from the extremity.

Antennæ stout, almost destitute of hairs. Claws of the chelæ very strongly curved, quite smooth on the opposable margins; the dactylus projects somewhat beyond the extremity of the preceding joint, and is very thick and strong.

Accessory legs nearly one-third as long as the legs; basal joint much stouter than the others; third joint longest; terminal joint strongly curved, smoothly rounded at the tip, armed on each side with six or eight simple spines directed backward, and below, with three or four stouter ones; the other joints bear a few scattered hairs.

Legs comparatively stout, remarkably smooth in appearance, though bearing a very few scattered hairs; basal joint nearly quadrate, about half the length of the second, which is somewhat longer than the third; the three following are nearly equal and longer than the three basal joints united; propodus stout and curved, about four times the tarsus; on its inferior margin are five stout spines followed by a series of very small ones; dactylus stout, more than half the propodus; auxiliary claws small, not one-fourth as long as the dactylus.

Color blackish or sepia. Length 4.75 millimeters; extent 29 millimeters.

The *Phoxichilidium femoratum* of Europe resembles this species, but differs in color and in the shape and armature of the propodus and dactylus, besides being less robust. *P. maxillare* is very common in the Bay of Fundy, at low water mark, under stones, numbers of them often being united in a tangled mass. It occurs also in Casco Bay, but has not been found farther south. A single young specimen was taken at Halifax on a hydroid growing on one of the wharves.

Phoxichilidium minor, sp. nov.

Plate IV, figures 2 *a* to 2 *f*.

Much smaller than *P. maxillare*, to which it is closely allied. Body more slender, surface nearly smooth.

Rostrum short and stout, slightly tapering, smoothly rounded at the extremity, not constricted. Antennæ more slender, dactylus slender and not so much curved as in *P. maxillare*.

Accessory legs with the spines scattered and not arranged in definite series on the last joint; inferior margin of the terminal joint sometimes without spines.

Legs slender, sparsely hairy; tarsus deeply emarginate; propodus

slender, basal spines slender and divergent. Auxiliary claws one-fourth the length of the dactylus.

Length, 2.1 millimeters; extent, 15.6 millimeters.

This species is closely similar to *P. maxillare*, of which it may be a dwarf variety. It is, however, less than half as large, as shown by the measurements, and in nearly all respects is more slender. The antennæ differ considerably in shape; the rostrum is shorter and lacks the slight constriction which appears to be characteristic of the former species; the auxiliary claws are longer, the propodus more slender and the entire surface of the animal smoother, though with more numerous hairs.

It was taken in considerable numbers on a sponge growing in a tide-pool on Ram Island Ledge, Casco Bay, by the U. S. Fish Commission in 1873. Many of them had large egg-masses, five or six in number.

Anoplodactylus Wilson.

Body slender. Rostrum cylindrical, rounded. Antennæ three-jointed, chelate. Palpi wanting. Accessory legs six-jointed, wanting in the male. Neck elongated, extending forward over the rostrum. Legs slender; dactylus without auxiliary claws.

This genus differs from *Phoxichilidium*, which it otherwise closely resembles, in the number of joints composing the accessory legs, and in the absence of auxiliary claws upon the dactylus. *Phoxichilidium* has been made to include several distinct types, among them a form having eleven-jointed accessory legs (*P. fluminense* Kr.), and "*Phoxichilidium cheliferum*" Claparède, a very remarkable form with the accessory legs ten-jointed and distinctly chelate.

Krøyer's *Phoxichilidium petiolatum* (Voy. en Scand., Laponie, etc., Pl. 38, fig. 3) belongs to *Anoplodactylus*, and probably also *Phoxichilidium virescens* Hodge.

Anoplodactylus lentus Wilson.

Am. Journal of Science and Arts, vol. xv, No. 87, p. 200, 1878.

Phoxichilidium maxillare Smith, in Rep. on the Invertebrata of Vineyard Sound, p. 250 (544), Pl. VII, fig. 35, 1874 (*non* Stimpson).

Plate IV, figures 3*a* to 3*e*.

Body slender, lateral processes widely separated. Oculiferous segment broad, as long as the two following segments united, not emarginate between the bases of the antennæ. Posterior segment somewhat elongated and very slender, the lateral processes directed obliquely backward. Neck swollen. Abdomen rather more than

twice as long as broad, slightly bifid at the extremity. Oculiferous tubercle prominent, acute, placed far forward. Eyes ovate, light brown to black.

Rostrum large, longer than the oculiferous segment, somewhat constricted basally, so as to appear clavate; extremity subglobose.

Antennæ long and slender, hairy, their bases closely approximated; basal joint extending beyond the extremity of the rostrum; chelæ stout, hairy, claws acute, opposable edges smooth.

Accessory legs stout, roughened by minute tubercles, the outer joints with many short stout hairs, most of which are directed backward; the two basal joints are very stout, the first shorter than its width, the second about twice as long; third nearly two and a half times the second, somewhat clavate, suddenly constricted a short distance from the base; fourth half the length of the third, considerably longer than the fifth; sixth much smaller than the preceding.

Legs very long and slender; first and third joints very short; second longer and clavate; the three following joints are much longer, sixth longest; tarsus very short, deeply emarginate; propodus curved, with a rounded lobe near the base bearing five or six strong spines; these are followed by a series of much smaller ones; daetylus stout, about two-thirds the length of the propodus. Entire surface of the body scabrous. Legs with a few scattered hairs, which are most numerous on the outer joints.

The sexes resemble each other closely, but the male does not possess accessory legs; the males are, as a rule, slightly larger than the females. Length 7 millimeters; legs 30 millimeters.

This species is nearest to "*Phoxichilidium petiolatum*" Kr., of Europe. The latter has, however, according to the figures, the anterior segment much more slender, and it is emarginate between the bases of the antennæ, which are thus separated by a distinct interval; the posterior segment is represented as stouter and shorter; the rostrum more abbreviated; and the propodus of a different shape. Krøyer figures the accessory legs with seven joints, probably mistaking the constriction near the base of the third joint for an articulation.

Common between tide-marks and down to six fathoms in Vineyard Sound, where it is found on shelly bottoms "clinging to and creeping over the hydroids and ascidians." "It is most frequently deep purple in color, but gray and brown specimens are often met with." (*Verrill*). It is also taken rarely in the Bay of Fundy, there being a single specimen in a vial with *Phoxichilidium maxillare* and *Pyenogonium littorale* from Eastport.

Family IV, NYMPHONIDÆ.

Ammothea Leach.

Body broad, neck scarcely apparent. Rostrum large, tapering. Antennæ small, three-jointed, chelate. Palpi eight-jointed. Accessory legs nine-jointed; in the male five-jointed (?). Legs slender. Auxiliary claws present.

Ammothea achelioides, sp. nov.

Plate V, figures 1 *a* to 1 *e*.

Body very broad, oval, segments not evident, lateral processes scarcely separated. Oculiferous tubercle prominent, acute; eyes dark; abdomen long and very slender, bifid at the extremity.

Rostrum large, tapering, extremity rounded.

Antennæ about three-fourths as long as the rostrum; basal joint narrowest near the middle, somewhat hairy, with one or two prominent tubercles, each tipped by a slender spine; chela with the claws very slender and strongly curved, armed with a few small spines on the opposable edges.

Palpi slender, longer than the rostrum, sparsely hairy, most so on the distal joints; the first, third, and four distal joints are very short; terminal one shortest; sixth longest; the second and fourth are nearly equal and more than twice the basal joint.

Accessory legs, in all the specimens examined, very short, swollen and pellucid, so that the joints could with difficulty be distinguished. They are composed of five joints; a very short basal one and four other longer ones; the terminal one is tapering, smoothly rounded at the tip. It seems probable that these appendages are either those of the male, or of the immature female.

Legs short, rather slender; the three basal joints are short, followed by three which are nearly equal and about as long as the three basal joints united; tarsus very short; propodus gently curved, with two stout spines on the inferior margin near the base, followed by a few smaller ones; dactylus nearly two-thirds the length of the propodus, rather stout; auxiliary claws two-thirds the dactylus.

The legs are rough and hairy, the hairs usually arising from tubercles or swellings. These tubercles are very large and acute-conical near the outer margin of the body processes and upon the first joint of the legs; on the outer joints they are smoothly rounded and less elevated, often producing a sinuous outline most apparent on the fourth, fifth and sixth joints.

Color of alcoholic specimens, light yellowish brown. Length 1.4 millimeters; extent 5.2 millimeters.

Three specimens only, taken in the Bay of Fundy by the U. S. Fish Commission, in 1872. In general appearance it is closely similar to *Achelica spinosa*.

Nymphon Chr. Fabricius.

Body slender. Neck distinct. Rostrum cylindrical, rounded. Antennæ three-jointed, chelate. Palpi five-jointed. Accessory legs present in both sexes, eleven-jointed. Legs slender; dactylus with auxiliary claws.

All the species of *Nymphon* are slender, some of them exceedingly so. The antennæ are slender and the claws of the chelæ are armed along their opposable edges with a series of close set, slender spines. The sexes generally resemble each other closely, the chief differences being found in the accessory legs. These appendages are armed, in both sexes, with a series of flattened denticulated spines, borne on the seventh, eighth, ninth, and tenth joints. The auxiliary claws are not large. The genital openings are small, sometimes minute.

In certain species the specific characters are extremely variable, as described below.

Nymphon Strœmii Krøyer.

Nat. Tidss., 1ste Bind, 2det Hæfte, p. 111, 1844; Voy. en Scand., Laponie, etc., Pl. 35, figs. 3a-f; Miers, Ann. and Mag. Nat. Hist., 4th series, vol. 20, No. 116, p. 109.

Nymphon giganteum Goodsir, Ann. and Mag. Nat. Hist., vol. xvi, No. xxviii, p. 293, 1845; Verrill, Am. Journ. Sci. and Arts, vol. vii, p. 411, 1874.

? *Nymphon gracilipes* Camil Heller, Die Crustaceen Pycnogoniden und Tunicaten der K. K. Österr.-Ungar. Nordpol-Exp., p. 16, Taf. iv, fig. 15, Taf. v, figs. 1, 2.

Plate VI, figures 1 a to 1 h.

Body very stout, nearly smooth. Neck very short, but deeply constricted. Oculiferous segment large, longer than the two following segments united, stout and swollen anterior to the constriction of the neck. Oculiferous tubercle prominent, smoothly rounded. Eyes very distinct, black, ovate. Abdomen small, tapering toward the extremity.

Rostrum rather large, nearly cylindrical though slightly expanded in the middle.

Antennæ smooth, rather slender; basal joint as long as the rostrum; claws of chelæ remarkably slender and elongated, gently curved, when closed meeting along nearly their whole length; they

are armed along their opposable margins with a series of small spines, which are much more numerous and more erect upon the dactylus.

Palpi much longer than the rostrum; basal joint stout, very short; second and third much longer, nearly equal; fourth and fifth a little less and more slender, sparsely hairy.

Accessory legs stout, slightly hairy; the three basal joints are nearly as broad as long; the following three are much longer, the sixth shortest and about as long as the three basal joints united; the remaining joints are much shorter and more slender, the terminal one acute and claw-like, with a row of spines on the inferior edge; the denticulated spines vary considerably and are sometimes nearly smooth.

Legs very long and slender; first and third joints short, about half the second; the three following are very long, sixth longest, fifth shortest; propodus and tarsus slender, nearly equal, hairy; the former is not armed with spines; dactylus long and slender, very acute, about three-fifths the length of the propodus; auxiliary claws very small, about one-fifth the dactylus. Color, when living, light salmon-yellow, the legs often annulated with broad reddish rings. Egg masses large, two to four in number, bright yellow. Length of largest specimens 15 millimeters; extent 140 millimeters; accessory legs 19 millimeters.

This fine species is not uncommon in deep water, attaining its greatest size on muddy bottoms, though occurring also on hard bottoms. Taken by the U. S. Fish Commission off Casco Bay, 73 to 82 fathoms; off Salem, Mass., 35 to 90 fathoms, mud, etc.; Le Have Bank, 59 fathoms, pebbles; off Halifax, 50 fathoms, mud, gravel and rocks; Bedford Basin, soft mud. Dredged by Dr. Packard and Mr. Cooke in 52 to 90 fathoms, rocks, south of Cashe's Ledge, and in 78 fathoms off the Isles of Shoals. Also taken at Eastport in 1870, by Professor Verrill; and by Mr. Whiteaves in the Gulf of St. Lawrence. In young specimens the legs are hairy, the auxiliary claws are much larger and the antennæ are extremely slender and delicate.

Heller's *Nymphon gracilipes* is very close to, if not identical with, this species. In his figure, however, the dactylus is represented as very nearly equalling the propodus, and it may be distinct.

Nymphon longitarse Kröyer.

Nat. Tidss., 1ste Bind, 2det Hæfte, p. 112, 1844; Voy. en Scand., Laponie, etc., Pl. 36, fig. 2*a-b*.'

Plate VII, figures 2 *a* to 2 *h*.

Entire animal extremely slender. Body smooth. Oculiferous segment produced into a very long slender neck, expanding anteriorly for the attachment of the antennæ. Posterior segment very narrow, lateral processes directed nearly backward. Abdomen small, tapering. Oculiferous tubercle rounded, eyes black, ovate.

Rostrum slender, rounded, shorter than the basal joint of the antennæ.

Antennæ very slender, slightly hairy; claws of chelæ very long and slender, their tips crossing when closed; the spines with which they are armed are larger and less numerous than those of *N. Strömii*.

Palpi resembling those of *N. Strömii*, but more slender and with the fourth joint shorter than the third or fifth.

Accessory legs remarkably slender; the three basal joints are very short and nearly equal; fourth nearly twice the length of the first three united; fifth somewhat less; sixth equal to the three basal joints, about twice the seventh; the remaining joints decrease to the last, which is claw-like with a few spines on its inferior margin; spines of the distal joints decidedly curved.

Legs resembling those of *N. Strömii* but much more slender and with the tarsus very long, nearly twice the propodus; both these joints are very slender, nearly straight, and along their entire inferior margin is a regular series of small hairs; dactylus nearly straight, very acute, more than half the propodus; auxiliary claws very small, about one-fourth the propodus. The legs are sparsely hairy, the hairs longest near the outer extremities of the joints, where they often form a semicircle on the upper side. Color, when living, light salmon or nearly white. Length 7 millimeters; extent 65 millimeters.

This species may be readily distinguished by its extremely attenuated appearance, which is more marked than in any other species of the genus. The neck varies considerably and in some specimens is much stouter than in others (see Plate VII, figures 2 *a* to 2 *c*).

Its range is nearly coincident with that of the preceding species, but it is not yet recorded from the Gulf of St. Lawrence, though not rare off Halifax. It was dredged in 60 fathoms on St. George's Banks, in 1872, by Smith and Harger. It is most often found on muddy bottoms, though occurring also on rocks and fine sand.

Nymphon grossipes Chr. Fabr.

? *Phalangium marinum* Ström, Söndmör, p. 208, 1762.

Phalangium grossipes Linné, Syst. Nat., ed. xii, i, p. 1027, 1767.

Pycnogonum grossipes O. Fabr., Fauna Grönlandica, p. 229, 1780.

? *Nymphum grossipes* Sabine, Suppl. to the Appendix Capt. Parry's First Voyage, p. 225, 1824.

Nymphon grossipes Chr. Fabr., Ent. Syst., Tom. 4, p. 217, 1794; Latreille, Hist. Nat. des Crust. et des Insect., Tom. vii, p. 333, 1804; Genera Crust. et Insect., Tom. i, p. 143, 1806; Kröyer, Nat. Tidss., 1ste Bind, 2det Hæfte, p. 208, 1844; Isis, Jahrg. 1846, Heft vi, p. 442; Voy. en Scand., Laponie, etc., Pl. 36, figs. 1a-h; Stimpson, Inv. Grand Manan, p. 38, 1853; Buchholz, Zweite Deutsche Nordpol-fahrt, Crust., p. 396, 1874; Verrill, Amer. Journ. Sci., vol. vii, p. 502, 1874.

Nymphon mixtum Kr., Nat. Tidss., 1ste Bind, 2 det Hæfte, p. 110; Voy. en Scand., Laponie, etc., Pl. 35, figs. 2a-f; Buchholz, l. c., p. 397.

Nymphon brevitarse Kröyer, Nat. Tidss., 1ste Bind, 2det Hæfte, p. 115; Voy. en Scand., Laponie, etc., Pl. 36, figs. 4a-f.

Nymphum hirsutum Kr., Grönland's Amfipoder, S. 92, (teste Kröyer).

Plate VII, figures 1 a to 1 q.

Body slender, smooth. Oculiferous segment variable; in some specimens nearly as short and stout as in *N. Strömi*, in others much longer and very slender. Oculiferous tubercle very prominent, conical, very acute. Eyes black, oval or nearly round. Abdomen small, tapering, often bent upward.

Rostrum large, somewhat variable, but usually shorter than the oculiferous segment, slightly swollen at the extremity.

Antennæ slender, basal joint about as long as the rostrum; chela similar to that of *N. longitarse*, but stouter, the claws shorter, slightly hairy.

Palpi slender, with a few small hairs most numerous on the outer joints; basal joint, nearly quadrate, about one-fourth the second; third slightly longer than the first two united; fourth less than half the third; fifth longer, slender, tapering, somewhat variable, being stouter in some specimens than in others.

Accessory legs very slender. In the male they are, on an average, about one-eighth the extent of the legs; in the female about one-sixth. The joints have nearly the same proportions as in *N. longitarse*, but the fourth and fifth joints are longer and still more slender.

Legs long and slender, proportions of the first six joints nearly as in *N. Strömi*. Tarsus extremely variable in length (Pl. VII, figs. 1 b to 1 g); in young specimens it is less than half the propodus, while in some large adult specimens it is nearly twice that joint; the propodus is armed, on the inferior margin, with a series of slender,

slightly curved spines, which are longest proximally; dactylus about two-thirds the propodus; auxiliary claws less than half the dactylus. The legs are sparsely hairy, the hairs often forming, as in *N. longitarse*, a semicircle on the outer extremities of the joints. Color, when living, light salmon-yellow, the legs often banded with reddish or light purple. Length 10.5 millimeters; extent 90 millimeters.

This species is, in most of its characters, extremely variable. Krøyer's *N. brevitarse* and *N. mixtum* are undoubtedly, I think, forms of *N. grossipes*. The former are young specimens, with a short, thick neck, very short tarsus, and abbreviated rostrum; the latter are those having a long slender neck, and with the tarsus from one and a half to two times the propodus. From the large collection in the Peabody Museum I have formed an almost complete series from extreme forms of *N. brevitarse* to undoubted *N. mixtum*, though in none of the specimens of the latter species is the tarsus quite so long as that figured in the *Voy. en Scand., Laponie, etc.* The palpi, also, vary considerably with age.

The variation is due in part to age, but is not sexual, since female specimens with egg-masses present the same differences. In some specimens the antennæ are tipped with brown, or jet black; in others they are white. The terminal joints of the legs are sometimes similarly tipped with brown.

The following table gives the relative length of the tarsus and propodus in a series of specimens selected to show the variation. The joints measured are, in all but one or two cases, from the second leg of the right side.

	Propodus. mm.	Tarsus. mm.	Ratio of t. to p.
<i>a</i> (<i>N. brevitarse</i> .)	0.465	0.249	0.54
<i>b</i>	0.498	0.332	0.65
<i>c</i>	0.930	0.670	0.72
<i>d</i> (<i>N. grossipes</i> .)	1.094	1.094	1.00
<i>e</i>	.999	1.195	1.20
<i>f</i>	1.062	1.328	1.25
<i>g</i>	1.295	1.693	1.315
<i>h</i> (<i>N. mixtum</i> .)	1.228	1.892	1.541

In Pl. VII, figs. 1 *i* to 1 *l*, the variation of the neck is shown. All the latter specimens are adult females.

This is, perhaps, the commonest species of the group. It was dredged by J. F. Whiteaves on Orphan Bank, Gulf of St. Lawrence, in 1873, and extends as far south as Long Island Sound (two young specimens, off Race Pt. Rock, 50 fathoms, rocks and shells, U. S. Fish

Comm., 1874). Frequently dredged by the U. S. Fish Commission off Salem, Eastport, Halifax, etc., in from 20 to 100 fathoms; also on Cashe's Ledge, and Jeffrey's Ledge, and in Casco Bay; and on St. George's Banks, in 50 fathoms, by Smith and Harger, in 1872. It is commonest on rocky or gravelly bottoms, but occasionally occurs on soft mud. At Halifax it was taken in Bedford Basin, where the bottom is a very offensive soft oozy mud.

Nymphon hirtipes Bell.

? *Nymphon hirtum* Fabr., Ent. Syst., vol. iv. p. 417, 1794; Kröyer, Nat. Tidss., 1ste Bind. 2det Hæfte p. 113; Voy. en Scand., Laponie, etc., Pl. 36, figs. 3a-g; Buchholz, Zweite Deutsche Nordpolfahrt, p. 397, 1874; Miers, Ann. and Mag. Nat. Hist., 4th series, vol. 20. No. 116, pp. 108-9, Pl. IV, fig. 3, 1877.

? *Nymphon hirsutum* Sabine, Supplement to the Appendix. Capt. Parry's First Voyage, p. 226. 1824.

Nymphon hirtipes Bell, Belcher's Last of the Arctic Voyages, Crust., p. 401, Pl. XXXV, fig. 3, 1855.

Plate V, figures 2, 3. Plate VI, figures 2 a to 2 k.

Body very robust, lateral processes scarcely separated. Oculiferous segment broad and stout, neck very thick. Oculiferous tubercle much elevated, slender, rounded. Eyes ovate, black. Abdomen slender, tapering from the middle toward the base and tip.

Antennæ very hairy, rather stout, basal joint slightly longer than the rostrum; claws of chelæ slender, acute, very strongly curved, when closed crossing each other at a considerable distance from the tips. The spines, with which they are armed, are rather long, slender, and not very closely set; toward the base they become strongly curved or even hook-shaped.

Palpi very stout; basal joint nearly quadrate, half the length of the second; the remaining joints decrease regularly to the last. The appendage is densely hairy; on the outer three joints the hairs are densely plumose.

The accessory legs differ considerably in the sexes. In the male there are three short basal joints, followed by two which are considerably longer, nearly equal, and somewhat clavate; the sixth is about two-thirds the fifth, and the remaining joints become successively smaller to the last, which is acute and claw-like, and armed below with a series of spines. In the female the appendage is larger and stouter, the fifth joint is about twice as long as the corresponding joint in the male, and near its outer extremity it is swollen and furnished on each side with a dense tuft of long hairs; the spines of the outer joints are scarcely denticulated and alike in both sexes.

Legs comparatively stout, often distended with the generative organs; first and third joints about as long as broad; second longer, somewhat clavate, longer in the female than in the male; the three following joints are much longer, the sixth longest; tarsus short, half the propodus, which has, below, a series of slender spines; dactylus about two-thirds the propodus; auxiliary claws very small and slender, about one-fifth the dactylus. All the appendages are thickly covered with coarse hairs, which are most numerous on the outer joints. The body is slightly hairy or nearly naked. Color light dull yellow. Adult specimens are very frequently covered with rubbish, and living Bryozoa, Sponges, Rhizopods, etc., are often attached to them. Length 12 millimeters; extent 73 millimeters.

This species has not before been recorded from our coast, though taken in great numbers off Halifax by the U. S. Fish Commission in 1877. It occurs on rocky, gravelly or muddy bottoms, down to 50 fathoms. Sept. 24th, 1877, several hauls made off Halifax in 50 fathoms, muddy bottom, brought them up by hundreds, clinging to the meshes of the trawl-net. A single specimen was dredged off Salem, Mass., in 48 fathoms, soft mud. Many of the specimens had egg-masses. In some of these, young were found in various stages of growth. In the earliest stage observed (Plate VI, figures 2*i*, 2*j*) the body is very large and swollen, without a trace of segmentation. The rostrum is short and directed downward. The five anterior pairs of appendages are developed, the posterior one rudimentary. The basal joint of the antenna bears a long flagellum.

The specimens agree well with Bell's figures and description, and are doubtless identical with the form described by him. Whether the latter is distinct from the *Nymphon hirtum* of Chr. Fabricius cannot be determined without direct comparison with Norwegian specimens. The species described by Krøyer as *Nymphon hirtum*?, and figured in the *Voy. en Scand., Laponie, etc.*, differs materially from the specimens examined by me, in the form of the antennae, size of the auxiliary claws, proportions of the palpal joints, and in other respects. This form was from Iceland, and is probably identical with Fabricius' species from the "Norwegian Ocean." It seems advisable to retain, for the present, the name *hirtipes* for the present species until it shall have been proved identical with *N. hirtum* by comparison with European specimens.

The following table is intended to show the general geographical and bathymetrical distribution of the species described in this paper. The occurrence of a species in any region is indicated by a + mark. A few of the species occur in the deeper waters far to the southward of their ordinary limits, and this is indicated by a ± mark.

	Geographical Distribution.										Bathymetrical Distribution.				
	Virginia.	Long Island Sound.	Vineyard Sound.	Mass. Bay.	Casco Bay.	Bay of Fundy.	Gulf of Maine.	Off Halifax.	Gulf of S. Lawrence.	Greenland.	Northern Europe.	Mediterranean.	Littoral.	Fathoms.	European.
<i>Pycnogonum littorale</i> Ström.		±										*	+	0-430	
<i>Tanystylum orbiculare</i> Wils.	+	+	+											0-14	
<i>Achelía spinosa</i> (Stimp.) Wils.		±			+	+							+	0-34	
<i>Pseudopallene hispida</i> (Stimp.) Wils.							+							0-12	
<i>Pseudopallene discoidea</i> (Kr.) Wils.							+							0-20	
<i>Pallene empusa</i> Wils.		+	+										+	0-3	
<i>Phoxichilidium maxillare</i> Stimp.						+	+		+				+		
<i>Phoxichilidium minor</i> Wils.							+						+	0-10	
<i>Anoplodactylus lentus</i> Wils.		+	+										+	0-6	
<i>Ammothea achelioides</i> Wils.							+								
<i>Nymphon Strömii</i> Kr.							+	+	+	+	+	+		35-112	
<i>Nymphon longitarse</i> Kr.							+	+	+	+	+	+		16-90	220
<i>Nymphon grossipes</i> Fabr.		±					+	+	+	+	+	+		16-100	416†
<i>Nymphon hirtipes</i> Bell.							+		+	+	+			25-90	299

* teste Philippi.

† *N. mixtum* Kr. (teste G. O. Sars).

NOTE.

After this article had been put in type, an important paper, "Prodrömus descriptionis Crustaceorum et Pycnogonidarum, quæ in Exp. Norvegica anno 1876, observavit G. O. Sars," in the *Archiv for Mathematik og Naturvidenskab*, 1877, page 337, was received. Owing to the absence of Mr. Wilson, he has been unable to make any use of that article. It may, however, be useful to state that Dr. Sars confirms the identity of *Nymphon hirtum* Fabr. and *N. hirtipes* Bell, adopting the former name. He also enumerates *N. mixtum* Krøyer and *N. gracilipes* Heller as valid species.

From this source I have also added to the table some facts concerning the bathymetrical distribution of the species on the northern coast of Europe.

A. E. VERRILL.

EXPLANATION OF PLATES.

PLATE I.

The figures are from drawings made from nature by J. H. Emerton.

Figure 1a.—*Pycnogonum littorale* O. Fabr.; dorsal view; 1b, ventral view.

Figure 2a.—*Nymphon Strömii* Kröyer; dorsal view; 2b, profile view.

PLATE II.

The figures are from camera-lucida drawings by the author.

Figure 1a.—*Achelia spinosa* (Stimp.) Wilson, dorsal view; 1b, rostrum seen from the ventral side; 1c, terminal joints of leg; 1d, accessory leg and palpus of female; 1e, accessory leg of male; 1f, antenna; 1g, recently hatched larva, dorsal view; 1h, spine of accessory leg.

Figure 2a.—*Tanystylum orbiculare* Wilson, dorsal view; 2b, terminal joints of leg; 2c, palpus; 2d, accessory leg of male; 2e, accessory leg of female; 2f and 2f', two of the bifid spines from accessory leg.

Figure 3a.—*Pycnogonum littorale* O. Fabr., accessory leg; 3b, ambulatory leg.

PLATE III.

The figures are from camera-lucida drawings by the author.

Figure 1a.—*Pseudopallene hispida* (Stimp.) Wilson, dorsal view; 1b, accessory leg; 1c, spines from accessory leg; 1d, terminal joints of leg; 1e, antenna.

Figure 2a.—*Pallene empusa* Wilson, dorsal view; 2b, terminal joints of leg; 2c, antenna; 2d, part of anterior segment with rostrum seen from the ventral side; 2e, accessory leg of male; 2f, accessory leg of female; 2g and 2g', spines from accessory leg.

Figure 3a.—*Pseudopallene discoidea* Wilson, dorsal view; 3b, antenna; 3c, accessory leg.

PLATE IV.

The figures are from camera-lucida drawings by the author.

Figure 1a.—*Phoxichilidium maxillare* Stimpson, dorsal view; 1b, accessory leg; 1c, terminal joints of leg; 1d, antenna; 1e, ambulatory leg.

Figure 2a.—*Phoxichilidium minor* Wilson, dorsal view; 2b, accessory leg of female with three ova; 2c, terminal joints of leg; 2d, antenna of female; 2e, antenna of male; 2f, ambulatory leg.

Figure 3a.—*Anoplodactylus lentus* Wilson, body, dorsal view, male; 3b, accessory leg of female; 3c, terminal joints of leg; 3d, antenna of male; 3e, ambulatory leg.

PLATE V.

Figure 2 was drawn from nature by J. H. Emerton; the remaining figures are from camera-lucida drawings by the author.

Figure 1a.—*Ammothoa achelioides* Wilson, dorsal view; 1b, accessory leg; 1c, terminal joints of leg; 1d, palpus; 1e, antenna.

Figure 2.—*Nymphon hirtipes* Bell, dorsal view.

In figures 1a and 2 the lettering is as follows: *a*, antenna; *b*, palpus; *c*, accessory leg; *d*, abdomen; *e*, eyes; *l', l'', l''', l''''*, the four pairs of ambulatory legs; 1, 2, 3, 4, 5, 6, 7, 8, 9, the joints of the legs; 9', auxiliary claws; *r*, rostrum; *s*, body; *s', s'', s''', s''''*, the four lateral processes of the body to which the legs are articulated.

PLATE VI.

The figures are from camera-lucida drawings by the author.

Figure 1a.—*Nymphon Strömii* Kröyer; dorsal view of body; 1*b*, lateral view of body; 1*c*, antenna, lateral view; 1*d*, antenna, dorsal view; 1*e*, ambulatory leg; 1*f*, terminal joints of leg; 1*g*, accessory leg of female; 1*h*, 1*h'*, 1*h''*, spines from accessory leg.

Figure 2a.—*Nymphon hirtipes* Bell, antenna; 2*b*, spines from antenna; 2*c*, palpus; 2*d*, accessory leg of male; 2*e*, fifth joint of accessory leg of male; 2*f*, fifth joint of accessory leg of female; 2*g*, terminal joints of leg; 2*h*, plumose hair from palpus; 2*i*, larva recently hatched, dorsal view; 2*j*, larva recently hatched, lateral view; 2*k*, seventh joint of accessory leg, showing arrangement of spines.

PLATE VII.

The figures are from camera-lucida drawings by the author.

Figure 1a.—*Nymphon grossipes* Chr. Fabr., dorsal view of body; 1*b* to 1*g*, terminal joints of leg, series to show variation in the length of the tarsus; 1*h*, antenna; 1*i* to 1*l*, oculiferous segment, to illustrate variation, (fig. 1*l* is from a young specimen). 1*m*, lateral view of body; 1*n*, palpus; 1*o*, palpus from a young specimen; 1*p*, accessory leg; 1*q*, spine from accessory leg.

Figure 2a.—*Nymphon longitarse*, dorsal view of body; 2*b*, lateral view of body; 2*c*, oculiferous segment of another specimen, to show variation; 2*d*, accessory leg; 2*e*, 2*e'*, 2*e''*, spines from accessory leg; 2*f*, palpus; 2*g*, antenna; 2*h*, terminal joints of leg.

II.—THE STALK-EYED CRUSTACEANS OF THE ATLANTIC COAST OF NORTH AMERICA NORTH OF CAPE COD. BY S. I. SMITH.

THIS paper is the result of work done in preparing a more complete account of the crustaceans of the coast of northern New England for the report of the United States Commissioner of Fisheries. The study of the extensive collections of crustaceans, made during the past fourteen years by Professor Verrill and myself, and particularly during the last seven years under the auspices of the Commission for the investigation of the fisheries, promised to add so much to the knowledge of the relations of the fauna of the western side of the North Atlantic, that it has seemed desirable to publish as early as possible the results bearing upon the geographical distribution of the species. This has been long delayed, however, by the great quantity of material which has each year been added to the collections, so that the time at my disposal has been little more than sufficient properly to separate and care for the specimens themselves. In the present paper I have attempted to give these results for the species of stalk-eyed Malacostraca inhabiting the coast between Cape Cod and northern Labrador. Only a very small portion of the species composing the crustacean fauna is thus included, but it is that portion which is best known and consequently most useful in determining the relations of the fauna. Although the paper has special reference to the geographical distribution of the species, considerable matter is introduced in regard to specific variation and specific characters, and, under some of the species, to the synonymy, where it seemed necessary to the proper understanding of the geographical distribution or to show the propriety of the nomenclature adopted, or where the species is not well-known.

The practice among zoologists of neglecting to make clearly apparent what parts of their writings are based on their own observations and what on the works of others, is a frequent source of annoyance and error. This is particularly the case in the statement of the habitats of species, as often given, without the slightest indication whether the occurrence of the species, in each of the regions specified, is known to the author from personal observation or the examination of specimens collected by others, or whether the statement is based

on the writings of other observers, or whether the author has merely conjectured that the species—perhaps never seen by him—inhabits certain regions. Heretofore my own practice has not always been free from fault in this respect, but throughout the following pages I have been careful to indicate distinctly what portions of the statements are based on my own observations and what are merely copied. To do this in the paragraphs devoted to the geographical distribution of the species, I have used the mark of affirmation (!) after each region from or in which I have examined specimens; but to avoid the too frequent repetition of this mark, in cases where the enumeration of several stations or depths immediately follows the name of a special region or locality, it has been placed after the latter only, it being understood that I have examined specimens from all the stations or depths mentioned under that region or locality. The name of the collector, or of the authority for the locality of the specimens examined,—unless I have myself been collector or observer,—is either inserted in parenthesis after the locality or indicated by the date, as explained below. The authorities for all localities from which I have not examined specimens are similarly indicated in parentheses. In the synonymy, all the references given have been made by direct examination of the works quoted, unless specially indicated to the contrary by the use of quotation marks.

To avoid the repetition of the names of collectors, after the numerous localities on our coast, mentioned under the geographical distribution of the species, the year in which the collections were made is, in most cases, alone inserted; and a short statement of the principal sources whence the collections have been received, is inserted here, that portion which is subsequently referred to as authority for collections being arranged chronologically.

1864. Collections made at Eastport, Maine, on the Bay of Fundy, during September and October, by Professor Verrill and the writer.

1868. At the same locality, during August and the early part of September, also at the Island of Grand Menan and in the deep waters off Eastport; by Prof. Verrill, Prof. H. E. Webster, Rev. Geo. A. Jackson, and the writer.

1870. At the same localities and during the same season as in 1868; by Professor Verrill and Mr. Oscar Harger. Also, by myself upon the southern side of Long Island, during August and the early part of September.

1871. Professors Verrill and J. E. Todd, and the writer made collections, for a short time in April, in the neighborhood of Great Egg

Harbor, New Jersey; a special object of the excursion being the determination of the species described from that region by Say.

The systematic exploration of the waters of our coast were this year begun, in connection with the investigations concerning the coast fisheries, under the direction of Professor Baird, United States Commissioner of Fish and Fisheries. Under these auspices, the larger part of the collections referred to in this paper have been made. In 1871, this work was carried on in the region of Vineyard Sound and Buzzard's Bay, from late in June to the middle of September. The dredging operations and the care of the collections of invertebrates were in my charge during the first part of the season, later in care of Prof. J. E. Todd, and finally under the direction of Professor Verrill, more or less assisted by Professors A. Hyatt and A. S. Packard, Jr., and particularly by Prof. W. G. Farlow, who was specially engaged in collecting and studying the algæ.

1872. Under the auspices of the Commissioner of Fisheries, large collections were made, during July and August, at Eastport, Maine, and in the whole neighboring region of the Bay of Fundy. As in the succeeding years, Professor Verrill had charge of the dredging operations and the collections of invertebrates. For a large part of the season Dr. T. M. Prudden cared for the crustaceans and made valuable notes on the stations and color of the species. For a part of the season Prof. H. E. Webster was at the island of Grand Menan where he made valuable additions to the collection of crustaceans, particularly among the species of *Hippolyte*. Several other gentlemen aided in the general work of collecting, and, for a time in August, Mr. Harger and I were present and took part in the work.

During the last of August and September, a series of dredgings were made, on board the Coast Survey steamer *Bache*, in the region of St. George's Banks and the adjacent waters. An account of these dredgings has already appeared in the third volume of these Transactions. This, the earliest exploration with the dredge, of the region referred to, was carried out through the coöperation of Professor Baird and the Superintendent of the Coast Survey. During the first cruise, on which dredgings were made on, and east of, St. George's Banks; at Halifax, Nova Scotia; and on Le Have Bank, the dredging was in charge of Mr. Harger and the writer. On the second cruise, dredgings were made by Prof. A. S. Packard, Jr., and Mr. Caleb Cooke, in the region of St. George's Banks. In the latter region the dredgings extend from north latitude $41^{\circ} 25'$ to $42^{\circ} 11'$, and from west longitude $68^{\circ} 10'$ to $65^{\circ} 42'3''$; on Le Have Bank, in

a line about southeast from Cape Sable, Nova Scotia, and a little south of latitude 43° north. The dredgings made by Professor Packard and Mr. Cooke were at five different stations, all on, or near, the northern slope of St. George's Banks, and in 110, 85, 45, 40, and 150 fathoms.

While waiting at Provincetown, Massachusetts, for the Bache, Mr. Harger and I were able to observe a large number of the shore and shallow-water species, showing the fauna to be intermediate in many respects between the fauna north and that south of Cape Cod.

1873. Collections were made in, and off, Casco Bay, coast of Maine, during July, August, and the early part of September, under the same auspices and direction as in 1872. During the season I had charge of the crustaceans and was greatly aided by Mr. J. H. Emerton, who not only made many most excellent drawings for use in the final reports upon the crustaceans, but also assisted in the work of collecting.

Through the same coöperation as in 1872, the steamer Bache made several trips, during September, to the deeper waters of an extensive region in the Gulf of Maine, between Cape Cod and the coast of the State of Maine. On these trips, Professor Packard and Mr. Cooke took charge of the dredgings, which were made in the following distinct regions: off the coast of Maine, south and east of Penobscot Bay, in 52 to 82 fathoms; a region on and near Jeffrey's Bank, extending from north latitude $43^{\circ} 15'$ to $43^{\circ} 36'$, and from west longitude $69^{\circ} 6'$ to $68^{\circ} 25'$, and at depths from 60 to 107 fathoms; in 52 to 118 fathoms on Cashe's Ledge and to the west of it (the Ledge being in about latitude $42^{\circ} 50'$, longitude $68^{\circ} 50'$, and the dredgings extending to $69^{\circ} 35'$); on and near Jeffrey's Ledge, off the coast of New Hampshire, in 24 to 33 and 95 to 118 fathoms; in the central part of Massachusetts Bay, in 50 and 65 fathoms; in 24 to 33 fathoms on Stellwagen's Bank, the outer barrier of Massachusetts Bay, situated between Cape Cod and Cape Ann; off Massachusetts Bay, 20 to 25 miles northeast of Cape Cod, in 117 and 142 fathoms; and in shallow water just south of Cape Ann.

In April of this year, Professors Verrill and D. C. Eaton made an excursion to Watch Hill, Rhode Island, and made a small collection of special interest on account of the season of the year.

1874. The dredgings, in connection with the work of the Fish Commission, were carried on in the region about the eastern end of Long Island Sound and extended from the mouth of the Connecticut River, to Gardner's and Peconic Bays, to the waters south of Montauk Point, and to the banks south and east of Block Island.

As in 1873, the steamer *Bache* continued the dredgings in the Gulf of Maine. Professor Packard, assisted by Mr. Cooke and Mr. Robert Rathbun, had charge of the work and made large collections between Cape Ann and the Isles of Shoals, on Jeffrey's Ledge, on Cashe's Ledge, and at numerous localities in the deep waters of the Gulf of Maine.

1875. The work under the direction of the Commissioner of Fisheries was in the same region as in 1871, but the dredgings extended further to the eastward and included the region east of Nantucket.

In addition to this, Professor Verrill and Mr. C. Hart Merriam, during a short excursion to Barnstable, on the north side of Cape Cod, made collections of many of the species inhabiting the shores and shallow waters of the southern part of Cape Cod Bay.

1876. Mr. C. Hart Merriam and Mr. E. B. Wilson made some collections at Eastport, Maine, in April, and very kindly submitted the crustaceans to me. The collection was particularly interesting on account of the season at which it was made, all the other collections which I have examined from the same region having been made late in the summer or early in the autumn.

1877. The extensive collecting prosecuted under the direction of the Commissioner of Fisheries was resumed, the collections of the invertebrates being, as before, in charge of Professor Verrill, who was this year assisted by Mr. E. B. Wilson. Extensive collections were made at Salem, Massachusetts, and in the neighboring waters of Massachusetts Bay and the Gulf of Maine. During a part of the season the work was transferred to Halifax, Nova Scotia, where large collections were made and whence the dredging was extended to the deep waters one hundred and twenty miles south of that city. On the passage from Salem to Halifax, dredgings were made in the deep waters of the Gulf of Maine and off the southern portion of the Nova Scotia coast.

1878. The work in connection with the investigation of the fisheries was continued in the vicinity of Cape Ann, the field investigated being contiguous to, and partially overlapping, that in the vicinity of Salem in 1877. In addition to the material obtained upon the shores and by dredging, valuable collections were procured, at Gloucester, Massachusetts, the head-quarters of the Commission for the season, from vessels engaged in the bank-fisheries. Professor Verrill was specially assisted by Mr. Richard Rathbun and Mr. Sanderson Smith. The collections of this year came to hand too late to be used to any considerable extent in the present paper, and consequently only occasional references are made to them.

I was not able to assist in the work of collecting either in 1877 or 1878, but the crustaceans in the collections of these years have nearly all been placed in my hands in the original packages in which the specimens collected at each special locality were placed, so that I am alone responsible for the determination of the species from each of these special localities.

Several gentlemen, in addition to those above mentioned in connection with the work of the Fish Commission, aided in collecting during different seasons; the gentlemen who were specially engaged in investigating the fishes, also, gave every season, more or less assistance in collecting the invertebrates. Mr. G. Brown Goode, who has for several years had charge of the work upon the fishes, should be particularly mentioned in this connection.

Mention should also be made of the small collections which have, from time to time, been made, in the interest of the United States Fish Commission, by Mr. Vinal N. Edwards in the vicinity of Wood's Holl, Massachusetts (Vineyard Sound and Buzzard's Bay). These collections have been made mostly in the winter and spring and for this reason have proved of special interest, often containing species rarely or never taken in summer, and in several cases materially helping to complete the annual history of a species.

For the use of a few specimens of rare species, not fully represented in the collections above referred to, and also for the freest access to the collections under their charge, I am under obligation to the officers of the Boston Society of Natural History, the Peabody Academy of Science at Salem, and the Portland Society of Natural History. In addition to the use of the collections made under the auspices of the United States Fish Commission, I am indebted to Professor Baird for the opportunities of examining several collections from our southern coast and from Europe, for the loan of books, and for the use of several of the drawings made by Mr. Emerton, which appear in the accompanying plates. To Professor Verrill, I am indebted for the constant use of the valuable collection of crustaceans, of which I formerly had charge, in the Museum of Yale College, as well as for his advice and assistance in many ways. The Museum, in addition to the collections above referred to, contains large collections made in the vicinity of New Haven during many years; an authentic set from the collection which served as a basis for Professor Packard's work upon the invertebrate fauna of Labrador, contained in the first volume of the *Memoirs of the Boston Society of Natural History*; a very valuable series of the crustacea of the coast of Norway, received from

Professor G. O. Sars; a similar series from the British Isles, received from the Reverend A. M. Norman; and a miscellaneous collection of authentically determined species received through Professor A. Milne-Edwards, from the Jardin des Plantes at Paris. These European collections have been of the greatest service for comparison with our closely allied or identical species. The collection from the Reverend Mr. Norman, however, has been received since the following pages were written, so that it is only occasionally referred to.

To the kindness of Mr. J. F. Whiteaves of Montreal, I am indebted for the opportunities of examining very nearly all the crustaceans obtained in his extended explorations of the Gulf of St. Lawrence. Brief accounts of these explorations by Mr. Whiteaves, whose investigations have added very largely to the knowledge of the fauna of the Gulf of St. Lawrence, are contained in his several reports to the Minister of Marine and Fisheries for the Dominion of Canada.

Gelasimus pugnax Smith.

Salt-marshes at Provincetown! (1872) and Barnstable! (1875), Massachusetts, and south to Florida! (Col. W. E. Foster, Dr. H. S. Williams, et al.) and the island of Hayti! (Dr. D. F. Weinland, J. S. Adam).

Gelasimus pugilator Latreille ex Bosc.

Muddy and sandy flats, Provincetown!, Massachusetts, 1872, to the west coast of Florida! (Col. E. Jewett). These species of *Gelasimus* and the two following species belong properly to the fauna of southern New England, which, as I have elsewhere remarked, seems to extend across Cape Cod into the shallow waters of Cape Cod Bay.

Callinectes hastatus Ordway ex Say.

A large specimen of this species has been reported from Salem, Massachusetts, (C. Cooke, American Naturalist, i, p. 52, 1867). This individual was probably only a wanderer from farther south, although the species may occur in Cape Cod Bay, during favorable seasons.

Platyonichus ocellatus Latreille ex Herbst.

Provincetown! (1872) and Barnstable! (1875), Massachusetts; abundant at the latter place. Fort Macon!, North Carolina (Cones, Packard), to Key West, Florida (Gibbes). Sandy shores and bottoms, low water to 10 fathoms.

Carcinus mænas Leach ex Linné.

Provincetown!, Massachusetts, 1872, to New Jersey!, 1871. The European coast!, from Fimmark (M. Sars) and the Baltic (Möbius) to both sides of the Mediterranean (Grube, Lucas, Heller) and the Black Sea (Rathke). It has also been reported from Brazil by Heller (Reise der Novara, Crust., p. 30, 1865) and from the Hawaiian Islands by Streets (American Naturalist, xi, p. 241; and Bulletin United States National Museum, No. 7, p. 109, 1877). In the Museum of Yale College there is a single specimen, unquestionably of this species, which was sent from Panama Bay, with a large collection of other marine animals, in 1866, by Professor F. H. Bradley. At these last three localities it seems to be very rare, and possibly accidental.

The range of this species upon the eastern coast of North America, as far as I can ascertain from positive information, is very limited. Streets states that "it is by no means an uncommon crab along the whole extent of the eastern coast of the United States," but gives no special localities, and I am inclined to believe that he generalized, very naturally, without carefully examining the facts. From personal observation, I know the species is common and often very abundant in Vineyard Sound, Buzzard's Bay, various parts of Long Island Sound, and in the bays on the south side of Long Island. I also observed it at Provincetown, Massachusetts, in 1872, and at Great Egg Harbor, New Jersey, in 1871. From beyond these limits, either north or south, I have never seen specimens nor any positive record of their occurrence. It is not a regular inhabitant of Casco Bay or the Bay of Fundy. I have examined several large collections from Fort Macon, North Carolina, and others from the coast of South Carolina, both coasts of Florida, Key West, and the east coast of Mexico, without finding a single individual of the species. It is not mentioned in Stimpson's list of Beaufort, North Carolina, species (Amer. Jour. Sci., II, xxix, p. 444, 1860), nor that of Coues for the same locality (Proc. Acad. Nat. Sci. Philadelphia, 1871, p. 120), nor is it mentioned from special localities in the Southern States by Gibbes, nor by any one else as far as I am aware. I know of no other common species of crustacean with a similarly restricted habitat upon our coast.

It is most abundant between tides or near low-water mark and is seldom found below a very few fathoms in depth.

Geryon quinquedens, sp. nov.Plate IX, figures 1, 1*a*, 1*b*, 2.

This species is closely allied to *G. tridens* Kröyer (Plate IX, figures 3, 3*a*) but is at once distinguished from it by the armament of the antero-lateral margins of the carapax.

In the larger specimens, the carapax, including the lateral spines, is about a third broader than long. The dorsal surface is considerably convex longitudinally, but only slightly transversely, entirely naked, finely, but irregularly, granulated, and not deeply areolated. The most prominent elevation is a short, rounded, transverse ridge each side, between the base of the lateral spine and the posterior portion of the gastric region. The front is narrower and more prominent than in *G. tridens*, its breadth between the tips of the inner angles of the orbits only equaling the width of the orbit itself between the tips of its inner and outer angles. The median teeth of the front are near together, triangular, and deflexed below the level of the inner angles of the orbits, in front of which they project for almost or quite their whole length. The outer angles of the orbits are acutely angular, but broader and less spiniform than in *G. tridens*. The next tooth (the second of the five normal teeth of the antero-lateral margin), which is entirely wanting in *G. tridens*, is a well-developed angular projection of the margin, but less prominent than the first tooth and not acutely angular. The third tooth is prominent, acutely triangular, but scarcely spiniform, and much shorter than in *G. tridens*. The fourth tooth, which, like the second, is entirely wanting in *G. tridens*, is represented by a distinct but only slightly angular emargination which is more conspicuous in the smaller than in the larger specimens. The postero-lateral margins are nearly straight as in *G. tridens*. In young specimens the three larger teeth of the antero-lateral margin are more acute and spiniform than in the larger specimens examined.

The eyes, antennule, antennæ, and epistome are very nearly as in *G. tridens*, but the inner angle of the inferior margin of the orbit is much less prominent in the new species. In *G. tridens*, this angle projects as a slender tooth to the extremity of the peduncle of the antenna, reaches as far as the outer angle of the orbit and nearly as far as the front itself (Plate IX, figure 3*a*), while in our species it is much less slender, falls far short of either of the other angles of the orbit and reaches but slightly beyond the third segment of the antenna (figure 1*a*).

The chelipeds, in the largest male examined (figure 1*b*), as well as in the females and young, are only slightly unequal and rather slender. The fingers on each hand are about as long as the basal portion of the propodus and their thin prehensile edges are armed with sharp serrations which shut slightly by on the two fingers when the dactylus is closed. The dactylus of the larger cheliped, in all the specimens, has, in addition to the serrations, a small obtuse tubercle near the base. In the only specimen of *G. tridens* examined (a male considerably larger than the largest specimens of *G. quinquedens*), the chelipeds are more unequal, the larger being proportionally stouter, and the teeth of the prehensile edges of the fingers are more obtuse and the proximal ones even obtusely tuberculiform; this may be, however, only a character of very old individuals. The sternum, ambulatory legs, and abdomen afford no distinctive characters.

The following are measurements of seven of the nine specimens before me, and also of a specimen of *G. tridens*, from Christiania Fiord, Norway, received from Professor G. O. Sars.

Carapax.	<i>a</i> , ♂	<i>b</i> , ♂	<i>f</i> , ♂	<i>c</i> , ♀	<i>f</i> , ♀	<i>d</i> , ♀	<i>e</i> , ♀	<i>G. tridens</i>
Length including frontal teeth,	33mm	45	28.7	28.5	25.6	21.7	12.2	56
Breadth including lateral spines,	45	58	36.8	38	33.7	29.1	16.7	75
Ratio of length to breadth,	1:1.36	1:1.29	1:1.28	1:1.33	1:1.32	1:1.34	1:1.37	1:1.34
Breadth in front of lateral spines,	39	51.8	32.5	32.3	29.2	24.4	13.8	64
Ratio of length to this breadth,	1:1.18	1:1.15	1:1.13	1:1.13	1:1.14	1:1.13	1:1.13	1:1.14
Length of posterior legs,		95	57	52	50	39	24	115

This very interesting species was first known to me, about ten years ago, from two specimens, in the collection of the Portland Society of Natural History, obtained by Mr. C. B. Fuller from stomachs of fishes taken in deep water off Casco Bay. These specimens were somewhat shrunken from partial digestion, immersion in alcohol and subsequent drying, and the measurements (given above in column *a*) of the smaller one of the two may be slightly incorrect. The other specimens which I have examined were all taken in deep water in the Gulf of Maine, off Massachusetts Bay. The largest two of these (*b* and *c*) were obtained, August 19, 1877, by Professor Verrill and party of the United States Fish Commission on board the "Speedwell," at 160 fathoms, soft muddy bottom, about forty miles east of Cape Ann, latitude 42° 38' north, longitude 69° 38' east. Two others were dredged off Massachusetts Bay by Professor Packard, while on board the "Bache" in September, 1873: a female (*d*), carrying an abundance of eggs, in latitude 42° 18' north, longitude 69° 49' east, 142 fathoms, soft blue mud; and a very small female (*e*), latitude 42° 20' north, longitude 70° east, 117 fathoms, on a bot-

tom of the same character. Four other specimens (*f*), two males and two females, one of which was carrying eggs, were dredged near these localities, August 31, 1878, latitude $42^{\circ} 33'$, longitude $69^{\circ} 35'$, in 100 to 115 fathoms, mud and stones. Fragments of a large specimen were also found in the stomach of a cod-fish taken in ninety-eight fathoms, soft mud, fourteen miles southeast of Cape Ann, September 2, 1878.

The *G. tridens* was described by Kröyer (Naturhistorisk Tidsskrift, i, p. 10, pl. 1, 1836) from specimens taken on the coast of Denmark. It has since been reported from Christiania Fiord, in ten to twenty fathoms (G. O. Sars, Christiania Videnskabs-Selskabs Forhandling for 1873, p. 393) and a few other Scandinavian localities, and from off Valentia, Ireland, in 159 fathoms (Thomson, "Depths of the Sea," p. 87, fig. 9, 1873). Like its American representative, it seems to be a deep-water species rarely taken in the dredge.

Panopeus depressus Smith.

Provincetown! (1872), Massachusetts, to the Gulf of Mexico! (Col. E. Jewett, et al.). This and the next species are apparently regular inhabitants of Cape Cod Bay. They are both, but more particularly this species, very abundant upon oyster-beds everywhere south of Cape Cod and are often carried alive long distances among oysters, so that it is difficult to determine their exact northern range.

Panopeus Sayi Smith.

Provincetown! (1872), Massachusetts, to the Gulf of Mexico! (Col. E. Jewett). Apparently less abundant, at least on the New England coast, than the last.

Panopeus Harrisii Stimpson ex Gould.

Massachusetts Bay! (Coll. Boston Soc. Nat. Hist.) and Long Island Sound! to St. John's River, Florida! (G. Brown Goode). This species, originally described by Gould, from Charles River, Massachusetts, is apparently a thoroughly brackish-water form. The specimens from the St. John's River, as I am informed by Mr. Goode, were taken at Arlington Bluffs, twenty-two miles from the mouth. It was associated at this place with *Sesarma cineria*, *Palaemonetes vulgaris*, and a *Bopyrus* which infested the branchial cavity of nearly every specimen of the latter species. Mr. Goode writes that these species were taken in water perfectly fresh to the taste, though brackish water is sometimes driven by the wind up the river to where they occurred.

Cancer irroratus Say.

Cancer irroratus (♂ only, ♀ being of the next species) Say, Journal Acad. Nat. Sci. Philadelphia, i, p. 59, pl. 4, fig. 2, 1817.—Stimpson, Annals Lyceum Nat. Hist. New York, vii, p. 50 (4), 1859.—A. Milne-Edwards, Nouvelles Archives du Muséum d'Hist. nat. Paris, i, p. 191, 1865.—Verrill, Invertebrate Animals of Vineyard Sound, Report U. S. Commissioner of Fish and Fisheries, part i, p. 312 (18), 1874.—Smith, in Verrill, op. cit., pp. 530 (236), 546 (252), 1874.

Platycarcinus irroratus Milne-Edwards, Hist. nat. des Crust., i, p. 414, 1834.—DeKay, Nat. Hist. of New York. Crust., p. 6 (in part), pl. 2, fig. 2, 1844.

Cancer Sayi Gould, Report on Invertebrata of Massachusetts, 1st edit., p. 323, 1841.

Platycarcinus Sayi DeKay, op. cit., p. 7, 1844.—Gibbes, Proceedings Amer. Assoc. Adv. Sci., 3d meeting, p. 176 (12), 1850.

Cancer borealis Packard, Memoirs Boston Soc. Nat. Hist., i, p. 303, 1867.

South Carolina (Gibbes), apparently rare. Fort Macon, North Carolina! (Cones, Yarrow). Great Egg Harbor!, New Jersey, 1871; apparently not very common in the muddy bays, but thrown up in large numbers upon the sandy outer beaches. Southern shore of Long Island!, 1870; on sandy beaches. Long Island Sound!; abundant on sandy and rocky shores. Equally abundant, in similar situations, along all the rest of the south coast of New England, and in Cape Cod! (1872, 1875), Massachusetts! (1877, 1878), and Casco! (1873) Bays. Apparently much less abundant in the Bay of Fundy! (1864, 1868, 1870, 1872), and at Halifax!, Nova Scotia (1872, 1877). Gulf of St. Lawrence!, 1873; "the common crab of the Gulf" (Whiteaves). "Not uncommon at Caribou Island, Straits of Belle Isle," south coast of Labrador! (A. S. Packard, Jr.).

The exact bathymetrical range of the adult is not easily determined, since full-grown specimens are seldom taken in the dredge. Specimens of considerable size were frequently taken in the trawl in Vineyard Sound, in from 6 to 12 fathoms, but I have never seen adult specimens from below the latter depth, although young individuals are often taken at much greater depths. Small specimens, from 10 to 25^{mm} in breadth of carapax, were common in shallow-water dredgings in Vineyard Sound! and Buzzard's Bay!, 1871, 1875, and were taken off Newport!, Rhode Island, in 29 fathoms, mud, 1871; in the region of St. George's Banks!, 30 to 50 fathoms, sand, sand and shells, and coarse sand, 1872; on Stellwagen's Bank!, 34 to 44 fathoms, sand, 1873,—one specimen about 40^{mm} in breadth of carapax; off Cape Ann!, Massachusetts, 26 fathoms, rocks, 1878; not rare on sandy and hard bottoms in Casco Bay!, in 5 to 10 fathoms, and once taken, between Eagle and Bates Islands, in 24 fathoms, hard bottom, 1873; several localities in and near Halifax Harbor!,

Nova Scotia, 16 to 21 fathoms, on bottoms of fine sand, and of fine sand and red algæ, 1877.

Found in abundance in the stomachs of the cod (!) taken in Casco Bay and the Bay of Fundy.

When found living between tides it is usually concealed among rocks or buried beneath the sand. It is usually much more abundant at or just below low-water mark than between tides, however.

The largest specimens I have examined are from Casco Bay. One of these, a male, has the carapax 83^{mm} long and 129·2^{mm} broad.

Cancer borealis Stimpson.

Cancer irroratus (♀ only, ♂ belonging to the last species) Say, Journal Acad. Nat. Sci. Philadelphia, i, p. 57, 1817.—Gould, Report on the Invertebrata of Massachusetts, 1st edit., p. 322, 1841.—Stimpson, Marine Invertebrata of Grand Manan, p. 59, 1853 (*teste* Stimpson).

Platycarcinus irroratus DeKay (in part), Nat. Hist. of New York, Crust., p. 6 (but not the figure), 1844.—Gibbes, Proceedings Amer. Assoc. Adv. Sci., 3d meeting, p. 177 (13), 1850.

Cancer borealis Stimpson, Annals Lyceum Nat. Hist. New York, vii, p. 54 (4), 1859.—Verrill, Invertebrate Animals of Vineyard Sound, pp. 486 (192), 493 (199) 1874.—Smith, in Verrill, op. cit., pp. 546 (252), 745 (451), 1874.—Kingsley, Proceedings Acad. Nat. Sci. Philadelphia, p. 317 (2), 1878.

Plate VIII.

Near Noank!, Connecticut (eastern end of Long Island Sound), 1874. Off Watch Hill!, Rhode Island, April, 1873; a small specimen dredged in four to five fathoms, among rocks and algæ. Nomansland!, 1871. Vineyard Sound!, 1871, 1875. Salem!, Massachusetts (J. H. Emerton). Casco Bay!, 1873. Bay of Fundy and Nova Scotia (Stimpson).

Leidy (Journal Acad. Nat. Sci. Philadelphia, iii, p. 149 (17), 1855) mentions "*Platycarcinus irroratus* M. Edw." and "*P. Sayi* DeKay" from Point Judith, Rhode Island, and Great Egg Harbor, New Jersey, intending, doubtless, to indicate both our species of *Cancer*, although the names with the authorities as given are in reality synonymous and apply to *C. irroratus* only.

Kingsley (*loc. cit.*) reports a young specimen of this species from Fort Macon, North Carolina. He also says: "I am informed by Mr. Faxon that there are specimens in the Museum of Comparative Zoology, at Cambridge, from the Bermudas," and that "it ranges from Nova Scotia to the West Indies," but fails to give any explanation of this last extension of its range southward.

In habits this species differs very greatly from *irroratus*. The best opportunities which I have had for observing it were at Peak's Island, in Casco Bay, August and September, 1873. Empty carapaces, chelipeds, etc., of *borealis* were at first found in abundance scattered along the outer shores, far above the action of the waves, where they had evidently been carried by gulls and crows, and were also found in considerable numbers half a mile from the shore in a forest of coniferous trees thickly inhabited by crows. For several weeks no living specimens of *borealis* were discovered, although the *irroratus* was found living in abundance all about the island, without, however, its remains scarcely ever being found scattered about with those of *borealis*. The *borealis* was finally discovered in abundance, at low water, on the exposed and very rocky shores of the northern end of the island. At this locality, between eighty and ninety specimens, all females and many of them carrying eggs, were obtained in a single morning. They were all found in situations exposed to the action of the waves and were either resting entirely exposed upon the bare rocks and ledges, or clinging to the sea-weeds in the edge of the waves or in the tide-pools. They were never found concealed beneath the rocks, where, however, *irroratus* abounded. It is a much heavier and more massive species than the *irroratus* and is consequently much better adapted than that species to the situations in which it is found. So many individuals falling a prey to birds is evidently a result of the habit of remaining exposed between tides, although the heavy shell must afford much greater protection than the comparatively fragile covering of *irroratus* would afford to that species if similarly exposed. The *borealis* was also found at a somewhat similar locality, but more exposed to the sea, on Ram Island Ledge, a low reef open to the full force of the ocean. One specimen of moderate size was dredged in the ship channel between Peak's Island and Cape Elizabeth, in ten fathoms, rocky and shelly bottom, and specimens were several times captured in "lobster-traps" set, at a depth of eight or ten fathoms, among rocks. Specimens were also several times found in stomachs of the cod taken on the Cod Ledges.

In the vicinity of Vineyard Sound, this species was not infrequently found thrown upon sandy beaches, but never upon beaches very far removed from rocky reefs. The following are the localities where it was seen in greatest numbers: along the sandy beach of Martha's Vineyard from Menemsha Bight to Gay Head; the rocky island of Cuttyhunk; and the rocky outer shores of Nomansland, where dead specimens were found in considerable abundance.

In the vicinity of Noank, Connecticut, it was occasionally found dead upon the shores and was several times obtained from "lobster-traps."

The largest specimens I have seen are two males, of almost exactly the same size, one from Casco Bay, the other from near Noank, Connecticut. The carapax of the specimen from Casco Bay is 91·6^{mm} long and 144·5^{mm} broad.

Chionœcetes opilio Krøyer.

Cancer phalangium O. Fabricius, Fauna Grœnlandica, p. 234, 1780 (not of J. C. Fabricius, 1775).

"*Cancer opilio* O. Fabricius, Det Kongelige Danske Vidensk. Selskabs Skr., nye Samling., iii, p. 180" (*teste* Krøyer).

Chionœcetes opilio Krøyer, Grønlands Amphipoder, Det Kongel. Danske Vidensk. Selskabs naturvidensk. og mathem. Afhandlinger, vii, p. 313 (85), 1838; *Conspectus Crustaceorum Grœnlandiæ*, Naturhistorisk Tidsskrift, ii, p. 249, 1838; in Gaimard, *Voyages en Scandinavie, en Laponie, au Spitzberg et aux Féroë*, *Crust.*, pl. 1, 1849.—Packard, *Memoirs Boston Soc. Nat. Hist.*, i, p. 302, 1867.—Whiteaves, Report on a second deep-sea dredging expedition to the Gulf of St. Lawrence [in 1872], p. 15, 1873.

Peloptastus Pallasii Gerstæcker, *Carcinologische Beiträge*, *Archiv für Naturgeschichte*, xxii, 1856, p. 105, pl. 1, fig. 1.

Chionœcetes Behringianus Stimpson, *Proceedings Boston Soc. Nat. Hist.*, vi, p. 84, 1857; *Journal Boston Soc. Nat. Hist.*, vi, p. 448 (8), 1857; *Proceedings Acad. Nat. Sci. Philadelphia*, 1857, p. 217 (23), 1858.

Chionocoetes phalangium Lütken, list of the Crustacea of Greenland, in *Manual of Instructions for the [British] Arctic Expedition*, 1875, p. 146.

From fish-stomachs, off Casco Bay! (C. B. Fuller, *Portland Soc. Nat. Hist.*), *h*. Two localities off the coast of Nova Scotia!, 1877: two specimens (*e, f*) off Cape Sable, 88 fathoms, very fine sand; and four small specimens about twenty-six miles south of Chebucto Head, 101 fathoms, fine sand. A large male specimen (*d*) in the collection of the Boston Society of Natural History is without indication of locality, but probably came from one of the fishing banks. Gulf of St. Lawrence (Whiteaves). Straits of Belle Isle and Chateau Bay!, coast of Labrador (A. S. Packard, Jr.), *a, b*. Greenland (O. Fabricius, Krøyer, Norman). Siberia (Gerstæcker). Arctic Ocean! (Capt. Rodgers, *North Pacific Expl. Expl.*), *i*. Bering Straits! (*North Pacific Expl. Expl.*), *c, g*.

A careful comparison of three of the original specimens of *C. Behringianus* with specimens from our North Atlantic coast, and with Krøyer's figure and description, convinces me that Stimpson's species is perfectly identical with the *C. opilio* of Greenland. The differ-

ences in the proportional lengths of the first and second pairs of legs, referred to by Stimpson, are variations due wholly to age and sex. The proportions given by Kröyer apply well to large males, like the specimen represented in his figure above referred to, while those given by Stimpson apply to specimens of smaller size. The following measurements exhibit these variations and show that they are even much greater in very young specimens than indicated by Stimpson. The proportions of the carapax in the specimen from Casco Bay (*h*) may have changed slightly by contraction in drying after partial digestion in a fish-stomach.

	<i>a.</i>	<i>b, ♂.</i>	<i>c, ♂.</i>	<i>d, ♂.</i>	
Length of carapax,	11·7mm.	17·0	27·3	115	
Breadth of carapax,	9·5	15·0	25·2	120	
Ratio of length to breadth,	1:0·81	1:0·88	1:0·92	1:1·04	
Between external angles of orbits,	7·3	9·6	14·0	49	
Length of cheliped,	11·5	28·5	32	220	
Length of anterior ambulatory leg,	19·5	31·0	55	300	
	<i>e, ♀.</i>	<i>f, ♀.</i>	<i>g, ♀.</i>	<i>h, ♀.</i>	<i>i, ♀.</i>
Length of carapax,	22·2	33·0	35·0	59	64·0
Breadth of carapax,	21·1	33·0	34·3	65	68·5
Ratio of length to breadth,	1:0·95	1:1	1:0·98	1:1·10	1:1·07
Between external angles of orbits,	12·3	17·2	18	27	
Length of cheliped,	23·0	37·7	36	67	
Length of anterior ambulatory leg,	44·3	72	61	120	125

Upon the New England coast this species is very rare and apparently confined to deep water and to the off-shore banks. It is one of the largest arctic crabs and occasionally attains gigantic proportions. The extent of the ambulatory legs, in the largest individual referred to above, was about 800 millimeters (over two and a half feet), while the specimen figured by Kröyer was even somewhat larger.

I have not been able to consult Otho Fabricius' original description of *Cancer opilio*, referred to by Kröyer, nor even to ascertain with certainty the exact date of its publication, which was very likely subsequent to that of *Cancer opilio* of J. C. Fabricius (*Entomologia systematica*, ii, p. 458, 1793), which is *Inachus opilio* of the same author (*Supplementum entom. system.*, p. 356, 1798) and the *Pisa armata* of Milne-Edwards. Even if priority of publication belongs to the species of J. C. Fabricius, I should not regard such a preoccupation in the ancient genus *Cancer* as sufficient reason for rejecting a name so well-established as *opilio* for the species under discussion. I see far less reason for restoring the old name *phalangium* which had not been in use for this species for more than three quarters of a

century, which was certainly preoccupied by J. C. Fabricius' *Cancer phalangium* (*Stenorhynchus phalangium* Milne-Edwards), and which was apparently rejected by Otho Fabricius himself.

Hyas araneus Leach ex Linné.

Massachusetts Bay, about ten miles southeast from Salem!, 35 fathoms, mud and clay nodules, 1877; Stellwagen's Bank!, 22 to 34 fathoms, sand and rocks, common, 1873. Casco Bay!, 1873, at the following localities: Haddock Ground off Whaleboat Island, 14 fathoms, gravel and broken shells; Broad Sound, 16 to 22 fathoms, stones and shells; northwest of Eagle Island, 13 fathoms, spongy bottom. Bay of Fundy!, 1868, 1872. Le Have Bank!, latitude 42° 44' north, longitude 64° 36' west, 60 fathoms, sand and gravel, 1872. Off Chebucto Head!, Nova Scotia, 20 fathoms, mud and fine sand, 1872. In and near Halifax Harbor!, N. S., 1877: 16 to 21 fathoms, very fine sand and red algæ; 18 fathoms, mud and fine sand, Sept. 15, very large specimens, some carrying eggs; 16 to 25 fathoms, rocks and nullipora, and stones, gravel, etc.; also in Bedford Basin, 35 fathoms, soft mud, a small specimen only. Newfoundland Banks!, from stomachs of cod-fish (collection Boston Soc. Nat. Hist.). Gulf of St. Lawrence!, "rare" (Whiteaves). Labrador! (A. S. Packard, Jr.).

Greenland (O. Fabricius, Krøyer et al.); Disco Island, 5 to 20 fathoms (Valorous Cruise, Norman). Sea of Ochotsk (Brandt, Middendorff's Sibirische Reise, Krebse, p. 79, 1851). Iceland (G. O. Sars). Spitzbergen (Goës, Æfversight af Kongl. Vetenskaps-Akad. Förhandlingar, Stockhohn, 1863, p. 161 (1)). Coast of Norway! (G. O. Sars), British Islands! (Norman), and on the continent of Europe, as far south as the coast of Belgium (Van Beneden), and according to Milne-Edwards (Hist. nat. des Crust., i, p. 312, 1834) to that of France.

Upon our coast this species is much less abundant than the next. I have never seen specimens from south of Cape Cod.

Hyas coarctatus Leach.

Coast of New Jersey (Leidy) and of Long Island (Say). Block Island Sound!, 8 to 15 fathoms, stones, gravel and sand; and Coxe's Ledge!, east-southeast of Block Island, 21 fathoms, rocky bottom, 1874. Stellwagen's Bank!, 22 to 44 fathoms, rocky and sandy,—abundant; Jeffrey's Ledge!, 24 fathoms, gravel and stones,—abundant; and Massachusetts Bay!, 29 and 33 fathoms, gravel and stones, 1873. Massachusetts Bay, off Salem!, 1877: 22 fathoms, gravelly; 48 fathoms, soft mud, August 13,—some females carrying eggs. Gulf of

Maine!, off Cape Ann; seven miles southeast by east one-half east of Cape Ann, 75 fathoms, soft mud, 1878; thirteen miles southeast from the same point, 50 fathoms, mud and stones, 1878; and fourteen miles southeast from the same point, 90 fathoms, soft mud, 1877. Platt's Bank! (latitude $43^{\circ} 11'$ north, longitude $69^{\circ} 35'$ west), 32 fathoms, sand; and near Jeffrey's Ledge!, 51 fathoms, mud and gravel, and 125 fathoms, mud, 1874. Casco Bay!, 1873: many localities in and near Portland Harbor, 9 to 24 fathoms, muddy, gravelly, and rocky bottom; East and West Cod Ledges, 10 to 15 fathoms, very rough and rocky,—taken with both the dredge and tangles, and also, in abundance, from stomachs of the "rock-cod;" 33 fathoms, hard, and 35 fathoms, muddy bottom, off Seguin Island; 64 and 68 fathoms, mud, sixteen to twenty miles southeast of Cape Elizabeth,—large specimens. Off the coast of Maine, near Monhegan Island!, 42 to 65 fathoms, muddy and gravelly bottom, 1874. Cashe's Ledge!, 27 to 40 fathoms, rocks and gravel, 1873, and 52 to 90 fathoms, rocky, 1874,—abundant. St. George's Banks!, 1872; 45 fathoms, coarse sand; 50 fathoms, sand and shells; 60 fathoms, gravel, stones and sponges. North of George's Banks!, latitude $42^{\circ} 11'$ north, longitude $67^{\circ} 11'$ west, 150 fathoms, soft sandy mud, 1872. Bay of Fundy!, 1864, 1868, 1870, 1872, rarely taken among rocks at low-water mark!, and not uncommon in 10 to 77 fathoms.

West of Brown's Bank!, about latitude $42^{\circ} 44'$ north, longitude $66^{\circ} 27'$ west, 75 fathoms, sand and mud, 1877. Le Have Bank!, 45 fathoms, gravel and stones, and 60 fathoms, sand, gravel and stones, 1872. Off Cape Negro and off Shelburne, Nova Scotia!, 47 fathoms, stony, and 59 fathoms, pebbles, sand and rocks, 1877. In and near Halifax Harbor, Nova Scotia!, 1877, 18 to 57 fathoms, common on bottoms of rocks, rocks and nullipora, gravel and sand, fine sand and mud, and sand and red algae. Newfoundland Banks!, from stomachs of cod-fish (collection Boston Soc. Nat. Hist.). Gulf of St. Lawrence! (Whiteaves). Labrador! (A. S. Packard, Jr.).

Greenland (Reinhardt et al.); Disco Island (Norman). Norway! (G. O. Sars), British Islands! (Norman), and the continent as far south as the British Channel (Milne-Edwards). Stimpson has reported this species as collected by the North Pacific Exploring Expedition, in Bering Straits and Bering Sea (Journal Boston Soc. Nat. Hist., vi, 450 (10)), and Brandt (op. cit., p. 79) records a variety, which he names "*alutacea*" (*us*), from the Sea of Ochotsk. Stimpson, however, subsequently (Proceedings Acad. Nat. Sci. Philadelphia, 1857, p. 227 (24)) in his official report makes no mention of specimens of

H. coarctatus but describes a new species, *latifrons*, as common in Bering Sea, apparently using the same specimens which were a few months before referred to *H. coarctatus*. *H. latifrons*, though closely allied to *coarctatus*, is certainly a good species, or a very remarkable variety, and quite distinct from Brandt's variety *alutaceus*. The occurrence of the true *coarctatus* in the arctic region west of America is therefore left doubtful.

This species apparently furnishes an important part of the food of the cod.

Libinia emarginata Leach.

Libinia emarginata Leach, Zoological Miscellany, ii, p. 130, pl. 108, 1815.

Libinia canaliculata Say, Journal Acad. Nat. Sci. Philadelphia, i, p. 77, pl. 4, fig. 1, 1817.

Not uncommon in the shallow parts of Casco Bay! where protected from the cold outside waters, 1873. More common in Massachusetts! and Cape Cod! (1875) Bays. Abundant in Vineyard Sound! and Buzzard's Bay!, 1871, 1875, and south to Key West!, Florida, (Gibbes), Nassau!, New Providence (Dr. Edward Palmer), and the west coast of Florida! (Col. E. Jewett).

It is a strictly shallow-water species, probably never occurring below ten fathoms, and appears to delight in muddy bays and inlets where the water is slightly brackish, though it often lives in pure sea-water and in exposed situations.

Leach's name *emarginata* takes precedence of Say's *canaliculata*. Leach states that "the locality of this species, which is the only one of the genus which has yet been observed, is unknown." A careful examination of his figure (which represents a female with the carapax about 65 millimeters long) convinces me of the certainty of the identity of his species with that of Say. White (List of Crust. in British Museum, p. 4) doubtfully retains the two species, although he places two males from Boston, U. S., under *emarginata* with Leach's type. The variation due to sex and age are very marked, and both Milne-Edwards and White probably failed to unite the species from want of a good series of specimens. Although Say mentions Leach's figure he evidently compared it with males of his species, from which alone his description was apparently taken.

Lithodes maia Leach ex Linné.

Off Cape Ann!, Massachusetts, 1875 (received from fishermen). Casco Bay! (Museum Yale College, received from A. S. Packard, Jr.) Cashe's Ledge!, Gulf of Maine, 52 to 90 fathoms, rocky, 1873. In

1878, fine specimens were obtained from off Sable Island!, Nova Scotia, 250 fathoms, rocks (Philip Merchant and Thomas Ginnevan, schooner "Marion"); from Marble Head Bank (schooner "Charger"); and one caught, in 1872, in Harbor Cove, Gloucester (Edw. W. Hodgkins). Specimens are occasionally brought from different fishing banks off the coast, where they are taken on trawl or cod lines, especially upon rocky bottoms. It has been reported from Greenland, but it is not inserted in Reinhardt's list (Rink's *Naturhistoriske Bedrag til en Beskrivelse af Grönland*, 1857, p. 28) and Lütken in a foot-note to his list (Manual of Instructions for the [British] Arctic Expedition, 1875, p. 146) says its occurrence in Greenland needs confirmation.

In Europe it is found upon the whole Atlantic coast of Scandinavia! (G. O. Sars), about the northern portions of the British Islands, and, according to Van Beneden, rarely upon the coast of Belgium.

Eupagurus bernhardus Brandt ex Linné.

Not rare in the eastern part of Long Island Sound!, Block Island Sound!, and off Block Island!, in 10 to 50 fathoms, sandy and hard bottoms, 1874; all the specimens small, however. Off Newport!, Rhode Island, 29 fathoms, 1872. Not uncommon in the deeper parts of the outer portion of Vineyard Sound!, 1871 and 1875; large specimens were taken in 8 to 12 fathoms, sandy bottom, near Menemsha Bight, and also at about the same depth, rocky bottom, off Gay Head. South of Cape Cod, it appears not to be abundant and I have never seen it at low-water.

Stellwagen's Bank!, 34 fathoms, sand, 1873. Gloucester!, Massachusetts, abundant at and just below low-water, 1878. Off Cape Ann!, 33 fathoms, gravel and stones, 1873. Very common in Casco Bay!, 1873, in 3 to 30 fathoms, sandy, gravelly, rocky, shelly and spongy bottoms, and occasionally on soft muddy bottoms in shallow water; dredged also in 48 to 64 fathoms, mud, sixteen to twenty miles off Cape Elizabeth, and found at low-water mark!, among rocks, on Ram Island Ledge. In the Bay of Fundy!, 1864, 1868, 1870 and 1872, it was occasionally found at low-water, and was common at the same depths and on similar bottoms as in Casco Bay; also dredged off White Head!, Grand Menan, in 40 to 50 fathoms, 1872. In the region of St. George's Banks!, 1872, it was dredged in abundance in 25 to 45 fathoms, sand; and in less abundance in 50 fathoms, sand and shells, and 150 fathoms, sandy mud. In and near Halifax Harbor, Nova Scotia!, 18 to 25 fathoms, sand, gravel, stones, and sand and

red algæ, 1877. I have never seen specimens from the Gulf of St. Lawrence nor Labrador and can find no record of its occurrence on our eastern coast north of Halifax. I have little doubt however that it occurs in the southern part of the Gulf of St. Lawrence.

On the European coast it is found from Finmark (M. Sars) and the rest of the Norwegian coast! (G. O. Sars) to the Baltic, the North Sea! (Möbius, Metzger), the British Islands! (Norman), and south to the coast of France (Milne-Edwards).

It is also reported from the region of Bering Sea by Owen and Brandt, and by Stimpson from Puget Sound.

Eupagurus longicarpus Stimpson ex Say.

Egmont Key!, west coast of Florida, common (Col. E. Jewett). Charleston, South Carolina (Gibbes). Fort Macon!, North Carolina, abundant (Coues, Packard). Also abundant on the coast of New Jersey!, 1871; southern shore of Long Island!, 1870; throughout Long Island Sound!; Block Island Sound!, 1874; Gardiner's!, Great Peconic! and Little Peconic! Bays, Long Island, 1874; Buzzard's Bay!, and Vineyard Sound!, 1871, 1875. Cape Cod Bay!, 1875, and Provincetown!, Massachusetts, 1872. Salem, Massachusetts (Kingsley, Proceedings Acad. Nat. Sci. Philadelphia, 1878, p. 326). Common at low-water, in a shallow and sheltered cove at the upper end of Quahog Bay!, an arm of Casco Bay, 1873.

It is most abundant at low-water or between tides on muddy and sandy shores and is seldom if ever found below 10 fathoms.

Eupagurus pubescens Brandt ex Kröyer.

Off the coast of New Jersey!, latitude 40° north, longitude 73° west, 32 fathoms, inhabiting shells overgrown with *Epizoanthus Americanus* Verrill (Capt. Gedney). Off Block Island!, 14 fathoms, sand and gravel, 1874. Stellwagen's Bank!, 22 to 44 fathoms, sand, 1873,—abundant. Massachusetts Bay!, off Salem, 1877: 22 and 45 fathoms, gravel; 33, 35 and 36 fathoms, sand and mud; and abundant in 48 to 50 fathoms, mud. Gulf of Maine!, off Cape Ann: seven miles southeast by east one-half east from Cape Ann, 75 fathoms, soft mud, 1878,—abundant; thirteen miles southeast from the same point, 50 fathoms, mud and stones, 1878; and fourteen miles southeast from the same point, 90 fathoms, soft blue mud, 1877,—abundant and very large. Off Massachusetts Bay!, latitude $42^{\circ} 20'$ north, longitude 70° west, 117 fathoms, soft blue mud, 1873. Common in Casco Bay!, 1873, on muddy, sandy, shelly and spongy bottoms in 10 to 48

fathoms; also found at low-water mark!, among rocks, at Ram Island Ledge, and dredged in 48 to 64 fathoms, mud, 16 to 20 miles off Cape Elizabeth. In the Bay of Fundy!, 1864, 1868, 1870 and 1872, it was found in abundance at about the same depths as in Casco Bay, was rarely found at low-water mark, and, in 1872, was dredged in 77 fathoms, mud and stones, off Head Harbor, near Eastport, and also in 97 to 105 fathoms, gravel and sand, off White Head, Grand Menan. In 1873, it was dredged, eight miles south off Monhegan Island!, off the coast of Maine, in 64 fathoms, mud and sand; and in 1874, on Cashe's Ledge!, in 27 fathoms, rocks and gravel. In the region of St. George's Banks!, 1872: 30 and 40 fathoms, sand; 50 and 60 fathoms, sand and shells; 65 fathoms, dead shells; and 150 fathoms, sandy mud. About thirty miles southeast one-half east from Cape Sable!, Nova Scotia, 88 fathoms, very fine sand, 1877. In Bedford Basin!, Halifax, 35 fathoms, soft mud, 1877. In and near Halifax Harbor!, 1877, 15 to 42 fathoms, sand, sand and red algæ, rocks, mud and stones. Gulf of St. Lawrence! (Whiteaves). Labrador! (Packard). Greenland (Kröyer, Norman). Bering Sea (Brandt, Stimpson). In the European seas, upon the coasts of Scandinavia and the British Islands.

On account of the apparent confusion of this species with the next I am not able to give the range of either of them upon the European coast with any certainty.

Eupagurus Kröyeri Stimpson.

This species and the last, although very closely allied and having apparently very similar geographical distribution, appear to be entitled to rank as distinct species; at least I have not been able to discover, in examining several hundreds of specimens, any which are intermediate between the two forms indicated by Stimpson. The *Kröyeri* attains nearly or quite as great size as the *pubescens*, but Stimpson had only small specimens of *Kröyeri* and the differences which he mentions in the relative lengths of the chelipeds and ambulatory legs do not hold good for full-grown specimens. The other differences which he points out, however, are quite sufficient for separating the species. The difference in the amount of pubescence is usually fully sufficient to distinguish them at a glance, but the form and ornamentation of the chelipeds afford the best distinctions. The tubercles and spines,—except the single series along the edge of the dorsal carina of the propodus of the left, or smaller, cheliped,—are

much smaller and more crowded on both chelipeds in *Kröyeri* than in *pubescens*. In *Kröyeri* the outer or left hand edge of the propodus of the smaller cheliped, as seen from above, is distinctly incurved near the base of the digital portion, while in *pubescens* the corresponding edge is full and regularly, though not strongly, arcuate, so that the digital portion of the propodus is much wider toward the base than in *Kröyeri*. In *Kröyeri* the dorsal carina of the propodus of the smaller cheliped is much nearer the right side toward the base than in *pubescens*, is very high and sharply prominent, and surmounted by a single series of dentiform teeth; the narrow space beneath the carina to the right is nearly or quite destitute of spines or tubercles; and the outer surface, or that to the left of the carina, is flat or slightly concave, and covered with very small tubercles. In *pubescens* the carina is low, obtuse and armed with a crest of spines which becomes a double series proximally; and the outer surface is slightly convex and is armed with scattered spiniform tubercles.

Kröyer's figure in Gaimard's *Voyages en Scandinavie*, Crustacés, plate ii, figure 1, evidently represents the *Kröyeri*, although the tubercles upon the chelipeds are represented in the figures as a little too large and more scattered than in any specimens I have seen, but this is probably due to a slight and very natural inaccuracy on the part of the artist or engraver; the original description of *Pagurus pubescens* (*Naturhistorisk Tidsskrift*, ii, p. 251, 1839), however, applies best to the other species, which Kröyer evidently had before him when writing the first phrase of the diagnosis, "cephalothoracis superficie dorsali pedibusque pilis flavis dense obsitis," which would not apply to any specimens of *Kröyeri* or to his figure published ten years after. Kröyer mentions having numerous specimens from different places on the Greenland coast and from Iceland, and it is probable, as Stimpson suggests, that he failed to distinguish the two species, as nearly all carcinologists have done since.

While having a geographical range similar to the *pubescens*, the *Kröyeri* is apparently a more strictly arctic species, and, upon the New England coast, is most common in deep water and upon the off-shore banks.

Stellwagen's Bank!, 29 to 44 fathoms, rocky and sandy, 1873, common. Massachusetts Bay!, off Salem, 43 and 50 fathoms, mud, 1877. Casco Bay!, 8 to 30 fathoms, rocky, spongy and sandy bottoms, and occasionally on muddy bottoms also, 1873. Bay of Fundy!, 1864, 1868, 1870, 1872, in similar situations as in Casco Bay, and more common and of larger size; in 1872, it was also dredged off Head

Harbor in 77 fathoms, mud and stones; and off White Head, Grand Menan, in 40 to 50 fathoms, and 97 to 105 fathoms. In the region of St. George's Banks!, 1872, it was common in 50, 60 and 65 fathoms, sand and shells; 45 fathoms, coarse sand; 150 fathoms, sand and mud; and six rather small specimens were brought up from 430 fathoms, sand, gravel and stones. Near Cashe's Ledge!, Gulf of Maine, 52 to 90 fathoms, rocky; 65 fathoms, mud and sand, and 110 fathoms, mud, 1873-4. Fifteen miles southeast of Monhegan Island!, off the coast of Maine, 82 fathoms, brown mud, 1873. Off Shelburne!, Nova Scotia, 47 fathoms, stony, 1877. Le Have Bank!, 45 fathoms, gravel and stones, and 60 fathoms, stones and sponges, abundant, 1872. Halifax Harbor!, Nova Scotia, 16 fathoms, fine sand and red algæ, 1877. Off Halifax!, 57 fathoms, mud and pebbles, 1877. One hundred and twenty miles south of Halifax!, 190 fathoms, 1877. Gulf of St. Lawrence!, "widely distributed through the Gulf" (Whiteaves). Labrador (A. S. Packard, Jr.). Greenland (Krøyer). Puget Sound (Stimpson). Lofoten Islands!, coast of Norway (G. O. Sars), and probably all the coast of northern Europe. Those from the coast of Norway, labeled *pubescens* by Professor G. O. Sars, are very characteristic specimens of *Krøyeri*. Norman's remark under *Pagurus pubescens* (Last report on dredging among the Shetland Isles, Report British Assoc. Advanc. Sci. for 1867, p. 264) that "a variety occurs in which the hands are entirely free from the hairs which ordinarily clothe them" probably refers to this species.

Parapagurus, gen. nov.

The genus here proposed is allied to *Eupagurus* and *Paguristes*, but the branchiæ (of which there are eleven pairs, two each at the bases of the external maxillipeds and the three first pairs of cephalothoracic legs, and three at the bases of the fourth pair of cephalothoracic legs,—as in *Eupagurus bernhardus*) are composed of numerous cylindrical papillæ, as in the majority of *Maerura*, instead of lamellæ, as in most *Paguroids*. It also differs from *Eupagurus* in having well-developed and symmetrically paired male appendages upon the first and second segments of the abdomen, and from *Paguristes* in the chelipids being very unequal and the external maxillipeds widely separated at their bases,—in both of which characters it agrees with *Eupagurus*. The small size of the eyes, the great length of the antennulæ and antennæ, and the narrowness of the sternum between the bases of the second and third pairs of cephalothoracic legs, are apparently additional generic characters.

Parapagurus pilosimanus, sp. nov.

Male. The carapax is divided by the deep cervical suture, which is arcuate,—not in the form of a truncated V with irregular sides, as in *Eupagurus*. The anterior portion is slightly broader than long, smooth, and almost entirely naked. The anterior margin is more nearly straight than in the species of *Eupagurus*, but projects in a well-marked, though broad and obtuse, rostrum, each side of which the margin is straight to the lateral margin, except a very slight prominence between the bases of the eye-peduncles and antennæ. The posterior portion of the carapax is but little broader than the anterior portion and is only slightly expanded posteriorly.

The eye-peduncles are slender, taper distally, are scarcely as long as half the width of the front of the carapax, and are clothed with long hairs along the upper side. The cornea is very small, almost wholly terminal, and the pigment black. The ophthalmic scales are small, spiniform, slender, and acute.

The peduncles of the antennulæ are very long and slender; the proximal segment is about as long as the eye-peduncle; the second and third are nearly cylindrical, though the second is slightly compressed laterally, smooth, and almost perfectly naked; the second is about as long as the first, and the third fully twice as long. The dorsal, or major, flagellum is more than three-fourths as long as the distal segment of the peduncle, is composed of about forty segments, tapers to a very long and slender tip, and is densely clothed beneath with hairs. The inferior, or minor, flagellum is very slender, about half as long as the superior, and composed of eight or nine segments. The peduncles of the antennæ reach to the distal end of the second segment in the antennular peduncle, and the segments have pretty nearly the same form and proportions as in *Eupagurus bernhardus*. The acicles reach to the tips of the peduncles and are densely hairy above, while the rest of the peduncle is smooth and nearly naked. There is no tooth or spine at the inner side of the base of the acicle, but outside the base there is a prominent dentiform lobe denticulated at its extremity. The flagella of the antennæ extend far beyond the long ambulatory legs, are very slender, smooth, and almost entirely naked.

As seen from without, the inner oral appendages do not differ essentially from the corresponding parts in *Eupagurus*. The three or four distal segments of the endognaths of the external maxillipeds are, however, more cylindrical and a little more slender than in *Eupagurus bernhardus*.

The right cheliped is stout and about as long as the whole body of the animal. The propodus is minutely tubercular and somewhat pubescent on the outer and under sides, which together form a continuous and strongly convex surface; the inner inferior angle is armed with small tubercles, but the distal margin, along the articulation with the carpus, is smooth and unarmed. The carpus is almost as long as the basal portion of the propodus, subcylindrical, without lateral angles, and its whole surface minutely tubercular and clothed with dense, but very fine and soft, light-colored pubescence. The basal portion of the propodus is pretty nearly as broad as long, flattened vertically, evenly convex above and below, with the lateral margins rounded, and the whole surface, except a small space near the base beneath, as well as the basal portion of both fingers, tuberculated and clothed like the surface of the carpus. The digital portion of the propodus is rather slender and tapers rapidly to the calcareous tip, so that its prehensile edge has an oblique direction toward the right. The dactylus corresponds in form with the digital portion of the propodus and is about as long as the inner margin of that segment. The prehensile edges of both fingers are nearly straight and armed with a few, low and obtuse tubercles. The left cheliped is very slender, about three-fourths as long as the right, and the carpus and propodus are less tubercular than in the right, but are clothed with a similar dense pubescence. The propodus is but little longer than the carpus, is scarcely as broad and considerably thinner. The digital portion, as well as the dactylus, is nearly as long as the basal, slender, and slightly curved downward at the tip. The tips of both fingers are horny, their prehensile edges sharp, but the rest of the surface rounded and naked, except for the scattering fascicles of short setæ arising from little pits in the surface.

Both pairs of ambulatory legs reach far beyond the tip of the right cheliped and, except the dactyli, are smooth and almost entirely naked. The second pair are a little longer and slightly stouter than the first but do not differ in other respects. In both pairs the carpal segments are about half as long as the meral and reach to the distal extremity of the carpus of the right cheliped; the propodal segments are slightly longer than the meral. The dactyli are considerably longer than the propodi, slender, strongly curved, particularly toward the very slender and acute tips; they are compressed laterally, the sides being nearly smooth and naked and having a very shallow, longitudinal groove extending to the strongly curved terminal portions which are still more compressed and very

slightly twisted; the inferior edge, and the superior, except on the terminal portion, are rounded, and the superior has a few scattered setæ which become more numerous and regular near the tip, where the edge is compressed and sharp for a short distance. All the distal portion of each of the short fourth and fifth pairs of cephalothoracic legs have the same form and structure as in *Eupagurus bernhardus*, but are a little less hairy.

The sternal plates between the bases of the ambulatory legs are very narrow, the bases of the first pair being nearly contiguous, and those of the second separated by a triangular plate longer than broad and with its posterior margin excavated. The sternal portion of the penultimate segment of the cephalothorax is much broader than that in front of it, but the calcareous plate, as in *Eupagurus*, is a slender transverse rod, which is here much above the plain of the sternal plates in front, so that the coxæ of the penultimate pair of legs project abruptly much below it. The sternal portion of the posterior segment does not differ essentially from the same part in *Eupagurus bernhardus*. The inferior edges of the coxæ of the posterior pair of legs, however, are compressed below and the sexual orifices are in the posterior side instead of in the ventral edge.

The sternal portion of the first segment of the abdomen is closely united with the corresponding part of the last cephalothoracic segment, and the first pair of male appendages arise near together and almost between the coxæ of the posterior cephalothoracic legs. This first pair of male appendages, in the single specimen here described, are about $7\frac{1}{2}^{\text{mm}}$ long and each is composed of a single plate, slightly thickened toward the base, but the distal half expanded into a thin lamella which is rolled into a slightly tapering half tube with its concavity facing inward and posteriorly. The second pair of appendages arise from the sides of the abdomen a considerable distance behind the first pair and are consequently widely separated at their bases. Each one is about $11\frac{1}{2}^{\text{mm}}$ long and composed of a cylindrical basal segment to which is articulated a somewhat longer lamellar terminal segment; this terminal segment (which is so arranged that, when applied to the grooved surface of the corresponding appendage of the first segment, they together form a tube) has, on its anterior side, a shallow groove which terminates on the outer side of the appendage at a point a little way from the tip, and beyond this point the extremity of the appendage narrows into a slender, pointed and hairy tip.

The appendages of the left side of the third, fourth and fifth abdominal segments, as in the males of *Eupagurus*, are each com-

posed of a short basal portion, a linear outer lamella about three times as long as the base, and a very slender and minute inner lamella. The appendages of the sixth segment show nothing to distinguish them from the corresponding appendages in the species of *Eupagurus*. The telson is about as long as broad and its posterior margin is arcuate and only very slightly emarginate in the middle.

Measurements.

Length from front of carapax to tip of abdomen,	-	-	-	-	60·mm
“ of carapax along median line above,	-	-	-	-	21·7
“ “ from front to cervical suture,	-	-	-	-	13·4
Breadth of carapax at bases of antennæ,	-	-	-	-	12·0
Length of eye-peduncles,	-	-	-	-	6·3
“ peduncle of antennula,	-	-	-	-	22·0
“ ultimate segment of same,	-	-	-	-	11·2
“ major flagellum “	-	-	-	-	9·0
“ minor “ “	-	-	-	-	5·0
“ peduncle of antenna beyond front,	-	-	-	-	11·0
“ flagellum of antenna,	-	-	-	-	110·
“ chelipeds,	-	-	-	right, 61·	left, 45·
“ carpus in chelipeds,	-	-	-	18·	12·
“ propodus in chelipeds,	-	-	-	26·	15·
Breadth of “ “	-	-	-	13·7	6·5
Length of dactylus. “	-	-	-	14·0	8·7
“ first ambulatory leg, left side,	-	-	-	-	83·
“ propodus of same,	-	-	-	-	20·
“ dactylus “	-	-	-	-	27·8
“ second ambulatory leg, left side,	-	-	-	-	90·
“ propodus of same,	-	-	-	-	24·
“ dactylus “	-	-	-	-	32·5

Of this remarkable species I have seen only a single specimen, received, after the first part of this paper was in type, from Mr. Daniel McEachern, schooner “Guy Cunningham,” Gloucester, Massachusetts. It was taken, probably upon a trawl line, in 250 fathoms, hard bottom, off the coast of Nova Scotia, nearly due south of Halifax, north latitude $42^{\circ} 41'$, west longitude $63^{\circ} 6'$, and was inhabiting a peculiar compound actinoid polyp, which had evidently first grown upon the spiral gasteropod shell inhabited by the crab, afterward extended far beyond the shell, which it has very nearly or quite absorbed, and continued its growth rudely in the form of the original shell; very much as *Epizoanthus Americanus* forms spiral cases inhabited by *Eupaguri*.

Munadopsis curvirostra Whiteaves.

American Journal of Science, III, vol. vii, p. 212 (3), 1874; Report on further deep-sea dredging operations in the Gulf of St. Lawrence [in 1873], p. 17, [1874?].

Gulf of St. Lawrence!, 180 to 220 fathoms (J. F. Whiteaves).

Homarus Americanus Milne-Edwards.

New Jersey! (1871) to the Gulf of St. Lawrence! (Whiteaves) and reported as rare at Henley Harbor (just north of the Straits of Belle Isle), coast of Labrador, by A. S. Packard, Jr.

Axius serratus Stimpson.

Plate X, figures 4, 4a.

The original specimen described by Dr. Stimpson (Proceedings Boston Soc. Nat. Hist., iv, p. 222, 1852) is preserved, in a dried state, in the collection of the Peabody Academy of Science, Salem. Stimpson states that it was taken, by Mr. S. Tufts, of Lynn, in 20 fathoms, off Sitate, a town upon the southern shore Massachusetts Bay. The only specimen I have seen is a partially digested one found in the stomach of a flounder (*Glyptocephalus cynoglossus*), taken about five miles southeast from Cape Ann, 42 fathoms, mud, August 15, 1878. The species will very likely prove to be identical with the European *S. stirynechus*.

The specimen figured is the one originally described by Stimpson.

Calocaris Macandréæ Bell.

History of British Crustacea, part v, p. 233, fig., 1847.—Goes, Crustacea decapoda podophthalma marina Sueciæ, Æfversight af Kongl. Vetenskaps-Akad. Förhandlingar, 1863, p. 167 (7).—G. O. Sars, Hardangerfjordens Fauna, part i, Christiania Videnskabs-Selskabs Forhandlingar, 1871, p. 259 (16); Om en hidtil lidet kjendt mærkelig Slægtstype af Polyzoer, Christiania Videnskabs-Selskabs Forhandlingar, 1873, pl. 9, fig. 1.—Whiteaves, American Journal of Science, III, vol. vii, p. 212 (3), 1874.—Report on further Deep-Sea Dredging Operations in the Gulf of St. Lawrence [in 1873], p. 17, [1874?].

Gulf of St. Lawrence, 190 fathoms, mud, twenty miles southwest of the southwest point of the island of Anticosti (Whiteaves). On the European coast it has been found in deep water about the British Islands and on the coasts of Scandinavia. I have seen no specimens.

Crangon vulgaris J. C. Fabricius ex Linné.

Fort Macon!, North Carolina (Coues, Packard). New Jersey! 1871. South shore of Long Island!, 1870. Abundant along the whole New England coast, from low-water mark to 30 fathoms or more, but somewhat less numerous north of Massachusetts Bay. Stellwagen's Bank!, 34 fathoms, sand, 1873. Massachusetts Bay!, off Salem, 20 fathoms, rocks and gravel, and 48 fathoms, soft mud, 1877. In the region of George's Bank!, 28, 30 and 45 fathoms, sand, 1872. Halifax!, Nova Scotia, abundant and very large at or near low water, and dredged in 16 and 18 fathoms, on bottoms of sand,

sand and mud, fine sand and red algæ, stones and red algæ, and rocks. Gulf of St. Lawrence!, "common everywhere in shallow water and at low-water mark on most sandy beaches" (Whiteaves). Caribou Island, Straits of Belle Isle (Packard). From the northern part of the Norwegian coast (Sars) to the Baltic (Möbius), North Sea (Metzger), British Islands! (Norman), and south to the north shores of the Mediterranean (Heller, et al.).

This species is found in greatest abundance in shallow water and on sandy or weedy bottoms, but occurs also on muddy, shelly and rocky bottoms, and extends at least to about 50 fathoms in depth.* It varies very much in coloration according to the location in which it is found. Upon the exposed and light-colored sandy shores of southern New England, specimens are invariably translucent and very pale in color so as to closely resemble the surface upon and beneath which they live, while upon dark-colored muddy bottoms they are very much darker in color. Specimens from a dark-colored muddy inlet of Vineyard Sound and others from dark muddy and sandy bottom at Halifax, Nova Scotia, are very dark indeed, the pigment spots covering nearly the entire surface, and the caudal appendages becoming almost black toward the tips.

Crangon boreas J. C. Fabricius ex Phipps.

Massachusetts Bay!, off Salem, 22 fathoms, gravelly bottom, 1877. Stellwagen's Bank!, fifteen to seventeen miles south-southeast from Cape Ann, 23 to 33 fathoms, gravel, stones and sponges, 1878,—common and of large size, one female being 63^{mm} in length. Casco Bay!, from stomachs of codfish taken on West Cod Ledge, and a single specimen dredged near the Ledge in 10 to 20 fathoms, rocky bottom, 1873. Bay of Fundy!, occasionally taken among rocks at low water!; common in 5 to 25 fathoms, rocky, gravelly, and shelly bottoms; and abundant at special localities in Johnson's and South

* According to my own observations, this species is very rare at depths greater than 45 fathoms and I have no positive evidence of its occurrence below 48 fathoms. There is, however, in the collections made off Cape Ann, in 1878, a single, small specimen, unquestionably of this species, which is labeled as having been dredged in 140 fathoms, soft mud, about forty miles east by south from Cape Ann. The specimen was alone in a vial when received and there may have been some mistake in the labeling, or it may have been taken among floating sea-weeds. My statement (Invertebrate animals of Vineyard Sound, Report of the U. S. Commissioner of Fish and Fisheries, part i, p. 550 (256)) that this species "extends from low water to 60 or 70 fathoms," was probably carelessly made from memory. Kingsley (Proceedings Acad. Nat. Sci. Philadelphia, 1878, p. 89 (1)), states that it is "common in 70 fathoms," without, however, giving any special locality or authority.

Bays, in 10 to 15 fathoms, on rocky bottoms overgrown with sponges, ascidians, hydroids, algæ, etc.; 1864, 1868, 1870, 1872, 1876. Halifax!, Nova Scotia, 1877: 18 fathoms, fine sand; 20 fathoms, shingly; and 25 fathoms, gravelly. Orphan Bank!, and off Cape Bon Ami, Gulf of St. Lawrence (Whiteaves). Square Island!, coast of Labrador, 15 to 30 fathoms (A. S. Packard, Jr.) Coasts of Grinnell Land and Greenland as far north as latitude $81^{\circ} 44'$ (Miers). East coast of Greenland (Buchholz). Iceland (Krøyer). Along the whole coast of North America to Bering Straits (Stimpson) and the Siberian coast (Brandt). Spitzbergen (Goës). Finmark (M. Sars). Lofoten Islands!, coast of Norway (G. O. Sars).

Robert Bell, Jr. (Canadian Naturalist and Geologist, iv, p. 210, 1859) records "a specimen corresponding nearly with Bell's description" of *Crangon sculptus*, from off Cape Chatte, Gulf of St. Lawrence, but was probably mistaken in the identification of the species, having had most likely *Crangon boreas*, or perhaps one of the species of *Sabinea*.

Sabinea septemcarinata J. C. Ross.

Crangon septemcarinatus Sabine, Supplement to the Appendix of Parry's first Voyage, p. ccxxxvi, pl. 2, figs. 11-13, 1824.—Milne-Edwards, Hist. nat. des Crust., ii, p. 343, 1837.—(?) Brandt, Middendorff's Sibirische Reise, Krebse, p. 114 (Davis' Straits).

Sabinea septemcarinata J. C. Ross, in J. Ross, Appendix to the narrative of a second Voyage in search of a northwest passage, p. lxxxii, 1835.—(?) M. Sars, Christiania Videnskabs-Selskabs Forhandling for 1858, p. 125, 1859 (coast of Norway).—(?) Stimpson, Proceedings Academy Nat. Sci. Philadelphia, 1860, p. 25 (94) (Arctic Ocean near Siberia).—(?) Packard, Memoirs Boston Soc. Nat. Hist., i, p. 302, 1867 (Thomas Bay, coast of Labrador).

Sabinea (*Crangon*) *septemcarinata* Krøyer, Naturhistorisk Tidsskrift, iv, p. 244, pl. 4, figs. 34-40, and pl. 5, figs. 41-44, 1842. (Not *Crangon septemcarinatus* Krøyer, Grönlands Amfipoder, p. 314 (86), 1838; and Naturhistorisk Tidsskrift, ii, p. 252, 1838).

Plate XI, figures 5, 9, 10, 11, 12, 13.

Two distinct species have been confounded under the name *septemcarinata*. In one of these the rostrum as seen from above is short and obtusely rounded at the tip, and the extremity of the telson is subtruncate and armed with a series of eight or more spines or stout setæ; in the other species the rostrum is acutely pointed and the telson terminates in an acute tip, with one or two spines each side. Sabine's original description and figures show very plainly that he had the first of these species, and to this species also Krøyer's figures and descriptions, above referred to, apply. I have, however, received, from Professor G. O. Sars of Christiania, both species under the name

septemcarinata, from the coast of Norway, and I have myself recorded, under the same name, specimens of the second species, taken by Mr. Harger and myself upon Le Have and St. George's Banks in 1872.

Of the *septemcarinata* there are over one hundred specimens before me, and all of them agree very closely in the form of the rostrum and telson, and in the armament and sculpturing of the carapax and abdomen. The rostrum is nearly horizontal, scarcely overreaches the eyes when they are directed forward, is obtusely rounded at the extremity as seen from above, and has a median dorsal carina which is most prominent near the tip. The dorsal carina of the carapax is well marked, but the teeth with which it is armed are not very prominent and in none of the specimens are there more than five in all. Of these spines the anterior is minute and scarcely forms a part of the carina, the second, third and fourth are about equal in size, while the fifth is smaller and very near the posterior margin, or wholly wanting in some of the smaller specimens. The subdorsal carinæ are distinct and irregularly dentate posteriorly, but on the anterior third of the carapax are faintly indicated and not at all, or only very obscurely, dentate. The superior lateral carinæ terminate anteriorly in a short tooth at the outer angle of the orbit but are not distinctly dentate near the anterior border of the carapax. The inferior lateral carinæ are strongly dentate anteriorly but posteriorly the teeth become very small or even obsolete.

The telson falls considerably short of, or reaches nearly to the tips of, the inner lamellæ of the uropods. Its extremity is truncated,—or rather terminates in a very obtuse and rounded angle,—and is usually armed with ten to fourteen slender spines or spiniform setæ. This armament of the tip of the telson is subject to considerable variation, apparently for the most part due to wear or to accidental injuries of various kinds; but there seems to be no approach to the structure in the next species. The number of spines slightly in different specimens but consists regularly of an even number—there being no median spine,—those cases where there is an odd number being apparently the result of accident. In small specimens which are very little worn, the spines are slender and vary much in length, the outer ones being short while those toward the center are very long, often fully equal in length to the breadth of the extremity of the telson, and ciliated toward their tips. This perfect form of armament is well shown in the specimen of a male figured (Plate XI, figure 10) and, in the specimens examined, seems to be more common among the males, although some of the young females have it in nearly as great per-

fection. In large specimens and those which are slightly worn the spines are usually much shorter, stouter and more uniform in length, and show scarcely any trace of ciliation (Plate XI, figure 11). In specimens considerably worn the spines are, of course, frequently partially or wholly destroyed.

The males are much smaller than the females; the largest male, among the specimens examined, is 45^{mm} in length and the largest female, 72^{mm}, which represents very nearly the average difference in size. In the armament of the carapax and of the extremity of the telson the sexes agree perfectly. The males are at once distinguished from the females, however, by the longer flagella of the antennulæ and antennæ.

Massachusetts Bay!, 1877, common in 35, 48, and 50 fathoms, muddy bottom, August 6 to 10,—many of the females carrying eggs; and taken also in 20 fathoms, rocks and gravel, and 36 fathoms, mud and fine sand. Off Cape Ann!, 1878, in 26 to 60 fathoms, common on muddy bottoms, and occasionally on sandy, pebbly and rocky bottoms. Gulf of Maine!, off the Isles of Shoals, 25 fathoms, rocky, 1874, and eight miles south of Monhegan Island, 64 fathoms, mud and sand, 1873,—only a single very small specimen in each case. Off Casco Bay!, twenty miles southeast of Cape Elizabeth, 68 fathoms, mud, August 12, 1873,—two females, one carrying eggs. Off Halifax!, Nova Scotia, 1877, 52 fathoms, fine sand and mud, September 21,—common; 57 fathoms, mud, gravel and stones, September 5,—two females, one carrying eggs. Gulf of St. Lawrence!, 60 fathoms, 1872 (J. F. Whiteaves). West coast of Davis' Straits (Sabine). Greenland (Reinhardt, Lütken). Iceland (Kröyer). Spitzbergen (Kröyer). Lofoten Islands!, coast of Norway (G. O. Sars),—one male with two large females of the next species.

Sabinea Sarsii, sp. nov.

Plate XI, figures 6, 7, 8.

The eyes, antennulæ, and the thoracic appendages differ very slightly if at all from those of the last species; the lateral squami-form appendage of the first segment of the pedicel of the antennula, in all the specimens examined, is, however, more prominent and acute than in *septemcarinata*. The rostrum reaches considerably beyond the eyes and, as seen from above, terminates in an acute tip. The dorsal carina of the rostrum is sharper and higher than in the last species and extends to the very tip, which is obtusely rounded as seen laterally. The dorsal carina of the carapax is sharper and its teeth more prominent, and usually more numerous, than in the last species.

The subdorsal carinæ are distinct and distinctly, and pretty regularly, dentate throughout. The superior lateral carinæ are better marked than in the last species and terminate in an acute and prominent tooth at the outer margin of the orbit, and just back of this there is a distinct tooth in the carina itself. The elaborate sculpturing of the dorsal surface of the abdomen, though apparently after the same pattern as in *septemcarinata*, is much more distinct and conspicuous.

The telson, in all the specimens seen, reaches to or slightly beyond the tips of the inner lamellæ of the uropods. The distal portion is a little more slender than in the last species and the dorsal aculei appear slightly more conspicuous. In adult specimens, the extremity terminates in an acute tip much longer than its breadth at base, where it is separated from the body of the telson by an emargination each side, from each of which arise two spines, a large inner one with a minute one outside at its base; this is the structure in the two perfect adult specimens examined, the larger of the two females from the coast of Norway (Plate XI, figures 6*b*, 6*c*) and a smaller individual of the same sex from the Gulf of Maine, 1877, (Plate XI, figure 7). In a very small specimen, only 16^{mm} in length, from St. George's Banks (Plate XI, figure 8), and in a still smaller specimen from Le Have Bank, the extremity of the telson is acutely triangular and armed each side with three slender spines of nearly equal length,—evidently an approach to the early stages of the young.

St. George's Banks!, 60 fathoms, shells and sand, 1872,—one young specimen 16^{mm} in length. Gulf of Maine!, about east-southeast from Cape Sable, Nova Scotia, latitude 42° 40' north, longitude 66° 58' west, 112 fathoms, gravel, August 20, 1877,—one female 36^{mm} in length. Le Have Bank!, 60 fathoms, coarse gravel, stones and sponges, September 12, 1872,—a female, 47^{mm} in length, carrying eggs, and a small specimen badly mutilated. Lofoten Islands!, coast of Norway (G. O. Sars),—two fine females, 62 and 53^{mm} in length.

I take great pleasure in associating the name of Professor G. O. Sars with this species.

Pontophilus Norvegicus M. Sars.

"*Crangon Norvegicus* M. Sars, Beretning om en zoologisk Reise ved Kysten af Romsdals Amt i Nyt Magazin f. Naturv., 11 B., 1861, p. 8" (Sars).—Goës, Æfversigt af Kongl. Vetenskaps-Akademiens Förhandlingar, Stockholm, 1863, p. 173 (13).

Pontophilus Norvegicus M. Sars, Christiania Videnskabs-Selskabs Forhandling, 1861, p. 183; Bidrag til Kundskab om Christianiafjordens Fauna (extr. Nyt Mag-

azine for Naturvidenskaberne), p. 2, pl. 1, figs. 1-25, pl. 2, figs. 17-37, 1868.—G. O. Sars, Beretning om en i Sommeren 1865 foretagen zoologisk Reise ved Kysterne af Christianias og Christiansands Stifter (extr. Nyt Mag. Nat.), p. 14, 1866; Undersøgelser over Christianiafjordens Dybvandsfauna (extr. Nyt Mag. Nat.), p. 17, 1869; Christiania Videnskabs-Selskabs Forhandlinger, 1871, p. 261 (18), 1872—Metzger, Jahresbericht der Comm. zur wissenschaftl. Untersuchung der deutschen Meere für 1872, 1873, Nordsee, p. 291, 1875.

Gulf of Maine!, about thirty miles east-southeast from Cape Ann, 115 fathoms, mud, sand, gravel and stones, August 24 and 31, 1878,—four specimens, one female about 70^{mm} long. Off the coast of Nova Scotia!, about thirty miles south of Halifax, 101 fathoms, fine sand, and 110 fathoms, fine sand and mud, September 6 and 20, 1877,—twenty-four specimens. It was previously known only from the Scandinavian coast. Coast of Norway!, 30 to 500 fathoms (G. O. Sars).

Nectocrangon lar Brandt ex Owen.

About twenty miles southeast from Cape Sable!, Nova Scotia, 59 fathoms, pebbles, sand and rocks, 1877. Common in Bedford Basin!, Halifax, Nova Scotia, 26-41 fathoms, mud, and also about ten miles off Halifax!, 52 fathoms, fine sand and mud, 1877. Gulf of St. Lawrence! (J. F. Whiteaves). St. Johns, Newfoundland (Stimpson). Labrador! (A. S. Packard, Jr.). Greenland (Krøyer, Norman). Bering Sea (Brandt, Stimpson). "Arctic Ocean" (Owen, Stimpson).

Caridion Gordoni Goës.

"*Hippolyte Gordoni* Bate, Nat. Hist. Review, v, p. 51." (Norman.)

Doryphorus Gordoni Norman, Annals and Magazine of Nat. Hist., III, viii, p. 277, pl. 13, figs. 6, 7, 1861 (from Moray Firth); Report British Assoc. Advanc. Sci., 1868, p. 265 (Shetland Isles). The name *Doryphorus* is preoccupied, having been used by Cuvier in 1829 for a genus of reptiles.

Caridion Gordoni Goës, Crustacea decapoda podophthalma marina Suecicæ, Æfversigt af Kongl. Vetenskaps. Akad. Förhandlingar, 1863, p. 170 (10), 1863.—G. O. Sars, Beretning om en i Sommeren 1865 foretagen zoologisk Reise ved Kysterne af Christianias og Christiansands Stifter, p. 13, 1866; Undersøgelser over Christianiafjordens Dybvandsfauna, p. 21, 1869; Christiania Videnskabs-Selskabs Forhandlinger, 1871, p. 261 (18), 1872.—Smith, Transactions Connecticut Acad., iii, p. 28, 1874.—Metzger, Jahresbericht der Comm. zur wissenschaftl. Untersuchung der deutschen Meere für 1872, 1873, Nordsee, p. 290, 1875.

Off the coast of New Hampshire, between the Isles of Shoals and Jeffrey's Ledge!, 51 fathoms, mud and gravel, 1874. Casco Bay!, from the stomach of cod taken on West Cod Ledge, August 21, 1873,—a female carrying eggs. Gulf of Maine!, on and near Cashe's Ledge, 27 and 40 fathoms, rocks and gravel, 1874, and south of the

Ledge, in 52 to 90 fathoms, rocky, 1873,—common. Near St. George's Banks!, 110 fathoms, "sand and mud with a few stones," 1872,—one young specimen. Bay of Fundy!, 40 to 50 fathoms, rocky, Aug. 14, 1868,—a female carrying eggs; and off White Head, Grand Menan, 40 to 50 fathoms, 1872. On the European coast it has been recorded from Scotland! (Norman), the North Sea (Metzger), and the west coast of Norway!, 150 to 200 fathoms (G. O. Sars).

As the above record of stations shows, this species is an inhabitant of hard, and usually rocky, bottoms in deep water. This is probably the reason of its apparent rarity, since such localities are not common and are difficult of exploration with the dredge.

European specimens, received from the coast of Norway through Prof. G. O. Sars, agree with all the American specimens examined in having well developed epipodi at the bases of the second, third and fourth cephalothoracic legs, as well as in all other respects. The dentition of the rostrum is subject to considerable variation. In twenty-two specimens examined, varying from 17 to 27^{mm} in length, four had the formula, $\frac{6}{1}$; seven, $\frac{7}{1}$; nine, $\frac{8}{1}$; one, $\frac{9}{1}$; and one, $\frac{7}{2}$;—each of the last two cases being adult specimens from Cashe's Ledge.

Hippolyte Leach.

In accordance with the rules for zoological nomenclature as at present generally accepted, the name *Hippolyte* should not be applied to the species now usually included under it and ought to be restored to the species without mandibular palpi, and for which Stimpson has proposed the new generic name *Virbius*.

The genus *Hippolyte*, as first proposed by Leach in 1813 or '14 (Edinburgh Encyclopædia, American edition, vol. vii, p. 271),* contains but one species, *H. varians* Leach, and in 1815 in the Transactions of the Linnean Society, vol. xi, p. 347, *varians* is still retained as the first species and a new species, *inermis*, added. In the first of these publications there is, under *Hippolyte*, the observation that "to this genus the *Cancer Astacus gibbosus* of Montagu belongs," and in both of them the "*Cancer spinus* of Sowerby" is referred to *Alpheus*. In 1817, in the Malacostraca Podophthalmata Britannicæ, however, Leach says, "Montagu sent to me *Hippolyte varians*, the type of this genus, as his *Cancer astacus gibbosus*, but he afterwards informed

*I have not been able to examine the original edition. The American edition seems, however, at least as far as the article under consideration is concerned, to be an exact reprint of the original, with changes only in paging and division into volumes.

me, by letter, that his figure and description had been made from mutilated specimens, of what he had since ascertained to be a very distinct species, and requested me to take the earliest opportunity to correct his mistake," thus fully disposing of Montagu's species and unquestionably establishing *varians* as the type of the genus. In this last work the genus *Hippolyte* includes five species, as follows: *H. Prideauxiana* (apparently the same as the *inermis* mentioned above), *H. Moorii* (a variety of the last), *H. varians* (*Virbius varians* of Stimpson), *H. Chranchii*, and *H. Sowerbæi* (Leach's *Alpheus spinus*, here for the first time referred to *Hippolyte*).

Numerous other more or less allied species were added to the genus by subsequent authors, but little was added to our knowledge of the structure and real affinities of the species until the appearance of Kröyer's monograph, in 1842, in which many new arctic species were very fully described and figured and the structural differences between them made known. Kröyer's first section of the genus contained but one species, the *smaragdina*, apparently synonymous with Leach's *varians*. This section of the genus is equivalent to Stimpson's genus *Virbius* (Proceedings Acad. Nat. Sci. Philadelphia, xii, p. 35 (104), 1861), which is characterized specially by non-palpigerous mandibles, the absence of epipodal appendages upon the external maxillipeds and thoracic legs, and by the tri-articulate carpus of the second thoracic legs, and, as originally constituted, included *Hippolyte acuminata* Dana, *H. viridis* Milne-Edwards, *H. smaragdina*, *H. obliquimana* Dana, *H. exilirostrata* Dana, *H. varians*, and *H. Prideauxiana*, together with *Virbius Australiensis*, *acutus* and *Kraussianus* Stimpson. Stimpson's *Virbius* is thus seen to include the type and all the original species of Leach's genus, and, according to common practice, it should be made a synonym of that genus and a new name given to the larger division, which includes nearly all the arctic species, of the genus as used by Kröyer. Nothing but additional synonymy and confusion would result, however, and I therefore accept the generic names as they now stand.

Hippolyte Fabricii Kröyer.

Salem Harbor!, 6 fathoms, 1873. Massachusetts Bay!, off Salem, 1877: abundant in 19 to 30 fathoms, gravelly, stony and rocky bottoms; common in 35 fathoms, mud and clay nodules, and in 48 fathoms, soft mud. Off Cape Ann!, 50 fathoms, mud, gravel and stones, 1877. Common on Stellwagen's Bank!, 22 to 29 fathoms, rocky, and on Jeffrey's Ledge!, 24 and 33 fathoms, gravel and

stones, 1873. Between Cape Ann and the Isles of Shoals!, 27 to 36 fathoms, rocks and mud, and off the Isles of Shoals!, 35 fathoms, clay, mud and sand, 1874. Abundant in 7 to 35 fathoms, rocky, gravelly, shelly and muddy bottoms, at various localities in Casco Bay!, and taken also near low water mark, among eel-grass!, in Portland Harbor, and a single specimen from 48 to 64 fathoms, stones and mud, sixteen to eighteen miles east-southeast Portland Light!, 1873. Found also in abundance in the stomachs of the cod taken on West Cod Ledge!, off Portland. Bay of Fundy!, 1864, 1868, 1870, 1872, 5 to 40 fathoms, but not found in so great abundance as in Casco and Massachusetts Bays. Large females carrying eggs were also collected at Eastport!, Maine, by C. Hart Merriam and E. B. Wilson, in April, 1876. Halifax! Nova Scotia, 1877, common in 16 to 21 fathoms, stones, sand and red algæ; in 18 to 25 fathoms, shingly, gravelly, sandy and muddy bottoms; and 16 fathoms, mud, at the mouth of Bedford Basin; and a single specimen, in company with *H. macilenta*, in 35 fathoms, very soft mud, in Bedford Basin itself. Also off Halifax!, 52 fathoms, sand, mud and rocks, and 57 fathoms, gravel and stones, 1877. Gulf of St. Lawrence!, 1871, (J. F. Whiteaves). Labrador! (A. S. Packard, Jr.) Greenland (Krøyer, Norman, et al.) Bering Sea (Stimpson).

Mr. Kingsley (List of the North American Crust. belonging to the Sub-order Caridea, Bulletin Essex Institute, vol. x, p. 59, 1878) gives "Massachusetts Bay northward to Europe" for the distribution of this species, but, as this is the only record I have been able to discover of its occurrence on the eastern side of the Atlantic, I am inclined to regard it as an error, although its discovery in Europe may very properly be expected.

A careful examination of a large series of specimens of this species shows considerable variation, even in characters which are usually regarded of at least specific value. The most important of these variations which I have noticed is—

The presence or absence of epipodi upon the bases of the second pair of cephalothoracic legs. The *Fabricii* differs from all the other species of the genus which I have examined in usually wanting epipodi at the bases of all the cephalothoracic legs except the first pair, while in the other species these appendages are usually present upon the bases of the first and second or upon the first, second and third pairs; and on this character it was placed alone in a section of the genus by Krøyer. Among fifty-two individuals (eighteen males varying in length from 27 to 39^{mm}, and thirty-four females varying

from 16.5 to 50^{mm}), from various localities on the New England coast, forty-seven had the normal number of epipodi, while five had epipodi upon one or both of the second pair of legs. Three of the latter are from the Bay of Fundy: one, a male 35^{mm} long, has well-developed epipodi on each of the second pair of legs; another male, 36^{mm} long, has a short epipodus on the left side but none on the right; the other specimen, a female 47^{mm} long, has a well-developed epipodus on the right side but none on the left. The two others are from Casco Bay: a female, 36^{mm} long, with a short epipodus on the left side, and a male, 28^{mm} long, with a rudimentary one on the right side. As the measurements of these specimens show, the presence of the additional epipodi is not a characteristic of the young.

The number and position of the teeth upon the rostrum and dorsal carina of the carapax vary considerably more than is usually indicated in the descriptions of the species and yet are very characteristic specifically. Except as a result of injury, the tip of the rostrum is always acute and without teeth, and there are never teeth upon the dorsal margin except near the base. The most usual formula for the dentition is $\frac{3+1}{3}$ or $\frac{2+2}{3}$, the third dorsal tooth being usually just above the base of the rostrum; in the series of specimens examined,

Formula.	Number of specimens and variation in length.		
	Males.	Females.	Total.
$\frac{3+1}{3}$ or $\frac{2+2}{3}$	45, from 16 to 39 ^{mm}	45, from 16.5 to 50 ^{mm}	90
$\frac{3+1}{2}$ or $\frac{2+2}{2}$	14, " 15 " 35 "	16, " 15 " 40 "	30
$\frac{3+1}{4}$ or $\frac{2+2}{4}$	8, " 22 " 33.5 ^{mm}	8, " 15.5 " 50 "	16
$\frac{3+2}{3}$ or $\frac{2+3}{3}$		8, " 27 " 40 "	8
$\frac{2+1}{3}$ or $\frac{3+0}{3}$	1, 30 "	8, " 20 " 37.5 "	9
$\frac{2+1}{4}$	2, 27 and 32 "		2
$\frac{3+2}{4}$		2, 40 and 44 "	2
$\frac{2+2}{5}$		1, 31 "	1
$\frac{2+3}{6}$		1, 30 "	1
$\frac{3 \text{ to } 5}{2 \text{ to } 6}$	70	89	159

however, the number of teeth varies from three to five above and from two to six beneath, although the extremes of these variations seem to be of rare occurrence, as the accompanying tabular summary of the result of the examination of one hundred and fifty-nine specimens shows.

This result is, perhaps most noticeable for showing the constancy of what seems a very trivial character, for, among all the specimens examined, not one varies more than a single tooth either above or below the most usual number upon the dorsal carina and only two specimens (the last in the table) exceed this amount of variation in the number of teeth in the ventral edge of the rostrum.

One specimen, not included in the above summary, has the rostrum slightly distorted and bifid at the tip as seen from above,—a peculiarity undoubtedly due to injury, though there is nothing but a slight lateral distortion to indicate such a cause.

The two *spines of the anterior margin of the carapax* are usually both well-developed, but the inferior one (the pterygostomial) is occasionally very minute or even entirely obsolete. This obsolescence was noticed only in adult males, and is apparently an approach to the usual entire disappearance of the same spines among the old males of *Hippolyte polaris*.

The *dorsal aculei and terminal spines of the telson* appear to be very constant in character and number. Among seventy-five specimens examined with reference to the dorsal aculei of the telson, sixty-nine had either four or five pairs, or four upon one side and five upon the other. Of the six remaining, four are young and have less than the normal number for adults, a male 15^{mm} long and a female 16.5^{mm} having only three pairs of aculei each, another male 15^{mm} and a female 17^{mm} having each three on one side and four on the other; while a male 32^{mm} long has also less than the normal number, having three on one side and four on the other, and a female 27^{mm} has more than usual, having five upon one side and six upon the other. Fifty specimens examined with reference to the armament of the tip of the telson all had the normal number of spines,—two slender and ciliated ones in the middle with two stouter ones each side.

The largest specimens examined were taken in the Bay of Fundy, the largest males being 39^{mm} long and the largest females 50^{mm}.

The only specimens I have seen carrying eggs were collected at Eastport, Maine, in April, 1876, by Messrs. Merriam and Wilson. Among over a hundred adult females taken from July to late in October, none were carrying eggs.

Hippolyte Gaimardii Milne-Edwards.

Hippolyte Gaimardii Milne-Edwards, Hist. nat. des Crust., ii, p. 378, 1837.

Hippolyte pandaliformis Bell, History of British stalk-eyed Crustacea, p. 294 [1850?]

Hippolyte Belcheri Bell, in Belcher, Last of the Arctic Voyages in search of Sir John Franklin, vol. ii, p. 402, pl. 34, fig. 1, 1855.

Plate IX, figures 8 and 9.

Boston Harbor, 3 fathoms, and other parts of Massachusetts Bay (Stimpson). Casco Bay!, among algæ and eel-grass near low-water mark, and also in 7 fathoms, mud and dead eel-grass, 1873. Eastport!, Maine, 1864,—one specimen only. Halifax!, Nova Scotia, 16 and 21 fathoms, stones, sand and red algæ, and 18 fathoms, fine sand and mud, 1877. Also off Halifax!, 52 fathoms, mud and fine sand, and 57 fathoms, mud and pebbles, September, 1877,—one specimen from 57 fathoms carrying eggs. Gulf of St. Lawrence!, “50 fathoms, stony and rocky,” and “56 fathoms, stones and coarse sand,” 1872 (J. F. Whiteaves). Labrador!, “common on the whole coast” (Packard). Grinnell Land, 79° 29' north latitude, (Miers). Bering Straits and Arctic Ocean (Stimpson),—*H. gibba* Kröyer. Greenland (Kröyer, et al). Iceland (Milne-Edwards, G. O. Sars). Spitzbergen (Kröyer, Miers). The whole Norwegian coast (Kröyer, et al.), the Cattegat (Kröyer), to the southern Baltic, at Kiel (Möbius, Metzger). Scotland! (Norman).

Of the twenty-five specimens which I have examined only five are males, and none of these have the remarkable dorsal prominence of the third segment of the abdomen characteristic of *H. gibba* Kröyer. None of these males, however, are over 30^{mm} long, and still in the largest of them, there is a slight carination of the third segment of the abdomen as if presaging the conspicuous character of the typical *gibba*, so that I have no reason to doubt the correctness of Goës' conclusion that Kröyer's *gibba* was based on old males of *H. Gaimardii*.

Milne-Edwards' “Troisième anneau de l'abdomen moins fortement denté,” which Stimpson (Annals Lyceum Nat. Hist. New York, x, p. 126, 1871) seems to regard as throwing doubt on the identity of Kröyer's *Gaimardii* with that of Milne-Edwards, may have referred to a young male like those just mentioned, although the fact that Milne-Edwards is comparing his species with *H. Sowerbyi* (*H. spinus*), would not necessarily imply any considerable angulation of the third segment of the abdomen. I think there is no reasonable doubt of the identity of Milne-Edwards' species with that of Kröyer and more modern authors.

The spines at the tip of the telson are normally of the same number and similar to those of *H. Fabricii*, and the terminal angle is usually very obtuse and rounded (Plate IX, figure 8). One specimen, however, out of the twenty-one in which the tip of the telson was examined, a female, 39^{mm} long, from Casco Bay, has the tip of the telson (Plate IX, figure 9) acute and armed with three small ciliated spines in the middle in place of two, so that there are seven spines in all. In other respects this specimen is perfectly normal and indistinguishable from ordinary individuals. Similar variations are noticed under *H. polaris* and *H. pusiola* and well illustrate the difficulty of stating accurately the specific characters in this genus.

Specimens taken among algæ and eel-grass in Casco Bay were, in life, translucent, slightly tinged with greenish brown, and without brightly colored markings of any kind.

Hippolyte spinus White.

Cancer spinus Sowerby, British Miscellany, p. 47. pl. 23, 1805.

Alpheus spinus Leach, "Edinburgh Encyclopedia, vii, p. 431, 1813-14" (Miers), American edit., vii, p. 271; Transactions Linnean Soc. London, xi, p. 347, 1815.

Hippolyte Sowerbæi Leach, Malacostraca Podophthalmata Britanniae, pl. 39, 1817.

Hippolyte spinus White, List Crust. British Museum, p. 76, 1847.—Bell, History of British Crustacea, p. 284 [1847?]

Hippolyte spina Stimpson, Proceedings Acad. Nat. Sci. Philadelphia, xii, p. 34 (103), 1860; Annals Lyceum Nat. Hist. New York, x, p. 126, 1871.

Massachusetts Bay!, off Salem, 1877; 20 to 30 fathoms, gravel and rocks, common; 33 fathoms, sand and mud; 35 fathoms, mud and clay nodules, abundant; 33 fathoms, sand and mud; 48 fathoms, soft mud. Gulf of Maine!, off Cape Ann, 1877, 50 fathoms, mud, gravel and rocks; and 90 fathoms, soft mud, common. Abundant on Stellwagen's Bank!, 29 fathoms, rocky, and on Jeffrey's Ledge!, 24 and 33 fathoms, gravel and stones, 1873. Near the Isles of Shoals!, 25 fathoms, rocky, abundant, and between the Isles and Cape Ann!, 27 to 36 fathoms, mud and rocks, 1874. Cashe's Ledge!, Gulf of Maine, 27 and 40 fathoms, gravel and rocks, very abundant; and a little south of the Ledge, 52 to 90 fathoms, rocky, 1873, 1874. Casco Bay!, 1873, among stones, at low-water mark!, on Rau Island Ledge, and common in 10 to 35 fathoms, on rocky, gravelly and shelly bottoms; taken also in 9 fathoms, mud, off Fort Georges, Portland Harbor. Very abundant in the Bay of Fundy!, 1864, 1868, 1870, 1872, 1876, on all kinds of hard bottoms in 5 to 40 fathoms; taken also, in 1872, off Whitehead, Grand Menan, 40 to 50 fathoms, gravelly bottom; west of Grand Menan, 50 to 55 fathoms, gravel;

off Head Harbor, 77 fathoms, mud and stones; and found rarely at low-water mark, under stones. Le Have Bank!, 45 fathoms, gravel and stones, 1872,—one specimen with two of *H. securifrons*. Off Cape Negro!, Nova Scotia, 56 fathoms, large stones, 1877. Halifax!, Nova Scotia, 1877; 16 fathoms, stones, sand and red algæ; and off Halifax!, 42 fathoms, fine sand; 52 fathoms, fine sand, mud and rocks, abundant; and 57 fathoms, mud and stones. Gulf of St. Lawrence!, "common on stony ground at moderate depths" (Whiteaves). Labrador! (Packard). Greenland (Krøyer, et al.). Grinnell Land, and as far north as latitude 81° 44' (Miers). Bering Straits (Stimpson). Spitzbergen (Krøyer). Coast of Norway! (G. O. Sars) and of Scotland (Sowerby, Leach, et al.). This is by far the most abundant species of the genus on the New England coast.

Females carrying eggs were taken off Cape Ann, October 17; in the Bay of Fundy, at Eastport, in September or October, 1864, and, by Messrs. Merriam and Wilson, in April, 1876; one specimen off Halifax, Nova Scotia, September 5, and many September 21 and 27. I have seen no specimens taken in winter, but the period of carrying eggs undoubtedly extends from October to April or May.

In life this species is usually translucent and thickly mottled and spotted with bright red, brownish red and white, the flagella of the antennæ, the thoracic legs and the caudal appendages being annulated or banded with bright red. In some specimens the brownish red predominates and the animal is less translucent. There are other individuals in which larger or smaller portions of the cephalothorax are opaque white, these markings sometimes extending on to the abdomen or even upon the cephalothoracic appendages, but they are seldom regularly disposed and are sometimes quite unlike on the two sides of the same animal. Stimpson mentions bluish markings also, and says the antennal scales are usually blue, but I have never noticed such coloration.

Hippolyte securifrons Norman.

"*Hippolyte securifrons* Norman, Transactions Tynside Naturalists' Field Club, v, p. 267, 1863" (Danielssen and Boeck, Metzger). Norman, in Brady, Report on deep sea dredging on the coasts of Northumberland and Durham, 1862-4, Nat. Trans. Northumberland and Durham, i, p. 24, 1865; Last Report on dredging among the Shetland Isles, Report British Assoc. Adv. Sci., 1868, p. 265.—G. O. Sars. Beretning om en i Sommeren 1865 foretagen zoologisk Reise ved Kysterne af Christianias og Christiansands Stifter (extr. Nyt Magazin for Naturvidenskaberne), p. 13, 1866; Christiania Videnskabs-Selskabs Forhandling, 1871, p. 261 (18).

Hippolyte Liljeborgii Danielssen and Boeck, Beskrivelse af nogle til Crust. decapoda (extr. Nyt Magazin for Nat.), p. 8, pl., figs. 15–20, 1872.—Metzger, Jahresbericht der Comm. zur wissenschaft. Untersuchung der deutschen Meere for 1872, 1873, Nordsee, 290, 1865 (*Liljeborgi*).

Plate X, figure 3.

Massachusetts Bay!: about six miles south to southeast from Gloucester, 40 to 45 fathoms, soft brown mud, 1878; about twelve miles east-southeast one-half south from Salem, 48 fathoms, soft brown mud, 1877,—common. Gulf of Maine!: about seven miles southeast by east one-half east from Cape Ann, 73 to 75 fathoms, soft mud, 1878; fourteen miles southeast from Cape Ann, 90 fathoms, soft mud, 1877,—common; about thirty miles east-southeast from Cape Ann, 85 fathoms, mud, sand and stones, 1878. Off Casco Bay!, twenty miles southeast of Cape Elizabeth, 68 fathoms, mud, 1873. Gulf of Maine!, seventeen miles south from Monhegan Island, 72 fathoms, brown mud, 1873; Cashe's Ledge, 27 and 40 fathoms, rocks and gravel, and west of the Ledge, 105 fathoms, mud and gravel, 1874. Latitude 42° 45' north, longitude 66° 28' west, about east-southeast from Cape Sable, Nova Scotia!, 75 fathoms, fine sand and mud, 1877. Le Have Bank!, 45 fathoms, gravel and stones, 1872. About thirty miles south of Halifax!, Nova Scotia, 101 fathoms, fine sand and mud, common, and also about one hundred and twenty miles south of Halifax, 190 fathoms, mud, 1877. West coast of Norway!, 60 to 100 fathoms (G. O. Sars). Scotland! (Norman). North Sea (Norman, Metzger).

The males, among the specimens examined, vary from 24 to 38^{mm} in length, and the females from 26 to 58^{mm}. All the American specimens were taken in August and September, and none of the females were carrying eggs.

I have seen neither Norman's nor Danielssen's original description of this species and have identified it by comparison with English specimens received from the Rev. Mr. Norman and Norwegian specimens received from Prof. G. O. Sars. The species agrees well too with *H. Liljeborgii* Danielssen as described and figured by Danielssen and Boeck (loc. cit.). These authors state that *H. Liljeborgii* was briefly described by Danielssen in *Nyt Magazin for Naturvidenskaberne*, 1861, p. 6, thus antedating Norman's species, which they quote as a synonym. Goës, however (*Øfversigt af Kongl. Vetenskaps-Akad. Förhandlingar*, 1863, p. 170 (10)), quotes "*H. Liljeborgi* Danielsen, *Fanna litor. Norveg. nondum edita*," and neither he, nor

G. O. Sars, nor Metzger refer to this early description, so that I allow the species to stand for the present under Norman's name.

Hippolyte macilenta Kröyer.

Bedford Basin!, Halifax, Nova Scotia, 26 to 41 fathoms, soft mud, common, 1877. Also off Halifax!, 42 fathoms, fine sand; 52 fathoms, fine sand and mud; and 57 fathoms, mud and pebbles. Gulf of St. Lawrence!, 30 to 70 fathoms, sandy and stony bottoms, 1872, 1873 (Whiteaves). Labrador! (Paekard). Greenland (Kröyer).

This species was described by Kröyer from a single specimen and I have noticed no mention of other specimens, except those of Paekard and Whiteaves above referred to. The species is very distinct from the others of the genus known to me. Kröyer's description and figures apply well to medium sized females, but there is some individual variation and the young differ very considerably from the adults in the form of the rostrum. It is the most slender of our species, the carapax being scarcely thicker posteriorly than in front, and its greatest breadth only about an eighth of the length of the animal. The appendages are likewise longer and more slender than usual in the genus. In adults of both sexes the dorsum of the carapax is evenly rounded the posterior two-thirds of its length and the rostral earina rises abruptly from the anterior fourth. The rostrum is very much shorter than the rest of the carapax, scarcely reaches the tips of the peduncles of the antennulæ, is very much compressed, and ascends so that the tip is considerably above the level of the dorsum of the carapax, while the dorsal edge is strongly arcuate and dentate, very nearly its entire length, with twelve to fifteen minute teeth, which are crowded anteriorly but much more remote at the base and on the carapax. The anterior portion of the rostrum is expanded below and armed with one to four small teeth near the very slightly prominent tip. In the young the rostrum is slender, nearly horizontal, only slightly expanded vertically, terminates in an acute tip and is armed with fewer teeth than in the adult, although there are at least nine above and one below in all the specimens I have seen. There are no supraorbital spines, but well-developed antennal and distinct pterygostomial spines are present in all the specimens. The flagellum of the antenna, at least in adult males, is considerably longer than the body; two males, 41 and 43^{mm} long, each have the flagella about 50^{mm} long. The telson is much more slender than usual in the genus. In twenty specimens specially examined, there were invariably three pairs of dorsal aculei, and in fourteen speci-

mens the terminal spines were invariably (as doubtfully described by Krøyer) six in number, the median pair slender and ciliated, the submedian very long and slender, and the outer short, as usual.

None of the females examined are carrying eggs. The males are scarcely perceptibly more slender than the females. The sexual characters are well-marked, in the antennulæ and abdominal appendages, in specimens 30^{mm} long, although in specimens 26^{mm} long the secondary appendage peculiar to the male is only just making its appearance on the inner lamella of the second pair of abdominal appendages.

Locality.	Sex.	Length.	Carapax and rostrum.	Rostrum, length.	Breadth of carapax.	Rostrum, formula.
Labrador,	♀	53·mm	17·5mm	6·1mm	6·1mm	$\frac{2+13}{2}$
Gulf St. Lawrence,	"	51·	16·0	6·0	6·0	$\frac{2+12+4}{4}$
"	"	47·	14·1	5·0	5·8	$\frac{2+12}{2}$
"	"	41·	13·0	5·1	5·0	$\frac{2+11}{1}$
Bedford Basin,	"	45·	14·7	6·0	5·8	$\frac{2+12}{1}$
"	"	44·	14·4	5·9	5·2	$\frac{2+13}{2}$
"	"	43·	13·8	5·4	5·1	$\frac{2+12}{4}$
"	"	42·	13·3	5·3	5·2	$\frac{2+13}{1}$
"	"	41·	13·0	5·1	4·9	$\frac{2+12}{2}$
Gulf St. Lawrence,	♂	43·	12·3	4·2		$\frac{2+10}{1}$
"	"	39·	12·2	4·3		$\frac{3+11}{3}$
Bedford Basin,	"	42·	12·6	4·9	5·1	$\frac{3+12}{2}$
"	"	41·	12·3	4·7	5·1	$\frac{3+13}{3}$
"	"	37·	11·3	4·4	4·8	$\frac{3+12}{2}$
Off Halifax,	"	29·	9·0	3·3	4·7	$\frac{2+9}{1}$
"	"	27·	8·7	3·2	3·8	$\frac{2+9}{2}$
"	"	26·	8·0	2·9	3·7	$\frac{2+8}{1}$
"	"	24·	7·1	2·4	3·6	$\frac{2+7}{1}$
Gulf St. Lawrence,	"	23·	7·2	2·5	3·4	$\frac{2+7}{1}$
"	"	22·				$\frac{2+7}{1}$
"	"	21·				$\frac{2+7}{1}$

The preceding table gives measurements* and the dental formula for the rostrum of some of the specimens from different localities.

Hippolyte Phippsii Kröyer.

Hippolyte Phippsii Kröyer, Naturhistorisk Tidsskrift, iii, p. 575, 1841 (♂).

Hippolyte turgida Kröyer, loc. cit., p. 575, 1841 (♀).

Hippolyte vibrans Stimpson, Annals Lyceum Nat. Hist. New York, x, p. 125, 1871 (♂, var.)

? *Hippolyte Ochotensis* Brandt, in Middendorff's Sibirische Reise, ii, p. 120, pl. 5, fig. 17, 1849 (♀).

Massachusetts Bay!, off Salem, 1877: 20 fathoms, rocks and gravel; 33 fathoms, sand and mud; 35 fathoms, mud and clay nodules; and 48 fathoms, soft mud. Off Cape Ann!, 50 fathoms, mud and gravel, 1877. Off the Isles of Shoals!, 27 to 36 fathoms, rocks and mud, 1874. Jeffrey's Ledge!, 24 fathoms, gravel and stones, 1873. Cashe's Ledge!, 27 and 40 fathoms, 1874,—27 males and 24 females. Near Cashe's Ledge!, 52 to 90 fathoms, rocky, 1873. Casco Bay!, 10 to 22 fathoms, rocky, near West Cod Ledge, 1873. Eastport!, Bay of Fundy, 18–25 fathoms, rocks and shells, 1868, 1870. Grand Menan!, Bay of Fundy, 1872 (Prof. H. E. Webster). Halifax!, Nova Scotia, 1877: 16 fathoms, fine sand and red algæ; 18 fathoms, fine sand; 25 fathoms, rocks and nullipora; 25 fathoms, gravel; and 26 to 41 fathoms, soft mud, in Bedford Basin,—a single specimen. Gulf of St. Lawrence! (J. F. Whiteaves): off Trinity Bay, 90 fathoms, small stones and coarse sand, and off Cape Rosier Light, 125 fathoms, mud, 1871; Orphan Bank, 1873. Labrador! (A. S. Packard, Jr.) Grinnell Land and as far north as latitude 81° 44' (Miers). Greenland (Kröyer, Stimpson, et al.). Arctic

* In these measurements, as in all those which I give of *Maerura* and *Sehizopoda*, the *length* is from the tip of the rostrum to the tip of the telson while the abdomen is extended nearly straight with the carapax; the *length of the carapax* and rostrum is from the tip of the rostrum to the middle of the posterior margin; the *length of the rostrum* is from the tip to the posterior margin of the orbit; the *breadth of the carapax* is at the widest point—a measurement which varies with the state of contraction more than the others. The length of the rostrum as measured above may be very slightly too great, particularly if the rostrum be relatively short, since it is not perfectly parallel with the longitudinal axis, but it has the practical advantage of being between definite points—a matter of the utmost importance. The length of the carapax exclusive of the rostrum is taken from the posterior margin of the orbit to the middle of the posterior margin, but is found accurately enough by subtracting the length of the rostrum from that of the carapax and rostrum. If the rostrum is very short it is better to measure the length of the carapax exclusive of the rostrum and find the length of the rostrum by subtraction.

Ocean and Bering Straits (Stimpson). ? Sea of Ochotsk (Brandt) and the island of Jesso (Stimpson)—*H. Ochotensis*. Spitzbergen (Kröyer). Coast of Norway! (G. O. Sars).

The examination of a large series of specimens shows conclusively that Kröyer's *H. turgida* is only the full-grown female of his *Phippsii*, as suggested by Goës, and that Stimpson's *vibrans* is a mere variety without any real claim to specific rank. Kröyer included young females under his *Phippsii*, as he distinctly states he had both sexes of that species, and it is not strictly true, as Goës implies, that all the males fall under one of Kröyer's species and all the females under the other, for the young males and young females are almost indistinguishable, except by the essential sexual characters, and agree with Kröyer's description of *Phippsii*. As in many similar cases of great differences in the sexes, the relation of the two forms may be easily established, with sufficient specimens, by tracing the forms back in two series toward the young, where the secondary sexual characters disappear and the two forms are seen to be specifically identical. In the present case the smallest females in which the sex is easily distinguishable differ scarcely at all in the form of the rostrum and in the other characters which Kröyer gives as characteristic of the two species.

I have never seen males which could be regarded as agreeing well with the characters of *turgida* as given by Kröyer, and I cannot explain the statement of Buchholz (who retains both Kröyer's species though regarding them as probably varieties of one species) that he had, from East Greenland, two males of *H. turgida*, 30 to 35^{mm} in length, without supposing some mistake in the determination of the sex of the specimens,—a supposition which I have no sufficient reason for hazarding.

The only characters which Stimpson gives for distinguishing his *H. vibrans*, found in Massachusetts Bay, from the *Phippsii* of Kröyer are that it has "but one spine over the eye," and that there are "only two or three teeth beneath the tip of the rostrum." The lower of the two supraorbital spines each side is really very small when best developed; it is not at all constant, there being a complete gradation between specimens in which it is well-developed and those in which it is entirely absent; and it often varies considerably on the two sides of the same individual. The number of teeth on the inferior edge of the rostrum is of even less importance as a distinguishing character, for three or four is the usual number in the typical *Phippsii* and specimens with only two beneath the rostrum

often have both pairs of supraorbital spines well-developed, so that the two characters do not even accompany each other. This variety is evidently the form of which Miers (Annals and Magazine Nat. Hist., iv, xx, p. 62 (12), 1877) had a single specimen from Cape Frazer, Grinnell Land, and to which he refers under *H. Phippsii*?

The following table exhibits these variations in a series of specimens selected from a much larger number. In the last column I have attempted to indicate the variation in the supraorbital spines, although it is impossible to express in words the completeness of the gradation between those individuals in which the lower spine is fully developed and those in which it is entirely wanting.

Locality.	Sex.	Length.	Rostrum.	Supraorbital spines each side.
Grand Menan,	♂	24.5mm	$\frac{3+6}{4}$	Two well-developed.
"	"	24.3	$\frac{4+5}{3}$	" "
"	"	25.0	$\frac{4+6}{2}$	Two, one very minute.
"	"	25.5	$\frac{4+5}{3}$	One only.
"	"	25.2	$\frac{4+5}{2}$	One, with rudiment of 2d.
"	"	24.3	$\frac{4+6}{4}$	One only.
"	"	21.8	$\frac{3+7}{3}$	" "
Cashe's Ledge,	"	19.2	$\frac{2+6}{2}$	Two well-developed.
"	"	17.0	$\frac{0+6}{2}$	Two, one very small.
"	"	15.5	$\frac{3+5}{2}$	" " "
"	"	18.5	$\frac{3+6}{2}$	Two, one scarcely percepti- [ble.
"	"	17.5	$\frac{3+5}{4}$	One only.
"	"	17.1	$\frac{4+6}{4}$	" "
"	"	17.0	$\frac{3+6}{3}$	Two.
"	"	16.0	$\frac{4+6}{2}$	One.
"	"	16.5	$\frac{3+7}{3}$	"
Isles of Shoals,	"	16.7	$\frac{3+6}{4}$	Two, one scarcely percepti- [ble.
Cashe's Ledge,	"	16.5	$\frac{3+7}{3}$	One.
"	"	15.5	$\frac{3+5}{2}$	Two well-developed.

Locality.	Sex.	Length.	Rostrum.	Supraorbital spines each side.
Cashe's Ledge,	♂	15.0 ^{mm}	$\frac{3+7}{3}$	Two.
"	"	14.3	$\frac{3+5}{2}$	Two, one very small.
Halifax,		12.0	$\frac{2+3}{1}$	One only!
"	♀	17.5	$\frac{4+7}{3}$	Two, one very small.
Mass. Bay,	"	18.0	$\frac{3+6}{4}$	Two, one scarcely percepti- [ble.
Cashe's Ledge.	"	19.0	$\frac{4+5}{4}$	One only!
"	"	21.8	$\frac{3+6}{4}$	Two well-developed.
"	"	21.3	$\frac{4+7}{6}$	" "
"	"	24.0	$\frac{4+4}{5}$	" "
Norway,	"	22.6	$\frac{4+6}{7}$	" "
Casco Bay,	"	29.0	$\frac{3+5}{6}$	" "
Grand Menan,	"	32.6	$\frac{4+6}{5}$	" "
"	"	35.5	$\frac{4+6}{5}$	" "
"	"	37.0	$\frac{4+6}{4}$	" "

The form of the telson and the number of its dorsal aculi and terminal spines was usually very constant in all the specimens examined. In thirty-five out of forty-four individuals there were four pairs of aculi, or four upon one side and five upon the other: of the remainder, six (two males, 21 and 26^{mm} long, and four females, 19 to 36.5^{mm} long) had five pairs; a male of 25^{mm}, five upon one side and six upon the other; a female of 37^{mm}, four upon one side and three upon the other; and a female of 25.5^{mm}, only three pairs. In thirty-seven specimens in which the spines of the tip were specially examined, only one (a female 36^{mm} long, from Halifax, Nova Scotia, and in all other respects perfectly normal) varied from the normal number, this specimen having three small ciliated spines in the middle in place of the two in normal specimens. This is a case precisely similar to that noticed under *H. Gaimardii*, and figured on Plate IX, figure 9, except that in this case there seems to be no variation whatever in the form of the terminal margin itself.

In life the males at least are semi-translucent, and specked and irregularly mottled with obscure brownish red on the carapax and appendages.

Hippolyte pusiola Kröyer.

Plate IX, figures 4, 5, 6, 7.

Off Block Island!, 8 to 10 fathoms, rocky, 1874. Off Stonington!, Connecticut, 4 to 5 fathoms, rocky, 1873 (A. E. Verrill and D. C. Eaton). Vineyard Sound!, 2 to 12 fathoms, gravelly and shelly, not common, 1871 and 1875. Off Nantucket!, 15 fathoms, 1875. Massachusetts Bay!, off Salem, 1877, 20 fathoms, rocks and gravel; 35 fathoms, mud and clay nodules; 48 fathoms, soft mud,—one specimen. Off Cape Ann!, 50 fathoms, mud, gravel and rocks, 1877. Also, Salem Harbor!, 4 fathoms (J. H. Emerton). Casco Bay!, 1873, at low-water mark!, among stones, on Ram Island Ledge; also at numerous localities in from 4 to 33 fathoms, rocky and gravelly, or "hard" bottoms, and abundantly in the stomachs of the cod taken on West Cod Ledge!. Jeffrey's Ledge!, 24 fathoms, gravel and stones, 1873. Cashe's Ledge!, 27 and 39 fathoms, rocks and gravel, 1874,—abundant; abundant also near the Ledge!, in 52 to 90 fathoms, 1873. George's Bank!, 45 fathoms, coarse sand, 1872,—one specimen. Bay of Fundy!, 1864, 1868, 1870, 1872, 1876: not uncommon at low-water mark!, among stones and algæ; common in 5 to 50 fathoms, rocky, gravelly and shelly bottoms; off White Head, Grand Menan, 97 to 105 fathoms, gravelly, 1872. Le Have Bank!, 45 fathoms, gravel and stones, 1872,—abundant. Halifax, Nova Scotia!, 1877: 16 fathoms, rocky; 18 fathoms, fine sand; 25 fathoms, gravel; and one specimen also from 16 fathoms, mud. Gulf of St. Lawrence!, Orphan Bank and, in 10 fathoms, gravel, stones and broken shells, off Sea-Cow Head, Prince Edward Island, 1873 (J. F. Whiteaves). Iceland (G. O. Sars). Lofoten Islands!, coast of Norway (G. O. Sars). Scotland! (Norman). North Sea (Norman, Metzger).

I have not been able to discover any authentic record of the occurrence of this species in Greenland. The statement, by Prof. Verrill and myself, in the Report on the Invertebrate Animals of Vineyard Sound, pp. 396 (102) and 550 (256), that it extends to Greenland, was made without any authority, and the including of Greenland in its geographical range by Kingsley (Bulletin Essex Institute, vol. x, p. 59), is probably due to our error, although Mr. Kingsley gives no authority for his statement. The species has, however, an extensive northern range, and will very likely yet be found in Greenland.

Out of one hundred and six specimens in which the rostrum was specially examined, ninety-two (among which the males varied from

10.5 to 17^{mm} in length, and the females from 13 to 23^{mm}) had either three or four teeth on the dorsal edge of the rostrum, and none at the tip or beneath; and this is evidently the normal rostral dentition of the species, although the fourteen remaining specimens show considerable deviation from this typical form. Of these fourteen specimens, nine) all females from off Nantucket, from the Bay of Fundy, and from Halifax, Nova Scotia, and varying from 19 to 25^{mm} in length), have four teeth above and one beneath the tip, and three of these nine, all females from the Bay of Fundy, and each about 23^{mm} in length, have the inferior tooth so near the tip that the tip is best described as bifid; one female, 22^{mm} long, from the Bay of Fundy, is similarly armed at the tip but has only three teeth above; one female, 16^{mm} long, from Halifax, Nova Scotia, has five distinct teeth above but none below; while three males, 12 to 13.5^{mm} long, from Casco Bay and Cashe's Ledge, have only two teeth above. This would seem to show that a tendency to an increase in the number of rostral teeth is characteristic of the females, while the reverse is the case in respect to the males.

The usually very constant arrangement of the terminal spines of the telson is occasionally subject to variation, which apparently follows the same tendency in the sexes as the variation in the number of rostral teeth, although the number of observations in either case is too small for a reliable generalization. Of forty-eight specimens in which the tip of the telson was specially examined, forty-five (among which the males varied from 12 to 17^{mm} in length, and the females from 14 to 25^{mm}), had the normal number of terminal spines; that is, a short one at the lateral angle each side, two much longer ciliated ones in the middle, and, between these and the lateral spines each side, a still longer and stouter spine, making six in all (Plate IX, figure 7). Of the remaining specimens, a male 17^{mm} long, from the Bay of Fundy, has but one median ciliated spine, so that there are only five in all (Plate IX, figure 6); and yet there is not the slightest appearance of this irregularity being due to injury, and the specimen is in all other respects perfectly normal. A female 20.5^{mm} long, from the Bay of Fundy, has nine spines, of which the three median are ciliated (Plate IX, figure 4); there is a little irregularity in the spines, apparently due to some slight injury. Another female 16^{mm} long, from Halifax, Nova Scotia, has also nine spines, of which the five central ones were probably ciliated, although, apparently on account of the imperfect state of preservation of the specimen, I was able to discover cilia on only a part of them, as shown in the figure

(Plate IX, figure 5). In this last specimen there is evidence of injury in the irregular outline of one of the lateral angles of the tip of the telson, in the irregularity of the spines, and particularly in the supplemental group of three aculei near this irregular angle as shown in the figure.

The largest specimens examined are from the Bay of Fundy, the largest male being 17^{mm} in length, and the largest female 25^{mm}.

The color in life varies considerably, as the following notes, unfortunately all made upon adult females, show. A specimen, taken among stones and algæ at low-water mark at Eastport, Maine, was translucent specked upon the body and appendages with bright red, and with a white dorsal line extending from the tip of the rostrum to the telson. Another, dredged at Eastport, in 20 to 25 fathoms, rocky and shelly bottom, was faintly specked with pale red on the carapax and the sides of the abdomen; the antennæ, antennulæ and cephalothoracic legs annulated and the abdominal legs, telson and the uropodal lamellæ banded with the same color. Still another specimen, from 40 to 50 fathoms, rocky bottom, at Eastport, was much more brilliantly colored, though after the same pattern: the eye-peduncles and the bases of the antennulæ, antennæ and cephalothoracic legs were thickly specked with bright red, the distal portions of the legs and the flagella of the antennulæ and antennæ were closely annulated, while the antennal scales, carapax and abdomen were transversely banded with the same color; the band upon the sixth segment of the abdomen and that across the telson and uropodal lamellæ were nearly as broad as the length of the sixth segment and the telson respectively, and very deep bright red. A considerable number of specimens taken among stones and red algæ upon the Cod Ledges, Casco Bay, were very brightly colored, much in the same way as the last specimen. According to notes made by Professor Verrill in 1870, two specimens dredged in 15 fathoms, stony bottom, north of Treat's Island, Eastport Harbor, differed considerably in color; one was pale flesh-color with a median dorsal stripe of whitish and the sides speckled with pale red, the flagella of the antennulæ and antennæ having alternate bands of pale reddish and flesh-color, and the legs thickly speckled with light brownish and obscurely banded with the same; while the other specimen was pale grayish, with about five transverse whitish bands on the abdomen, and a dark gray band across the sixth segment and another across the telson and uropodal lamellæ, and with the cephalothoracic legs banded with white and gray.

Females carrying eggs are abundant in all the collections I have

examined; these collections have been made in July, August, September, October and April, so that the species evidently breeds during a large portion of the year.

Hippolyte polaris Ross.

Alpheus polaris Sabine, in Supplement to appendix of Parry's [first] Voyage, p. ccxxxviii, pl. 2, figs. 5-8, 1824.

Hippolyte polaris J. C. Ross, in John Ross, Appendix to narrative of a second Voyage in search of the northwest passage, p. lxxxv, 1835 (♀).

Hippolyte borealis J. C. Ross, in John Ross, op. cit., p. lxxxiv, pl. B, fig. 3, 1835 (♂).

? *Hippolyte cuttellata* Norman, in Report of exploring the Hebrides, part ii, Report British Assoc. Adv. Sci., 1866, p. 200, 1867; Last Report on dredging among the Shetland Isles, op. ult. cit., 1867, p. 265.

Plate XI, figures 1 to 4.

Massachusetts Bay!, off Salem, 1877: 35 fathoms, mud and clay nodules; and 48 fathoms, soft mud [*a*]. Between Cape Ann and the Isles of Shoals!, 33 fathoms, gravel and stones, 1873 [*b*]. Casco Bay!, 1873 [*c*]: near West Cod Ledge, 10 to 15 fathoms, rocky, and from stomachs of the cod taken at the same locality. Also off Seguin Island!, 48 fathoms, gravel, 1873 [*d*]. Cashe's Ledge!, 30 to 40 fathoms, gravel [*e*]; and near the Ledge, 65 fathoms, mud and gravel, 1874 [*f*]. Bay of Fundy!, 1870, 1872 [*g*]. About east-southeast from Cape Sable, Nova Scotia!, north latitude 42° 45', west longitude 66° 27', 75 fathoms, fine sand and mud, 1877 [*h*]. Off Cape Negro!, Nova Scotia, 59 fathoms, pebbles, sand and rocks, 1877. Halifax!, Nova Scotia, 1877: 16 fathoms, rocks, and stones and red algæ [*i*]; 18 fathoms, fine sand [*k*]; and 25 fathoms, gravel. Off Halifax!, 1877: 25 fathoms, rocks and nullipora [*l*]; 52 fathoms, fine sand and mud; and 100 fathoms, fine sand [*m*]. Gulf St. Lawrence! (Whiteaves, 1871). Labrador! (Packard). Grimmell Land (Miers). Greenland (Kröyer, et al.), as far north as 81° 44' (Miers). Arctic Ocean, north of Bering Straits (Stimpson). Spitzbergen (Kröyer, Miers). West coast of Norway! (G. O. Sars) [*n*]. North Sea (Metzger). ? Shetland Islands (*H. cuttellata* Norman).

This species presents another case of differences between certain individuals among the adult males, or perhaps more properly old males, on the one hand, and the females and younger males, on the other hand; that is, the *borealis*-form bears much the same relation to the original *polaris* as *gibba* does to *Gaimardii*, and a relation somewhat similar to that of *Phippisii* to *turgida*. The specimens before me show a very complete series connecting the most characteristic form of *borealis* with the ordinary forms of *polaris*. Of the spe-

cimens examined, all the males 28^{mm} or less in length have well-developed rostral teeth and a distinct spine (the pterygostomian) at the inferior angle of the anterior margin of the carapax, and in these characters agree fully with the female. In all the specimens much above 30^{mm} in length the pterygostomian spines are small, rudimentary or wanting, though they do not seem to disappear wholly at any particular size of the individual. The disappearance of the dorsal teeth of the rostrum is still more irregular and is evidently a character peculiar to, but not characteristic of, the adult male. There are often very rudimentary teeth present which could not be discovered without the aid of a lense, and the gradation between the forms in which they are well-developed and those in which they are wholly wanting is most complete. That the form of male with edentulous rostrum and without pterygostomian spines has no claim to be retained as a species is conclusively shown, (1) by the complete gradation in these characters between this form and the original *polaris*-form, (2) by the fact that one of the characters may exist without the other in the same individual, and (3) by the negative evidence that there is no corresponding female form.

The following tabulation of the character of the rostral teeth and the pterygostomian spines, together with the length of the individual and the rostral formula, in a series of specimens selected from a much greater number, exhibits some of the variations. The letters indicating the localities correspond with those in brackets under the distribution of the species given above.

Locality.	Sex.	Length.	Rostral Formula.	Dorsal teeth of rostrum.	Pterygostomian spine.
<i>k</i> ₁		23.7mm	$\frac{2+3}{2}$	Well-developed.	Well-developed.
<i>k</i> ₂		24.0	$\frac{2+2}{2}$	"	"
<i>k</i> ₃	<i>r</i>	25.0	$\frac{2+3}{3}$	"	"
<i>l</i>	"	25.7	$\frac{2+3}{2}$	"	"
<i>i</i> ₁	"	26.0	$\frac{2+5}{3}$	"	"
<i>c</i> ₁	"	26.5	$\frac{2+4}{2}$	"	"
<i>j</i> ₁	"	27.0	$\frac{2+5}{4}$	"	"
<i>b</i> ₁	"	28.0	$\frac{2+2}{2}$	"	"
<i>k</i> ₄	"	30.0	$\frac{2+3}{3}$	"	"
<i>c</i> ₂	"	32.0	$\frac{2+2}{3}$	"	Small.

Locality.	Sex.	Length.	Rostral Formula.	Dorsal teeth of rostrum.	Pterygostomian spine.
k,	♂	34.0mm	$\frac{2+3}{4}$	Well-developed.	Rudimentary.
g,	"	35.4	$\frac{2+4}{3}$	"	Very small.
f,	"	39.5	$\frac{3+5}{4}$	"	Scarcely perceptible.
g,	"	43.0	$\frac{2+3}{2}$	Very small.	Rudimentary.
b,	"	32.0	$\frac{? ?}{3}$	Scarcely perceptible.	Small.
b,	"	33.0	$\frac{? ?}{3}$	Very minute.	Absent?
m,	"	34.0	$\frac{2+3}{4}$	Very small.	Wholly absent.
n,	"	36.0	$\frac{2?+3?}{4}$	Very minute.	Wholly absent.
h,	"	37.0	$\frac{? ?}{2?}$	Scarcely perceptible.	Wholly absent.
e,	"	30.0	$\frac{0+0}{3}$	Absent.	Very rudimentary.
e,	"	31.0	$\frac{0+0}{3}$	"	Very rudimentary.
e,	"	32.0	$\frac{0+0}{0?}$	"	Wholly absent.
k,	♀	29.4	$\frac{2+3}{3}$	Well-developed.	Well-developed.
k,	"	31.0	$\frac{3+3}{3}$	"	"
e,	"	33.0	$\frac{2+3}{3}$	"	"
e,	"	33.5	$\frac{2+2}{2}$	"	"
g,	"	35.0	$\frac{2+4}{4}$	"	"
c,	"	40.0	$\frac{2+3}{2}$	"	"
i,	"	41.0	$\frac{2+3}{3}$	"	"
n,	"	42.4	$\frac{2+2}{4}$	"	"
n,	"	45.0	$\frac{2+5}{3}$	"	"
n,	"	48.0	$\frac{3+4}{3}$	"	"
n,	"	49.0	$\frac{2+4}{5}$	"	"
l,	"	55.0	$\frac{2+3}{3}$	"	"
d,	"	55.0	$\frac{2+3}{2}$	"	"
g,	"	56.0	$\frac{2+4}{3}$	"	"
a,	"	56.0	$\frac{2+3}{3}$	"	"

The number of dorsal aculei upon the telson varies from four to ten pairs. The greatest number noticed being in the case of two females 48 and 49^{mm} in length, from the coast of Norway; the smallest number, in males 27 to 35^{mm} long and females 31 to 34^{mm}, from our own coast. That the number has no very close relation to the size of the individual is shown by a male 34^{mm} long having six aculei on one side and eight upon the other; while the largest specimen examined, a female 56^{mm} long, from the Bay of Fundy, has four upon one side and five upon the other. In thirty specimens from New England, Nova Scotia and the coast of Norway, the terminal spines of the telson are as described by Kröyer, that is four median ciliated ones and two stouter each side, making eight in all. A single female specimen, 31^{mm} long, from Labrador, differs however in having five median ciliated spines with two stouter spines each side, making nine in all,—a case precisely similar to that mentioned under *H. Gaimardii*.

The following notes on the color while living were made by Professor Verrill on an adult female, from 12 fathoms, Johnson's Bay, Bay of Fundy, 1870. Body pale flesh-color, beautifully spotted and barred transversely with orange-brown, the abdomen with somewhat rounded, unequal spots which tend to form transverse bars above, but on the second, third and fourth segments there is a regular band of this color. The carapax is spotted on the sides with orange-red and sparingly with sulphur-yellow; the upper portion bluish green, finely specked with brown and yellow, and with three lateral spots on each side and two median of bright blue. Between the eyes and passing obliquely backward is a stripe of red. On the sides of the abdomen are five specks of sulphur-yellow and above these are two small bright blue spots on the fifth segment and a median one with two smaller each side on the second. The telson and uropodal lamellæ are brownish at base, behind which there is a sulphur-yellow band bordered with white, the rest of the lamellæ speckled with brown, and the outer ones with a semi-circular spot of dark purplish brown near the middle of the outer margin. The flagella of the antennæ are salmon-color banded with orange-red. The first pair of cephalothoracic legs are red at base and on the terminal segments; the second are banded with red near the base and at the tip; the third and fourth are red at base, then banded with yellow, whitish and dark brown alternately, and the terminal segments flesh-color; the posterior pair are similar but have a sulphur-yellow base. The abdominal legs are flesh-color, spotted and transversely banded with dark red and sulphur-yellow.

Males when not more than 25^{mm} in length show distinctly the sexual characters in the first and second pairs of abdominal legs, and they arrive at sexual maturity at a little over 30^{mm} in length, if not earlier, since two specimens which I have examined, 34 and 37^{mm} long, have the sperm ducts, or spermatophores extruded,—probably a result of the contraction due to the preservation of the specimens in alcohol. Among four females carrying eggs the smallest is about 40^{mm} in length. These four, the only specimens seen with eggs, were all taken in 16 to 100 fathoms, at and off Halifax, Nova Scotia, September 4, 5, 6, 1877.

Since some, even recent, authors have apparently had difficulty in distinguishing with certainty the sexes in the species of *Hippolyte*, I introduce figures of the first pair of abdominal appendages and of the inner lamella of the second pair in the male and female of this species, to illustrate the sexual differences in these appendages in the genus. (Plate XI; figure 1, appendage of the left side of the first segment of the male; figure 3, corresponding appendage of the female; figure 2, inner lamella of the appendage of the left side of the second segment of the male; figure 4, corresponding part of the appendage of the female). At least in all the species of *Hippolyte* mentioned in this paper, the differences in these appendages in the two sexes are very similar to those shown in these figures, and are so conspicuous that they afford the readiest means for distinguishing the sexes, which is easily done at a glance.

In the first pair of abdominal appendages of the female, both lamellæ are furnished with long plumose setæ upon each margin to the very tip, as in the succeeding appendages; the outer lamella is always much narrower than the more or less ovate inner one and is linear in outline. In the male the basal portion of the appendage is relatively smaller than in the female; the outer lamella is similar to that in the female, but very much larger, and even larger than the inner lamella in the male; this inner lamella always tapers rapidly into a slender terminal portion which is naked, except a few minute, very short, modified and hook-like spines at the very tip; the margins toward the base, however, are furnished with short setæ or slender spinules, but entirely want the long plumose setæ so characteristic of the corresponding parts of the other appendages.

In the second pair of abdominal appendages, the differences are mostly confined to the inner lamellæ, which are narrowly ovate, and margined with long, plumose setæ in both sexes, but in the female there is, arising from the proximal half of the inner margin,

a single, slender process which is entirely naked except at the tip, where it is armed with numerous modified spines like those upon the tip of the inner lamella of the first pair of appendages in the male; while in the male there is a similar process, usually arising nearer the base, however, but always accompanied by a somewhat smaller process arising just at the base of the first and furnished with numerous long setæ like the marginal setæ of the lamella itself.

Hippolyte Grœnlandica Miers.

Astacus Grœnlandicus J. C. Fabricius, Systema Entomologiæ, p. 416, 1775; Entomologia systematica, ii, p. 484, 1793.

Cancer aculeatus O. Fabricius, Fauna Grœlandica, p. 239, 1780.

Alpheus aculeatus Sabine, in Supplement to appendix of Parry's [first] Voyage, p. cxxxviii, pl. 2, figs. 5-8, 1824.

Hippolyte aculeata J. C. Ross, in John Ross, Appendix to narrative of a second Voyage in search of the northwest passage, p. lxxxiii, 1835.

Hippolyte armata Owen, Voyage of the Blossom, p. 88, pl. 27, fig. 2, 1839 (♀).

Hippolyte cornuta Owen, op. cit., p. 89, pl. 28, fig. 2, 1839 (♂).

Hippolyte Grœnlandica Miers, Annals and Magazine Nat. Hist., IV, xx, p. 62 (12), 1877.

Salem Harbor!, Massachusetts, 6 fathoms, 1873; also off Baker's Island!, 20 fathoms (J. H. Emerton, 1878). Between Cape Ann and the Isles of Shoals!, 33 fathoms, gravel and stones, 1873. Casco Bay!, 1873: between Overset and Peak's Islands, 18 fathoms, rocks and sponges; West Cod Ledge, 10 to 20 fathoms, rocky; and from the stomachs of cod taken at the last locality. Grand Menan!, Bay of Fundy, 1872; also off Flagg's Cove!, Grand Menan, 15 fathoms, shells, mud and stones, 1873. Off Treat's Island!, Eastport, Maine, 15 fathoms, stones, 1870. Halifax!, Nova Scotia, 1877: 16 fathoms, stones, sand and red algæ; 18 fathoms, fine sand, also mud and fine sand; 21 fathoms, fine sand and red algæ; and 25 fathoms, gravel. Murry Bay!, Gulf of St. Lawrence (Principal J. W. Dawson). Labrador (Packard). Grimmell Land, as far north as 82° 30' (Miers). Greenland (J. C. Fabricius, O. Fabricius, Krøyer, et al.). Bering Sea and Arctic Ocean north of Bering Straits (Owen, Stimpson).

The largest specimens examined were from the Bay of Fundy, the largest male 41^{mm}, the largest female 55^{mm} in length.

According to the following notes, made by Professor Verrill in 1870, on two males from the Bay of Fundy, this species varies considerably in coloration. A male 41^{mm} long, from 15 fathoms, stony, north of Treat's Island, Eastport Harbor, had the body very pale whitish gray with faint clouds of dark gray on the carapax and a large spot of the same color on each side of each of the first five seg-

ments of the abdomen, those on the first three segments connected by a transverse dorsal band of the same, which, however, was narrowly interrupted in the middle on the first two segments. Flagella of the antennæ and antennulæ annulated with wide alternate bands of light red and white. Teeth of the rostrum dark brownish. Cephalothoracic legs white, annulated with pale red or flesh-color. Caudal lamellæ mottled with gray.

In the other specimen, 37^{mm} long, from 10 fathoms, shells, mud and stones, Flagg's Cove, Grand Menan, the carapax was flesh-color specked and mottled with light red, dorsal teeth and rostrum thickly specked with darker red, and the posterior border with two spots of the same color. The first three segments of the abdomen with broad interrupted transverse bands of light red; the posterior segments and caudal appendages mottled and specked with the same. Flagella of the antennulæ and antennæ, and the cephalothoracic legs as in the other specimen.

Pandalus borealis Kröyer.

Massachusetts Bay!, about twelve miles east-southeast from Salem, 45 to 50 fathoms, mud, 1877, and also in 1878,—very abundant. Gulf of Maine!, off Cape Ann, 40 to 98 fathoms, mud, 1877, 1878,—very abundant, particularly in a region about fourteen miles southeast from Cape Ann, in from 50 to about 100 fathoms. East of Jeffrey's Ledge!, 114 fathoms, soft mud, 1873. Gulf of Maine!, about forty miles east of Cape Ann, 160 fathoms, 1877. Off Casco Bay!, eighteen to twenty miles southeast from Cape Elizabeth, 48 to 68 fathoms, mud, 1873,—common. Twenty to thirty miles southeast to southeast one-half east from Cape Sable, Nova Scotia!, 59 to 88 fathoms, fine sand, pebbles and rocks, 1877,—two small specimens. About thirty miles south to south by west one-fourth west from Halifax!, Nova Scotia, 85 to 110 fathoms, fine sand and mud, 1877. Greenland (Kröyer). Bering Sea (Brandt), Norway! (G. O. Sars), and south to the Cattegat (Goës).

According to notes made by Professor Verrill in 1877, this species when living is "thickly sprinkled with small red stellate spots, which, from closer aggregation, make the tail deeper in color than the rest of the body. Flagella of the antennulæ annulated with very narrow white rings alternating with very broad red bands. Flagella of antennæ deep red. Spermaries purplish red, the outer membrane golden. Ovaries blue. Eggs ultramarine blue."

Females carrying eggs were taken in August and September, 1877 and 1878, in and off Massachusetts Bay and off Cape Ann.

Pandalus Montagu Leach.

Pandalus Montagu Leach, "Edinburg Encyclopedia, vii, p. 432" (teste White), 1813 or 1814; American Edition, vii, p. 271.—White. Catalogue of British Crustacea in British Museum, p. 41, 1850.

Pandalus annulicornis Leach, Malacostraca Podophthalmata Britannia, pl. 40. March, 1815; Transactions of the Linnean Society, London, xi, p. 346, 1815.

Pandalus terigatus Stimpson, Marine Invertebrata of Grand Manan, p. 58, 1853.

Vineyard Sound!, in deep water off Gay Head, 1871; also off Buzzard's Bay!, 25 fathoms, and off Newport!, Rhode Island, 29 fathoms, 1871. At these localities south of Cape Cod, the species was rare and all the specimens of small size. Massachusetts Bay!, off Salem, 22 to 48 fathoms, gravelly, sandy and muddy bottoms, 1877, common. Also 45 fathoms, soft mud, off Cape Ann!, 1878. Stellwagen's Bank!, 22 to 44 fathoms, rocky and sandy, 1873. Gulf of Maine!, off Cape Ann, 75 and 90 fathoms, mud, 1877,—common and very large, and associated with *P. borealis*. Common on St. George's Banks!, in 28 fathoms, coarse sand; 30 fathoms, soft sand; 50 and 60 fathoms, sand and shells; and 45 fathoms, coarse sand, 1872. Also east of St. George's Banks!, 430 fathoms, sand, gravel and stones, 1872,—several specimens, unquestionably of this species. Casco Bay!, common in 10 to 45 fathoms, rocky, shelly, gravelly, sandy, and muddy bottoms, and in abundance in the stomachs of the cod taken on the Cod Ledges, 1873. Also off Casco Bay!, eighteen to twenty miles southeast of Cape Elizabeth, 48 to 68 fathoms, mud, 1878,—large individuals associated with *P. borealis*. Bay of Fundy!, 10 to 77 fathoms, 1864, 1868, 1870, 1872, 1876,—very common. About east-southeast from Cape Sable!, Nova Scotia, north latitude $42^{\circ} 45'$, west longitude $66^{\circ} 27'$, 75 fathoms, fine sand and mud, 1877. Halifax!, Nova Scotia, 16 to 25 fathoms, on bottoms of stones and red algae, gravel, and fine sand and stones, 1877. In Bedford Basin!, Halifax, 26 to 41 fathoms, soft mud, 1877,—two specimens. About ten miles off Halifax, 53 fathoms, sand, mud and rocks, 1877. Gulf of St. Lawrence! (Whiteaves). Labrador! (Packard). Greenland (Kröyer et al.). Iceland (G. O. Sars). Scandinavian coast! (G. O. Sars) and British Isles! (Norman et al.).

The largest specimens examined are from 90 fathoms, off Cape Ann, and are 115^{mm} long. There are specimens over 100^{mm} long from

other localities in the Gulf of Maine, from off Casco Bay, 48 to 68 fathoms, and from deep water in the Bay of Fundy.

In examining many hundreds of specimens only seven were found carrying eggs; these specimens vary between 75 and 100^{mm} in length: one of them is from 48 fathoms, Massachusetts Bay, August 13, 1877; another is from 45 fathoms, in the same region, August 29, 1878; three are from 75 fathoms, Gulf of Maine, off Cape Ann, October 17, 1877; and two are from Halifax, Nova Scotia, September, 1877.

This species differs in color from the *borealis* in having the red more intense and arranged in clearly defined markings, of which those upon the carapax and abdomen are arranged in conspicuous, obliquely transverse lines or bars, while the color upon the rest of the body and upon the appendages is collected in distinct specks, blotches, or annulations.

Stimpson's *Pandalus levigatus* is undoubtedly synonymous with *P. Montaguï*. The latter species is exceedingly abundant in the Bay of Fundy and Dr. Stimpson could scarcely have failed to obtain it in his dredgings at Grand Menan. Moreover, the description of the *levigatus* applies perfectly to the *Montaguï*, except as to the color, in regard to which there was probably some mistake. There are similar discrepancies in regard to the color of some of the species of Amphipoda described in the same memoir.

Palæmonetes vulgaris Stimpson ex Say.

Kingsley (Proceedings Acad. Nat. Sci., 1878, p. 330 (15)) gives "Salem, Mass. (C. Cooke)," as a locality for this species, and it undoubtedly occurs regularly in the shallow waters of Cape Cod Bay, although I have never observed specimens north of Cape Cod. It is very common among eel-grass, etc., in Vineyard Sound! and Buzzard's Bay!, 1871, 1875; Fisher's Island Sound!, 1874; Long Island Sound!; south shore of Long Island!, 1870; New Jersey!, 1871; Fort Macon!, North Carolina (Coles, Packard); to the St. Johns River!, Florida (G. Brown Goode).

Pasiphaë tarda Krøyer.

Pasiphaë tarda Krøyer, Naturhistorisk Tidsskrift, II, i, p. 453, 1845; in Gaimard, Voyages en Scandinavie et Laponie, pl. 6, fig. 1 (*Pasiphaë*), 1849.—Lütken, in Manual of the Natural History of Greenland, for the use of the English Arctic Expedition, p. 148, 1875.—G. O. Sars, Archiv for Mathematik og Naturvidenskab, Kristiania, ii, p. 342, 1877.

Pasiphaë multidentata Esmark, Christiania Videnskabs-Selskabs Forhandling for 1865, pp. 259, 316.

Pastiphaë Norvegica M. Sars, Christiania Videnskabs-Selskabs Forhandlinger for 1865. pp. 260, 314; Bidrag til Kunskaab om Christianiafjordens Fauna (extract Nyt Magazin for Naturvidenskaberne), p. 42, pls. 4, 5, figs. 65-90, 1868.—G. O. Sars. Undersøgelser over Christianiafjordens Dybvandsfauna (extract Nyt Mag. Nat.), p. 21, 1869; Christiania Videnskabs-Selskabs Forhandlinger for 1871, p. 262 (19), 1872.

Plate X, figure 1.

Gulf of Maine!, forty-two miles east by south from Cape Ann, about $42^{\circ} 38'$ north latitude, $69^{\circ} 38'$ west longitude, 160 fathoms, soft mud, August 19, 1877,—two specimens, 75 and 53^{mm} in length. Also near the same locality, 140 and 175 fathoms, soft mud, August 27, 1878,—two specimens, one 62^{mm} in length, the other fragmentary.

Greenland (Krøyer). West coast of Norway!, 100 to 525 fathoms (M. and G. O. Sars).

Thysanopoda Norvegica M. Sars.

Forhandlinger ved de Skandinaviske Naturforskere, 1856, p. 169, 1857; Christiania Videnskabs-Selskabs Forhandlinger, 1863, p. 2.—Goës, Æfversigt af Kongl. Vetenskaps-Akad. Förhandlingar, Stockholm, 1863, p. 173 (13).—G. O. Sars, Beretning om en i Sommeren 1865 foretagen zoologisk Reise ved Kysterne af Christianias og Christiansands Stifter, p. 15, 1866 (extr. Nyt Magazin for Naturvidenskaberne); Christiania Vidensk.-Selsk. Forhandlinger, 1871, p. 262 (19); Archiv for Matematik og Naturvidenskab, Kristiania, ii, p. 342, 1877—(?) Norman, Last report on dredging among the Shetland Isles, Report British Assoc. Advanc. Sci., 1868, p. 265, 1869.—Buchholz, Zweite deutsche Nordpolfahrt, ii, p. 285, 1874.—Metzger, Jahresbericht der Comm. zur wissenschaftl. Untersuchung der deutschen Meere für 1872, 1873, Nordsee, p. 288, 1875.

Massachusetts Bay!, off Salem, 48 fathoms, soft mud, 1877. Gulf of Maine!, off Massachusetts Bay and off Cape Ann, 1873, 1877 and 1878: 40 to 160 fathoms, mud, sand and mud, mud and stones. Casco Bay!, 1873: in great abundance at the surface on "mackerel ground," during both day and evening; also in dredgings from 64 and 94 fathoms, mud, off Casco Bay. Bay of Fundy!, 1864, 1868, 1870, 1872, 1876: in great abundance at the surface, and often brought up in the dredge. Several localities off the coast of Maine!, 95 to 105 fathoms, 1873, 1874. East of St. George's Banks!, 430 fathoms, 1872. Off Cape Sable!, Nova Scotia, 59, 88, and 115 fathoms, sand, gravel and stones, sandy mud, sand and gravel, 1877. Gulf of St. Lawrence!, 210 fathoms, mud, 1873. Greenland (Buchholz). North latitude 75° , east longitude 12° (Goës). West coast of Norway! (G. O. and M. Sars). North Sea (Metzger). (?) Shetland Islands (Norman).

Since this, as well as the next species, is essentially pelagic, swim-

ming in vast numbers at the surface, and doubtless at great depths as well, it is of course somewhat uncertain whether the specimens taken in the dredge really come from the bottom or from some point between that and the surface. It was found in the stomachs of the hake taken in the Bay of Fundy, in 1872, however, which is very good evidence that it lives at the bottom for a part of the time.

In the Bay of Fundy it occurs at the surface in vast swarms, filling the water for miles, and is usually accompanied by schools of mackerel, young pollock, and other fish, and in the autumn by immense flocks of gulls; the fish and smaller gulls appearing to feed almost exclusively upon the *Thysanopoda* at such times. It not infrequently occurs in this way in the harbor of Eastport, Maine, and, with a hand-net, may be caught by the quart even from the wharves. I have observed it only in August, September and October, but Messrs. Merriam and Wilson found it in abundance in April. Professor Verrill observed it, in 1859, swarming in myriads at the "Replings," in the center of the Bay of Fundy. In the Bay of Fundy, the *inermis* was often found associated with this species, but always in very much smaller numbers. The *Norvegica* occurred on "mackerel grounds" in Casco Bay, in the same way as in the Bay of Fundy, though not in such vast abundance.

In life, this species is very beautiful. The whole animal, except the black eyes, is very translucent; the edges of the carapax and the lower edges of the abdominal segments are faintly tinged with red; the upper surface of the carapax, the peduncles of the antennulæ and antennæ, and the cephalothoracic appendages are spotted and banded with deep bright red; the peculiar sense organs at the bases of the first and last pairs of pediform cephalothoracic appendages, and beneath the anterior segments of the abdomen are deep purplish red; the principal ganglia of the nervous system and many of the peripheral nerves are red, or tinged with red. The ganglia of the nervous system are sometimes, if not always, beautifully phosphorescent.

While at Casco Bay in August, 1873, and before I was aware of G. O. Sars' observations on the development of this species (in his zoological voyage of 1865, above referred to), several of the very remarkable larval stages of two species of *Thysanopoda*, most of the larvæ apparently belonging to this species, were found among the collections made at the surface with the towing-net in the evening. The youngest individuals observed belonged to the more common species, and, though apparently by no means the earliest of the free-

swimming stages, show close affinities with the nauplius-stage of the Copepoda, and at once convinced me of the correctness of the conclusions of Claus based on his earlier observations on *Euphausia*. In the earliest stage observed the animal is about $2\frac{1}{2}^{\text{mm}}$ long. The compound eyes are already present but are crowded closely together, sessile, and wholly covered above by the front of the carapax. The antennulæ and antennæ are highly developed biramus natatory appendages, the antennæ being still in the simplest naupliar form. The mandibles, both pairs of maxillæ, and the first pair of maxillipeds are developed and show considerable resemblance to the adult form of these appendages. The remaining cephalothoracic appendages have not yet appeared and the corresponding segments of the cephalothorax are only indicated by a closely crowded series of rather obscure annulations. The abdomen, however, is already well-developed and composed of the normal number of segments, and the uropods have even made their appearance in a rudimentary form. This earliest larval stage was unmistakably connected with the adult *Thysanopoda* by several intermediate stages found in company with the younger larvæ.

I should not have alluded to these very imperfect observations in connection with this subject, had not C. Spence Bate,* having apparently overlooked Sars' observations, recently seemed to question the correctness of Claus' conclusions in regard to the larvæ referred by him to *Euphausia*.

I am able to throw no light whatever upon the question as to the manner in which the eggs are discharged or hatched, though it seems most probable to me that the eggs are discharged while the embryo is still immature and are hatched while floating in the water.

Thysanopoda inermis Krøyer.

In Gaimard, Voyages en Scandinavie, en Laponie, au Spitzberg, pl. 7. fig. 2, 1849; Forsøg til en monographisk Fremstilling af Kræbstdyrslægten Sergestes, Kongl. Danske Vidensk. Selsk. Skr., V, naturvidensk. mathem. Afl., iv, pl. 5, fig. 24, 1856 (showing the peculiar sense organs).—Goës, Oversigt af Kongl. Vetenskaps-Akad. Förhandlingar, Stockholm, 1863, p. 174 (14).—Reinhardt, Naturhistoriske Bidrag til en Beskrivelse af Grönland, p. 30, 1857 (extr. from Rink's Grönland).—Lütken, list of the Crustacea of Greenland, in Manual of Instructions for the [British] Arctic Expedition, 1875, p. 148.

Mentioned, on my authority, as *T. neglecta*?, by Verrill, American Journal of Sci-

* On the Nauplius Stage of Prawns, Annals and Magazine of Natural History, V, ii, p. 79, 1878.

ence, III, vii, p. 411, 1874. Also by Whiteaves, American Journal of Science, III, vii, pp. 213, 214, 1874; and Report on further deep-sea dredging operations in the Gulf of St. Lawrence [in 1873], p. 16, [1874?].

Very abundant at the surface in Vineyard Sound!, January 8, 1875, and January 14, 1876 (V. N. Edwards). Massachusetts Bay!, 48 fathoms, mud, 1877. Off the coast of Maine!, 102, 105 and 107 fathoms, mud and gravel, and mud, 1873, 1874. Bay of Fundy!, at the surface, 1864, 1868, 1872; dredged in 40 to 50 fathoms, rocky, 1868; and found in the stomachs of pollock and hake, 1872. Gulf of St. Lawrence!, 50, 70, 210 and 220 fathoms (J. F. Whiteaves). Greenland (Reinhardt, Lütken). Spitzbergen and Finmark (Goës). Lofoten Islands!, Norway (G. O. Sars).

The specimens taken in Vineyard Sound in winter are very slightly smaller and apparently more slender in form than the northern specimens taken in summer and autumn, but seem to differ in no other respect. Specimens from the Bay of Fundy agree perfectly with Krøyer's figures referred to above, and with specimens received directly from Prof. G. O. Sars and labeled by him *T. inermis* Krøyer. Specimens sent several years earlier from the same locality by Prof. Sars to the Smithsonian Institution, as a specimen of the food of *Gadus virens*, and labeled *T. neglecta* Krøyer, appear, however, to be the same species, and do not agree with Krøyer's figures of *T. neglecta*. It was an examination of these specimens which led me to label specimens of our species *T. neglecta*? for Prof. Verrill and Mr. Whiteaves.

In life this species is at once distinguished from the *Norvegica* by its much fainter coloring. It is exceedingly translucent, the sides of the carapax and abdomen, and the bases of the cephalothoracic and abdominal appendages are only slightly tinged with red. The nervous system and the peculiar sense organs, however, are brightly colored as in the *Norvegica*, and these together with the eyes are all that is easily visible as the animal swims gracefully about near the surface of the water.

Erythrops Goësii G. O. Sars.

Mysis erythropthalma Goës, Crustacea marina Suecicæ, (Eftversigt af Kongl. Vetenskaps-Akademens Förhandlingar, 1863, p. 178 (18), 1863.

Nematopus Goësii G. O. Sars, Beretning om en i Sommeren 1865 foretagen Reise ved Kysterne af Christianias og Christiansands Stifter (extr. Nyt. Mag. Nat.), p. 15, 1866.

Erythrops Goësii G. O. Sars, Carcinologiske Bidrag til Norges Fauna, Mysider, part

i, p. 24, pl. 1, 1870; Undersøgelse over Hardangerfjordens Fauna, Crustacea, Christiania Videnskabs-Selskabs Forhandling, 1871, p. 262 (19), 1872.—Metzger, Jahresbericht der Comm. zur wissenschaft. Untersuchung der deutschen Meere für 1872, 1873, Nordsee, p. 288, 1875.

Massachusetts Bay!, off Salem, August, 1877: 20 fathoms, rocks and gravel; 33 fathoms, sand and mud; and 48 fathoms, soft mud. Skager Rack, 49 fathoms (Metzger). West coast of Norway!, 30 to 150 fathoms (G. O. Sars). Spitzbergen (Goës).

Meterythrops, gen. nov.

The large and very interesting species, for the reception of which this genus is here proposed, was first made known to me, several years ago, by a few, more or less imperfect, specimens dredged in the Gulf of St. Lawrence, in 1873, by Mr. J. F. Whiteaves, and, in his report on dredging for that year, it is referred to, on my authority, as a species "near to *Erythrops* and *Parerythrops*." The same species was dredged in 1877 by the party of the U. S. Fish Commission on board the "Speedwell," but only imperfect specimens were obtained. The following description and the accompanying figures are based on this meager material. The species combines several characters of the genera *Erythrops* and *Parerythrops* of G. O. Sars, but in general appearance is more like the latter genus. The new genus may be characterized as follows:

The body very short and obese with the posterior cephalothoracic segments almost completely covered above by the large and broad carapax. The eyes well-developed, large, nearly globular, and black after preservation in alcohol. The antennulæ, antennæ, and the oral and cephalothoracic appendages nearly as in *Parerythrops*. The pleopods in the female rudimentary and very nearly as in *Mysis*; in the male, as in *Erythrops*, all the five pairs being well-developed, biramous, and natatory; the inner ramus in the first pair, however, rudimentary and with the terminal part membranaceous, expanded, and nearly naked. The telson long, narrow, sub-triangular, the lateral margins naked, and the apex narrow, truncate, and armed with four spines and two median setæ. The ovigerous pouch composed of four large lamellæ nearly as in *Mysis*.

Meterythrops robusta, sp. nov.

Plate XII, figures 1 and 2.

The carapax as seen from above is of nearly equal breadth to near the posterior extremity, where it is slightly contracted. The frontal

margin projects in an obtuse and rounded angle between the eyes, and, beneath the eye each side, the lateral margin projects into an acute and spiniform angle, just above which there is a deep sinus in the margin for the reception of the base of the antenna. The transverse sulcus is well-marked, strongly arcuate, and terminates each side just above the antero-lateral spine. The lateral margin is bent strongly upward in an obtuse angle at a point about a third of its length from the anterior margin. The posterior margin is only slightly emarginate. The eyes are very large, their greater diameter being more than a third of the breadth of the carapax, remote from each other, and attached by very slender bases; they are very nearly globular, though slightly flattened above, and the black, faceted area, occupying the greater portion of the surface, terminates in a regular and slightly arcuate line above. The peduncles of the antennulæ are only a little longer than the eyes, and the distal segment in each is as long as the two proximal, of which the second one is very short, not half as long as the first and much shorter upon the outer than upon the inner side. The flagella are stout and the outer longer than inner, as usual. In the adult male the segments of the peduncle are stouter than in the female, the basal and terminal segments each being as broad as long, and the distal segment terminates, beneath the base of the inner flagellum, in an obtuse, conical, and densely hirsute or ciliated process similar to that in the males of *Erythropus* and *Parerythropus*. The squamiform appendage of antenna (Plate XII, figure 2), is only about three times as long as broad, the greatest breadth being toward the distal extremity; the outer margin is nearly straight from near the base and terminates in a very large dentiform spine. From the base of this spine the anterior margin is very oblique, only slightly arcuate, scarcely longer than the breadth of the scale itself, and terminates in an oval tip which is about a third of the width of the scale in front of the tip of the lateral spine. The inner and terminal margins together are furnished with nearly fifty setæ, of which about a third are on the terminal margin. The peduncle of the antennula does not reach to the middle of the squamiform appendage, and the three distal segments are very short, the ultimate and antepenultimate each being about as broad as long and the two nearly equal in length, while the penultimate is shorter than either. The flagellum is stout and probably nearly as long as the rest of the animal, though, in all the specimens examined, the terminal portion is wanting.

The mandibles agree very closely, except in some of the details of

the armament of the coronal extremities, with the mandibles of *Parerythropros obesa*. In each mandible the inferior angle of the crown is separated by a broad space from the superior, or molar, angle. The inferior edges and the molar processes in both mandibles are almost exactly as in *Parerythropros obesa*: the inferior edge itself is much alike in the two mandibles, being composed of about four irregular, obtuse teeth, but the dentiform process just within the edge differs in the two mandibles; in the right it is more slender and prominent than in the left, and enlarges at the extremity, which is armed with several rather slender teeth; while in the left the process is shorter, stouter, and terminates in shorter teeth. The space between the armament of the inferior edge and the molar process is, in each mandible, furnished with twelve to fourteen setiform teeth which are very different in the two mandibles: in the left they are slender, crowded closely together, and armed with minute, spiniform teeth; while in the right they occupy a much larger space, are thin, acutely triangular, and wholly destitute of secondary spines or dentations, except, possibly, one or two exceedingly minute spinules at the bases of a few of them. The mandibular palpi have almost precisely the same form, proportions, and armament of spines and setæ as in *Parerythropros obesa*.

The first maxillæ are throughout exactly as in *Parerythropros obesa*. The second, also, have very nearly the same form and proportions as in that species; the outer lobe, or scaphognath, however, differs in being broadly oval, margined with twenty-five to thirty setæ, and in having the anterior extremity rounded and tipped with four setæ, two of which are very distinctly on the inner margin inside the tip, while in *Parerythropros obesa* the scaphognath is triangular anteriorly, is margined with only fifteen to eighteen setæ, none of which are really on the inner margin, although there are two at the narrow tip; the three lobes of the protognath and the two segments of the palpus (endognath) are exactly as in *Parerythropros obesa*, except that they are furnished with a few more setæ.

The endognath in the maxillipeds is almost exactly like this part of the same appendage in *Parerythropros obesa*. The exognath differs in being very slightly larger proportionally and in having thirteen or fourteen segments in the flagelliform portion. The endognath in the first gnathopods (second maxillipeds) does not differ from the same part in *Parerythropros obesa*, except that it is armed with a somewhat greater number of setæ and spines, particularly on the distal part of the outer margin of the longest segment (merus). The exognath is

exactly like that of the succeeding appendages: the base is very broad and muscular in both sexes, though somewhat broader in the males, and the outer distal angle projects in a distinct and rather acute tooth; and the flagelliform portion is composed of fifteen or sixteen segments.

The second gnathopods (third maxillipeds) and the five pairs of pereopods (cephalothoracic legs) are all alike in size and armament, the second gnathopods being apparently fully as long as the succeeding appendages. The length of the endognath in each is about equal to the length of the carapax, and the four distal segments (forming the "tarsus") are almost exactly equal in length to the three (basis, ischium and merus)* which next precede them, the relative proportions of the different segments and their ratio to the rest of the animal being in fact almost exactly as in the pereopods of *Parerythropros obesa*. The endognaths of the second gnathopods and of the five pairs of pereopods are rather larger proportionally than in *Parerythropros obesa*, and, as in the exognath of the first gnathopods, the outer distal angle of the basal portion projects in an angular

* The distal portion of the pediform cephalothoracic appendages, which is normally composed of three segments, the carpus, propodus and dactylus, often contains in the Mysidæ more than the normal number of segments, and is well called the tarsus by G. O. Sars, in some of his recent papers. The additional segments appear to result from the segmentation of the carpal segment only, and I so regard them in this and the following descriptions. In the Caridea the carpal segments in some of the cephalothoracic legs are often divided or even multiarticulate, and that this is the normal segment which gives rise to the more or less numerous supplementary segments in the tarsus of the Mysidæ, is, I think, well shown in the second pair of gnathopods in the different genera of the family. In *Heteromysis* this portion of the tarsus is composed of the normal number of segments, although the carpus is very large and the propodus unusually short; in *Parerythropros obesa*, in the new species here described, and in the species of *Pseudomma*, the tarsus is composed of four segments but the division between the two first segments is very imperfect, admits of very little if any motion, and apparently has no special muscles attached near it, while the more distal articulations are of the ordinary character. In the new species of *Pseudomma* described beyond, this division of the carpus is so very incomplete that it is usually exceedingly difficult to discover it. It is evident that the four tarsal segments in the succeeding pairs of cephalothoracic appendages in *Parerythropros*, *Meterythropros* and *Pseudomma*, correspond to the four tarsal segments in the second gnathopods; and, in the absence of any facts to the contrary, it would seem proper to conclude that the ultimate and penultimate segments of the more or less numerous segmented tarsi of all the pediform cephalothoracic appendages of Mysidæ in general are homologous with the dactylus and propodus, and that the additional segments have all resulted from segmentation of the carpus.

tooth and the flagelliform portion is composed of fifteen or sixteen segments.

The abdomen is much narrower than the carapax and tapers only slightly; the first four segments are subequal in length, the fifth a little shorter, and the sixth a fourth longer than the fifth. The telson (Plate XII, figure 2 *c*) is as long as the sixth segment, narrow, triangular and twice as long as the width at base; the lateral margins are wholly unarmed and are suddenly expanded laterally near the base, but are nearly straight from this expansion to the tip. In the dorsal surface there is a deep median sulcus extending the whole length, and from this the surface slopes down each side to the lateral margin which is strongly upturned throughout. The extremity (figure 2 *d*) is very narrow, truncated in a straight line and armed with a median pair of slender spines of which the outer one is much shorter and more slender than the inner, which is itself about two-thirds as long as the space between the bases of the outer spines.

The inner lamella of the uropods (Plate XII, figure 2 *a*) reaches only a little beyond the tip of the telson, is expanded at the base for the reception of the acoustic apparatus, but beyond this is narrow and linear in outline; both margins are furnished with long ciliated setæ which are nearly twice as numerous on the inner as on the outer edge, and, in addition, the inner edge is armed beneath with a small spine at the base of each seta. The outer lamella is nearly a third longer than the inner, fully six times as long as broad, the greatest breadth being near the middle of the length, and both margins are regularly, though slightly, curved inward and each furnished with about equally numerous setæ.

The bases of all the pleopods in the male are rectangular in outline, and are very stout and muscular. The inner rudimentary ramus in the first pair of pleopods (Plate XII, figure 1 *a*) is soft, membranaceous, and about a third as long as the outer; the terminal portion is slightly swollen, and rounded at the extremity; and the lamellar appendage projecting outward from near the base, and corresponding to that upon the same ramus of the succeeding pleopods, has three or four hairs at the truncated tip and about the same number of shorter ones on the upper edge. The outer ramus in the first pair is, like the same ramus in the succeeding pairs, slender, much longer than the base, and composed of about fourteen segments. The inner rami of the second to the fifth pair of pleopods are similar to the outer, except that they all have the lamellar appendage near the base, like that upon the rudimentary ramus of the first pair, and usually

have one or more less segments than the corresponding outer branch. The number of segments in both the inner and outer rami varies somewhat, however: in the fully adult male, 28·5^{mm} in length, there are fourteen segments in each of the outer rami of the first pair; twelve in the outer and thirteen in the inner of the second and third pairs; eleven in the inner and twelve in the outer of the fourth pair; and only eight in the inner and twelve in the outer of the fifth pair. In a young male, only 13·5^{mm} long, there appear to be one or two less segments in each of the natatory rami of all the pleopods, although the rudimentary rami in the first pair, and the lamellar appendage of the inner ramus in the succeeding pairs, are well-developed.

The rudimentary pleopods of the female do not differ essentially from same appendages in the allied genera. They resemble more closely, however, the pleopods of the females of the species of *Mysis* than of *Parerythrops obesa*, the setæ with which they are armed being fewer in number and much longer than in that species.

Massachusetts Bay!, off Salem, 33 fathoms, sand and mud, August 4, 1877,—young male and female; also 33 fathoms, soft mud, August 13,—one young male. Off Bay of Chaleurs, Gulf of St. Lawrence!, 50 and 70 fathoms, 1873,—adult male and two females, one, 16·5^{mm} long, the other, 14^{mm}.

Pseudomma roseum G. O. Sars.

Pseudomma roseum G. O. Sars, Nye Dybvandscrustaceer fra Lofoten, Christiania Videnskabs-Selskabs Forhandling, 1869, p. 154 (10); Carcinologiske Bidrag til Norges Fauna, Mysider, part i, p. 54. pl. 4, 1870; Undersøgelser over Hardangerfjordens Fauna, Crustacea, Christiania Videnskabs-Selskabs Forhandling, 1871, p. 263 (20); Archiv for Mathematik og Naturvidenskab, Kristiania, ii, p. 344, 1877.—Metzger, Jahresbericht der Comm. zur wissenschaft. Untersuchung der deutschen Meere für 1872, 1873, Nordsee. p. 288. 1875.—Whiteaves, Report on further deep-sea Dredging Operations in the Gulf of St. Lawrence [in 1873], p. 16. [1874?].

Near Jeffrey's Bank!, Gulf of Maine, 105 fathoms, brown mud, September, 1873,—one specimen. Gulf of St. Lawrence!, 1873, 28 miles east-northeast of Cape Gaspé, 110 fathoms; and 25 miles east by north of Cape Gaspé, 210 fathoms,—several specimens at each locality. West coast of Norway, at the Lofoten Islands!, 200 to 300 fathoms; and Hardanger Fiord, 100 fathoms, and between 400 and 500 fathoms (G. O. Sars). Off Mandel, southern Norway, 220 fathoms (Metzger).

Pseudomma truncatum, sp. nov.

Plate XII, figures 3, 4.

This species is nearly allied to *P. roseum* and resembles it very closely in form and general appearance. The new species has proportionally shorter pereopods, however, and is readily distinguished by the terminal portion of the antennal scale and by the form of the telson.

The form and proportions of the carapax and abdomen are exactly as in *P. roseum*. The ophthalmic segment (Plate XII, figure 3 a) is a little broader in front than in *P. roseum*, the dentated portions of the margin are slightly more lateral and the dentations not quite as well-marked as in that species, and there seems to be less difference in the sexes in the form of the anterior margin. The antennulæ are as in *P. roseum*, except that the flagella are apparently a little shorter. The relative proportions of the segments of the peduncles of the antennæ are the same as in *P. roseum*. The squamiform appendage (figure 3) of the antenna is about three and a half times as long as broad; the outer margin is about five-sixths of the entire length and terminates in a stout tooth, as in the allied species; the inner margin is regularly arcuate and furnished with in the neighborhood of thirty setæ; the terminal portion, in front of the base of the terminal spine of the outer margin, is regularly and rather broadly ovate and not longer than the breadth of the scale; the setæ of the outer portion of the terminal margin, from the base of the lateral spine to near the tip, are nearly or quite twice as remote from each other as on the corresponding part of the inner margin, there being only three or four setæ until near the tip where there are three to five more, closely crowded together as on the inner margin. In *P. roseum* the terminal portion of the antennal scale is proportionally longer than in *P. truncatum*, being about one and a half times the breadth of the scale in advance of the base of the lateral spine, and the setæ on the outer portion of the terminal margin are as closely crowded as on the inner margin and twice or three times as numerous as in *P. truncatum*.

The oral appendages are as in *P. roseum*. The second gnathopods (third maxillipeds) have the same structure and proportions of the distal and proximal segments of the endopod, and the same number of segments in the flagelliform portion of the epipodal branches, as in *P. roseum*; but the three longest segments (the meral and the divided carpal), though varying considerably in different individuals of the same sex and size, and even on the different sides of the same

individual, are proportionally shorter than in that species, and consequently the entire endopod is correspondingly shorter, being only very slightly longer than the carapax. The articulation between the two divisions of the carpus is imperfect, very indistinct, and in some specimens is made out only with the greatest difficulty, even when the appendages in question have been specially mounted for the purpose; in *P. roseum*, however, this articulation is perfectly distinct as it is in the five pairs of pereopods in both species.

The five pairs of pereopods have precisely the same form and structure as in *P. roseum*, and, as in that species, increase successively in length posteriorly, but differ in the lengths of the three longest segments in the same way as the second gnathopods. In *P. truncatum* the length of the pereopods varies considerably in different specimens of the same sex and age, and even on the different sides of the same specimen, but the first pereopods are about a third as long as the entire body of the animal and the posterior pair are fully one-half as long, or about as long as the second pair in *P. roseum*.

The proportions of the segments of the abdomen are almost exactly as in *P. roseum*: the five anterior segments are sub-equal in length, though increasing very slightly posteriorly, and the fifth is about as broad as long and the first about a third broader than long; the sixth segment is about once and a half as long as the fifth and about two-fifths as long as broad. The telson (figures 3*b* and 4) is considerably shorter than the sixth segment, and, at base, about three-fourths as broad as long, sub-triangular, and truncated at the tip, which is about a third as broad as the base; the lateral margins are armed for a little more than the distal half of the length, with about seven small spines which are rather more crowded proximally; the tip is truncated and armed with two pairs of strong spines several times as long as those upon the lateral margins, and a median pair of slender plumose setæ, which are slightly longer in the male than in the female. In *P. roseum* the telson is as long as the sixth segment of the abdomen, the tip is rounded, and the lateral and terminal spines form a single series. The lamellæ of the uropods are somewhat shorter and broader in proportion to the length, but absolutely of about the same breadth as in *P. roseum*.

Gulf of St. Lawrence!, 1873 (J. F. Whiteaves): off the Bay of Chaleurs, 50 and 70 fathoms, August 4,—between twenty and thirty specimens; and also between Bradelle Bank and Miscou Island, 45 fathoms, mud and stones, August 7,—one male.

Heteromysis.

Heteromysis Smith, Invertebrate animals of Vineyard Sound, in Report of U. S. Commissioner of Fish and Fisheries, part i, p. 553 (259), 1874.

Chiomysis G. O. Sars. Middelhavets Mysider, Archiv for Matematik og Naturvidenskab, Kristiania, ii. p. 56 (48), pls. 19, 20. 1877.

Professor Sars' *Chiomysis microps*, described from females only, is unquestionably congeneric and specifically very closely allied to my species mentioned below. As pointed out both by Professor Sars and myself, the most conspicuous characteristic of the genus is in the structure of the endognath of the second pair of gnathopods (third maxillipeds, or, according to Sars, first legs), which are very unlike the pereopods, being longer, very much stouter, with the terminal, or "tarsal," portion composed of the three normal segments, of which the proximal (carpus) is about as large as the preceding segment (merus), the two distal segments very short, the propodus being as broad as long and the dactylus forming a terminal claw; while the five pairs of pereopods are as in the genus *Mysis*. The male affords additional generic characters, in having all the pleopods like those of the female (in which they are as in *Mysis*), and in having no prominently projecting sexual appendage upon the peduncles of the antennulæ, but in its place only a slightly raised and nearly transverse elevation, densely clothed with hairs.

Heteromysis formosa Smith, loc. cit.

New Haven!, Connecticut. Tide-pool at Thimble Islands!, near New Haven (A. E. Verrill, 1874). Gardener's! and Peconic! Bays, 1874. Vineyard Sound! and Buzzard's Bay!, surface to 10 fathoms in depth, 1871, 1875. "Among weeds, Haste Island," Salem!, Massachusetts (J. H. Emerton, 1878).

Although very closely allied to the Mediterranean species, the *H. formosa* is readily distinguishable by the following characters. The stout carpal segment in the second pair of gnathopods, in the female, is armed along the distal half of the inner margin with six to eight slender spines in place of the four in *H. microps*, and there are in addition twelve to fifteen setæ longer than the spines and extending nearly the whole length of the margin. In the male, however, this segment is a little more slender and has fewer spines and setæ than in the female. The short propodal segment, as seen in a side view, is nearly square, its distal margin being parallel with the proximal and having no angular prominence on the inner side as in *H. microps*. The inner lamellæ of the propods are nearly as long as the outer,

taper distally more than in *H. microps*, and the inner margin in each is armed with a series of twelve to eighteen slender spines, extending almost to the tip, in addition to the long setæ, while in *H. microps* there is only a single spine near the base. The telson differs from that of *H. microps* in having the lateral margins incurved at the tips and each armed with eleven to sixteen spines, of which nearly all are on the distal half of the margin and all placed at nearly equal distances from each other, none of the proximal ones being scattered from the series as in *H. microps*; the terminal spine each side has no small spine at its base but stands entirely alone; the sinns of the terminal margin is broad and broadly rounded at the proximal end, its lateral margins are nearly straight instead of convex in outline, and there are only fourteen to twenty spines on the entire margin.

All the specimens I have examined have been taken in August and September and a large proportion of the individuals are females carrying eggs or young. The species was never found in abundance except hidden away inside dead bivalve shells, usually *Mactras*, dredged in 5 to 10 fathoms. As many as twenty were sometimes found in a single shell. The males and young were occasionally taken at the surface in the evening in Vineyard Sound.

Mysis mixta Liljeborg.

Mysis mixta Liljeborg, Hafs-Crustaceer vid Kullaberg, (Efvorsigt af Kongl. Vetenskaps-Akad. Förhandlingar, Stockholm, 1852, pp. 3, 6.—Goës, Crustacea decapoda Sueciae, Efvorsigt af Vet. Akad. Förhand., 1863, 175 (15).—G. O. Sars, Undersøgelse over Christianiafjordens Dybvandsfauna, 35, 1869 (extr. Nyt Magazin Naturvidenskaberne); Archiv for Matematik og Naturvidenskab, Kristiania, ii, p. 344, 1877.

?*Mysis latitans* Krøyer, Et Bidrag til Kundskab om Krebsdyrfamilien Mysidæ, Naturhistorisk Tidsskrift, III, i, p. 30, pl. i, fig. 4, 1861.

Massachusetts Bay!, off Salem, 1877: 20 fathoms, gravel, August 6,—more than 200 specimens: abundant, also in August, in 22 fathoms, gravel; 33 fathoms, sand and mud; 33 fathoms, soft mud; and 35 fathoms, mud and clay nodules: common in 48 fathoms, mud, August 13. Gulf of Maine!, off Cape Ann, 1877: common at 90 fathoms, mud, August 14, and at 50 fathoms, mud, gravel and rocks, October 17. Off Cape Ann!, 54 fathoms, gravel and stones, 1873. Also abundant, in 30 to 50 fathoms, muddy and gravelly bottoms, at various localities off Cape Ann!, 1878. Casco Bay!, August, 1873: six miles southeast from Seguin Island, 35 fathoms, mud; about seventeen miles off Cape Elizabeth, 64 fathoms, mud; and about

twenty miles off, 68 fathoms, mud. Bay of Fundy, 1864,—one specimen. ? Greenland (Krøyer,—*M. latitans*). Iceland (G. O. Sars). Finmark (Goës), Lofoten Islands! and Christiania Fiord (G. O. Sars). Baltic (Liljeborg, et al.).

All the American specimens examined were taken between August 4 and October 17; most of them are young, between 12 and 20^{mm} long, a few, however, are females, from 20 to 25^{mm} long, with nearly fully developed ovigerous lamellæ, but none of them carrying eggs. This seems to show that the breeding season is during the winter, and it apparently indicates that the species is an annual like *M. mixta*.

Mysis stenolepis Smith.

? *Mysis spinulosus* Gould, Report on the Invertebrata of Massachusetts, 1st edit., p. 333, 1841 (not of Leach).

Mysis stenolepis Smith, Report on the Invertebrate Animals of Vineyard Sound, Report, U. S. Commissioner of Fish and Fisheries, part i, p. 551 (257), pl. 3, fig. 12, 1874.

New Haven!, Connecticut, among eel-grass. Noank!, Connecticut, among eel-grass, etc., 1874. Vineyard Sound! and Buzzard's Bay!, among eel-grass, and also dredged in a few fathoms among algæ, 1871, 1875. Gloucester!, Massachusetts, 7 to 10 fathoms, sand and red algæ, 1878. Casco Bay!, 1873: Portland Harbor, among eel-grass; Quohog Bay, among eel-grass; between Overset Island and Peak's Island, 18 fathoms, rocks and sponges; and off Ram Island, 18 fathoms, mud. Halifax!, Nova Scotia, 1877: Onter Harbor, 16 to 21 fathoms, fine sand, stones, and red algæ; also, 18 fathoms, mud and fine sand.

This species, although very closely allied to *M. mixta* is certainly distinct. The antennal scales in *stenolepis* are much longer and proportionally narrower toward the base than in the allied species (in the full-grown female the greatest breadth being contained in the length about twelve times in *stenolepis*, and scarcely nine times in *mixta*), and nearly the whole outer margin of the scale is concave in outline in *stenolepis*, while in *mixta* it is nearly straight, or even slightly convex toward the base, where the concavity is usually greatest in *stenolepis*. The two distal segments of the antennular peduncle are nearly equal in length in *stenolepis*, the penultimate being only very slightly the longer; while in *mixta* the penultimate is fully a third longer than the ultimate and absolutely longer than in *stenolepis* (the length of the penultimate segment being contained in the

length of the antennal scale little over six times in *mixta*, but about ten times in *stenolepis*.

The sinus of the posterior margin of the telson is much broader and deeper in *mixta* than in *stenolepis*, but the edges of the sinus are armed with fully as many spines in *stenolepis*, so that they are much more closely crowded. The spines of the lateral margins of the telson are fewer and rather larger in *stenolepis* (there are usually twenty-four or twenty-five spines each side in the adult *stenolepis*, and over thirty in *mixta*) and do not extend to so near the tip, the most posterior spines in *stenolepis* arising very little if at all back of the bottom of the sinus of the posterior margin, while in *mixta* there are at least three or four spines arising back of the bottom of the sinus. A part of this last difference is due to the greater depth of the sinus in *mixta*, but the terminal portion of the margin back of the spines is absolutely fully twice as long in *stenolepis* as in *mixta*.

The coloration, even in ordinary alcoholic specimens, affords the readiest means for distinguishing the two species, however. In *mixta* there is a small arborescent spot of black pigment upon the upper side of the last cephalothoracic segment, upon each of the segments of the abdomen except the sixth, one each side at the base of the telson, and beneath upon the ovigerous lamellæ and upon each of the first five segments of the abdomen; there are similar but much smaller spots upon the bases of the antennulæ and antennæ and usually two minute ones on the distal half of the antennal scales; but with the exception of these pigment spots and the eyes, the entire animal is opaque white, turning to grayish white in alcohol. In specimens which have been preserved in alcohol for a very long time, the pigment spots often become obscure or wholly obliterated. In *stenolepis*, on the other hand, the peduncles and inner flagella of the antennulæ, the scales of the antennæ, the dorsal sides of the eye-peduncles, the dorsal surface of the whole abdomen, the telson, and both lamellæ of the uropods are covered with widely and thickly branching ramifications of numerous large pigment spots. The color is particularly conspicuous upon the peduncles and inner flagella of the antennulæ and upon the antennal scales, all which parts of the animal appear very dark or often almost black. There is considerable variation in the amount of pigment in different individuals, but in all the specimens examined it is invariably present upon all the parts above mentioned, and is still very conspicuous in specimens which have been preserved in alcohol for many years.

This difference in the coloration of the two species is undoubtedly

a result of the difference in their habitats, the *stenolepis* being confined to shallow water where the bottom is overgrown with eel-grass or algæ, abounding particularly among eel-grass during the summer and autumn; while the *miata* is apparently confined to deeper, and, at least in summer, very much colder, water, ranging from twenty to a hundred or more fathoms, where there is no eel-grass and seldom, if ever, algæ.

The *stenolepis* is an annual species; the young appear in early summer, come to maturity early in the winter, produce young from mid-winter to spring, and all the mature individuals disappear before the second summer, the males disappearing long before the females. The following tabulation of the results of an examination of several collections made at different seasons of the year, illustrates this fact.

Locality.	Date.	No. of specimens, age and sex.	Length in mm.	Remarks.
Vineyard Sd..	July 4	10 +; young.	10 to 15	Among eel-grass.
Casco Bay,	14	50 + "	10 to 18	" "
"	16	100 + "	12 to 18	" "
"	Aug. 19	200 + "	15 to 18	" "
Halifax,	25	2 "	14	16 fathoms, algæ.
Casco Bay,	27	20 + "	15 to 20	18 fathoms, rocks and sponges.
Vineyard Sd.,	Sept. 2	3 "	17	Taken at surface.
Halifax.	6	9 "	14 to 16	16 fathoms, sand and algæ.
"	15	8 "	14 to 16	18 fathoms, mud and sand.
Vineyard Sd.,	Dec. 13	80; females.	25 to 30	Ovigerous sacs well developed and many filled with eggs.
"		16; males.	21 to 24	
"	Jan. —	100 +; females.	24 to 28	Ovigerous sacs well developed and nearly all filled with eggs.
"		1; male.	21.5	
"	April 3	50 +; all females.	25 to 29	All with fully developed young or empty ovigerous sacs.
"	24	100 +; "	25 to 30	Mostly with empty ovigerous sacs.
"	May 12	100 +; "	25 to 29	All, or very nearly all, with empty ovigerous sacs.

Mysis oculata Krøyer ex O. Fabricius.

Mysis spinulosus Packard. Canadian Naturalist and Geologist, vol. viii, p. 419, 1863.

Mysis oculata Packard. Memoirs Boston Society Nat. Hist., vol. i, p. 301, 1867.

Labrador!, "abundant along the whole coast" (Packard). Grinnell Land, as far north as latitude 79° 29' (Miers). Greenland (Krøyer, Stimpson, et al.). Iceland (G. O. Sars). Buchholz and Miers each include Spitzbergen among the habitats of this species. The very closely allied form, *M. relicta* Lovén, by Professor G. O. Sars regarded as only a variety *M. oculata*, occurs in the Gulf of Bothnia (G. O. Sars), in the fresh-water lakes of southern Scandinavia! (Lovén, G. O. Sars), and in Lakes Michigan! and Superior!

Stimpson (Marine Invertebrata of Grand Manan, p. 58), reports this species (with an?) as "very abundant in the waters at the mouth of the Bay of Fundy, swimming near the surface in swarms." I have never seen specimens from the Bay of Fundy, and, during several seasons spent there, I have never observed any species of *Mysis* swimming at the surface, as described by Stimpson. *Thysanopoda Norvegica* and *inermis*, however, were found in vast numbers in precisely the same way as the *Mysis* is said by Stimpson to occur, and it is possible that Stimpson, without making a special examination, mistook the vast swarms of *Thysanopoda* for *Mysis oculata*.

Mysis Americana Smith.

Mysis Americana Smith, Report on the Invertebrate Animals of Vineyard Sound. Report U. S. Commissioner of Fish and Fisheries, part i, p. 552 (258), 1874.

Great Egg Harbor!, New Jersey, 1871,—in pools on salt-marshes, and in great abundance in the stomachs of the ocellated flounder (*Chenopsetta ocellaris*), the spotted flounder (*Lophosetta maculata*), and the shad. Stomach of shad!, Great South Bay, Long-Island, May 21, 1875. New Haven!, Connecticut,—abundant among seaweed, etc., May, 1873 (A. E. Verrill and D. C. Eaton); and in great abundance among hydroids, etc., under wharves, May, 1875 (S. F. Clark); also dredged in 4 to 5 fathoms. Vineyard Sound!, young occasionally taken at the surface in summer, 1871, 1875; also in the dredge from 25 fathoms, but probably taken on the way up; and common in the stomachs of shad, mackerel, and sea-herring. Portland Harbor!, Casco Bay, taken at the surface and dredged in 3 fathoms, mud, 1873.

This species breeds during the spring and summer, and very likely during the larger part of the year, since the young and old are often found together in spring and summer. The males are nearly or quite as large as the females. Females carrying eggs or young vary, in a large lot from New Haven, from 10 to 14^{mm} in length, and many of the males in the same lot are of the latter length. One egg-carrying female from Casco Bay is only 9.5^{mm} long.

The *Americana* is closely allied to *M. vulgaris* of Europe, but is very readily distinguished by the telson, the lateral margins of which are armed with spines of nearly uniform size in *vulgaris*, while in *Americana* they are armed with stout spines alternating with intervals of several smaller ones. There are numerous other, but less conspicuous differences.

CUMACEA.

The following account of the Cumacea is even more imperfect than the enumeration of the species of the groups treated above. No reference is made to a few small species, which are represented in the collections examined by young or imperfect specimens only. Several of the species were first very kindly determined for me several years ago by Professor G. O. Sars.

Diastylis Rathkii Bate.

Cuma Rathkii Krøyer, Naturhistorisk Tidsskrift, iii, pp. 513, 531, pls. 5, 6, figs. 17-30, 1841 (♀); *ibid.*, II, ii, pp. 145, 207, pl. 1, figs. 4 and 6, 1846: in Gaimard, Voyages en Scandinavie, en Laponie, etc., pl. 5, fig. 1, 1849.—Liljeborg, Æfversigt Kongl. Vetenskaps-Akad. Förhandlingar, Stockholm, 1852, p. 6.—Möbius, Die wirbellosen Thiere der Ostsee, Exped. 1871 auf Pommerania, p. 122, 1873.

Cuma angulata Krøyer, Naturhistorisk Tidsskrift, II, ii, pp. 156, 206, pl. 2, fig. 1, 1846; in Gaimard, *op. cit.*, pl. 5, fig. 2, 1849 (♂).

Diastylis Rathkii Bate, Annals and Magazine Nat. Hist., II, xvii, p. 451 (3), pl. 13, figs. 1-21, 1856.—G. O. Sars, Christiania Videnskabs-Selskabs Forhandlingar, 1864, p. 160; Om Cumaceer fra de store dybder i Nordishafvet, Kongl. Svenska Vetenskaps-Akad. Handlingar, Stockholm, xi, no. 6, p. 7, pl. 3, figs. 8-9, 1873; Archiv for Mathematik og Naturvidenskab, Kristiania, ii, p. 345, 1875.—Metzger, Jahresbericht der Comm. zur wissensch. Untersuchung der deutschen Meere für 1872, 1873, Nordsee, p. 286, 1875.

Alauna Goodsiri Packard, Memoirs Boston Soc. Nat. Hist., i, p. 301, 1867. (Not of Bell, in Belcher, Last of the Arctic Voyages in search of Sir John Franklin, ii, p. 403, pl. 34, fig. 2, 1855; though it is very probably the species mentioned by Bell as perhaps a form of his species and partially figured on the same plate, figure 3, with which figure Packard identified his specimens.)

Off Halifax!, Nova Scotia, 1877: 42 fathoms, fine sand,—five males, six females; 52 fathoms, fine sandy mud,—one male, seven females; 57 fathoms, gravel and stones,—one specimen. Also just off Chebucto Head!, Halifax, 1872, 20 fathoms, soft mud and fine sand,—young only. Gulf of St. Lawrence!, 1871, 1872, 1873 (Whitceaves). Labrador! (Packard). Greenland (Krøyer, Norman). North latitude 81°, east longitude 1°, 450 fathoms (G. O. Sars). British Isles! (Norman). Norway! (G. O. Sars). Baltic! (Möbius).

In 1873 I sent some of the specimens collected on the coast of Labrador by Prof. Packard, to Prof. G. O. Sars and he wrote me that they belonged to a new species, but I am unable to find any constant differences which will distinguish the specimens which still remain from Prof. Packard's collection from European specimens of *D. Rathkii*. Most of the specimens from Labrador have the sides of

the anterior part of the carapax a little smoother than usual in the species, but the difference is very slight and apparently not constant, and it may be due to the bad state of preservation of the specimens. The specimens from off Halifax, and most of those from the Gulf of St. Lawrence, agree perfectly with the European specimens which I have examined.

Diastylis politus, sp. nov.

Adult female.—The cephalothorax is elongated and, including the lateral spiniform processes of the last segment, nearly half as long as the length from the tip of the rostrum to the tip of the telson, pretty regularly oval in outline as seen from above, and regularly and strongly convex dorsally as seen from the side. The carapax is rather more than half as long as the whole cephalothorax, about three-fourths as broad as long, and very much longer than high. The posterior edge is regularly arcuate and has an elevated margin which extends round the broadly sinuous inferior edge to an angular prominence below the base of the rostrum as in *D. sculptus*, and the anterior portion of the inferior edge is minutely dentate as in that species. The rostrum is short, nearly horizontal, and rather obtuse as seen from above.

The surface of the carapax is naked and nearly smooth, except that the anterior portion is areolated somewhat after the manner of *D. sculptus*, but the areolations are fewer and less deeply excavated, and they do not extend to the postero-lateral portions of the carapax as in that species. As seen from above, there are two minutely dentate transverse crests, as in *D. sculptus*, upon the semi-circular median lobe, and the posterior of these extends across the lobe and connects with a perpendicular crest which extends in a nearly straight line to the lateral margin just back of the angular prominence below the base of the rostrum. In front of this vertical crest each side there is a short and prominent crest, slightly curved and nearly parallel with the inferior margin, but which does not reach the inferior margin of the rostrum and fades out posteriorly before it reaches the vertical crest. Just back of the first vertical crest, is a second which curves sharply forward and connects with the first below, but which is straight and slightly diverges from the first above. At the suture round the median lobe this second crest is connected with the first by a short ridge, so as to leave a nearly square area, as in *D. sculptus*, each side of the median line, as seen from above, and just back of the posterior transverse crest of the median lobe. Just back of the upper

part of this second vertical crest, there is each side a similar but less conspicuous crest parallel with the second, but extending only a short distance from the median line. The whole postero-lateral region of the carapax is unsculptured and nearly smooth.

Of the five free segments of the cephalothorax, the first and second are nearly as in *D. sculptus*, except that the lateral expansion of the second segment, just above the attachment of the leg each side, projects more abruptly and further anteriorly, so as to overlap the first segment and nearly reach the margin of the carapax. The third and fourth segments together are a little broader than the first and second, but the third is only about half as wide as the fourth and is closely consolidated with it above. The lateral portions of these segments are very much as in *D. sculpta*, except that the third segment projects slightly forward, as well as backward, above the base of the leg each side. The fifth segment projects back each side and terminates in a slender spiniform process over the base of each leg as in *D. Rathkii*. The three last segments in fact resemble the corresponding parts of *D. Rathkii* much more nearly than those of *D. sculptus*.

The antennæ and the three pairs of maxillipeds are almost exactly as in *D. sculptus*. The first cephalothoracic legs are a little shorter than in that species, the distal end of the propodus only just about reaching to the tip of rostrum, but the relative lengths of the segments themselves are about the same. The second legs are of about the same length relatively as in *D. sculptus*, but the proportions of the segments are different, the carpus being conspicuously long and slender. The stout curved basis is about as long as the merus and carpus combined, and is margined below with ciliated setæ. The carpus is very slender, longer than the combined lengths of the merus, propodus and dactylus, and naked except a few short hairs on the outer side and a group of slender setæ at the distal extremity. The propodus and dactylus are correspondingly slender, the dactylus slightly the longer, and the combined length of the two segments is only slightly more than half the length of the carpus. The third, fourth and fifth legs are nearly as in *D. sculptus*, but the carpal segments are only about three-fourths as long as the meral.

The abdomen, to the tip of the telson, is only slightly longer than the cephalothorax, and all the segments, except the telson, have very nearly the same form and proportions as in *D. sculptus*. The telson is about as long as the fifth segment, broad at the base and abruptly narrowed to a slender terminal portion scarcely longer than the stout basal part, and the slender portion is armed with only six to nine

pairs of spines. The basal portions of the uropods are about a fourth longer than the telson, slender, and each armed along the distal three-fourths of the inner side with a series of ten to twelve small spines which become more scattered proximally and never extend to the base. The inner ramus is about two-thirds as long as the base, composed of two segments, slender, tapers to a long and slender spiniform tip, and is armed along the inner edge with eight to ten spines, of which four are usually upon the basal segment, and one, or sometimes two, upon the outer edge. The outer ramus is somewhat longer than the inner, slender, tipped with two long setiform spines, and armed upon the outer edge with six to ten very slender spines, but with only a single spine upon the inner margin near the tip.

The *adult male* differs from the female in being more slender, in having the cephalothorax much more compressed vertically, and, as usual in the genus, in the structure of the antennæ, the anterior abdominal appendages, etc. The carapax is much more depressed than in the female, the height being less than half the length, and much broader and more obtuse anteriorly as seen from above. The surface is more conspicuously punctated than in the female, but the anterior portion is areolated in the same manner, except that there is in addition a prominent longitudinal carina-like crest each side, extending in a straight line from the inferior margin just in front of the postero-lateral angle to the sharp curve at the lower end of the second vertical crest. The margin of the carapax below this is incurved much more abruptly than in the female, so that the sides of the carapax are angulated each side at the widest part,—almost exactly as in the male of *D. Rathkii*. The telson is much longer than in the female, has the usual sharp dorsal angle between the basal and terminal portion, and is armed with eight to ten pairs of slender spines which are longer than in the female. The bases of the uropods are armed with ten to sixteen spines, and the inner edge of the inner ramus with twenty-four to thirty spines, of which ten to twelve are on the basal segment.

This is a much larger species than *D. sculptus*, the length of the adult female, from tip of rostrum to extremity of telson, being about 12^{mm}; of adult male, about 14^{mm}.

In life the males, at least, are semi-translucent, whitish, with the ophthalmic lobe pink.

Vineyard Sound!, July 20, 1875,—one young male taken at the surface. Adult males were taken at the surface at the same locality, by Mr. Vinal N. Edwards, December 8, 1875, March 22, 1876, April,

1877; adult males and a female carrying eggs, May 2, 1878; and a young specimen January 20, 1876. Gloucester!, Massachusetts, 7 to 10 fathoms, sand and red algæ, August, 1878,—the young abundant, the adult females, carrying eggs and young, common, but the adult males rather rare. Casco Bay!, August, 1873: 9 fathoms, sand and mud,—one male and four egg-bearing females; also at other depths; and the young taken at the surface, in the evening. Trenton Bay!, coast of Maine (A. E. Verrill). Halifax!, Nova Scotia, 18 to 20 fathoms, fine sand, stones and red algæ, 1877. Also one hundred and twenty miles south of Halifax!, 190 fathoms, gravel and pebbles, 1877,—two egg-bearing females. Northumberland Straits, Gulf of St. Lawrence!, 1873 (J. F. Whiteaves).

Diastylis sculptus G. O. Sars.

Diastylis sculpta G. O. Sars, Æfversigt af Kongl. Vetenskaps-Akad. Förhandlingar, Stockholm, 1871, p. 71; Kongl. Svenska Vetenskaps-Akad. Handlingar, ix, no. 13, p. 24, pls. 1 to 9, figs. 1-49, 1871.—Smith, Invertebrate Animals of Vineyard Sound, Report U. S. Commissioner Fish and Fisheries, part i, p. 554 (260) 1874; Transactions Connecticut Acad., iii, p. 29, 1874.

Off Shinnecock Bay, Long Island, 18 fathoms (Josephine Expedition, G. O. Sars). Block Island Sound!, 17 fathoms, sand; and off Watch Hill!, Rhode Island, 18 fathoms, 1874. I have no record of the dredging of this species in Vineyard Sound, but it was not uncommon in collections made at the surface, during July, August and September, 1871 and 1875. Most of these specimens are females or young and were taken both during the day-time and evening; adult males occurred rarely, however. A single adult specimen of the male was also collected at the surface, at the same locality, in April, 1877, by Vinal N. Edwards. Gloucester Harbor!, Massachusetts, 7 to 10 fathoms, sand and red algæ, 1878. Also off Gloucester! and off Cape Ann!, 1878: 26 fathoms, sand, gravel and stones; 35 fathoms, sand; 33 fathoms, sand and gravel. Casco Bay!, 1873; at the surface in the evening; among Laminaria; 9 fathoms, sand and mud; 17 fathoms, mud; 27 to 34 fathoms, hard bottom. Bay of Fundy!: found at low-water mark!, in sandy mud, 1868; at the surface, at low-water mark, and in 4 fathoms, very soft mud, 1872; also in 60 fathoms, mud, off Head Harbor, 1872. Near Halifax!, Nova Scotia, in company with *D. Rathkii* and *D. quadrispinosus*, 20 fathoms, soft mud and fine sand, 1872. Halifax Harbor!, 16, 18 and 21 fathoms, fine sand, stones and red algæ, 1877. About one hundred and twenty miles south of Halifax!, 190 fathoms, gravel and pebbles,

1877,—ten large females, all carrying eggs. Northumberland Straits, Gulf of St. Lawrence!, 10 fathoms, sand (J. F. Whiteaves).

Diastylis luciferus Danielssen.

Cuma lucifera Krøyer, Naturhistorisk Tidsskrift, iii. pp. 527, 531. pl. 6, figs. 34–35. 1841: *ibid.*, II, ii, p. 171, 207, 1846; in Gaimard, Voyages en Scandinavie, en Laponie, etc., pl. 3, fig. 3, 1849.—Liljeborg, Æfversigt Kongl. Vetenskaps-Akad. Förhandlingar, Stockholm, 1855, p. 119.

“*Diastylis lucifera* Danielssen. Beretning om en zoologisk Reise i Sommeren 1858 i Thronhjemske Vidensk. Selsk. Skrifter, iv, p. 108” (G. O. Sars).—G. O. Sars, Christiania Videnskabs-Selskabs Forhandlingar, 1864, p. 161; Undersøgelser over Christianiafjordens Dyblandsfauna (extr. Nyt Magazin for Naturvidenskaberne), p. 38, 1869; Christiania Videnskabs-Selskabs Forhandlingar, 1871, p. 269 (26); Beskrivelse af de paa Fregatten Josephines Expedition fundne Cumaceer, Kongl. Svenska Vetenskaps-Akad. Handlingar, Stockholm, ix, no. 13, p. 5, 1871.—Metzger, Jahresbericht der Comm. zur wissensch. Untersuchung der deutschen Meere für 1872, 1873. Nordsee, p. 286, 1875.

? *Diastylis borealis* Bate, Annals and Magazin Nat. Hist., II, xv, p. 85, pl. 1, fig. 3, 1865 (Port Kennedy, north latitude 72°, west longitude 94°).

Bay of Fundy!, 60 and 77 fathoms, mud, off Head Harbor, August 16, 1872. About ten miles north of Shediac, Gulf of St. Lawrence! (J. F. Whiteaves). Scandinavia! (G. O. Sars, et al.)

Diastylis quadrispinosus G. O. Sars.

Diastylis quadrispinosa G. O. Sars, Æfversigt af Kongl. Vetenskaps-Akad. Förhandlingar, Stockholm, 1871, p. 72; Beskrivelse af de paa Fregatten Josephines Expedition fundne Cumaceer, Kongl. Svenska Vetenskaps-Akad. Handlingar, ix, no. 13, p. 28, pls. 10, 11, figs. 51–61, 1871.—Smith, Invertebrate Animals of Vineyard Sound, Report U. S. Commissioner of Fish and Fisheries, part i, p. 554 (260), pl. 3, fig. 13, 1874; Transactions Connecticut Acad., iii, p. 28, 1874.

Cuma bispinosa Stimpson, Invertebrata of Grand Manan, p. 30, 1853 (description insufficient. Not the European *Diastylis bispinosa* G. O. Sars (*D. bicornis* Bate)).

Off the coast of New Jersey, north latitude 39° 54', west longitude 73° 15', 30 to 35 fathoms, and off Shinnecock Bay, Long Island, 18 fathoms (Josephine Expedition, G. O. Sars). Block Island Sound!, 17 fathoms, sand and mud, 1874. Off Watch Hill!, Rhode Island, 18 fathoms, 1874. Off Buzzard's Bay! 29 fathoms, fine sandy mud, common, 1871. Off Martha's Vineyard!, 23 fathoms, 1871. Southwest Ledge!, off Martha's Vineyard, 18 fathoms, 1875. Vineyard Sound, off Tarpaulin Cove!, 10 to 12 fathoms, 1875: Massachusetts Bay!, off Salem, 20 fathoms, gravel and stones, 1877. Off Cape Ann!, Massachusetts, 1878: 26 to 33 fathoms, sand, gravel and stones; 35

fathoms, sand, very abundant. Between Cape Ann and the Isles of Shoals!, 43 to 68 fathoms, mud, 1874. Jeffrey's Ledge!, Gulf of Maine, 51 fathoms, hard sandy mud, 1874. Cosco Bay!, 1873: 16 and 17 fathoms, mud, abundant; 27 fathoms, off Halfway Rock; 45 fathoms, off Seguin Island; also taken with numerous Amphipoda, in 2 fathoms, muddy bottom, in a small trap baited with pieces of fish. Bay of Fundy!, 1868, 1870, 1872. In 1872 it was also dredged in vast numbers at Eel Cove, Grand Menan, in 8 to 10 fathoms, sand, by Prof. H. E. Webster. Off Cape Sable!, Nova Scotia, 75 fathoms, fine sand and mud, 1877. In and near Halifax Harbor!, Nova Scotia, 1872, 1877: 20 fathoms, soft mud and sand; 16 and 18 fathoms, fine sand and red algæ; 21 fathoms, sand, stones and algæ; 42 fathoms, fine sand; 52 fathoms, fine sandy mud. Also about one hundred and twenty miles south of Halifax!, 190 fathoms, gravel and pebbles, 1877. Northumberland Straits, Gulf of St. Lawrence!, 1873 (Whiteaves).

Upon the coast of northern New England, this is by far the most abundant species of the genus. It is undoubtedly the species which Stimpson called *Cuma bispinosa*, but his description is wholly insufficient to characterize the species and I therefore prefer to retain the more appropriate name proposed by G. O. Sars, who has described and figured the species most admirably. Professor Sars has identified specimens which I have sent to him from different localities on the New England coast.

Diastylis bicornis Bate, is a very different species, of which I have examined European specimens, but which I have never seen upon the American coast.

Diastylis abbreviatus G. O. Sars.

Diastylis abbreviata G. O. Sars, Æfversight Kongl. Vetenskaps-Akad. Förhandlingar, Stockholm, 1871, p. 74; Kongl. Svenska Vetenskaps-Akad. Handlingar, ix, no. 13, p. 30, pl. 12, figs. 62-64, 1871.

Very rare in 30 to 35 fathoms, off the coast of New Jersey, north latitude $39^{\circ} 54'$, west longitude $73^{\circ} 15'$ (Josephine Expedition, Sars). Off Cape Ann!, 35 fathoms, sand, 1878,—one specimen among great numbers of *D. quadrispinosus*. Casco Bay!, 1873: 17 fathoms, mud; also at one other station.

This very pretty species appears to be rare.

Leptostylis longimanus G. O. Sars.

Diastylis longimana G. O. Sars, Christiania Videnskabs-Selskabs Forhandling, 1864, p. 173: Reise ved Kysterne af Christianias og Christiansands Stifter, 1865, p. 23, 1866 (extr. Nyt Magazin for Naturvidenskaberne).

Leptostylis longimanu G. O. Sars, Christianiafjordens Dybvandsfauna, p. 39, 1869 (extr. Nyt Mag. Nat.).

A single female, apparently of this species, was dredged in Casco Bay!, in 1873. It seems to have been known previously only from the coast of Norway (G. O. Sars).

Leptostylis ampullaceus G. O. Sars.

Cuma ampullacea Liljeborg, (Efversight Kongl. Vetenskaps-Akad. Förhandlingar, Stockholm, 1855, p. 120.

Diastylis ampullacea G. O. Sars, Christiania Videnskabs-Selskabs Forhandling, 1864, p. 175: Reise ved Kysterne af Christianias og Christiansands Stifter, 1865, p. 24, 1866 (extr. Nyt Magazin for Naturvidenskaberne).

Leptostylis ampullacea G. O. Sars, Christianiafjordens Dybvandsfauna, p. 40, 1869 (extr. Nyt Mag. Nat.): Archiv for Mathematik og Naturvidenskab, Kristiania, ii, p. 345, 1877.

Gulf of Maine, near Cashe's Ledge!, 52 to 90 fathoms, 1873,—a single specimen.

Leucon nasicus Kröyer.

Cuma nasica Kröyer, Naturhistorisk Tidsskrift, iii, pp. 524, 532, pl. 6, figs. 31–33, 1841.

Leucon nasica Kröyer, Naturhistorisk Tidsskrift, II, ii, pp. 189, 209, pl. 2, fig. 5a–b, 1846; in Gaimard, Voyages en Scandinavie, en Laponie, etc., pl. 3, fig. 2, 1849.—Liljeborg, (Efversight Kongl. Vetenskaps-Akad. Förhandlingar, Stockholm, 1855, p. 121.—G. O. Sars, Christiania Videnskabs-Selskabs Forhandling, 1864, p. 178 (*nasicus*); Reise ved Kysterne af Christianias og Christiansands Stifter, 1865, p. 24, 1866 (extr. Nyt Magazin for Naturvidenskaberne); Christianiafjordens Dybvandsfauna, p. 41, 1869 (extr. Nyt Magazin for Nat.); Christiania Videnskabs-Selskabs Forhandling, 1871, p. 27 (270).—Whiteaves, Report on further deep-sea dredging operations in the Gulf of St. Lawrence [in 1873] p. 16, [1874?].—Metzger, Jahresbericht der Comm. zur wissenschaft. Untersuchung der deutschen Meere für 1872, 1873, Nordsee, p. 286, 1875.—Norman, Annals and Magazine Nat. Hist., V, iii, p. 70, 1879 (*nasicus*).

Gulf of St. Lawrence!, 50 and 70 fathoms, 1873 (J. F. Whiteaves). Greenland (Kröyer). Scandinavian coast! (G. O. Sars, Liljeborg). North Sea, coast of Scotland (Metzger). The Minch, west coast of Scotland (Norman).

Leucon nasicoïdis Liljeborg.

Leucon nasicoïdes Liljeborg, Öfversigt Kongl. Vetenskaps-Akad. Förhandlingar, Stockholm, 1855, p. 122.—G. O. Sars, Christianiafjordens Dybvandsfauna, p. 41, 1869 (extr. Nyt Magazin for Naturvidenskaberne); Christiania Videnskabs-Selskabs Forhandlingar, 1871, p. 270 (27).

A single female was dredged at Eastport!, Maine, Bay of Fundy, in 1868. I have also examined one female dredged in the Gulf of St. Lawrence!, by Mr. Whiteaves, in 1873. Scandinavian coast (Liljeborg, G. O. Sars). In life, the specimen from the Bay of Fundy was translucent whitish; the eggs orange.

Eudorella emarginata Norman.

Leucon emarginatus Krøyer, Naturhistorisk Tidsskrift, II, ii, pp. 181, 209, pl. 1, fig. 7, pl. 2, fig. 3, 1846; in Gaimard, Voyages en Scandinavie, en Laponie, etc., pl. 5, fig. 2, 1849.—Liljeborg, Öfversigt Kongl. Vetenskaps-Akad. Förhandlingar, Stockholm, 1852, p. 6.

"*Cyrtanassa ciliata* Norman, Transactions Tyneside Naturalists' Field Club, v. p. 273, pl. 13, figs. 4-9 (δ)" (G. O. Sars); Natural History Transactions of Northumberland and Durham, i, p. 24, 1865.

Eudora emarginata G. O. Sars, Christiania Videnskabs-Selskabs Forhandlingar, 1864, p. 185; Reise ved Kysterne af Christianias og Christiansands Stifter, 1865, p. 24, 1866 (extr. Nyt Magazin for Naturvidenskaberne); Undersøgelser over Christianiafjordens Dybvandsfauna, p. 42, 1869 (extr. Nyt Magazin for Nat.)

Eudorella emarginata Norman, in Report of exploring the Hebrides, part ii, Report British Assoc. Adv. Science, 1866, 197, 1867.—G. O. Sars, Christiania Videnskabs-Selskabs Forhandlingar, 1871, p. 270 (27); Kongl. Vetenskaps-Akad. Handlingar, Stockholm, ix, no. 13, p. 44, pl. 18, fig. 98, 1871; Archiv for Mathematik og Naturvidenskab, Kristiania, ii, p. 345, 1877.—Metzger, Jahresbericht der Comm. zur wissensch. Untersuchung der deutschen Meere für 1872, 1873, Nordsee, p. 287, 1875.

Off Halifax!, Nova Scotia, 52 fathoms, fine sandy mud, 1877,—two specimens, male and female. Entrance of Gaspé Bay, Gulf of St. Lawrence!, 30 fathoms, 1873 (J. F. Whiteaves). Scandinavian coast! (G. O. Sars, Krøyer, et al.). Scotland! (Norman).

Eudorella hispida G. O. Sars.

Eudorella hispida G. O. Sars, Öfversigt Kongl. Vetenskaps-Akad. Förhandlingar, Stockholm, 1871, p. 80; Kongl. Vetenskaps-Akad. Handlingar, ix, no. 13, p. 49, pl. 18, figs. 95-97, 1871.—Smith, Invertebrate Animals of Vineyard Sound, Report U. S. Commissioner Fish and Fisheries, part i, p. 555 (261), 1874.

Rare in 30 to 35 fathoms, off the coast of New Jersey, north lati-

tude 39° 54', west longitude 73° 15' (Josephine Expedition, G. O. Sars). Salem Harbor!, Massachusetts, 5 fathoms, 1873. Off Cape Ann!, 35 fathoms, sand, and 54 fathoms, sand and mud, 1878. Casco Bay!, 1873: 3 fathoms, mud,—both males and females; males also taken at the surface in the evening. Off Casco Bay, about twenty miles east-southeast from Cape Elizabeth, 50 fathoms, mud, 1873. Bay of Fundy!, 1872, abundant in 1 to 4 fathoms, very soft mud,—both males and females.

Eudorella pusilla G. O. Sars.

Eudorella pusilla G. O. Sars, Öfversigt Kongl. Vetenskaps-Akad. Förhandlingar, Stockholm, 1871, p. 79; Kongl. Svenska Vetenskaps-Akad. Handlingar, ix, no. 13, p. 46, pls. 16, 17, figs. 76-94, 1871.—Smith, Invertebrate Animals of Vineyard Sound, Report U. S. Commissioner Fish and Fisheries, part i. p. 554 (260), 1874.

Off Shinnecock Bay, Long Island, 18 fathoms (Josephine Expedition, G. O. Sars). Block Island Sound!, 17 fathoms, sand and mud, 1874, —common, both males and females. Massachusetts Bay!, off Gloucester, 25 fathoms, sand and gravel, 1878. Casco Bay!, 3, 16, 17 fathoms, mud; 9 fathoms, sand and mud, 1873. Bay of Fundy!, 1872, very abundant in 1 to 4 fathoms, very soft mud; also in 10 to 15 fathoms, mud. Gulf of St. Lawrence!, 1873 (Whiteaves).

Eudorella deformis G. O. Sars.

Leucon deformis Kröyer, Naturhistorisk Tidsskrift, II, ii, p. 194, pl. 2, fig. 4, 1846; in Gaimard, Voyages en Scandinavie, en Laponie, etc., pl. 5A, fig. 3, 1849.

Eudorella (?) *deformis* G. O. Sars, Kongl. Svenska Vetenskaps-Akad. Handlingar, ix, no. 13, p. 50, pls. 19, 20, figs. 101 to 118, 1871: Archiv for Mathematisk og Naturvidenskab, Kristiania, ii, p. 345, 1877 (no ?).

Off Shinnecock Bay, Long Island, 18 fathoms (Josephine Expedition, G. O. Sars). Massachusetts Bay!, off Gloucester, 25 fathoms, sand and gravel, 1878. Greenland (Kröyer). Iceland (G. O. Sars). West coast of Norway (G. O. Sars).

Eudorella integra, sp. nov.

An aberrant form, more like *E. deformis* than any other described species of the genus, perhaps generically distinct from the typical species of *Eudorella*.

Female. The cephalothorax is about as long as the abdomen exclusive of the uropods, and regularly and strongly arcuate dorsally.

The carapax, as seen in a side view, is about as long as the first four free segments, nearly three-fourths as high as long, with the dorsal margin approximately parallel with the posterior part of the lateral margins. Both the anterior and posterior portions of the lateral margin are nearly straight, but the anterior portion is directed upward at an angle very oblique to the posterior portion, from which it is separated by a broadly rounded angle. The anterior portion is obscurely denticulate posteriorly but distinctly, though very minutely, toward the slightly prominent anterior angle. The anterior margin is edentate and scarcely at all emarginate; below it is straight and nearly perpendicular, but curved considerably forward above, where the dorsal or inner edges of the lateral lobes are turned abruptly upward at nearly a right angle just in front of the median lobe, to form, as it were, a dorso-frontal rostrum. There is a slight approach to this form of the antero-lateral lobes of the carapax in *E. deformis*, but in that species the dorsal edges of the lobes are prolonged and sharply upturned to form a slender dorsal horn in front of which the edges of the lobes are on a level with, and parallel to, the dorsum back of the horn; while in this new species the whole lateral lobes are prolonged upward and terminate in a slightly incurved edge nearly parallel with the posterior margin of the carapax. The anterior part of the carapax is in fact much as in some of the species of *Leucon*: if the rostrum in *L. nasicoides* were edentate and more strongly upturned, it would represent very nearly the form of this part of the front in the present species.

The major flagellum of the antennula is much shorter than the terminal segment of the peduncle; the minor flagellum falls considerably short of the distal end of the first segment of the major flagellum, but is proportionally larger than in *E. deformis*. The first pereopods are proportionally of about the same length as in *E. deformis*, the carpus reaching to or a little beyond a line with the front, and the segments are relatively of about the same length, but the terminal ones are more slender than in that species. The four posterior pairs of pereopods are distally a little more slender than in *E. deformis*, but do not differ essentially in other respects.

The first five segments of the abdomen increase slightly in length posteriorly and are almost entirely naked, wanting wholly the plumose setae conspicuous beneath the abdomen of *E. deformis*. The sixth segment is about as broad as long, the posterior margin evenly arcuated and armed in the middle with six, or sometimes only four, conspicuous setae. The basal portion of the uropods is stout, scarcely

longer than the sixth segment of the abdomen, and is furnished with a series of long setæ on the inner margin. The inner ramus is much longer than the base; of its two segments the proximal is much the longer and is armed with six to eight stout spines on the inner margin and with three to five much more slender spines on the outer; the distal segment terminates in a very long and stout spiniform tip, at the base of which there is a long seta on the outside, and upon the inner edge about three spines like those upon the proximal segment. The outer ramus is slightly longer than the inner, tapering, and slightly curved outward at the tip, armed along the inner edge and at the tip with a few long setæ, and on the outer edge and above with a few setæ near the middle.

The *adult males* differ from the females as usual in the genus. The carapax is not as high posteriorly, the lateral margin is more nearly straight, not denticulate anteriorly, the anterior angle rounded, and the frontal margin is very nearly straight throughout. The major flagellum of the antennulæ shows distinctly four segments. The uropods are similar to those of the female, but very much more elongated and armed with more numerous and longer spines and setæ, both of which are, as usual, plumose. The setæ which are so conspicuous upon the posterior margin of the terminal segment of the abdomen of the female, appear to be wholly absent in the male.

Length of adult females, about 5^{mm}; males a very little longer.

Off Halifax!, Nova Scotia, 1877: females carrying eggs common, 42 fathoms, fine sand, and 52 fathoms, sandy mud; also two females from 57 fathoms, stones, sponges and red algæ. About thirty miles south of Halifax!, 110 fathoms, fine sandy mud. Gulf of St. Lawrence!, 1873 (J. F. Whiteaves): both males and females, south of the eastern part of Prince Edward Island, and in 70 fathoms, off the Bay of Chaleurs.

Lamprops quadriplicata, sp. nov.

Female. The cephalothorax is as long as the abdomen exclusive of the telson. The carapax is about as long as the first four of the free segments, and, as seen in a side view, very slightly arcuate dorsally, the front truncated above and with a slight sinus in the frontal margin below it, leaving the antero-inferior angle slightly projecting, but obtuse and evenly rounded, and in most of the specimens armed with three or four very minute teeth. On each side of the carapax there are four, very distinct, arcuate and nearly parallel plications, of which the first is short and extends from the antero-inferior angle to

the side of the median lobe of the carapax; the second extends from the inferior margin a little back of the first to the dorsal line at the back of the median lobe; the third and fourth extend from the inferior margin to the dorsal line, the fourth nearly touching the posterior margin above. The minor flagellum of the antennula is only a little longer than the proximal segment of the major flagellum. The carpus in the first pair of pereopods reaches very nearly to a line with the front of the carapax, and the carpus, propodus and dactylus are sub-equal in length. The second pereopods do not quite reach a line with the front, the dactylus and propodus are about equal in length and together about equal to the length of the carpus, which is very slightly longer than the merus. The rudimentary exopods of the third and fourth pereopods have three or four plumose setæ at the tip and several more upon the proximal segment. The basal portion of the uropods is as long as the telson and armed with about ten spines upon the inner margin: the inner ramus is about as long as the basal portion; the first segment is longer than the second and third together and is armed with about sixteen spines on the inner and two or three on the distal part of the outer margin; the second with four or five spines on the inner margin and one at the distal extremity of the outer; the third or terminal with two upon the inner margin and three at the tip: the outer ramus is a little shorter than the inner and its two segments are sub-equal in length. The telson is as long as the fifth segment of the abdomen and about twice as long as the sixth segment, and is armed with either two or three spines upon the distal portion of each lateral margin and at the tip with five spines of about the same size as the marginal ones, though the median is a little larger than the others.

Length 9^{mm}.

Smaller, immature females differ in having the anterior pairs of pereopods proportionally shorter than in the adult, and in having fewer spines on the uropods.

The only male seen is about 8½^{mm} long and not fully mature, although the antennæ are as long as the cephalothorax and the exopods of the third and fourth pairs of pereopods are fully developed, but there is no indication whatever of rudimentary pleopods. From this fact it seems probable that the adult male is wholly without pleopods, and that this species represents a genus distinct from *Lamprops*.

I have seen only the male just referred to, one female with eggs and a few immature females. Gloucester Harbor!, Massachusetts, 7

to 10 fathoms, sand and red algæ, 1878; Casco Bay!, 1873,—a single immature female taken at the surface in the evening.

Campylaspis rubicunda G. O. Sars.

Cuma rubicunda Liljeborg. Æfversigt Kongl. Vetenskaps-Akad. Förhandlingar, Stockholm, 1855, p. 121.

Campylaspis rubicunda G. O. Sars, Christiania Videnskabs-Selskabs Forhandling. 1864, p. 202: Reise ved Kysterne af Christianias og Christiansands Stifter, 1865, p. 24, 1866 (extr. Nyt Magazin for Naturvidenskaberne); Undersøgelser over Christianafjordens Dybrandsfauna, p. 44, 1869 (extr. Nyt Magazin for Nat.); Christiania Videnskabs-Selskabs Forhandling, 1871, p. 272 (29): Om Cumaceer fra de store dybder i Nordishafvet. Kongl. Svenska Vetenskaps-Akad. Handlingar, Stockholm, xi, no. 6, p. 10, pl. 4, figs. 14-16, 1873.—Norman, in Jeffreys, Valorous Cruise, Proceedings Royal Society, London, xxv, p. 209, 1876; Annals and Magazin Nat. Hist., V, iii, p. 73, 1879.

Off Cape Ann!, Massachusetts, 35 fathoms, sand, 1878. Casco Bay!, stomach of the common flounder (*Pseudopleuronectes Americanus*). Greenland (Norman). Coast of Scandinavia (Liljeborg, G. O. Sars).

Pelagic species found near the borders of the Gulf Stream off St. George's Banks.

The following pelagic species, characteristic of the fauna of the Gulf Stream, were taken, in 1872, east of St. George's Banks, north latitude $41^{\circ} 20'$ to $30'$, west longitude 65° to $65^{\circ} 30'$, and should perhaps be mentioned here, though they in no sense belong to the coast fauna north of Cape Cod. Most, if not all, these semi-tropical pelagic species are, however, occasionally found in summer along the south coast of New England, and the coast of the Middle and Southern States.

Nautilograpsus minutus Milne-Edwards.

Cancer minutus Linné, Systema Naturæ, edit. 12. i, p. 1040, 1767.—J. C. Fabricius, Systema Entomologiæ, p. 402, 1775; Entomologia systematica, ii, p. 443, 1793; Supplementum Entom. syst., p. 343, 1798.

Grapsus minutus Latreille. Hist. nat. Crust. et Insectes, vi, p. 68, 1803.

Grapsus cinereus Say, Journal Acad. Nat. Sci. Philadelphia, i, p. 99, 1817 (not *Grapsus cinereus* Bosc, nor *Grapsus (Sesarma) cinereus* Say, loc. cit., p. 442, 1818).

Grapsus pelagicus Say, loc. cit., p. 442, 1818.

Nautilograpsus minutus Milne-Edwards, Hist. nat. Crust., ii, p. 99, 1837; Annales des Sci. nat., Paris, III, xx, p. 174 (140), 1850.—Goodsir, Annals Magazin Nat. Hist., xv, p. 73, pl. 7, fig. 1, 1845.—Gibbes, Proceedings American Assoc. Adv. Sci.

3d meeting, p. 182 (18), 1850.—Stimpson, Proceedings Acad. Nat. Sci. Philadelphia, 1858, p. 103 (49); Annals Lyceum Nat. Hist. New York, vii, p. 231 (103), 1860.—Heller, Crustaceen des südlichen Europa, p. 114, 1863.—Smith and Harger, Transactions Connecticut Acad., iii, p. 26, 1874.

Planes Linnaeana Bell, British Stalk-eyed Crust., p. 135 (cut), 1844.—White, List of Crust. British Museum, p. 41, 1847; Catalogue of British Crust. Brit. Museum, p. 19, 1850.

Planes minutus Dana, United States Exploring Expedition, Crust., p. 346, 1852.

Gulf of Mexico (Gibbes); Bermuda! (G. Brown Goode); and throughout the warmer parts of the North Atlantic and occasionally upon the English coast (White, Bell, et al.). Mediterranean (Heller). Cape St. Lucas (Stimpson). Indian Ocean (Milne-Edwards).

Neptunus Sayi Stimpson.

Portunus pelagicus Bosc, Hist. nat. des Crust., p. 219, pl. 5, fig. 3, 1805.

Lupa pelagica Say, Journal Acad. Nat. Sci. Philadelphia, i, p. 97, 1817.—DeKay, Nat. Hist. New York. Crust., p. 11, pl. 6, fig. 8, 1844.

Lupa Sayi Gibbes, Proceedings American Assoc. Adv. Sci., 3d meeting, p. 178 (14), 1850.—Dana, United States Exploring Expedition, Crust., p. 273, pl. 16, fig. 8, 1852.—Stimpson, Proceedings Acad. Nat. Sci. Philadelphia, 1858, p. 38 (36).

Neptunus Sayi Stimpson, Annals Lyceum Nat. Hist. New York, vii, p. 220 (92), 1860; Bulletin Museum Comp. Zoology, Cambridge, i, p. 147, 1870.—A. Milne-Edwards, Archives du Muséum d'Hist. Nat., x, p. 317, pl. 29, fig. 2, 1861.—Smith and Harger, Transactions Connecticut Acad., iii, p. 26, 1874.—Kingsley, Proceedings Acad. Nat. Sci. Philadelphia, 1878, p. 319 (4), 1878.

Gulf Stream!, from the Straits of Florida (Stimpson) to north latitude 41° 30' (1872) and probably much further, both north and south.

Latreutes ensiferus Stimpson.

Hippolyte ensiferus Milne-Edwards, Hist. nat. des Crust., ii, 374, 1837.—Krauss, Südafrikanischen Crustaceen, p. 56, 1843.—Goodsir, Annals and Magazin Nat. Hist., xv, p. 74, pl. 7, fig. 2, 1845.—Dana, United States Exploring Expedition, Crust., p. 562, 1852.

Latreutes ensiferus Stimpson, Proceedings Acad. Nat. Sci. Philadelphia, 1860, p. 27 (96), 1860.—Smith and Harger, Transactions Connecticut Acad., iii, p. 26, 1874.—Kingsley, Bulletin Essex Institute, Salem, x, p. 56, 1878.

Bermuda! (G. Brown Goode). Various points in the Gulf Stream!. Near the Azores (Milne-Edwards). African coast (Krauss).

Leander tenuicornis Kingsley.

Palaemon tenuicornis Say, Journal Acad. Nat. Sci. Philadelphia, i, p. 249, 1818.—DeKay, Nat. Hist. New York, Crust., p. 30, 1844.—White, List of Crust. British Museum, p. 78, 1847.

Palaemon tenuirostre Milne-Edwards, Hist. nat. des Crust., ii, p. 395, 1837 (evidently a mistake for *tenuicornis*).

Palaemon natator Milne-Edwards, op. cit., ii, p. 393, 1837.

Palaemon natator Goodsir, Annals Magazin Nat. Hist., xv, p. 74, pl. 7, fig. 3, 1845.—White, List of Crust. British Museum, p. 77, 1847.—Dana, United States Exploring Expedition, Crust., p. 588, pl. 38, fig. 11, 1852.—Heller, Crustaceen des südlichen Europa, p. 268, pl. 9, figs. 11, 12, 1863.

Leander erraticus Desmarest, Annales Soc. Entomologique de France, II, vii, p. 92, cut, 1849.

Leander natator Stimpson, Proceedings Acad. Nat. Sci. Philadelphia, 1860, p. 40 (109).

Leander tenuicornis Smith, MSS.—Kingsley, Bulletin Essex Institute, Salem, x, p. 66, 1878.

Off Gaudeloupe (Desmarest). Various parts of the Gulf Stream! Bermuda!, (G. Brown Goode). North latitude $41^{\circ} 25'$, west longitude $66^{\circ} 20'$! (1872). Banks of Newfoundland (Say).

Siriella? sp.

A single immature female, apparently belonging to this genus, was taken east of St. George's Banks, latitude $41^{\circ} 25'$, longitude $65^{\circ} 10'$, by Mr. Harger and myself, September 15, 1872.

Lucifer sp.

Taken at the same time and place as the last species.

On the Geographical Distribution of the foregoing species, and on the Relation of the Fauna of the Atlantic coast of North America north of Cape Cod to that of Greenland and Europe.

In order to exhibit in a connected manner the principal facts in regard to the geographical and bathymetrical distribution of the species properly belonging to the marine fauna of our coast north of Cape Cod, I have prepared the following tabular synopsis.

The headings of a part of the eleven columns, in which the geographical distribution is indicated, do not state fully the region included, so that the following explanations are necessary. Under "South of Cape Cod," all those species are included which are found

anywhere near the south coast of New England or the coast still further south, whether they properly belong to the fauna south of the Cape or are northern species which occur only in exposed situations, in deep water, or in winter; but to distinguish these two classes of species, the northern ones are indicated by an asterisk (*). Under "Massachusetts Bay," two or three rare species taken off Cape Ann, but not as yet actually in the Bay, are included. Under "Nova Scotia," only those species which have been observed on or near the southeast coast are included; the species of the northern, or Gulf-of-St. Lawrence, coast being included in the eighth column, while a few species taken only in deep water (one hundred or more fathoms) far off the Atlantic coast, are included in the seventh column. Under "Gulf of Maine, etc.," are included the species found in the Gulf of Maine proper (the great region of comparatively deep water, but with numerous banks and "ledges," between St. George's Banks and the shallow waters of the coast from Cape Cod to Nova Scotia), and also the species found on St. George's Banks, LeHave Bank, etc., and the deep waters outside of them. Under "Gulf of St. Lawrence and Labrador," are included the species found in the Gulf and on the east, or Atlantic, coast of Labrador, though in the present list all the species known from the east coast of Labrador have been found also in the Gulf. A few species which have been found in the shallow southwestern part, including Northumberland Straits and the Bay of Chaleurs, and not in other parts of the Gulf, are indicated by a dagger (†). Under "Bering Sea," species known from any part of the North Pacific or from the Arctic Ocean immediately north of Bering Straits are included. The number of species common to this region and the North Atlantic will undoubtedly be very largely increased by subsequent investigation.

In checking in the table the occurrence of the species, a mark of affirmation (!) is used, as in the previous pages, when I am myself responsible for the identification of the species; the plus sign (+), when the species has not been seen by me but has been recorded on good authority; and by a mark of interrogation (?), when there is doubt in regard to the identification of the species.

In the bathymetrical distribution, under "Fathoms," the depths within which the species have been found upon our coast only are given.

	S. Cape Cod.	Cape Cod Bay.	Mass. Bay.	Casco Bay.	Bay of Fundy.	Nova Scotia.	G. of Maine, etc.	G. St. Lav. and Lab.	Greenland.	Europe.	Bering Sea.	Fathoms.
<i>Gelasimus pugnax</i>	!	!										Shore.
<i>pugillator</i>	!	!										"
<i>Callinectes hastatus</i>	!		+									0- 2
<i>Platyonichus ocellatus</i>	!	!										0- 10
<i>Carcinus mænas</i>	!	!								!		0- 2
<i>Geryon quinquedens</i>							!					100-160
<i>Panopeus depressus</i>	!	!										0- 5
<i>Sayi</i>	!	!										0- 5
<i>Harrisii</i>	!		!									0-
<i>Cancer irroratus</i>	!	!	!	!	!	!	!	!				0- 50
<i>borealis</i>	!		!	!	+	+						0- 10
<i>Chionœetes opilio</i>							!	!	+		!	88-101
<i>Hyas araneus</i>			!	!	!	!	!	!	!	!	+	16- 60
<i>coarctatus</i>	!*		!	!	!	!	!	!	+	!		0-150
<i>Libinia emarginata</i>	!	!	!	!	!							0- 5
<i>Lithodes maia</i>			!	!	!		!	+	?	!		50-250
<i>Eupagurus bernhardus</i>	!*		!	!	!	!	!			!	+	0-150
<i>longicarpus</i>	!	!	+	!								0- 10
<i>pubescens</i>	!*		!	!	!	!	!	!	+	+	+	0-150
<i>Krøyeri</i>			!	!	!	!	!	!	+	!	+	8-430
<i>Parapagurus pilosimanus</i>							!					250
<i>Munidopsis curvirostra</i>							!					180-220
<i>Homarus Americanus</i>	!	!	!	!	!	!	!					0- 10
<i>Axius serratus</i>			+				!					20- 40
<i>Calocaris Macandree</i>								+		+		190-
<i>Crangon vulgaris</i>	!	!	!	!	!	!	!	!		!		0- 48
<i>boreas</i>			!	!	!	!	!	!	+	!	+	0- 33
<i>Sabinea septemcarinata</i>			!	!	!	!	!	!	+	!	?	26- 68
<i>Sarsii</i>							!			!		60-112
<i>Pontophilus Norvegicus</i>						!	!			!		101-115
<i>Nectocrangon lar</i>					!		!	+		+		29- 59
<i>Caridion Gordoni</i>				!	!	!	!			!		27-110
<i>Hippolyte Fabricii</i>			!	!	!	!	!	!	+		+	0- 64
<i>Gaimardii</i>			+	!	!	!	!	!	+	!	+	0- 57
<i>spinus</i>			!	!	!	!	!	!	+	!	+	0- 90
<i>securifrons</i>			!			!	!			!		27-190
<i>macilenta</i>					!		!	+				26- 70
<i>Phippsii</i>			!	!	!	!	!	!	+	!	+	10-125
<i>pusiola</i>	!*		!	!	!	!	!	!		!		0-105
<i>polaris</i>			!	!	!	!	!	!	+	!	+	10-100
<i>Grœnlandica</i>			!	!	!	!	!	!	+		+	6- 33

	S. Cape Cod.	Cape Cod Bay.	Mass. Bay.	Casco Bay.	Bay of Fundy.	Nova Scotia.	G. of Maine, etc.	G. St. Law. and Lab.	Greenland.	Europe.	Bering Sea.	Fathoms.
<i>Pandalus borealis</i>			!			!	!		+	!	+	40-160
<i>Montagui</i>	!*		!	!	!	!	!		+	!		10-430
<i>Palaemonetes vulgaris</i>	!		!									
<i>Pasiphaë tarda</i>							!		+	!		140-175
<i>Thysanopoda Norvegica</i>			!	!	!	!	!		+	!		0-430
<i>inermis</i>	!*		!	!		!	!		+	!		0-220
<i>Erythrops Goëssii</i>			!							!		20- 48
<i>Meterythrops robusta</i>			!				!					33- 70
<i>Pseudomma roseum</i>							!	!		!		105-210
<i>truncatum</i>							!					45- 70
<i>Heteromysis formosa</i>	!		!									0- 10
<i>Mysis mixta</i>			!	!	!		!		+?	!		20- 90
<i>stenolepis</i>	!		!	!	!							0- 18
<i>oculata</i>					?		!		+	+		0-
<i>Americana</i>	!		!	!								0- 5
<i>Diastylis Rathkii</i>					!	!	!	+	!			20- 57
<i>politus</i>	!		!	!	!	!	!	!				0-190
<i>sculptus</i>	!		!	!	!	!	!	!				0-190
<i>luciferus</i>					!		!			!		60- 97
<i>quadrispinosus</i>	!*		!	!	!	!	!	!				2-190
<i>abbreviatus</i>	+		!	!								17- 35
<i>Leptostylis longimanus</i>				!						+		
<i>ampullaceus</i>							!			+		52- 90
<i>Leucon nasiceus</i>							!	+	!			50- 70
<i>nasicoides</i>					!		!		+			
<i>Eudorella emarginata</i>					!		!		!			52
<i>hispida</i>	+		!	!	!		!					1- 54
<i>pusilla</i>	!		!	!	!		!		!			1- 25
<i>deformis</i>	+*		!						+	+		25
<i>integra</i>					!	!	!					42-110
<i>Lamprops quadriplicata</i>			!	!								0- 10
<i>Campylaspis rubicunda</i>			!	!					+	+		35

A simple summation of the columns of the above table gives the following as the number of species found in the whole region under discussion, and the number of these species recorded from the regions specified :

	Number of species in list.	S. Cape Cod.	Cape Cod Bay.	Mass. Bay.	Casco Bay.	Bay of Fundy.	Nova Scotia.	G. of Maine, etc.	G. St. Law. and Lab.	Greenland.	Europe.	Bering Sea.
Brachyura,	15	12	8	7	5	4	4	5	4	3	3	2
Anomura,	7	3	1	5	5	3	3	5	4	2	4	3
Macrura,	23	5	2	16	13	12	17	17	15	13	16	9
Total Decapoda,	45	20	11	28	23	19	24	27	23	18	23	14
Schizopoda,	11	4		8	4	3	2	4	6	4	6	
Cumacea,	17	7		9	9	6	6	6	10	4	9	
Total,	73	31	11	45	36	28	32	37	39	26	38	14

This summation, however, does not fairly represent the Thoracos-tracan fauna of our northeastern coast, since it takes no account of the rare or accidental occurrence of species outside their regular habitats, and, in particular, because it takes no account of the occurrence of species, under favorable local conditions, far north and south of their ordinary limits.

As has been previously remarked, the fauna of Cape Cod Bay is an extension of the southern, or Virginian, fauna across Cape Cod, and should properly be excluded from the fauna of the coast of northern New England. Although the crustacean fauna of Cape Cod Bay is very poorly represented in the previous list, the number of species recorded is sufficient to illustrate its southern character, which is abundantly proved by the other classes of its inhabitants. Of the eleven species recorded from Cape Cod Bay, the following have not been recorded from elsewhere north of the Cape and do not, in any sense, belong to the fauna of northern New England :

Gelasimus pugnax.

G. pugilator.

Platyonichus ocellatus.

Carcinus menas.

Panopeus depressus.

P. Sayi.

(1.)

With the single exception of the apparently cosmopolitan *Carcinus*, these species represent the extreme northern limit, on our coast, of the genera to which they belong, and of the genera themselves none

appear to be represented in the European Seas. Of the five other species recorded from Cape Cod Bay, all are common far to the south and none of them are truly arctic species, although a single one, *Crangon vulgaris*, extends north to the Gulf of St. Lawrence and to Europe.

The following, in addition to list (1), are southern species occurring north of Cape Cod Bay only accidentally or in exceptionally protected localities:

Callinectes hastatus.	Palaemonetes vulgaris.	(2.)
Panopeus Harrisii.	Heteromysis formosa.	
Libinia emarginata.	Mysis Americana.	
Eupagurus longicarpus.		

Excluding the species in lists (1, 2), there are left eighteen northern species which extend south of Cape Cod. Of these,

Hyas coarctatus,	Pandalus Montagu,	(3.)
Eupagurus bernhardus,	Thysanopoda inermis,	
E. pubescens,	Eudorella deformis,	
Hippolyte pusiola,		

are northern and European species which extend but a short distance south of Cape Cod, where they are found usually only in cool waters of exposed localities, or, in the case of *Thysanopoda inermis*, only in winter.

Of the eleven remaining species which occur both north and south of Cape Cod,

Cancer irroratus.	Crangon vulgaris,	(4.)
C. borealis,	Mysis stenolepis,	
Homarus Americanus,		

have about equally extensive ranges and are about equally common both north and south of Cape Cod, and must be regarded as belonging properly to both faunæ. The others,

Diastylis politus,	Diastylis abbreviatus.	(5.)
D. sculptus.	Eudorella hispida,	
D. quadrispinosus,	E. pusilla,	

are all Cumacea which may fall in the same category as the four preceding species, although it is probable that some or perhaps all of them will be found to belong more exclusively to the northern fauna. None of the species in the last two lists are known to extend far north, nor, with the exception of *Crangon vulgaris*, to Europe, although they all belong to genera well represented in European seas.

Excluding, from the number of species recorded from both north and south of Cape Cod Bay, the seven southern species (2) which

occur locally or accidentally north, and the seven southern species (3) which occur similarly south of Cape Cod, there are left only eleven species (4, 5) which can be properly regarded as common to two regions of the New England coast. This fairly represents, I think, the marked difference between the two faunæ; a difference due principally to the difference in the temperature of the water, but partially undoubtedly, to the different structure of the coast and to the different nature of the shore and bottom in the two regions.

That there is no similar change in the fauna of the coast and shallow waters from Massachusetts Bay to Labrador is well shown by a comparison of the fauna of Massachusetts and Casco Bays with the fauna of the Gulf of St. Lawrence at similar depths. Omitting the southern species of lists (1, 2) and also the deep-water species (8) which are ordinarily not found at depths less than fifty fathoms, the following species are left recorded from Massachusetts and Casco Bays; those not yet recorded from the Gulf of St. Lawrence being prefixed by an asterisk:

Cancer irroratus.	Hippolyte Grœnlandica.	(6.)
*C. borealis.	*Pandalus borealis.	
Hyas araneus.	P. annulicornis.	
H. coarctatus.	Thysanopoda Norvegica.	
*Eupagurus bernhardus.	T. inermis.	
E. pubescens.	*Erythrogs Goëssii.	
E. Krøyeri.	Meterythrogs robusta.	
Homarus Americanus.	*Mysis mixta.	
*Axius serratus.	*M. stenolepis.	
Crangon vulgaris.	Diastylis politus.	
C. boreas.	D. sculptus.	
Sabinea septemcarinata.	D. quadrispinosus.	
*Caridion Gordoni.	*D. abbreviatus.	
Hippolyte Fabricii.	*Leptostylis longimanus.	
H. Gaimardii.	*Eudorella hispida.	
H. spinus.	E. pusilla.	
*H. securifrons.	*E. deformis.	
H. Phippsii.	*Lamprogs quadriplicata.	
H. pusiola.	*Campylaspis rubicunda.	
H. polaris.		

This list contains all the species recorded from less than fifty fathoms in the Bay of Fundy (unless *Mysis oculata* or *Leucon nasicooides* may prove to be exceptions), and is, as far as known, a complete list of the species which should be regarded as the regular inhabitants of the coast region of northern New England. Only six species additional to this list are recorded from the Gulf of St. Lawrence; they are the following:

Nectocrangon lar.	|	Mysis oculata.	(7.)
Hippolyte macilentata.		Diastylis Rathki.	
Pseudomma truncatum.		Leucon nasicooides.	

With the exception of the new species of *Pseudomma*, these are all thoroughly arctic species, and show a slight increase in the arctic character of the fauna of the Gulf of St. Lawrence over that of northern New England. The *Nectocrangon*, the *Hippolyte*, and the *Diastylis* were found also upon the Atlantic coast of Nova Scotia and may, very likely, yet be found on the New England coast; while the *Leucon* is already known from the Bay of Fundy and will doubtless yet be found in Casco and Massachusetts Bays.

The fifteen species from Massachusetts and Casco Bays (6) not yet recorded from the Gulf of St. Lawrence afford very little evidence in regard to the relations of the fauna of the Gulf, for some of them are known to be arctic and will undoubtedly be found in the Gulf, and the distribution of most of the others is not sufficiently well ascertained to be used as evidence. The absence of *Eupagurus bernhardus* from the Gulf of St. Lawrence and Greenland, while it occurs on the New England coast, in Europe, and in the North Pacific is, however, an interesting fact which should not be overlooked.

The shallow southwestern part of the Gulf of St. Lawrence, including the region of Northumberland Straits, etc., as shown particularly by its Molluscan fauna, is much more southern in its character than the rest of the Gulf; but too little is known of the stalk-eyed crustaceans of this region to illustrate the fact, or to affect the statements above made in regard to the fauna of the Gulf as a whole, for the species which are recorded from this part of the Gulf only are all Cumacea of which the distribution is not sufficiently known to make their occurrence here evidence in regard to the character of the fauna.

The deep-water species, or those which have not been recorded from less than fifty fathoms on our coast, and which are not inserted in lists (6, 7), are the following; those known from the Gulf of Maine, from off the coast of Nova Scotia, etc., being indicated by an M; those from the Gulf of St. Lawrence, by an L:

M Geryon quinqueidens.	|	M Pasiphaë tarda.	(8.)
M L Chionæcetes opilio.		M Pontophilus Norvegicus.	
M L Lithodes maia.		M L Pseudomma roseum.	
M Parapagurus pilosimanus.		M L Diastylis luciferus.	
L Munidopsis curvirostra.		M Leptostylis ampulaceus.	
L Calocaris Macandrewæ.		M L Leucon nasium.	
M Sabinea Sarsii.		M L Eudorella emarginata.	

The differences between the deep-water faunæ of the two regions, as shown in this list, are probably wholly accidental, the species which are not known to be common to both regions, being new or, at least on the western side of the Atlantic, little known species which will, most likely, eventually be found to inhabit both regions.

The facts above presented show conclusively, I think, that, as far as the Thoracostraca are concerned, the fauna from Cape Cod Bay to Labrador is essentially a continuous one, or at least that there are no changes in it comparable with the differences between the fauna south and that north of Cape Cod Bay. An uncompleted investigation of the distribution of the Amphipoda sustains these conclusions, which appear to be essentially in harmony with the facts at present known in regard to the distribution of the Mollusca and of other groups of the better known marine animals of the region in question.

Of the fauna of the east, or Atlantic, and of the north coast of Labrador, very little is at present known, but I believe no species of crustaceans, which are not found also in the Gulf of St. Lawrence or further to the south, have been recorded from this region, and the very close resemblance between the fauna of the northern part of the Gulf and that of the Greenland seas (to which I shall presently allude) renders it very improbable that the fauna of the east and north coasts of Labrador differs essentially from that of the northern part of the Gulf of St. Lawrence. The close relationship existing between the marine fauna of Greenland and that of northern Europe has long been observed and fully admitted by European zoologists, but the similarly close relationship between the marine fauna of Greenland and that of the coasts of the continent of North America itself, as well as the similar relationship between the fauna of the latter region and that of the seas of northern Europe, has not been so generally recognized by them and has recently been strenuously controverted.* This has probably been largely due to the fact that

* Dr. J. Gwyn Jeffreys: Preliminary Report of the Biological Results of a cruise in H. M. S. Valorous to Davis Strait in 1875. Proceedings Royal Society, London, vol. xxv, p. 188, 1876.

The Rev. A. M. Norman, however, appears to have fully recognized the true relation between the faunæ of the eastern and western sides of the North Atlantic, and also the American rather than the European character of the fauna of the Greenland seas; and in this very report arrives at conclusions the reverse of those of Mr. Jeffreys. Mr. Norman has, in a letter received since these pages were written, very kindly communicated to me his general conclusions in regard to the fauna of the North Atlantic, and I am pleased to find that his investigations in nearly all the classes of marine Invertebrata, have led to conclusions essentially the same as those resulting from my special study of the Thoracostraca.

the Greenland fauna has been studied almost exclusively by European zoologists to whom the fauna of our coast has usually been very little known. The earlier American zoologists fell into the same error, and, being without specimens of the known European species for comparison, and without sufficiently accurate figures or descriptions, described as new species already known from European and Greenlandic seas. This process has sometimes been reversed, however, the species being first described from our coast and later from the European. But the crustaceans have been more fortunate in this respect than some other classes of animals.

Further on, I have discussed the facts in regard to the geographical distribution of the Thoracostraca of Greenland, and need not specially allude to them here. The relation of the Thoracostracan fauna of the region between Cape Cod and Labrador to that of Greenland, that of Europe, and that of the region of Bering Sea, is shown in a general way in the summary, previously given, of the table of distribution (A), but is better shown if we omit from the summary the southern species (1, 2) which properly have no place in the fauna. Rejecting these, there are left belonging to the fauna between Cape Cod Bay and Labrador, sixty species, of which twenty-six are known in Greenland, thirty-seven in Europe, and fourteen in the region of Bering Sea. This is shown for different groups of Thoracostraca, in the following table:

(B.)	Cape Cod to Labrador.	Greenland.	Europe.	Region of Bering Sea.
Brachyura	6	3	2	2
Anomura	6	2	4	3
Macrura	22	13	16	9
Total Decapoda	34	18	22	14
Schizopoda	9	4	6	
Cumacea	17	4	9	
Total	60	26	37	14

This shows that a little more than three-fifths (sixty-one per cent.) of the species known to our northern marine fauna are common to the European fauna, while over two-fifths (forty-three per cent.) are found in Greenland, and that the proportions are very nearly the same if

the comparison be restricted either to the Decapoda proper, the Schizopoda, or the Cumacea.

The numerical distribution of the above twenty-six species known to be Greenlandic, along the western side of the North Atlantic is shown in the last five columns of table (D) beyond.

The similar distribution of the thirty-seven species common to our fauna and that of the European seas, and also the whole number of species recorded from each of the regions included in the second, third, fourth and fifth columns, is given in the following table, in which the fifth column is made to include the number of species found at less than fifty fathoms along the New England coast north of Cape Cod, while the other columns include the same regions as in table (A):

(C)	Europe.	Greenland.	G. St. Lawrence.	G. of Maine, etc.	N. Eng. coast north Cape Cod.	South of Cape Cod.	Region of Bering Sea.
Brachyura	2	2	2	2	2	1	1
Anomura	4	2	3	4	4	1	3
Macrura	16	9	10	14	12	3	6
Total Decapoda	22	13	15	20	18	5	10
Schizopoda	6	4	4	4	4	1	
Cumacea	9	4	5	1	6	1	
Total European	37	21	24	25	28	7	10
Whole no. recorded		36	39	37	42		

Comparing the number of European species found in each of the four regions north of Cape Cod, with the whole number of species recorded from each of these regions, as given in the last line of the table, it will be seen that the proportion of European species is very nearly the same in each of the regions, while south of Cape Cod there is a very sudden diminution in the number of European species.

Thirty of the thirty-seven species common to the two sides of the North Atlantic are known to occur on our coast in fifty fathoms or less, while some of the remaining species are recorded from equally shallow water in the European seas. This is a smaller proportion of deep-water species than is found among the species which are left as peculiar to the fauna between Cape Cod and Labrador, which shows that the species common to Europe and America are not predominantly deep-water species.

In the following list of the twenty-three species belonging to the fauna between Cape Cod and Labrador and not known to be European, those which are known to be true arctic species are indicated by an A; those which extend south of Cape Cod and appear to have their center of distribution on the New England coast are indicated by an S, but some of the Cumacea thus indicated may very likely prove to be arctic species.

Geryon quinquedens.	A Hippolyte Grœnlandica.	(9.)
S Cancer irroratus.	Meterythropus robusta.	
S C. borealis.	Pseudomma truncatum.	
A Chionoecetes opilio.	S Mysis stenolepis.	
Parapagurus pilosimanus.	S Diastylis politus.	
Munidopsis curvirostra.	S D. sculptus.	
S Homarus Americanus.	S D. quadrispinosus.	
Axius serratus.	S D. abbreviatus.	
A Nectocrangon lar.	S Eudorella hispida.	
A Hippolyte Fabricii.	S E. pusilla.	
A H. macilenta.	E. integra.	
	S Lamprops quadriplicata.	

Excepting *Axius serratus* (which will very likely prove to be specifically identical with the European species), the species not prefixed by either A or S, are all new or recently described and little is yet known of their geographical range, but they are probably arctic species. It is worthy of notice that, of the five species known to be arctic and not known to be European, all are Greenlandic and all but one (*Hippolyte macilenta*) are also known to occur on the western coast of North America, in the region of Bering Sea. These four species, common to both the northern Atlantic and northern Pacific coasts of North America are all conspicuous forms not likely to escape detection, and their geographical distribution apparently indicates that there are a certain number of arctic American species which are not European—perhaps because they are too arctic to be European.

The relation of the Thoracostracan Fauna of Greenland to that of the rest of North America and to that of Europe.

In order to exhibit clearly the similarity of the relation of the Thoracostracan fauna of Greenland, on the one hand, to the fauna of the rest of the North American seas, and, on the other hand, to that of the European seas, I have compiled the following list of the species of Thoracostraca known to inhabit the Greenland coast, and have given in foot-notes the principal synonyms, the most important refer-

ences, and the geographical distribution, for the species not known from the region between Cape Cod and Labrador, and consequently not treated of in the foregoing pages, where the geographical distribution of all the other species is given. The species known from the eastern coast of North America are indicated by the letters E. A. (all these occur in the Gulf of St. Lawrence or further south); those from the western coast (the region of Bering Sea, etc.) by the addition of the letter W.; those from the European coast by the letter E.

Chionæcetes opilio,	E. & W. A.		H. macilenta,	E. A.	
Hyas araneus,	E. & W. A.	E.	H. Phippsii,	E. & W. A.	E.
H. coarctatus,	E. A.	E.	H. polaris,	E. & W. A.	E.
Eupagurus pubescens,	E. & W. A.	E.	H. Grœnlandica,	E. & W. A.	
E. Krøyeri,	E. & W. A.	E.	H. microceras,†		
Crangon boreas,	E. & W. A.	E.	H. Panschii,‡		
Sabinea septemcarinata,	E. & W. (?) A.	E.	Pandalus borealis,	E. & W. A.	E.
Nectocrangon lar,	E. & W. A.		P. Montaguï,	E. A.	E.
Hippolyte Fabricii,	E. & W. A.		Hymenodora glacialis,§		E.
H. Gaimardii, *	E. & W. A.	E.	Pasiphaë tarda,	E. A.	E.
H. incerta,*			Sergestes arcticus,||		
H. spinus,	E. & W. A.	E.			

* HIPPOLYTE INCERTA Buchholz, Zweite deutsche Nordpolfahrt, ii, p. 272, 1874. East Greenland (Buchholz). Perhaps only a variety of *H. Gaimardii*.

† HIPPOLYTE MICRO CERAS Krøyer, Naturhistorisk Tidsskrift, iii, p. 578, 1841; Monografisk Fremstilling af Slægten Hippolyte's nordiske Arter, Kgl. danske Vidensk. Selsk. Skr., naturvidensk. mathem. Afh., ix, p. 341 (*microceros*), pl. 5, fig. 105-109 (*microceras*), 1842.—Lütken, list of Crust. of Greenland, in Manual of Instructions for the [British] Arctic Expedition, 1875, p. 148. Greenland (Krøyer).

‡ HIPPOLYTE PANSCHII Buchholz, Zweite deutsche Nordpolfahrt, ii, p. 277, pl. 1, fig. 1, 1874.—Kingsley, Bulletin Essex Institute, Salem, x, p. 62, 1878. East Greenland (Buchholz).

§ HYMENODORA GLACIALIS G. O. Sars.

Pasiphaë glacialis Buchholz, Zweite deutsche Nordpolfahrt, ii, p. 279, pl. 1, fig. 2, 1874.—Kingsley, Bulletin Essex Institute, Salem, x, p. 69, 1878 (*Pasiphaë*).

Hymenodora glacialis G. O. Sars, Archiv for Mathematikk og Naturvidenskab, Kristiania, ii, p. 341, 1877.

East Greenland (Buchholz). Deep water off the coast of Norway (G. O. Sars).

|| SERGESTES ARCTICUS Krøyer, Oversigt Kgl. danske Vidensk. Selsk. Forhandling, Kjøbenhavn, 1855, p. (6); Forsøg monog. Fremstil. Kræbsdyrslægten Sergestes, Kgl. danske Vidensk. Selsk. Skr., V, naturvidensk. mathem. Afh., iv, pp. 240, 276, pl. 3, fig. 7, pl. 5, fig. 16, 1859.

Greenland (Krøyer).

Thysanopoda Norvegica.	E. A.	E.	Diastylis Rathkii.	E. A.	E.
T. inermis.	E. A.	E.	D. Edwardsii, §		
T. longicaudata.*			D. resimus, ¶		
T. Raschii, †		E.	Leucon nasieus,	E. A.	E.
? Mysis mixta.	E. A.	E.	Eudorella deformis,	E. A.	E.
M. oculata.	E. A.	E.	Campylaspis rubicunda,	E. A.	E.
Boreomysis arctica, ‡		E.			

The following table gives a numerical summary of this list, and also the numerical distribution of the species in several regions along the eastern coast of the continent of North America.

* **THYSANOPODA LONGICAUDATA** Krøyer, in Gaimard, Voyages en Scandinavie, en Laponie, etc., pl. 8, fig. 1, 1849.—Lütken, list of Crust. of Greenland, in Manual of Instructions for the [British] Arctic Expedition, 1875, p. 148.
Greenland (Reinhardt, Lütken).

† **THYSANOPODA RASCHII** Sars, Christiania Videnskabs-Selskabs Forhandlingar, 1863, p. 83.—Buchholz, Zweite deutsche Nordpolfahrt, ii, p. 285, 1874.
Coast of Norway (Sars). East Greenland (Buchholz).

‡ **BOREOMYSIS ARCTICA** G. O. Sars.

Mysis arctica Krøyer, Et Bidrag til Kundskab om Kiebsdyrfamilien Mysidae, Naturhistorisk Tidsskrift, III, i, pp. 34, 42, pl. 1, fig. 5, 1861.

Boreomysis arctica G. O. Sars, Christianiafjordens Dybvandsfauna, p. 26, 1869 (extr. Nyt Magazin for Naturvidenskberne); Christiania Videnskabs-Selskabs Forhandlingar, 1871, p. 264 (21).—Metzger, Jahresbericht der Comm. zur wissenschaftl. Untersuchung der deutschen Meere für 1872, 1873, Nordsee, p. 288, 1875.
Greenland (Krøyer). West coast of Norway (G. O. Sars, Metzger).

§ **DIASTYLIS EDWARDSII** Krøyer.

Cuma Edwardsii Krøyer, Naturhistorisk Tidsskrift, iii, pp. 504, 531, pl. 5, figs. 1-16, 1841; op. cit., II, ii, pp. 128, 207, pl. 1, figs. 1, 3, 5, 9-14, 1846; in Gaimard, Voyages en Scandinavie, etc., pl. 4, 1849 (♀).

Cuma brevisrostris Krøyer, Naturhistorisk Tidsskrift, II, ii, pp. 174, 208, 1846; Voyages en Scandinavie, etc., pl. 5A., fig. 1, 1849 (adult ♂).

Diastylis Edwardsii G. O. Sars, Kongl. Vetenskaps-Akad. Handlingar, Stockholm, ix, no. 13, p. 5, 1871.—Norman, Proceedings Royal Soc., London, xxv, p. 209, 1876; Annals and Magazin Nat. Hist. V, iii, p. 61, 1879.

Greenland (Krøyer, Norman).

¶ **DIASTYLIS RESIMUS** G. O. Sars.

Cuma resima Krøyer, Naturhistorisk Tidsskrift, II, ii, pp. 165, 206, 1846; Voyages en Scandinavie, etc., pl. 3, fig. 1, 1849.

Diastylis resima G. O. Sars, Kongl. Vetenskaps-Akad. Handlingar, Stockholm, ix, no. 13, p. 5, 1871.

Greenland (Krøyer).

(D.)	Greenland.	Europe.	Eastern coast of North America.	G. St. Lawrence.	G. Maine, etc.	N. Eng. coast north Cape Cod.	South of Cape Cod.	Region of Bering Sea.
Brachyura	3	2	3	3	3	2	1	1
Anomura	2	2	2	2	2	2	1	3
Macrura	18	10	13	11	11	9	1	6
Total Decapoda	23	14	18	16	16	13	3	10
Schizopoda	7	6	4	3	3	2	1	
Cumacea	6	4	4	2	1	2		
Total	36	24	26	21	20	17	4	10

Of the thirty-six Greenland species, six are not yet recorded from outside the Greenland seas, so that out of thirty species, twenty-six, or about eighty-seven per cent., are known upon the eastern coast of North America from the Gulf of St. Lawrence southward; while twenty-four species, or eighty per cent., are known in the European seas. An uncompleted examination of the Amphipoda gives results entirely in harmony with those above derived from the Thoracostraca, so that it is certainly safe to assert that, at least as far as the Malacostraca are concerned, the marine fauna of Greenland is essentially the same as that of the arctic seas of both Europe and America, or, in other words, it is only a part of the great arctic, circumpolar fauna. That the fauna of the Greenland seas should have its closest relations with the fauna of the North American coast proper, rather than with that of Europe, is what might be expected from the geographical position of Greenland and the fact that the waters of the northern part of the North American coast are more arctic in temperature than the waters upon the coast of Europe.

ERRATA.

Page 31, 2d line. for 'Robert,' read 'Richard.'

" 54, for 'Munadopsis,' read 'Munidopsis.'

" 61, 6th line from bottom, for 'Mere,' read 'Meere.'

" 69, 9th line from bottom, for 'Tynside,' read 'Tyneside.'

" 105, 3d line from bottom, insert 'of' before '*M. oculata*.'

" 115, 1st line, for 'nasicoidis,' read 'nasicoides.'

" 129, 16th line. for '*Pseudopleuronectes*,' read '*Pseudopleuronectes*.'

EXPLANATION OF PLATES.

PLATE VIII.

Figure 1.—*Cancer borealis* Stimpson; dorsal view of a small male from Caseo Bay; nine-tenths natural size. Figures 1a, 1b, terminal portions of the chelipeds of the same specimen, seen from the outer side; natural size.

PLATE IX.

Figure 1.—*Geryon quinquedens* Smith; dorsal view of the carapax of a large male (b) from off Cape Ann; four-fifths natural size. Figure 1a, frontal region of the same specimen, seen from beneath; one and a third times natural size. Figure 1b, terminal portions of the chelipeds of the same specimen; enlarged the same amount.

Figure 2.—The same species; dorsal view of the carapax of a small female (c) from off Massachusetts Bay; one and a third times natural size.

Figure 3.—*Geryon tridens* Kröyer; dorsal view of the carapax of a large male from Christiania Fiord, Norway; two-thirds natural size. Figure 3a, frontal region of the same specimen, seen from beneath: one and a third times natural size.

Figure 4.—*Hippolyte pusiola* Kröyer; tip of the telson of a female 20.5^{mm} long, from the Bay of Fundy, with more than the normal number of terminal spines; enlarged thirty-two diameters.

Figure 5.—The same species; terminal portion of the telson of a female 16^{mm} long, from Halifax, Nova Scotia, with an abnormal arrangement of aculei and spines, apparently resulting from some injury; enlarged thirty-two diameters.

Figure 6.—The same species; terminal portion of the telson of a male, 17^{mm} long, from the Bay of Fundy, with less than the normal number of terminal spines; enlarged thirty-two diameters.

Figure 7.—The same species; terminal portion of the telson of a male, 15^{mm} long, from near Cashe's Ledge, off the coast of Maine, with the normal arrangement of spines; enlarged thirty-two diameters.

Figure 8.—*Hippolyte Gaimardii* Milne-Edwards; tip of telson of a female, 36^{mm} long, from Halifax, Nova Scotia, with the normal armament of spines; enlarged sixteen diameters.

Figure 9.—The same species; tip of the telson of a female, 39^{mm} long, from Caseo Bay, with an abnormal armament of spines; enlarged thirty-two diameters.

PLATE X.

Figure 1.—*Pasiphæ tarda* Kröyer; from the Gulf of Maine; lateral view, three-fourths natural size.

Figure 2.—*Hippolyte Grønlandica* Miers; female from the Bay of Fundy; lateral view, one and a half times natural size.

Figure 3.—*Hippolyte securifrons* Norman; female from off Massachusetts Bay; lateral view, one and a half times natural size.

Figure 4.—*Azius serratus* Stimpson; dorsal view of the original specimen in the collection of the Peabody Academy of Science, Salem. Figure 4a, lateral view of the right cheliped.

PLATE XI.

- Figure 1.—*Hippolyte polaris* Ross: anterior pleopod of the left side of a male, 39.4^{mm} long, from the Gulf of Maine; enlarged twelve diameters.
- Figure 2.—Inner lamella of the left pleopod of the second pair of the same specimen; enlarged the same amount.
- Figure 3.—The same species: anterior pleopod of the left side of a female, 45^{mm} long, from near Cashe's Ledge, off the coast of Maine; enlarged twelve diameters.
- Figure 4.—Inner lamella of the left pleopod of the second pair of the same specimen; enlarged the same amount.
- Figure 5.—*Sabinea septemcarinata* Ross: dorsal view of the carapax of a female from off Massachusetts Bay; enlarged two diameters.
- Figure 6.—*Sabinea Sarsii* Smith; dorsal view of the carapax of a female, 62^{mm} long, from the Lofoten Islands, Norway; enlarged two diameters. Figure 6a, lateral view of the same. Figure 6b, dorsal view of the extremity of the abdomen of the same specimen, showing the right uropod and the telson; enlarged three diameters. Figure 6c, tip of the telson of the same specimen; enlarged twelve diameters.
- Figure 7.—The same species; tip of the telson of a female, 36^{mm} long, from the Gulf of Maine; enlarged twelve diameters.
- Figure 8.—The same species; tip of the telson of a young specimen, only 16^{mm} long, from St. George's Bank; enlarged twenty-four diameters.
- Figure 9.—*Sabinea septemcarinata* Ross: dorsal view of the extremity of the abdomen of a female from off Massachusetts Bay, showing the appendages of the right side of the sixth segment and the telson; enlarged three diameters.
- Figure 10.—The same species; tip of the telson of an adult male, 40^{mm} long, from off Massachusetts Bay, with what appears to be the normal arrangement of the terminal spines; enlarged twelve diameters.
- Figure 11.—The same species; tip of the telson of an adult female, about 60^{mm} long, from off Massachusetts Bay, with the normal armament; enlarged twelve diameters.
- Figures 12 and 13.—The same species; tips of the telsons of two adult females from off Massachusetts Bay, with an apparently abnormal arrangement of terminal spines—in the second case evidently the result of injury; enlarged twelve diameters.

PLATE XII.

- Figure 1.—*Meterythropus robusta* Smith; dorsal view of the front part of a male, 19^{mm} long, from the Gulf of St. Lawrence; enlarged six diameters. Figure 1a, one of the anterior pleopods of the same specimen; enlarged twelve diameters.
- Figure 2.—The same species; antennal scale of a female, 16.5^{mm} long, from the Gulf of St. Lawrence; enlarged twenty-four diameters; the marginal plumose setæ omitted. Figure 2a, dorsal view of the lamellæ of the uropod of the left side of the same specimen; enlarged fifteen diameters. Figure 2b, a part of the inner margin of the inner lamella, more highly magnified to show the marginal spines and the bases of the plumose setæ. Figure 2c, telson of the same specimen; enlarged thirty diameters. Figure 2d, tip of the same telson, more magnified.
- Figure 3.—*Pseudomma truncatum* Smith: dorsal view of the antenna of an adult male; enlarged thirty diameters. Figure 3a, outline of the ophthalmic segment of the same specimen; enlarged thirty diameters. Figure 3b, tip of the telson of the same specimen; enlarged thirty diameters; the cilia of the median setæ omitted.
- Figure 4.—The same species; telson of an adult female; enlarged thirty diameters; the cilia of the median terminal setæ omitted.

III.—A LIST OF THE BRAZILIAN ECHINODERMS, WITH NOTES ON THEIR DISTRIBUTION, ETC. BY RICHARD RATHBUN.

THE following list comprises all the species of Echinoderms collected or observed on the Brazilian Coast, by Mr. John C. Branner, the author, and other members of the Geological Commission of Brazil, during the years 1875-77; together with the species hitherto recorded from that region, in the principal works treating of this class of animals.

In accordance with the instructions of the late Prof. Ch. Fred. Hartt, as chief of the Brazilian Survey, collections of marine animals were made at all the sea-coast localities visited by the assistants of the survey, in the course of their geological explorations. The intention was to procure material from as many points as possible, to serve for the study of the geographical distribution of the several species. But the limited time available for zoological work usually rendered it impossible to collect other than the larger and commoner species, the majority of which, at least in the class of Echinoderms, had already been noticed by other travelers, as occurring on the Brazilian coast. Comparatively few additions were therefore made to the previously known Echinoderm-fauna of Brazil, only a single species, a *Leptasterias*, being with certainty new to science. One important result of these researches, however, was the more careful determination of the range and exact habitats of many of the species, and this, together with the fact that no complete list of the Brazilian Echinoderms has yet been published, has been deemed a sufficient reason for the preparation of the present list.

Except in a few instances, lists of synonymy have been omitted; the authority is always given for the occurrence of the species at the localities recorded—in the cases of the Geological Commission and the Hartt Expeditions it is the name of the collector, otherwise generally the publisher. Mr. Alex. Agassiz's "Revision of the Echini" is taken as the sole authority for all the localities given in the list of that group, excepting where the species were also collected on the private expeditions of Prof. Hartt, or by the Geological Commission. The other authorities used throughout the paper will be understood by reference to the list of bibliography which precedes

the lists of species. I am to be held responsible only for the identification of the species collected by the Geological Commission; beyond this the work is entirely a compilation. To render the list more complete and serviceable, there has been added the extra-Brazilian range of all species not confined to that coast: where a species is widely distributed, the regions inhabited by it are indicated only in a general way; where it has been found at only one or a few localities, these are defined.

In the preparation of this paper, I have been placed under many obligations to Prof. A. E. Verrill, for the use of valuable specimens and books, and for much aid and advice, enabling me to better perfect my work than I could otherwise have done. To Mr. Theo. Lyman I am indebted, for the identification of several of the more critical Ophiurans, and for valuable suggestions in making up the list of species of that group.

The principal publications that have furnished materials for this paper, are as follows, arranged alphabetically, according to the authors:

- Agassiz, Alexander. Revision of the Echini. Illustrated Catalogue of the Museum of Comparative Zoölogy at Harvard College, No. VII, 1872-74.
- Gray, John E. Synopsis of the Species of Starfish in the British Museum. London, 1866.
- Ljungman, Axel Vilh. Om några nya arter af Ophiurider. Öfversigt af Kongl. Vetenskaps-Akademiens Förhandlingar, No. 6, 1866.—Ophiuroidea Viventia hucusque cognita. Öfvers. af K. Vet.-Akad. Förh., No. 9, 1866.—Förteckning öfver uti Vestindien af Dr. A. Goës samt under korvetten Josefinas expedition i Atlantiska Oceanen samlade Ophiurider. Öfvers. af K. Vet.-Akad. Förh., no. 6, 1871.
- Lütken, Chr. Fr. Additamenta ad Historiam Ophiuridarum, Part II, 1859.—Fortsatte kritiske og beskrivende Bidrag til Kundskab om Söstjerneerne (Asteriderne). Videnskabelige Meddelelser fra den naturhistoriske Forening i Kjöbenhavn, Nr. 15-19, 1871.
- Lyman, Theodore. Ophiuridæ and Astrophytidæ. Illustrated Catal. of the Museum of Comparative Zoology, No. I, 1865.—Supplement to the Ophiuridæ and Astrophytidæ. Illust. Catal., No. VI, 1871.—Zoölogical Results of the Hassler Expedition. Part II. Ophiuridæ and Astrophytidæ. Illust. Catal., No. VIII, 1875.
- Müller (J.) and Trosehel (F. H.) System der Asteriden, 1842.
- Perrier, Edmond. Révision de la Collection de Stellérides du Muséum d'Histoire Naturelle de Paris. Archives de Zoologie Expérimentale et Générale, t. iv, Nos. 2 and 3, 1875, t. v, Nos. 1, 2 and 3, 1876.
- Pourtalès, L. F. de. Reports on the Results of Dredging, under the Supervision of Alexander Agassiz, in the Gulf of Mexico, by the United States Coast Survey Steamer "Blake." (Crinoids). Bulletin of the Museum of Comparative Zoölogy, vol. v, No. 9, 1878.
- Selenka, Emil. Beiträge zur Anatomie und Systematik der Holothurien. Zeitschrift für Wissenschaftliche Zoologie, Leipzig. Vol. xvii, 1867.

Verrill, A. E. Comparison of the Tropical Faunæ of the East and West Coasts of America. Transactions of the Connecticut Academy of Arts and Sciences, vol. i, part II, 1867.—Notice of the Corals and Echinoderms collected by Prof. C. F. Hartt, at the Abrolhos Reefs, Province of Bahia, Brazil, 1867. Trans. Conn. Acad., vol. i, part II, 1868.

HOLOTHURIOIDEA.

Chirodota rotiferum Stimpson.

Amer. Jour. Sci., xxix, p. 134, 1860; Verrill, Trans. Conn. Acad., i, p. 371, 1868; Selenka, Zeitschr. für Wiss. Zoöl., 1867, p. 367 (*rotifera*).

Abrolhos Reefs (Hartt, '67). Plataforma, Bay of Bahia, buried in the sandy mud of tide pools (Rathbun). Florida (Pourtalès).

Thyone (Sclerodactyla) Braziliensis Verrill.

Trans. Conn. Acad., i, p. 370, 1868.

Abrolhos Reefs, under dead corals, in the shallow tide pools and holes in the reefs (Hartt, '67). Plataforma, Bay of Bahia, buried in the mud or impure sand, filling the pools and crevices of the rocky shores (Rathbun).

Thyonella, Sp.

Plataforma, Bahia (Rathbun), associated with *Thyone Braziliensis*.

This species of *Thyonella* resembles very closely in external appearance and characters *T. gemmata* Verr.,* of the Southern coast of the United States, with which it might readily be united, except for the very different nature of its skin-plates. These are mostly of one kind, corresponding nearly with the larger, elongate plates of *T. gemmata*. They are large and flattened, and irregularly fusiform, oblong or even triangular in outline, with generally two, sometimes more, rows of large openings. At times the openings are irregularly scattered and of smaller size. In addition there are more rarely slender, curved plates, with two or three perforations at each end and in the middle, or with a row of perforations.

Holothuria, Sp.

Plataforma, Bahia (Rathbun), associated with *Thyone Braziliensis*.

A specimen of this species, in alcohol, but not much contracted, measures in length, about 125^{mm}, greatest diameter, about 24^{mm}. The

* *Thyonella gemmata* Verr., Amer. Jour. Sci. and Arts, III, vol. iii, p. 437, 1872.

Colochirus gemmatus Pourtalès, Proc. Amer. Ass. Adv. Sci., 1851, p. 11.

Thyonidium gemmatum Selenka, Zeitschrift für Wissenschaftl. Zoöl., vol. xvii, p. 345, 1867.

skin is nearly smooth, of a brownish yellow color, and with two rows of large purplish brown spots along the dorsal side, and many smaller, darker spots scattered promiscuously, but most numerous on the lateral and dorsal surfaces. The skin is further covered with a net-work of fine reticulations of slight purplish color, giving it a tessellated appearance. A narrow line of the same color extends through the middle of the interambulacral spaces.

The ambulacral zones are of sub-equal width, and about two to three times as broad as the intervening spaces. The suckers are moderately abundant, slightly more numerous in the median ventral than in the other zones, but without regular arrangement, except toward the posterior extremity, where there are two rows to each zone; near the middle of the body, about four to five range across each zone. Around the anus there are five clusters, each of five to eight, more or less pointed papillæ.

The plates of the skin (with suckers) are very numerous, and of several very distinct kinds. The commonest kind is the smallest; minute, flattened, regularly oblong-elliptical in outline, with six small, elongate perforations, arranged in two rows. Four other kinds are common: (1.) A larger, heavier plate, with the margin forming four strong lobes, to each of which corresponds a large, circular perforation, each lobe in turn being usually divided into two or three smaller lobes, bearing a large rounded tubercle; two or three similar tubercles occur between the perforations. This plate may be much enlarged, the number of perforations increasing in proportion. (2.) A table-shaped plate, smaller than the last, and composed of a narrow, upper rim of a squarish outline—a square, with slightly curved sides and rounded corners—pierced at each corner by an oval hole, or seldom with a complete circle of perforations; and four legs, which begin just within the corner perforations, and bend strongly inward for one-half their length, to where they are banded together; below this they are straight, and closely joined at the base, leaving only a small central perforation, surrounded by ten to twelve pointed, divergent tubercles. (3.) A slender, flattened, elongated plate, bulging strongly outward on both sides at the center, and tapering slightly to the ends, which are also enlarged and rounded; on each side of the center there is an elongated perforation, and the rounded ends have one to three small holes. This plate is sometimes broadened and bears a row of perforations along one-half or all of one side. (4.) A rather small ege or basket-shaped plate, of nearly globular form, coming probably from the suckers.

ECHINOIDEA.

Cidaris tribuloides (Lam.) Blainv.

Dict. S. Nat., p. 200, 1830; A. Agassiz, *Illust. Cat. Mus. Comp. Zoölogy*, No. VII, p. 99, 1872.

Cidaris annulata A. Agass., *Bull. Mus. Comp. Zool.*, p. 17, 1863.

Fernando de Noronha, very abundant (Brammer). Bay of Bahia, a few fragments dredged in about four fathoms (Rathbun). Rio de Janeiro (Mus. Copenhagen). S. Carolina—Florida; West Indies; Gulf of Mexico; Aspinwall; Cape Verde Isls. (A. Ag.).

Arbacia pustulosa (Leske) Gray.

Proc. Zool. Soc. London, April, 1835; A. Agass., *Illust. Cat.*, No. VII, p. 92, 1872.

Armação and Ilhas de Maricás, Prov. of Rio de Janeiro (Hartt, Thayer Exp.). Rio de Janeiro, common about entrance to Bay, etc. (Agassiz, Thayer Exp.; Rathbun). Desterro, Prov. of Santa Catharina (F. Müller). Azores; Madeira; Cape Verde Isls.; west coast of Africa; Mediterranean (A. Ag.).

Diadema setosum Gray.

Ann. Phil., p. 4, 1825 (*setosa*); A. Agass., *Illust. Cat.*, No. VII, p. 103, 1872.

Fernando de Noronha, abundant (Brammer). The distribution of this species is nearly world-wide. West Indies; Gulf of Mexico; Carribean Sea; Atlantic, Pacific and Indian oceans; mostly confined within the tropics (A. Ag.).

Echinometra subangularis (Leske) Desml.

Syn., p. 266, 1837; A. Agass., *Illust. Cat.*, No. VII, p. 116, 1872.

Echinometra Michelini Desor, *Catal. Rais.*, 1846; A. Agass., *Bull. Mus. Comp. Zoology*, p. 21, 1863; Verrill, *Trans. Conn. Acad.*, i, p. 369, 1868.

Fernando de Noronha (Brammer). Pernambuco, boring into the sandstone reef, etc. (Geol. Comm.). Island of Santo Aleixo, Pernambuco, boring into trap rock (Brammer). Bay of Bahia, very abundant, boring into coral reef, conglomerate, gneiss, etc. (Geol. Comm.) Porto Seguro; Victoria; Guarapary; Campos; Ilhas de Maricás (Hartt and Copeland, Thayer Exp.). Abrolhos Islands (Hartt, 1867; Rathbun). Rio de Janeiro (Agassiz; Geol. Comm.). Desterro (F. Müller).

This species has been found on nearly all the rocky shores of the coast of Brazil, from Pernambuco to Santa Catharina, and probably also ranges to the north and south of these points. It has the power

of boring into many different kinds of rocks, which are sometimes so completely riddled with its holes, that they yield readily to the force of the waves. It is edible, and contributes to the support of the poor fishermen of the coast, where it occurs (Hartt).

S. Carolina—Florida; West Indies; Aspinwall; Cumana; Bermudas; Cape Verde Isles (A. Ag.).

Strongylocentrotus Gaimardi (Blainv.) A. Agassiz.

Illust. Cat. Mus. Comp. Zool., No. VII, p. 163, 1872.

Brazil (Jardin de Plantes; Hartt and Copeland, Thayer Exp.). Bahia; Rio de Janeiro (Mus. Copenhagen). Desterro (F. Müller).

Toxopneustes variegatus (Lam.) A. Agass.

Illust. Cat., No. VII, p. 168, 1872.

Lytechinus variegatus A. Agassiz, Bull. Mus. Comp. Zool., p. 24, 1863; Verrill, Trans. Conn. Acad., i, p. 369, 1868.

Fernando de Noronha (Brammer). Pernambuco (Geol. Comm.). Bay of Bahia, common (Hartt, '67; Rathbun). Porto Seguro; Victoria; Armação; Cape Frio (Hartt, Thayer Exp.). Alcobaça, Bahia (Max. zu Neu Wied). Bay of Rio de Janeiro (Agassiz; Rathbun). N. Carolina—Florida; W. Indies; Gulf of Mexico; Bermudas (A. Ag.). This species is said not to be edible (Neu Wied).

Hipponoë esculenta (Leske) A. Agass.

Illust. Cat., No. VII, p. 135, 1872.

Tripneustes ventricosus Agassiz, Int. Mon. Scut., 1841.

Fernando de Noronha, abundant and of large size; Rio Formoso, common and large (Brammer). Florida; West Indies; Yucatan; Cumana; Surinam; Bermudas (A. Ag.).

Clypeaster subdepressus (Gray) Agass.

Prod., p. 187, 1836; A. Agass., Illust. Cat., No. VII, p. 101, 1872.

Bay of Bahia, not uncommon on sandy bottoms, and often attaining a large size (Rathbun). Brazil (Castelneau). S. Carolina—Florida; West Indies; west coast of Africa (A. Ag.).

Mellita sexforis (Lamk.) A. Agass.

Illust. Cat., No. VII, p. 141, 1872.

Pernambuco (O. A. Derby, 1870, in Mus. Yale Coll.). Bay of Rio de Janeiro, very abundant near Fort Villegagnon, on sandy bottom

(Prof. Emil Selenka, 1877). S. Carolina—Florida; West Indies; Mexico; Bermudas (A. Ag.)

Mellita testudinata Klein.

Nat. Disp. Ech., 1734; A. Agass., *Illust. Cat.*, No. VII, p. 141, 1872.

Maranhao (Agassiz, Thayer Exp.; O. A. Derby, 1870). Itaparica and Cannavieiras, Prov. of Bahia (Rathbun). Rio Doce and Itabapuna, Prov. of Espirito Santo (Hartt and Copeland, Thayer Exp.). Vineyard Sound—Florida; Texas; West Indies; Mexico; Cumana (A. Ag.)

Encope emarginata (Leske) Agass.

Mon. Scut., p. 47, 1841; Verrill, *Trans. Conn. Acad.*, i, p. 370, 1868; A. Agass., *Illust. Cat.*, No. VII, p. 126, 1872.

Maranhao (Agassiz, Thayer Exp.). Pernambuco and Maria Farinha (O. A. Derby, 1870; Geol. Comm.). Pernambuco (Belval). Bay of Bahia, very abundant on sandy bottoms (Hartt, '67; Rathbun). Rio Santo Antonio (Max. zn Nen Wied). Victoria; Ilhas de Santa Anna (Hartt and Copeland, Thayer Exp.). Rio de Janeiro, very common on sandy shores, near entrance to Bay, etc. (Agassiz, Thayer Exp.; Rathbun). Desterro (F. Müller). S. Carolina—Florida; West Indies; Yucatan; Nicaragua; Cumana (A. Ag.).

ASTERIOIDEA.

Asterias Atlantica Verrill.

Trans. Conn. Acad., i, p. 368, 1868.

Abrolhos Reefs (Hartt, '67). Only a single specimen of this species, the one collected by Prof. Hartt, has been recorded from Brazil. Bermudas; Remedios, Cuba? (Verr.)

Leptasterias Harttii, sp. nov.

A very small star-fish, with six rays. Rays elevated, nearly or quite as high as broad, somewhat flattened below, but strongly and regularly arched above, and regularly tapering to rather sharply pointed tips. Disk small, its diameter equal to about one and one-half times the width of the rays near base. Radii as 1:6 nearly, the greater radius of the largest specimen examined being about 19^{mm}.

Adambulacral spines rather slender-clavate toward base of ray, but tapering somewhat farther out, placed regularly two to a plate, those of the outer row slightly larger than the inner. Ventral spines

very much broader than the above, but not much longer, clavate in general form, with compressed tips, not arranged regularly in longitudinal rows, but in short, slightly oblique series of two, seldom three, spines. Between the ventral and adambulacral rows of spines the intervening space is very narrow, but the ventral and lateral rows are widely separated. The lateral and dorsal spines are all of subequal size, very small and short, about one-half as long as the adambulacral or even shorter, cylindrical, or slightly tapering, and with truncate, rounded ends. First above the ventrals comes a single row of these spines, rather widely separated, and arranged one to a plate, seldom two, with sometimes a short lower row, of six or seven smaller spines, near the middle of the arm. Above the first lateral rows of each side, we can distinguish in all five longitudinal series of spines, including the median dorsal one. In these series the spines are not generally regularly placed, but we can make out a certain arrangement among them. The first series consists usually of two rows of alternating spines, distinct nearly or quite to the tip of arm. The second series, toward the disk, is made up of successive, irregular or slightly curved, transverse rows of four or five spines, with an intervening spine to connect the several rows; farther out the series becomes reduced to a single, irregular, longitudinal row of spines. The median dorsal series is formed of similar transverse rows of about five spines each, arranged irregularly in the shape of a very broad V, with the angle turned toward the disk; toward the tip there are only two or three spines to a group. Near the disk there are many additional spines scattered over the arms, more or less obscuring the above arrangement. The spines of the disk are similar in character to those of the rays, and of the same size or slightly smaller; they are closely arranged but without order.

The major pedicellariæ are very large and numerous, being scattered over the entire surface of the rays and disk. Where perfectly preserved, they are elongate triangular in outline, with strongly curved base, and are about two-thirds as broad as long; they often appear ovate in outline. They vary in size, many being only one-half or two-thirds as long as others. The larger ones equal or slightly exceed the lateral and dorsal spines in length, and are very much broader. Everywhere above the first lateral rows of spines, they are about uniformly distributed, ranging most commonly along the edges of the plates. Between the ventral and lateral rows of spines, they are much more numerous, being especially abundant just above the bases of the ventral spines. They also occur, but more

rarely, between the ventral and adambulacral rows of spines. On the disk they are about as numerous as upon the dorsal side of the arms.

The madreporic plate is small, flattened, rather low down between the arms, and surrounded by a row of spines; it has but few, rather simple convolutions. The openings between the plates, on the inner half of the arm, are rather large; papulae placed singly. The above description was made from dried specimens.

This species may be readily distinguished by its very small, simple spines, and proportionately very large pedicellariae; the latter often much exceed the former in size.

Locality: About 30 miles east of Cape Negro, Brazil, lat. 23° 20' S., depth 62 fathoms, gravelly bottom. Brought up on the cable by the telegraph steamer "Norseman."

Echinaster echinophorus (Lam.) Perrier.

Arch. de Zool. Expér., iv, No. 3, p. 364, 1875.

Echinaster (Othilia) crassispina Verrill, Trans. Conn. Acad., i, p. 368, 1868.

This species is apparently the most common one of the genus *Echinaster* on the Brazilian coast. Specimens collected at the Abrolhos Islands in 1876, agree perfectly with the types of *E. crassispina*, from the same locality, as described by Prof. Verrill (loc. cit.). The same species also occurs in great abundance at many places in the Bay of Bahia, generally on rocky bottom (Rathbun); on the coast of the province of Pernambuco (Branner); and near the mouth of the Rio Parahyba do Norte (Br.). It undergoes considerable variation, at times approaching the next species enumerated in this list, and the study of a large series of specimens might serve to prove the identity of the two species. It is generally found in slight depths of water, and when living is of a very bright red color. Bahia and Rio de Janeiro (Perrier, in the Museum at Paris from Castelneau). It is extremely doubtful if this species occurs at Rio de Janeiro.

West Indies (Lütken). North America; Yucatan; Central America (Perrier).

Echinaster sentus (Say) Lütken.

Vidensk. Meddel., p. 284, 1871.

From the Bay of Bahia, there were procured by the author, in 1876, several specimens of *Echinaster*, which it is impossible to distinguish from authentic specimens of *E. sentus* from Florida and the West Indies. This species does not, however, appear to be common at the former locality. A single specimen of this genus, collected at Per-

nambuco in 1870, by Mr. O. A. Derby, and contained in the Museum of Yale College, approaches more closely to this than any other described species. Its greatest diameter is about 120^{mm}, and it has more slender and gradually tapering arms than typical specimens of *E. sentus*. The spines are slightly longer than usual in this species, and number about eighteen in each of the upper median rows from the center of the disk to the tip of the arm. At Rio Formoso, Pernambuco (Branner) were found young individuals of this same variety, associated with more typical specimens of *E. sentus*. Florida; Hayti (Verrill). West Indies (Mus. Yale Coll.).

Echinaster Braziliensis Müll. and Trosch.

Syst. der Asterid., p. 22, 1842.

I have seen only a single specimen that could be referred to this species, as originally described by Müller and Troschel; it was from Rio Formoso, Pernambuco (Branner). Greatest diameter about 80^{mm}, arms quite slender, spines very small and arranged in about nine longitudinal rows, the upper median rows of each arm containing 25–30 spines, from center of disk to tip of arm.

Brazil (Müll. and Trosch., in Mus. Berlin). Rio de Janeiro (Perrier, in Mus. Paris, collected by Freycinet, 1822, Gaudichaud, 1839, and Castelneau, 1844). This species was not found at Rio de Janeiro by the Geological Commission. The term *Rio de Janeiro* is often used in a general way to designate Brazil, and it is not improbable that the specimens in the Paris Museum came from some other part of the coast. Florida to Rio de Janeiro (Lütken). Puerto Cabello; Jamaica (Verr.),

Linckia Guildingii Gray.

Ann. and Mag. Nat. Hist., vi, p. 285, 1840.

Linckia ornithopus (Lütken) Verrill. Trans. Conn. Acad., i, p. 367, 1868.

Rio Formoso, Pernambuco (Branner). Maceio, Alagoas (Hartt, '67). Mar Grande, Bay of Bahia (Rathbun). Abrolhos Reefs (Hartt, '67). So far as known, this species is very rare on the Brazilian coast, only a few specimens having been collected at each of the above localities. Bahia (Perrier, Mus. Paris). Vera Cruz; Guadeloupe; Cape Verde Isl. (Perr.). St. Thomas (Ltk.). St. Vincent (Gray).

Pentagonaster semilunatus (Linck, 1733) Perrier.

Arch. de Zool. Expér., v, No. 1, p. 24, 1876.

Goniaster cuspidatus Gray, Ann. Nat. Hist., vi, p. 280, 1840.

Brazil (Perrier, Mus. Paris, from Castelneau).

According to the generally accepted rules of nomenclature, the above name should give place to one of more modern date, and of such there is an abundance in the long list of synonymy arranged by M. Perrier. As, however, he is the authority for the consolidation of several of the species included in that list, and also for the determination of the only specimens that appear to be recorded from Brazil, I prefer to retain here the old name of Linck, which he has revived. Indian Ocean (Müll. and Tr.). China; West Coast of Africa, at Gorée, Sénégal; Bissagos and Cape Verde Isls. (Perrier). Off Charleston, S. C. (*Goniaster Americanus* Verrill).

Oreaster gigas (Linn.) Lütken.

Vidensk. Meddel., 1859, p. 64; Verrill, Trans. Conn. Acad., i, p. 367, 1868.

City of Pernambuco, and also at several places in the same province to the north of the city, abundant (Geol. Comm.). Bay of Bahia, abundant nearly everywhere, on sandy bottom, from low-water mark to two fathoms and deeper; Abrolhos Islands; Caravellas Barra (Rathbun). Abrolhos Reefs (Hartt, '67). Bahia (Perrier, Mus. Paris). St. Thomas (Ltk.). West Indies; Barbadoes; St. Vincent (Gray). Hayti; Florida (Verrill).

Asterina marginata (Hupé) Perrier.

Arch. de Zool. Expér., v, No. 2, p. 220. 1876.

Brazil; Rio de Janeiro (Perrier, Mus. Paris). Brazil (Müll. and Trosch., Mus. Vienna). Specimens apparently of this species were collected in the Bay of Rio de Janeiro, by Mr. Branner. Sénégal (Perrier).

Luidia Senegalensis (Lam.) Müll. and Trosch.

Syst. der Asterid., p. 78, 1842.

Luidia Marcgravii Steenstrup, in Lütken, Vidensk. Meddel., p. 43, 1859.

Rio Formoso, Pernambuco, very abundant and often of large size (Branner). One specimen, collected by Mr. Branner, had a greatest diameter of more than 360^{mm}; diameter of disk, 51^{mm}. All the specimens observed had nine arms. Pernambuco (Derby, '70, in Mus. Yale Coll.). Brazil (Perrier, Mus. Paris). Sénégal; Guadeloupe (Perrier). Jamaica (Browne).

Luidia clathrata (Say) Lütken.

Vidensk. Meddel., 1859, p. 37.

Rio de Janeiro (Perrier, Mus. Paris). A young specimen, probably of this species, was collected in Botafogo Bay, Rio de Janeiro; and two larger specimens, agreeing perfectly with the small one from Rio, were obtained in the Bay of Bahia (Rathbun). N. Carolina—Florida; West Indies (Perr. and Verrill).

Astropecten Braziliensis Müll. and Trosch.

Syst. der Asterid., p. 68, 1842.

Bay of Rio de Janeiro, common (Rathbun). Brazil (Perrier, Mus. Paris; Müll. and Trosch., Mus. Vienna).

Pteraster Danæ Verrill.

Proc. Bost. Soc. Nat. Hist., xii, p. 386, 1869.

Rio de Janeiro? (J. D. Dana, U. S. Exploring Exp.) It has since been dredged on the east coast of Patagonia (Lütken), and it is possible that the Exploring Expedition specimen also came from that region.

OPHIUROIDEA.

Ophiura cinerea (Müll. and Tr.) Lyman.

Illust. Catal. Mus. Comp. Zoology, No. I, p. 27, 1865; Verrill, Trans. Conn. Acad., i, p. 367, 1868.

This Ophiuran is one of the commonest on the northern and central coasts of Brazil; but it has not been recorded from south of the Abrolhos Islands. It is generally found between high and low water marks, under stones in the shallow pools of the rocky shores and coral reefs, in which situations it often occurs in great abundance. The largest specimens obtained were from Fernando de Noronha. One of these afforded the following measurements; diameter of disk, 37^{mm}, length of arm, 210^{mm}.

Fernando de Noronha; Parahyba do Norte (Brauner). Plataforma, Mar Grande, and throughout the Bay of Bahia (Rathbun). Abrolhos Islands (Hartt, '67). Mr. Lyman refers doubtfully to this species an Ophiuran obtained by the Hassler Expedition in lat. 11° 39' S., long. 37° 20' W., depth 75 fathoms. Florida; West Indies; Gulf of Mexico (Lym.). Aspinwall (Verrill).

Ophiura appressa Say.

Jour. Phil. Acad., v, p. 151, 1825; Lyman, *Illust. Cat.*, No. I, p. 34, 1865.

Parahyba do Norte; Rio Formoso, Pernambuco (Branner). Platayforma, Bay of Bahia (Rathbun). Generally found associated with *O. cinerea*. Bahia (Lütken). About the same general distribution as *O. cinerea*.

Ophiura brevispina Say.

Loc. cit., v, p. 149, 1825; Lyman, *Illust. Cat.*, No. I, p. 18, 1865.

Brazil (Ljungman). Florida; Bahamas; St. Thomas (Lyman).

Ophiura Januarii (Lütken) Lyman.

Illust. Cat., No. I, p. 25, 1865.

Rio de Janeiro (Lütken, collected by Prof. Kröyer). Cotinguiba, Prov. of Sergipe (Lütken, collected by Capt. Hygom). Southern Brazil (Ljung.).

Ophiolepis paucispina (Say) Müll. and Trosch.

Syst. Asterid., p. 90, 1842; Lyman, *Illust. Cat.*, No. I, p. 55, 1865; Verrill, *Trans. Conn. Acad.*, i, p. 367, 1868.

Abrolhos Islands (Hartt, '67). One small Ophiuran, dredged in 3-4 fathoms, near the Island of Paqueta, Bay of Rio de Janeiro, appeared to be the young of this species (Rathbun). Florida; West Indies (Lyman).

Ophioceramis albida (Ljung.) Lyman.

Illust. Cat., No. VIII, part II, p. 10, 1875.

Rio de Janeiro Harbor (Hassler Exp.). Atlantic, near Rio de Janeiro (Ljungman, collected by Kinberg). Off the Rio de la Plata, 19-44 fathoms; East Argentina, 34 fathoms; Barbadoes, 100 fathoms (H. E.).

Ophioceramis Januarii (Lütken) Lyman.

Illust. Cat., No. I, p. 62, 1865.

Rio de Janeiro (Lütken, collected by Prof. Kröyer). Off Bahia, 40 fathoms; Cape Frio, 35 fathoms (H. E.). Barbadoes, 100 fathoms; East Patagonia (H. E.).

Ophionereis reticulata (Say) Lütken.

Addit. ad Hist. Oph., p. 110. 1859; Lyman, *Illust. Cat.*, No. I, p. 141, 1865; Verrill, *Trans. Conn. Acad.*, i, p. 366. 1868.

Plataforma and Mar Grande, Bay of Bahia, flat rocky shores, under stones, moderately abundant (Rathbun). Abrolhos Islands (Hartt, '67; Rathbun). Rio de Janeiro Harbor; off Cape Frio (H. E.). Northern Brazil (Ljungman). Florida; West Indies; Bay of Cumana; Bermudas (Lyman).

Ophiocoma echinata (Lam.) Agass.

Prod. Mém. Soc. Scien. Nat. de Neuchatel, i, 1835; Lyman, *Illust. Cat.*, No. I, p. 81. 1865.

Several specimens of this species, in fine condition, were brought from Parahyba do Norte, by Mr. Branner in 1876. They were obtained from shallow water, near the shore. A medium size specimen measured: diameter of disk, 26.5^{mm}; length of arm, 84^{mm}. Florida; West Indies; Aspinwall; Bay of Cumana (Lyman).

Ophiocoma Riisei Lütken.

Vidensk. Meddelelser, Jan., 1856, p. 14; Lyman, *Illust. Cat.*, No. i, p. 76, 1865.

One large specimen of this species was obtained by Mr. Branner in 1876, from the shore of the Island of Fernando de Noronha. It measured: diameter of disk, 29^{mm}; length of arm, 181^{mm}. In the characters of its several parts it agreed quite closely with the description of Mr. Lyman (*loc. cit.*), the differences noted being such as would naturally arise from its increased growth. Florida; West Indies; Bay of Cumana (Lyman).

Ophiopsila Riisei Lütken.

Addit. ad Hist. Oph., p. 136. 1859; Lyman, *Illust. Cat.*, No. I, p. 150. 1865.

Northern Brazil (Ljungman). Florida (Lyman). West Indies (Ljung.)

Ophiothrix violacea Müll. and Trosch.

Syst. Asterid., p. 115. 1842; Lyman, *Illust. Cat.*, No. I, p. 164. 1865; Verrill, *Trans. Conn. Acad.*, i, p. 366. 1868.

This is one of the most wide-spread of the Brazilian Ophiurans, having been recorded from Parahyba do Norte in the north, to Rio de Janeiro in the south, and from the littoral zone to a depth of at least 35 fathoms. In the Bay of Bahia it is particularly abundant,

being more common there than any other species. It undergoes considerable variation as regards shades of coloration, but is otherwise quite constant in its characters.

Parahyba do Norte; Rio Formoso, Pernambuco; very abundant (Branner). Plataforma, Mar Grande, Mapelle, and nearly everywhere along the shores of the Bay of Bahia; also dredged in about 4 fathoms in front of the city of Bahia (Rathbun). Abrolhos Islands, abundant (Hartt, '67; Rathbun). Near Bahia; lat. $11^{\circ} 49' S.$, long. $37^{\circ} 27' W.$ G.; off Cape Frio, 35 fathoms; Rio de Janeiro Harbor, (H. E.). Rio de Janeiro (Lütken, coll. by Prof. Kröyer; Müll. and Trosch., in the Museum at Vienna). Southern Brazil (Ljungman). Florida, shore to 50 fathoms; West Indies; Yucatan (Lym.). Aspinwall; Barbadoes (H. E.).

Ophiothrix Suensonii Lütken.

Vidensk. Meddel., Jan., 1856, p. 16; Lyman, *Illust. Cat.*, No. I, p. 157, 1865.

Lat. $22^{\circ} S.$, long. $40^{\circ} W.$ G., sandy bottom, depth not recorded; obtained by the Brazilian cable repair steamer "Norseman," 1876, (identified by Mr. Theo. Lyman). West Indies; Carthagen, New Granada (Lyman). Barbadoes, 100 fathoms (H. E.)

Ophiactis Krebsii Lütken.

Addit. ad *Hist. Oph.*, p. 126, 1859; Lyman, *Illust. Cat.*, No. I, p. 111, 1865; *Verrill. Trans. Conn. Acad.*, i, p. 366, 1868.

Plataforma, Bay of Bahia, only a few specimens obtained (Rathbun). Abrolhos Islands (Hartt, '67). Near Island of Paqueta, Bay of Rio de Janeiro, 3-4 fathoms, five specimens dredged (Rathbun). The majority of the specimens obtained had six arms. S. Carolina—Florida; Bahamas; St. Thomas (Lyman).

Ophiactis Mülleri Lütken.

Addit. ad *Hist. Oph.*, p. 127, 1859; Lyman, *Illust. Cat.*, No. I, p. 109, 1865.

Off the Abrolhos Islands, 30 fathoms (H. E.). Florida; West Indies (Lyman).

Hemipholis cordifera (Bosc) Lyman.

Illust. Cat., No. I, p. 137, 1865.

Southern Brazil (Ljungman). S. Carolina (Lyman).

Amphiura Kinbergi Ljung.

Vestindiska och Atlantiska Ophiurider, p. 643. 1871.

Southern Brazil (Ljungman).

Amphiura flexuosa Ljung.

Oph. Viventia, p. 319. 1866.

Southern Brazil (Ljungman, coll. by Kinberg). Barbadoes, 100 fathoms? (H. E.). Key Biscayne, Fla.? (Lyman).

Amphiura Stimpsonii Lütken.

Addit. ad Hist. Oph., p. 116. 1859.

Off Cape Frio, 35 fathoms (H. E.). West Indies (Lyman).

Amphiura complanata Ljung.

Oph. Viventia, p. 319. 1866.

Atlantic Ocean, lat. $22^{\circ} 30' S.$; long. $40^{\circ} 55' W.$ (Ljungman, coll. by Kinberg). Also from northern Brazil (Ljung.)

Amphiura crassipes Ljung.

Oph. Viventia, p. 319, 1866.

Atlantic ocean, lat. $22^{\circ} 30' S.$, long. $40^{\circ} 55' W.$ (Ljungman, coll. by Kinberg). Mr. Theo. Lyman has referred doubtfully to this species a single specimen of Ophiuran, obtained in 1876 by the steamer "Norseman," about twenty-five miles south of the entrance to the Bay of Rio de Janeiro, in 45 fathoms. The specimen was too much mutilated to permit of an accurate determination.

Amphiura tenera Lütken.

Addit. ad Hist. Oph., p. 124, 1859; Lyman, *Illust. Cat.*, No. I. p. 123, 1865.

Off Cape Frio, 35 fathoms (H. E.). S. Carolina; West Indies (Lyman).

Amphiura duplicata Lym.

Illust. Cat., No. VIII, part II, p. 19, 1875.

Brazil? (H. E.). Barbadoes, 100 fathoms (H. E.).

Amphiura planispina E. v. Martens.

Monatsbericht der Kon. Akad. Berlin, p. 347, 1867.

Rio de Janeiro.

Amphipholis Riisei (Lütken) Ljung.

Oph. Viventia, p. 313, 1866.

Southern Brazil (Ljungman). West Indies (Ljungman).

Amphipholis Januarii Ljung.

Om nagra nya arter af Ophiurider. p. 165, 1866.

Bay of Rio de Janeiro (Ljungman, coll. Kinberg).

Amphipholis subtilis Ljung.

Oph. Viventia, p. 314, 1866.

Atlantic, near Rio de Janeiro (Ljungman, coll. Lovén).

Amphipholis limbata (Grube) Ljung.

Oph. Viventia, p. 314, 1866.

Rio de Janeiro (Lyman). Coast of Brazil (Ljungman).

Ophiocnida scabriuscula (Lütken) Lyman.

Illust. Cat., No. I, p. 135, 1865.

Plataforma, Bay of Bahia, near low-water mark (Rathbun,—identified by Mr. Theo. Lyman). Florida; West Indies (Lyman).

Ophiocnida Loveni Lyman.

Bull. Mus. Comp. Zool., i, No. 10, p. 337, 1869.

Ophiophragmus Loveni Ljung., Om nagra nya arter af Oph., p. 165, 1866.*Amphipholis Loveni* Ljung., Vestindiska och Atlantiska Ophiurider, p. 648, 1871.

Bay of Rio de Janeiro (Ljungman, coll. by Kinberg). Off the Island of Paqueta, Bay of Rio de Janeiro, 3-4 fathoms, muddy bottom (Rathbun,—identified by Mr. Theo. Lyman).

Ophiostigma isacanthum (Say) Lyman.

Illust. Cat., No. I, p. 103, 1865.

Off Cape Frio, 35 fathoms (H. E.). Florida,—63 fathoms; St. Thomas; St. John (Lyman).

Ophiomyxa flaccida (Say) Lütken.

Addit. ad Hist. Oph., p. 138, 1859; Lyman, Illust. Cat., No. I, p. 178, 1865; Ver-rill, Trans. Conn. Acad., vol. i, p. 366, 1868.

Abrolhos Islands (Hartt, '67). Near Bahia (H. E.). Florida,—50 fathoms; West Indies (Lyman).

TRANS. CONN. ACAD., VOL. V.

20

JULY, 1879.

CRINOIDEA.

Antedon carinatus?

Alecto carinata Leach.

Comatula carinata Lamarek. Anim. sans Verteb., 2^d ed., iii, p. 210, 1840.

Antedon Dübentii Verrill (non Bölsche), Trans. Conn. Acad., i, p. 365, 1868 (with?).

Mr. L. F. de Pourtales, in a recent publication,* refers to *Comatula carinata* Lam., with query, a species of *Antedon* which he states to be common on the Brazilian coast. He does not, however, give the exact localities from which the specimens he has examined were obtained. Only two species of *Antedon* were collected by the members of the Geological Commission. One of these is a small species, with more than ten arms, to be described further on; the other is ten-armed, and, from comparisons I have been able to make, is evidently identical with the form mentioned by Mr. Pourtales. It was found in abundance at Rio Formoso, Pernambuco, at many localities in the Bay of Bahia, and at the Abrolhos Islands; but probably ranges along the entire coast, at least as far south as Rio de Janeiro. It generally occurs in holes and crevices of the rocky shores, and of millepores and other corals, clinging tightly by means of its cirri, but completely exposing its arms. A single, much mutilated specimen was collected at the Abrolhos Islands, by Prof. Hartt in 1867, and referred doubtfully to *Antedon Dübentii* Bölsche, by Prof. Verrill. Another specimen contained in the Peabody Museum of Yale College, was received from Dr. C. F. Lütken, labeled *Antedon Braziliensis* Lütk., Rio de Janeiro. This is apparently the same as the form now under discussion, and it approaches in many of its characters more closely the *A. carinatus* of the Mauritius and Zanzibar, than do the specimens from northern Brazil.

The Peabody Museum possesses several specimens of *Antedon* from Zanzibar, which, although I found them undetermined, agree so closely with the original descriptions of *A. carinatus*, as to leave little doubt of their identity. The Brazilian forms that I have been able to study differ from the Zanzibar specimens about as follows:—The *A. Braziliensis*, above mentioned, has the dorsal side of the arms rather more strongly carinate, the tubercle projecting from the median outer edge of each joint being usually very strongly marked, and often reaching inward one-half to two-thirds the length of the joint, as a very prominent, slightly elongate, sub-angular ridge, with a minutely spinose surface. One or two joints alternate between the

* Bull. Mus. Comp. Zoology, Cambridge, v, No. 9, p. 214, 1878.

successive syzygia. In the characters of the cirri and the centro-dorsal piece there are no appreciable differences.

The specimens from Bahia and Pernambuco, on the contrary, differ mostly with regard to the centro-dorsal piece and the cirri. The former is usually proportionally broader and flatter, but is extremely variable. The cirri are, as a rule, proportionally longer and fewer in number; they are placed in about two irregular rows, or in one crowded row, and range in number from about fifteen to thirty, on medium-sized specimens. They are composed of from nineteen to twenty-two joints each. The total spread of the largest perfect specimen observed was a little over twenty-five centimeters. The color varies from a light yellowish brown to a deep violet, with many intermediate shades, specimens being usually banded with lighter and darker colorings, and seldom of uniform tint.

The study of a large series of specimens would probably serve to unite the Brazilian with the East African species beyond all doubt.

Antedon meridionalis (A. Ag.) Verrill.

Proc. Bost. Soc. Nat. Hist., vol. x, p. 339, 1866; Pourtales, Bull. Mus. Comp. Zool., i, No. 11, p. 355, 1869; *Ibid.*, v, No. 9, p. 214, 1878.

Charleston, S. Carolina, to Cape Frio, Brazil (Pourtales, Mus. Comp. Zool.)

Antedon Dübenii Bölsche.

Archiv. für Naturgeschichte, 1866, p. 92.

Rio de Janeiro (Bölsche).

Antedon. sp.

A small species of *Antedon*, having between ten and twenty arms, was collected by Mr. Bramer, in great abundance, at some locality not definitely recorded, either on the coast of Pernambuco, or of Parahyba do Norte. I have not been able to identify it with any described species that has come under my notice, although it may not be new.

It is rather a delicate species, with slender arms and cirri, the former at times presenting only one division of the second order, resulting in the formation of eleven arms. There may, however, be any number of arms, up to at least twenty. It has a total spread of only about 9^{mm}, the centro-dorsal piece, measuring 2^{mm} in diameter, being flat and destitute of cirri on top, but sometimes still preserving

there traces of their points of attachment. Around the edge of the piece is a single row of twelve to sixteen cirri, each composed of eleven to twelve simple joints, in addition to the large, incurved, sharply-pointed terminal spine. First joint very short; second as long as broad; third to sixth or seventh longer than broad, somewhat constricted toward the centre, or enlarged at the ends, so as to produce a series of swellings along this part of each cirrus; the remaining joints, to the tip, decrease successively in size, and are slightly compressed laterally, the last three bearing each a minute, sharp tubercle at or near the upper distal end.

First radial slightly exposed; axials low, pentagonal; usually three brachials between first and second axials, and one brachial between second and third axials, when the latter occurs. At base of arm the joints are simple; but shortly after the last division they become rather long, and well-separated, with an oblique distal edge, which is thin and slightly raised so as to appear imbricating; this edge terminates in a row of minute, sharp tubercles. The first pinnule starts from the second joint after the first division; after the second division, there is a pinnule to each joint on alternate sides, with seldom an intervening joint. The first pinnules are very long and slender, their length being equal to about the diameter of the oral surface of the disk, or slightly longer. They are composed of rather elongated joints, those toward the base having their distal ends, on two sides, thin, slightly elevated and minutely spinose. The last seven to ten—not including the three terminal ones—bear each a very large, irregular tubercle, which is nearly as long as the joint itself. In alcoholic specimens these pinnules curve gracefully over and lie entangled together upon the oral side of the disk, appearing not unlike the young, unfolding fronds of a fern. The second pinnules are similar in structure to the first, but shorter. The others, to the tips of the arms, are of subequal size throughout, and from one-third to one-half the length of the first; they are rather broader at the base, and each of the three terminal joints composing them is marked with a minute, sharp tubercle.

Oral surface very minutely granulose; mouth eccentric; anus nearly central, raised on an elevated, conical prominence.

**IV.—THE COMET OF 1771: INVESTIGATION OF THE ORBIT. BY
WILLIAM BEEBE.**

THE orbit of this comet, as computed by Encke, has an excentricity of 1.0093698; and as it was observed for more than three months and through a path of more than 130° , it is considered the best determined of all hyperbolic orbits. But an examination of Encke's work shows that this result was obtained by the use of only six of the large number of observations available, and that he has computed a parabolic orbit which satisfies the same observations, not quite as well as the hyperbolic it is true, but yet within very reasonable errors of observation.

To render his work complete, therefore, needs a discussion of all the observations by the method of least squares. This discussion will be three-fold:

First. To verify Encke's work as far as that extended, by showing whether the whole body of observations gives the same result as six, when treated in the same way.

Second. To show whether a consideration of the perturbations, which Encke neglected, will modify these results and how much.

Third. Since the last and a highly important part of the observations is subject to large errors, to show what effect will be produced by any reasonable variation of these observations.

I.—The observations are as follows:

a. Ten by Maskelyn at Greenwich, differential measurements, made with a telescope of thirty inches focal length mounted on an equatorial sector, that is, a brass arc of 6° in length for measuring differences of declination, placed upon a portable stand with leveling screws, etc., and provided with a motion parallel to the equator. The observations in right ascension were made over three wires, and the time estimated to the eighth of a second; one measurement was made for difference of declination at each transit and two or three transits were taken over all the wires at each observation. They are published in the original form in Maskelyn's Observations, vol. i, page 115 of Zenith Distances; clock rates and errors are also appended as well as comparison stars. As the comet had a good bright nucleus, these right ascensions seem about as reliable as measurements of the

present day, but the declinations are less so, differences of declination of 2° to 3° having been measured.

b. Forty-eight by Messier, the discoverer, at Paris, differential measurements made with a two-foot finder of a larger instrument, furnished with a rhomboidal reticle of his own construction. It is referred to by Messier as a "*machine parallaxique*," and apparently had the same mounting as Maskelyn's. The comparison stars and the differences of Rt. Ascension and declination are published in the *Histoire de L'Academie* for 1777. The clock errors and rate are not given and the comparisons in R. A. are only to even seconds of time.

c. Forty-seven at Kremsmunster, Rouen and Stockholm. The original observations are not preserved. The results are published by Messier in connection with his own. Nineteen at Stockholm are accompanied by a list of comparison stars, but the differential measures are not given. All forty-seven cover the same period as Messier's, and not being, like his, susceptible of independent reduction, are of comparatively little value. There is no record of the instruments with which they were made.

d. Sixty-three at Marseilles by St. Jacques de Sylvabelle, published by Messier. Sylvabelle made two sets of measurements, direct and differential. Messier says that his differential measurements were as many as 400 or 500, but that for want of a catalogue of the comparison stars they were never reduced but preserved in the original manuscript. When in 1820 Encke computed the orbit, he visited Marseilles, and made thorough search for them at the observatory, but without success. Their loss is much to be regretted, since the climate of Marseilles allowed observation to continue up to July 17, whereas the latest elsewhere is on June 9, one of Messier's on June 19 being only an approximation. The succeeding computations show that the later observations are of decisive influence, while Sylvabelle's direct measurements, which are the sixty-three published, are inaccurate in a high degree, as we should expect from the account we have of them.

Messier says that lacking a catalogue of stars, Sylvabelle "made use of the R. A. and Decl. circles of the parallaxic machine" of his eight-foot telescope. This must mean that bringing the comet into the center of the field of the finder of the telescope in which he made the differential measurements, he then read off the circles which guided the motion of the telescope on its portable stand, and entered the results as the comet's position. In such observations the

variations of 6' to 8' which comparison with an ephemeris reveals are no larger than might be expected.*

Preparatory to the reduction of the observations, an ephemeris was computed from the parabolic orbit given by EucKe.

	T Apr. 19.18444 Paris m. t.				
(A)	$\pi - \Omega$	76°	1'	35".8	} Ecliptic and mean equinox 1771.0
	Ω	27	56	16.2	
	i	11	15	27.9	
		log q 9.9552324			
		Motion, direct.			

The ephemeris was computed at intervals of eight days and interpolated, taking account of sixth differences. The sun's places, to be used through the work, were computed from Hansen's and Olufsen's tables, as follows:

	Paris m. t.	☉			log. R.
Mar.	29.5	9°	5'	3".51	9.9998715
Apr.	6.5	16	57	7.22	0.0008842
	14.5	24	47	16.31	18774
	22.5	32	35	19.52	28010
	30.5	40	21	10.96	36748
May	8.5	48	5	18.32	45056
	16.5	55	47	59.59	52368
	24.5	63	29	6.08	58451
June	1.5	71	8	48.83	63652
	9.5	78	47	44.32	67878
	17.5	86	26	3.88	70611
	25.5	94	3	43.44	71936
July	3.5	101	41	8.14	72246
	11.5	109	18	52.22	71296
	19.5	116	56	58.47	68949

The values of log R differ somewhat from those found in the British Nautical Almanac for 1771, computed from less reliable tables. No other reason can be found why the corrections to the ephemeris are so much larger than would be expected from the nearness with which the same orbit as used by EucKe satisfies the six observations on which his work is based. (*Vide* p. 165).

*The successors of Sylvabelle, furthermore, told EucKe that he employed the janitor of the observatory to count seconds for him when observing, who, to avoid what was in his view tedious and unnecessary labor, disarranged the clock and other instruments, so that his master was often puzzled even to find the comet.

From the ephemeris the aberration was computed, and also a table of the comet's daily motion, including second differences. Instead of interpolating to the fraction of a day for each observation, the corrections were applied with a contrary sign to the observations themselves, and thus all were reduced to Paris midnight. The corrections for parallax, precession and nutation, all small, were applied, and the comparison stars where known were reduced from the B. A. C. to Jan. 1st, 1771. Several places used by Messier were found to be incorrect by 1' and 2'. The observations thus corrected did not agree together as well as before, indicating that they may have been somewhat altered to create uniformity.

In the following list, the first column denotes the place of observation. P. stands for Paris; G. Greenwich; S. Stockholm; R. Rouen; M. Marseilles; K. Kremsmunster. The second denotes the local time of observation reduced to Paris. The fourth and fifth are the observations corrected for precession, nutation and parallax, and reduced to midnight of Paris mean time.

	1771.				Reduced to midnight,		C—O		Wt.	Star.
	Paris m. t.				Paris m. t.		$\Delta\alpha$	$\Delta\delta$		
		h	m	s	Obs. a.	Obs. b.				
P	Apr. 1	8 22 40	13 50	38 56 50.6	21 21 24.8	- 3 44	-1 57.6	5	<i>ab</i>	
"	"	2 7 33 52	48	40 0 5.9	47 4.5	- 2 13.4	-1 34.8	5	<i>bc</i>	
"	"	3 7 42 30	45	41 4 55.1	21 12 56.9	- 1 59.1	-1 33.3	3	<i>c</i>	
"	"	4 8 0 3	41	42 10 4.2	38 23.1	- 1 1.9	-1 15.6	5	<i>c</i>	
"	"	5 8 3 49	37	43 18 19.7	22 4 25.2	- 2 7.7	-1 44.9	3	<i>cef</i>	
"	"	6 7 51 45	33	44 28 37.6	29 34.3	- 4 14.5	-1 34.6	3	<i>df</i>	
"	"	7 7 51 28	28	45 37 19.4	55 33.5	- 3 40.2	-1 29.9	5	<i>df</i>	
"	"	8 7 50 23	22	46 46 59.5	23 20 13.4	- 1 59.6	-2 23.0	5	<i>df</i>	
"	"	9 7 51 23	17	47 58 22.1	44 5.8	- 2 55.3	-1 47.0	5	<i>dfh</i>	
"	"	10 7 53 56	11	49 10 46.7	24 8 14.5	- 2 47.4	-1 48.1	5	<i>dfh</i>	
"	"	11 8 6 30	7	50 24 9.0	32 1.4	- 2 30.0	-1 41.8	5	<i>dfgh</i>	
"	"	12 8 17 46	4	51 38 44.8	55 12.1	- 2 19.9	-1 39.9	6	<i>fgh</i>	
R	"	12 8 58 14	4	39 52.	51 59.2	- 3 27.1	+1 33.0	2		
P	"	13 7 52 50	12 58	52 53 36.7	25 18 34.4	- 1 19.8	-2 8.5	4	<i>gh</i>	
P	"	13 8 21 51	58	56 9.5	18 35.	- 3 52.6	-2 9.5	2		
P	"	14 8 4 20	53	54 9 5.3	39 52.1	+ 9.3	-1 1.4	4	<i>h</i>	
G	"	14 9 22 55	53	11 33.8	40 15.2	- 2 19.2	-1 24.5	6	<i>i</i>	
R	"	14 8 10 39	53	13 10.8	40 36.9	- 3 56.2	-1 46.2	2		
P	"	15 8 12 46	49	55 28 38.9	26 1 53.5	- 2 21.4	-1 9.0	3	<i>hl</i>	
R	"	15 8 22 0	49	30 57.	2 48.	- 3 40.	-2 4.	2		
G	"	15 8 58 30	49	29 42.9	2 23.5	- 2 25.4	-1 39.1	5	<i>k</i>	
P	"	16 8 14 51	45	56 48 12.4	22 4.1	- 1 47.5	- 0.6	2	<i>h</i>	
R	"	16 8 27 56	45	49 2.2	22 54.6	- 2 7.	- 50.	2		
P	"	17 8 15 2	41	58 9 43.	44 53.6	- 3 6.4	-2 4.3	5	<i>h l n o</i>	
R	"	17 8 10 21	41	10 14.	42 16.	- 3 38.	+ 23.	2		
G	"	17 9 2 13	41	9 58.0	44 54.5	- 3 21.4	-2 5.2	3	<i>l</i>	
P	"	18 8 20 13	39	59 30 2.7	27 3 56.2	- 2 12.1	-1 0.1	3	<i>l n o</i>	
R	"	18 8 6 27	39	31 38.	2 55.	- 3 47.	+ 1.	2		
G	"	18 8 48 55	39	31 12.	4 41.7	- 3 20.4	-1 45.6	6	<i>o</i>	
"	"	18 9 2 20	39	31 9.2	4 34.8	- 3 17.6	-1 38.7	5	<i>p</i>	
S	"	19 10 58 41	36	60 46 47.	24 23.	- 3 22.	-2 10.	1	<i>o</i>	
"	"	21 11 3 42	30	53 23 29.	58 26.	+ 2.	-1 44.	1	<i>m</i>	
G	"	21 9 12 0	30	40 58.1	28 1 21.2	- 3 11.0	-2 14.0	7	<i>p</i>	
M	"	22 8 16 23	26	64 59 46.	17 49.	+ 3 19.	-1 29.	0		
S	"	22 11 56 42	26	65 6 53.	17 31.	- 3 48.	-1 11.	1	<i>r</i>	

	1871.	Paris m. t.		Aber.	Reduced to midnight. Paris m. t.		C-O		Wt.	Star.										
		h	m		s	m	s	Obs. c.			Obs. d.	Δα	Δδ							
R	Apr.	22	8	26	7	12	26	65	6	5	28	16	23	-	2	58	-	3	2	
R	"	23	8	18	28		23	66	32	48		32	34	-	3	27	-	11	2	
R	"	24	8	38	41		20	67	59	46-0		50	2-2	-	3	14-9	-	1	44-3	2
P	"	25	8	5	28		18	69	28	3-3	29	4	5-7	-	3	29-0	-	1	10-4	2
P	"	25	8	41	32		18		23	38		6	41	+	56	-	3	43	0	
M	"	25	8	54	17		18		27	23-0		4	46-8	-	2	48-7	-	1	48-5	6
G	"	26	8	19	0		16	70	56	17-0		18	20-5	-	2	50-2	-	1	38-5	2
P	"	26	8	20	33		16		51	32		17	13	+	1	55	-	29	0	
P	"	27	8	23	39		13	72	25	47-0		30	55-5	-	2	46-8	-	1	22-5	2
M	"	27	8	28	1		13		26	25		28	33	-	3	24	-	1	0	
S	"	27	11	10	46		13		28	27		31	30	-	5	26	-	1	57	1
S	"	28	8	25	20		11		56	47		41	7	-	3	17	-	17	0	
S	"	28	11	5	48		11	73	58	52		42	50	-	5	22	-	1	26	1
R	"	28	8	49	34		11		57	21		41	0	-	3	51	-	24	2	
P	"	29	8	18	4		8	75	27	36-2		54	12-7	-	3	07	-	1	58-8	2
S	"	29	10	57	4		9		29	39		53	50	-	5	4	-	1	36	1
M	"	30	8	44	13		7	76	55	41	30	3	31	-	38	-	1	28	0	
S	"	30	10	51	35		7	77	1	7		3	49	-	4	48	-	1	46	1
M	May	1	9	0	27		5	78	27	13		13	16	-	1	21	-	2	28	0
S	"	1	11	38	31		5		31	6		12	31	-	2	32	-	1	43	1
S	"	2	8	38	54		4	80	4	26		20	15	-	2	56	-	1	47	0
S	"	2	10	45	39		4		6	28		20	1	-	4	58	-	1	32	1
R	"	2	8	54	31		4		7	3		19	3	-	5	53	-	2	31	2
P	"	3	8	50	14		3	81	38	28-2		26	0-4	-	3	38-6	-	57	1	8
M	"	3	9	11	16		3		40	8		28	57	-	5	16	-	3	54	0
S	"	3	11	10	53		3		39	24		26	21	-	4	34	-	1	18	1
R	"	3	8	45	14		3		40	21		28	56	-	5	22	-	1	8	2
P	"	4	8	41	44		2	83	12	14-8		31	27-1	-	3	43-3	-	55	1	8
M	"	4	9	16	24		2		11	36		34	48	-	3	4	-	4	19	0
S	"	4	11	31	34		2		12	21		31	27	-	3	49	-	55	1	8
R	"	4	9	35	15		2		14	36		28	57	-	6	5	-	1	36	2
P	"	5	9	22	24		1	84	46	4-0		35	49-4	-	3	34-5	-	55	7	8
M	"	5	8	19	43		1		46	4		36	52	-	3	34	-	1	58	0
S	"	6	12	5	46		0		20	46		38	28	-	4	3	-	21	1	0
P	"	7	8	49	4	11	59	87	54	27-1		40	3-8	-	3	14-3	-	8	4	
S	"	7	11	42	26		59		55	56		38	44	-	4	43	-	1	28	1
S	"	7	9	5	30		59		57	23		38	47	-	6	11	-	1	25	2
S	"	8	11	27	41		59	89	32	3		41	50	-	6	13	-	42	1	7
M	"	9	9	4	57		59	91	2	10		46	9	-	1	44	-	5	15	0
P	"	10	8	54	29		59	92	39	17-5		40	6-6	-	4	18-1	-	1	13	4
M	"	10	9	22	42		59		37	43		46	1	-	2	44	-	6	30	0
"	"	11	9	9	26		59	94	13	36		38	53	-	4	10	-	1	55	0
"	"	12	9	25	53		59	95	45	15		38	47	-	1	33	-	5	30	0
"	"	13	8	34	52		59	97	25	35		28	31	-	7	52	-	1	0	
"	"	13	11	57	8		59		23	42		29	38	-	5	59	-	1	8	1
P	"	14	9	10	37	12	0	98	56	21-4		22	32-3	-	4	38-0	+	3	4	8
M	"	14	8	34	6		0		44	4		23	18	+	7	19	-	42	0	
S	"	14	11	46	54		0		56	50		23	4	-	5	27	-	28	1	8
P	"	15	8	51	9		1	100	29	54-7		15	53-3	-	5	15-3	-	19	4	8
"	"	15	9	41	28		1		29	23		15	58	-	4	44	-	22	2	
K	"	15	10	43	19		1		24	21-8		16	27	-	18	-	51	1	0	
P	"	16	9	22	24		2	102	2	13-2		7	59-8	-	5	8-4	-	19	3	4
M	"	16	8	41	9		2		5	26		8	6	-	7	38	-	34	0	
S	"	16	11	57	28		2		3	5		8	16	-	4	38	-	44	1	8
S	"	16	12	10	44		1		2	58		8	20	-	5	31	-	48	1	0
R	"	16	9	50	50		2		2	17		7	22	-	4	50	-	10	2	
K	"	16	10	24	38		2	101	27	12		7	18	-	15	-	14	1	0	
P	"	17	9	18	26		3	103	35	51-3	20	58	13-4	-	5	43-0	-	8	3	8
M	"	17	9	22	9		3		30	43	10	1	17	-	6	2	-	2	48	0
R	"	17	9	36	9		3		35	19	20	28	8	-	6	34	-	19	2	
P	"	18	8	21	10		3	105	2	39-0		47	47-1	-	4	10-7	-	26	4	8
M	"	18	9	42	14		3		3	38		46	14	-	2	19	-	2	0	0
K	"	18	10	51	40		3		6	10		47	0	-	1	9	-	1	14	1
P	"	19	9	49	35		3	106	28	8		38	54-0	-	3	49	-	4	7	8
R	"	19	9	34	31		3		37	50		35	41	-	5	32	-	1	50	2
P	"	20	9	30	38		3	108	7	45-0		24	12-7	-	5	13-5	-	44	5	8

	1771. Paris m. t.	Aber.		Reduced to midnight. Paris m. t.		C-O		Wt.	Star.		
		h	m	Obs. a.	Obs. d.	Δa	$\Delta \delta$				
		s	s	z	z	z	z				
M	May	20	8 43 56	12	108 10 23	29	22 34	- 7 42	+ 2 22	0	
R	"	20	9 22 47	8	7 51		23 36	- 5 18.7	+ 1 20	2	
P	"	21	9 50 6	10	109 36 34.6		12 16.9	- 4 32.9	- 25.0	5	z
M	"	21	9 44 23	10	39 2		10 58	- 7 0	+ 54	0	
R	"	21	9 10 4	10	36 51		10 58	- 4 49	+ 54	2	
M	"	22	9 27 1	12	111 9 45	28	58 43	- 9 3	- 49	0	
R	"	22	9 55 18	12	6 44		57 20	- 6 2	+ 32	2	
G	"	22	10 43 56	12	5 35		57 18.2	- 4 53.0	+ 35	3	z y
P	"	23	9 24 27	14	112 33 8.4		42 31.8	- 4 38.1	+ 31.3	5	z
M	"	23	9 17 14	14	36 1		42 32	- 7 31	+ 31	0	
R	"	23	9 6 30	14	34 35		42 38	- 6 4	+ 25	3	
K	"	23	11 43 34	14	27 13.7		41 53	+ 1 17	+ 1 10	1	
P	"	24	9 38 23	17	114 0 6.4		27 13.3	- 4 42.9	+ 9.4	3	z
M	"	24	9 11 6	17	1 44		26 23	- 6 20	+ 1 0	0	
R	"	24	9 58 45	17	1 32		26 47	- 6 8	+ 36	2	
G	"	24	10 7 15	17	0 24.2		26 14.2	- 5 0.7	+ 1 18.9	7	z
P	"	25	9 26 30	20	115 26 19.8		9 52.3	- 5 0.9	+ 1 2.2	4	z
M	"	25	9 15 55	20	30 23		11 51	- 9 4	- 56	0	
P	"	26	9 40 56	22	116 50 56.2	27	52 37.8	- 4 41.4	- 1 2.9	4	z a
M	"	29	8 57 0	28	120 58 57	26	56 47	- 4 7	+ 1 2	0	
M	"	30	9 16 30	31	122 26 44		39 15	[- 11 10]	- 1 18	0	
P	"	30	9 32 0	34	26 12.7		35 21.5	[- 10 38.4]	+ 21.6	0	β
G	"	30	10 15 50	35	20 50.5		37 1.9	- 5 10.2	+ 55.4	6	y
P	"	31	9 28 27	39	123 39 40.2		16 14.5	- 4 27.5	+ 51.0	3	β
M	"	31	9 9 14	39	42 30		17 6	- 7 17	+ 23	0	
M	June	1	9 14 36	44	125 3 50	25	54 49	- 10 5	+ 1 46	0	
P	"	2	10 1 52	49	126 16 4.1		34 21.6	- 4 55.4	+ 40.2	5	β
M	"	2	9 10 20	49	18 56		33 42	- 7 47	+ 1 20	0	
R	"	3	9 50 30	52	127 32 13.9		11 12.3	- 4 48.6	+ 1 54.9	4	y
M	"	3	9 12 57	52	36 9		12 41	- 8 44	+ 26	0	
"	"	4	9 5 52	56	128 51 40	24	48 35	- 9 6	+ 2 12	0	
"	"	5	9 10 34	13	1 130 6 15		25 32	- 9 40	+ 2 31	0	
"	"	6	9 11 2	6	131 19 21		5 31	- 9 53	- 32	0	
P	"	7	9 49 39	11	132 25 29.6	23	41 12.1	- 4 14.9	+ 33.3	5	$\epsilon \delta$
M	"	7	9 15 17	11	29 30		41 33	- 8 15	+ 3	0	
P	"	8	10 12 14	17	133 36 6.0		16 27.6	- 4 12.1	+ 1 29.2	4	ϵ
M	"	8	9 14 31	17	37 10		16 31	- 5 16	+ 1 26	0	
P	"	9	10 18 32	23	134 46 47.6	22	52 6.7	- 5 20.9	+ 1 55.7	1	ϵ
M	"	9	9 9 22	23	49 32		53 24	- 8 5	+ 38	1	
"	"	11	9 18 52	34	137 6 16		6 0	- 9 1	- 23	1	
"	"	12	9 29 41	41	138 11 28	21	40 40	- 7 55	+ 29	1	
"	"	15	9 17 26	59	141 25 18	20	26 29	- 9 13	+ 33	1	
"	"	16	9 35 40	14	6 142 26 9		3 29	- 7 36	- 1 18	1	
"	"	17	8 44 44	12	143 27 20	19	31 40	- 8 0	+ 5 37	1	
"	"	18	8 48 8	11	144 25 18		5 44	- 5 49	+ 6 38	1	
"	"	19	9 2 28	25	145 26 35	18	44 10	- 7 55	+ 3 17	1	
P	"	19	10 0 0	25	32 46.2		43 55.3	[- 14 5.8]	[- 3 23.4]	0	
M	"	20	9 21 59	33	14 51		31 3	- 4 11	- 8 33	1	
"	"	21	9 20 51	40	147 17 8		3 29	- 2 54	- 5 47	1	
"	"	22	9 31 23	48	148 12 22	17	36 40	- 1 44	+ 6 47	1	
"	"	23	9 15 2	56	149 11 39		12 24	- 5 31	- 4 16	1	
"	"	25	9 28 39	15	9 150 58 41		16 24 39	- 4 8	- 5 46	1	
"	"	28	9 27 52	32	153 35 1	15	7 39	- 4 8	- 1 50	1	
"	"	29	9 22 16	41	154 25 34	14	44 5	- 4 7	- 2 22	1	
"	July	2	9 9 56	16	3 156 55 15		13 32 26	- 6 27	- 2 15	1	
"	"	5	8 56 18	30	159 29 49		12 19 16	[- 19 27]	+ 39	0	
"	"	7	9 2 57	48	160 42 39	11	33 23	- 1 15	+ 29	0	
"	"	8	8 41 47	57	161 27 41		8 6	- 2 37	+ 2 59	1	
"	"	9	8 51 12	17	5 162 34 21		10 47 7	[- 24 43]	+ 1 22	0	
"	"	10	8 46 25	14	54 37		26 12	- 1 0	- 8	1	
"	"	12	8 38 27	33	164 22 55	9	39 6	- 4 10	+ 2 43	1	
"	"	14	8 47 23	51	165 44 31	0	21	- 2 57	- 1 54	1	
"	"	15	8 48 47	18	0 166 24 8	8	39 41	- 2 48	- 2 16	1	
"	"	16	8 42 7	9	167 3 15		16 50	- 1 19	- 47	1	
"	"	17	8 48 36	18	42 43		7 55 28	- 1 33	- 14	1	

Comparison Stars.

		1771.0		
Name.		B. A. C.	<i>a.</i>	<i>δ</i>
<i>a</i>	47 Arietis.	913	41° 15' 15".75	19° 44' 7".8
<i>b</i>	<i>e</i> "	921	32 16.95	20 24 37.6
<i>c</i>	γ "	999	45 26 38.10	20 10 50.1
<i>d</i>	64 "	1052	47 42 24.60	23 53 49.2
<i>e</i>		1069	48 46 37.95	21 59 57.6
<i>f</i>		1095	50 13 46.35	23 40 48.6
<i>g</i>		1126	51 46 59.40	24 34 17.3
<i>h</i>	η Tauri.	1166	53 28 37.05	23 22 47.7
<i>i</i>		1192	54 8 39.90	24 52 19.0
<i>k</i>	36 "	1253	57 40 26.40	23 27 27.1
<i>l</i>	41 "	1262	58 8 54.90	26 57 50.5
<i>m</i>	ψ "	1265	58 13 16.65	28 21 46.5
<i>n</i>	ρ "	1279	59 13 46.65	25 51 51.3
<i>o</i>	φ "	1326	61 34 36.91	26 46 59.4
<i>p</i>		1408	65 4 39.60	28 28 17.5
<i>q</i>		1444	66 45 18.45	28 9 2.6
<i>r</i>	β "	1681	77 57 22.65	28 24 7.6
<i>s</i>	26 Aurigae.	1768	80 59 6.90	30 19 58.2
<i>t</i>	41 "	1963	86 57 34.65	31 14 51.3
<i>v</i>	κ "	2001	90 11 42.15	29 33 37.0
<i>w</i>	48 "	2082	93 27 38.70	30 36 42.7
<i>x</i>	τ Geminorum.	2340	104 8 4.80	30 35 56.3
<i>y</i>	σ "	2540	112 14 30.00	29 25 2.0
<i>z</i>	β "	2555	112 49 8.25	28 33 56.0
<i>a</i>	φ "	2617	114 51 43.65	27 20 22.2
<i>β</i>	α ² Cancri.	2730	119 9 20.85	26 11 3.9
<i>γ</i>	ο "	2817	123 13 45.30	27 40 25.3
<i>ε</i>	ξ "	3117	134 2 19.20	22 57 28.5
<i>δ</i>	ν "	3079	132 19 17.95	25 20 21.5

Corrections to the Ephemeris.

1771	In Rt. Ascension.					
	Paris m. t.	Paris and elsewhere.			Marselles.	
		No. obs.	Wt.	Corr. Δ <i>a</i>	No.	Corr. Δ <i>a</i>
Apr. 6.5	11	49	-2' 36" ± 10".4	0		
14.5	22	65	+2 44" ± 7.2	0		
30.5	23	36	-3 29" ± 7.6	10	+1' 19" ± 38"	
May 8.5	7	16	-4 21" ± 11.5	4	+3 27" ± 21"	
16.5	27	45	-5 24" ± 4.9	6	+6 7" ± 59"	
24.5	12	36	+5 2" ± 3.0	5	+8 21" ± 18"	
June 1.5	4	18	-5 8" ± 3.8	9	+8 19" ± 33"	
9.5	3	12	+4 27" ± 8.4	6	+8 13" ± 27"	
25.5	0	18	[+3 0"]	12	+5 30" ± 25"	
July 11.5	0	15	[- 8"]	9	+2 38" ± 24"	

Corrections to the Ephemeris (continued).

1771	In Declination.					
	Paris m. t.	Paris and elsewhere.			Marseilles.	
		No. obs.	Wt.	Corr. $\Delta d.$	No.	Corr. $\Delta d.$
Apr. 6.5	11	49	+1' 42'' \pm 6''8	0		
14.5	22	65	+1 31' \pm 4.1	0		
30.5	23	36	+1 29' \pm 5.3	10	-1' 49'' \pm 19''	
May 8.5	7	16	- 8' \pm 14.3	4	+3 27' \pm 44'	
16.5	27	45	- 6' \pm 5.7	7	+ 44' \pm 41'	
24.5	12	36	- 38' \pm 6.8	5	- 9' \pm 17'	
June 1.5	4	18	- 57' \pm 4.8	9	-1 14' \pm 10'	
9.5	3	12	- 1.5 \pm 15.0	6	- 18' \pm 8'	
25.5	6	18	[- 37']	12	- 37' \pm 65'	
July 11.5	6	15	[- 1']	9	- 1' \pm 28'	

The Marseilles observations were not used to correct the ephemeris until after June 9, the date of the last reliable observation elsewhere. Preparatory to using the rest, an attempt was made to detect the presence of any systematic error by comparing the earlier part of the series with those more reliable. A set of ten dates was decided on, eight of which fell within the period embraced by the other observations. The corrections to the ephemeris due to all the other observations were obtained from these eight dates and compared with the corrections derived from the Marseilles observations, as above.

The ephemeris thus approaches the observations in right ascension, nearer at the ends than in the middle; and we might expect by July to find the ephemeris very near the observations.

This would require a diminution of the corrections for June 25 and July 11, as derived from the Marseilles observations, and the excess of these observations for May 24 and June 1 and 9 confirms this opinion. Consequently the last two corrections were diminished each by 2° 30'.

In declination, the same principle would lead us to expect larger subtractive corrections at the end than the Marseilles observations give; but these show too many irregularities throughout to warrant any change. Encke made use of one observation in July, which he diminished by 40' in right ascension, but left unchanged in declination, giving no reason for so doing.* The amount of the correction is very arbitrary, and can only be called an attempt to remove what seems to be a systematic excess in the Marseilles observations.

The ephemeris corrected by the amounts given in the first of the two columns of corrections, including those in brackets for June 25 and July 11, gives the following normal places.

* See Von Zach's Astr. Corresp. 1821. p. 557.

	<i>a</i>	<i>δ</i>		<i>a</i>	<i>δ</i>
April 6.5	44° 26' 59''	22° 29' 42''	May 24.5	114° 0' 26''	28° 26' 45'
14.5	54 11 59	25 40 22	June 1.5	124 58 53	25 55 32
30.5	76 59 48	30 3 32	9.5	134 45 54	22 52 57
May 8.5	89 30 11	30 41 0	25.5	150 57 33	16 18 16
16.5	102 2 51	30 7 38	July 11.5	163 36 9	10 3 51

The observations up to June 9 lie so nearly on the arc of a great circle that it was found inconvenient to compute an orbit from four places. By the use of the normal places for April 6 and 30, and May 24, the following orbit was derived.

Comet 1771. T April 19:12200 Paris. C—O

$$\begin{aligned} \pi & 104^\circ 18' 19''.93 & \left. \begin{array}{l} \text{ecliptic and} \\ \text{main equinox} \end{array} \right\} & \text{April 30.} \\ \Omega & 28 11 51.86 & & \cos \delta \Delta \alpha, \quad \Delta \delta \\ (B) \quad i & 11 17 27.86 & 1771.0 & +^{\circ}07 \quad +^{\circ}40 \\ \varphi & 75 38 21.85 & \log \varepsilon 9.9862135 & \\ & & \log a 1.4576122 & \\ & & \log q 9.9524080 & \end{aligned}$$

An ephemeris computed from these elements and compared with the normal places gives the following residuals.

	C—O			C—O	
	$\Delta \alpha$	$\Delta \delta$		$\Delta \alpha$	$\Delta \delta$
April 6	0' 0'	0' 0'	May 24	+ 0' 0'.2	+ 0' 0'.3
14	+ 27.9	+ 21.0	June 1	+ 1 27.5	- 1 0.5
30	- 1	+ 4	9	+ 4 6.1	- 2 35.8
May 8	- 47.0	- 1 5.7	25	+ 10 3.0	- 7 14.6
16	- 1 22.4	+ 12.7	July 11	- 16 37.4	- 11 22.6

From these residuals corrections to the ephemeris were obtained by the variation of the two geocentric distances for April 6 and May 24, taken from the previous ephemeris.

This method was preferred, though more tedious, because it requires elimination between only two normal equations; for when, as here, the differential coefficients cover only a short period, they vary so little as to render the elimination of six unknown quantities not wholly trustworthy.

The elements, referred to the equator, are

$$\begin{aligned} \pi & 105^\circ 26' 15''.81 \\ \Omega & 9 34 7.59 \\ i & 33 49 2.32 \end{aligned}$$

The variation of θ , the geocentric longitude referred to the plane of the unchanged orbit as the fundamental plane, depends only on

the four elements; χ , which in the unchanged orbit is taken equal to $\pi - \varepsilon$, q and T , and since the latitude η is affected only by the small changes in the position of the orbit, depending on i and Ω , the elements which satisfy θ will nearly satisfy η also.

The partial differentials of the four elements with reference to Δ and Δ'' , computed from equations of the form

$$\frac{dx}{d\Delta} + \frac{dv}{de} \frac{de}{d\Delta} + \frac{dv}{dt} \frac{dt}{d\Delta} + \frac{dv}{dq} \frac{dq}{d\Delta} = \frac{1}{r} \cos n \sin(\theta - u')$$

$$\frac{dr}{de} \frac{de}{d\Delta} + \frac{dr}{dt} \frac{dt}{d\Delta} + \frac{dr}{dq} \frac{dq}{d\Delta} = \cos n \cos(\theta - u')$$

and the same for Δ'' ; give by elimination

$$\log \frac{dx}{d\Delta} 0.23212 \qquad \log \frac{dx}{d\Delta''} 0.15056$$

$$\log \frac{de}{d\Delta} 0.49956 \qquad \log \frac{de}{d\Delta''} 0.74700$$

$$\log \frac{dt}{d\Delta} 1.93140 \qquad \log \frac{dt}{d\Delta''} 1.69946$$

$$\log \frac{dq}{d\Delta} 9.58362 \qquad \log \frac{dq}{d\Delta''} 9.32929$$

$\frac{dv}{de}$, $\frac{dv}{dt}$, &c., having been computed by the ordinary differential formulæ.

Then the partial differential coefficients of θ with reference to Δ and Δ'' are computed for each normal place from equations of the form

$$\cos n \frac{d\theta}{d\Delta} = \cos n \frac{d\theta}{dx} \frac{dx}{d\Delta} + \cos n \frac{d\theta}{de} \frac{de}{d\Delta} + \cos n \frac{d\theta}{dt} \frac{dt}{d\Delta} + \cos n \frac{d\theta}{dq} \frac{dq}{d\Delta},$$

as follows:

	$\cos n \frac{d\theta}{d\Delta}$	$\cos n \frac{d\theta}{d\Delta''}$		$\cos n \frac{d\theta}{d\Delta}$	$\cos n \frac{d\theta}{d\Delta''}$
April 6,	-000055	+000036	May 24,	-000027	-000000
14,	-11732	+06530	June 1,	+11544	-10734
30,	-21066	+13701	9,	+22364	-21520
May 8,	-18644	+13184	25,	+37886	-46916
16,	-10443	+08130	July 11,	+44275	-66823

The values for April 6 and March 24, which should be zero, furnish a check for the correctness of the work to the fifth place.

From $\Delta\alpha$ and $\Delta\delta$ we compute $\Delta\theta$, and also Δn which will be used in another place, from the formulæ

$$\cos n \Delta\theta = \sin \gamma \Delta\delta + \cos \gamma \cos \delta \Delta\alpha$$

$$\Delta n = \cos \gamma \Delta\delta - \sin \gamma \cos \delta \Delta\alpha, \text{ as follows:}$$

O—C	$\cos n \Delta\theta$	Δn	O—C	$\cos n \Delta\theta$	Δn
April 6,	0	— 0	May 24,	0	0
14,	— 31'·4	+ 9'·3	June 1,	— 90'·9	— 39'·8
30,	0	0	9,	— 245'·6	+ 46'·7
May 8,	+ 33'·8	+ 69'·3	25,	— 711'·2	+ 137'·3
16,	+ 73'·5	— 71'·3	July 11,	— 1192'·2	+ 1003'·0

With these values we form seven equations of condition of the form $\cos n \Delta\theta = \cos n \frac{d\theta}{d\Delta} \Delta\Delta + \cos n \frac{d\theta}{d\Delta''} \Delta\Delta''$, the weights being those assigned to the observations from which the residuals were obtained, and the numbers in parentheses, logarithms.

$$\begin{aligned}
 (1^{\text{n}}.49748) &= (9^{\text{n}}.06937) \Delta\Delta + (8^{\text{s}}.81491) \Delta\Delta'' \text{ wt. } 65 \\
 (1^{\text{s}}.52910) &= (9^{\text{n}}.27054) \text{ " } + (9^{\text{s}}.12005) \text{ " } \text{ " } 16 \\
 (1^{\text{s}}.85467) &= (9^{\text{n}}.01887) \text{ " } + (8^{\text{s}}.91009) \text{ " } \text{ " } 45 \\
 (1^{\text{n}}.95811) &= (9^{\text{s}}.06236) \text{ " } + (9^{\text{n}}.03076) \text{ " } \text{ " } 18 \\
 (2^{\text{n}}.39028) &= (9^{\text{s}}.34955) \text{ " } + (9^{\text{n}}.33284) \text{ " } \text{ " } 12 \\
 (2^{\text{n}}.85199) &= (9^{\text{s}}.57848) \text{ " } + (9^{\text{n}}.67132) \text{ " } \text{ " } 18 \\
 (3^{\text{n}}.07635) &= (9^{\text{s}}.64616) \text{ " } + (9^{\text{n}}.82493) \text{ " } \text{ " } 15
 \end{aligned}$$

These combined by least squares give

$$\begin{aligned}
 (4^{\text{n}}.139627) &= (0.963599) \Delta\Delta + (1^{\text{n}}.031530) \Delta\Delta'' \\
 (4^{\text{n}}.277655) &= (1.031530) \text{ " } + (1^{\text{n}}.110118) \text{ " } \\
 \Delta\Delta &= + 2101^{\text{s}}.2 = + .0101871 \text{ (units 7th dec. place)} \\
 \Delta\Delta'' &= + 3223.5 = + .0156284 \text{ " } \text{ " }
 \end{aligned}$$

Substituting these values in equation of the form

$$\begin{aligned}
 \Delta\chi &= \frac{d\chi}{d\Delta} \Delta\Delta + \frac{d\chi}{d\Delta''} \Delta\Delta'', \text{ \&c., gives} \\
 \Delta\chi &= - 16' 13^{\text{s}}.5 \\
 \Delta\varepsilon &= + .0409094 \\
 \Delta t &= + .087541 \\
 \Delta q &= + .0072416
 \end{aligned}$$

Also, from $\Delta v = \frac{d(v + \chi)}{d\Delta} \Delta\Delta - \Delta\chi$

$$\Delta v = - 5' 30^{\text{s}}.8 \quad \Delta v'' = - 17' 35^{\text{s}}.6$$

The values of v from the elliptic elements are

$$v = - 20^{\circ} 9' 18^{\text{s}}.55 \quad v'' = + 50^{\circ} 20' 20^{\text{s}}.88.$$

Applying these corrections $v = - 20^{\circ} 14' 49^{\text{s}}.35 \quad v'' = + 50^{\circ} 2' 45^{\text{s}}.28.$

The values found from an ephemeris computed by the corrected elements are $v = - 20^{\circ} 14' 47^{\text{s}}.95 \quad v'' = + 50^{\circ} 2' 51^{\text{s}}.08.$

The agreement is not complete, owing to the magnitude of the

second differences neglected in computing differential coefficients, but furnishes a proof that the computations are as accurate as necessary. The equations

$$\left. \begin{aligned} r \sin u \Delta i' - r \cos u \sin i' \Delta \Omega' &= \sin n \Delta \mathcal{J} \\ r'' \sin u'' \Delta i'' - r'' \cos u'' \sin i'' \Delta \Omega'' &= \sin n'' \Delta \mathcal{J}'' \end{aligned} \right\} \text{give } \left\{ \begin{aligned} \Delta \Omega' &= -8'4''\cdot31 \\ \Delta i' &= -12''\cdot98 \end{aligned} \right.$$

And the equations

$$\left. \begin{aligned} \Delta w' &= \Delta \chi - \cos i' \Delta \Omega' \\ \Delta \pi' &= \Delta \chi + 2 \sin^2 \frac{1}{2} i' \Delta \Omega' \end{aligned} \right\} \text{give } \left\{ \begin{aligned} \Delta w' &= -9'31''\cdot13 \\ \Delta \pi' &= -17'35''\cdot46 \end{aligned} \right.$$

And the corrected elements are:

	Ref. to equator.	Ref. to ecliptic.	Encke's elements.	
T	April 19 ^h 20 ^m 54 ^s .1		19 ^h 21 ^m 9 ^s .1	
log <i>q</i>		9.9559031	9.9559104	
<i>e</i>		1.009663	1.0093698	
(C) π	105° 8' 40"·35	104° 1' 41"·17	104° 3' 16"·	(D)
Ω	9 26 32·8	27 50 36·00	27 51 55·	
<i>i</i>	33 48 49·34	11 15 45·08	11 15 19·	

An ephemeris computed from these elements and compared with the observations gives the residuals $\Delta \alpha$ and $\Delta \delta$. The substitution of the adopted values of $\Delta \mathcal{J}$ and $\Delta \mathcal{J}''$ in the equations of condition gives $\Delta \theta$.

C-O	$\Delta \alpha$	$\Delta \delta$	$\Delta \theta$
April 6,	-5"·7	-1·8	0
14,	-11·5	-5·9	-4·5
30,	-22·2	-39·3	-9
May 8,	-19·5	+32·7	-5
16,	-53·2	-12·1	-29·1
24,	-19·4	+0·8	0
June 1,	-33·1	+1·1	-12·7
9,	-15·9	-16·5	+21·7
25,	-5·7	-36·2	-5·1
July 11,	+17·5	+9·5	-31·6

To ascertain the most probable parabola, the variations of the elements are computed as functions of Δe . The residuals and differential coefficients are substituted in the equations

$$\cos n \frac{d\theta}{d\chi} \Delta \chi + \cos n \frac{d\theta}{d\varepsilon} \Delta \varepsilon + \cos n \frac{d\theta}{dT} \Delta T + \cos n \frac{d\theta}{dq} \Delta q = \cos n \Delta \theta (O-C)$$

$$\frac{dn}{d\Omega} \Delta \Omega + \frac{dn}{di} \Delta i + \frac{dn}{d\chi} \Delta \chi + \frac{dn}{d\varepsilon} \Delta \varepsilon + \frac{dn}{dT} \Delta T + \frac{dn}{dq} \Delta q = \Delta n (O-C)$$

giving the following equations of conditions, where the numbers are logarithms; and $\cos n \Delta \theta$ and Δn in seconds of arc:

$$9.67306\Delta\chi + 8n45512\Delta\varepsilon + 8n04383\Delta T + 9.77950\Delta q = 0.73918$$

9.66112	8n13076	8n08879	9.69718	1.07379
9.66200	8.65092	8n15499	9.33129	1.43398
9.67796	8.92146	8n17558	8.62751	1.10315
9.70257	9.07881	8n17949	9n13817	1.65901
9.73171	9.17362	8n17309	9n49295	1.23047
9.76094	9.22290	8n15436	9n66724	1.46474
9.78146	9.23991	8n12397	9n76081	0.93085
9.82486	9.16872	8n04264	9n87146	1n03723
9.84563	8.98327	7n94400	9n90298	1n00484
8n45118 $\Delta\Omega'$ + 9.74667 $\Delta i'$ + 7.874976	n97176	6n40109	7n82564	9n92583
7n58490	9.76666	7.38426	5n96919	5n86962
8.69794	9.76344	8n10342	6n77957	6.45360
8.88207	9.73556	8n34567	6n95930	6.59696
8.99977	9.68842	8n49771	6n12314	6.62805
9.07774	9.62001	8n59532	7.36145	6.57138
9.09908	9.52835	8n66313	7.79760	6.41522
9.16148	9.40916	8n69075	8.05202	6.10851
9.18963	9.03101	8n63993	8.31594	5n99938
9.19015	8.10293	8n54447	8.41873	6.33294
			8.63430	1n22735

Hence, solving by the method of least squares, so to obtain each differential as a function of $\Delta\varepsilon$, by making

$$\begin{aligned} \Delta\varepsilon &= -0.0096634 \text{ gives} \\ \Delta\Omega' &= +5'42''.9 \\ \Delta i' &= + \quad \quad \quad .91 \\ \Delta q &= -0.0013387 \\ \Delta T &= -0.088149 \\ \Delta\pi' &= -1'35''.6 \end{aligned}$$

and the corrected elements are

(E)	Ω'	9° 31' 46''.1	Ω	28° 6' 2''.9	} Ecliptic and mean equinox 1771.0
	i'	33 48 45.2	i	11 16 45.3	
	π'	105 7 4.8	π	103 59 26.1	
	T	April 19.121392		Paris m. t.	
	log q	9.9552581			
	ε	1.00000			

Motion, direct.

An ephemeris computed from these elements gives the residuals

	$\Delta\alpha$	$\Delta\delta$
April 6,	+25''.6	- 12''.1
14,	+34.7	+ 20.3
30,	- 8.	+3 26.8
May 8,	+ 3.	+ 3.7
16,	+14.2	- 42.
24,	-22.6	+1 33.

	C-O	
	Δa	$\Delta \delta$
June 1,	- 37.7	+1 37.
9,	- 8.1	-1 33.
25,	+ 46.6	+ 51.
July 11,	-2 8.5	+ 57.

Comparing these results with those of Encke we find a close agreement, especially in the most probable eccentricity. The increase in the residuals on passing to the most probable parabola is also about the same.

II.

In computing the perturbations, the action of Venus was not considered. For during the whole period of observation, when alone the action of Venus could be sensible, the motion of the comet was just sufficient to keep it very close to opposition to that planet. In such a position the entire influence of a planet would be expressed by an increase in the value of k , the constant of solar attraction wherever used in calculating the orbit. For Venus, the value of $\log k$ would be unchanged to the 8th decimal place.

The nearest approach of the comet to Mars was .35R, June 17th, 1771, to Jupiter, about 4R, nearly a year before perihelion; and to Saturn, 8R, shortly after perihelion. The perturbations of the rectangular coördinates referred to the ecliptic were computed in units of the 7th decimal place; for Mars, at intervals of 8 days from April 1, 1771, for Jupiter, at intervals of 20 days from July 20, 1769; and for Saturn, at intervals of 40 days from Jan. 1, 1770, as follows:

	δ	dx	dy	dz		
April 30,		- 1.2	- .5	+ .1		
May 16,		4.8	- .8	1.6		
June 1,		13.1	+ .8	7.7		
17,		32.4	11.8	24.1		
July 3,		53.4	39.2	52.1		
19,		-68.9	+77.4	+88.4		
α	dx	dy	dz	da	$d\delta$	
April 2,	-2648.	+ 5122.	+ 731.	+ 66".9	+ 27.6	
12,	1996	5310	783	64.0	20.8	
22,	1313	5888	902	51.6	12.2	
May 2,	909	7101	1153	+ 31.9	6.0	
12,	721	8563	1481	0	5.7	
22,	1070	10060	1862	- 33.0	13.8	
June 1,	1687	11632	2278	61.3	30.0	

z	dx	dy	dz	da	$d\delta$
June 11,	2504·	12998·	2687·	83·3	49·1
21,	3485	14268	3088	100·4	62·6
July 1,	4528	15586	3463	113·0	75·2
July 11,	-5636	+16361	+3817	-115·1	+82·4
$\hat{\delta}$					
Mar. 13,	+ 299·	- 266·	+167·	- 11·3	+ 0·8
April 2,	341	315	162	9·2	2·9
22,	368	337	159	6·7	4·8
May 12,	374	364	164	4·2	5·8
June 1,	360	422	173	- 1·7	6·7
21,	382	492	184	+ 0·7	6·8
July 11,	+ 402	-566	+192	+ 3·2	+6·8

Hence by interpolation

Corrections to the Ephemeris.

	Δa	$\Delta \delta$		Δa	$\Delta \delta$
April 6,	-57"·4	-28"·6	May 24,	+ 41"·7	- 22"·9
14,	54·1	23·2	June 1,	1' 3"·0	36·7
30,	30·7	11·5	9,	1 20·9	51·7
May 8,	- 8·7	11·3	25,	1 45·4	1' 14"·6
16,	+17·1	- 13·8	July 11,	+1 51·9	-1 29·2

Applying these corrections with contrary sign to the normal places we obtain

	a	δ	O—C		
			Δa	$\Delta \delta$	$\cos n \Delta \theta$
April 6,	44° 26' 2"	22° 29' 13"	- 51"	- 27"	
14,	54 11 5	25 39 59	- 43	- 17	- 42"·3
30,	76 59 17	30 3 20	- 9	+ 28	- 1·5
May 8,	89 30 2	30 40 49	+ 10	- 44	+ 4·4
16,	102 3 8	30 7 24	+1' 9"	- 2	+ 59·5
24,	114 1 8	28 26 22	+1 1	- 24	
June 1,	124 59 56	25 54 55	+1 36	- 38	+1' 32"·9
9,	134 47 14	22 52 5	+1 36	- 36	+1 35·3
25,	150 59 18	16 17 1	+1 51	- 39	+1 52·9
July 11,	163 38 1	10 2 22	+1 25	-1' 39"	+2 2·1

The annexed residuals were obtained by comparing these normals with an ephemeris computed from elements (C). The computations from the differential formulæ were now all repeated, since in the previous computations the checks showed some discrepancy due to neglected second differences. This labor, perhaps unnecessary, gives

$\log \frac{d\chi}{dJ} 0.21529$	$\log \frac{d\chi}{dJ''} 0n.14082$
$“ \frac{d\varepsilon}{dJ} 0.50483$	$“ \frac{d\varepsilon}{dJ''} 9.77036$
$“ \frac{dT}{dJ} 1.91865$	$“ \frac{dT}{dJ''} 1n.69112$
$“ \frac{dq}{dJ} 9.58473$	$“ \frac{dq}{dJ''} 9.33368$

	$\cos n \frac{d\theta}{d\Delta}$	$\cos n \frac{d\theta}{d\Delta''}$		$\cos n \frac{d\theta}{d\Delta}$	$\cos n \frac{d\theta}{d\Delta''}$
Apr. 6,	+000009	-000002	May 24,	000000	-000004
14,	-11624	+06481	June 1,	+11446	-10676
30,	-20936	+13708	9,	+22268	-22655
May 8,	-17771	+12782	25,	+38092	-46282
16,	-10375	+08117	July 11,	+44831	-65705

Forming the equations of condition and solving the normal equations as before,

$$\begin{array}{rcl}
 \Delta J = -217''.3 & \Delta J'' = -154''.8 & \\
 \left. \begin{array}{l}
 \Delta\chi \quad -2' 35''.7 \\
 \Delta\varepsilon \quad -0037620 \\
 \Delta T \quad -052605 \\
 \Delta q \quad -0005532
 \end{array} \right\} \text{equator.} & \left. \begin{array}{l}
 \Delta\delta' \quad + 24''.45 \\
 \Delta i' \quad - 1.96 \\
 \Delta v' \quad - 3' 3.24 \\
 \Delta\pi' \quad - 239.81
 \end{array} \right\}
 \end{array}$$

Applying these corrections to elements (C) and transforming to the ecliptic gives

T Apr. 19.156936, Paris m. t.

log q	9.9556371
(F) ε	1.005901
π	103 59 3.69
Ω	27 51 41.78
i	11 15 47.68

} ecliptic and
} mean equinox
} 1771.0

from $\Delta v = \frac{d(v+\chi)}{dJ} \Delta J - \Delta\chi$ we have

$$\begin{array}{rcl}
 \Delta v + 4' 47''.72 & \Delta v'' + & 4' 7''.59 \\
 v - 20^\circ 10' 0''.23 & v'' + 50^\circ 6' 55''.57 &
 \end{array}$$

The values computed in an ephemeris from the corrected elements are

$$v - 20^\circ 10' 0''.05 \qquad v'' + 50^\circ 6' 55''.66$$

and the ephemeris gives the residuals,

O—C	Δa	$\Delta \delta$
April 6.5	+ 6 ^{''} .9	+ 3.7
14.5	— 3.2	+ 2.2
30.5	— 22.6	+ 31.7
May 8.5	— 1.5	— 34.1
16.5	+ 43.1	+ 12.4
24.5	+ 21.7	— 0.8
June 1.5	+ 45.8	+ 3.3
9.5	+ 34.8	+ 8.2
25.5	+ 24.5	+ 33.1
July 11.5	— 4.3	— 7.8

The most probable parabola computed as before, gives the following results :

T Apr. 19.146741		Paris m. t.
ϵ	1.	
$\log q$	9.9551889	
i	11 15 9.70	} ecliptic and mean equinox 1771.0
(G) Ω	27 48 39.06	
π	104 1 11.22	

O—C	Δa	$\Delta \delta$
April 6.5	+ 3 ^{''} .5	+ 3.6
14.5	— 15.2	+ 10.5
30.5	— 32.1	+ 5.4
May 8.5	— 0.1	+ 8.0
16.5	+ 48.7	+ 1' 3.1
24.5	+ 29.0	+ 59.0
June 1.5	+ 50.4	+ 1 12.2
9.5	+ 24.6	+ 1 32.4
25.5	— 2' 12.6	+ 2 19.8
July 11.5	+ 38.4	+ 2 18.6

The residuals here are no more favorable than those computed from orbit (E) and point to the conclusion that the perturbations do not render a parabolic orbit more probable.

III.

The attempt to discuss the orbit independently of the Marseilles observations, thus avoiding the effect of their large probable errors, fails; because the normal places exclusive of the Marseilles observations are too indeterminate to be trustworthy, owing to the smallness of the variations of the differential coefficients. For instance, if we

compute the variation of the geocentric distances from the same differentials and residuals as on page 168, omitting June 25 and July 11, we obtain $\Delta\mathcal{A}'' = -7786''$, $\Delta\mathcal{A} = -5178$; but omitting also April 30 we find $\Delta\mathcal{A}'' = +15581''$, $\Delta\mathcal{A} = -11159''$.

The only available process, therefore, consists in varying the last two normal places as much as it seems reasonable to suppose they can be affected by errors of observation and noting the effect upon the elements. Also, instead of varying α and δ , we may vary θ , since errors in both or either of the coördinates α and δ can affect the elements only through the change that they occasion in θ .

A number of different values were accordingly given to θ for the uncertain places and the results derived so far as to ascertain the effect on the equations of condition and on the eccentricity. These results show that while it is possible by a change in the value of θ for June 25 and July 11, to obtain an orbit of somewhat less eccentricity, no reasonable change will reduce the excess over unity in the eccentricity by more than a small fraction; and that any thing more than a small diminution in the eccentricity occasions an increase of the residuals in the equations of condition.

Repeated attempts to satisfy the normal equations by different elements greatly strengthens my belief that the difference between the residuals from the hyperbolic and from the parabolic elements can be but little reduced by any supposition of error in the Marseilles observations.

In this view of the case we must then conclude that elements (F) should be taken as the best definitive elements of this comet, and that while the parabolic residuals are not large enough to render the supposition of such an orbit untenable, the balance of probability is still with the hyperbola.

New Haven, June 5th, 1879.

V. THE CEPHALOPODS OF THE NORTH-EASTERN COAST OF AMERICA.

BY A. E. VERRILL.

PART I.—THE GIGANTIC SQUIDS (*Architeuthis*) AND THEIR ALLIES; WITH OBSERVATIONS ON SIMILAR LARGE SPECIES FROM FOREIGN LOCALITIES.

THE early literature of Natural History has, from very remote times, contained allusions to huge species of Cephalopods, often accompanied by more or less fabulous and usually exaggerated descriptions of the creatures.* In a few instances figures were attempted, which were largely indebted to the imagination of their authors for their more striking peculiarities.

In recent times many more accurate observers have confirmed the existence of such monsters, and several fragments have found their way into European museums.

To Professor Steenstrup and to Dr. Harting, however, belongs the credit of first describing and figuring, in a scientific manner, a sufficient number of specimens to give a fair idea of the real character and affinities of these colossal species. More particular accounts of the specimens described by these and other recent writers will be given farther on.

Special attention has only recently been called to the frequent occurrence of these 'big squids,' as our fishermen call them, in the waters of Newfoundland, and the adjacent coasts. The cod-fishermen, who visit the Grand Banks, appear, from their statements, to have been long familiar with them, and occasionally to have captured and used them for bait. The whalemen have also repeatedly stated that sperm whales feed upon huge squid, and that, when wounded, they

* The description of the "Poulpe" or devil-fish by Victor Hugo, in "The Toilers of the Sea," with which so many readers have recently become familiar, is quite as fabulous and unreal as any of the earlier accounts, and even more bizarre. His description represents no real animal whatever. He has attributed to the creature habits and anatomical structures that belong in part to the *polyps* and in part to the 'poulpe' (Octopus). His description appears to have been derived from descriptions of these totally distinct groups of animals contained in some cyclopaedia, which he has confounded and hopelessly mixed up.

often vomit large fragments of them in such a condition as to be recognizable.* The first reliable account, known to me, of specimens actually taken in American waters by our fishermen and whalers was published by Dr. A. S. Packard, in 1873.† In that article Dr. Packard described a portion of a jaw from a large specimen (our No. 1) taken by the Gloucester fishermen on the Grand Banks, and a very large pair of jaws taken from the stomach of a sperm whale, (our No. 10). Soon after this, in 1873, a large living specimen was encountered by two fishermen in Conception Bay, and one of the tentacular arms, which was secured, was preserved in the museum of St. John's, Newfoundland, by the Rev. Mr. Harvey and Mr. Alexander Murray, (our No. 2). Both these gentlemen wrote good and interesting accounts of this specimen, which were extensively copied in the magazines and newspapers, while a photograph of the arm itself was also secured and distributed.

This important addition to our knowledge of these creatures was followed, a few weeks later, by the capture of a nearly perfect specimen of the same species, near St. John's. Mr. Harvey and Mr. Murray likewise secured this specimen and published detailed accounts of it, which gave a more accurate idea of the character of the genus and species than any previous descriptions.

My own attention was specially directed to these large Cephalopods, at that time, on account of being so fortunate as to secure for study most of the preserved portions of all the specimens referred to above, with some additional ones, detailed below. For these very interesting specimens I am especially indebted to the zeal and kindness of the Rev. Mr. Harvey, and to Professor S. F. Baird. To Dr. A. S. Packard I am indebted for the use of the jaws of No. 10. Mr. Pourtales, of the Museum of Comparative Zoology, has also kindly sent the specimens belonging to that museum, and Mr. W. H. Dall has contributed his specimens and drawings of a species from Alaska. Special acknowledgments to others will be found in connection with the descriptions of the specimens.

Although I have, in several former papers,‡ given details of the

* See Maurer's Sailing Directions; also articles by N. S. Shaler, *American Naturalist*, vol. vii. p. 3, 1873; by Dr. Packard, *op. cit.*, p. 90; and by Mr. W. H. Dall, *op. cit.*, p. 484.

† *American Naturalist*, vol. vii. p. 91, February, 1873.

‡ *American Jour. Science*, vol. vii. p. 158, Feb., 1874; vol. ix. pp. 123, 177, Plates II-V, 1875; vol. x. p. 213, Sept., 1875; vol. xii. p. 236, 1876; vol. xiv. p. 425, Nov., 1877. *American Naturalist*, vol. viii. p. 167, 1874; vol. ix. pp. 21, 78, Jan. and Feb., 1875.

time and place of occurrence of fourteen of the specimens enumerated below, it seems desirable to bring together, at this time, accounts of all these, as well as of several additional specimens, in order that the various descriptions and measurements may be more readily compared, and also that some errors in the former accounts may be corrected and new information added. To facilitate the comparison of the general accounts of the twenty examples that I am now able to enumerate from our coast, I have given, by themselves, the statements of the time and place of their occurrence, with such general descriptions and measurements of each, as are most available, reserving the more detailed special descriptions of the preserved specimens for the systematic part of this article.

This seemed the more desirable because the information concerning many of the specimens is so scanty as to render it impossible to refer them, with certainty, to either of the species now recognized or named. It is probable, however, that only three distinct forms exist among the large Newfoundland specimens of *Architeuthis*, and two of these may be merely the males and females of one species. One of the principal differences usually indicated by the measurements is in respect to the size and length of the shorter arms, one form having them comparatively stout, often "thicker than a man's thigh," while the other form has them long and slender, (usually three to five inches in diameter, with a length of six to eleven feet). In case these differences prove to be sexual, those with stout arms will probably be the females, judging from analogy with the small squids nearest related.* The two specimens, of which I have seen the arms, both have them long and slender, but in one the arms are much longer in proportion to the body than in the other, and there are marked differences in the denticulation of the suckers of the short arms. These differences appear to indicate two species.

A few words of explanation may be desirable in regard to the relative value of the measurements usually given, and also with reference

* By examinations of very numerous specimens of the common squids, *Onmycterephes illecebrosa* and *Loligo Pealii*, I have satisfied myself that the females of both differ from the males by having the head, the siphon, the arms, and the suckers relatively larger and stronger than in the males. In comparing specimens of the two sexes having the body and fins of the same length, this difference is very evident. The large suckers of the tentacular arms show this increased size in a very marked degree. The short arms show a greater increase in diameter than in length. In my former article, by an unfortunate error, the increase in size of these parts was inadvertently said to be in the male. In these common squids I have found scarcely any variation in the relative size and form of the caudal fins, when adult.

to the parts most useful to preserve when, as will usually happen, the whole cannot be saved. The measurements of the soft external parts of Cephalopods are, for the most part, only approximate, and they are not all of equal value, for some parts are more changeable in size and shape than others. The long, contractile tentacular-arms, especially, are liable to great variation in length according to their state of contraction or extension, and therefore their relative length is of little or no value in discriminating species. Unfortunately this, either by itself or combined with the length of the 'body' as total length, is often the principal one given. The circumference of the body varies, likewise, according to its state of contraction or relaxation, and the 'breadth' of the body, when such soft creatures are stranded on the shore, will depend much upon the extent to which it is collapsed and flattened from its proper cylindrical form, and is of less value than the circumference. Measurements of the length of the body to the mantle edge, and to the base of the arms; length and circumference of the various pairs of short arms; of the length and circumference of the head; size of the eyes; length and breadth of the tail-fin; size of the largest suckers on the different arms; and size of the 'club' of the long arms, are all very useful and valuable. The shape of the tail-fin should be carefully noted, also the presence or absence of eye-lids, and of a sinus or groove at the front edge of eye-lids. The size and shape of the thin internal 'bone' or 'pen' is particularly desirable. Usually it will not be possible to preserve the pen in any satisfactory shape by drying, for it cracks in pieces and curls up. It may be preserved packed in salt, in brine, or in alcohol. The same is true of the beak. The horny rims of the suckers can usually be dried, but are better by far in alcohol or brine. The parts most useful for preservation in alcohol or salt, in cases when only a portion can be saved, are the long tentacular-arms, especially their terminal 'clubs' with the suckers in place; the short arms, with their suckers; of these the left arm of the lower, or ventral, pair will probably be the most valuable, being probably the one that will show the sexual distinction, by the alteration of its suckers toward the tip or in some other part; the lateral arms next to the ventral are next in importance; the caudal fin, and if possible the entire head, should be preserved; also the 'pen,' if possible. In cases where the head cannot be saved entire, even with the arms removed, the beak and tongue, and other fleshy parts in and behind the beak, should be carefully preserved, as nearly entire as possible, either in strong brine or alcohol.

*General account of the several specimens, and of their occurrence.*No. 1.—Grand Banks specimen, 1871. (*Architeuthis princeps*.)

PLATE XVIII, FIGURE 3.

This specimen was found floating at the surface, on the Grand Banks of Newfoundland, in October, 1871, by Captain Campbell, of the schooner "B. D. Haskins," of Gloucester, Mass. It was taken on board and part of it used for bait.* Dr. A. S. Packard has given, in the *American Naturalist*, vol. vii, p. 91, Feb., 1873, the facts that have been published in regard to the history of this individual. But its jaws were sent to the Smithsonian Institution, and were sent to me by Professor Baird to be described and figured. The horny jaw or beak from this specimen is thick and strong, nearly black; it is acute at the apex, with a decided notch or angle on the inside, about .75 of an inch from the point, and beyond the notch is a large prominent angular lobe. The body of the specimen from which this jaw was taken is stated to have measured 15 feet in length and 4 feet 8 inches in circumference. The arms were mutilated, but the portions remaining were estimated to be 9 or 10 feet long, and 22 inches in circumference, two being shorter than the rest. It was estimated to weigh 2000 pounds.

No. 2.—Conception Bay specimen, 1873. (*A. Harveyi* ?.)

A large individual attacked two men, who were in a small boat, in Conception Bay, October 27, 1873. Two of the arms, which it threw across the boat, were cut off with a hatchet, and brought ashore. Full accounts of this adventure, written by Rev. M. Harvey, have been published in many of the magazines and newspapers.† A portion of one of these arms, measuring 19 feet in length, was preserved by Rev. M. Harvey and Mr. Alexander Murray for the museum at

* I have been informed by many other fishermen that these 'big squids,' as they call them, are occasionally taken on the Grand Banks and used for bait. Others state that they have seen them in that region, without being able to capture them. Nearly all the specimens hitherto taken appear to have been more or less disabled when first observed, otherwise they probably would not appear at the surface in the day-time. From the fact that they have mostly come ashore in the night, I infer that they inhabit chiefly the very deep and cold fiords of Newfoundland and come up to the surface only in the night.

† See *Amer. Jour. Science*, vol. vii, p. 158, 1874; and *American Naturalist*, vol. viii, No. 2, p. 120, Feb., 1874, in a letter from Mr. Alexander Murray. Also, *Proc. Zool. Soc. Lond.*, p. 178, 1874. *Proc. Boston Soc. Nat. Hist.*, xvi, p. 161, 1873.

St. John's, Newfoundland. It was photographed, and cuts copied from the photograph were published in some of the English magazines.* Before it was secured for preservation it had been considerably injured, many of the larger suckers having been torn off or mutilated. Owing to this fact they were originally described by Mr. Harvey as destitute of marginal denticulations, but he subsequently re-examined the specimen, at my request, and informed me that they were all originally denticulated. Of this specimen I have seen only the photograph and some of the smaller suckers. This fragment represents the distal half of one of the long tentacular-arms, with its expanded terminal portion or "club," originally covered with cup-shaped suckers, about 24 of which, forming two central rows, are very large, the largest being 1.25 inches in diameter; others, alternating with these along each margin, are smaller, with the edge supported by a serrated ring. The tip of the arm is covered with numerous smaller suckers, in four rows. The part of the arm preserved measured, when fresh, 19 feet in length, and 3.5 inches in circumference, but wider, "like an oar," and 6 inches in circumference, near the end, where the suckers are situated.

It is stated that six feet of this arm had been destroyed before it was preserved, and the captors estimated that they left from six to ten feet attached to the creature, which would make the total length between 31 and 35 feet. According to Mr. Murray, the portion preserved measured but 17 feet in length, when he examined it, Oct. 31, 1873, after it had been a few days in strong brine. The other arm was destroyed and no description was made; but the portion secured was estimated by the fishermen to have been 6 feet long and 10 inches in diameter; it was evidently one of the eight shorter sessile arms, and its size was probably overestimated. The fishermen estimated the body of this individual to have been about 60 feet in length and 5 feet in diameter; but if the proportions be about the same as in the specimens since captured, (No. 5 and No. 14), as I believe, then the body could not have been more than about 10 feet long, and 2.5 feet in diameter, and the long arms should have been about 32 feet in length.† Allowing two feet for the head, the total length would, therefore, be about 44 feet.

* See *Annals and Magazine of Natural History*. IV. xiii. p. 68. Jan., 1874; and "The Field," Dec. 13, 1873. The central line of this photograph is reduced four and a quarter times, while the front part is reduced about four times.

† Doubtless these long arms are very contractile, and changeable in length, like those of the ordinary squids.

No. 3.—Coombs' Cove specimen, 1872. (*A. Harveyi?* 2.)

Another specimen (No. 3), probably considerably larger than the last, was captured at Coombs' Cove, Fortune Bay, Newfoundland. The following account has been taken from a newspaper article of which I do not know the precise date,* forwarded to me by Professor Baird, together with a letter, dated June 15, 1873, from the Hon. T. R. Bennett, of English Harbor, N. F., who states that he wrote the article, and that the measurements were made by him, and are perfectly reliable.†

“Three days ago, there was quite a large squid run almost ashore at Coombs' Cove, and some of the inhabitants secured it. The body measured 10 feet in length and was nearly as large round as a hog's-head. One arm was about the size of a man's wrist, and measured 42 feet in length; the other arms were only 6 feet in length, but about 9 inches in diameter, very stout and strong. The skin and flesh were 2.25 inches thick, and reddish inside as well as out. The suction cups were all clustered together, near the extremity of the long arm, and each cup was surrounded by a serrated edge, almost like the teeth of a hand-saw. I presume it made use of this arm for a cable, and the cups for anchors, when it wanted to come to, as well as to secure its prey, for this individual, finding a heavy sea was driving it ashore, tail first, seized hold of a rock and moored itself quite safely until the men pulled it on shore.”

Mr. Bennett, in a memorandum subsequently given to Mr. Sanderson Smith, and communicated to me by him, states that both the tentacular-arms were present and that the shorter one was 41.5 feet in length. The large diameter of the short arms, compared with their length, and with that of the long arms, and their shortness compared with the length of the body, are points in which this specimen apparently differed essentially from those that have been preserved and are better known. It was probably a female. The total length, as I understand the measurements, was 52 feet.

* The exact date of this capture I do not know, but it was probably in the autumn or winter of 1872.

† Through Mr. Sanderson Smith, who visited Mr. Bennett after the publication of my former articles, I learn that this specimen is the same as the one designated as No. 6 in my previous papers, and that the measurements of No. 6, as given to me by Mr. Harvey, are incorrect, owing to a mistake in supposing that 42 feet was the *total length*, instead of the length of the longer tentacular-arm.

No. 4.—Bonavista Bay specimen. (*A. Harveyi*?)

PLATE XVI, FIGURES 5, 6.

A pair of jaws and two of the suckers from the tentacular-arms were forwarded to me by Professor Baird of the Smithsonian Institution. These were received from Rev. A. Munn, who writes that they were taken from a specimen that came ashore at Bonavista Bay, Newfoundland; that it measured thirty-two feet in length (probably the entire length, including the tentacular-arms); and about six feet in circumference. The jaws are large and broad, resembling those of No. 5, both in size and form, but much thinner than those of No. 1, and without the deep notch and angular lobe seen in that specimen. The suckers also agree with those of No. 5, but are a little smaller.

No. 5.—Logie Bay specimen, 1873. (*Architeuthis Harveyi*, type.)

PLATE XIII. PLATE XIV. PLATE XV, FIGURES 1, 2, 3. PLATE XVI, FIGURES 1 TO 4.

A complete specimen was captured in November, 1873, at Logie Bay, near St. John's, Newfoundland. It became entangled in herring-nets and was secured by the fishermen with some difficulty, and only after quite a struggle, during which its head was badly mutilated and severed from the body, and the eyes, most of the siphon-tube, and part of the front edge of the mantle were destroyed. It is probable that this was a smaller specimen of the same species as No. 2. Fortunately this specimen was secured by the Rev. M. Harvey of St. John's. After it had been photographed and measured, he attempted to preserve it entire in brine, but this was found to be ineffectual, and after decomposition had begun to destroy some of the most perishable parts, he took it from the brine and, dividing it into several portions, preserved such parts as were still undecomposed in strong alcohol. These various portions have all been examined by me and part of them are now in my possession, and with the photographs have enabled me to present a restoration, believed to be tolerably accurate, of the entire creature (plate XIV). In this figure the eyes, ears, siphon-tube and front edge of the mantle have been restored from a small squid (*Ommastrephes*). The other parts have been drawn directly from the photographs and specimens.* There were two photographs of the

* The figure was originally made, from the photographs only, by Mr. P. Røtter, of the Museum of Comparative Zoology, but after the arrival of the specimens it had to be altered in many parts. These necessary changes were made by the writer, after a careful study of the parts preserved, in comparison with the photographs and original measurements. As published in my former papers, the eyes and back of the head of

specimen:* one showing the entire body, somewhat mutilated anteriorly; the other showing the head with the ten arms attached (plate XIII). The body or mantle of this specimen was about seven feet long, and between five and six feet in circumference; the relatively small caudal fin was arrow-shaped and twenty-two inches broad, but short, thick, and very pointed at the end; the two long tentacular arms were twenty-four feet in length, and two and a half inches in circumference, except at the broader part near the end; the largest suckers, which form two regular alternating rows, of twelve each, were 1.25 inches in diameter, with serrated edges. There is also an outer row of much smaller suckers, alternating with the large ones, on each margin; the terminal part is thickly covered with small serrated suckers; and numerous small suckers and tubercles are crowded on that portion of the arms where the enlargement begins, before the commencement of the rows of large suckers. The arrangement of the suckers is nearly the same as on the long arm of No. 2, but in the latter the terminal portion of the arm, beyond the large suckers, as shown in the photographs, is not so long, tapering, and acute, but this may be due to the different conditions of the two specimens. The eight short arms were each six feet long; the two largest were ten inches in circumference at base; the others were 9, 8 and 7 inches. These short arms taper to slender acute tips, and each bears about 100 large, oblique suckers, with serrated margins.

The portions of the pen in my possession belong mostly to the two ends, with fragments from the middle region, so that although neither the actual length nor the greatest breadth can be given, we can yet judge very well what its general form and character must have been. It was a broad and thin structure, of a yellowish brown color, and translucent. Its anterior portion (plate XV, fig. 3) resembles that of *Loligo*, but its posterior termination is entirely different, for instead of having a regular lanceolate form, tapering to a point at

the figure were restored as in *Loligo*. Subsequent studies and additional specimens show that this genus is closely allied to *Ommastrephes*. Therefore, the head would have been more correctly shown had it been restored with reference to that genus, which has been done in this paper. The most obvious difference is in the eyes, which have distinct lids and an anterior sinus.

* Cuts made from these photographs have been published in several magazines and newspapers, but they have been engraved with too little attention to details to be of much use in the discrimination of specific differences. I have, therefore, prepared new figures from these photographs with the greatest care possible. These figures are particularly valuable, as showing the arrangements of the suckers on the short arms.

the posterior end, as in *Loligo*, it expands and thins out toward the posterior end, which is very broadly rounded or irregularly truncate, fading out insensibly, both at the edges and end, into soft membrane. The anterior end, for about an inch and a half, was rapidly narrowed to a pen-like point, as in *Loligo*; from this portion backward the width gradually increases from 1.2 inches to 5 inches, at a point 25 inches from the end, where our specimen is broken off; at this place the marginal strips are wanting, but the width is 5 inches between the lateral midribs (*d*, *d'*), which were, perhaps, half an inch from the margin. Along the center of the shell, there is a strong, raised, rounded midrib, which fades out a short distance from the posterior end, but is very conspicuous in the middle and anterior sections. On each side of the midrib is a lateral rib of smaller size. These at first diverge rapidly from the central one, and then run along nearly parallel with the outer margin and about $\frac{1}{4}$ of an inch from it, but beyond 11 inches from the point the margins are torn off. Like the midrib the lateral ribs gradually fade out before reaching the posterior end; near the place where they finally disappear, they are about six inches apart.*

No. 6 (of former articles).—Same as No. 3.

No. 7.—Labrador specimen.

Dr. D. Honeyman, geologist, of Halifax, Nova Scotia, has published, in a Halifax paper, a statement made to him by a gentleman who claims to have been present at the capture of another specimen (No. 7) in the Straits of Belle Isle, at West St. Modent, on the Labrador side. "It was lying peacefully in the water when it was provoked by the push of an oar. It looked fierce and ejected much water from its funnel; it did not seem to consider it necessary to discharge its sepia, as mollusca of this kind generally do, in order to cover their escape." . . . "The length of its longest arm was 37 feet; the length of the body 15 feet; whole length 52. The bill was very

* Mr. Harvey published popular accounts of this specimen and of the previously captured arm of the larger one (No. 2), in the *Maritime Monthly Magazine* of St. John, N. B., for March, 1874, and in several newspapers. Acknowledgments are also due to Mr. Alexander Murray, Provincial Geologist, who cooperated with Mr. Harvey in the examination and preservation of these specimens, and who has also written some of the accounts of them that have been published. See also the *American Naturalist*, vol. viii, p. 122, February, 1874; *American Journal of Science*, vol. vii, p. 469; *Nature*, vol. ix, p. 322, February 26, 1874; and *Appleton's Journal*, January 31, 1874; *Forest and Stream*, p. 356 (with figure), Jan., 1874.

large. The suckers of its arms or feet, by which it lays hold, about 2 inches in diameter. The monster was cut up, salted, and barreled for dog's meat." In this account the length given for the 'body' evidently includes the head also. This creature was probably disabled, and perhaps nearly dead, when discovered at the surface, and this seems to have been the case with most of the specimens hitherto seen living. Animals of this sort probably never float or lie quietly at the surface when in good health.

Nos. 8 and 9.—Lamaline specimens, 1870-71.

Mr. Harvey refers to a statement made to him by a clergyman, Rev. M. Gabriel, that two specimens (Nos. 8 and 9), measuring respectively 40 and 45 feet in total length, were cast ashore at Lamaline, on the southern coast of Newfoundland, in the winter of 1870-71.

No. 10.—Sperm Whale specimen. (*Architeuthis princeps*.)

PLATE XVIII, FIGURES 1, 2.

This specimen, consisting of both jaws, was presented to the Peabody Academy of Science, at Salem, Mass., by Captain N. E. Atwood, of Provincetown, Mass. It was taken from the stomach of a sperm whale, but the precise date and locality are not known. It was probably from the North Atlantic. The upper jaw was imperfectly figured by Dr. Packard in his article on this subject.* It is one of the largest jaws yet known, and belonged to an apparently undescribed species, which I named *Architeuthis princeps*, and described in my former papers, with figures of both jaws.

No. 11.—Second Bonavista Bay specimen, 1872.

The Rev. M. Harvey, in a letter to me, stated that a specimen was cast ashore at Bonavista Bay, December, 1872, and that his informant told him that the long arms measured 32 feet in length, and the short arms about 10 feet in length, and were "thicker than a man's thigh." The body was not measured, but he thinks it was about 14 feet long, and very stout, and that the largest suckers were 2.5 inches in diameter. The size of the suckers is probably exaggerated, and most likely the length of the body also. It is even possible that this was the same specimen from which the beak and suckers described as No. 4, from Bonavista Bay, were derived, for the date of capture of that specimen is unknown to me. The latter, however, was much smaller than the

* American Naturalist, vol. vii, p. 91, 1873.

above measurements, and it will, therefore, be desirable to give a special number (11) to the present one.

No. 12.—Harbor Grace specimen, 1874-75.

Another specimen, which we have designated as No. 12, was cast ashore in the winter of 1874-1875, near Harbor Grace, but was destroyed before its value became known, and no measurements were given.

No. 13.—Fortune Bay specimen, 1874.

PLATE XVII.

A specimen was cast ashore December, 1874, at Grand Bank, Fortune Bay, Newfoundland. As in the case of several of the previous specimens, I was indebted to the Rev. M. Harvey for early information concerning this one, and also for the jaws and one of the large suckers of the tentacular-arms, obtained through Mr. Simms, these being the only parts preserved. Although this specimen went ashore in December, Mr. Harvey did not hear of the event until March, owing to the unusual interruption of travel by the severity of the winter. He informed me that Mr. George Simms, Magistrate of Grand Bank, had stated in a letter to him that he examined the creature a few hours after it went ashore, but not before it had been mutilated by the removal of the tail by the fishermen, who finally cut it up as food for their numerous dogs; and that the long tentacular arms were 26 feet long and 16 inches in circumference; the short arms were about one-third as long as the long ones; the "back of the head or neck was 36 inches in circumference," (evidently meaning the head, behind the bases of the arms); the length of the body "from the junction to the tail" was 10 feet, (apparently meaning from the base of the arms to the origin of the caudal fins). He thought that the tail, which had been removed, was about one-third as long as the body, but this was probably overestimated. In No. 14 the tail, from its origin or base, was about one-fifth as long as the balance of the body and head. Applying the same proportions to No. 13, the head and body together would have been 12 feet. In a letter to me, dated Oct. 27, 1875, Mr. Simms confirmed the above measurements, but stated that the long arms had been detached, and that the bases of the arms measured as those of the tentacular-arms (they had previously been cut off about a foot from the head), were triangular in outline, the sides being respectively 5, 6, 5 inches in breadth, the longest or outer side being convex and the two lateral sides straight.

He moreover says that *all* the arms were covered with large suckers, *from the base outward*. Hence it is probable that he made a mistake as to these stumps, and that they really belonged to a pair of sessile arms. Probably the tentacular-arms, when extended, had been cut off so close to their contractile bases that their stumps had afterwards become contracted within their basal pouches, and were, therefore, overlooked. He adds that the body was three feet broad (doubtless it was much flattened from its natural form), and that the measurements were made while the body lay upon uneven ground, so that its exact length could not be easily ascertained, and that the caudal-fin had been cut off at its base. As the tail-fins of Nos. 5 and 14 were about one-fifth the length of the rest of the body and the head together, this specimen, if belonging to either of those species, should have been about 12 feet from the base of the arms to the tip of the tail.

The large sucker, in my possession, is one inch in diameter, across the denticulated rim, and in form and structure agrees closely with those described and figured by me from the tentacular-arms of Nos. 4, 5 and 14, (Plate XVI, figs. 3, 5, 6, and Plate XVII, figures 1, 1^a).

The jaws are still attached together, in their natural position, by the cartilages. They agree very closely in form with the large jaws of *Architeuthis princeps* V. (No. 10), figured on Plate XVIII, but they are about one-tenth smaller.

No. 14.—Catalina specimen, 1877. (*Architeuthis princeps*.)

PLATE XVII. FIGS. 1-5. PLATE XIX. PLATE XX.

A nearly perfect specimen of a large squid, was found cast ashore after a severe gale, at Catalina, Trinity Bay, Newfoundland, Sept. 24, 1877. It was living when found. It was exhibited for two or three days at St. John's, and subsequently was carried in brine to New York, where it was purchased by Reiche & Brother for the New York Aquarium. There I had an opportunity to examine it, very soon after its arrival.* I am also indebted to the proprietors of the aquarium for some of the loose suckers. Other suckers from this specimen were sent to me from Newfoundland, by the Rev. M. Harvey. Although

* See American Journal of Science and Arts, vol. xiv, p. 425, Nov., 1877. When examined by me it was loose in a tank of alcohol. Dr. J. B. Holder gave me valuable assistance in making this examination, and also made one of the drawings of the caudal fin. It was afterwards "prepared" for exhibition by a taxidermist, who misplaced the arms, siphon, and other parts, and inserted two large, round, flat, red eyes close together on the top of the head!

somewhat mutilated, and not in a very good state of preservation when received, it is of great interest, being, without doubt, the largest and best specimen ever preserved. The Catalina specimen, when fresh,* was 9.5 feet from tip of tail to base of arms; circumference of body, 7 feet; circumference of head, 4 feet; length of tentacular-arms, 30 feet; length of longest sessile arms (ventral ones), 11 feet; circumference at base, 17 inches; circumference of tentacular arms, 5 inches; at their expanded portion, 8 inches. Length of upper mandible, 5.25 inches; diameter of large suckers, 1 inch; diameter of eye-openings, 8 inches. The eyes were destroyed by the captors. It agrees in general appearance with *A. Harveyi* (No. 5), but the caudal fin is broader and somewhat less acutely pointed than in that species, as seen in No. 5; it was two feet and nine inches broad, when fresh, and broadly sagittate in form. The dried rims of the large suckers are white, with very acutely serrate margins; the small smooth-rimmed suckers, with their accompanying tubercles, are distantly scattered along most of the inner face of the tentacular arms, the last ones noticed being nineteen feet from the tips. The sessile arms present considerable disparity in length and size, the ventral ones being somewhat larger and longer than the others, which were, however, more or less mutilated when examined by me; the serrations are smaller on the inner edge than on the outer edge of the suckers. On the smaller suckers the inner edge is often without serrations.

No. 15.—Hammer Cove specimen, 1876.

In a letter from Rev. M. Harvey, dated Aug. 25, 1877, he states that a big squid was cast ashore Nov. 20, 1876, at Hammer Cove, on the southwest arm of Green Bay, in Notre Dame Bay, Newfoundland. When first discovered by his informant it had already been partially devoured by foxes and sea-birds. Of the body, a portion 5 feet long remained, with about 2 feet of the basal part of the arms. The head was 18 inches broad; tail, 18 inches broad; eye-sockets, 7 by 9 inches; stump of one of the arms, 2.5 inches in diameter.

The only portion secured was a piece of the 'pen' about 16 inches long, which was given to Mr. Harvey.

No. 16.—Lance Cove specimen, 1877. (*Architeuthis princeps* ?.)

In a letter dated Nov. 27, 1877, Mr. Harvey gives an account of another specimen which was stranded on the shore at Lance Cove,

* Measurements of the freshly caught specimen were made by the Rev. M. Harvey, at St. John's, and communicated to me.

Smith's Sound, Trinity Bay, about twenty miles farther up the bay than the locality of the Catalina Bay specimen (No. 14). He received his information from Mr. John Duffet, a resident of the locality, who was one of the persons who found it and measured it. His account is as follows: "On Nov. 21, 1877, early in the morning, a 'big squid' was seen on the beach, at Lance Cove, still alive and struggling desperately to escape. It had been borne in by a 'spring tide' and a high inshore wind. In its struggles to get off it ploughed up a trench or furrow about thirty feet long and of considerable depth by the stream of water that it ejected with great force from its siphon. When the tide receded it died. Mr. Duffet measured it carefully, and found that the body was nearly 11 feet long (probably including the head); the tentacular-arms, 33 feet long. He did not measure the short arms, but estimated them at 13 feet, and that they were much thicker than a man's thigh at their bases. The people cut the body open and it was left on the beach. It is an out-of-the-way place, and no one knew that it was of any value. Otherwise it could easily have been brought to St. John's, with only the eyes destroyed and the body opened." It was subsequently carried off by the tide, and no portion was secured.

This was considerably larger than the Catalina specimen.

The great thickness of the short arms of this specimen, and of some of the others, indicates a species distinct from *A. Harveyi*, unless the sexes of that species differ more than is usual in this respect, among the smaller squids. The length of the sessile arms, if correctly stated, would indicate that this specimen belonged to *A. princeps*. In the female *Ommastrephes illecebrosa*, the common northern squid, the head is larger and the short arms are stouter and have larger suckers than in the male, of the same length.

No. 17.—Trinity Bay specimen, 1877.

Mr. Harvey also states that he had been informed by Mr. Duffet that another very large 'big squid' was cast ashore in October, 1877, about five miles farther up Trinity Bay than the last. It was cut up and used for manure. No portions are known to have been preserved, and no measurements were given.

No. 18.—Thimble Tickle specimen, 1878.

The capture of this specimen has been graphically described by Mr. Harvey, in a letter to the Boston Traveller, of Jan. 30, 1879.

"On the 2d day of November last, Stephen Sherring, a fisherman

residing in Thimble Tickle, not far from the locality where the other devil-fish [No. 19], was cast ashore, was out in a boat with two other men; not far from the shore they observed some bulky object, and, supposing it might be part of a wreck, they rowed toward it, and, to their horror, found themselves close to a huge fish, having large glassy eyes, which was making desperate efforts to escape, and churning the water into foam by the motion of its immense arms and tail. It was aground and the tide was ebbing. From the funnel at the back of its head it was ejecting large volumes of water, this being its method of moving backward, the force of the stream, by the reaction of the surrounding medium, driving it in the required direction. At times the water from the siphon was black as ink."

"Finding the monster partially disabled, the fishermen plucked up courage and ventured near enough to throw the grapnel of their boat, the sharp flukes of which, having barbed points, sunk into the soft body. To the grapnel they had attached a stout rope which they had carried ashore and tied to a tree, so as to prevent the fish from going out with the tide. It was a happy thought, for the devil-fish found himself effectually moored to the shore. His struggles were terrific as he flung his ten arms about in dying agony. The fishermen took care to keep a respectful distance from the long tentacles, which ever and anon darted out like great tongues from the central mass. At length it became exhausted, and as the water receded it expired.

"The fishermen, alas! knowing no better, proceeded to convert it into dog's meat. It was a splendid specimen—the largest yet taken—the body measuring 20 feet from the beak to the extremity of the tail. It was thus exactly double the size of the New York specimen, and five feet longer than the one taken by Budgell. The circumference of the body is not stated, but one of the arms measured 35 feet. This must have been a tentacle."

No. 19.—Three Arms specimen, 1878. (*Architeuthis princeps*?)

Mr. Harvey has also given an account of this specimen, in the same letter to the Boston Traveller, referred to under No. 18. This one was found cast ashore after a heavy gale of wind, Dec. 2, 1878, by Mr. William Budgell, a fisherman residing at a place called Three Arms. It was dead when found, and was cut up and used for dog meat. Mr. Harvey's account is as follows:

"My informant, a very intelligent person, who was on a visit in that quarter on business, arrived at Budgell's house soon after he

had brought it home in a mutilated state, and carefully measured some portions with his own hand. He found that the body measured 15 feet from the beak to the end of the tail, which is five feet longer than the New York specimen. The circumference of the body at its thickest part was 12 feet. He found only one of the short arms perfect, which was 16 feet in length, being five feet longer than a similar arm of the New York specimen, and he describes it as "thicker than a man's thigh." The statement that the sessile arms were longer than the head and body together, indicates that this was a specimen of *A. princeps*, like No. 14, but larger.

No. 20.—Banquereau specimen, 1878. (*Architeuthis megaptera* V.?)

This consists of the terminal part of a tentacular arm, which was taken by Capt. J. W. Collins and crew, of the schooner "Marion," from the stomach of a large and voracious fish (*Alepidosaurus ferox*) together with the only specimen hitherto discovered of the remarkable squid, *Histioteuthis Collinsii* V. The fish was taken on a halibut trawl-line, N. lat. 42° 49'; W. long. 62° 57', off Nova Scotia, 1879. This fragment, after preservation in strong alcohol, now measures 18 inches in length. It includes all the terminal club, and a portion of the naked arm below it. The club is narrow, measuring but .75 inch across its front side, while the naked arm is 1.25 broad, and rather flat, where cut off. From the commencement of the large suckers to the tip, it measures 9.25 inches. It had lost most of its suckers, so that it cannot be identified with certainty. Part of the large suckers and some of the marginal ones still remain, though the horny rings are gone; diameter of large suckers, .50 inch; of marginal ones, about .12. The suckers have the same form and arrangement as in the larger specimens of *Architeuthis*. It may, perhaps, belong to *Architeuthis megaptera*, or to a young *A. Harveyi*.

No. 21.—Cape Sable specimen. (*Architeuthis megaptera* V.)

PLATE XXI.

This specimen was found thrown on the shore near Cape Sable, N. S., after a very severe gale, several years ago. It is preserved in alcohol, entire, and in good condition, in the Provincial Museum at Halifax, where it is well exhibited in a large glass jar. It is the type specimen of *Architeuthis megaptera*, described by me, Sept., 1878.* It is a comparatively small species, its total length being but 43

* American Journal of Science, xvi. p. 207, 1878.

inches; its head and body together, 19 inches; body alone, 14 inches; its tentacular-arms, 22 and 24 inches; short arms, from 6.5 to 8.5 inches; tail-fin, 13.5 inches broad and 6 long.

This species differs widely from all the others in the relatively enormous size and breadth of its caudal fin, which is nearly as broad as the body is long, and more than twice as broad as long. It will form the type of a new generic group.

No. 22.—Brigus specimen, 1879.

Mr. Harvey states that portions of another large squid were cast ashore near Brigus, Conception Bay, in October, 1879.

Two of the short arms, each measuring eight feet in length, were found with other mutilated parts, after a storm.

No. 23.—James's Cove specimen, 1879.

From Mr. Harvey I have also very recently received an account of another specimen, which was captured entire about the first of November last, at James's Cove, Bonavista Bay, N. F. It seems to have been a fine and complete specimen, about the size of the Catalina Bay specimen (No. 14). Unfortunately the fishermen, as usual, indulged immediately in their propensity to cut and destroy, and it is doubtful if any portion was preserved. The account referred to was published in the *Morning Chronicle*, of St. John's, N. F., Dec. 9, 1879, and was credited to the *Harbor Grace Standard*. The author of the article is not given. The following extract contains all that is essential: "A friend at Musgrave Town sends us the following particulars relative to the capture of a big squid at James's Cove, Goose Bay, about a month ago. Our correspondent says: Mr. Thos. Moores and several others saw something moving about in the water, not far from the stage. Getting into a punt they went alongside, when they were surprised to see a monstrous squid. One of the men struck at it with an oar, and it immediately struck for the shore, and went quite upon the beach. The men then succeeded in getting a rope around it, and hauled it quite ashore. It measured 38 feet altogether. The body was about 9 feet in length, and two of its tentacles or horns were 29 feet each. There were several other smaller horns, but they were not so long. The body was about 6 feet in circumference. When I saw it, it was in the water, and was very much disfigured, as one of the men had thoughtlessly cut off the two longest tentacles, and had ripped the body partly open, thereby completely spoiling the appearance of the creature. The foregoing particulars I obtained from Mr. Moores."

Histioteuthis Collinsii Verrill.

In addition to the foregoing examples, all of which are believed to be referable to the genus *Architeuthis*, I have in a former article* described a very remarkable squid, belonging to the genus *Histioteuthis*, in which a broad thin membrane or 'web' unites the six upper arms together, nearly to their tips, while the lower ones have a shorter web uniting them to the rest. Although small, when contrasted with some of the gigantic specimens of *Architeuthis*, it is considerably larger than any of the common small squids, and as it inhabits the same localities with *Architeuthis*, and has some points of resemblance to the latter genus, especially in having the smooth-rimmed suckers for uniting together the long tentacular-arms, I have thought it best to describe it in this part of my article, in connection with the species of *Architeuthis*. The only specimen known was obtained (with No. 20) from the stomach of a large and voracious fish (*Alepidosaurus ferox*), having a formidable array of long sharp teeth, eminently adapted for the capture of such prey. It was taken by Captain J. W. Collins and crew of the schooner Marion, in deep water off the coast of Nova Scotia, and presented to the U. S. Fish Commission. This species (*H. Collinsii*) is figured on Plate XXII, and will be described farther on.

Onychoteuthis robusta (Dall MSS.).

In this connection I may also refer to a gigantic Pacific Ocean species, obtained by Mr. W. H. Dall, on the coast of Alaska, in 1872, which will be described as fully as possible in another part of this article, when discussing the foreign species of large Cephalopods. (see Plates XXIII and XXIV.) Three specimens were observed and measured by Mr. Dall. The largest measured, from the base of the arms to the end of the body, 8.5 feet. The ends of all the arms had been destroyed, in all the specimens. It was formerly† briefly described by me under Mr. Dall's MSS. name, *Ommastrephes robustus*, but a more careful study of the parts preserved, especially the 'cone' of the 'pen' and the odontophore, has convinced me that it belongs to the genus *Onychoteuthis*, characterized especially by having rows of sharp claws or hooks on the 'club' of the tentacular-arms, instead of suckers. All the species of this genus previously known are of small size, and pelagic in their habits. It is, therefore, of especial interest to add another generic type to the list of gigantic species.

* American Journal of Science, vol. xvii. p. 241, 1879.

† American Journal of Science, vol. xii. p. 236, 1876.

Comparative measurements of the specimens (in inches).

	Archibuteuthis (Harvey)?							Archibuteuthis princeps?											
	No. 2.	No. 3.	No. 4.	No. 5. Fresh.	No. 5. Preserv'd.	No. 8.	No. 9.	No. 11.	No. 15.	No. 1.	No. 7.	No. 10.	No. 13.	No. 14.	No. 16.	No. 18.	No. 19.	No. 22.	No. 23.
Total length, to tip of tentacular-arms,-----	624	384	382	--	--	480	540	--	--	624	--	--	450?	480	528	--	--	456	--
Total length, to tip of short arms,-----	--	--	166	--	--	--	--	--	--	--	--	--	--	246	--	--	--	--	--
Base of arms to insertion of tail-fin,-----	--	--	75	--	--	--	--	--	--	--	--	--	120	95	--	--	--	--	--
Base of arms to tip of tail,-----	420	--	92	--	--	--	--	168?	--	170?	180	--	140?	114	132	240	180	--	108
Head, length (base of arms to mantle),-----	--	--	10	--	--	--	--	--	--	--	--	--	--	14?	--	--	--	--	--
Mantle edge to tip of tail, above,-----	90?	--	82	--	--	--	--	--	--	56?	--	--	--	100?	--	--	--	--	72
Circumference of body,-----	--	--	66	--	--	--	--	--	--	--	--	--	--	84	--	144	--	--	--
Circumference of head,-----	--	--	--	--	--	--	--	36	--	--	--	--	--	48	--	--	--	--	--
Breadth of head, across eyes,-----	--	--	--	--	--	--	--	18	--	--	--	--	--	8	--	--	--	--	--
Breadth of eye-openings,-----	--	--	--	--	--	--	--	7 x 9	--	--	--	--	--	8	--	--	--	--	--
Length of tail-fins, (tip to insertion),-----	--	--	18?	--	--	--	--	--	--	--	--	--	--	19 p.	--	--	--	--	--
Breadth of tail-fins,-----	--	--	22	16	--	--	--	18	--	--	--	--	--	28 p.	--	--	--	--	--
From outer angle to tip of tail-fins,-----	--	--	27?	23	--	--	--	--	--	--	--	--	--	24.5 p.	--	--	--	--	--
Outer angle of tail-fin to side of body,-----	--	--	--	6.5	--	--	--	--	--	--	--	--	--	10 p.	--	--	--	--	--
Length of tentacular-arms,-----	348?	504	288	161	--	--	--	384	--	444	--	--	312	360	396	420	--	--	348
Length of 'club' bearing rows of suckers,-----	30	--	30	30	--	--	--	--	--	--	--	--	--	30.5 p.	--	--	--	--	--
Part bearing largest suckers,-----	18	--	15	14	--	--	--	--	--	--	--	--	--	19 p.	--	--	--	--	--
Length of longest sessile arms,-----	72	--	72	--	--	--	--	120	--	120+	--	--	104?	132	156?	--	192	96	--
Circumf. of largest sessile arms (at base),-----	9	--	10	3	--	--	--	10.5	22	22	--	--	16?	17	--	--	--	--	--
Breadth of largest sessile arms (at base),-----	--	--	2 1/3	2.75	--	--	--	3.5?	--	--	--	--	--	6	--	--	--	--	--
Circumf. of tentacular-arms (middle),-----	4	--	2 1/3	8	--	--	--	--	--	--	--	--	--	5	--	--	--	--	--
Circumference of 'club' of snout,-----	6	--	--	4.5	--	--	--	--	--	--	--	--	--	6 p.	--	--	--	--	--
Diameter of largest suckers, of club,-----	1.28	--	1.25	1.15	--	--	--	2.25?	--	2	--	--	1.10	1.15	--	--	--	--	--
Diameter of largest suckers of short arms,-----	--	--	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--
Upper jaw, total length,-----	--	--	3.55	3.85	--	--	--	--	--	5	--	--	4 +	5.25	--	--	--	--	--
Upper jaw, breadth (front to back),-----	--	--	2.5+	2.50	--	--	--	--	--	3.50	--	--	3.24	3.88	--	--	--	--	--
Lower jaw, total length,-----	--	--	--	3	--	--	--	--	--	3.63	--	--	3.24	3.75	--	--	--	--	--
Lower jaw, total breadth,-----	--	--	--	2.65	--	--	--	--	--	--	--	--	3.08	3.88	--	--	--	--	--
Lower jaw, tip of beak to notch,-----	--	--	.62	.65	--	--	--	--	65	--	--	--	.80	.87	--	--	--	--	--

* The measurements given from the preserved specimen of No. 14 are designated by (p) affixed.

*Special Descriptions of the Atlantic Coast Species.***Architeuthis** Steenstrup.

Oplysninger om Atlanter, Collossale Blæksprutter, Förhandlingar Skand. Naturf., 1856, vii. p. 182, Christiana, 1857.

Size large. Body stout, nearly round, swollen in the middle. Caudal fin, in the typical species, very small, sagittate (very large, broad, rhomboidal in *A. megaptera*).* Head large, short. Eyes very large, oblong-ovate with well-developed lids and anterior sinus. Sessile arms stout, their suckers large, very oblique, with the edges of the horny rings strongly serrate, especially on the outer margin. The margin has around it a free-edged membrane, which closely surrounds the denticles when the sucker is used, and allows a vacuum to be produced. Tentacular-arms very long and slender, in extension, the proximal part of the club furnished with an irregular group of small, smooth-rimmed suckers, intermingled with rounded tubercles on each arm, the suckers on one arm corresponding with the tubercles of the other, so that, by them, the two arms may be firmly attached together without injury, and thus used in concert; other similar suckers and tubercles, doubtless for the same use, are distantly scattered along the slender part of these arms, one sucker and one tubercle always occurring near together. The internal shell (known only in one species) is thin and very broad, expanding from the anterior to the posterior end, with divergent ribs.

This genus is closely allied to *Ommastrephes*, from which it may be best distinguished by the presence of the peculiar suckers and tubercles for uniting the tentacular-arms together. A small cluster of smooth-edged suckers also occurs at their tips.

Architeuthis *Harveyi* Verrill.

Megaloteuthis Harveyi Kent, Proc. Zool. Soc. London, 1874, p. 178.

Architeuthis monachus Verrill, Amer. Journal Science, vol. ix, pp. 124, 177, Pl. ii, iii. iv, 1875; vol. xii, p. 236, 1876. American Naturalist, vol. ix, pp. 22, 78, figs. 1-6, 10, 1875, (? non Steenstrup).

Ommastrephes harveyi Kent, Proc. Zool. Soc. London, 1874, p. 492.

Ommastrephes (Architeuthis) monachus Tryon, Manual of Conchology, I, p. 184, Pl. 83. fig. 379, Pl. 84, figs. 380-385, 1879. (Descriptions compiled and figures copied from the papers by A. E. V.)

PLATES XIII, XIV, XV, XVI, XVIIa.

The diagnostic characters of this species, so far as determined, are as follows: Sessile arms unequal in size, nearly equal in length,

* This species differs so much in dentition and other characters from the typical forms, as to deserve separation, as a subgenus, or perhaps as a distinct genus, which I propose to call *Stenoteuthis*.

decidedly shorter than the head and body together, and scarcely as long as the body alone, all bearing apparently similar suckers; their tips slender and acute. Tentacular-arms, in extension, about four times as long as the short ones; about three times as long as the head and body together. Caudal fin small, less than one-third the length of the mantle, sagittate in form, with the narrow lateral lobes extending forward beyond their insertions; the posterior end tapering to a long acute tip. Jaws with smaller notch and lobe than in *A. princeps*. Suckers of the sessile arms (so far as seen) with numerous acute teeth all around the circumference, all similar in shape, but those on the inner margin smaller than those on the outer. Sexual characters are not yet determined.

Special description of the specimen, No. 5.—The preserved parts of this specimen (see p. 184), examined by me, are as follows: The anterior part of the head, with the bases of the arms, the beak, lingual ribbon, etc.; the eight shorter arms, but without the suckers, which dropped off in the brine, and are now represented only by a few of the detached marginal rings; the two long tentacular-arms, which are well preserved, with all the suckers in place; the caudal fin; portions of the 'pen' or internal shell; the ink-bag; and pieces of the body.

The general appearance and form of this species* are well shown by Plates XIII and XIV. The body was relatively stout. According to the statement of Mr. Harvey, it was, when fresh, about 213^{mm}

* Mr. W. Saville Kent, from the popular descriptions of this species, gave it new generic and specific names, viz: *Megaloteuthis Harveyi*, in a communication made to the Zoological Society of London, March 3, 1874 (Proceedings Zool. Soc. p. 178; see also Nature, vol. ix, p. 375, March 12, and p. 403, March 19). My former identification was based on a comparison of the jaws with the jaws of *A. monachus*, well figured and described by Steenstrup in proof-sheets of a paper which is still unpublished, though printed several years ago, and referred to by Harting. The agreement of the jaws is very close in nearly all respects, but the beak of the lower jaw is a little more divergent in Steenstrup's figure. His specimen was a little larger than the one here described and was taken from a specimen cast ashore at Jutland, in 1853. Mr. Kent was probably unacquainted with Steenstrup's notice of that specimen when he said (Nature, ix, p. 403) that *A. monachus* "was instituted for the reception of two gigantic Cephalopods, cast on the shores of Jutland in the years 1629 and 1790, and of which popular record alone remains." In his second communication to the Zoological Society of London, March 18, 1874, (Proc., p. 490), he states (on the authority of Crosse and Fischer) that a third specimen "was stranded on the coast of Jutland in 1854, and upon the pharynx and beak of this, the only parts preserved; the same authority founded his species *Architeuthis duz.*" The specimen here referred to is

(seven feet) long and five and one-half feet in circumference. The 'tail' or caudal fin (Plate XIII, fig. 2, and Plate XVI, fig. 2) is decidedly sagittate, and remarkably small in proportion to the body. It is said by Mr. Harvey to have been 55.9^{cm} (22 inches) across, but the preserved specimen is considerably smaller, owing, undoubtedly, to shrinkage in the brine and alcohol. The posterior termination is unusually acute and the lateral lobes extend forward considerably beyond their insertion. In the preserved specimen the total length, from the anterior end of the lateral lobes to the tip of the tail, is 58.4^{cm} (23 inches); from the lateral insertions to the tip, 48.2^{cm} (19 inches); total breadth about 38^{cm} (15 inches); width of lateral lobes, 15.2^{cm} (6 inches). The eight shorter arms, when fresh, were, according to Mr. Harvey's measurements, 182.9^{cm} (six feet) long and all of equal length,* but those of the different pairs were respectively 25.4,

evidently the same that Steenstrup named *A. monachus*, in 1856. The confusion in reference to these names is evidently due to this mistake.

The statement that *Architeuthis dux* Steenstrup is known from the beak alone is evidently erroneous. Steenstrup, himself, Harting, and Dr. Packard, in their articles on this subject, all state that the suckers, parts of the arms, and the internal shell or pen were preserved, and they have been figured, but not published, by Prof. Steenstrup. Harting has also given a figure of the lower jaw, copied from a figure by Steenstrup. In the proof-sheets that I have seen, this specimen is referred to as "*A. Titan*," but Harting cites it as *A. dux* Steenstrup, which is the name given to it by Steenstrup in his first notice of it, in 1856. Therefore two distinct species were confounded under this name by Kent.

I have more recently been led to consider our species distinct from the true *A. monachus* by correspondence with Professor Steenstrup, from whom I learn that the caudal fin in his species does not agree with that of the species here described, and that in his species the ventral arms differ from the others, both in form and in the character of the suckers. Certain differences in the arms can be detected in the photograph of our specimen (reproduced on Plate XIII) in which, fortunately, the ventral arms are well-displayed; but their suckers do not appear to differ, except in size. Unless these differences prove to be sexual characters, which is not likely, they would indicate a specific difference. Therefore, I have, for the present, adopted the specific name given by Kent to the Newfoundland specimens. The name was given, as a well-merited compliment to the Rev. M. Harvey, who has done so much to bring these remarkable specimens into notice. Nevertheless it is probable that when the original specimens of *A. monachus* shall have been fully described and figured, one of our species may prove to be identical with it. At present I am unable to decide whether the affinities of *A. monachus* may not be with *A. princeps*, rather than with *A. Harveyi*. With the former it apparently agrees in having two forms of suckers on the short arms.

* It is possible that they may have been originally somewhat unequal, and that mutilation of their tips made them appear more nearly equal than they were in life.

22.9, 20.3 and 17.8^{mm} (ten, nine, eight and seven inches) in circumference.* They are, except the ventral, compressed trapezoidal in form and taper very gradually to slender acute tips. Their inner faces are occupied by two alternating rows of large obliquely campanulate suckers, with contracted apertures, surrounded by broad, oblique, thin, horny, marginal rings, much broader on the outer side than on the inner, and armed with strong, acute teeth around their entire circumference, but the teeth are largest and most oblique on the outside (Plate XVI, fig. 4; XVIa, figs. 6-8). These suckers gradually diminish in size to the tips of the arms, where they become very small, but all that are preserved are similar in form and structure. The ventral pair of arms still have, as they show in the photograph, the inner face much broader than it is in the others, especially near the base, and they are more nearly square than any of the others. Their suckers are more numerous, farther apart transversely, and closer together in the longitudinal series, there being about 46 on the proximal half (36 inches) of each, while on each of the subventral arms there are only about 30 on the corresponding portion; the suckers also diminish rather abruptly in size at about 26 to 30 inches from the base, beyond which they are scarcely more than half as large as those on the second and third pairs of arms, at the same distance from the base. The largest of these suckers are said, by Mr. Harvey, to have been about an inch in diameter, when fresh. The largest of their marginal rings, in my possession, are 14^{mm} to 16^{mm} in diameter, at the serrated edge, and 18^{mm} to 20^{mm} beneath.

The horny rings are yellowish horn-color, oblique, and more than twice as wide on the back side as in front. A wide peripheral groove runs entirely around the circumference, just below the denticulated margin; it is narrower and deeper on the front side. On the front side the edge is nearly vertical, and the denticles point upward or are but slightly incurved; but on the outer or back side the edge and denticles are bent obliquely inward; along the side the edge is more or less incurved and the denticles are inclined more or less forward, toward the front edge of the sucker. The denticles are golden yellow, or when dry, silvery white; those on the outer and lateral

* In the original statement it is not mentioned to which pairs of arms these dimensions apply. After having been five years in alcohol the ventral arms now measure 7.5 inches in circumference, and one of the lateral ones (perhaps one of the third pair) 8 inches. The marginal membranes or crests had decayed, apparently, before the arms were preserved: their terminal portions are also gone, so that the real length cannot be given.

margins are largest, flat, lanceolate, with sharply bevelled lateral edges and acuminate tips; those on the front margin are shorter, narrower, acutely triangular, and in contact at their bases. On the largest of these suckers there are forty-eight to fifty denticles. Some of the suckers of rather smaller size (*a*, *b*,) are more oblique, with the outer side of the horny rings relatively wider and more incurved; the denticles of the outer margin are strongly incurved and decidedly narrower and more acute than the lateral ones, which are broad-triangular; the inner or front denticles are rather smaller, acute-triangular, and usually inclined somewhat inward. On these there are forty to forty-six denticles. No suckers of this specimen have been found with the denticles rudimentary or wanting on the front edge, as is frequently the case in those of *A. princeps*. Nor is there so much contrast in the form and size of the inner and outer denticles of the largest suckers as in that species. The rings of the smaller suckers are still more oblique and more contracted at the aperture than those of the larger ones, with the teeth more inclined inward, those on the outside margin being largest.

Measurements of suckers of short arms (millimeters).

	<i>a</i> (alc.)	<i>b</i> (alc.)	<i>c</i> (alc.)	<i>d</i> (dry.)
Transverse diameter, outside,	17	17	20	18
Diameter of aperture,	13	10	16	14
Breadth of horny ring, back side, ...	7.5	9	8	7
Breadth of horny ring, front side, ...	3	3	3.5	3
Number of distinct denticles,	46	41	50	49

The two long tentacular-arms are remarkable for their slenderness and great length when compared with the length of the body. Mr. Harvey states that they were each 731.5^{cm} (24 feet) long and 7^{cm} (2.75 inches) in circumference when fresh. In the brine and alcohol they have shrunk greatly, and now measure only 411.5^{cm} (13.5 feet) in length, while the circumference of the slender portion varies from 5.7^{cm} to 7.25^{cm} (2.25 to 3.25 inches). These arms were evidently highly contractile, like those of many small species, and consequently the length and diameter would vary greatly according to the state of contraction or relaxation. The length given (24 feet) probably represents the extreme length in an extended or flaccid condition, such as usually occurs in these animals soon after death. The slender portion is nearly three-cornered or triquetral in form, with the outer angle rounded, the sides slightly concave, the lateral angles prominent, and the inner face a little convex and generally smooth.

The terminal portion, bearing the suckers, is 76.2^{cm} in length and expands gradually to the middle, where it is 11.4^{cm} to 12.7^{cm} in circumference (15.3^{cm} when fresh), and 3.9 to 4.1^{cm} across the inner face. The sucker-bearing portion may be divided into three parts. The first region occupies about 17.8^{cm} (7 inches); here the arm is rounded-triangular, with margined lateral angles, and gradually increases up to the maximum size, the inner face being convex and bearing about forty irregularly scattered, small, flattened, saucer-shaped suckers, attached by very short pedicels, and so placed in depressions as to rise but little above the general surface. The larger ones are 5 to 6^{mm} in external diameter; 3^{mm} across aperture; 1.5^{mm} high. The smaller ones have a diameter of 4^{mm} ; aperture 2.5^{mm} ; height 1^{mm} . The horny ring (Plate XVIa, figs. 9, 9a) is circular, thin, and of about uniform breadth all around; the edge is smooth and even, slightly everted; just below the edge there is a groove all around; below this a prominent, rounded ridge surrounds the periphery, below which the lower edge is somewhat contracted. A thick, soft membrane surrounds the edge. These suckers are at first distantly scattered, but become more crowded, distally, forming six to eight irregular alternating rows, covering the whole width of the inner face, which becomes 4.1^{cm} broad. Scattered among the suckers are about an equal number of low, broad, conical, smooth, callous verrucæ, or wart-like prominences, rising above the general surface, their central elevation corresponding in form and size to the apertures of the adjacent suckers. These, without doubt, are intended to furnish secure points of adhesion for the corresponding suckers of the opposite arm, so that, as in some other genera, these two arms can be fastened together at this wrist-like portion, and thus may be used unitedly. By this means they must become far more efficient organs for capturing their prey than if used separately. The absence of denticulations prevents the laceration of the creature's own flesh, which the sharp teeth of the other suckers would produce, under pressure, and the verrucæ prevent the lateral slipping, to which unarmed suckers applied to a smooth surface would be liable. Between these smooth suckers and the rows of large ones there is a cluster of about a dozen small suckers, with sharply serrate margins, from 5 to 8^{mm} in diameter, attached by slender pedicels. They are arranged somewhat irregularly in four rows, those of the outer rows more oblique and corresponding in form with the larger marginal suckers.

The second division, 35.6^{mm} in length, succeeds the small suckers. Here the arm is flattened on the face, well-rounded on the back, and provided with a sharp dorsal carina, increasing in width toward the tip. It bears two alternating rows of about twelve very large serrated suckers, and an outer row of smaller ones, on each side, alternating with the large ones. The upper edge is bordered by a rather broad, regularly scalloped, marginal membrane, the scallops corresponding to the large suckers, while prominent transverse ridges, midway between the large suckers, join the membrane and form its lobes. On the lower edge there is a narrower and thinner membrane, which runs all the way to the tip of the arm. In one (the lower) of the rows of large suckers there are eleven, and in the other ten, above 20^{mm} in diameter. The former row has one additional sucker at its proximal end 15^{mm} in diameter, and three others at its distal end, respectively 16, 12, and 8^{mm} in diameter. The other row, of ten suckers, is continued by a proximal sucker 10^{mm} in diameter, and by two distal ones, respectively 15 and 13^{mm} in diameter. The number of 'large' suckers in each row may, therefore, be counted as 12, 13, or 14, according to the fancy of the describer, there being no well-defined distinction between the larger and smaller ones in either row. The largest suckers, along the middle of the rows, are from 24^{mm} to 30^{mm} in diameter (Plate XVI, fig. 3, *a*). They are attached by slender but strong pedicels, about 10^{mm} long and 6 to 7^{mm} in diameter. The outer or back side of these suckers is 16 to 18^{mm} high; the front side 10 to 11^{mm}, so that the rim is about 24 to 28^{mm} above the surface of the arm. The horny rings are 7 to 8^{mm} high and have the aperture 20 to 23^{mm} in diameter. Each one is situated in the center of a pentagonal depressed area, about 25^{mm} across, bounded by ridges, which alternate regularly, and interlock on the two sides, so as to form a zigzag line along the middle of the arm. These large suckers are broadly and obliquely campanulate, but much less oblique than those of the short arms; the marginal ring is strong, and sharply serrate all around; the denticles are acute-triangular and nearly equal. The rings are somewhat calcified and rather rigid when dried; a well-marked broad groove runs around the entire circumference, below the bases of the denticles.

The small marginal suckers (fig. 3, *b*) are similar in structure, but much more oblique, and mostly 9 to 11^{mm} in diameter; they are attached by much longer and more slender pedicels, and their marginal teeth are relatively longer, sharper and more incurved, especially on the outer margin. The peripheral groove is broad and deep,

but is interrupted on the outer side for about a third of the circumference; the outer third portion of the horny ring is somewhat flattened from the circular form.

The terminal division of the arm is 22.8^{cm} long. It gradually becomes much compressed laterally, and tapers regularly to the tip, which is flat, blunt and slightly incurved. Just beyond the large suckers, where this region begins, the circumference is 9^{cm}. The face is narrow and bears a large number of small pedicellate suckers, (Plate XVIa, figs. 10, 10a) arranged in four regular, alternating rows, gradually diminishing in size to near the tip of the arm, where the rows expand into a small cluster of about ten smooth-edged suckers. The suckers, except in the final group, are much like the marginal ones of the previous division, and at first are 5 to 7^{mm} in diameter, but decrease to about 2.5^{mm} near the tip of the arm. They have sharply serrate, oblique, marginal rings, broader on the outer side, with a peripheral groove on the front and sides only. In our preserved specimens the rings are gone from many of these small suckers, but those of the two rows next to the lower margin appear to have been larger than the others.

The suckers of the final group are close to the tip, which is slightly recurved over them. They are flat, attached to short pedicels, and provided with a narrow horny rim, which has the edge smooth, or nearly so, and surrounded by a thick membranous border. The diameter of these suckers is from .5 to 2^{mm}. They are rather crowded and the cluster is broader than long.

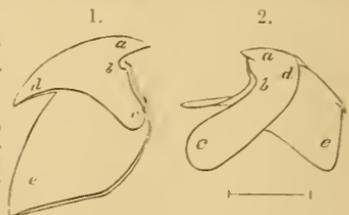
The color of the body and arms, where preserved, is pale reddish, with thickly scattered small spots of brownish red.

The form of the jaws* of this specimen is well shown by Plate XV, figs. 1 and 2. When in place the tips of these jaws constitute a pow-

* In order to explain the terms employed in describing the various parts of the jaws of Cephalopods, as used in this article, I have introduced figures of the jaws of one of our common small squids (*Loligo pallida* V.) from Long Island Sound. The nomenclature adopted is essentially that used by Professor Steenstrup.

Figure 1. Upper mandible: *a*. rostrum or tip of the beak; *b*. the notch; *c*. the inner end of ala; *d*. the frontal lamina; *e*. the palatine lamina; *ab*. the cutting edge of beak; *bc*. anterior or cutting edge of ala.

Figure 2. Lower mandible: *a*. rostrum; *ab*. cutting edge; *bc*. anterior edge of ala; *d*. mentum or chin; *e*. gular lamina.



erful beak, looking something like that of a parrot or hawk, except that the upper jaw shuts into the lower, instead of the reverse, as in birds. The color is dark brown, becoming almost black toward the tip, where its substance is thicker and firmer and smoothly polished externally. The upper jaw (Plate XV, fig. 1), in 1875, measured 97^{mm} in total length; 25^{mm} in transverse breadth; and 66^{mm} in breadth or height. The lower jaw (fig. 2) was 76^{mm} long, 70^{mm} transversely, and 67^{mm} broad, vertically. It was larger when first received, but has subsequently shrunk considerably more, in alcohol.

The upper mandible has the rostrum strong, convex, acute, and curved considerably forward, with concave cutting edges, and a slight notch at its base. The anterior edges of the alæ are irregular and uneven. The palatine lamina is broad and thin.

The lower mandible has the rostrum stouter and less curved, the tip acute, with a distinct notch just below the tip, the cutting edges nearly straight, and with a moderately deep and rather narrow notch at its base; a ridge runs backward, from near the tip, in a curved line, circumscribing a more flattened area, on which are grooves and ridges parallel with the notch. Beyond the notch, on the anterior edges of the alæ, there is, on each side, a broad, low, obtuse lobe or tooth, beyond which the edge is even and slightly concave, to near the end of the alæ. The lamina of the mentum is short and strongly emarginate in the median line. Detailed measurements of the parts are given in the table of measurements on a subsequent page.

The roof of the mouth, or palate, between the anterior portions of the palatine laminae, is lined with a rather firm, somewhat chitinous or parchment-like membrane,* having its surface covered with strong, acute, recurved, yellowish teeth, apparently chitinous in nature, attached by broad, oval or roundish, flattened bases (Plate XVI, fig. 1; XVI*a*, fig. 4). These teeth are mostly curved, and very unequal in size and form, the various sizes being intermingled. They are arranged in irregular quincunx, in many indefinite rows. Many irregular, roundish, rough, white, stony granules are also attached to this membrane, among the teeth. Similar granules (Plate XVI*a*, fig. 5) occur in large numbers on the thinner extension of this membrane, which everywhere lines the mouth and pharynx.

* In my first examination of this species, this tooth-bearing membrane was found, like the surrounding parts, much mutilated, and was mistaken for the odontophore, and described and figured as such. The real odontophore was discovered later, loose in another can, with other fragments of the same specimen, and this serious mistake was corrected in the American Journal of Science, vol. xii, p. 236, 1876.

The odontophore is about 64^{mm} in total length, with the dentigerous portion, where widest, about 11^{mm} in width. The teeth are in seven rows, with an exterior row of small, unarmed, thin, rhomboidal plates on each side, thus conforming to the arrangement in the other ten-armed cephalopods. The teeth are deep amber-color to dark brown, and not unlike those of *Loligo* and *Onumastrepes* in form. Those of the median row have three fangs, the central one longest; those on the next row, on either side, have two fangs; while those of the two outer lateral rows, on each side, are acute and strongly curved; the outermost longest and simple, the next to the outer often having a small denticle on the outer side, near the base. (See Plate XVIa, figs. 1, 2, 3.)

The membrane of the odontophore is broad, firm and thick; the dentigerous portion occupies only about a third of its width, in the middle or broader portion, where it is bent abruptly back upon itself. The lower or ventral portion measures, from the anterior bend to the end, 20^{mm}; it narrows gradually to the broad obtuse end, the width of the dentigerous portion decreasing from 9 to 5^{mm}, the naked lateral membrane decreasing from 8^{mm} to a very narrow border. The upper portion, from the bend to the end, measures 42^{mm} in length (in a straight line). The upper surface is deeply concave and infolded, at first, with the lateral membrane broad and recurved; farther back it becomes more flattened, with the dentigerous portion broader (11^{mm}), while the lateral membrane is abruptly narrowed and then extends to the end as a very narrow border. Toward the end the rows of teeth become more separated and the teeth smaller and paler, while the membrane becomes thinner and narrower.

The internal shell, or 'pen,' was represented by numerous detached pieces, which, after much trouble, I succeeded in locating and matching, so as to restore both the anterior and posterior ends, and thus to gain a fair idea as to what its original structure must have been. The texture, form and structure of the pen was somewhat like that of *Loligo*, but it was thinner, and had less definite outlines, and less of the peculiar quill-shape seen in the latter. The posterior end, instead of being pointed and regular in outline, appears to have been broadly rounded, or somewhat truncated, with an indefinite outline, thinning out gradually on all sides into a soft fibrous membrane, while the shaft, or quill-portion, was not so distinctly differentiated from the broader central portion, but increased in width quite regularly, from near the anterior end. The fragments in my possession belong to four more or less separated sections. The first section includes eleven

inches of the anterior end, from close to the extreme tip backward; the second section includes about nine inches, belonging to the anterior portion, and extends to about twenty-five inches from the anterior end, but lacks the extreme lateral margins, outside the costæ (Plate XV, fig. 3); the third section consists of about 7.5 inches belonging to the middle region, but does not include the whole width on either side of the midrib; the fourth section is about 10 inches in length, and comes from close to the posterior end, apparently representing nearly the whole width, on both sides.

From these fragments we can restore, pretty accurately, the first twenty-five inches, and the last twelve inches or more, though the precise form of the indefinite posterior margin must remain doubtful. The extreme anterior tip is broken off, but it was evidently pointed and pen-shaped, as in *Loligo*. At the mutilated end the breadth is now about a third of an inch. From this point the lateral edges diverge rapidly with a slightly concave outline, for about 1.25 inches, where the breadth becomes 1.20 inches; beyond this the margins are nearly straight and diverge gradually to the end of the first section, at eleven inches from the tip. At this place the breadth is 3.10 inches, the marginal portions, outside of the lateral costæ, being about .40 of an inch, and the midrib about .25 of an inch broad. Beyond this point a section about 4.75 inches long is entirely wanting, and the succeeding section lacks the marginal portions, the lateral costæ forming the margins on both sides. At 19.50 inches from the tip, the breadth, between the lateral costæ, is 3.75 inches; at 25 inches it is 5 inches broad. Whether the marginal portions originally extended to this point with a breadth as great as they have at 11 inches is uncertain, for their breadth decreases backward to that point from a point about 4 inches from the tip, where their breadth is .60 of an inch. The midrib is strongly marked, being raised into a semi-cylindrical form, and of somewhat thicker material than the lateral portions; its breadth and height steadily increases throughout both these sections and the following one, until it becomes nearly half an inch broad, but in the section from near the posterior end it is low and narrow and decreases rapidly toward the end. The lateral costæ are well-marked, considerably elevated, and well rounded; they run, at first, close to and nearly parallel with the midrib, but after the first three inches they diverge quite regularly to the point, at 25 inches from the end, beyond which we cannot trace them, until they reappear in the first part of the posterior section, where they are quite small and soon fade out entirely, at some distance from

the extreme end. Near the anterior end, between the principal costæ and the margin, there are two additional costæ, much less distinct, and many faint radiating lines on each side. But these diverge more rapidly and mostly run into the margin at six to eight inches from the anterior end. The anterior portions and posterior portions are pale yellow or buff, fading to whitish at the thin margins, and deepening into pale amber at the midrib. Their substance is flexible, translucent, and very thin—scarcely thicker than parchment, except at the midrib and costæ.

The third section evidently came from the middle region, where the shell was thickest and broadest. This piece is 7.50 inches long, and 4.10 broad, with a strongly convex midrib, .30 to .35 of an inch broad, running through the center, but without any lateral costæ. In this portion the shell is much thicker and firmer than in the others, and of a decided brownish yellow, or dull amber-color, but quite translucent; it is finely striated with close, nearly parallel lines. The breadth and form of this middle portion must remain undetermined, for the present. The posterior section is quite incomplete, but is over ten inches long, and shows an extreme width of about six inches, or 5.75 where the lateral costæ disappear. Some of the fragments extend backward eight inches or more beyond that point, and gradually fade out, both at the ends and lateral margins, into a white, soft but tough, fibrous membrane. So far as this portion is preserved, it indicates a broadly rounded and ill-defined posterior termination.

To this species I refer, with some doubt, the tentacular-arm of No. 2, preserved in the museum of St. John's, Newfoundland. It agrees essentially in form and size, as will be seen from the description and measurements, with the corresponding arms of No. 5. Still it must be remembered that, as yet, no reliable distinctions have been made out between the tentacular-arms of *A. Hurceyi* and *A. princeps*.

The total length of the tentacular-arm of No. 2 was estimated at 30 to 35 feet. The portion saved measured, when fresh, 579.12^m (19 feet). The circumference of the slender portion was 9 to 10^m; of the enlarged sucker-bearing part, 15.24^m (6 inches); length of the part bearing suckers, 76.2^m (30 inches); diameter of the largest suckers, 3.17^m (1.25 inches). Calculating from the photograph, the portion bearing the larger suckers was about 45.7^m (18 inches) in length, and about 6.35^m (2.5 inches) broad, across the face; distance between attachments of large suckers, 4.27^m (1.68 inches); outside diameter of larger suckers, 2.95 to 3.15^m (1.16 to 1.25 inches); inside

diameter, 1.86 to 2.54^{cm} (.74 to 1 inch); diameter of the small suckers of the outside rows, 1.02 to 1.22^{cm} (.40 to .48 of an inch). Mr. Harvey afterwards sent to me a full series of measurements of this arm, as then preserved. It had contracted excessively in the alcohol, and was only 13 feet one inch in length (instead of 19 feet, its original length), the enlarged sucker-bearing portion being 27 inches; the large suckers occupied 12 inches; the terminal part bearing small suckers, 9 inches; circumference of slender portion, 3.5 to 4.25 inches; of largest part, 6 inches; breadth of face, among large suckers, 2.5 inches; from face to back, 1.62 inches; diameter of largest suckers outside, .75 of an inch; aperture, .63 of an inch. It will be evident from these measurements, when compared with those made while fresh and from the photograph, that the shrinkage had been chiefly in length, the thickness remaining about the same, but the suckers (which had lost their horny rims, and therefore their size and form,) were considerably smaller than the dimensions previously given. Comparing all these dimensions with those of the Logie Bay specimen, and calculating the proportions as nearly as possible, it follows that this specimen was very nearly one-third larger than the latter, but the large suckers appear to have been relatively smaller, for they were hardly one-twelfth larger than in the Logie Bay specimen. As the relative size of the large suckers is a good sexual character in certain species of squids, it is possible that this difference may be a sexual one, in this case.

To this species I formerly referred the jaws and two large suckers from the 'club' of the tentacular-arms of the Bonavista Bay specimen (No. 4, see p. 194). In form, size, and proportions the jaws resemble those of the specimen (No. 5), described above, so that the size of these two individuals must have been about the same. These jaws had been dried and were very badly broken when received, so that only part of their dimensions could be ascertained, at first, but I have recently partially repaired them, so as to study them more fully, (see table under *A. princeps*). The total length of the upper mandible was about 105^{mm}. Tip of beak to notch 16^{mm}; notch to end of proper cutting edge of alæ, 75^{mm}. The lower mandible (Plate XXV, figs. 5, 5a) shows both sides of the rostrum and alæ. The notch and tooth are well-marked, and the tooth in front of it is narrower and much more elevated on one side than on the other. It is, therefore, quite possible that it belongs to *A. princeps*. The suckers (Plate XVI, figs. 5 and 6) had been dried, and have lost their true form, but the marginal rings are perfect, and only 23.4^{mm} (.92 of an inch) in

diameter, but though somewhat smaller than in the specimen just described, they have the same kind of denticulation around the margin. Their smaller size may indicate that the specimen was a male, but they may not have been the largest of those on the arm.

Architeuthis princeps Verrill.

Architeuthis princeps Verrill, Amer. Journ. Science, vol. ix, pp. 124, 181, Plate V, 1873; American Naturalist, vol. ix, pp. 22, 73, figs. 25-27, 1875.

Goniatites (*Architeuthis*) *princeps* Tryon, Manual of Conchology, p. 185, Pl. 85, 1879 (figures copied and description compiled from papers by A. E. V.).

PLATE XVII. PLATE XVIII. PLATE XIX. PLATE XX.

This species is distinguished by the length and inequality of the short arms, of which the longest (ventral or subventral) exceed the combined length of the head and body by about one-sixth; by the denticulation of the suckers of the short arms, of which there are two principal forms, some having very oblique horny rings with the outer edge very strongly toothed and the inner edge slightly or imperfectly denticulated; the others having less oblique rings with the denticles similar in form all around, though smaller on the inner margin; by the stronger jaws, which have a deeper notch and a more elevated tooth on the anterior edge; and by the caudal fin, which is short-sagittate in form, with the posterior end less acuminate than in the preceding species.

This species was originally based on the lower jaw, mentioned as No. 1, and on the upper and lower jaws, designated as No. 10, in the first part of this article. The jaws of No. 10 were obtained from the stomach of a sperm whale taken in the North Atlantic, and were presented to the Essex Institute by Capt. N. E. Atwood, of Provincetown, Mass., but the date and precise locality of the capture are unknown. The size and form of these jaws is well shown in Plate XVIII, figs. 1, 2. The total length of the upper jaw (fig. 1) is 127^{mm} (5 inches); greatest transverse breadth, 37^{mm} (1.45 inches); front to back, 89^{mm} (3.5 inches); width of palatine lamina, 58.9^{mm} (2.32 inches). The frontal portion is considerably broken, but the dorsal portion remaining appears to extend nearly, but not quite, to the actual posterior end, the length from the point of the beak to the posterior edge being 86.4^{mm} (3.4 inches). The texture is firmer and the laminae are relatively thicker than in *A. Hareeyi*. The rostrum and most of the frontal regions are black and polished, gradually becoming orange-brown and translucent toward the posterior border, and marked with faint striæ radiating from the tip of the beak, and

by faint ridges or lines of growth parallel with the posterior margin; a slight but sharp ridge extends backward from the notch at the base of the cutting edge, and other less marked ones from the anterior border of the alæ. The tip of the beak is quite strongly curved forward, and acute, with a slight shallow groove, commencing just below the tip, on each side, and extending backward only a short distance and gradually fading out. The front or cutting edge is nearly smooth and well curved, the curvature being greatest toward the tip; at its base there is a broad angular notch, deepest externally. The inner face of the rostrum is convex in the middle and concave or excavated toward the margins, which are, therefore, rather sharp. The anterior borders of the alæ are convex, or rise into a broad, but low, lobe or tooth beyond the notch, but beyond this they are nearly straight, but with slight, irregular lobes, which do not correspond on the two sides. The anterior edges of the alæ make nearly a right angle with the cutting edges of the rostrum. The palatine lamina is broad, thin, and dark brown, becoming reddish brown and translucent posteriorly, with a thin, whitish border. The surface is marked with unequal divergent striæ and ridges, some of which, especially near the dorsal part, are quite prominent and irregular; the posterior border has a broad emargination in the middle, but the two sides do not exactly correspond.

The lower jaw (Plate XVIII, fig. 2) was badly broken, and many of the pieces, especially of the alæ, are lost, but all that remain have been fitted together. The extreme length is 92^{mm} (3.63 inches); the total breadth, and the distance from front to back cannot be ascertained, owing to the absence of the more prominent parts of the alæ; from tip of beak to posterior ventral border of mentum, 42.6^{mm} (1.68 inches); from tip of beak to posterior lateral border of alæ, 55.9^{mm} (2.20 inches); from tip of beak to posterior ventral border of gular lamina, 60^{mm} (2.37 inches); from tip of beak to bottom of notch at its base, 20^{mm} (.80 inch); tip of beak to inner angle of gular lamina, 47^{mm} (1.85 inches); height of tooth from bottom of notch, 6.25^{mm} (.25 inch); breadth between teeth of opposite sides, 15^{mm} (.60 inch); breadth of gular lamina, in middle, 44.5^{mm} (1.75 inches). The beak is black, with faint radiating striæ, and with slight undulations parallel with the posterior border; the rostrum is acute, slightly incurved, with a notch near the tip, from which a very evident groove runs back for a short distance, while a well marked angular ridge starts from just below the notch, and descends in a curve to the ala, opposite the large tooth, defining

a roughened or slightly corrugated and decidedly excavated area between it and the cutting edges; the cutting edge below this ridge is nearly straight, or slightly convex; the notch at its base is rounded and deep and strongly excavated at bottom; the tooth is broad, stout, obtusely rounded at summit, sloping abruptly on the side of the notch, and gradually to the alar edge. The anterior edge of the alæ, beyond the tooth, is rounded and strongly striated obliquely; it makes, with the cutting edge, an angle of about 110° . The inner surfaces of the two sides of the internal plate of the rostrum form an angle of about 45° .

The lower jaw of No. 1 (Plate XVIII, fig. 3) is represented only by its anterior part, the alæ and gular laminae having been cut away by the person who removed it.* It agrees very well in form and color with the corresponding parts of the one just described, but is somewhat smaller. The lateral ridges of the rostrum are rather more prominent, and the area within it is narrower and more deeply excavated, especially at the base of the notch, where the excavation goes considerably lower than the inner margin. The notch is narrower and not so much rounded at its bottom. The tooth is about the same in size as that of No. 10, and appears to be even more prominent, because the anterior edge of the alæ is more concave at its outer base; it is also more compressed and less regularly rounded at summit. This jaw measures 32.5^{mm} (1.30 inches) from the tip to the posterior ventral border of mentum; 17^{mm} from the tip to the bottom of the notch; 4^{mm} from bottom of notch to tip of the tooth.

Both these lower jaws agree in having a very prominent tooth on the alar edge, with a large and deeply excavated notch between it and the cutting edge of the beak, and in this respect differ from the lower jaw of *A. Harceyi*, for in the latter the tooth or lobe is broad and less prominent, while the notch is narrower and shallower. This seems to be the best character for distinguishing the jaws of the two species. But they also differ in the angle between the alar edge and the cutting edge of the rostrum, especially of the lower jaw, for while in *A. Harceyi* this is hardly more than a right angle, in *A. princeps* it is about 110° . Moreover, the darker color and firmer texture of the jaws of the latter seem to be characteristic.

To this species I have referred the Catalina specimen (No. 14, p. 189), preserved in the New York Aquarium. The jaws of the latter, which were examined and carefully measured by me, agree very

* The specimen was given to the Smithsonian Institution by Mr. G. P. Whitman, of Rockport, Mass., in 1872. (No. 2524.)

closely, both in form and size, with those of No. 10, the type of the species, but are a trifle larger. The total length of the upper mandible is 133^{mm}; greatest breadth, 99^{mm}; from inner angle of anterior edge to the dorsal end of frontal lamina, 95; tip of rostrum, or beak, to the dorsal end of frontal lamina, 92; tip of rostrum to bottom of notch, 19; notch to inner end of anterior edge, 38; transverse breadth between anterior edges, 17^{mm}.

The total length of the lower mandible is 95^{mm}; breadth, from gular lamina to inner end of alæ, 99; front edge of jaw to posterior end of gular lamina, 83; breadth of alæ, 41; posterior edge of alæ to end of gular lamina, 44.5; tip of beak to bottom of notch, 22; notch to inner angle of alæ, 70; depth of notch, 3.5^{mm}.

The general form of this species is very well shown on Plate XX. This figure has been based upon the sketches and measurements made by me soon after the specimen was received in New York and before it had been "mounted" (see page 189). The head was, however, so badly injured that it could not be accurately figured, and this part is, therefore, to be regarded as a restoration, as nearly correct as could be made under the circumstances. It may require considerable corrections, both as to size and form. The caudal fin is remarkable for its small size, as in *A. Harveyi*. Its breadth is scarcely more than that of the greatest diameter of the body. It is short-sagittate in form, with strongly divergent side lobes, which extend forward beyond their lateral insertions, and end in a rounded or blunt angle. The posterior end is somewhat prolonged and acute, but less so than in that of *A. Harveyi*, which it otherwise resembles. One of the figures (Plate XIX, fig. 2), was made by me several weeks after it had been placed in strong alcohol, and had shrunk considerably; the other (fig. 1) was made by Dr. J. B. Holder after it had been in alcohol only a few days.

When fresh, the caudal fin was 84^{mm} in breadth, but when sketched by Dr. Holder its breadth was 71^{mm}; its length, from posterior tip to lateral insertions, 48.3^{mm}; from tip to end of lateral lobes, 61^{mm}.

The length of the body and head together, when fresh, was about 289^{mm} (9.5 feet); but when measured by me it was about 218^{mm}.

The sessile arms were unequal in size and length, the longer ones considerably longer than the head and body together. Mr. Harvey found that the longest arms, said to be the ventral ones, were 335^{mm} (11 feet) long, and 43.2^{mm} (1.7 inches) in circumference at base. When first examined by me the ventral arms measured 10.5 feet, and were longer than any of the others, but all the rest were more

or less mutilated at the tips, and several had thus lost a considerable portion of their length, so that it is quite probable that originally the sub-ventral arms (or third pair) were actually longer than the ventral ones. The circumference of the third pair of arms, when measured by me, was considerably greater than that of the ventral ones; the former being 11.25 inches; the latter 10 inches. Hence I have inferred that the greatest circumference (17 inches), measured by Mr. Harvey, applies to the third pair of arms.

The ventral arms have both outer angles bordered by a strong, thick marginal membrane, about an inch wide. The arms are all more or less trapezoidal in form, and taper to very slender tips. When examined by me they had already lost nearly all their suckers. A few remained near the base of one of the arms of the third pair. These were 25^{mm} (1 inch) in diameter, with the aperture 15.5^{mm} (.62 inch) across; the denticles on the outer border of the marginal ring were broad-triangular, acute, and strongly incurved, much larger than those on the inner margin.

Of the detached suckers, I have been able to study, with care, 18 specimens from the sessile arms. Part of these are represented only by the horny marginal rings. The three largest differ from the rest in having the denticles less incurved and more nearly alike all around the margin, those on the inner edge being only somewhat smaller and more slender than those on the outer margin, while the rings themselves are less oblique and eccentric. These may have come, perhaps, from the ventral arms, near the base. The other suckers all belong to one type, like those seen upon the third pair of arms, described above. They differ, however, very much in size, in the number of denticles, and in the presence or absence of more or less perfect denticles on the inner margin, this, in the smaller ones, often being without any distinct denticles whatever; the horny rings are very oblique and the aperture eccentric. The diameters vary from 8^{mm} to 24^{mm} externally; the apertures from 3.5^{mm} to 20^{mm}.

One of the most perfect of these suckers (*b*) is preserved in alcohol with the soft parts (Plate XVII, figs. 5, 6), and was sent to me from Newfoundland by Mr. Harvey. This has a greater external diameter of 22^{mm}; diameter of aperture, 10^{mm}; height of cup (outside), 16^{mm}; height at center, 15^{mm}, height near inner margin, at attachment of pedicel, 6^{mm}; length of pedicel, 14^{mm}; diameter of pedicel, 1.5^{mm}. In a side-view the sucker is oblique and gibbous; the lower surface is convex centrally, but has a deep notch or pit near the front margin, in the bottom of which the slender but strong pedicel is attached,

and the horny ring has a corresponding notch; the outer or back portion is much swollen and produced downward and backward, and here the horny ring is correspondingly broad. The aperture is nearly circular, but is rather shorter from front to back than transversely. In this and some of the other suckers of similar size, the entire circumference of the margin is furnished with rather large sharp denticles which are strongly inclined inward and considerably larger on the outer than on the inner margin. There are about thirteen of the large teeth, occupying rather more than half the circumference; these are broad at base, bevelled off to an acute edge on the sides, and somewhat acuminate, with sharp tips. Those on the middle of the outer border point inward to the center of the sucker, but those along the sides point rather obliquely to the front margin. The front margin is occupied by about seventeen smaller, unequal, acute, denticles, those in its center the smallest and most regular; these are acute-triangular and their points are directed more upward than those of the opposite edge. The horny rings are light yellow (when dried they are white and osseous), their denticles yellowish white, and often silvery white and lustrous at tip and along their edges, especially when dried. The suckers smaller than the above have fewer of the larger outer teeth, and usually fewer and less perfectly formed teeth along the front margin. Those that have the aperture 7^{mm} or less in diameter usually have the front margin of the ring only irregularly fissured, with the intervals minutely denticulate or crenulate, while the outer half of the margin may bear nine or ten large and well-developed denticles, with broad stout bases and sharp edges and tip; the edges of these teeth along the middle are usually convex, and then the outline is incurved to the acute point. One of the smaller suckers examined has the aperture about 4.5^{mm} in diameter, with the same form as the larger ones; this has about six large, sharp, denticles, like those above described, on the outer half of the margin of the rings, while the front margin is nearly entire and smooth. The smallest one (*j*) is similar, with but four distinct, large denticles, with another imperfect, lobe-like one, on one side, and with a smooth front margin.

The three largest suckers, (Plate XVII, fig. 9), supposed to be from near the base of the ventral arms, have about 45 marginal denticles, of nearly uniform size, and less incurved than in those above described. In these the back side of the horny ring is less expanded, and therefore the suckers were less oblique than in the smaller ones. The largest of these (*a*) had the aperture 20^{mm} in diameter.

Measurements of suckers of short arms (millimeters).

	a.	b.	c.	d.	e.	f.	g.	h.	i.	j.
Transverse diameter, outside.	24	21	20	20	17	16	16	10	9.5	8
Diameter of aperture, inside.	20	10.5	9	9	8.5	8	7	5	4.5	3.5
Breadth of horny ring, back side.	10	---	11	12	11	11	11	---	7	5
" " " front side.	5	---	3.5	3	3	2.5	3	---	2	1.5
Number of large denticles.	23	13	12	12	9	12	10	7	6	4
Number of small denticles.	22	17	10	17	12	15	---	---	---	---

The long tentacular-arms agree very closely with those of *A. Harveyi* (No. 5) in form and in the arrangement of the suckers on the 'club.' When fresh they measured 914.4^{mm} (30 feet) in length with a circumference of about 12.7^{mm} (5 inches), except at the enlarged club, which was 20.32^{mm} (8 inches) in the middle. But when first examined by me they had shrunk to 731.5^{mm} (24 feet) in length, and the circumference of the slender portion was 9 to 10^{mm}; that of the club was 15.24^{mm} (6 inches). At that time the 'club' was 77.47^{mm} (30.5 inches) long; that portion bearing the larger suckers was 48.26^{mm} (19 inches); the wrist or portion bearing the smaller and partly smooth-rimmed suckers and tubercles was 15.24^{mm} (6 inches) long; the terminal portion, bearing small denticulated suckers was 22.86^{mm} (9 inches); the breadth of the front of the club was 7.62^{mm} (3 inches). The terminal portion had a strong carina-like membrane or crest along the back, and was here 5^{mm} (2 inches) wide, from front to back.

The large suckers (Plate XVII, figs. 1, 1a) of the tentacular-arms are nearly circular in outline, and are broad, depressed, little oblique, constricted just below the upper margin, and then swelled out below the constriction to the base. The calcareous ring is strong, white, and so ossified as to be somewhat rigid and bone-like. The margin is surrounded by numerous (about 45 to 50) nearly equal, acute-triangular teeth, sometimes separated by spaces equal to their breadth, at other times nearly in contact at their bases; their edges are so bevelled as to be sharp; while there is a triangular thickening in the middle of each, at base. A wide, deep and concave groove extends entirely around the rim a short distance below the margin; below this the lower part of the rim is somewhat expanded and irregularly plicated, varying in width. The largest ring studied by me measures 31^{mm} in its greatest diameter externally; the aperture is 26^{mm} and 23^{mm} across its longer and shorter diameters;* greatest

* This specimen is somewhat warped, by drying, so that the aperture is not so circular as when fresh.

height or breadth of rim, 11^{mm} ; least height, 8^{mm} ; breadth of groove, 1.5 to 2^{mm} .

The marginal suckers (Plate XVII, fig. 10), alternating with the large ones on the 'club,' are very oblique, with the rings strong and very one-sided, the height of the back being more than twice that of the front margin. The aperture is not circular, the outer portion of the margin being incurved or straight. The groove below the margin is narrow and deep, especially on the sides, but only extends around the front and sides, being entirely absent on the outer third of the circumference. The denticles are about 22 to 24, slender, acute, not crowded, the most of them being separated by spaces greater than their breadth at base. The outer ones are strongly incurved; those along the sides are curved forward obliquely toward the front margin, while those on the front margin point upward and sometimes rather outward. The denticles are of nearly equal length, but those of the front margin are both more slender and more acute; they all have sharp bevelled edges and a thickened median ridge or tubercle. The largest ring examined was 14^{mm} in diameter, height or breadth of back side of rim, 8^{mm} ; of front side, 3.5^{mm} .

The small suckers, covering the last division of the club, are very similar to the marginal ones last described, except that they are much smaller and more delicate, with a narrower and less oblique rim. The denticles of the inner margin are very acute and point obliquely outward and upward. Greatest diameter of the one described, 6^{mm} ; height of back side of rim, 4^{mm} ; of front side, 1.5^{mm} .

The small terminal group of smooth-rimmed suckers, seen in No. 5, were not noticed, but they were not looked for specially.

To this species I have also referred the specimen (No. 13) from Grand Bank, Fortune Bay, (see page 188, where the general measurements are given). Fortunately, Mr. Simms was able to obtain the jaws in pretty good condition, and also one of the largest suckers of the tentacular-arms. These specimens were forwarded to me by the Rev. M. Harvey. They had been dried, and the jaws, which were still attached together by the ligaments, had cracked somewhat, but all parts were present, except the posterior end of the palatine lamina, which had been cut or broken off. Although these jaws had undoubtedly shrunk considerably, even when first received, they were afterwards put into alcohol and have since continued to shrink, far more than would have been anticipated, so that, at present, the decrease in some of the dimensions amounts to 20 per cent., while even

the harder portions have decreased from 5 to 10 per cent. from the measurements taken when first received by me.* When first received in 1875, the upper mandible measured 111^{mm} in total breadth (front to back); 88^{mm} from tip of beak to anterior end of palatine lamina; 20^{mm} from tip of beak to the bottom of the notch. The lower mandible measured 96^{mm} in total length; 80^{mm} from tip of beak to inner end of alæ; 19^{mm} from tip to bottom of notch.

At the present time (Jan., 1880), the breadth of the upper mandible is about 90^{mm}; from tip of beak to anterior end of palatine lamina (at junction with anterior edge of alæ) 89^{mm}; tip of beak to bottom of notch, 19^{mm}; breadth of palatine lamina, 58^{mm}; beak to posterior end of frontal lamina, 90^{mm}; beak to posterior lateral edge of alæ, 43^{mm}; notch to end of anterior edge of alæ, 33^{mm}; notch to end of hardened or black portion of same (proper cutting edge), 17^{mm}; transverse breadth at notches, 16^{mm}. The lower mandible measures, in length, 82^{mm}; beak to inner end of alæ, 67; to bottom of notch, 18; breadth, alæ to mentum, 78; end of alæ to outer side of gular lamina, 84; inner side of gular to mentum, 50; breadth of gular, 44; breadth of alæ, anterior to posterior edge, laterally, 29; tip of beak to posterior ventral end of mentum, 33; tip to posterior lateral border of alæ, in line with cutting edge of rostrum, 45^{mm}; posterior lateral border of alæ to end of gular, 40; depth of notch, 3; breadth of tooth, 8; notch to end of cutting or hardened edge of alæ, 20; to inner end of alæ, 55; breadth transversely, across teeth, 16^{mm}, (see also table of measurements of jaws).

The beak of the upper mandible is sharp, strongly and regularly curved, most so near the tip; a radial ridge runs from the notch to the lateral border of the alæ; the anterior or cutting edges of the alæ are somewhat convex and irregularly crenulate. The lower mandible has a sharp beak, with a slight notch close to the tip; the cutting edges of the rostrum are otherwise nearly straight; the notches at the base are deep and narrow V-shaped. The teeth are rather prominent, obtuse, slightly bilobed at the summit; the one on the right side of the mandible is more prominent than the other, owing to the fact that the edge of the alæ, beyond it, is more concave in outline. There is also a broad and slightly prominent lobe in the middle of the

* There is no reason to suppose that the shrinkage has been any more in this case than in the others, but I have not had an opportunity for making comparative measurements from the same specimens when recently preserved, and again after long preservation in alcohol, except in one other instance (No. 5), in which a similar shrinkage was evident.

anterior edge of the alæ. The sides of the rostrum are strongly excavated toward the base and around the notches, and radially striated. The jaws are dark brown, becoming blackish toward the tips.

*Comparative measurements of jaws (in inches).**

	A. Harveyi.			A. princeps.				
	No. 4.	No. 5. Rec.	No. 5. Later.	No. 1.	No. 10.	No. 13' Fr'sh	No. 13. Pres'd.	No. 14.
<i>Upper mandible:</i>								
Length, beak to end of palatine. . .	3.55	--	3.85	--	5.	--	3.75 +	5.25
Greatest breadth, palat. to frontal.	2.49 +	2.84	2.60	--	3.50 +	4.50	3.54 +	3.88
Greatest transverse diameter. . . .	--	--	1	--	1.45	--	1.15	--
Inner end of alæ to dorsal end of frontal.	--	--	2.50	--	3 +	--	2.95 +	3.75
Tip of beak to same.	2.37 +	--	2.55	--	3.40 +	--	3.17	3.62
Tip to anterior end of palatine lamina.	--	2.06	--	--	--	3.57	--	--
Tip to bottom of notch. . . . .	.63	.69	.61	--	.75	.81	.75	.75
Notch to end of anterior edge of alæ.	--	--	1.10	--	1.15	--	1.30	1.50
Transverse breadth at notch. . . . .	.60	--	--	--	--	--	.63	--
Transverse breadth between edges of alæ.	--	--	--	--	--	--	1	.69
Breadth of palatine lamina.	--	--	1.70	--	2.32	--	2.30	--
End of palatine to edge of frontal lamina.	--	--	2.20	--	3.15	--	--	3.50
Beak to posterior edge of alæ. laterally.	--	--	1.40	--	1.95 +	--	1.70	--
<i>Lower mandible:</i>								
Total length, beak to end of gular.	--	3.44	3	--	3.63	3.89	3.24	3.75
Mentum to inner end of alæ.	2.60 +	--	2.55	--	--	--	3.08	--
Total breadth, gular lamina to end of alæ.	--	--	2.65	--	--	--	3.32	3.88
Breadth of gular lamina.	--	--	1.50	--	1.75	--	1.74	--
Anterior edge of alæ to end of gular lamina.	--	--	2.45	--	3.15	--	2.68	3.25
Tip of beak to end of mentum, medially.	--	--	.85	1.30 +	1.68	--	1.31	--
Tip to end of gular lamina, medially.	--	--	1.85	--	2.37	--	2.40	--
Breadth of alæ (laterally).	1.18	--	.93 +	--	1.50	--	1.15	1.62
End of gular lamina to alæ. laterally.	--	--	1.50	--	1.60	--	1.58	1.75
Tip of beak to bottom of notch. . . .	.62	.69	.60	.67	.80	.77	.71	.87
Tip to post. edge of alæ, laterally. . .	1.67	--	1.50 +	--	2.20	--	1.78	--
Tip to inner end of alæ.	2.33	2.63	2.10 +	--	--	3.45	2.67	--
Tip to inner angle of gular lamina.	1.20	--	1.18	--	1.85	--	1.28	--
Notch to inner angle of alæ.	1.92	--	1.77	--	--	--	2.17	2.75
Depth of notch. . . . .	.12	--	.12	.15	.15	--	.12	.13
Breadth of tooth in front of notch.	.30	--	--	.35	.32	--	.32	.38
Spread of jaws, between teeth. . . .	--	--	--	--	.60	--	.64	--

* Nos. 1 and 10 had been dried for many years: all the others had been preserved in alcohol: Nos. 4 and 13 for several years; No. 5 about one year; No. 14 for only a few days. The amount of shrinkage is considerable in those preserved long in alcohol, or dried.

*Comparative measurements of Architeuthis Harveyi and
A. princeps (in inches).*

	No. 5. A. Harveyi.		No. 2. A. Harveyi.		No. 14. A. princeps.	
	Fresh.	Pres'd.	Fr'h.	Pres'd.	Fr'h.	Pres'd.
Total length, to tips of short arms,	1667	--	--	--	246	212
Total length, to tip of tentacular-arms,	3822	--	--	--	480	372
From base of arms to tip of tail,	922	--	--	--	114	86
From base of arms to origin of fins,	752	--	--	--	95	67
Head, from base of arms to mantle (above),	102?	--	--	--	142	12
Body, edge of mantle to tip of tail (above),	82	--	--	--	100?	74
Tip of tail to insertion of fin,	182?	17	--	--	--	19
Breadth of caudal fin,	22	16	--	--	33	28
From end of body to outer angle of fin,	27?	23	--	--	--	24.5
Front edge of fin, outer angle to side of body,	2	6.5	--	--	--	10
Circumference of body,	66	--	--	--	84	66
Circumference of head,	--	--	--	--	48	--
Length of tentacular-arms,	88	161	348?	--	360	289
Length of sucker-bearing portion,	30	30	30	27	36	30.5
Length of dorsal arms (1st pair),	72?	--	--	--	--	81 +
Length of lateral arms (2d pair),	72?	--	--	--	--	100 +
Length of lateral arms (3d pair),	72?	--	--	--	--	76 +
Length of ventral arms (4th pair),	72	--	--	--	132	126
Circumference of 1st pair of arms, at base,	7	--	--	--	--	9
Circumference of 2d pair of arms, at base,	8	--	--	--	--	9.50
Circumference of 2d pair, 3 ft. from base,	--	--	--	--	--	7.50
Circumference of 3d pair, at base,	10	8	--	--	17	11.25
Circumference of 3d pair, 3 ft. from base,	--	--	--	--	--	9
Circumference of 4th pair, at base,	9	7.5	--	--	--	10
Circumference of 4th pair, 4 ft. from base,	--	--	--	--	--	8.5
Circumference of tentacular-arms,	3.75	2.75	4	3½-4¼	5	4
Circumference of terminal club of same,	--	4.5	6	6	8	6
Diameter of largest sucker of tentacular-arms,	--	1.15	1.28	1.25	1.25	1
Diameter of largest sucker of sessile arms,	1	.84	--	--	1	1
Aperture of latter,	--	.68	--	--	.80	.80
<i>Details of tentacular-arms:</i>						
Length of 'club' or expanded portion,	31	30	30	27	--	30.5
Of part of club bearing 24 largest suckers,	15	14	18	14	--	19
Of 'wrist' or part with group of small suckers,	7	7	--	--	--	6
Of terminal part, with small suckers,	9	9	--	9	--	9
Breadth of 'club' in middle,	--	1.5	2.5	2.5	--	3
Breadth of wrist,	--	1.6	2.6	1.5	--	3
Breadth of slender middle portion,	--	1.15	--	--	--	1.5
Breadth of tip (from front to back),	--	1.75	--	1.5	--	2
Circumference of club,	--	4.5	--	5.5	--	6
Circumference of wrist,	--	5	--	6	--	6
Circumference of middle portions of arm,	2¼-3¼	2¼-3¼	--	3½-4¼	--	3½-4
Distance between pedicels of large suckers,	--	1.15	1.68	1.44	--	--
Distance between pedicels diagonally,	--	1	1.32	1.31	--	--
<i>Details of suckers of 'club':</i>						
Largest suckers, diameter in middle,	1.25	1.15	1.28	1.24	1.25	--
Largest suckers, diameter of horny ring,	--	.92	--	--	1.15	1.15
Diameter of facets around suckers,	--	1	--	1.40	--	1.25
Largest suckers, height from attachment,	--	1	--	--	--	.75
Largest suckers, length of pedicels,	--	.40	--	--	--	.50
Largest suckers, height of ring,	--	.32	--	--	--	.42
Secondary suckers, next to wrist, diameter,	--	.24	--	--	--	.44
Marginal suckers, diameter of rings,	--	.40	--	.48	--	.60
Marginal suckers, height of rings, outer side,	--	.28	--	--	--	.35
Sessile suckers of wrist, diameter,	--	.12	--	.28	--	--
Suckers of terminal section, diameter,	--	¼	--	1/10	--	--

The dried sucker from the tentacular-arm appears to have been one of the largest, (Plate XVII, fig. 11). At the present time the transverse diameter of the ring, outside, is 28^{mm}; diameters of the edge, 24 and 22^{mm}; greatest breadth of the ring, including denticles, 9.5^{mm}; least breadth, on inner side, 6.5^{mm}. There are 48 marginal denticles, which are nearly the same in size and form, all around. They are narrow, triangular, acute, with the edges bevelled sharp, and with a central, thickened, triangular ridge on the outside. The ring is white, hard, smooth, and osseous in appearance.

Of the other specimens enumerated in the first part of this paper, it is probable, judging from the proportions given, that Nos. 16, 18, and 19 also belonged to *A. princeps*. Nos. 18 and 19 appear to have been much larger than any of the examples of which portions have been preserved, and it was very unfortunate that the persons who secured them did not know their value, for they were both found within a few miles of the settlement at Little Bay Copper Mine, on the south arm of Notre Dame Bay, and could easily have been taken to St. John's.

Additional note on the suckers of Architeuthis Harveyi.

After printing the description of *A. Harveyi* some additional loose sucker-rims, from specimen No. 5, were found. Among these are some of the second or oblique kind, described as existing on the sessile arms of *A. princeps*. Therefore the remarks (on p. 201), in respect to the supposed absence of suckers on the former, will no longer hold good. These suckers of the second kind differ, however, from the corresponding ones of *A. princeps* in having, on the outer margin, more numerous, more slender and sharper teeth, which taper regularly from base to tip and are not so flattened. The larger of these sucker-rims (*i*) are 14.5^{mm} in diameter, across the base; aperture, 9^{mm}; height at back, 7^{mm}; in front, 2^{mm}; number of large denticles on outer margin, 10 to 14; the inner margin, except in the smaller ones, is either finely toothed or distinctly crenulated, and there are usually one or more irregular, broad, sharp, lobes or imperfect teeth on the lateral margins. The teeth of the outer margin are regular, strongly incurved, tapering from the base to the very sharp tips, and sharply bevelled on the edges. A smaller one (*j*) 11^{mm} across the base, and 4.5 across the aperture, with height of back, 6^{mm}, has five regular sharp teeth on the outer margin; two broad irregular ones on each side, while the front edge is nearly entire.

With these there were also some of the largest and least oblique

of the suckers, some of them (*e*, *g*) slightly exceeding the largest of those described on p. 201. but showing no distinct variation; others (*h*) are completely intermediate between the two principal forms, having very oblique rims, with a small aperture, but distinctly denticulate all around, the denticles on the inner margin being distinctly smaller than on the outer.

The following table of measurements will supplement those on page 201.

Measurements of sucker-rims from short arms (millimeters).

	<i>e.</i>	<i>f.</i>	<i>g.</i>	<i>h.</i>	<i>i.</i>	<i>j.</i>
Diameter, at base.	21	19	20.5	16	14.5	11
Diameter of aperture.	17	16	16.5	9.5	9	4.5
Height or breadth of ring, at back,	8	7.5	7.5	9.5	7	6
" " " front side,	3	3	3	3	2	1.5
Number of distinct denticles.	50	48	49	34	14	7

Sthenoteuthis, gen. nov.

(Type *Architeuthis megaptera* Verrill.)

This group is instituted to include certain species of squids, remarkable for the large size and high development of their organs of locomotion, especially of the caudal fin and siphon, and for the presence of a broad, thin web along the lower side of the lateral arms, outside the suckers.

The tentacular-arms are, like those of *Architeuthis*, very long, slender, and provided, at the base of the club, with smooth-rimmed suckers alternating with rounded tubercles, for the mutual adhesion of the two arms; the central part of the club is, as in *Architeuthis*, provided with two central rows of large serrated suckers, and a row of smaller marginal ones, on each side, of different form, alternating with them. The lateral arms have a well-developed median crest, (most developed on the third pair) along the outer side; on the lower inner angle there is a thin, membranous web, often more than twice as wide as the arm, along the whole length, much more highly developed than in typical *Ommastrephes*, in which a narrow marginal membrane occurs. On the ventral arms the inner face is broader than on the others, and the two rows of suckers are wider apart. The suckers on all the sessile arms are strongly denticulated on the outer side of the rim, with smaller or obsolete teeth on the inner side.

Caudal fin very large, rhomboidal. Internal bone or pen similar to that of *Ommastrephes*.

Odontophore with seven rows of teeth, median tooth with three

large denticles; inner lateral teeth with two unequal points; two outer laterals simple, slender. Eyes as in *Ommastrephes*.

This group is related on one side to *Architeuthis*, on the other to *Ommastrephes*. The armature of the tentacular-arms will distinguish it from the latter, and the large caudal fin and broad membrane of the sessile arms from the former.* The dentition of the type is peculiar, so far as known. In addition to the typical species, this genus will doubtless include several species with marginal webs, that have hitherto been referred to *Ommastrephes*; but they are mostly too indefinitely described and figured to show the special characters referred to. Thus, *O. pteropus* Steenstrup belongs to this genus, if a specimen from Bermuda, now in my possession, be correctly identified.†

Sthenoteuthis megaptera Verrill.

Architeuthis megaptera Verrill. Amer. Journ. Science, vol. xvi, p. 207, 1878. Tryon, Manual of Conchology, vol. i, p. 187 (description copied from preceding paper).

PLATE XXI, figures 1-9.

Much smaller than the species of *Architeuthis*, the total length of the body and head being but nineteen inches. Body relatively short and thick. Caudal fin more than twice as broad as long, the length about half that of the body. Its form is nearly rhombic, with the lateral angles produced and rounded, and the posterior angle very obtuse, the posterior edge, as preserved, being slightly concave.

The ventral anterior edge of the mantle is concave centrally, with a slight angle to either side, about .75 inch from the center; from these angles it is again concave to the sides; on the dorsal side the edge advances farther forward than beneath, terminating in a slightly prominent, obtuse angle in the middle of the dorsal edge. The external ear consists of a slightly elevated, transverse lamina, with three thicker and much more elevated laminae which extend forward, on the head, one in the median line of the eye, with one above and one below it, the lower one longest and least elevated, curving downward beneath the head. The two upper ones are broadly rounded at top. Behind the transverse fold there is a deep, irregularly crescent-shaped fossa. The eye-sockets are large, oblong, and furnished with distinct

* According to the statement of Gervais, *Architeuthis dux* has similar membranes.

† *S. Bartramii* (*Ommastrephes Bartramii* (Leach) D'Orb.) also belongs to this genus, but is a more slender species. It has the characteristic smooth suckers and tubercles on the wrist of the 'club,' and a very broad caudal fin. It lives in the region of the Gulf Stream.

lid-like margins. The eyes are large, prominent, oblong, and naked; the anterior portion is swollen laterally on both sides. The short arms are trapezoidal, the dorsal ones somewhat shorter (about 1.25 inch) and smaller than the others, which are nearly equal in length, the second pair being stouter than the rest, and a little longer. The dorsal arms have a slightly prominent membrane along the outer angles; the subdorsal or upper lateral arms are narrowed to an acute edge or crest on the outer angle, but on the inner angle have a broad, thin, marginal membrane, outside the suckers. The lower lateral arms are similar in size and form, and also have a very broad, lateral, marginal membrane, next to the suckers, on the lower side. The ventral arms are more slender and a trifle longer, and have narrower marginal membranes. The tentacular-arms are slender, elongated, expanded toward the tip, and have suckers arranged much as in the gigantic species, even to the smooth-edged suckers and opposing tubercles, proximal to the large suckers, as I have described them in *A. Harveyi*. The sucker-bearing portion is margined by a membrane on each side.

The small proximal suckers of the tentacular-arms occupy about 4.5^{mm} (1.75 inches) at the commencement of the terminal club; they are about 1.5^{mm} in diameter, circular, regularly cup-shaped, with a nearly even, smooth rim; they are raised on slender pedicels. Alternating with these are smooth rounded tubercles, which are also on pedicels and slightly larger than the intervening suckers. There are four suckers and four tubercles in the row along the inner margin; along the outer margin there are fewer, smaller suckers, but without horny rings; if they originally had such rings they were probably smaller than the others. The large suckers (Plate XXI, fig. 9), forming the two central rows on the terminal club, are furnished with a somewhat oblique, dark brown ring, very strongly and sharply toothed around the outer portion of the edge, and usually with one tooth larger and longer than the rest, on the middle of the outer margin; inner margin with much smaller, very acute teeth, of unequal size. The teeth are gold-colored at tip.

Larger suckers of the sessile arms are very oblique, with the rim strong, dark brown, bearing large, strong, sharp, much incurved, unequal teeth on the outer side of the rim; the inner margin is entire. The ventral arms bear about 44 similar suckers, exclusive of the minute ones close to the end; the largest ones are situated beyond the middle of the arm. The lateral arms bear about the same number of large suckers, with numerous minute ones at the tip. The

dorsal arms bear, each, about 30 suckers, exclusive of the small terminal ones.

The 22d sucker of the left ventral arm (Plate XXI, figs. 8, 8a), has a strong, somewhat elliptical rim, with 7 strong and very acute incurved teeth on the outer side, and with the opposite margin on the inner side smooth for more than a third of the circumference. The median tooth on the outer margin is decidedly larger and longer than the others, and abruptly bent inward above its base. It is elongated and gradually tapered to the very acute tip, but thick and channelled externally at its base. To the right and left of this are three similar, but smaller, unequal teeth, all strongly curved inward toward the inner margin, (not convergent to the center). Of these the second from the central tooth, on each side, is the largest, and the third is the smallest. Between the latter and the smooth inner edge there is a small rounded lobe, or blunt tooth. Peduncle broad toward the rim, tapering rapidly to the slender base. Outer sides of rim much higher than inner. Greater diameter, 10^{mm}; lesser, 7^{mm}; greater interior diameter, 7^{mm}; total height, 13^{mm}; longest tooth, 2.5^{mm}.

The exposed portion of the upper mandible is black; the point is strongly curved, acute, with a smooth cutting edge, separated from the inner lobe by a deep, acute notch; inner lobe or edge of alæ thin, broadly rounded, with a slightly rounded, uneven edge. Length of mandible, 29^{mm}; distance from bottom of notch to tip, 10^{mm}; internal breadth between lobes, 8^{mm}.

The lining membrane of the palate (Plate XXI, fig. 2), is pale, translucent, covered with rather large, whitish, translucent teeth, variable in form and size, but mostly rather broad at base and tapering to an obtuse tip; some are more slender and acute. No granules were detected on the membrane.

The odontophore (Plate XXI, figs. 3-7), was too much injured to show its general form, but it appeared to resemble that of *A. Harveyi*. The lateral membrane was broad in the middle, translucent, white. No plates outside the lateral teeth could be detected. The teeth all have slender, acute tips. The median teeth have three points of equal length; the inner lateral ones have two points, the outer one considerably shorter and smaller than the other; the two outer lateral teeth are simple, long, acute, the outermost rather narrower at base and somewhat longer.

Total length, 109^{cm} (43 inches); length of body and head, 48.2^{cm} (19 inches); length of body from dorsal edge of mantle, 35.56^{cm} (14 inches); from ventral edge, 33.16^{cm} (13 inches); of head from edge

Measurements of Sthenoteuthis megaptera and S. pteropus (in inches).

	S. megaptera. N. Scotia.	S. pteropus. Bermuda.	S. megaptera? Sable I. Bk.
Length, tip of tail to end of dorsal arms,	25.5	27.5	
“ tip of tail to end of 3d pair	--	29.5	
“ to end of tentacular-arms,	43	--	
“ to base of arms,	19	20.5	
From base of arms to mantle,	5	6.25	
Tip of tail to edge of mantle (above),	14	14.75	
“ “ “ (below),	13	14.5	
Tip of tail to center of eye,	--	18.5	
Length of caudal fin (tip to insertion),	6	6.75	
Breadth of caudal fin,	13.5	11.25	
Breadth between lateral insertions,	2.33	2	
End of body to outer angle of fin,	7	7.25	
Front edge of fin, from outer angle to insertion,	6.5	5.5	
Circumference of body,	12.5	11.5	
Breadth of body,	5	4.75	
Breadth of head,	4	3+	
Diameter of eye-opening (longitudinal),	1.25	1.75	
“ “ (transverse), .....	.75	1.25	
Length of tentacular-arms,	24	--	
Length of dorsal arms, (1st pair),	6.5	7.25	
“ subdorsal “ (2d pair),	8	8.75	
“ subventral “ (3d pair),	8.5	9.25	
“ ventral “ (4th pair),	8	9.25	
Breadth of 1st pair of arms, at base, .....	.75	.75	
“ 2d “	1.12	.80	
“ 3d “	1.00	.90	
“ 4th “	1.00	.90	
“ tentacular-arms, .....	.33-.50	40-75	
“ terminal club of same, .....	.75	--	
Length of siphon, in middle,	--	2.5	
Breadth of siphon, at base,	--	2	
Breadth of aperture of siphon,	--	1	
<i>Details of tentacular-arms:</i>			
Length of 'club,' or expanded part,	6.5	--	
“ part bearing large suckers,	3.25	--	
“ 'wrist,' bearing smaller suckers,	1.25	--	
“ tip, with small suckers,	1.50	--	
Breadth of 'club,' in middle, .....	.75	--	
“ middle of arm, .....	.50	--	
<i>Details of suckers:</i>			
Diameter of largest suckers of tentacular-arms, .....	.40	--	
“ rims of same, .....	.32	--	
“ largest suckers of dorsal arms,	--	.28	
“ rims of same,	--	.20	
“ largest suckers of 2d pair,	--	.40	
“ rims of same,	--	.28	
“ largest suckers of 3d pair,	--	.32	
“ rims of same,	--	.24	
“ largest suckers on ventral arms, .....	.40	.30	
“ rims of same, .....	.32	.22	
<i>Jaws:</i>			
Upper mandible—total length,	1.16	1.68	1.25
“ “ tip of beak to bottom of notch, .....	.40	.40	.34
“ “ tip to dorsal edge of frontal lamina,	--	1.32	.98
“ “ breadth between anterior lobes of alæ, .....	.32	.32	.25
“ “ breadth of palatine,	--	.84	.70
Lower mandible—total length,	--	1.16	.91
“ “ depth, end of alæ to mentum,	--	1.12	.87
“ “ beak to notch,	--	.44	.31

of mantle to base of arms, 12.7^{cm} (5 inches); length of long tentacular-arms, 55.8 and 60.9^{cm} (22 and 24 inches) respectively; of first (dorsal) pair of arms, 16.5^{cm} (6.5 inches); of second pair, 20.3^{cm} (8 inches); of third pair, 21.6^{cm} (8.5 inches); of fourth pair, 20.3^{cm} (8 inches); length of caudal fin, 15.24^{cm} (6 inches); breadth, 34.3^{cm} (13.5 inches); transverse distance between insertions of caudal fins, 5.9^{cm} (2.33 inches); breadth across body in middle, 12.7^{cm} (5 inches); circumference of body, 31.7^{cm} (12.5 inches); length of eye-opening, 3.2^{cm}; its breadth, 1.9^{cm}; length of sucker-bearing portion of tentacular-arms, 16.5^{cm} (6.5 inches); of portion bearing large suckers, 8.25^{cm} (3.25 inches); breadth, 1.9^{cm} (.75 inch); length of terminal portion, 3.8^{cm} (1.5 inches); diameter of naked or peduncular portion, .8 to 1.25^{cm}; breadth of dorsal arms at base, 1.9^{cm}; of second pair, 2.57^{cm}; of third pair, 2.54^{cm}; of fourth pair, 2.54^{cm}; diameter of largest tentacular suckers, 9^{mm} to 10^{mm}; of their rims, 7 to 8^{mm}; diameter of largest suckers of ventral arms, 10^{mm} (.40 inch); of their rims, 7 to 8^{mm}.

Color, in alcohol, reddish or purplish brown, speckled with darker brown, on the dorsal surface of body; upper side of head and outer sides of arms thickly covered with specks of purplish brown; inner surfaces paler, much as in the common small squids; sides yellowish brown, under surfaces yellowish brown, tinged with purplish.

This unique specimen was cast ashore, during a severe gale, near Cape Sable, N. S., several years ago, and was secured for the Provincial Museum at Halifax by J. Matthew Jones, Esq. It is preserved entire, in alcohol, and is still in good condition.

I refer doubtfully, to this species, an entire beak, with the odontophore, presented by Capt. Geo. A. Johnson and crew, of the schooner "A. H. Johnson." It was taken at Sable Island Bank, Nova Scotia, in 280–300 fathoms, Sept., 1878. This beak has the exposed parts black; the internal laminae reddish brown. The upper mandible is sharp and strongly incurved, with a small narrow notch at its base, from which runs a raised lateral line; beyond the notch the anterior edge of the ala is convex and slightly uneven. The lower mandible has a small notch below the incurved tip; below this, the cutting edge is slightly concave to the basal notch, which is narrow on the right side, but broader and V-shaped on the left; beyond the notch the alar tooth is narrow, prominent and truncate on the right, but broader and blunt on the left. Opposite the notch and tooth the side of the beak is strongly excavated. Total length of upper mandible, 31^{mm}; height, palatine to frontal, 24; tip to bottom of notch, 8.5; tip to dorsal edge of frontal laminae, 24.5; breadth between anterior lobes

of alæ, 6.2; breadth of palatine, 17.5. Total length of lower mandible, 23^{mm}; height, mentum to inner end of alæ, 22; tip to notch, 7.8; tip to end of mentum, 8.2; tip to dorsal end of gular, 16; transverse breadth at alar teeth, 7^{mm}. (See Plate XXVI).

The odontophore is similar to that of *S. megaptera*, but the lateral denticles of the median and inner lateral teeth are relatively shorter, and these, with some other differences, render it doubtful whether this beak can belong to that species. The odontophore is 4^{mm} broad; the teeth are all sharp, rather slender, pointed, and pale amber-color. A slight, smoothish, marginal ridge borders the dentigerous zone on each side, but is scarcely divided into distinct plates. The median teeth have three sharp, rather slender denticles, the median about a third longer than the lateral; the inner lateral teeth have a long point, with the acute outer denticle much shorter; the teeth of both outer rows are long, considerably incurved, acute, the outer ones the more slender.

Sthenoteuthis pteropus Verrill.

Ommastrephes pteropus Steenstrup?

PLATE XXVI.

A large squid, 74.8^{cm} (29.5 inches) long from tail to tip of longest sessile arms, similar in size and form to the preceding, and closely allied to it, has been sent to me by Mr. G. Brown Goode, who collected it at Bermuda. It is probably the *Ommastrephes pteropus* of Steenstrup, but I have seen no full description of the latter, and figures only of the mandibles.

Our specimen is entire, except that it has lost the 'clubs' of the tentacular-arms. It is in fair condition, though considerably contracted by long preservation in too strong alcohol. The head, however, has been pulled out from the mantle to an unnatural extent, so as to increase the total length from 3 to 4^{cm}, at least. The ventral arms do not show any of the sexual modifications characteristic of the male squids, and, therefore, it is doubtless a female.

Most of the measurements are given in the table with those of *S. megaptera*; some of the more general are as follows: length from end of body to tip of dorsal arms, 69.8^{cm} (27.5 inches); to edge of mantle, dorsally, 37.5^{cm} (14.75 inches); to base of dorsal arms, 52^{cm} (20.5 inches); to center of eye, 47^{cm}; to lateral insertion of fin, length, 17^{cm} (6.75 inches); to outer angle of fin, along posterior edge, 18.4^{cm} (7.25 inches); breadth of fins transversely, 28.5^{cm} (11.25 inches); outer angle to lateral insertion, along front edge, 14^{cm} (5.5 inches); between

lateral insertions, 5^{cm} (2 inches); breadth of body, 11.9^{cm}; circumference of body, 29.2^{cm} (11.5 inches).

The body is stout, acuminate posteriorly; the anterior border of the mantle, beneath, is even, and not distinctly emarginate in the middle.

The caudal fin is large, broad, transversely rhomboidal, but neither so broad nor so large proportionally as in *S. megaptera*. The siphon is very large and broad, (63^{mm} long by 50 broad), with a large aperture, 25^{mm} wide. The eye-balls are very large, elongated, measuring, although somewhat collapsed, about 42^{mm} long by 31^{mm} broad. The eye-openings, as distended, are large, oblong, elliptical, with a broad sinus, and slightly thickened edges.

The arms are stout and rather long, the third and ventral pairs being nearly equal in length; those of the second pair are about 12.5^{mm} shorter than those of the third; the dorsal ones about 63^{mm} shorter than those of the second. The dorsal arms are 18.4^{cm} long, trapezoidal in form, the outer face convex and about 1.9^{cm} broad; the lateral and inner faces, 1.2^{cm}; along the inner angles there is a narrow membrane, outside the suckers. Those of the second pair are 24.7^{cm} in length; their transverse breadth is about 2^{cm}; from inner face to outer angle, 1.9^{cm}; along the outer angle, in these, is a thick acute-edged crest, widest in the middle of the arm; along the lower inner angle, outside the suckers, there is a broad and very thin membrane, 2.5^{cm} or more in width; along the upper inner angle, is a similar membrane, about .6^{cm} wide.

The arms of the third pair are 26^{cm} long, (31^{cm} from center of eye to tip of arms); they are compressed, 2.25^{cm} broad at base; on the outer angle, along the middle, there is a very prominent crest, so that, in this part, the distance from inner face to outer angle, is 4^{cm}; along the lower-inner angle there is a very broad, thin, delicate web, where widest at least 5 to 7^{cm} (2 to 2.75 inches) wide, (it is considerably torn and may have been still wider); it is widest beyond the middle of the arm; on the upper-inner angle the corresponding membrane is about 0.6^{cm} wide. Transverse, thick, fleshy ridges run out from between the suckers a short distance on these membranes, and then fade out. The ventral arms are 2.25^{cm} broad at base, and trapezoidal; they have a smaller crest along the outer angle, and a narrow membrane along each inner angle.

All the sessile arms bear similar suckers, all of which are provided with 7 to 13 large, very acute, incurved teeth on the outer margin of the very oblique, horny rings, and with much smaller, sometimes rudimentary ones on the inner margin, much as in *S. megaptera*.

The largest of all the suckers are near the middle of the second pair of lateral arms, from the sixth to the sixteenth, and especially from the ninth to the fourteenth; the diameter of the ninth is 10^{mm} , the edge of its rim, 8^{mm} . On the dorsal arms the eighth to the thirteenth are the largest; the diameter of the ninth is 7^{mm} ; edge of horny rim, 5^{mm} . On the third pair the eighth to the fourteenth are largest; the diameter of the tenth is 8^{mm} ; its rim 6^{mm} . On the ventral arms the fourteenth to the twentieth are largest; the diameter of the fifteenth is 7.5^{mm} ; its rim 5.5^{mm} . On the ventral arms the rows of suckers are more separated than on the others, its inner face being wider. On the lateral arms, toward the base, the two rows are nearer together, while the suckers of each row are distant, so that they almost form one irregular row, at first. The suckers are all very oblique, with the horny rims very low or narrow in front, and very high on the outer side; these rings are dark brown, but the teeth have a golden luster.

The thick fleshy margin, outside the denticulated edge of the horny ring, is completely covered all around, by a series of thin, bracket-shaped, horny plates, light brown in color, arranged radially and movable with the membrane to which they are attached for the most of their length; both the outer and the inner ends are free and turned upward, like a small tooth or denticle; those of the inner end are mostly acute, and form a circle of minute movable denticles, nearly in line with the large teeth of the horny ring, five to ten occupying the intervals between the large teeth of the largest suckers; those plates that stand opposite the teeth of the horny ring are shorter than the others, and often broader, and have no denticle on the flat or upcurved inner ends, which fit to the form of the base of the tooth in front of them; the outer ends are abruptly bent upward and often inward, forming a denticle or flattened hook, usually rounded at the end. These marginal plates vary greatly in width and form, even on the same sucker, according to position, and small, imperfectly developed, wedge-shaped ones are interpolated between the larger ones, around the periphery.

One of the largest suckers (the twelfth of the second pair of arms) has 22 teeth on the horny ring; of these five are small, but sharp, on the middle of the inner border; nine, on the outer border, are largest; and four, on each side, are intermediate in size. The median tooth on the outer margin is largest, and the one next to it, on each side, is a little smaller than the second one from it. The thirteenth sucker of the ventral arms has, on its rings, eighteen denticles; of these nine

are very large, with the median more decidedly the largest, and the one on each side of it is shorter as compared with the next; six, on the inner margin, are minute, and these are connected, by one or two somewhat larger ones, at each end of the inner border, with the larger series.

The stumps of the tentacular-arms are flattened, oval, and smooth, measuring about 10 by 18^{mm}, near the base; their length is about 28^{cm} (11 inches), which is doubtless less than half their original length.

The exposed parts of the jaws are black and polished; the laminae are reddish brown, with broad, thin, yellowish-white margins. The upper mandible has a long sharp rostrum, with regularly curved cutting edges, and a small, well-defined, V-shaped notch, from which a short groove runs backward, beyond which there is a slight ridge; anterior edge of alæ, beyond the notch, forming no distinct lobe or tooth, but slightly convex, and irregularly crenulate; posterior lateral borders of alæ with a broad sinus in the middle; palatine lamina long and thin, with sinuous posterior margins; frontal lamina broad, extending well backward.

The total length of the upper mandible is 42^{mm}; tip to posterior end of frontal, 33^{mm}; to notch, 10^{mm}; greatest breadth (or height), from palatine to end of frontal, 30^{mm}; transverse breadth, across frontal, 15^{mm}; transverse breadth, across anterior edges of alæ, 8^{mm}.

The lower mandible has a strongly incurved beak, with the cutting edges rather suddenly incurved at about the proximal third, and a well-developed, broad, V-shaped notch at base, beyond which there is a slightly prominent, broad tooth; alæ broad, the inner ends broader than the middle, well-rounded; mentum short, with a broad dorsal emargination; gular lamina short, the inner edges incurved.

The total length of the lower mandible is 29^{mm}; tip of beak to end of mentum, 10^{mm}; to ventral end of gular, 21^{mm}; to bottom of notch, 11^{mm}; to inner ends of alæ, 24^{mm}; breadth, from inner ends of alæ to mentum, 28^{mm}; breadth of gular lamina, 17^{mm}; breadth of alæ, 12.5^{mm}; greatest transverse breadth, across alæ, 32^{mm}; transverse breadth, across anterior edges of alæ, at teeth, 11^{mm}.

These jaws agree pretty nearly, in form and size, with those of *O. pteropus*, figured by Steenstrup, but the latter have a deeper notch in the upper mandible, with a more evident lobe beyond it, while the lower mandible has a broader and less triangular notch.

The buccal membrane is large, thin, prolonged into seven acute angles or lobes, of which the upper is in the median plane, opposite

the interval between the dorsal arms; the six others are opposite the three other pairs of sessile arms. The inner surface of this membrane is covered, near the periphery, with small rounded papillæ; externally it is connected to the arm by seven membranous bridles, corresponding to the seven angles; of these the dorsal one forks, one branch going to the inner margin of each dorsal arm; the upper lateral ones join the marginal membrane of the upper angle of the upper lateral arms; the lower lateral ones join the lower marginal membrane of the third pair of arms; the ventral ones join the marginal membrane outside of the sucker-bearing face of the ventral arms. In front of the bases of each of the dorsal and tentacular arms there is a large opening to the space beneath this membrane.

The beak is closely surrounded by a thick, prominent, lobed and wrinkled, fleshy collar, with papillæ on its inner surface; outside of this there is a smooth, sharp-edged, erect collar, less prominent than the inner one.

The odontophore is similar to that of *Ommastrephes*; it is sharply bent upon itself anteriorly, with the ventral end less than half as long as the dorsal; the dentigerous zone is yellowish brown in color and bordered laterally by a thin ridge formed by a row of small plates; the lateral membrane is broad, thin, and pale yellow, running straight across, from the ventral end, at right angles to the dorsal portion, and then folding back upon itself, joins the dorsal part of the odontophore farther back, near its middle; beyond this point it is very narrow and rolled in. Length of the dorsal portion, 19^{mm}; of the ventral, 9; breadth of the dentigerous zone, anteriorly, 5^{mm}; breadth of marginal membrane, anteriorly, 7^{mm}.

The median teeth are broad, with three stout points, the middle one nearly twice as long as the lateral; the inner lateral teeth are much longer, with one long stout point and a short denticle on the outer side, below the middle; the two outer rows have simple, long, and rather stout, curved teeth, those of the outermost row a little longer and narrower than the others. The teeth differ decidedly from those of *S. megaptera* in the shortness of the lateral denticles of the median and inner lateral teeth; moreover all the teeth are stouter and less acute.

The pen resembles that of *Ommastrephes*; it is long, widest anteriorly, bordered by strong ribs, obtusely pointed at the anterior end, gradually narrowing to the very narrow slender portion, about three inches from the posterior end, beyond which there is a thin margin, which expands into a lanceolate form, widest at 1.25 inches from the

end; the terminal portion forms a short, hollow hood, formed by the infolding of the margin, and marked by slender, divergent, raised lines, stronger laterally, and with a dorsal keel. The central rib begins at the anterior end, increases in size to the middle region, then narrows to the slender part, where it forms a slender, prominent rib, only visible dorsally, and then becoming confluent with the lateral ribs, extends as a sharp keel to the end. The lateral ribs commence at about .75 inch from the anterior end, and each at first consists of three riblets; farther back another appears on the outside margin but is separated only by a slender groove, and toward the slender part of the pen they all coalesce into a single rib on each side, which nearly meet in the middle line ventrally, where they are separated by a slender groove, which disappears farther on. Total length of pen, 349^{mm} (13.75 inches); greatest breadth, 22.5^{mm} (.90 inch); length of posterior cone or hood, .9^{mm} (.35 inch); breadth of posterior expansion, 15^{mm}.

This specimen was collected at Bermuda, by Mr. G. Brown Goode, and now belongs to the Museum of Wesleyan University, Middletown, Conn. Mr. Goode informs me that it was picked up on the north shore of the island, in December, 1876, and that it was regarded by the inhabitants as a novelty or great rarity, and was noticed as such in the local newspapers.

Histioteuthis D'Orbigny, 1839.

Histioteuthis Férussac & D'Orbigny, Histoire naturelle des Céphalopodes Acétabulifères, p. 226.

This genus is remarkable for having the six upper, sessile arms united together nearly to their tips by a thin elastic membrane or web. The ventral arms are also united together for a part of their length and their common web is joined to the great web, in the median line, by a bridle-like membrane. The tentacular-arms are very long, and have expanded clubs, with a broad dorsal keel. As in *Architeuthis* and *Sthenoteuthis*, they are furnished with a series of small smooth-rimmed suckers, alternating with tubercles, on the proximal part of the club and adjacent part of the arm, for the purpose of uniting the arms together, at will, but in the following species a row of such suckers and tubercles also extend along one side of the club, opposite part of the large central suckers. The large suckers are serrated, and alternate in two rows; two rows of large marginal suckers exist on one side and two rows of much smaller ones on the other. At the extreme tip of the arm there is a cluster of small smooth-edged suckers, as in *Architeuthis*.

The mouth is surrounded by a broad buccal membrane, with six angles or lobes, but without suckers. The body is relatively short, with short bilobed caudal fins. The eyes are large, and have distinct lids. The dorsal bone or pen is thin, short, lanceolate, and somewhat quill-shaped, with long, lateral expansions.

The species, so far as known, are brilliantly colored, having ocellated spots on raised verrucæ, in addition to the ordinary coloration of squids.

The two foreign species, hitherto described, are both from the Mediterranean.

Histioteuthis Collinsii Verrill.

American Journal of Science, vol. xvii, p. 241, March, 1879. Tryon, Manual of Conchology, i, p. 166, 1879 (description copied from the original).

PLATES XXII and XXVI.

A large and handsome species, with the broad, thin, dark brown web, extending between and nearly to the ends of the six upper arms. The outer surface of the head and arms is covered with large, slightly raised warts or tubercles, which are dark blue with a whitish center, specked with brown; three rows extend along the ventral arms and two along the others; a circle of these surrounds the eye-lids, but the edges of the eye-lids are narrowly bordered with dark brown. Color, between the warts, pale purplish brown, with small, raised, dark brown spots, reddish specks, and white granules; web and inner surface of arms uniform dark reddish or purplish brown; suckers yellowish white, their pedicels specked with brown; tentacular-arms light orange-brown. Eyes mutilated; their lids form a large simple, rounded opening.

Tentacular-arms slender, about two feet long and expanding near the end into a broad, long-oval, sucker-bearing portion or 'club,' which is bordered by a membrane, widest on the upper edge; it ends in a tapering tip, on the back of which there is a thin, crest-like membrane or keel, enlarging proximally to its end, where it forms a rounded lobe. The most expanded portion of the 'club' bears six rows of suckers, with finely serrate horny rings; the two central rows contain much the largest suckers, four or five in each; the more central of these two rows contains four suckers, larger than the rest, and of these the two median are largest; outside of these two median rows, are two regular marginal rows of nearly equal, medium-sized, serrate suckers, on the upper edge; and along the lower edge of the club there is one row of few, similar, but smaller ones; outside of these there is an incomplete

alternating row of much smaller marginal ones. On the lower edge of the proximal portion of the club, extending from the middle backward, there is a row of four small, smooth-edged, unequal suckers, alternating with rounded, sessile tubercles that fit into corresponding suckers on the other arm; a row of similar but smaller suckers extends for about six inches along the inner surface in the median line of the arm, alternating at first singly, and then two by two, with tubercles, and gradually becoming more distant. The end of the arm, beyond the expanded club, bears minute serrate suckers, at first in six rows, decreasing to two toward the end. The extreme tip bears a small group of minute, smooth-edged suckers. The largest suckers of the club are decidedly constricted below the margin, and then swell out at the basal portion. The edge of the horny rim is divided into very numerous, small, incurved and crowded denticles, nearly equal in length, but part are thickened and obtuse, while the rest are more slender and acute. Diameter of the largest suckers, 6.5^{mm}; of the largest in the second row, 5.5; of the largest in the lateral rows, 3 to 4; of the largest smooth-rimmed marginal suckers, 2 to 2.5; of the smooth-rimmed suckers of the wrist, 1.5 to 2.

Sessile arms stout, trapezoidal, tapering to slender tips, and bearing two rows of numerous suckers. All the arms on the left side are an inch or more longer than the corresponding right ones. The dorsal and ventral arms, of the same side, are about equal, and decidedly shorter than the two lateral pairs, which differ but little in length. Web about two-thirds as broad as the length of the arms, uniting the upper three pairs together, and as a narrowing border extending along their sides, to the tips. The lower lateral arms have a thin, crest-like membrane on their outer, median surface, commencing at the basal fourth and extending nearly to the tips. The ventral arms are united together, toward the base, by a web, which is also joined to the main web, in the median plane. A narrow outer web, arising from the outer angles of the arms, also unites all the arms together for a short distance above their bases.

The suckers are all similar in form. The larger ones on the dorsal arms are, perhaps, a little larger than those on the lateral and ventral ones. The largest are subglobular, laterally attached, and gibbous; the aperture is small, usually with three or four flat, blunt, or rounded lobes or denticles on the outer margin, with none on the inner margin. The pedicels of the larger suckers are very stout at base, tapering up to their attachment on the lower side of the sucker, where they are small and slender. The largest suckers of the dorsal arms are 5^{mm}

in diameter; their apertures 2^{mm} ; length of pedicels 4 to 5^{mm} . The largest suckers on the ventral arms are not so large as those on the others; the largest are 4^{mm} in diameter. Only a few suckers (5 or 6), and these of very small size and nearly in one row, extend below the level of the ventral web, which is attached along the inner margin, inside the row of suckers. The larger ventral suckers are depressed and oblique, with a very one-sided horny ring, which has a small oblique aperture, with about three bluntly rounded, slightly prominent lobes or denticles on the outer margin; while the inner margin is smooth.

The membranes about the mouth are arranged nearly as in *Onma-strephes*. The mouth is surrounded externally by a broad, elevated, smooth, dark chocolate-brown buccal membrane or collar, which is prolonged into six angular lobes, corresponding to all the intervals between the arms, except those between the 2d and 3d pairs; this buccal collar is connected to the interbrachial membrane by six membranous bridles, corresponding to the six lobes; on both sides of the dorsal and ventral bridles are large pouches. The beak is immediately surrounded by a thick, fleshy, lobed and wrinkled collar, and outside of this by another less prominent and less wrinkled one.

The exposed parts of the mandibles are black; the inner laminae bright reddish brown. The beak of the upper mandible is very acute, strongly incurved, with scarcely any distinct notch at the base of the cutting edge, but with a conspicuously excavated V-shaped area; the anterior edges of the alae are irregularly and slightly denticulate or crenulate. The lower mandible has a much incurved beak, with the cutting edges decidedly concave, and a very small notch at their bases, but with a broad excavated area along their sides and bases; the anterior edges of the alae are slightly convex and form a very obtuse angle with the edges of the beak or rostrum; a small, thin tooth exists just beyond the notch; the alae are broadest near their inner ends; the gular lamina is peculiar in having a prominent, thickened, curved, lateral rib, on each side, running to the end of the prolonged and subacute lateral lobes; and another dorsal one, running to the dorsal emargination. Length of upper mandible, 30^{mm} ; height, palatine to frontal, 20; height (or breadth) of palatine 14; tip of beak to end of frontal, 22; to base of cutting edge (notch), 7.5; notch to inner end of alae (union with palatine), 7.5; beak to posterior lateral border of alae, 13.5; transverse breadth across outer side of alae, 9.5. Lower mandible, length, 23^{mm} ; inner ends of alae to mentum, 22.5; tip of beak to dorsal border of gular lamina, 17; to inner ends of alae, 18; to notch, 8.5; breadth of alae in middle, 8; greatest

transverse breadth across alæ, 2·3; across anterior edge, at teeth, 7·5; notch to union of gular lamina and alæ, 6·5; breadth of gular lamina, 12·5.

The odontophore is rather short, the dorsal portion not much exceeding the ventral in length; the lateral membrane is broad and thin, its posterior border extending transversely straight across to the dorsal fold, nearly at right angles to the dorsal portion of the odontophore; the dentigerous portion, including a thickened lateral ridge, outside the teeth, is light red in color. Length of dorsal portion, from anterior bend, 8·5^{mm}; of ventral portion, 8; breadth of dentigerous zone, 3.

The median teeth are short, with a strongly incurved, acute central point, and with small inconspicuous or rudimentary, blunt lateral denticles on each side; the inner lateral teeth are considerably longer, without a distinct lateral denticle; the two outer rows have simple, rather slender, strongly incurved, acute teeth, the outermost a little longer and more slender. The plates along the border appear to be so closely united as not to be easily separated entire; they form a continuous, but slight, narrow ridge, which has an undulated surface. The membrane lining the palate bears pale yellowish, scattered, stout, not very acute, and but slightly curved teeth, with bases not much enlarged; among these are clusters of small, stony, smoothish granules, often aggregated into masses of considerable size. The gular membrane also bears aggregations of small, smoothish, rounded and angular granules, with others that are larger, oblong and oval, smooth, and more or less regularly arranged. The œsophagus is very long and slender, dark-colored.

Measurements of Histioeuthis Collinsii.

	Millimeters.	Inches.
Tentacular-arms, length.....	609 and 635	24 and 25
Diameter at base.....	12·5	·50
Breadth of club, without membrane.....	17·5	·70
Its membranous border.....	6·2	·25
Length of club.....	69	2·75
Length of the slender tip.....	31	1·25
Of dorsal crest.....	37	1·50
Length of dorsal arm of left side.....	355	14
Of 1st lateral (2d pair).....	432	17
Of 2d lateral (3d pair).....	438	17·25
Of ventral.....	361	14·25
Breadth of lateral arms, at base.....	22·5	·90
Thickness.....	19	·75
Diameter of eye-opening.....	22·5	·90
Diameter of head, at base of arms.....	87	3·50
Breadth of web, between arms.....	203 to 251	8 to 10
Diameter of largest suckers of tentacular-arms.....	6·5	·26

Taken from the stomach of *Alepidosaurus ferox*, lat. $42^{\circ} 49'$, long. $62^{\circ} 57'$, off Nova Scotia, by Capt. J. W. Collins and crew of the schooner "Marion," 1879.

All parts back of the eyes are absent, the eyes are mutilated, but the specimen is otherwise in excellent preservation, even the web and suckers being nearly uninjured.

*Observations on some of the more important specimens described
from other localities.*

We are largely indebted to Professor Steenstrup and to Dr. Harting for our knowledge of the specimens preserved in European museums, or cast ashore on the European coasts. Professor Steenstrup* has given accounts, compiled from contemporary documents, of a specimen taken at Malmö, Sweden, about 1546 or 1549, and of two specimens of huge cephalopods cast ashore at Iceland, in 1639 and Nov. or Dec., 1790.

The specimen of 1790, described in the MSS. of Svend Paulsen, 1792, had tentacles 3 fathoms long; the body (with head) was $3\frac{1}{2}$ fathoms long. That of 1639, described in Olafsens og Povelsens Reise til Island, ii, 716, was 4 to 5 fathoms long.

In the article published in 1857, he also briefly mentioned a specimen cast ashore at Jutland, Dec., 1853, of which the jaws were preserved, and on which he then based the species *Architeuthis monachus*; and another specimen, which he named *Architeuthis dux*, taken by Capt. Vilh. Hygom, in the western Atlantic. He has also since described and figured† the jaws of the specimen of *Architeuthis monachus*, obtained at Jutland, in Dec., 1853.

In the same memoir, of which I have seen only the first part, there are references to a description and figures of '*A. Titan*,' obtained in 1855, by Capt. Hygom, in N. lat. 31° , W. long. 76° . The latter specimen appears to be the same as that referred to in 1856, as *A.*

* Meddelelse om tvende Kiæmpestore Blæksprutter, opdrevne 1639 og 1790 ved Islands Kyst, og om nogle andre nordiske Dyr. Förhandlinger Skandinaviske Naturforskeres. v. pp. 950-957, 1847, Copenhagen, 1849.

Oplysninger om Atlanter colossale Blæksprutter Förhandlinger, Skand. Naturf., 1856, vii, p. 182, Christiania, 1857. Cephalopodum, qui in Museis Hafn. inveniuntur, Kjøbenhavn Oversigt., 1861, pp. 69, 165.

† In a paper of which I have seen some proof-sheets, given by him to Dr. Packard, entitled "Spolia Atlantica." This memoir has not been published. The plate (1) that I have seen is marked "Vid. Selsk. Skrifter, V. Række, naturv. og mathem. Afd. iv Bind;" and there are references to three other plates, illustrating '*A. Titan*,' etc.

dux, and the same that Harting* mentioned, under the name '*Architeuthis dux* Steenstrup,' as collected at the same time and place, and of which he published an outline figure (see Plate XXV, fig. 2) of the lower jaw, copied from a drawing furnished to him by Steenstrup.

Harting states that the pen or 'gladius' of this specimen is six feet long. Many important parts of this specimen were secured, and I regret that I have been unable to see the figures and description of it, referred to by Harting as forming part of Professor Steenstrup's unpublished memoir. But to judge by the outline figure given by Harting, it is a species quite distinct from those described by me. The lower jaw resembles that of *A. Harveyi* more than *A. princeps*, and is a little larger than that of our No. 5. The beak is more rounded dorsally, less acute, and scarcely incurved; the notch is narrow, and the alar tooth is not prominent.

M. Paul Gervais, in the *Journal de Zoologie*, iv, p. 90, 1875, gives a short description of this species, based apparently on the proof-sheets and unpublished plates, not seen by me, of Steenstrup's article, referred to above. He describes it as follows: A large species, of which a fragment of an arm preserved in the Museum of Copenhagen is nearly as large as the arm of a man. The sucker-bearing surface of the arm is extended bilaterally into a membrane exceeding, on each side, the arm itself. Diameter of the opening of the suckers, 0.020; of the suckers themselves, 0.030. Length of the dorsal bone (pen), 2^m; breadth [longueur, by error], measured in the middle of its length [longueur], 0.17. He refers to Steenstrup's Plates, III and IV.

In a letter to the writer, dated Sept. 4, 1875, Professor Steenstrup states that in addition to the specimens above mentioned, there are, in the Museum of the University of Copenhagen, two complete specimens of *Architeuthis*, preserved in alcohol. Both are of comparatively small size. One, from the northern coast of Iceland,† he refers to *A. monachus*. It has tentacular-arms 10 feet long, and sessile arms 4 feet long. The other is a still smaller one, from the warmer parts of the Atlantic, possibly the young of *A. dux*.

It is evident, therefore, that at no distant day, most of the remaining doubtful points in respect to the structure and relationship of the

* Description de quelques fragments de deux Céphalopodes gigantesques. Publiées par l'Académie Royale des Sciences à Amsterdam. 1860. 4to, with three plates (Verh. K. Akad. Wet., ix, 1861.) The figures have been partly copied in Tryon's *Manual of Conchology*, i, plates 60 and 86.

† This one is referred to by Dr. Packard, *Amer. Naturalist*, vol. vii, p. 94, 1873.

species of this genus, can be cleared up by Professor Steenstrup, even if additional specimens should not be obtained.

The publication of Professor Steenstrup's detailed memoir upon this genus would give great pleasure and satisfaction to all students of this class of animals. His thorough knowledge of the group, and his numerous and important investigations of the Cephalopods, published during many years, will give especial value to his conclusions.

Harting, in the important memoir referred to, describes specimens of two species, both of which are apparently distinct from all the Newfoundland specimens enumerated by me.

The first of these (his Plate I) is represented by the jaws and buccal mass, with the lingual dentition, and some detached suckers, preserved in the museum of the University of Utrecht, but from an unknown locality. These parts are well figured and described, and were referred to *Architeuthis dur* by Harting. The form of the lower jaw (see Pl. XXV, fig. 1) is unlike that of *A. dur*, for the beak is very acute, the cutting edge is concave, the notch shallow and broad, and the alar tooth is somewhat prominent. The size is about the same as our No. 5. The suckers (Pl. XXV, fig. 1a, 1b) are from the sessile arms, and agree pretty nearly with those of *A. Harveyi*. The edge is strengthened by an oblique, strongly denticulated ring, which, in all the suckers figured, including both larger and smaller ones from the short arms, has regular, acute, sub-equal denticles all around the circumference, in this respect agreeing with *A. Harveyi*. The internal diameter of the largest of these suckers is .75 of an inch; the external, 1.05 inches. They were furnished with slender pedicels, attached obliquely on one side. The lingual teeth (see Plate XVI, fig. 8, copied from Harting) are in seven regular rows, and resemble closely those of *Loligo*. On that account mainly, in a former paper, I proposed to designate it by the name of *Loligo Hartingii*. But since that time I have been able to study the dentition of species of *Architeuthis* and *Sthenoteuthis*, and now refer Harting's species to *Architeuthis* without hesitation, although the dentition is poorly figured. Professor Steenstrup, in a letter to me, subsequent to the publication of my former papers, also expressed the opinion that Harting's specimen belongs to *A. monachus*. If distinct, however, as is possible, it may be called *Architeuthis Hartingii*.

The other species described by Harting was from the Indian Ocean, and belongs to the genus *Euoploteuthis*.

In this genus there are large, sharp, curved claws (Pl. XXV, figs. 4, 4a), both on the club of the tentacular-arms and on the sessile arms,

in place of the suckers of ordinary squids. The teeth of the odontophore, in Harting's species, are remarkably small and simple (see fig. 4, *b*), after Harting. As this species does not appear to have had a special name, I propose to call it *Enoploteuthis Hartingii*.

D'Orbigny* gave the name *Enoploteuthis Molinae* to a large species, of which the body was estimated to be about 4 feet long, found floating and mutilated in the South Pacific, S. lat., 30° 44'; W. long. 110° 33', by Banks and Solander, in 1769, on Capt. Cook's second voyage. Of this, fragments are preserved in the Museum of the College of Surgeons, London.†

A similar species, perhaps identical, had previously been recorded by Molina, from the coast of Chili, as *Sepia unguiculata*.

According to Jeffrey's British Conchology, vol. v, p. 124, a huge Cephalopod was stranded in 1860 or 1861, between Hillswick and Scalloway, on the west of Shetland. "From a communication received by Professor Allman it appears that the tentacles were 16 feet long, the pedal-arms about half that length, and the mantle sac, 7 feet; the mantle was terminated by fins; one of the suckers examined by Professor Allman was $\frac{3}{4}$ inch in diameter."

Mr. Kent, in the articles already referred to,‡ mentions a sessile arm of a giant cephalopod, which has been long preserved in the British Museum, but of which the origin is unknown. He states, in the first article, that it is just 9 feet long and 11 inches in circumference at the base, tapering off to a fine point. There are about 150 suckers, in each of the two alternating rows, those at the base being $\frac{7}{8}$ of an inch in diameter.

In his second article he refers this arm doubtfully to *Ommastrephes todarus*, and gives the following description:

"The length of this arm, from one extremity to the other, is just 9 feet; the circumference at the base 11 inches; and from this it gradually decreases, terminating in a fine point. The suckers are arranged in two rows throughout the extent of the arm, numbering, approximately, 150 to each row, or a total of 300 to the whole organ. Forty-three suckers only are stationed on each side in the first or proximal half of the arm; one hundred on each side occupy the whole length, with the exception of 14 inches, this smaller length including the remaining fifty on each side, which are very minute and crowded

* Histoire Nat. des Céphalopodes Acétabulifères, p. 339, 1845.

† See also Todd's Cyclopaedia of Anatomy and Physiology, i, p. 529.

‡ Proceedings Zoological Society of London for 1874, pp. 178 and 493.

together. The comparative distances between the suckers throughout the whole length in each row are as follows:—between the first and second sucker, $1\frac{1}{2}$ inch; halfway up the arm, 1 inch; at three quarters of the entire length, $\frac{1}{2}$ inch; and within six inches of the distal extremity, $\frac{1}{4}$ inch. The relative diameters of the suckers at similar distances are:—at the base, extreme outside measurement $\frac{3}{4}$ inch, inside measurement of corneous ring $\frac{1}{2}$ inch; and, those suckers a little past the first few being the largest, halfway down $\frac{1}{2}$ inch outside and $\frac{1}{2}$ inch inside measurement, at three quarters length $\frac{1}{4}$ inch, and at 6 inches from the extreme point $\frac{1}{8}$ inch outside measurement, gradually diminishing from here to the size of a pin's head.

The shape and structure of the suckers upon this British-Museum specimen agree with those of *Ommastrephes todarus* as given by D'Orbigny, corresponding also with those figured by Harting, referred by him to the same species, and anticipated by the same authority to be also identical with Prof. Steenstrup's *Architeuthis duæ*. More minutely they may be described as hemispherical in shape, the stalk or peduncle being attached laterally at the base of the hemisphere, the point of insertion of the same in the cup being marked by a conspicuous pit-like depression. The horny ring is obliquely set, and much deeper at the side opposite the insertion of the stalk; the inner margin is serrated; and in most examples the serratures bordering the deeper side are considerably larger than in the other portions of the circumference; in some instances the serratures, except at the particular point mentioned, are altogether aborted, having the inner margin of the ring quite smooth; in other examples, and more especially among the larger suckers, the teeth or serratures are equal or subequal. The average number of the teeth of the largest rings is twenty."

Mr. Kent, unfortunately, does not state to which pair this arm belongs. But from his description, it is, perhaps, a ventral arm. It evidently belongs to an *Architeuthis*, and is very near to our *A. princeps*.

Lient. Bouyer, of the French steamer 'Alceton,' encountered a huge cephalopod, in November, 1860, between Madeira and Teneriffe. Its body was estimated to be between 15 and 18 feet in length. A long and laborious attempt was made to capture it, and a slipnoose was passed around the body, but on attempting to hoist it on board the rope cut through the soft flesh and the tail alone was secured. A sketch of the animal was made by one of the officers, and Messrs. Crosse and Fischer* have, from this figure and the narrative of the

* Journal de Conchyliologie, 3d ser., vol. ii, p. 138, 1862. See also Tryon's Manual of Conchology, vol. i, p. 87, Plate 59, 1879 (figure copied from the original).

officers,* proposed to establish a species for this specimen, which they named *Loligo Bouyeri*. The figure is very imperfect, but evidently represents a ten-armed cuttle-fish, though only eight arms are shown, and the tail is represented as truncated. In fact, there is nothing about the figure or description sufficient to indicate specific, or exact generic characters. The eight short arms, shown in the figure, are stout, tapered, and less than half the length of the head and body together. It was more probably a species of *Architeuthis*, to judge from the caudal fin, described as consisting of two rounded lobes, of small size. It may be designated as *A. Bouyeri*, provisionally.

In the *Journal de Zoologie*, vol. iv, No. 2, p. 88, 1875, M. Paul Gervais has given a partial summary of the gigantic Cephalopods previously known, and has mentioned an additional species (*Architeuthis Mouchezi* Vélain), of which portions were brought to Paris by M. Vélain, from the Island of St. Paul, Indian Ocean, where it was cast ashore in November. He also quotes the brief notice of the animal by M. Vélain (in *Comptes Rendus*, t. lxxx, p. 1062, Seance du April 19, 1875). It is stated that this example belongs to the same group with *Ommastrephes*. A description and a rude figure of it, made from a photograph taken in the position in which it lay upon the shore, has also been published by M. Vélain in the *Arch. de Zool. Exper.*, vol. vi, p. 83, 1877. The figure has been copied in Tryon's *Manual of Conchology*, vol. i, Pl. 82. According to this figure the tentacular-arms were very long and the short arms were truncated, probably owing to mutilation. One of the tentacular-arms was saved, and, with the beak, is preserved in Paris. The caudal fin was narrow and lanceolate, adhering to the sides of the body by its entire length. In the latter feature this is very different from any of the northern species.†

In the *Archives de Zool. Experimentale*, vol. vi, 1877, M. Vélain has proposed a new genus (*Mouchezia*) for this specimen. The peculiarity of the pen appears to be the only character, of any importance, referred to by him.

In *The Zoologist*, London, 2d Series, No. 118, p. 4526, July, 1875, there is an article entitled, "Notice of a gigantic Cephalopod (*Dino-teuthis proboscideus*), which was stranded at Dingle, in Kerry, two hundred years ago. By A. G. More, F.L.S." The article is chiefly a reprint of the rude, but interesting, popular accounts written at the time of the capture, and upon these Mr. More attempted to found a new genus and species. The character which he mainly relied upon,

* See *Comptes Rendus*, Acad. Sci., vol. 53, pp. 1263-7, 1861.

† See also Tryon's *Manual of Conchology*, i, pp. 89 and 184, 1879.

as of generic value, is the power of projecting the beak in the form of a proboscis. But this is habitually done by the various common species of *Ommastrephes*, *Loligo*, etc., and perhaps by all ten-armed cephalopods. There is not sufficient evidence, from the published accounts, that this specimen differed in any way from the *Architeuthis monachus*. It was described as 19 feet in total length; the long arms having been mutilated, the part remaining was 11 feet long, and as thick as a man's arm; the short arms varied from 6 to 8 feet in length, and were as thick as a man's leg, and had two rows of large serrated suckers; the proboscis (buccal mass with beak) was the size of a man's fist; the beak was "somewhat like to an Eagle's Bill, but broader." The whole animal was said to have been as large as a large horse. The length of the head and body together was 8 feet.

Mr. More has kindly sent me a tracing from the original figure. This shows a broad, oval, flat body, and a small caudal fin. The body or mantle had evidently been split open and spread out flat.

This fact is also evident from the original descriptions reprinted by Mr. More, in which the sides of the mantle are described as follows: "Over this Monster's back was a mantle of a bright Red Color, with a fringe round it, it hung down on both sides like a Carpet on a table, falling back on each side, and faced with white." The liver, according to the descriptions, had been removed: "When it was dead and opened the liver wayed 30 pound." The proboscis had also been removed before it was exhibited, and it is therefore very probable that the figure and descriptions represent it as more extended than was natural.

The measurements given indicate a specimen smaller than several of the American examples, and but little, if any, larger than our No. 5, from Logie Bay.

In the *Zoologist*, June, 1875, p. 4502, and August, p. 4569, and in the August number of the *Annals and Magazine of Natural History*, vol. xvi, p. 123, the same writer gave an account of the capture, and briefly described the beak, odontophore, and portions of the tentacles and arms of another specimen, taken off Boffin Island, on the west coast of Ireland, April, 1875. The tentacular-arms are said to have been 30 feet long; the expanded portion 2 feet 9 inches; the large central suckers nearly 1 inch in diameter; those of the outer rows .5 of an inch; one short arm is said to have been 8 feet long, and 15 inches in circumference at the base, when fresh. It had small suckers without teeth on the horny rings, on the 'wrist' of the 'club' and

scattered along the tentacular-arms, as do our specimens. The rounded tubercles that always accompany these smooth-rimmed suckers are not mentioned, but doubtless they were also present. The beak was 5.25 inches long and 3.5 broad, dark reddish brown, "with a large tooth in both margins of the inner mandible and a much smaller notch on each side of the outer mandible."

Mr. More believed this to be distinct from the Newfoundland species and referred it to *A. dur*, but his description agrees closely with the corresponding parts of *A. Harveyi* (No. 5) described by me, except in the relatively somewhat greater size of the sessile arms at base. In this respect, however, it is equalled or surpassed by our No. 14, and by others of the Newfoundland examples. This may also be only a peculiarity of the female. The measurements indicate a specimen intermediate in size between our Nos. 5 and 14, but the description is not sufficient to indicate with certainty to which of our species it was nearest related. A more detailed description, with figures of the suckers and odontophore, would probably settle this point. Mr. More supposed that the lateral suckers of the tentacular-club were larger in his example than in *A. Harveyi*, but that is not the case.

A large cephalopod, referred doubtfully to *Ommastrephes*, has been recorded from Japan and described by Dr. F. Hilgendorf.* It was taken on the east coast of Japan, N. lat. 35° to 36°. It had been split open, salted, and partly dried, and the viscera had been removed. The ends or clubs of the tentacles were also gone. In this condition it was on exhibition in Yedo. The following are the measurements given: Tip of tail to front edge of mantle, 186^{cm} (6 feet, 1 inch); mantle to mouth, about 41^{cm} (1 foot, 5 inches); longer sessile arms, 197^{cm} (6.5 feet); from tip of tail to tip of sessile arms, 414^{cm}; total expanse across outstretched tentacles, 600^{cm}; circumference of mantle (breadth as cut open), 130^{cm}; length of caudal fin, 60^{cm}; breadth of caudal fin in middle, 45^{cm}; breadth of forward end of caudal fin, 28^{cm}; diameter of posterior tip, 1^{cm}; tongue of funnel, 10^{cm} broad, 6^{cm} long; eye-opening, which was oblong-oval, without an obvious sinus, 19^{cm}; distance between eyes, 26^{cm}; diameter of oval skin of lip, 12^{cm} by 8^{cm}; breadth of sessile arms, 11^{cm}; of tentacles, 2 to 3^{cm}; diameter of horny rings of suckers, on base, 1.5^{cm}; height, 0.7^{mm}; number of denticles, 37.

* Mittheilungen der deutschen Gesellschaft für Natur und Völkerkunde Ostasiens. Herausgegeben von dem Vorstande, 1st Heft, p. 21, May, 1873, Yokohama, Japan. See also American Journal of Science, vi, p. 237, Sept., 1873.

The following species, although the specimens, when found, had lost some of their most characteristic parts, appears to be nearly related to *Onychoteuthis*, a genus having sharp claws instead of suckers on the 'club' of the tentacular-arms, and a cluster of small tubercles and smooth suckers on its 'wrist,' to unite the arms together. It probably belongs to the group *Lestoteuthis*, characterized below.

Onychoteuthis robusta (Dall).

Ommastrephes robustus (Dall. MSS.) Verrill, American Journal Science, vol. xii, p. 236. 1876.

PLATES XXIII and XXIV.

This large and very interesting species* was discovered by Mr. W. H. Dall, near Iliulik, Unalashka I., off the coast of Alaska.† He found three specimens thrown upon the beach, April 26 and May 8, 1872. He made descriptions, measurements, and some very valuable drawings of them, while fresh. The specimens had all been more or less mutilated by the ravens before they were discovered. He preserved the pharynx, beak, and odontophore of No. 1; part of the 'bone,' a piece of the caudal fin, and the basal part of one of the ventral arms, with five of the suckers adhering, from one of the other specimens, (No. 2), and has generously placed them in my hands for examination, together with his drawings, measurements and notes.

The parts remaining of the largest specimen, No. 3, when found had a total length of 427^{cm} (14 feet), but the ends of the tentacular-arms had been destroyed; length from tail to base of tentacular-arms, 559^{cm} (8 feet, 6 inches); to front edge of mantle, 232·4^{cm} (7 feet, 7½ inches); width across fins, 107^{cm} (42 inches); diameter of body, 45·7^{cm} (18 inches); slender basal portion remaining of tentacular-arms, 155^{cm} (61 inches); their diameter, 6·3^{cm} (2·5 inches); short arms (ends gone), 76 to 102^{cm} (30 to 40 inches); length of pen, 226^{cm} (7 feet, 5 inches).

According to Mr. Dall's notes the color was reddish, in fine red dots on a whitish ground, with a darker stripe on the outer median line of the arms. The eyes were bluish-black, furnished with lids, and with a small sinus in front; diameter of the opening, 2·5^{cm} (1 inch).

The mandibles retracted into a short, yellow, puckered muzzle, which was included in a longer, plain, proboscis-like tube, extending an inch or two beyond. Siphon, short and thick.‡ Region of the eye

* This is the species referred to as perhaps *Onychoteuthis Bergi* by Mr. Dall in his note upon large cephalopods, in the American Naturalist, vol. vii, p. 484, 1873.

† The first specimen was found by Mr. M. W. Harrington, of Mr. Dall's party, on the west shore of Amaknak Island, Captain's Harbor, Unalashka, April 26th.

‡ No valve is shown in Mr. Dall's sketches.

somewhat raised. The nuchal collar is well-marked, and slightly above it, on each side, is a raised epidermal ridge, from which three wavy, raised bands or frills, attached at their inner edge, pass obliquely backward, on each side. No cranial cartilage was observed. Mantle firm and dense. The neck has one median dorsal and two ventral facets, long, oval-shaped, with a median depressed line, but otherwise smooth and white; the dorsal moves on a smooth part of the inside of the mantle; the ventrals move on similar raised facets of the mantle beneath. The caudal fin was rather broad, lanceolate or spear-shaped, acute at tip. Gills yellowish olive, with obliquely transverse laminae. Gizzard, yellowish, the muscles laid like a coil of spun-yarn, in layers transverse to one another.

The pen, (Pl. XXIII, figs. 4, 5,) was gone from the first specimen (No. 1) and broken in the others. It was found unattached, in the dorsal cavity. It had a thickened median rib, but becomes very thin at the sides, and is divided by sharp, stiff ribs or folds into three longitudinal areas, on each side (Pl. XXIII, fig. 6). The posterior end is one-sided, funnel-shaped close to the tip, which is inserted into a long, round, thick, firm, cartilaginous cone, which tapers to a point posteriorly. The portion of the pen (of No. 2) preserved* and forwarded to me, includes all the cone and a part of the posterior end of the quill-portion, attached within the concavity of the cone (Pl. XXIV, fig. 7). The anterior end of the cone is concave and very obliquely terminated, the dorsal side extending forward some distance along the dorsal side of the quill. The whole length of the preserved cone, (doubtless much shrunken by the alcohol) is 44.5^{cm} (17.5 inches); of the oblique anterior termination, 15.25^{cm} (6 inches); greatest diameter, 4^{cm} (1.6 inches). The cone is nearly round, firm, translucent, brownish, or deep amber-color, and composed of numerous distinct concentric layers. The concavity of the anterior end firmly embraces the remnant of the funnel of the quill, which has numerous small costae converging to the apex; two of the dorsal costae are much stronger than the rest, forming a strong ridge each side of the smaller median costa, which lies in a deep median depression or furrow.

The tentacular-arms had lost their clubs; but the part remaining was cylindrical, 2.5 inches in diameter. The other arms were some-

* Mr. Dall states that he attempted to dry the rest of this pen, and that of No. 3, but they turned brown, and then black, effloresced, and decomposed. He also states that the pen, when fresh, was translucent whitish, and that it changed to brownish yellow in the alcohol.

what thicker. The few suckers remaining on them, were attached by slender pedicels, and arranged in two alternating rows; they were furnished with horny rims having the edge entire, except where irregularly broken away; those of the distal part of the arms were gone.

The portion of the arm of the second specimen, preserved in alcohol and sent to me, came from the base of the left ventral arm. It is 65^{mm} in length; diameter, from inner to outer surface, not including marginal membrane, 45^{mm} ; including membrane, 64^{mm} . It is well rounded on the inner face, but more flattened on the upper side, while the outer surface is broadly rounded; the outer angle has a strong, thick, marginal membrane, 19^{mm} wide (see section of this arm, Plate XXIV, fig. 8, *c*). The sucker-bearing surface is broad, with a slight marginal membrane along each margin (*b*, *b'*) rising into broad, flat, somewhat thickened blunt lobes alternating with the suckers. Two alternating rows of firm, smooth, rather irregular-shaped tubercles, run along the median region, between the rows of suckers, with which they alternate, on each side.

This segment of the arm still bears five suckers, which appear to represent the 1st, 2d, and 4th pairs, though there may possibly have been others before the first of these. They are all similar, rather small in proportion to the arm, round, but little oblique, decidedly convex beneath, and with a rather long, slender pedicel, (fig. 8, *a*). The horny marginal rings are dark brown, yellowish at the thin edge, which is entire and nearly smooth, except where broken. The largest of these remaining suckers are 8.5^{mm} in diameter, outside; aperture, 5^{mm} ; height of cup, 7^{mm} ; length of pedicel, 3^{mm} .

The exposed parts of the jaws are black and polished; their internal laminae are reddish brown, becoming translucent yellowish toward the margins.

The upper mandible (Plate XXIV, fig. 5), has an elongated, tapered, considerably incurved and sharp rostrum; the notch is rather narrow and deep, and a well-developed, triangular, lateral groove runs down from the notch for some distance, its upper border being in line with the cutting edge of the rostrum. The anterior edge of the alæ, so far as normally exposed, is nearly straight, but slightly undulated.

The lower mandible (Plate XXIV, fig. 6), has the cutting edges of the rostrum slightly concave, with a slight notch close to the tip, which is small and incurved; the notch at the base is broad and shallow, bordered externally by a slight, angulated ridge; the exposed anterior edges of the alæ have, each, two slight lobes, but are otherwise nearly straight; the alæ are broader toward the inner end, which is obtusely rounded.

The lower mandible now measures, from the tip of the rostrum to the posterior dorsal border of the mentum, 13^{mm}; tip to the extreme posterior end of the gular lamina, 50^{mm}; to the dorsal angle of the same, 33^{mm}; tip to the inner end of the alæ, 46^{mm}; to the bottom of the notch, 13^{mm}; breadth of alæ, 24^{mm}; transverse breadth at notches, 12^{mm}.

The upper mandible, from the tip of the beak to the end of the palatine lamina, is 71^{mm} long; from tip of beak to end of frontal lamina, 53^{mm}; to bottom of notch, 11^{mm}; length of exposed (dark) portion of anterior edge of alæ, 14^{mm}.

The odontophore (Plate XXIV, figs. 1-4), has a very broad, thin, marginal membrane, yellowish-white in color, becoming brown and thickened toward the dentigerous portion, where there is a row of very small, thin plates, bordering the outer row of teeth; the ventral portion of the dentigerous band is dark brown, regularly convex, and narrowed gradually to the obtuse end; the dorsal portion is considerably longer, abruptly bent backward, with the borders incurved, gradually decreasing to the posterior end; on this part the teeth become much smaller and paler.

The outer lateral teeth, on the anterior portion, are long, slender, sharp, and strongly curved; the median ones are much shorter, with a sharp, strongly curved central point and a very small, almost rudimentary denticle on each side; the inner laterals are a little longer than the median, with a stout incurved point; on the outer side of its base there is a small denticle; the teeth of the two outer rows, on each side, are simple.

Length of odontophore, from anterior bend to posterior tip of dorsal end, 22^{mm}; to tip of ventral end, 14^{mm}; breadth of lateral membrane, in middle, 11^{mm}; of dentigerous belt, anteriorly, 3^{mm}.

The following measurements were made by Mr. Dall, from the fresh specimens.

Table of measurements (in inches).

	No. 1.	No. 2.	No. 3.
Total length (to mutilated ends of tentacles).....	80 +	110 +	167 +
Base of arms to tip of tail (head and body).....	51	67	102
Base of arms to edge of mantle (head).....	5	6	10.5
Edge of mantle to tip of tail (body),	46	61	91.5
Length of tail-fins (insertion to tip),	--	33.75	48
Breadth of tail-fins,	13.5 +	25.5	42
Length of 'pen,'	--	60	89
Breadth of pen, in middle,	--	--	12.25
Length of tentacular-arms (ends gone),	30 +	43 +	61 +
Length of longest sessile arms (ends gone),	30 +	23.5 +	40 +
Diameter of body,	7.5	--	18
Breadth between insertions of fins,	--	3.5	5
Diameter of eye,	--	1	1.25

The generic affinities of this species must be regarded as still somewhat doubtful, owing to the absence of the tentacular-clubs, and most of the suckers of the sessile arms. The characters of the 'pen;' of the dentition, especially of the median teeth; of the nuchal frills; of the siphon; and of the cartilaginous facets of the neck, all indicate that it belongs in the family *Onychoteuthidae*, near *Onychoteuthis*. But in this family there is great diversity as to the arrangement of the hooks and suckers, constituting the armature of the arms. Some of these combinations are as follows:

Sessile arms with suckers only.

Onychia.—Tentacular-club with two central rows of hooks, rows of small suckers along each margin, and a cluster of suckers and tubercles on the 'wrist.' Sessile arms with smooth suckers.

Onychoteuthis (typical).—Tentacular-club with two rows of hooks, with an apical cluster of suckers, and with a cluster of suckers and tubercles on the wrist. Sessile arms with suckers in two rows.

Ancistroteuthis (typical).—Two central rows of hooks, with proximal and apical suckers on the club, as in the last. Pen with a long, terminal, cartilaginous cone.

Ancistroteuthis Krohnii.—Tentacular-club with one row of suckers and one of hooks in the middle portion.

Dosidicus.—Tentacular-club with hooks. Sessile arms with large suckers on the proximal portion and small ones on the distal. Pen with a solid cone.

Sessile arms with both suckers and hooks.

Gonatus.—Tentacular-club with one or two central hooks proximally, and with numerous, multiserial, small suckers, distally. Sessile arms with four rows of suckers, those of the two central rows with a median hook, the outer ones serrate.

Abralia.—Tentacular-club with two rows of alternating hooks and suckers, in the middle, and with clusters of suckers on the wrist and apex. Sessile arms with hooks on the basal portion, and suckers toward the tips.

Lestoteuthis (gen. nov.).—Tentacular-club with numerous suckers, and few large central hooks. Sessile arms dissimilar; lower ones with four rows of suckers; upper with two central rows of hooks, and with marginal suckers on each side. Pen with a long terminal cone. (Type *A. Kamschatica* Middendorff, sp.)

Sessile arms with hooks only.

Verania.—Tentacular-club with suckers only; sessile arms with hooks only.

Acanthoteuthis.—Tentacular and sessile arms with hooks (fossil).

Ancistrocheirus.—Tentacular and sessile arms with hooks in two rows. Pen dilated at both ends.

Enoploteuthis (typical).—Tentacular-club with two rows of hooks, and with a cluster of small suckers on the wrist. Sessile arms all with hooks in two rows, extending to the tips.

It will be evident from these characters, that Mr. Dall's species, having two rows of smooth suckers, at least on the basal portion of the ventral arms, can belong to none of these genera, except those in the first group and *Lestoteuthis* in the second. Of these, *Gonatus* would be excluded from consideration by its different pen and four rows of suckers; *Onychia* and typical *Onychoteuthis* by the form of the pen. After this elimination we still find three generic groups to either of which it might belong, so far as its armature is known, viz: *Ancistroteuthis*, *Dosidicus*, and *Lestoteuthis*. The first of these is, perhaps, nothing more than a sub-genus of *Onychoteuthis*, the principal difference being in the pen, which is somewhat pennate and lanceolate in the typical species of the latter, but nearly linear with a solid cartilaginous terminal cone in the former. In this last character, and in the general form of the pen, *O. robusta* somewhat approaches *A. Lichtensteinii*. But *Dosidicus* and *Lestoteuthis* also have a solid cartilaginous cone, and the latter, especially, agrees most closely in the general form of the body and caudal fin; and its pen has very nearly the form and structure seen in *O. robusta*.

So far as we can judge, therefore, with our present imperfect data, the relationship of *O. robusta* appears to be rather with *Lestoteuthis* than with any other known group. It is possible, however, that its affinities may prove to be closer to *Ancistroteuthis*, when the armature is discovered.

Lestoteuthis, gen. nov.

The characters of *Lestoteuthis Kamschatica*, which I propose to take as the type of this generic group, are not yet fully known. The peculiarities in the armature, both of the sessile and tentacular-arms, as given above (p. 250) are quite sufficient, however, to warrant its separation from all the other genera. Its pen, as figured, also differs from all others, hitherto described. It is narrowest anteriorly, gradually and slightly expanding backward to the one-sided conical

hood or cone, which appears to be inserted into a solid terminal cone, much as in *L. robusta*, but the cone is relatively shorter. The caudal fin is large, rhomboidal, and acute posteriorly, as in the latter. The tentacular-club bears two large, abruptly curved, claw-like hooks in the middle, with numerous small suckers around them, and on the proximal part. The length of the head and body of the original example was about 28^{cm} (11 inches).

Mr. Dall has described a small species (probably young) from the coast of California, which may possibly belong to the same group. He referred it doubtfully to *Onychoteuthis* (*O. lobipennis* Dall).

Professor G. O. Sars, in his recent work (Mollusca Reg. Arct. Norvegiæ, p. 377), also mentions a specimen of *Architeuthis* (12 feet long), cast ashore on the Norwegian coast, at Foldenford, in 1874. He refers it doubtfully to "*A. dux* Steenstrup," (from the Kattegat) by which we should understand *A. monachus*, without doubt.

Note on Large Species of *Octopus*.

Although this article relates specially to the gigantic species of ten-armed Cephalopods, it may not be amiss to add a few lines in respect to species of *Octopus*, that attain large dimensions. It is certain, however, that none of the latter that have hitherto been examined by naturalists reach dimensions to be compared with those of the species of *Architeuthis*, *Onychoteuthis* (or *Lestoteuthis*) *robusta* and their allies.

The common *Octopus* of the west coast of North America (*O. punctatus* Gabb) is one of the largest of its tribe, hitherto studied. According to Mr. W. H. Dall,* it occurs abundantly at Sitka, and there "reaches a length of sixteen feet or a radial spread of nearly twenty-eight feet, but the whole mass is much smaller than that of the decapodous cephalopods of lesser length. In the *Octopus* above mentioned, the body would not exceed six inches in diameter and a foot in length, and the arms attain an extreme tenuity toward their tips." Dr. W. O. Ayres tells me that he has often seen this species exposed for sale in the markets of San Francisco (where it is eaten chiefly by the French), and that specimens with the arms 6 or 7 feet long are common. A smaller specimen, presented to the museum of Yale College, was over 4 feet long, and weighed 14½ pounds.

Prof. W. H. Brewer states that he has seen specimens in the San Francisco markets which spread fourteen feet across the outstretched arms.

* American Naturalist, vii, p. 485, 1873.

The common *Octopus vulgaris* ("poulpe" or "devil-fish") of the Mediterranean, sometimes grows to a somewhat formidable size. According to Verany, the largest one seen by him was 9 feet long and weighed 25 kilogrammes (Tryon). This one was captured by a fisherman, with his hands only.

A large species, perhaps the same, occurs in the West Indies. According to Professor B. G. Wilder,* a correspondent, Mr. J. S. George, of Nassau, N. P., mentions, in a letter, the occurrence there of an *Octopus* "ten feet long, each arm measuring five feet; the weight was estimated at between two hundred and three hundred pounds." It was found dead on the beach.

Specimens of similar size have been recorded from other parts of the world, while more or less fabulous accounts of more gigantic forms are numerous, especially among the early writers. But at present it seems most probable that the large fragments recorded as being frequently vomited by wounded sperm whales, belong to species allied to *Architeuthis*, though such fragments have often been referred to *Octopus*.

There is no satisfactory evidence that any of these species of *Octopus* ever intentionally attack man, or that any one has ever been seriously injured by them. They are rather sluggish and timid creatures, seeking shelter in holes and crevices among rocks. They feed mainly upon bivalve mollusks, but will also eat fish, and might, perhaps, like lobsters and crabs, devour dead bodies. Their power and ferocity, as well as their size, have often been excessively exaggerated.

ERRATA.

Page 190, line 32, for 2·5, read 3·5.

Page 193, line 11, for 1878, read 1879.

* American Naturalist, vol. vi, p. 772, 1872.

EXPLANATION OF THE PLATES.

PLATE XIII.

Figure 1.—*Architeuthis Harveyi* (No. 5). Head and arms, $\frac{1}{3}$ natural size, from a photograph of the specimen when freshly caught. The back of the head rests upon an oar so as to cause the beak to protrude, while the arms hang down in a reversed position. The diameter of the bathing tub was 38.5 inches: *a*, left, and *a'* right ventral arms; *b*, left, and *b'* right arms of the third pair; *c*, left, and *c'*, right arms of the second pair; *d'*, right dorsal arm, mostly concealed behind the others; *e*, left and *e'*, right tentacular-arms, folded several times over the oar; *i* to *iv*, the 'club'; *i* to *ii*, the 'wrist'; *ii* to *iii*, the part bearing large suckers; *iii* to *iv*, the terminal division; *o*, the beak.

Figure 2.—Part of the body and caudal fin of the same specimen, $\frac{1}{3}$ natural size, from a photograph made at the same time with the preceding; *u*, mantle cut open; *t*, tip of tail; *b*, right and *l*, left lateral lobes of caudal fin.

PLATE XIV.

Figure 1.—*Architeuthis Harveyi*. A restoration, $\frac{1}{2\frac{1}{2}}$ natural size, based on the preceding figures and on the specimens received. (See note, p. 184).

PLATE XV.

Figure 1.—*Architeuthis Harveyi* (No. 5). Upper mandible, natural size.

Figure 2.—Lower mandible of same, natural size; lacks a small piece at *a*.

Figure 3.—Anterior part of the 'pen' of the same specimen, $\frac{1}{3}$ natural size. The dotted lines indicate missing parts. (Restored and drawn by the author).

Figures 1 and 2 were drawn by Mr. J. H. Blake, from alcoholic specimens.

PLATE XVI.

Figure 1.—*A. Harveyi* (No. 5). Portion of the lining membrane of the palate, enlarged.

Figure 2.—*A. Harveyi* (No. 5). Caudal fin, $\frac{1}{10}$ natural size, drawn from the preserved specimen.

Figure 3.—*A. Harveyi* (No. 5). Suckers of tentacular-arm, natural size; *a*, one of the largest suckers; *b*, one of the marginal suckers.

Figure 4.—The same. Horny marginal ring of one of the suckers from a sessile arm, enlarged 2 diameters.

Figure 5.—*A. Harveyi* (No. 4). One of the larger suckers from the tentacular-arms, natural size. From a dried specimen.

Figure 6.—Portion of the marginal ring of the same sucker, enlarged.

Figure 7.—*Loligo pallida* V. Part of odontophore, much enlarged.

Figure 8.—*Architeuthis Hartingii* V. Part of odontophore, enlarged. Copied from Harting's figures.

Figures 5 and 6 were drawn by J. H. Emerton; the rest by the author.

PLATE XVIa.

- Figure 1.—*Architeuthis Harveyi* V. (No. 5). Teeth of the odontophore, from the anterior portion, enlarged 18 diameters; *a*, median; *b*, inner lateral; *c*, and *d*, the two outer lateral teeth; *e*, marginal plates.
- Figure 2.—The same. Teeth from the same specimen, from farther back, on the dorsal portion of the odontophore. Lettering as in figure 1.
- Figure 3.—The same. Anterior portion of odontophore, showing the teeth nearly in their natural positions, enlarged.
- Figure 4.—The same. Portion of the membrane lining the palate, showing teeth and hard granules, enlarged.
- Figure 5.—The same. Two of the granules from the membrane lining the mouth, enlarged 18 diameters.
- Figures 6 and 6^a.—The same. One of the largest and least oblique of the horny rings from the suckers of the sessile arms; top and side-views, enlarged 1½ diameters.
- Figures 7 and 7^a.—The same. One of the medium sized, and more oblique suckers of the sessile arms; top and side-views, enlarged 1½ diameters.
- Figure 8.—The same. Another similar sucker, but smaller and more oblique; top-view, enlarged 1½ diameters.
- Figures 9 and 9^a.—The same. One of the horny rings from one of the smooth-rimmed suckers on the 'wrist' of the 'club' of the tentacular-arms; top and side-views, enlarged 3 diameters.
- Figures 10 and 10^a.—The same. One of the small suckers from the terminal portion of the 'club,' top and side-views, enlarged 3 diameters.
- Figures 1 to 5, and 8, are camera-drawings by the author. The others are by J. H. Emerton.

PLATE XVII.

- Figures 1 and 1^a.—*Architeuthis princeps* Verrill (No. 14). A marginal ring from one of the large suckers of the tentacular-arm; 1, side-view, enlarged 1½ diameters; 1^a, portion of the rim, enlarged 3 diameters.
- Figures 2 and 2^a.—The same. One of the medium-sized oblique sucker-rims from a sessile arm, enlarged 1½ diameters; top and side-views.
- Figures 3 and 4.—The same. Top and side-views of one of the smaller sucker-rims from a sessile arm, enlarged 3 diameters.
- Figures 5 and 6.—The same. Top and side-views of a complete sucker, with its pedicel, from a sessile arm, enlarged 1½ diameters.
- Figure 7.—The same. Top-view of one of the smaller, very oblique sucker-rims from a sessile arm, enlarged 3 diameters.
- Figure 8.—The same. Portion of the horny rim of a medium-sized sucker from a sessile arm; top-view, enlarged 6 diameters, from a camera-drawing.
- Figure 9.—The same. Side-view of the horny ring of one of the largest and least oblique of the suckers of the sessile arms, enlarged 1½ diameters.
- Figure 10.—The same. Side-view of the horny ring of one of the marginal suckers of the tentacular-club, enlarged 3 diameters.
- Figure 11.—*A. princeps* (No. 13). Portions of the horny ring of one of the large suckers of the tentacular-arm, much enlarged; *a* and *b*, portions of the margin, from the outside; *c*, portion seen from the inside.
- Figures 8 and 11 are camera-drawings by the author; all the others are by J. H. Emerton.

PLATE XVIII.

Figure 1.—*Architeuthis princeps* V. (No. 10). Upper jaw, natural size.

Figure 2.—The same. Lower jaw; the dotted line shows the parts that are present on the opposite side.

Figure 3.—*Architeuthis princeps* (No. 1). Part of lower jaw, natural size.

Figures 1 and 2 were drawn by the author; figure 3 by J. H. Emerton.

PLATE XIX.

Figure 1.—*Architeuthis princeps* V. (No. 14). Caudal fin from beneath; from the specimen a few days after it had been placed in alcohol.

Figure 2.—The same specimen, after it had been preserved several months in strong alcohol.

Figure 1 was drawn by J. B. Holder, M.D.; figure 2, by the author.

PLATE XX.

Architeuthis princeps V. (No. 14). General figure; from the recently preserved specimen; restored, in part, in accordance with the measurements of the freshly caught specimen; $\frac{1}{13}$ natural size. Drawn by the author.

PLATE XXI.

Figure 1.—*Sthenoteuthis megaptera* Verrill. Body seen from beneath, $\frac{1}{8}$ natural size; from the alcoholic specimen.

Figure 2.—The same. Part of the membrane lining the palate, enlarged 8 diameters; *a*, and *b*, from different places.

Figure 3.—The same. A single row of teeth from the odontophore, enlarged 8 diameters.

Figure 4.—The same. Teeth from the odontophore, enlarged 16 diameters; *a*, two median teeth; *b*, inner lateral teeth; *c* and *d*, teeth of the two outer lateral rows.

Figure 5.—The same. Two of the outer lateral teeth, profile-view, enlarged 16 diameters.

Figure 6.—The same. Several lateral teeth in their natural sequence, enlarged 16 diameters.

Figure 7.—The same. Two of the next to the outer lateral teeth, enlarged 16 diameters.

Figures 8 and 8^a.—The same. Twenty-second sucker from the ventral arm; front and side-views, enlarged 3 diameters.

Figure 9.—The same. One of the largest suckers from the club of the tentacular arm; front view, enlarged 3 diameters.

Figures 8, 8^a and 9 are by J. H. Emerton; the others by the author; 2 to 7 are camera-drawings.

PLATE XXII.

Histioteuthis Collinsii Verrill. Side-view of the head and arms; from the preserved specimen, $\frac{1}{7}$ natural size. Drawn by J. H. Emerton.

PLATE XXIII.

Figure 1.—*Onychoteuthis robusta* (Dall). Side-view of one of the specimens, as found on the beach, $\frac{1}{26}$ natural size.

Figure 2.—The same. Dorsal view. The dotted lines indicate portions of the arms that had been destroyed.

Figure 3.—The same. Side-view of the head and siphon, with the anterior part of the mantle, cut open; *e*, the eye; *s*, siphon; *o*, *o'*, *o''*, the three nuchal frills; *c*, *c'*, *c''*, the smooth facets where the mantle bears upon the neck; *c*, ventral facet of mantle; *c'*, ventral facets at base of siphon; *c''*, dorsal facet of neck; *m*, *m'*, cut edge of mantle.

Figure 4.—The same. The entire dorsal 'pen'; side-view, $\frac{1}{2}$ natural size.

Figure 5.—The same. Ventral view.

Figure 6.—The same. A portion from the middle of the 'pen,' less reduced.

All the figures were made from the fresh specimens by Mr. W. H. Dall.

PLATE XXIV.

Figure 1.—*Onychoteuthis robusta* (Dall). Odontophore; side-view, enlarged $3\frac{3}{4}$ diameters.

Figure 2.—The same. Part of a row of the teeth from near the anterior bend of the odontophore, $\times 22$ diameters; *a*, median tooth, front view; *a'*, side-view of same; *b*, first lateral; *b'*, the same, side-view; *c*, second lateral, front view; *d*, outer lateral, front view.

Figure 3.—The same. One of the inner lateral teeth, side-view. $\times 54$ diameters.

Figure 4.—The same. Median tooth, side-view, $\times 54$ diameters.

Figure 5.—The same. Upper mandible, natural size.

Figure 6.—The same. Lower mandible, natural size.

Figure 7.—The same. Anterior end of cone of pen, showing portion of posterior end of quill inserted into it, $\frac{1}{2}$ natural size.

Figure 8.—The same. Section of a ventral arm, close to the base, natural size; *a*, one of the suckers, side view; *b*, and *b'*, marginal membranes; *c*, crest on membrane along outer angle; *e*, median vessel near inner surface.

Figures 1 to 4 are camera-drawings by the author; the rest are by J. H. Emerton.

PLATE XXV.

Figure 1.—*Architeuthis Hartingii* V. Lower mandible, showing anterior portion only, natural size; *1a*, section of a sucker of sessile arm of same; *1b*, horny ring of same, natural size. After Harting.

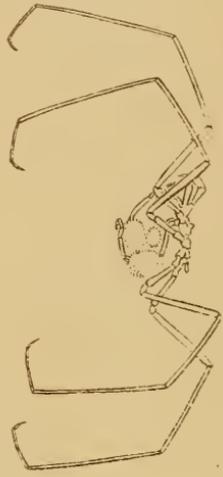
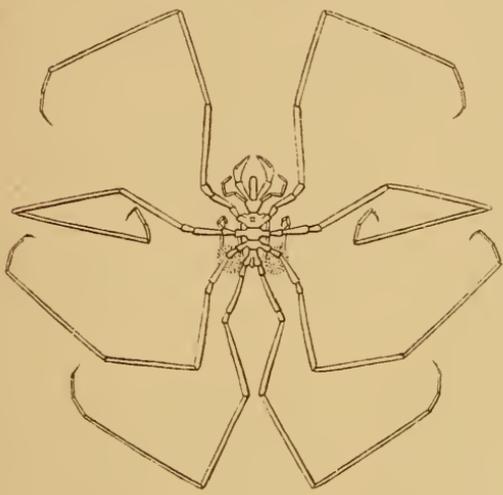
Figure 2.—*Architeuthis dux* Steenstrup. Lower mandible, natural size. Copied from Harting's figure, after Steenstrup.

Figure 3.—*Architeuthis monachus* Steenstrup (type specimen). Lower mandible, natural size. After Steenstrup.

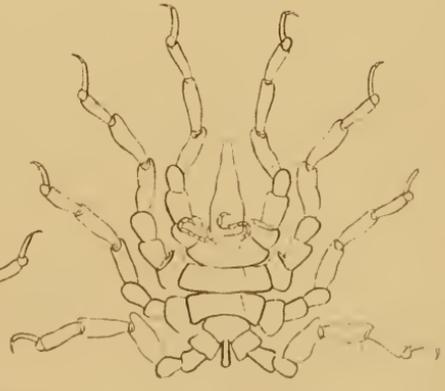
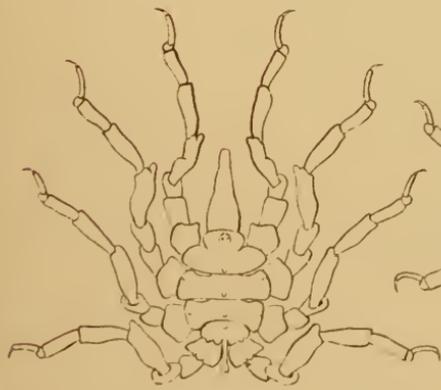
Figure 4.—*Enopoteuthis Hartingii* Verrill. A section of one of the claw-bearing suckers, somewhat enlarged; *4a*, the horny claw, isolated; *4b*, median and lateral teeth of odontophore. After Harting.

Figures 5 and *5a*.—*Architeuthis Harveyi* V. (No. 4). The two halves of the lower mandible, natural size. Camera-drawings from the specimen, by the author.

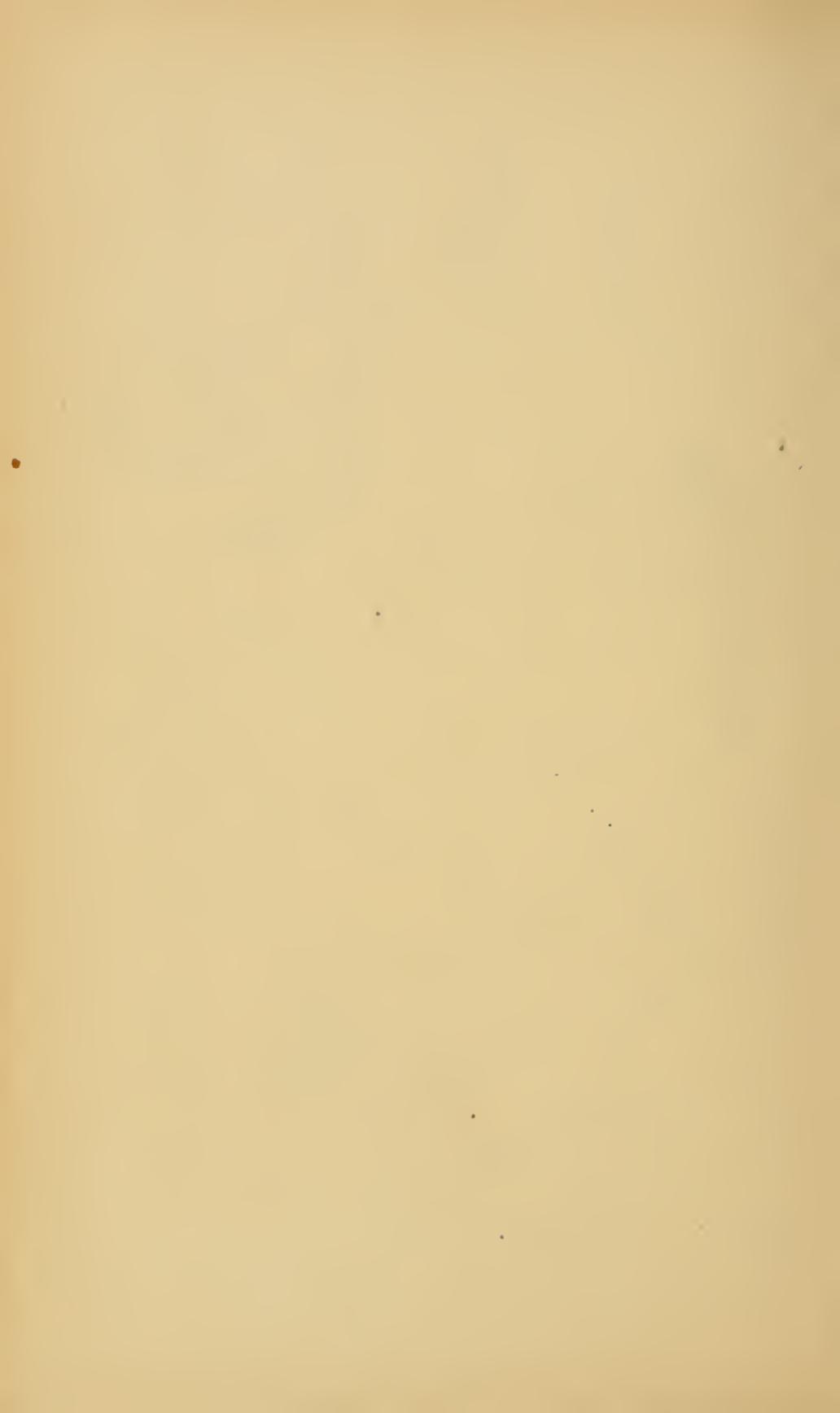
The author is greatly indebted to Professor S. F. Baird, U. S. Commissioner of Fish and Fisheries, for the use of a large number of the excellent drawings made by Mr. J. H. Emerton, of Salem, Mass., under the direction of the author, for the Fish Commission, many of which are included in these plates.

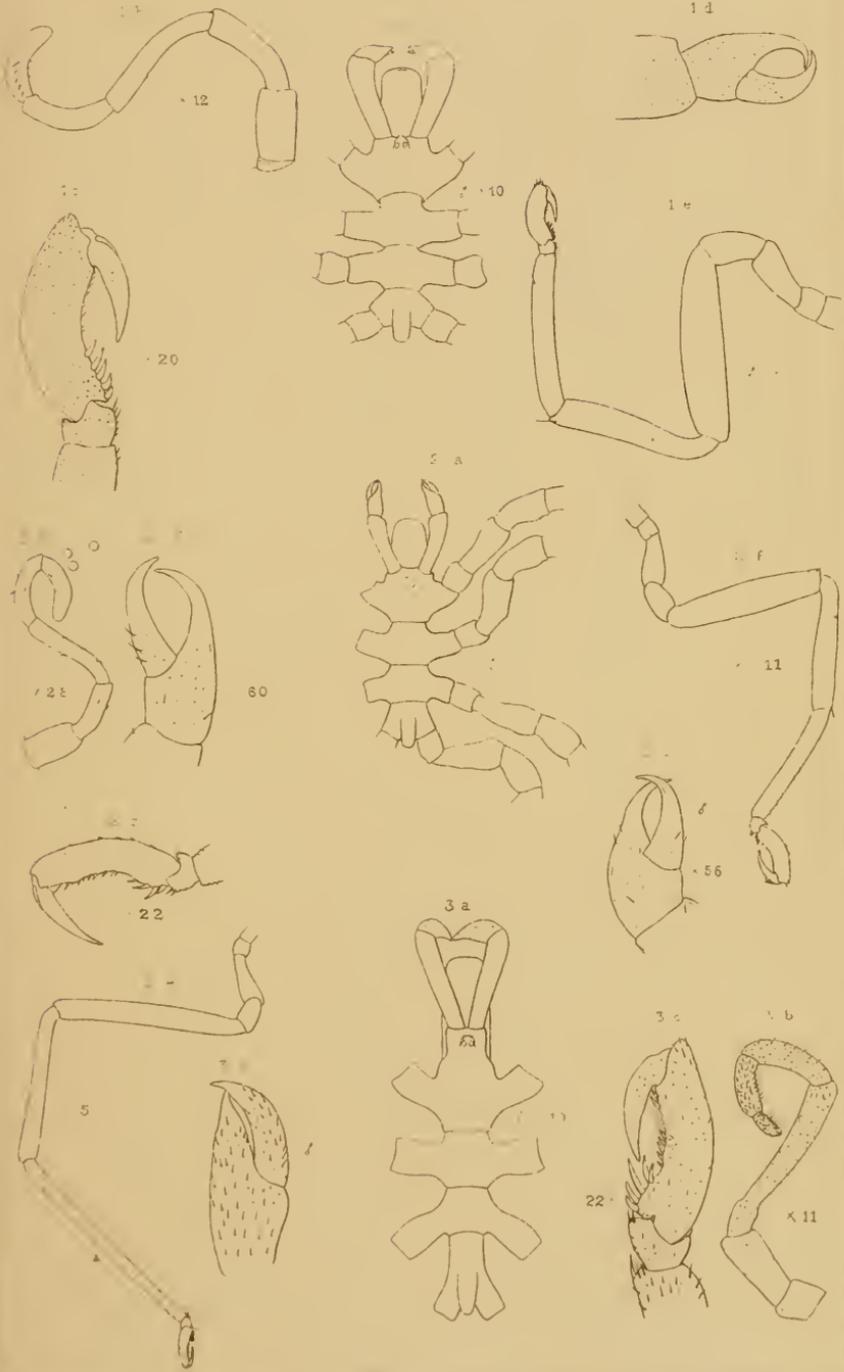


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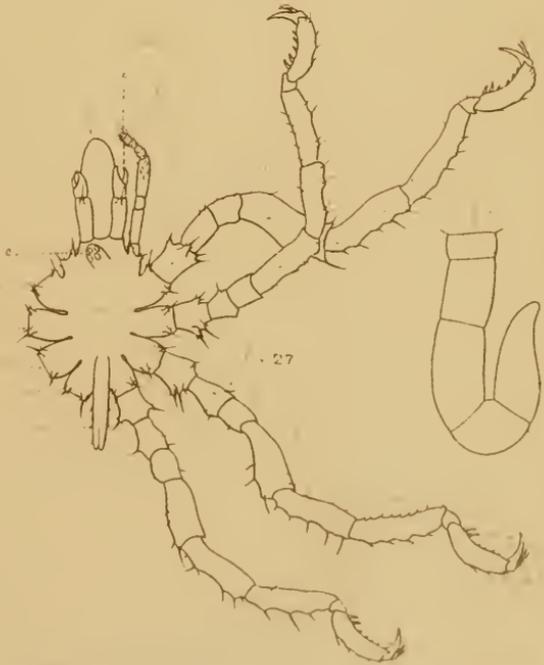
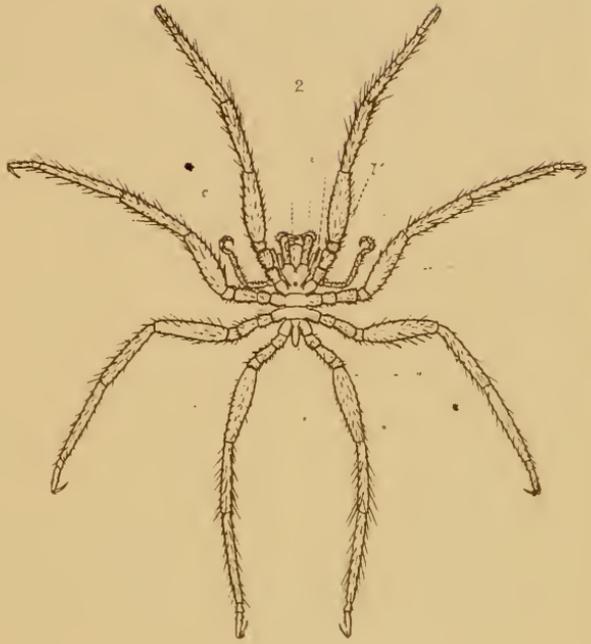
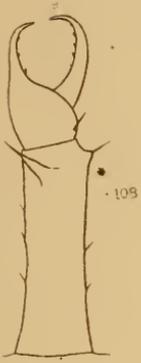




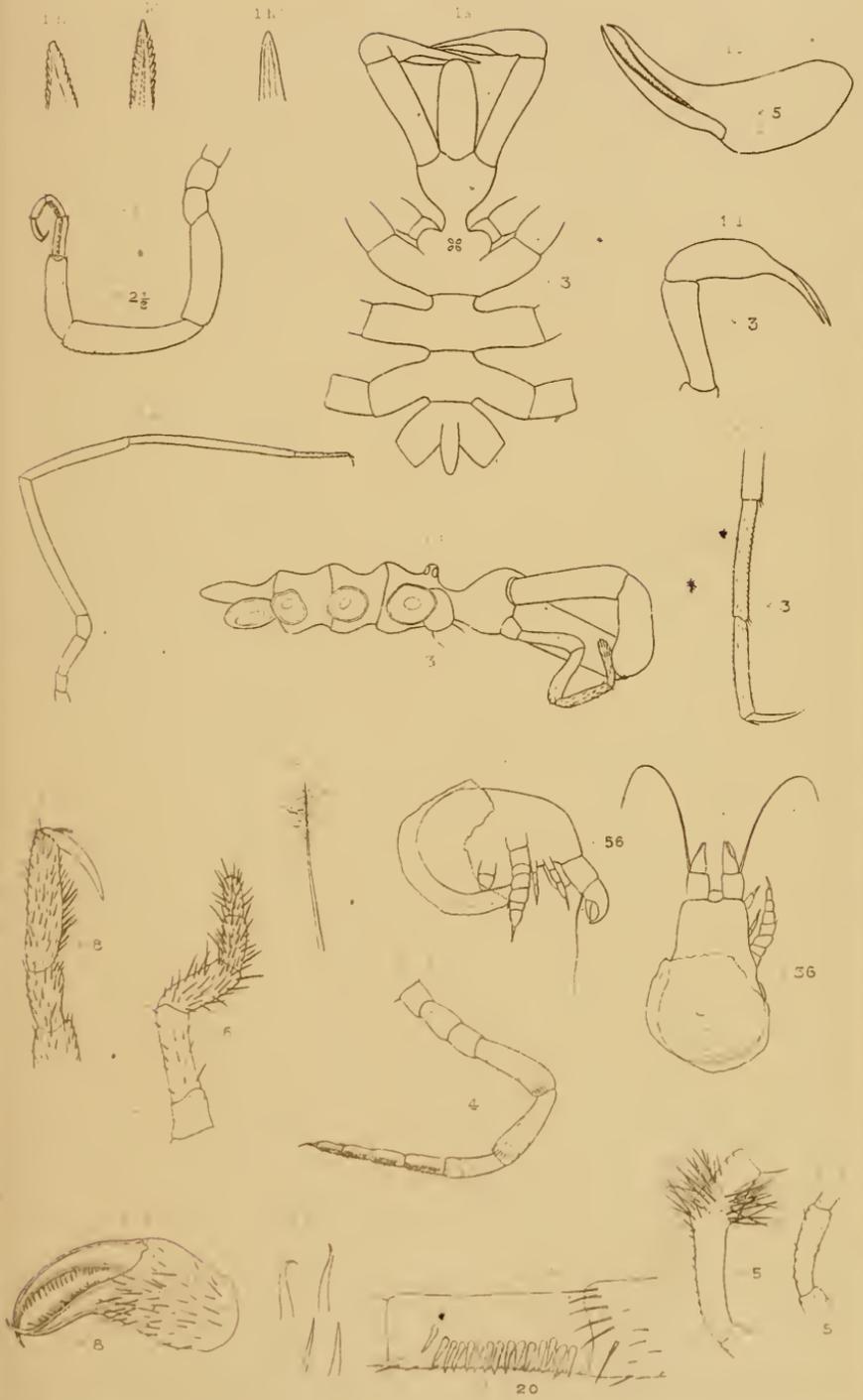


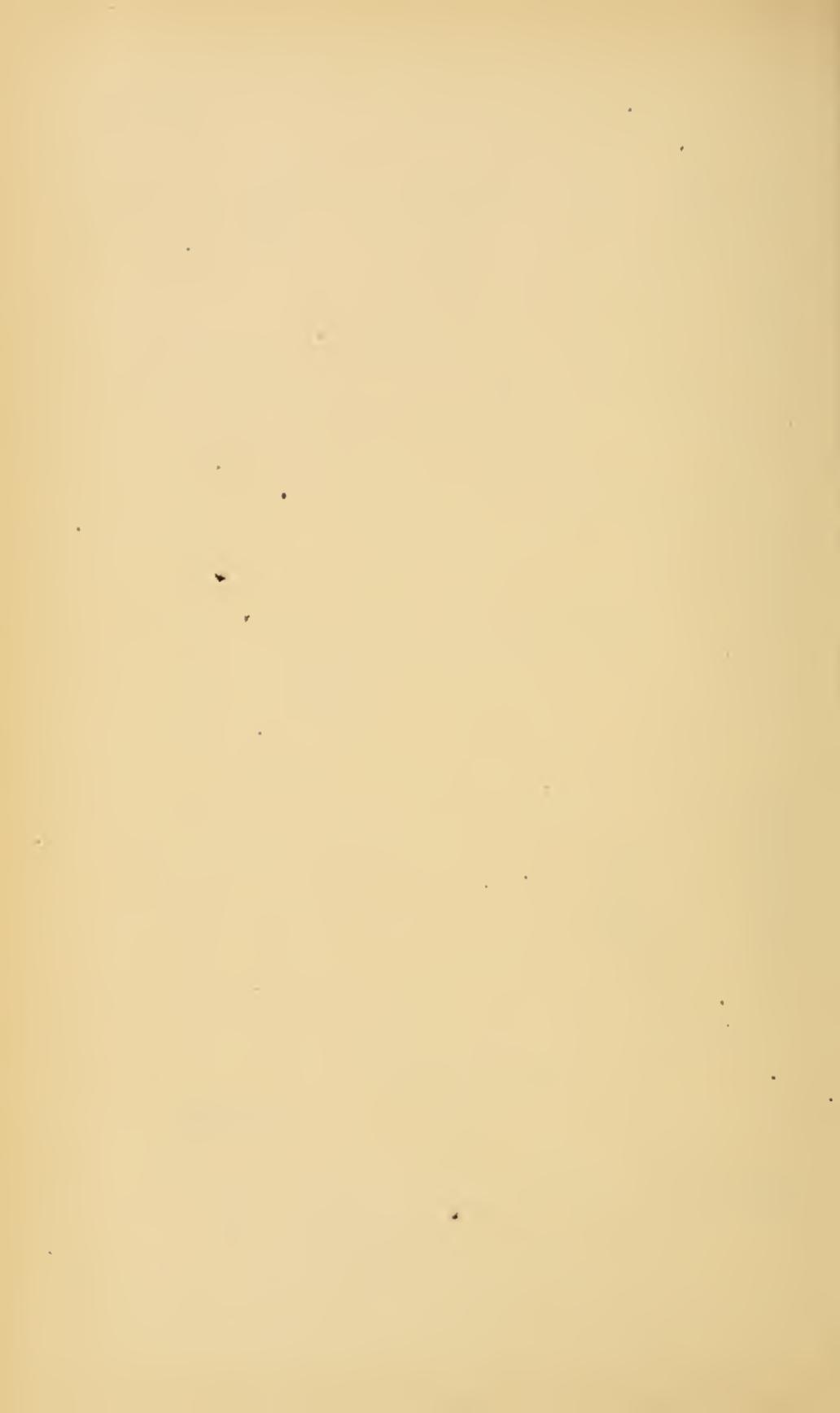


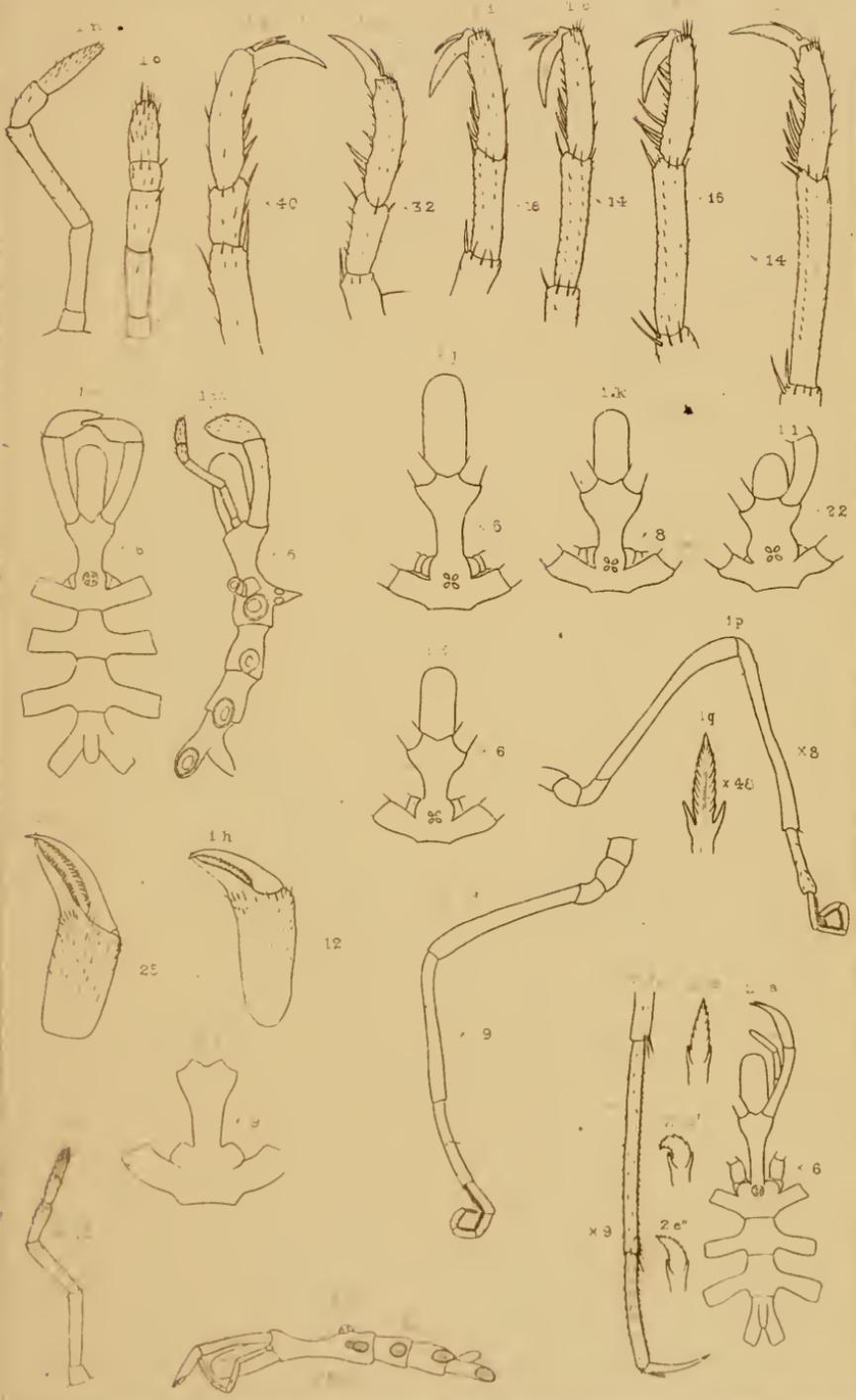




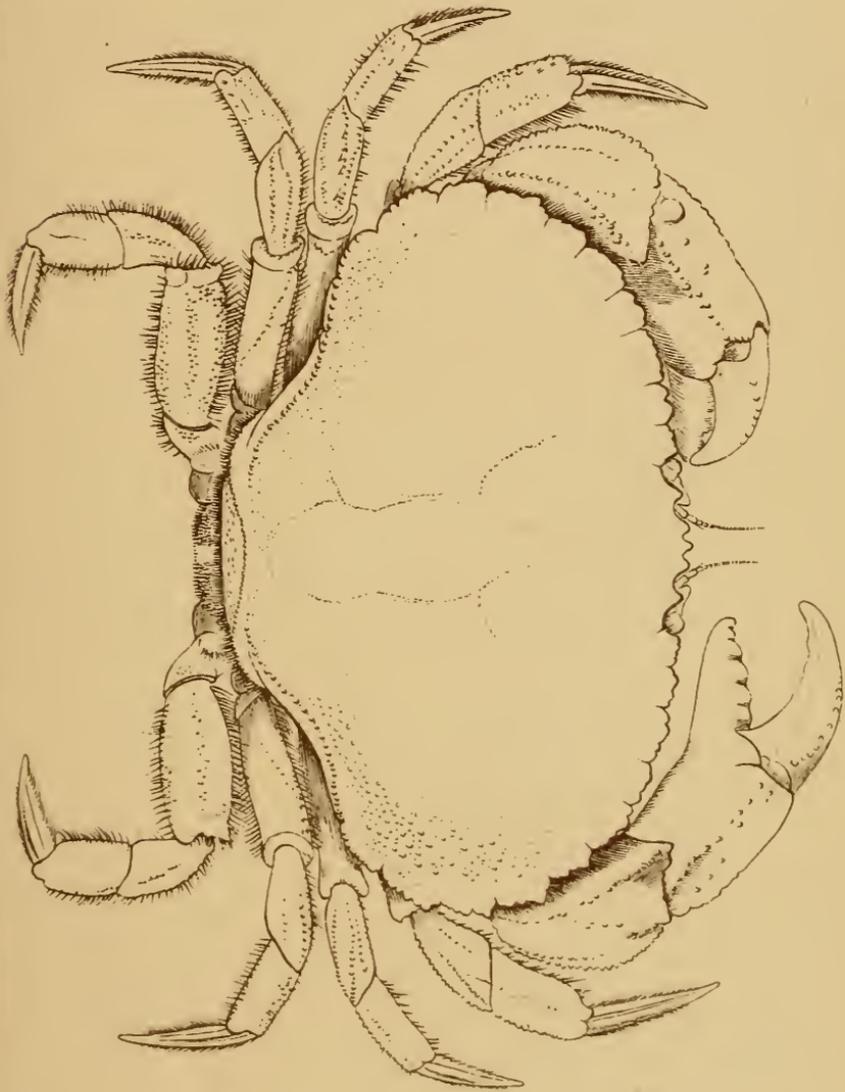


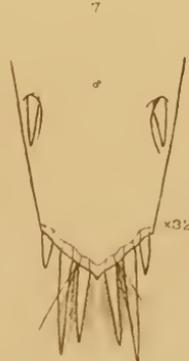
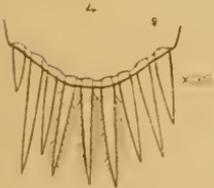
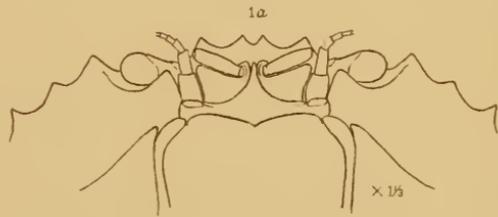
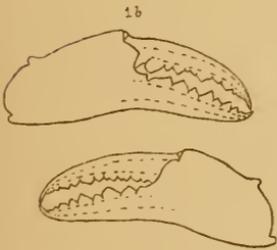
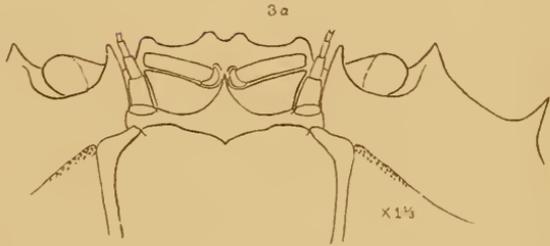
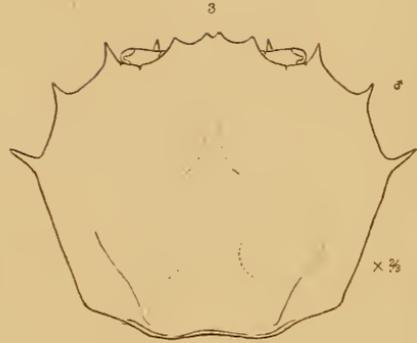
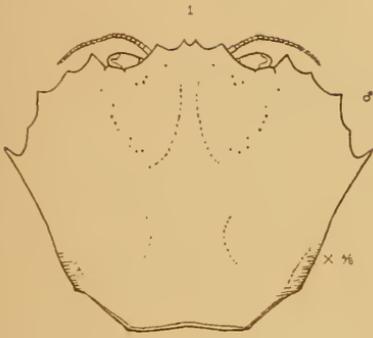


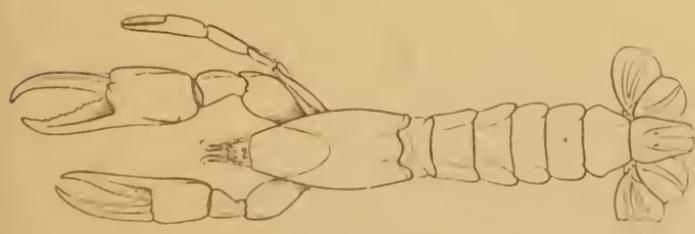
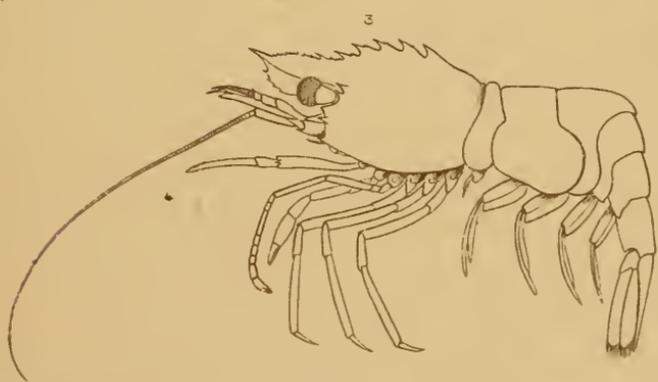
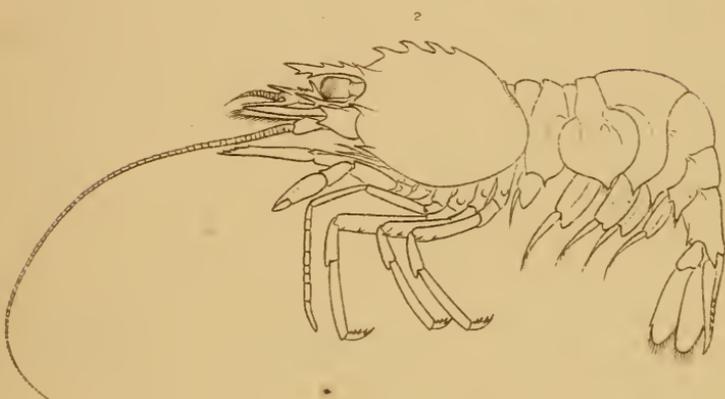
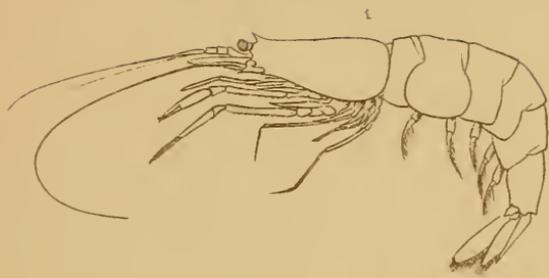


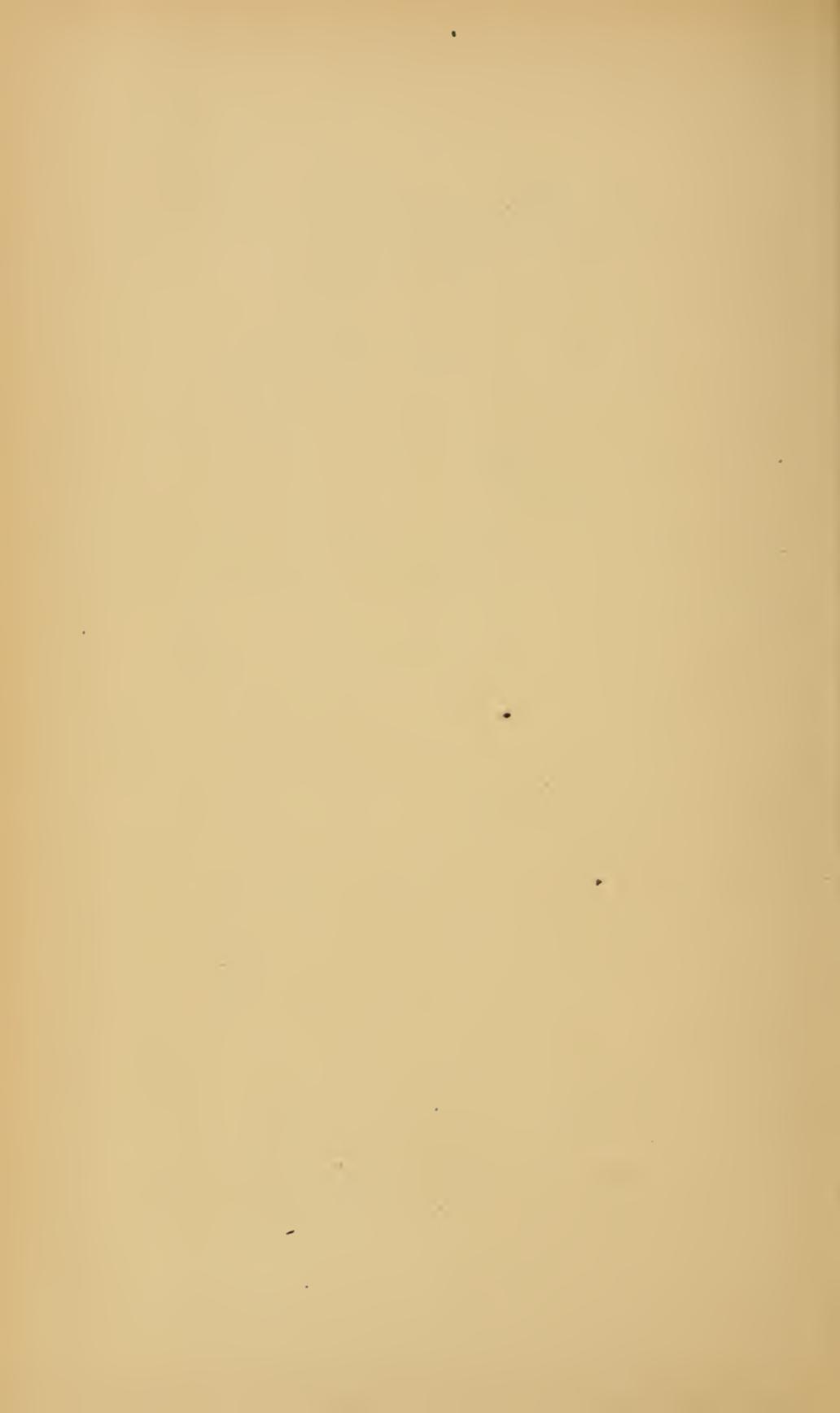


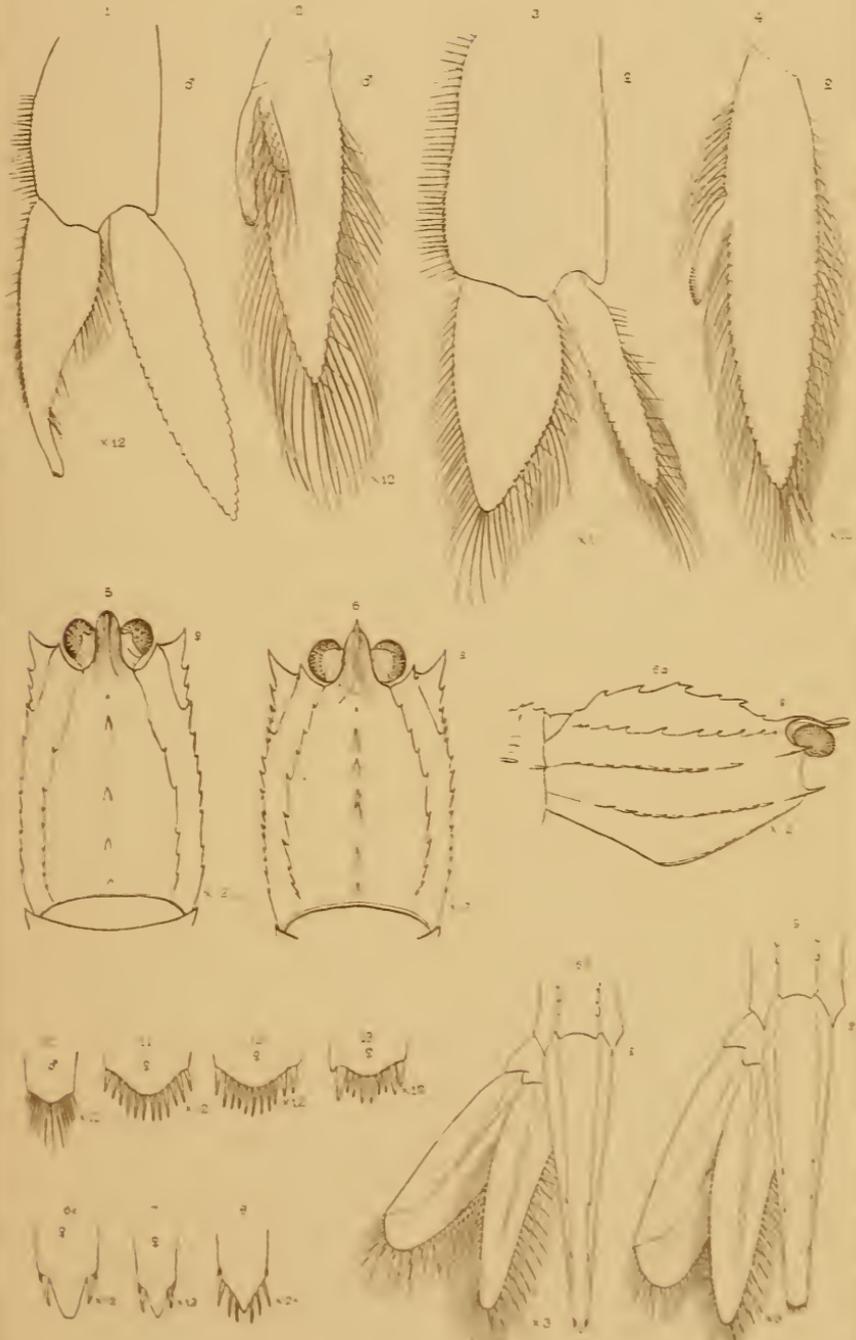
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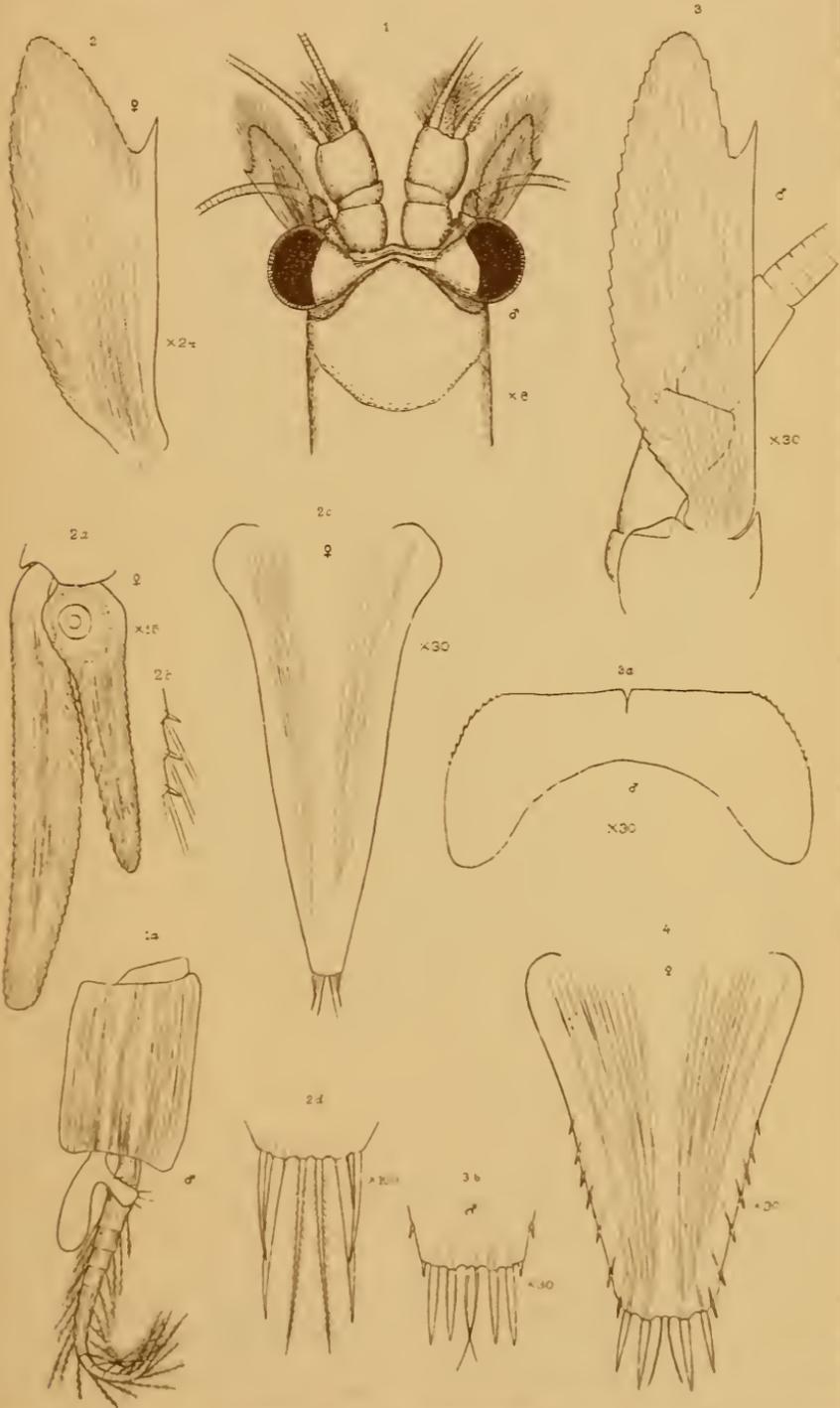


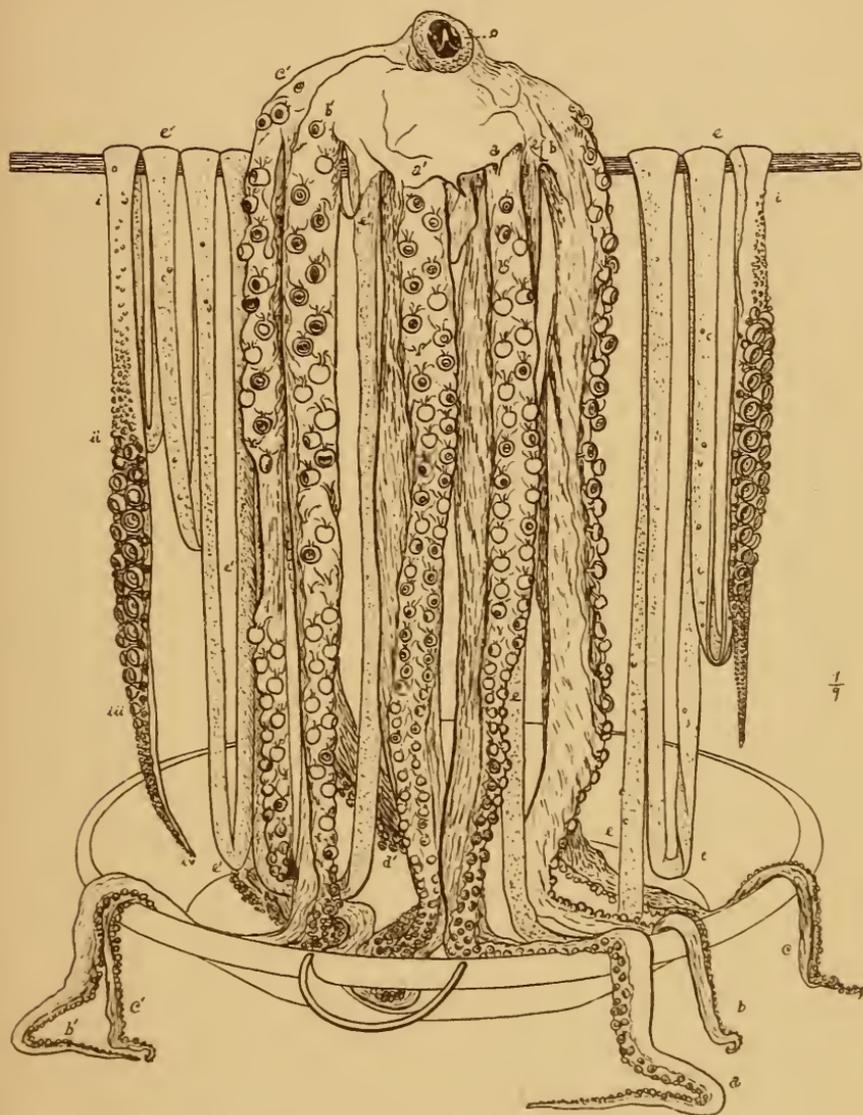




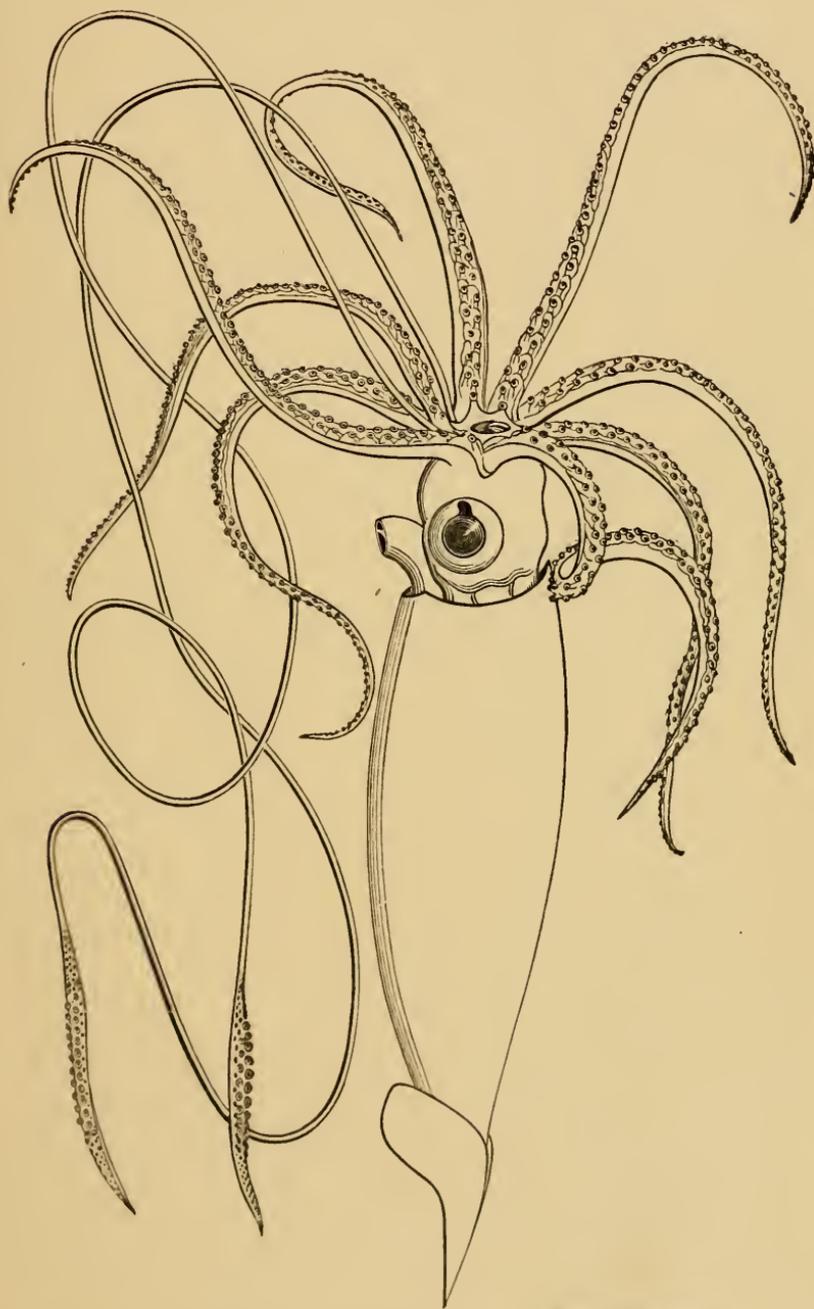






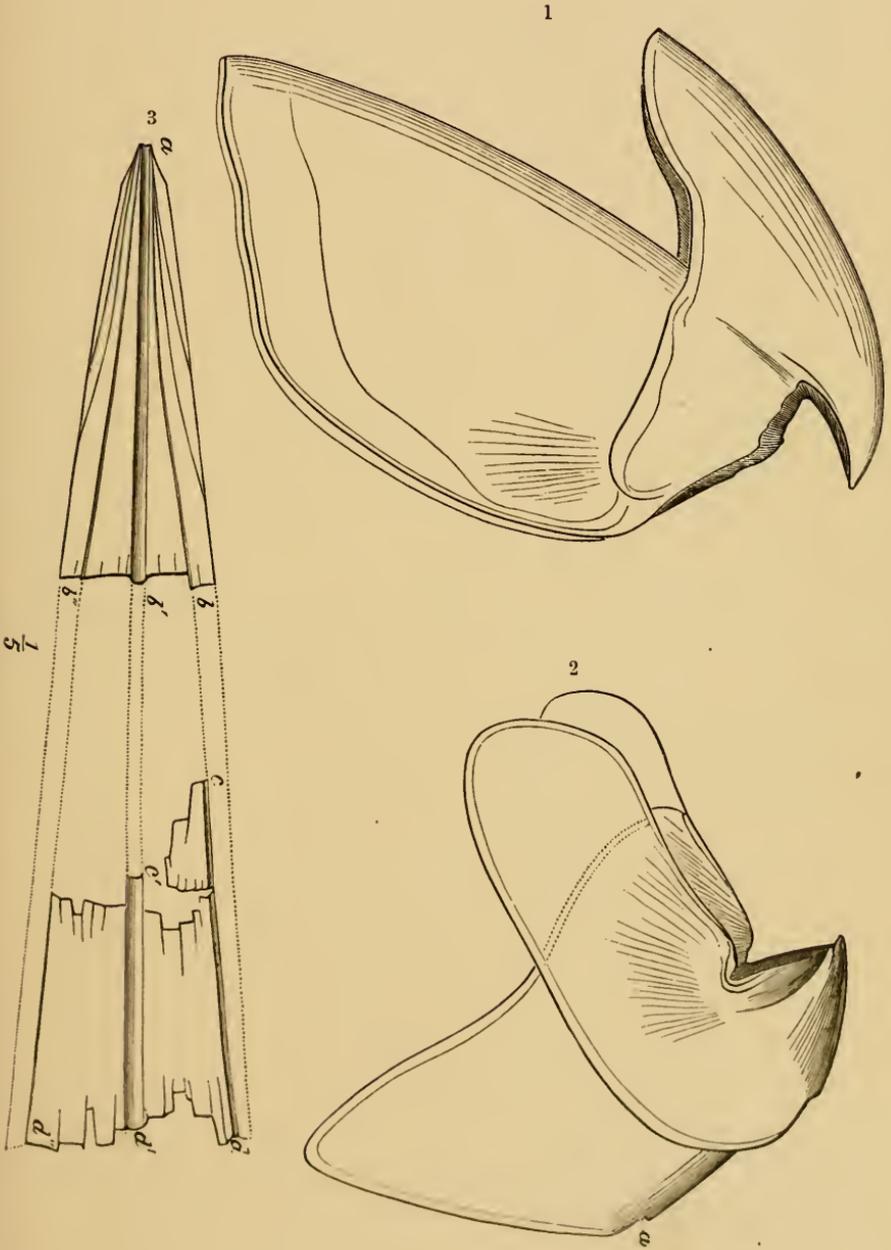


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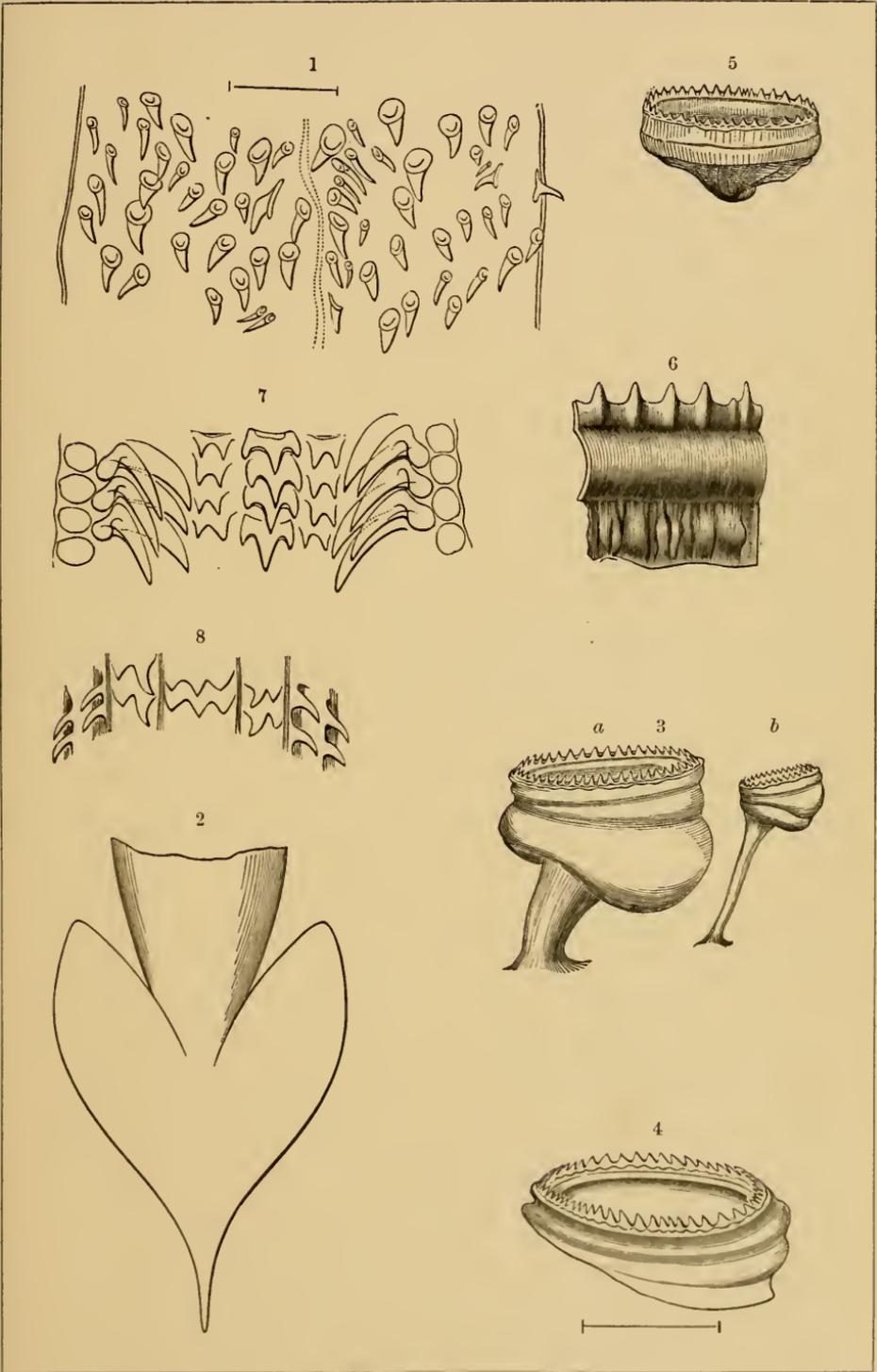


$\frac{1}{2}$ natural size.

Architeuthis Harveyi.



Architeuthis Harveyi.



Architeuthis Harveyi, etc.

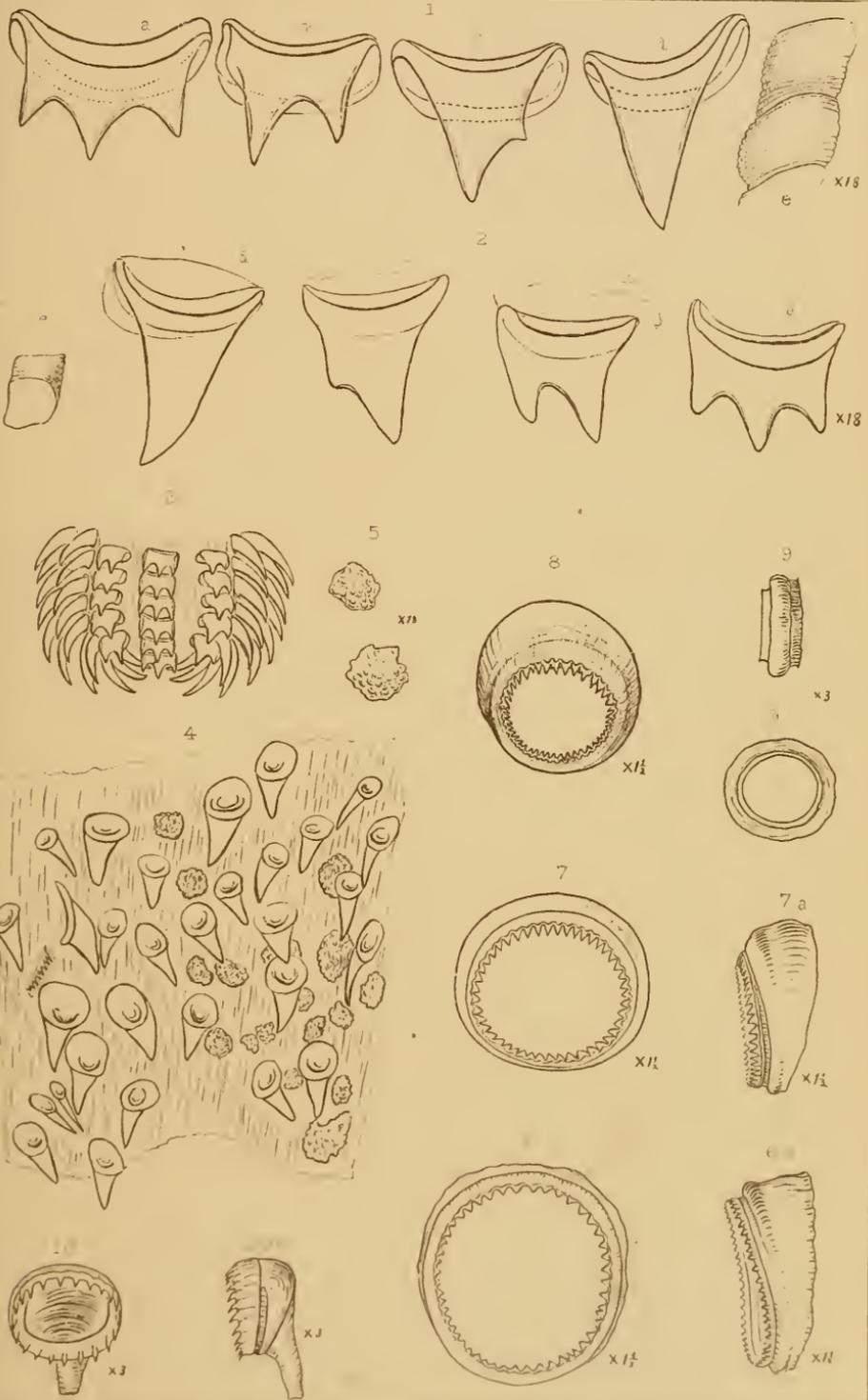
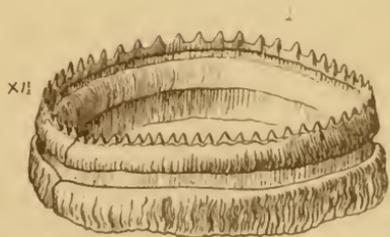
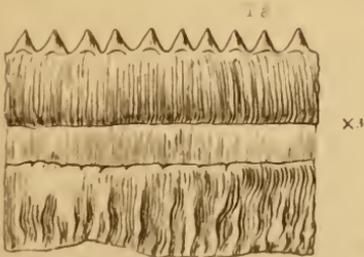
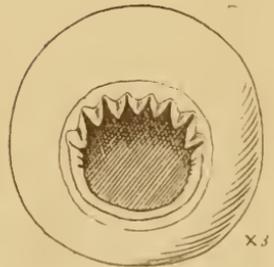
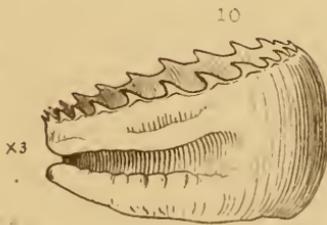
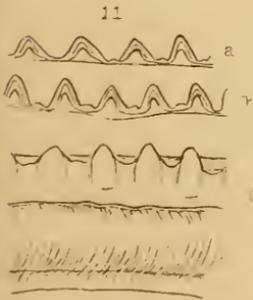
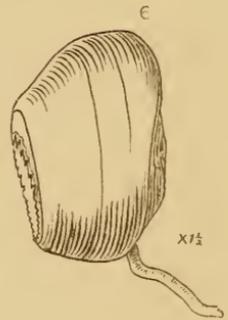
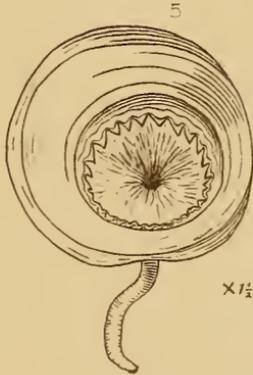
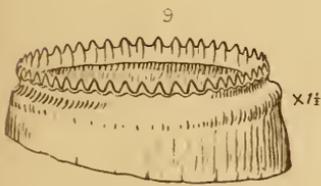
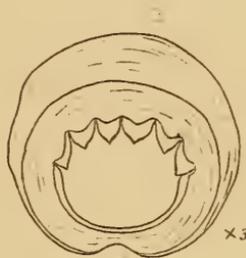
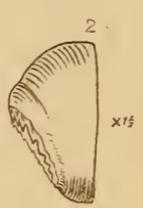
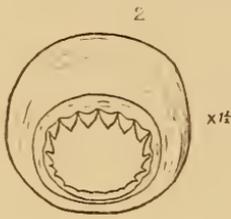


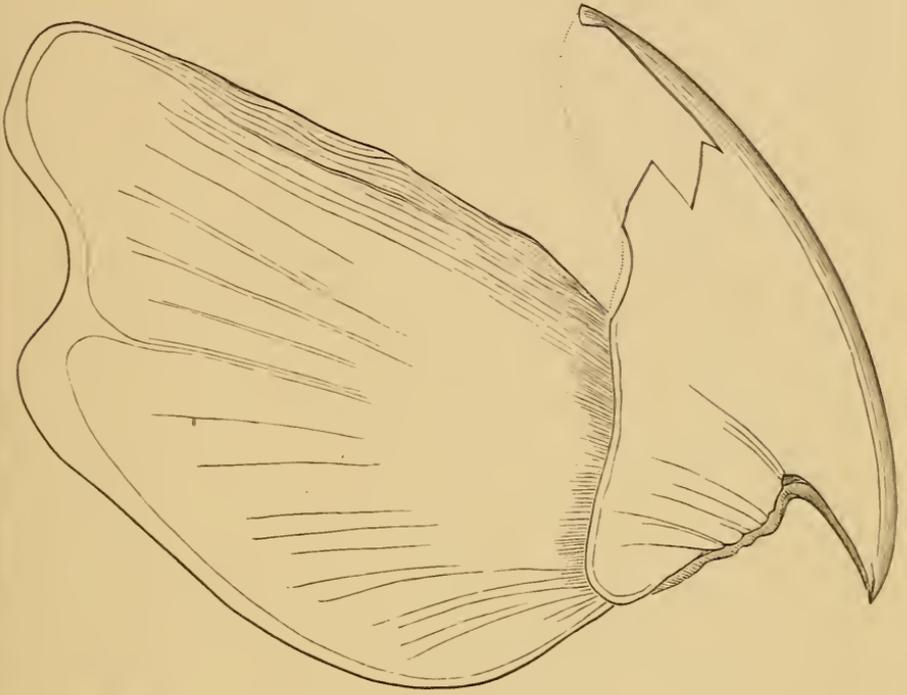
PLATE XVI^a *Amphiteuthis harveyi*

PLATE XVI^a *Amphiteuthis harveyi*

AMPHITEUTHIS HARVEYI WELLS.



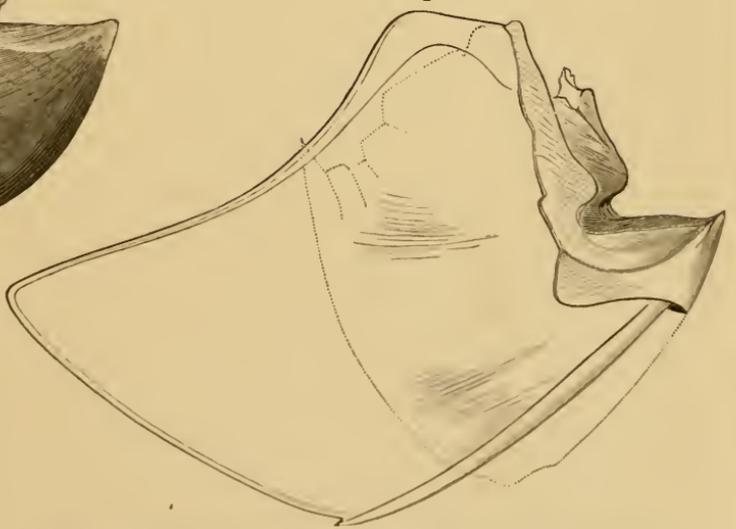
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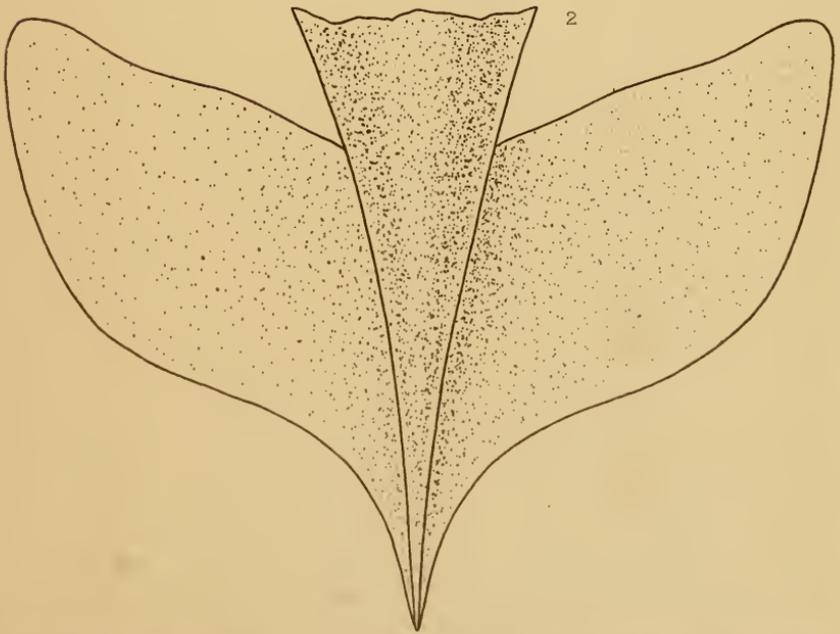
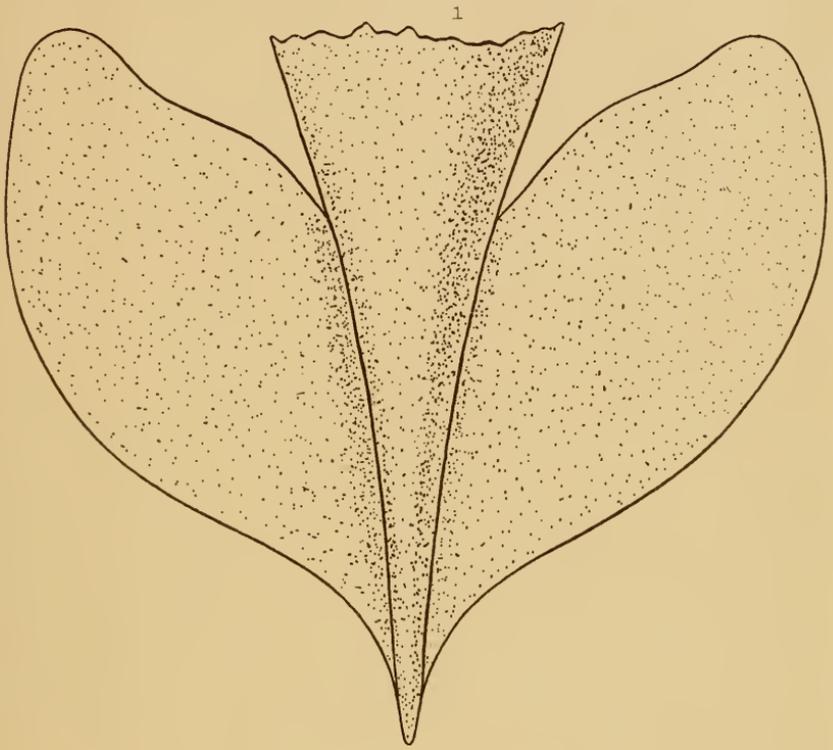
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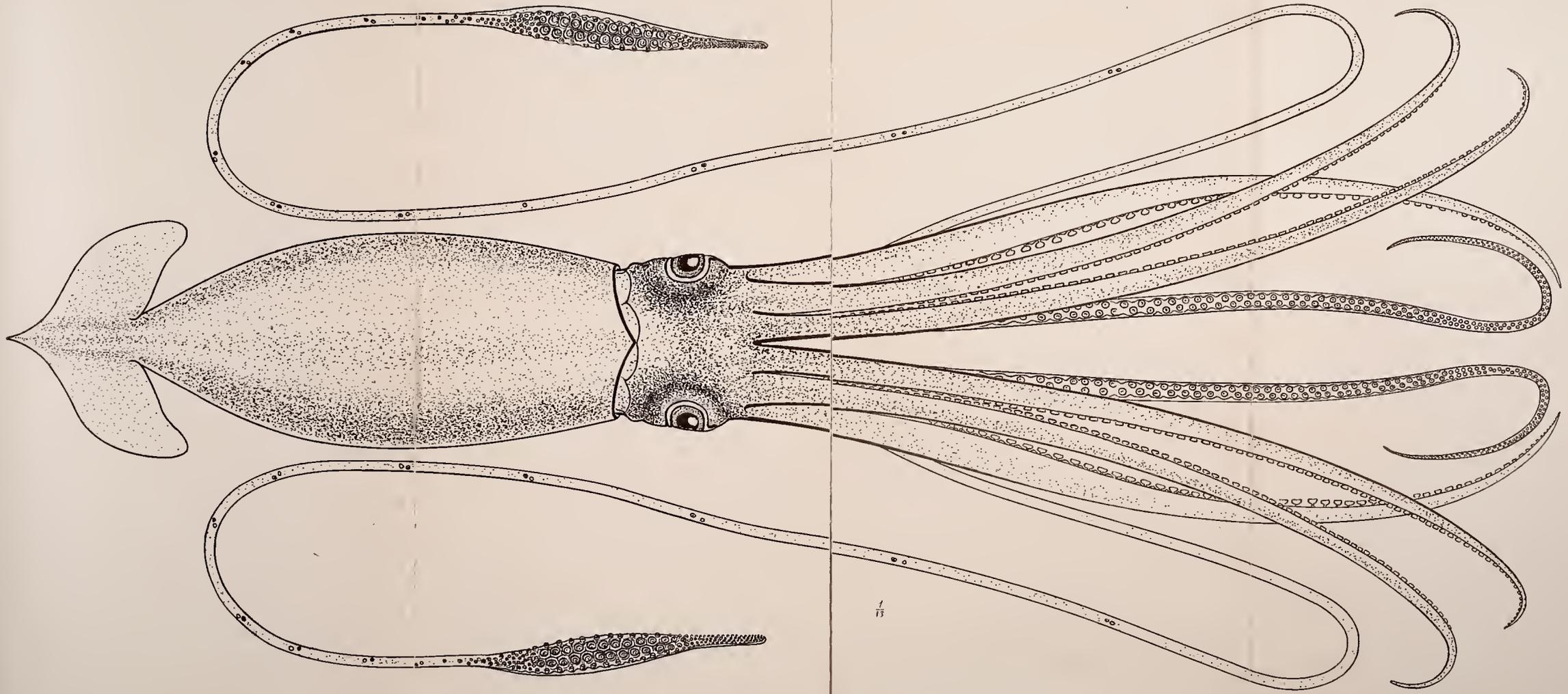
Architeuthis princeps.



A. E. Vertill & J. B. Holder from nature

Photo Lida Punderich & Grand New Haven, Ct.

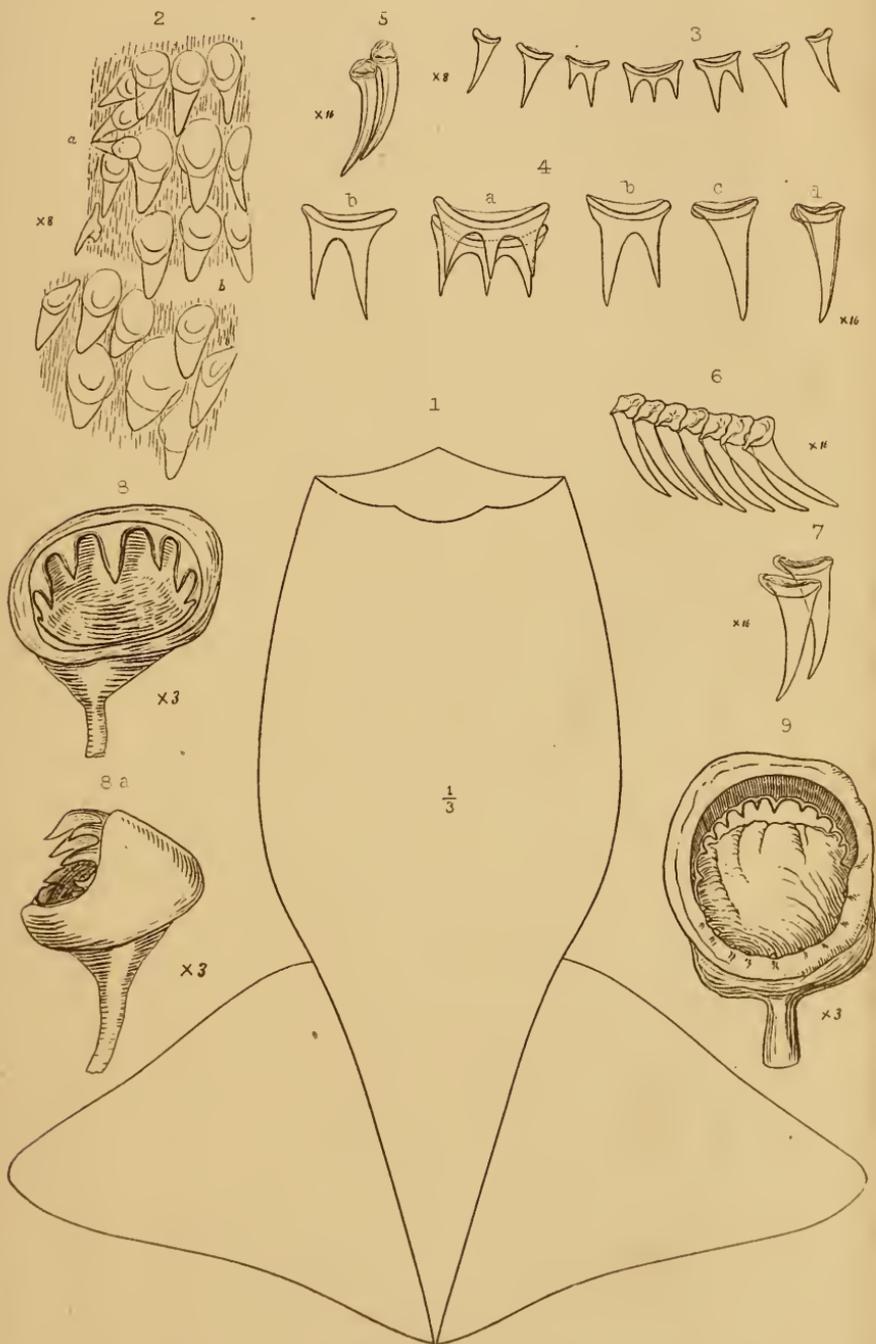
ARCHITEUTHIC FRINCRES VERKILL

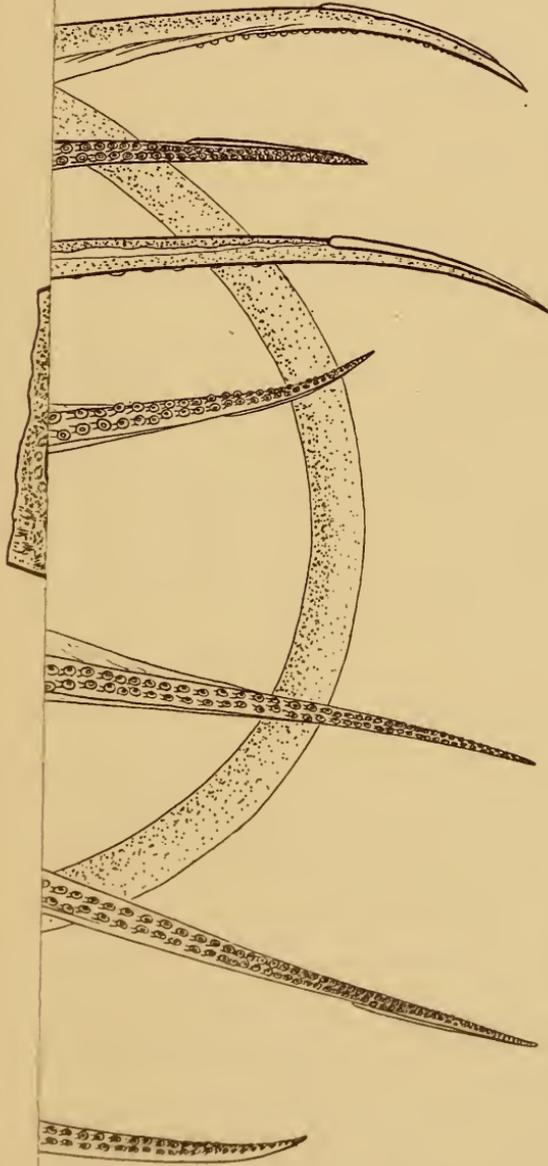


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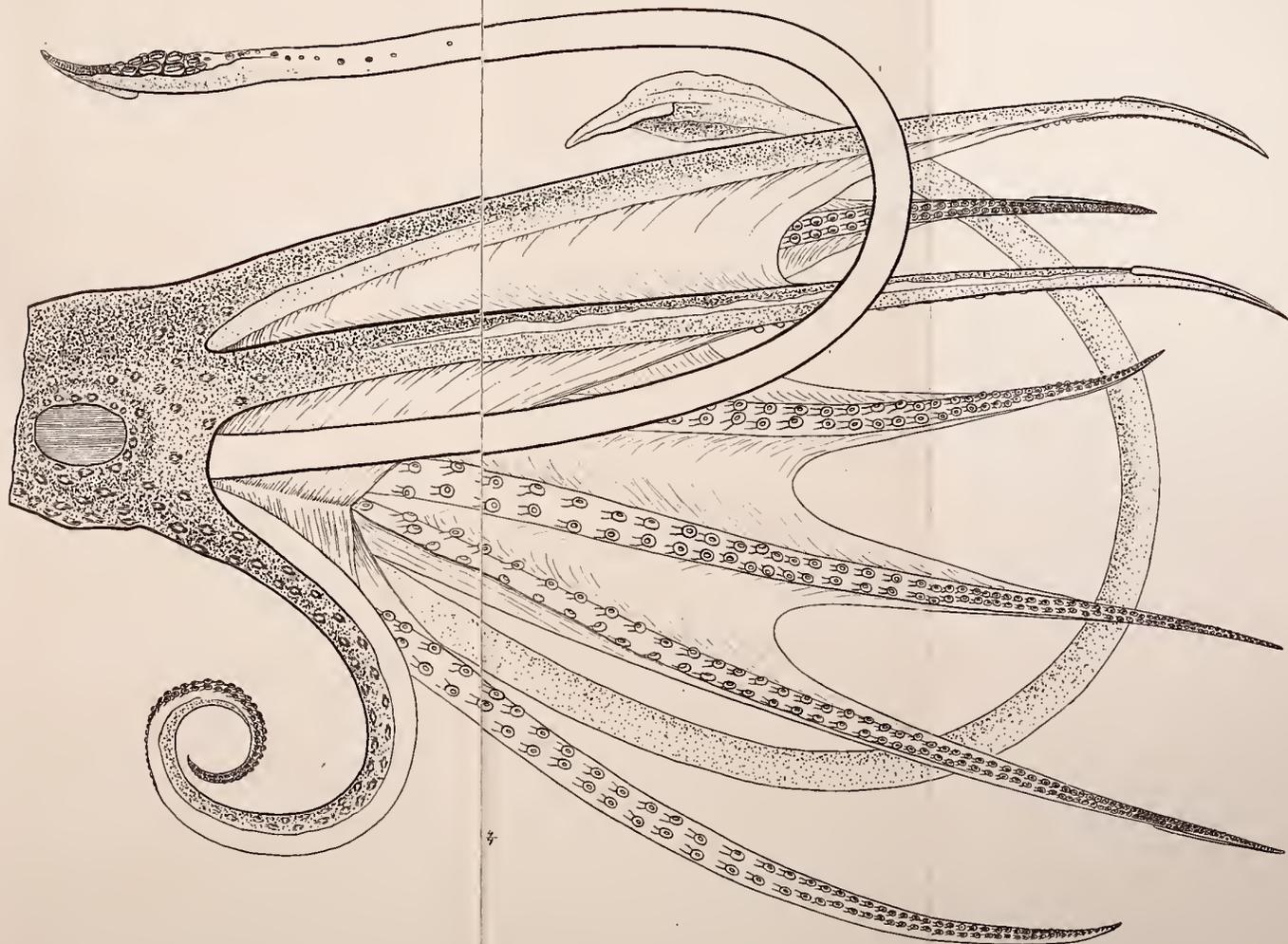
ARCHITEUTHIS PRINCEPS VERRILL

A. E. Verrill from nature.

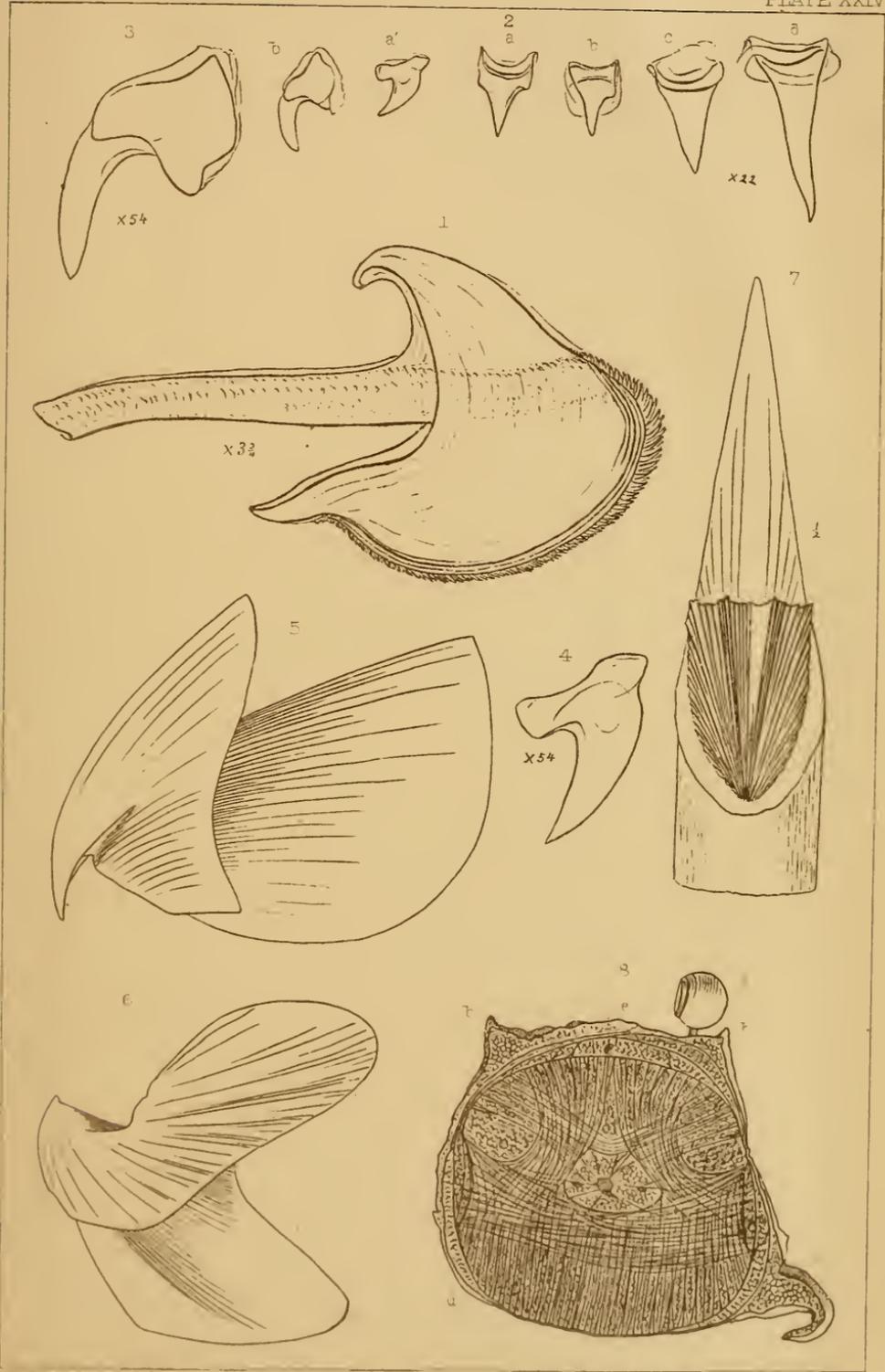




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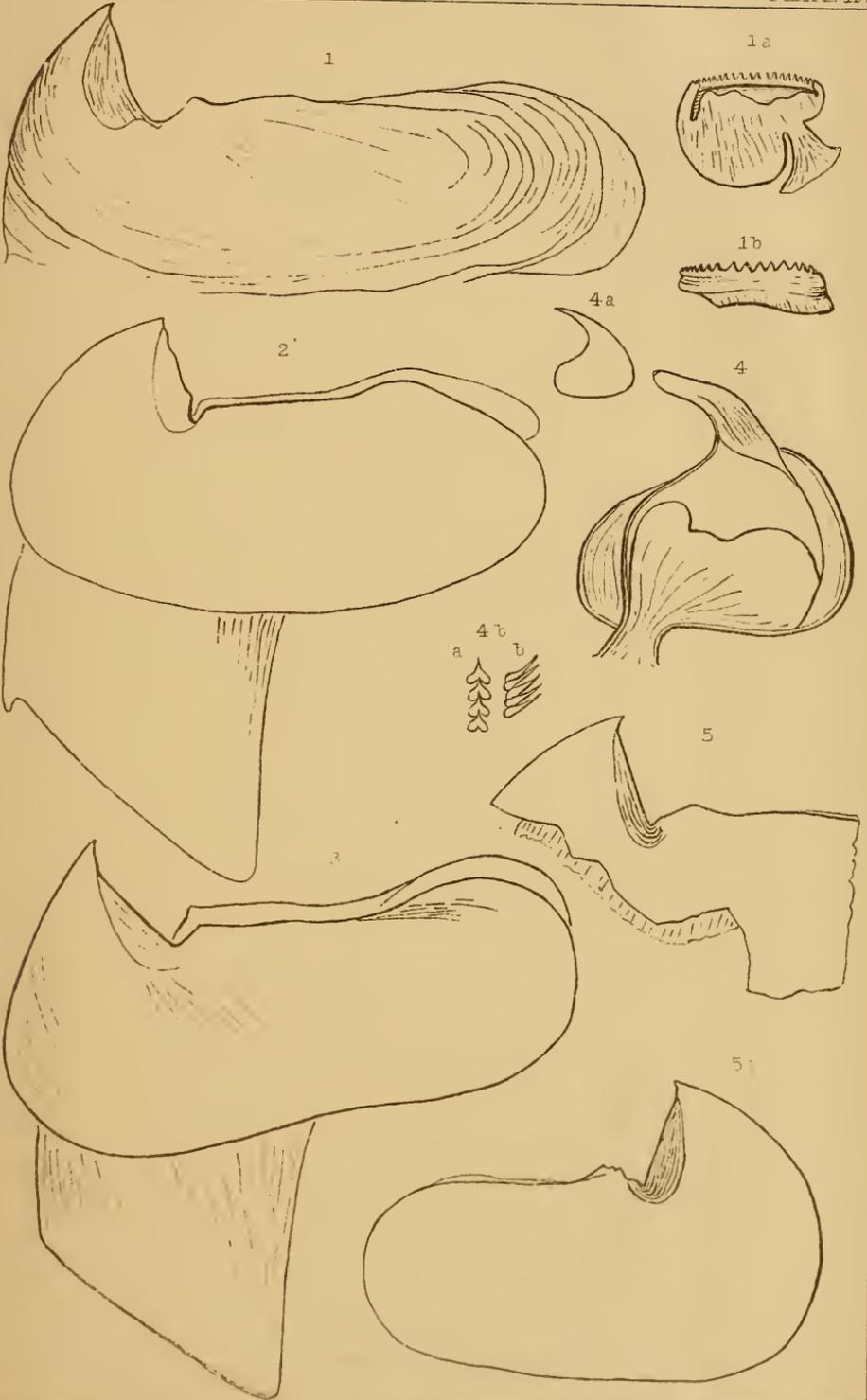
HISTIOTENTHIS COLLINSII VERRILL



1. *Myxotrichia* (H. Sowerb.) transverse

2. *Myxotrichia* (H. Sowerb.) transverse

MYXOTRICHIA (H. SOWERB.)



TRANSACTIONS
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VI. THE CEPHALOPODS OF THE NORTHEASTERN COAST OF AMERICA.
By A. E. VERRILL.

PART II. THE SMALLER CEPHALOPODS, INCLUDING THE "SQUIDS" AND
THE OCTOPI, WITH OTHER ALLIED FORMS.

BEFORE proceeding with the special subjects of this Part it seems desirable to describe in detail an important, though young and small, example of one of the gigantic species of *Architeuthis*, as a supplement to the first part of this article.

Description of a young example of Architeuthis Harveyi.

PLATES XXVI and XXXVIII.

This specimen, which I have designated as No. 24, was received subsequent to the publication of the previous part of this article. It was found, dead and mutilated, floating at the surface, at the Grand Bank of Newfoundland, April, 1880, by Capt. O. A. Whitten and crew of the schooner "Wm. H. Oakes," and by them it was well preserved and presented to the U. S. Commission of Fish and Fisheries. It is of great interest because it furnishes the means of completing the description of parts that were lacking or badly preserved in the larger specimens, especially the sessile arms and the buccal membranes.

The specimen consists of a part of the head with all the arms attached, and with the suckers in a good state of preservation on all the arms, though the tips of all the short arms, except one, are destroyed, and all of the arms are more or less injured on their outer surfaces. The jaws and buccal membranes are intact, with the odontophore and œsophagus. Parts of the cartilaginous skull, with some of the ganglia and the collapsed eyes are present, but the external surface of the head is gone and the eyelids are badly mutilated. No part of the body was preserved. The tentacular-arms are in good preservation, with all the suckers present. Unfortunately the distal portions of both the ventral arms had been destroyed, so that the sex cannot be determined. The color of the head, so far as preserved, and of the external surfaces of the sessile arms is much like that of the common squids,—a rather dark purplish brown, due to minute crowded specks of that color, thickly distributed, with a pink-

ish white ground-color between them. The outer buccal membrane is darker; the inner surfaces of the arms are whitish; the peduncular portions of the tentacular arms have fewer color-specks, and are paler than the other arms.

Reproduction of lost parts.

This creature had been badly mutilated long before its death, as its healed wounds show, and to this fact many of the imperfections of the specimen are due. At the time of its death, or subsequently, the extremities of the ventral arms and of the third right arm appear to have been destroyed, besides other injuries. But both the dorsal arms and both the lateral arms of the left side had previously been truncated at 12 to 13 inches from their bases. The ends had not only healed up entirely, but each one had apparently commenced to reproduce the lost portion. The reproduced part consists, in each case, of an elongated, acute, soft papilla, arising from the otherwise obtuse end of the arm. At its base one or two small suckers have already been reproduced, and minute rudiments of others can be detected on some of them. Whether these arms would have been perfectly restored in course of time is, perhaps, doubtful,* but there can be no doubt that a partial restoration would, at least, have been effected. On the basal half of several of the arms some of the suckers had also been previously lost, and these were all in the process of restoration. The restored suckers were mostly less than one half the diameter of those adjacent, and in some cases less than one-third. Among the restored suckers were some malformations. One has a double aperture, with a double horny rim. In one case two small suckers, with pedicels in close contact, occupy the place of a single sucker. In another instance a small pedicelled sucker arises from the pedicel of a larger one, near its base.

The arms and suckers.

With the exception of the left arm of the second pair, none of the sessile arms have their tips perfect. Therefore it is not possible to give their relative lengths. The dorsal arms are the smallest at base and the third pair largest. They are all provided with a rather narrow marginal membrane along each border of the front side. These membranes are scarcely wide enough to reach to the level of the rims of the suckers, though they may have done so in life. The front margin, bearing the suckers is narrow on all the arms, but relatively

* That mutilations of the arms in species of *Octopus* are regularly restored is well-known, but it has been doubted whether this occurs in the ten-armed forms.

wider on the ventrals than on any of the others. Each sucker-pedicle arises from a muscular cushion, that is slightly raised and rounded on the inner side; these, alternating on the two sides, leave a zigzag depression along the middle of the arm; from each of these cushions two thickened muscular ridges run outward to the edge of the lateral membranes, one on each side of the pedicels of the suckers. These transverse muscular ridges give a scalloped outline to the margin of the membranes. These marginal membranes are narrowest and the suckers are smallest on the ventral arms. The dorsal and lateral arms are strongly compressed laterally, but slightly swollen or convex in the middle, and narrowed externally to a carina, which is most prominent along the middle of the arms, and most conspicuous on the third pair of arms. The dorsal arms are rather more slender than the second pair, and were probably somewhat shorter.

The left arm of the second pair has the tip preserved, with all its suckers present. On this arm there are 330 suckers, in all. The total length of the arm is 26.25 inches. The first 50 suckers extend to 12.25 inches from the base; the next 50 occupy 4.5 inches; the next 50 cover 3.5; the next 100 occupy 4.25 inches; the last 80 occupy 1.75 inches. This arm is .80 of an inch in transverse diameter, near the base; 1.20 inches from front to back; breadth of its front or sucker-bearing surface (without the lateral membranes), is, where widest, near the base of the arm, .50 of an inch; the width gradually decreases, to .18 of an inch at 20 inches from the base; beyond this the arm tapers to a very slender tip, with numerous small crowded suckers in two regular rows. At the base (Plate XXVI, fig. 4) there is first one very small sucker; this is succeeded by two or three much larger ones, increasing a little in size; beyond these are the largest suckers, extending to about the 25th, beyond which they gradually change their form and regularly diminish in size to the tips. The larger proximal suckers, up to the 25th to 30th, are relatively broader than those beyond, and have a wider and more open aperture, and a more even and less oblique horny ring, which is sharply denticulate around the entire circumference, with the denticles rather smaller on the inner than on the outer margin, but similar in form. These are about .31 of an inch in external diameter. They show a gradual transition to those with more oblique rims and smaller apertures. Beyond the 30th, the horny rims become decidedly more oblique and one-sided, with the denticles nearly or quite abortive on the inner side, and larger and more incurved on the outer margin, while the aperture becomes more contracted and oblique.

At first there are 8 to 10 denticles on the outer margin, but these diminish in number as the suckers diminish in size, till at about 6 inches from the tip there are mostly but two or three, and the aperture is very contracted. Still nearer the tip there are but two, blunt ones; then these become reduced to a single bilobed one; and finally only one, which is squarish, appears in the minute suckers of the last two inches of the tip. The first two or three suckers at the base of the arm are more feebly denticulated than those beyond, with smaller apertures.

On many of the suckers (Plate XXXVIII, fig. 3) there are still remaining, in more or less complete preservation, a circle of minute horny plates arranged radially, or transversely, on the edge of the membrane around the aperture, similar in arrangement to those already described in the former part of this article (p. 230) on the suckers of *Sthenoteuthis pteropus* (Plate XXXVI, fig. 9). They are less developed, however, than in that species, being thinner and more delicate, nor do their ends appear to turn up in the form of hooks. They seem to be generally very thin, oblong, scale-like structures, with rounded or blunt ends and slightly thickened margins. These structures will probably be found to vary with age, and perhaps with the season. They appear to be easily desiduous, and are often absent in preserved specimens.

On the dorsal and third pairs of arms the suckers have essentially the same arrangement, form and structure, and on these three pairs of arms the larger suckers differ but slightly in size. The character and arrangement of the suckers on the distal portion of these arms is well shown on Plate XXVI, figs. 3, 3a, which represent a portion of one of the third pair of arms, commencing at the 67th sucker.

The ventral arms are trapezoidal in section, at base, and rather stout. Breadth of front surface, near the base, exclusive of membranes, .55; transverse diameter, .95; front to back, 1.25 inches. The sucker-bearing surface is, therefore, broader than in the other arms. The suckers are, however, distinctly smaller and the proximal ones are different in form from the corresponding ones on the other arms. They are narrower and deeper, with more oblique and more contracted apertures, more oblique horny rims, which are denticulated on the outer margins only. On the larger ones there are 12 to 15 sharp incurved denticles. In fact, the proximal suckers on the ventral arms agree better with the middle suckers, beyond the 30th, on the other arms, for there are none having wide open apertures, surrounded by nearly even horny rims, denticulated all around. The

Young *Architeuthis Harveyi*. Measurements of arms (in inches).

		Near base.	At 5 in.	At 10 in.	At 15 in.	At 20 in.
<i>Dorsal pair.</i>						
Breadth of front, excluding membranes,	--	.35	.50	.30	--	--
Breadth of lateral membranes,	--	.20	.30	.20	--	--
Diameter, transversely,	--	.75	.60	.40	--	--
Diameter from front to back,	--	1.05	.90	.70	--	--
<i>Second pair.</i>						
Total length,	26.25	--	--	--	--	--
Breadth of front,	--	.40	.50	.35	.22	.18
Breadth of membranes,	--	.25	.30	.15	--	--
Diameter, transversely,	--	.80	.65	.35	.30	.16
Diameter, front to back,	--	1.20	1.20	.85	.60	.40
<i>Third pair.</i>						
Breadth of front,	--	.50	.50	.40	--	--
Breadth of membranes,	--	.20	.25	.15	--	--
Diameter, transversely,	--	1.10	.70	.40	--	--
Diameter, front to back,	--	1.08	1.60	1.20	--	--
<i>Fourth pair.</i>						
Breadth of front,	--	.40	.55	.30	--	--
Breadth of membranes,	--	.20	.25	.10	--	--
Diameter, transversely,	--	.98	.90	--	--	--
Diameter, front to back,	--	1.40	1.12	--	--	--
<i>Tentacular-arms.</i>						
Total length,	67.	--	--	--	--	--
Base to expansion of club,	58.75	--	--	--	--	--
Diameter of slender portion,	4.6	--	--	--	--	--
Length of club,	8.25	--	--	--	--	--
Length of part occupied by 24 largest suckers, ..	4.25	--	--	--	--	--
Length of part occupied by small distal suckers, ..	2.60	--	--	--	--	--
Greatest breadth of club, .....	.70	--	--	--	--	--
Diameter, front to back, .....	.60	--	--	--	--	--

Sessile arms, from base to particular suckers.

	To 25th.	To 50th.	To 100th.	To 150th.	To 200th.	To 250th.	To 300th.	To tip.
Dorsal pair, base to suckers,	7.5	12.25	--	--	--	--	--	--
Second pair, base to suckers,	7.75	12.25	16.75	20.25	22.90	24.50	25.75	26.25
Third pair, base to suckers,	7.25	12.25	--	--	--	--	--	--
Fourth pair, base to suckers,	6.25	10.	16.50	20.75	--	--	--	--

Measurements of suckers of sessile arms (in inches).

	15th.	30th.	50th.	100th.
On 1st pair of arms, external diameter, .....	.31	.24	.16	--
On 1st pair of arms, aperture diameter, .....	.25	.15	.10	--
On 2d pair of arms, external diameter, .....	.31	.27	.20	.15
On 2d pair of arms, aperture diameter, .....	.25	.18	.11	.08
On 3d pair of arms, external diameter, .....	.31	.28	.22	--
On 3d pair of arms, aperture diameter, .....	.22	.18	.12	--
On 4th pair of arms, external diameter, .....	.25	.21	.16	.14
On 4th pair of arms, aperture diameter, .....	.15	.11	.10	.07

suckers diminish regularly in size, and in the number of denticles, till at the 200th (where the arms are broken off) there are but three denticles.

Tentacular-arms.

PLATE XXVI, fig. 2.

The tentacular-arms are both entire, with all the suckers well preserved. The total length is 65 and 67 inches respectively; length of the expanded portion or club, 8.25 inches; diameter of the peduncular portion varies from .40 to .70 of an inch; at the base, .90; breadth of the proximal part of the club, where it is broadest, .70; diameter from front to back, .60; external diameter of the largest suckers, .35 of an inch; height of their cups, .28; of lateral suckers, .18; of the largest marginal suckers on the distal portion, .14.

The peduncular portion is somewhat thickened and rounded at the base, but through most of its length it is slender, varying in size, and nearly triangular in section, with the corners rounded, each side measuring, where largest, .60 of an inch in breadth. At about a foot from the base the small smooth-rimmed suckers and their opposing tubercles begin to appear on the inner surface. At first these are placed singly and at considerable intervals (2.5 to 3.5 inches), each sucker alternating with a tubercle on each arm; further out they are nearer together, and towards the club they alternate, two by two, on each arm; near the commencement of the club they become more numerous and are arranged somewhat in two rows; just at the commencement of the club they become more crowded, forming three and then four oblique transverse rows of suckers, with the same number of tubercles alongside of them; on the basal expansion of the club, which is its thickest portion, these suckers and tubercles become very numerous, covering nearly the whole inner surface, forming rather crowded and irregular oblique rows of six or more. These smooth-rimmed suckers are followed by an irregular group of about twenty, somewhat larger, denticulated suckers, occupying the entire breadth for a very short distance. Then follow the two median rows of large suckers, alternating with a row of marginal ones, of about half their size, on each side. The first three or four large suckers of each row gradually increase in size; then follow six to eight nearly equal ones of the largest size; these are followed by two to four distal ones, decreasing in size. In one of the rows there are fourteen that distinctly belong to the large series; in the other row there are twelve. The distal section of the club is occupied by

four regular rows of small denticulated suckers, more strongly toothed on the outer margins, and similar in form to the marginal suckers of the middle region. Of these the two rows next the upper (?) margin are decidedly larger than those of the two lower (?) rows. Close to the tip there is a group of about a dozen minute suckers, with smooth even rims. The middle portion of the club is bordered on each side by a rather broad, thin scalloped membrane. The distal section has a broad keel on the outer margin.

Suckers of tentacular-arms.

Diameter of largest,	·35
Height of largest,	·28
Diameter of lateral,	·18
Height of lateral,	·09
Diameter of smooth-rimmed ones,	·10
Diameter of tubercles,	·08
Of largest lateral ones of distal section,	·14
Of median lateral ones of distal section,	·11

Buccal membranes and jaws.

PLATE XXVI, fig. 7.

This specimen fortunately had the buccal membranes and other parts about the mouth perfectly preserved, which has not been the case in the large specimens. The outer buccal membrane is broad and thin, rather deeply colored externally. Its margin extends into seven acute angles—one of which is opposite each of the lateral and ventral arms, but on the dorsal side there is only one, which corresponds to the interval between the two dorsal arms. From each of these angles a membrane runs to, and for a short distance along the side of the opposite arm, except from the dorsal one, which sends off a membrane which divides, one part going to the inner lateral surface of each dorsal arm. The membranes from the upper lateral and ventral angles join the upper lateral sides of their corresponding arms; those from the lower lateral angles go to the lower lateral sides of the third pair of arms. The inner surface of the buccal membrane is whitish and deeply and irregularly reticulated by conspicuous, soft, wrinkles and furrows, which become somewhat concentric toward the margin. Beneath this membrane are openings to the aquiferous cavities. The inner buccal membrane, immediately surrounding the beak, is whitish, thickened at the margin, and strongly irregularly wrinkled and puckered.

The jaws have sharp, dark brown tips, changing to clear brown backward, with the laminae very thin, transparent, and whitish. The

upper mandible has the rostrum regularly curved, with a distinct ridge, in continuation with its inner edges, extending down the sides, and only a slight notch at its base.

The lower mandible has a notch close to the tip, with the rest of the inner edge nearly straight; at the base is a rather large and wide V-shaped notch; the tooth beyond it being broad-triangular and rather large; beyond the tooth the alæ are white, soft and cartilaginous.

Measurements of jaws (in inches).

Transverse diameter of buccal mass,	1.50
Vertical diameter of buccal mass,	1.70
<i>Upper Mandible:</i>	
Tip to end of frontal lamina,	1.25
Tip to notch, .....	.37
Tip to lateral border of lamina, .....	.77
<i>Lower Mandible:</i>	
Tip to border of mentum, .....	.45
Tip to lateral border of alæ, .....	.70
Tip to inner end of alæ,	1.02
Tip to bottom of notch, .....	.32
Height of tooth, .....	.06
Notch to inner end of alæ, .....	.80
Mentum to inner end of alæ,	1.20

The portion of the œsophagus preserved is 1.475 inches long and about .15 of an inch broad, in its flattened condition.

The odontophore (Plate XXXVIII, figs. 1, 2) is amber-color, .18 of an inch broad. The tridentate median teeth have moderately long but not very acute points, of which the middle one is a little the longest. The inner lateral teeth are bidentate and somewhat broader and longer than the median ones; their outer denticle is well-developed, but considerably shorter than the inner one. The next to the outer lateral teeth are larger at base and much longer, simple, broad, tapering, flattened, slightly curved, acute at tip. They appear not to have the small lateral denticle observed on the corresponding teeth of the adult *Architeuthis* (see Plate XVIa, figs. 1, 2). The outer lateral teeth are similar to the preceding, but rather larger and not quite so broad at base. The marginal plates are well-developed, thin, somewhat rhomboidal.

The internal cavity of the ears is somewhat irregularly three-lobed, with several rounded papillæ projecting inward from its sides, very much as in those of *Ommastrephes*. Each ear contained two irregular-shaped otoliths, one of which (Plate XXXVIII, fig. 4) was much larger than the other, in each ear.

The eyes were both burst, and most of their internal structure was destroyed. So far as preserved they closely agree with those of

Ommastrephes. The eye-balls were large and somewhat oblong in form, and appear to have been nearly two inches broad and three long. The eye-lids are badly mutilated, but the anterior sinus can be imperfectly made out. It seems to have been broad and rounded. The aquiferous cavities appear to have been like those of *Ommastrephes*. The form and structure of the cartilaginous 'brain-box' also appear to be essentially the same as in the genus last named.

Ommastrephes.

Ommastrephes (pars) D'Orbigny, Voy. Am. Merid., 1835; Cephal. Acétabulifères, p. 341.

Body elongated, pointed posteriorly. Caudal fin broad, transversely rhomboidal. Pen narrowed behind the middle, with a strong median rib and large marginal ribs on each side; near the posterior end thin and concave, expanded into a lanceolate form, with the tip infolded and slightly hooded. Head large. Eyes with lids, having a distinct sinus in front.

Arms stout, the third pair stoutest, with a dorsal keel; all the arms have marginal membranes exterior to the suckers. Suckers of the arms deep and oblique, with horny rims which are strongly denticulate on the outer margin, the median tooth usually largest. Tentacular-arms rather long and contractile, stout, with a moderately wide terminal club, which has along its middle region two rows of large central suckers, and a row of smaller marginal ones alternating with them, on each side; proximal part of club with small denticulate suckers only; distal part of club with four to eight rows of small denticulate suckers.

Siphon-tube placed in a depression of the under side of the head, and attached to the head by a lateral bridle on each side, behind the eyes, and by a pair of bridles on its dorsal surface, at the bottom of the depression in which it is lodged. Terminal orifice transversely elliptical, furnished with an internal valve.

Mantle-fastenings ('apparatus of resistance'), situated on the basal extension of the siphon, consist, on the ventral side, of two large triangular bosses, with an elongated and somewhat ear-shaped longitudinal fosse, and a shallower transverse one; and on each side of the inner surface of the mantle, of a corresponding short, raised, longitudinal ridge, swollen posteriorly, and a lower transverse ridge, which fit closely into the fosses. The dorsal side of the head has a median, longitudinal facet, that fits upon its counterpart on the mantle, over the anterior part of the pen, which gives it support.

The nuchal lamellæ are formed by a transverse tegumentary fold behind the eyes, from which run backward, on each side, three longitudinal lamellæ, which are delicate, and have a sensory (perhaps olfactory) function.

Buccal membrane seven-angled, thin, corrugated on the inner surface, destitute of suckers.

Branchial auricles, and gills large. Liver and stomach voluminous.

The male has one of the ventral arms (which may be either right or left in our species) hectoetolyzed near the tip, by enlargement and flattening of the bases of the sucker-stalks, while their cups become small or abortive.

The female has oviducts developed on both sides, but they are small, and simple, opening far back. Two pairs of nidamental glands, which are small and simple.

Ommastrephes illecebrosa Verrill. (Short-finned squid.)

Loligo illecebrosa Lesueur, Journ. Phil. Acad. Nat. Sci., ii, p. 95, Plate 10, figs. 18-21, 1821 (figures incorrect).

Blainville, Dict. des Sci. nat., vol. xxvii, p. 142, 1823.

Gould, Invert. Mass., ed. I, p. 318, 1841 (habits).

Loligo piscatorum La Pylaie, Ann. des Sci. nat., iv, p. 319, 1825, Pl. 16 (habits as observed at Saint Pierre).

Ommastrephes sagittatus (pars) D'Orbig., Cephal. Acétab., p. 345, Plate 7, figs. 1-3 (after Lesueur).

Gray (*pars*), Catalogue Moll. of British Mus., Part I, Cephal. Antep., p. 58, 1849.

Binney, in Gould's Invert. Mass., ed. II, p. 510, 1870 (excl. syn.), Pl. 26, figs. 341-4 [341 is imperfect],* not Plate 25, fig. 339.

Tryon (*pars*), Man. Conch., I, p. 177, Pl. 78, fig. 342 (very poor, after Lesueur), Pl. 79, fig. 343, 1879 (not Plate 78, figs. 341, 345).

Ommastrephes illecebrosa Verrill, Amer. Jour. Sci., vol. iii, p. 281, 1872 (synonymy); Report on Invert. Viney. Sd., etc., 1873, pp. 441 (habits), 634 (descr.); Amer. Jour. Science, vol. xix, p. 289, April, 1880.

Plates XXVIII; XXIX, figs. 5, 5a; XXXVII, fig. 8; XXXIX.

Body, in the younger specimens, long and slender; in the adults, especially when the stomach is distended with food, and in the breeding season, rather stout; most so in the gravid female; in preserved specimens the apparent stoutness of the body depends very much upon whether the mantle was in a contracted or expanded

* This species is not well figured in the last edition of Gould's Invertebrates. Plate 25, fig. 339, which Mr. Binney refers to it, really represents a *Loligo*. Plate 26, figs. 341-344 (erroneously referred to *Loligopsis pavo*), was doubtless made from a specimen of this species, but if so, the long arms were incorrectly drawn, and confused with the short arms.

state when the animal died. Caudal fin transversely rhomboidal, or broad spear-shape, about one-third wider than long; its breadth usually less than half the length of the mantle; the posterior borders are nearly straight and form nearly a right angle at the posterior end; the anterior margins are somewhat convexly rounded, and the front margin extends, at the sides of the body, considerably forward beyond the insertion of the fin. Ratio of fin-length to mantle-length 1:2.48 to 1:3.00 (the latter in the young ones). Average proportions in eight adult specimens: of fin-length (from insertion) to length of dorsal side of mantle, about 1:2.55; breadth of fin to length of mantle, average, 1:1.90; length of head (dorsal edge of mantle to base of arms) to mantle-length, average, 1:7.15.

The head is large, well-rounded; the exposed portion is shorter than broad, its breadth about equals that of the body, in ordinary contraction; its sides, in the region of the eyes, are somewhat swollen; the under surface is flattened, and has a deep excavation in front, semi-circular, or rather semi-elliptical, in outline, to receive the dorsal half of the siphon-tube, which fits into it closely.

The sides of the head, back of the eyes, have a rather prominent, transverse ridge, back of which the head suddenly narrows, to the neck. The transverse ridges curve backward slightly and meet on the dorsal side of the head, where they are less prominent. Three thin, lamelliform, erect folds of the skin extend backward from the transverse ridge, on each side of the head; of these the middle or lateral one is about in line with the lower eye-lid; the upper one is, at its origin, about midway between the latter and the median dorsal line, but its posterior edge bends downward and joins that of the one below; the lowest of the three is shorter and curves upward, and finally joins the middle one, at its posterior edge. These folds form, therefore, in connection with the transverse ridge, two well-defined lateral areas or faeets, of delicate and probably very sensitive integument, placed just in front of the mantle-opening, on each side, where they must be bathed by the inflowing currents of water. It seems probable to me, therefore, that they are the seat of a special sense, analogous to, if not identical with, that of smell. They are, also, closely connected with the organs of hearing, and may be of some service in concentrating sound-vibrations. A small pore is situated within the lower faeet.

The pupils are round and the eyes are large, though the opening between the lids is usually rather small, especially in alcoholic specimens. In these the aperture is usually contracted to a small obliquely transverse, irregular-triangular form, or even to a narrow oblique slit;

when more open the aperture is still usually somewhat angular; the anterior sinus is narrow and extends downward and forward.

The eye-lids form, when nearly expanded, an irregular oval, the longest diameter placed transversely and somewhat obliquely, while the narrow and deep sinus extends forward and somewhat downward. When partly closed (Plate XXIX, fig. 5) the opening between the lids generally becomes more oblong and sometimes approaches a triangular form.

The mantle is thick and very muscular; its anterior margin has a concave outline beneath, forming a slightly prominent angle on each side; from these angles it advances somewhat to the slight median dorsal angle, which projects forward but little, and does not form a distinct lobe, and sometimes it is hardly noticeable, even as an angle, the transverse outline of the edge on the dorsal side being, in that case, nearly straight, or advancing a very little in the middle.

The sessile arms are rather stout, tapering to acute tips. The dorsal arms are a little smaller and shorter than the others; the second and third pairs are nearly equal in size and length, the second often a trifle the longer; those of the fourth pair are usually intermediate in length between the first and second pairs.

All the sessile arms are stout and armed with similar suckers. Along their inner angles, outside the suckers, they are all similarly provided with marginal membranes, which rise to about the same height as the suckers, on each side. Just proximal to each sucker on the inner face of the arm, arises a thickened, transverse, muscular fold, that extends to the edge of the lateral membrane, which often recedes between their extremities, so as to have a scolloped outline.

The dorsal arms are a little shorter and decidedly smaller than the others. The two lateral pairs of arms are stoutest and longest, and nearly equal, sometimes one pair and sometimes the other, being longest. The ventral arms are a little longer than the dorsal and shorter than the lateral ones. The dorsal and upper-lateral arms are trapezoidal in section, with the inner face rather broad. The dorsal arms have a slightly elevated, median dorsal fold, commencing near the base and running to the tip. Those of the second pair have a broader, membranous fold on the lower-outer angle, along the whole length. Those of the third pair are stouter than the others, and much compressed laterally, with the outer surface rounded, close to the base, but becoming compressed and keeled farther out, and having a high median ridge along its middle region, becoming narrow toward the tip. The ventral arms are trapezoidal in section, with a narrow fold

along the outer angle, which is acute, while the ventral angle is rounded.

The tentacular-arms (Plate XXVIII, figs. 1*a*, 2) are long; when extended, in fresh specimens, they reach back beyond the base of the caudal fin. They are rather stout, rounded-trapezoidal along the peduncular portion; along the upper-outer angle a thin fold runs from the base to the tip, becoming a wide carina on the backside of the club; two less marked folds run along the inner angles, defining a narrow inner face, along the whole length, but on this face there are no suckers, except close to where it begins to expand into the broader face of the club; along the sides of the club, the marginal membranes become much wider, rising to a level with the suckers.

In the male of our species, one of the ventral arms (Plate XXVIII, figs. 3, 3*a*) is strongly hectocotylized, somewhat as in *Loligo*. But in this species it is the right arm, about as often as the left, that is modified. Toward the tip of the arm, for some distance, the pedicels of the suckers, especially of the outer row, become shorter, and the bases of the sucker-stalks become larger, broader, and transversely compressed, while the cups of the suckers themselves decrease rapidly, till they become very minute, and on a number of the most flattened and largest stalks, they are entirely abortive, in the case of the medium sized males, but, very close to the tip, they may again become normal. The inner row of suckers is more or less modified, in a similar manner; but fewer of the sucker stalks are affected, and these are, usually, not so extensively altered, though in the larger males many of them are commonly destitute of cups and have the same flattened form as those of the outer row, with which they are usually united along the median line of the arm, forming a zigzag ridge. In a very large male (J), with the right ventral arm modified, the alteration of the sucker-stalks becomes obvious at about the 45th sucker, and there are, beyond this, about 80 modified suckers, extending to the very tip; of these about 30, in the outer row, are represented only by the flat, lamelliform bases of the sucker-stalks, without cups; on the inner row, the small cups extend for about ten suckers farther than on the outer. The lamelliform processes are united medially in a zigzag line, along the entire tip. The modified part is about an inch in length. This arm is as long as its mate, (though in other specimens it is often shorter); but it is broader, stouter, and more blunt at tip, both the inner face and lateral membrane being increased in width. The younger males, 4 to 6 in. long, have the corresponding suckers less extensively modified, and the cups, though very much reduced in size, are usually present on all or nearly all the stalks.

The portion of the tentacles which bears suckers is always less than half the whole length. The relative size of the suckers varies greatly in both sexes, perhaps in connection with a periodical renewal of their horny rings.

The club is long and moderately broad, gradually widening from the peduncular part of the arm, and tapering at the end to a rather blunt, flattened and curved tip, which is strongly carinated on the outer side by a thin lamina. The suckers commence a short distance in advance of the expansion of the club. They are at first small, deep cup-shaped, and somewhat scattered, in two alternate rows, but all of these small ones have oblique rims, strongly denticulated on the outer margin with four or five long incurved teeth, while the inner edge is smooth. Of the small ones, before the commencement of the two median rows of large suckers, there are from ten to fifteen.

The middle region of the club is occupied by two rows of large suckers (fig. 7) and by a row of small marginal ones, on each side, alternating with the large ones. The uppermost of the two rows of large suckers contains one or two more suckers than the lower, and they are also larger. The number in the upper row is seven to nine, in the lower five to seven, the largest specimens having the greater number. Of these, the three to five middle ones in each row are decidedly the largest and have the edge of the marginal ring nearly smooth and even; at each end of each row the suckers diminish in size and the edge becomes denticulate, at first by the formation of narrow incisions, which leave broad, stout, blunt denticles; but as the suckers diminish in size these become longer, narrower and more acute; their inner margins remain smooth. The large suckers are broad and moderately deep, somewhat swollen below, and a little oblique. The marginal suckers are much smaller, shallower, more oblique, and have the entire rim finely and sharply denticulate, the denticles being longer and strongly incurved on the outer margin. Beyond the rows of large suckers there is, at first, a small group of sharply denticulate suckers, in four rows, resembling the marginal ones in form and size; but these rapidly decrease in size and are succeeded by eight crowded rows of very small suckers, with minute apertures, which occupy the entire face of the terminal section to the tip.

The suckers of the sessile arms are largest on the two lateral pairs, on which they are nearly equal, and the largest are about the same in size as those on the tentacular-club;* those of the ventral arms are smallest; those of the dorsal arms are intermediate in size between

* In the males the tentacular suckers are usually the smaller; in the females often the larger.

those of the lateral and ventral arms. The first few suckers (three to five), at the base of each arm, are smaller than those beyond, but increase regularly in size; they have the edge of the rim nearly entire, or with only a few blunt teeth on the outer margin; then follow about twelve suckers, of the largest size. These large suckers (Plate XXVIII, figs. 5, 5*a*) are deep, oblique cup-shaped, somewhat swollen in the middle, with oblique horny rims, which are entire on the inner margin, but on the outer have a large, strongly incurved, acute median tooth, on each side of which there are usually four or five shorter, flat, blunt teeth; but toward the base of the arms these are fewer and shorter, while distally they become more numerous, longer, and more acute, and often the edge is more or less denticulate nearly all around. The larger suckers are followed by a regularly decreasing series of thirty to forty smaller secondary ones (figs. 6, 6*a*), not counting the numerous very small ones, within one-third of an inch of the tip. These secondary suckers grade gradually into the large or primary ones, both in size and form; they are, however, armed with four or five very sharp incurved teeth, on the outer margin, of which the median one is longest, while the inner margin is usually entire. They are very oblique and one-sided in form. The membrane around the rim of all the suckers is thickened, but most so on the basal ones; it usually recedes behind the large median tooth, leaving there an emargination.

The outer buccal membrane is not very large; its inner surface is closely covered with lamelliform folds and wrinkles; its border is prolonged into seven acute angles, from which membranes extend to the opposite arms, going to the upper sides of the second and fourth pairs of arms; to the lower side of the third pair; but the seventh angle is in the median dorsal line, and the membrane from it bifurcates, one-half going to the inner side of each dorsal arm. Immediately around the jaws there is a circular, thickened, rugose oral membrane, with a strongly lobed edge, while its inner surface is radially wrinkled and covered with scattered rounded verrucæ. A plain fold intervenes between this and the outer buccal membranes.

The jaws are sharp and incurved at tip, reddish brown to brownish black in color, with the posterior borders of the laminae whitish and translucent. The upper mandible has a much incurved tip, with the cutting edges regularly curved, and with a shallow notch at their bases, beyond which the anterior edges rise into a broad obtuse lobe or low tooth, by which the hardened and dark-colored part, as seen by transmitted light, has the form of a sharp angular tooth, but its

actual projection anteriorly is but slight, because the translucent edge beyond it rises to about the same level. The lateral-posterior borders of the frontal laminae are sinuous and incurved in the middle; the palatine lamina is broad, with the posterior lateral edges incurved and sinuous.

The lower mandible has the extreme tip strongly incurved, forming a slight notch, close to the tip, below which the edges are slightly incurved or nearly straight, with a decided V-shaped notch at the base; the anterior edges, beyond the notch, form a triangular tooth of the inner laminae, but this is obscured, unless viewed by transmitted light, by the outer alar laminae, which rises at its anterior edge, which is translucent, nearly to a level with the tooth; the inner ends of the alae are wider than the middle, and broadly rounded; the gular laminae are short, narrowed posteriorly, with their inner edges incurved, and with a thickened, prominent ventral carina.

The jaws of a large specimen measure as follows: upper mandible, tip to posterior end of palatine lamina, 22^{mm}; to dorsal end of frontal lamina, 16; to posterior lateral edge of same, 9; to base of cutting edge, 5; inner edge of palatine lamina to dorsal end of frontal lamina, 17. Lower mandible, tip to inner end of alae, 13^{mm}; to ventral notch of alae, 4; to ventral notch of gular laminae, 9; to posterior end of same, 16; to base of cutting edges, 5.

The buccal mass has, on the outer surface of the dorsal and lateral sides, a broad, thin, brown horny plate, with a notch posteriorly, in the median line.

The odontophore (Plate XXXVII, fig. 8), is remarkable for the length and sharpness of the teeth, especially of the central and outer rows. The median teeth have a long and very acute median denticle, with much shorter lateral ones. The inner lateral teeth have broad bases and a long and very sharp central denticle, with a much shorter lateral one, on the outside. The next to the outer lateral teeth are simple, slender and sharp. The outer lateral teeth are much longer, strongly curved, and very acute.

The pen (Plate XXVIII, fig. 4) is long and slender, with a slender midrib and strong marginal ribs; the anterior end is thin, broad pen-shaped, subacute; from very near the anterior end it tapers gradually backward to about the posterior fourth, where it becomes very narrow, apparently consisting only of the consolidated lateral ribs and midrib, the former showing on the ventral side a thin groove between them, the latter appearing as a slender ridge on the dorsal side. The posterior portion is narrow-lanceolate in form, with thin

edges, and a strong midrib, composed of the united marginal ribs of the anterior portion; the thin edges are incurved, so as to give a canoe-shaped form to this portion, and near the tip, the edges unite beneath into a short hood-like tip. Anteriorly the lateral ribs show two grooves on the ventral side, and appear to be composed of three united ribs.

The ground-color of a specimen taken by me, in 1870, at Eastport, Maine, when first caught, was pale bluish-white, with green, blue and yellow iridescence on the sides and lower surface; the whole body, head, and outer surfaces of arms and fins were more or less thickly covered with small, unequal, circular, orange-brown and dark brown spots, having crenulate margins; these spots were continually changing in size, from mere points, when they were nearly black, to spots 1^{mm} to 1.5^{mm} in diameter, when they were pale orange-brown, becoming lighter colored as they expanded. On the lower side of body, head, and siphon the spots were more scattered, but the intervals were generally less than the diameter of the spots. On the upper side the spots were much crowded and in different planes, with the edges often overlapping, thus increasing the variety of the tints. Along the middle of the back the ground-color was pale flesh-color, with a distinct median dorsal band, along which the spots were more crowded and tinged with green, in fine specks. Above each eye there was a broad lunate spot of light purplish red, with smaller and much crowded brown spots. The upper surface of the head was deeply colored by the brown spots, which were here larger, darker, and more crowded than elsewhere, and situated in several strata. The under sides of the arms and fins were colored like the body, except that the spots were smaller and much less numerous. The suckers were pure white. The eyes were dark, blue-black, surrounded by an iridescent border.

The colors change constantly, when living or recently dead, by means of the continual contraction and dilation of the chromatophores. The different tints pass over the surface like blushes.

In specimens recently preserved in alcohol, the same pattern of coloration is usually visible. The dark dorsal band on the body and head, and the dark patches above the eyes, as well as smaller dark patches in front of the eyes, can be plainly seen. In these darker parts the chromatophores are much crowded, and have a purplish brown color, varying to chocolate-brown in specimens longer preserved. On other parts of the body the chromatophores are more scattered and usually reddish brown in color, with a circular or elliptical outline; when expanded, the larger ones are about 1^{mm} in diam-

eter. The under surfaces of the fins, siphon, head, and arms have fewer and smaller spots, and are, therefore, lighter colored, and appear nearly white when these spots are contracted.

A fresh specimen, caught in Casco Bay, in 1873, had the following proportions: Length of head and body, not including the arms, 221^{mm}; length of caudal fin, 86; breadth of fin, 90; diameter of body, 35; length of upper arms, 80; of second pair, 100; of third pair, 100; of the ventral pair, 90; of tentacular-arms, 182^{mm}.

Of our species, I have measured large numbers of specimens, preserved in different ways, and also fresh, and have found no great variation in the form and relative length of the caudal fin, among specimens of similar size and in similar states of preservation, nor do the sexes differ in this respect. The young, however, differ very decidedly from the large specimens in these respects. The modes of preservation also cause much of the variation in the proportions of fins and arms to the mantle. The two sexes are probably equally numerous, but in our collections the females usually predominate, and the largest specimens are usually females, though equally large males occur. In 31 measured specimens, in alcohol, from various localities and of both sexes, the average length, from tip of tail to dorsal edge of the mantle, was 176^{mm} (6.96 inches); from tip of tail to insertion of fin, 66^{mm} (2.60 inches); average proportion of fin to mantle-length, 1:2.68. Among these the proportions varied from as low as 1:2.48, in some of the larger ones (with mantle above 8 inches), up to 1:3.00, in the smaller ones (with the mantle less than 3 inches long).

The following tables are intended to illustrate the natural variation in the proportions, due mainly to age, and the accidental variations caused by differences in the modes of preservation and strength of the alcohol.

The specimens from Eastport, Me., designated G. H. I. R., were collected at one time, in midsummer, and preserved in the same way, in alcohol of moderate strength, repeatedly changed; at the present time the strength of the alcohol is about 80 per cent. They are in good condition, moderately firm and not badly contracted. Those designated as D. E. F. N. O. P., were also collected at one time, in August, and preserved together. They are in fair condition, but not so well preserved as the former lot. Those numbered ii to xiv were preserved together, about the last of July. They were placed in strong alcohol and are hard and badly contracted. J. K. and L. were preserved together, but were originally found dead on the beach and in a relaxed state. They are only moderately contracted by the alcohol.

Measurements of *Ommastrephes illecebrosa* (in inches).

	O ♀	P ♀	D ♀	E ♀	J ♂	I ♂	R ♂	W ♂	Fresh.
Tail to tip of dorsal arms,	13.40	13.00	12.75	10.50	13.50	10.50	10.50	8.25	--
Tail to tip of second pair arms, ..	14.20	13.70	--	--	14.30	10.80	11.10	--	--
Tail to tip of third pair arms, ...	14.20	13.70	13.25	11.00	14.20	11.00	11.20	--	--
Tail to tip of fourth pair arms, ...	13.10	13.60	--	--	13.40	10.60	11.00	--	--
Tail to tip of tentacular arms, ...	16.50	17.50	15.5	12.00	15.50	12.20	12.50	--	--
Tail to base of dorsal arms,	10.00	9.40	9.00	7.90	10.00	8.30	8.20	6.50	8.84
Tail to center of eye,	9.30	8.90	8.25	7.35	9.50	7.75	7.70	--	--
Tail to edge of mantle, above, ...	8.60	8.00	7.75	7.10	8.70	7.50	7.20	5.70	--
Tail to edge of mantle, below, ...	8.20	7.50	7.30	--	8.10	7.15	6.65	5.38	--
Tail to insertion of fin,	3.30	3.20	3.10	2.75	3.50	2.90	2.80	2.10	3.447
Breadth of fin,	4.20	4.30	4.25	3.78	5.15	3.80	3.90	2.65	3.60
Distance between lateral inser- tions,	--	--	.50	.40	.65	.45	--	--	--
Front edge, outer angle to inser- tion,	2.20	2.20	2.00	1.90	2.50	2.80	2.10	1.45	--
Back edge, outer angle to tip of tail,	3.30	3.25	3.15	2.90	3.50	3.00	2.90	2.00	--
Circumference of body,	4.80	4.80	--	--	6.50	4.30	4.00	--	--
Breadth of body,	1.70	1.60	--	--	2.15	1.30	1.40	1.10	1.40
Breadth of head at eyes,	1.60	1.50	1.35	1.15	1.65	1.20	1.30	1.00	--
Breadth of eye-opening, .....	.40	.45	.35	--	.36	.20	.23	.25	--
Breadth of siphon at bridle, ...	.75	.70	.65	.55	.78	.60	.55	--	--
Length of head, mantle to base of dorsal arms,	1.40	1.40	1.25	.80	1.30	.80	1.00	.80	--
Length of dorsal arms,	3.75	3.60	3.25	2.70	2.65	2.20	2.43	1.75	3.20
Length of 2d pair,	4.30	4.20	4.00	3.15	4.40	2.70	3.12	2.25	4.00
Length of 3d pair,	4.10	4.25	4.00	3.00	4.55	2.67	3.15	2.25	4.00
Length of 4th pair,	3.60	3.80	3.50	2.80	3.80	2.43	2.75	2.00	3.60
Length of tentacular arms,	6.80	8.00	6.50	4.00	5.80	4.00	4.10	4.50	7.28
Length of club,	3.30	3.50	2.75	1.85	2.55	1.75	1.90	1.30	--
Breadth of dorsal arms, .....	.35	.36	.28	.25	.35	.30	--	.20	--
Breadth of 2d pair, .....	.45	.44	.35	.30	.45	.35	--	.25	--
Breadth of 3d pair, .....	.45	.44	.35	.28	.50	.35	--	.25	--
Breadth of 4th pair, .....	.44	.42	.32	.30	.45	.35	--	.25	--
Breadth of tentacular arms, ...	.25	.28	.30	.30	.28	.20	--	.17	--
Breadth of club, .....	.30	.30	.22	.18	.25	.22	--	--	--
Front to back of 3d pair, .....	.65	.60	.50	.40	.65	.45	--	--	--
<i>Diameter of Suckers:</i>									
Largest on tentacular arms, .....	.18	.17	.15	.11	.18	.10	.13	--	--
Largest on 3d pair, .....	.18	.16	.14	.11	.21	.14	.14	--	--
Largest on ventral arms, .....	.11	.11	.10	.09	.11	.09	.07	--	--
<i>Proportions:</i>									
Length of fin to mantle length, 1:	2.60	2.50	2.50	2.58	2.48	2.58	2.57	2.71	--
Breadth of fin to mantle length, 1:	2.04	1.86	1.82	1.87	1.69	1.97	1.84	2.15	--
Length* to breadth of fin, 1: ...	1.27	1.34	1.37	1.37	1.46	1.30	1.39	1.26	--
Length of head to mantle, 1: ...	6.14	5.70	6.20	8.87	6.70	9.30	7.20	7.12	--

The same specimens, included both in this and the following tables, show small differences in their measurements (made at different times), due partly to the different degrees of extension employed in measuring them, and partly to the fact that the alcohol had been changed, and its strength altered.

* The length of the fin, in these tables, means the distance from the lateral insertions to the tip of the tail, which is somewhat less than the extreme length.

Measurements of *Onmastrephes illecebrosus*, males, (in inches).

Sex and designation.	Vineyard Id.	Eastport.	Eastport.	Eastport.	Vineyard Id.	Mass. Bay.	Cape Cod.	Newport.											
Locality.	J	L	I	R	M	W	ii	iii	iv	v	vi	vii	viii	ix	x	xi	xii	xiii	xiv
End of body to edge of mantle, above,	8.70	7.80	7.45	7.10	6.80	6.15	4.00	4.40	5.25	4.05	4.15	6.70	5.55	6.70	5.60	5.80	4.15	4.10	2.70
End of body to edge of mantle, beneath,	8.10	8.00	7.30	7.10	6.70	6.35	3.70	4.00	4.80	3.90	4.00	6.30	5.25	6.15	5.40	5.70	3.90	3.85	2.60
End of body to origin of fin,	3.30	3.30	3.00	2.90	2.80	2.70	2.30	1.45	1.60	2.00	1.45	1.50	2.60	2.10	2.60	2.20	2.20	1.50	1.40
End of body to center of eye,	9.50	9.30	8.20	7.80	7.50	7.10	6.80	4.35	4.70	5.45	4.10	4.40	7.10	5.90	6.90	5.90	6.25	4.30	4.20
End of body to base of dorsal arms,	10.00	10.30	9.00	8.20	7.80	7.10	4.50	5.00	5.75	4.50	4.80	7.70	6.30	7.70	6.50	6.60	4.60	4.55	3.15
Eye to tip of dorsal arms,	4.50	4.15	3.05	2.60	2.95	3.30	2.70	1.35	1.65	2.05	1.35	1.50	2.90	2.10	3.00	2.50	2.35	1.40	1.40
Eye to tip of 2d pair of arms,	4.90	4.80	3.50	2.95	3.20	3.60	3.00	1.45	1.85	2.30	1.50	1.70	3.10	2.35	3.30	2.80	2.65	1.65	1.50
Eye to tip of 3d pair of arms,	4.95	4.90	3.30	2.95	3.40	3.80	2.95	1.50	1.80	2.20	1.45	1.70	3.00	2.35	3.10	2.60	2.40	1.70	1.55
Eye to tip of 4th pair of arms,	4.50	4.10	3.10	2.90	3.20	3.35	2.70	1.40	1.70	2.20	1.35	1.50	2.90	2.00	2.95	2.50	2.25	1.60	1.30
Eye to tip of tentacular arms,	6.50	5.70	4.40	4.00	4.20	4.85	3.70	1.90	2.40	2.75	2.15	2.20	4.20	3.30	5.40	3.60	3.10	2.30	2.00
Breadth of head across eyes,	1.60	1.30	1.40	1.15	1.30	1.00	1.20	.70	.80	.90	.75	.80	1.20	1.00	1.10	1.00	.90	.70	.58
Breadth of head in front of eyes,	1.60	1.30	1.25	1.05	1.20	1.00	1.00	.60	.70	.80	.70	.65	1.05	.90	1.00	.90	.85	.70	.60
Breadth of body,	2.10	1.75	1.55	1.40	1.35	1.20	1.05	.80	.80	.90	.80	.70	1.10	.95	1.15	1.15	1.00	.80	.70
Breadth of caudal fins,	3.15	4.35	1.30	3.60	3.75	3.70	3.00	1.95	2.20	2.60	1.90	2.05	3.30	2.70	3.40	2.75	2.70	2.05	1.90
Circumference of body,	6.30	5.60	4.80	4.30	4.05	3.90	3.10	2.10	2.20	2.95	2.40	2.40	3.20	2.90	3.80	3.30	3.15	2.25	2.20
Length of tentacular-club,	2.55	2.50	1.80	1.60	1.85	2.30	1.60	.90	1.10	1.20	.95	1.00	1.65	1.40	2.10	1.50	1.40	.90	.95
Diameter of largest suckers of club, . . . . .	.17	.14	.12	.11	.13	---	---	---	---	---	---	---	---	---	---	---	---	---	.01
Of largest suckers on 3d pair arms, . . . . .	.20	.16	.15	.15	.14	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Ratio of fin to length of mantle, 1 :	2.48	2.57	2.60	2.57	2.53	2.51	2.67	2.75	2.75	2.62	2.80	2.76	2.58	2.64	2.58	2.54	2.63	2.76	2.85
Breadth of fin to length of mantle, 1 :	1.69	1.95	1.81	1.82	1.10	1.90	1.83	2.05	2.00	2.02	2.15	2.02	2.03	2.05	1.97	2.03	2.15	2.02	1.62

Measurements of *Onnamastrophes illecebrosa*, females, (in inches).

Sex and designation.	Locality.																
	Eastport.	Eastport.	Vineyard Id.	Eastport.													
End of body to edge of mantle, above, ---	7.80	7.15	9.50	8.70	8.70	8.60	8.10	7.60	8.70	8.10	7.80	7.45	6.85	8.80	5.55	8.70	6.25
End of body to edge of mantle, beneath, ---	7.30	7.00	8.70	8.30	8.05	8.10	7.60	8.50	8.10	7.60	7.20	6.85	6.50	8.40	5.30	7.90	6.10
End of body to origin of fin, ---	3.10	2.80	3.70	3.40	3.50	3.40	3.20	3.10	3.00	2.85	3.00	2.85	3.50	3.50	2.15	3.60	2.40
End of body to center of eye, ---	8.25	7.60	10.00	9.10	9.00	9.30	9.10	8.30	7.98	7.30	9.60	5.80	9.70	9.60	5.80	9.70	6.70
End of body to base of dorsal arms, ---	9.00	8.00	10.50	9.90	9.70	10.00	9.85	8.70	8.20	7.80	10.50	6.20	10.50	10.50	7.20	10.50	7.20
Eye to tip of dorsal arms, ---	4.00	3.50	4.80	4.30	4.45	4.20	4.20	3.30	3.00	3.20	4.70	---	5.60	4.70	---	5.60	2.65
Eye to tip of 2d pair of arms, ---	4.55	3.70	5.60	4.75	4.95	4.40	4.70	3.90	3.50	3.25	5.10	2.55	6.30	5.10	2.55	6.30	2.65
Eye to tip of 3d pair of arms, ---	4.50	3.60	5.40	4.75	4.65	4.30	4.75	3.65	3.45	3.30	5.15	2.50	6.20	5.15	2.50	6.20	2.80
Eye to tip of 4th pair of arms, ---	4.30	3.20	5.40	3.80	4.40	4.20	4.75	3.60	3.20	3.20	5.00	---	6.15	5.00	---	6.15	2.70
Eye to tip of tentacular-arms, ---	7.00	4.60	8.10	7.00	6.00	5.50	8.00	6.10	4.80	4.95	7.00	3.40	10.50	7.00	3.40	10.50	3.70
Breadth of head across eyes, ---	1.35	1.15	1.30	1.60	1.50	1.55	1.30	1.20	1.35	1.10	1.90	1.00	1.50	1.90	1.00	1.50	1.05
Breadth of head in front of eyes, ---	---	---	1.45	1.40	1.50	1.50	1.30	1.10	1.25	1.00	1.65	---	---	1.65	---	---	---
Breadth of body, ---	---	---	1.72	1.60	1.90	1.85	1.00	1.20	1.50	1.25	2.35	---	---	2.35	---	---	---
Breadth of caudal fins, ---	4.25	3.85	5.50	4.15	4.85	5.00	4.30	4.00	4.05	3.70	5.50	2.85	5.30	5.50	2.85	5.30	3.10
Circumference of body, ---	---	---	2.85	3.20	2.75	2.60	3.15	2.90	2.40	3.70	6.80	---	---	6.80	---	---	---
Length of tentacular-club, ---	2.75	1.85	2.85	3.20	2.75	2.60	3.15	2.90	2.00	1.90	2.70	1.55	4.20	2.70	1.55	4.20	1.55
Diameter of largest suckers of club, ---	.15	.11	.16	.18	.18	.20	.17	.12	---	---	.17	---	.19	.17	---	.19	---
Of largest suckers on 3d pair arms, ---	.14	.11	.16	.18	.20	.19	.15	.13	---	---	.18	---	.20	.18	---	.20	---
Ratio of fin to length of mantle, 1 : ---	2.51	2.55	2.56	2.56	2.46	2.52	2.53	2.51	2.48	2.40	2.51	2.58	2.60	2.51	2.58	2.60	2.60
Breadth of fin to length of mantle, 1 : ---	1.85	1.85	1.72	2.09	1.80	1.72	1.88	1.95	1.83	1.85	1.60	1.95	2.01	1.60	1.95	2.01	2.01

Coast of Rhode Island (Verrill) to Cumberland Gulf (Kumlein). Abundant from Cape Cod to Newfoundland. Newport, R. I. (U. S. Fish Com.) Vineyard Sd., Mass., rare, large in winter, small in May (V. N. Edwards).

Ommastrephes illecebrosa.—Specimens examined.

No.	Locality.	When Collected.	Received from.	Specimens.	
				No.	Sex.
10280	Newport, R. I.	1872	U. S. Fish Com.	1	young.
10027, J.	Vineyard Sound.	Nov. 2, 1876	V. N. Edwards	1	♂, left-hand.
10027, K.	" "	" "	" "	1	♀
10027, L.	" "	" "	" "	1	♀
M.	" "	May, 1876	" "	1	♂, r.-band.
W.	Provincetown, Mass.	July, 1879	U. S. Fish Com.	1	♂, fig'd.
--	" "	" "	" "	9	♂
--	" "	" "	" "	5	♀
--	" "	" "	" "	3	young.
--	" "	" "	" "	28+	dupl.
--	Salem, Mass.	Oct. 25, 1873	J. H. Emerton	1	♀
--	Gloucester, Mass.	1878	U. S. Fish Com.	1	young.
S. T. U.	Casco Bay, Me.	1873	U. S. Fish Com.	3	♀
X.	Off Seguin I., Me. (50 fath.)	1879	(lot. 517) U.S.F.C.	1	♀ young.
--	Mt. Desert, Me.	1860	A. E. Verrill	50+	large.
--	Off Cashe's Ledge.	1873 (loc. 21)	U. S. Fish Com.	1	mutilated.
9693, G.	Eastport, Me.	1870	A. E. Verrill	1	♀, large.
9693, H. I.	" "	" "	" "	2	♂, left-hand.
9693, R.	" "	" "	" "	1	♂, r.-hand.
D. E. F.	" "	1872	U. S. Fish Com.	3	♀, large.
N. O. P.	" "	" "	" "	3	♀
--	" "	" "	" "	1	young.
--	Halifax, N. S.	J. R. Willis	Smithsonian	1	young.
10028	" "	J. M. Jones	J. M. Jones	1	♀, large.
10278, Q.	Newfoundland.	" "	" "	1	♀, large.
--	Cumberland Gulf.	L. Kumlein	Nat. Museum	1	mutilated.

Several of the smaller specimens, included in this list, are so young that it is impossible to determine their sex with certainty, without dissection. The hectocotylyzation of the ventral arm in the male is scarcely recognizable in those with the mantle less than 4 inches long.

The Mediterranean form, usually identified with the *var. b.* of *Loligo sagittata* Lamarck, 1799,* is closely related to our species, but if the published figures and descriptions can be relied upon, it can hardly be identical, as D'Orbigny and other writers have considered it. The American form has a more elongated body, with a differently shaped caudal fin, which is relatively shorter than the best authors attribute to *O. sagittatus*. The figure given by Verany is, however, an exception in this respect, for in it the body is represented about as

* It seems more probable, however, that Lamarck's description applied rather to *O. Bartramii* (Les. sp.) of the Gulf Stream region. Blainville and others have thus applied it, correctly, as I believe.

long as in some of our larger specimens.* It should be remarked, however, that Lesueur's figure of *O. illecebrosa* shows the body too small and too short in proportion to the size of the fin, and the fin wrong in shape and occupying more than half the length of the mantle; the proportions of the arms are also erroneous. But Lesueur explains these defects by his statement that the figures were hasty sketches made for the sake of preserving the colors, and that he saved a specimen by which to correct, afterwards, his drawings and description, but the specimen saved turned out to be *L. pavo*, so that the original sketches were published without correction. Tryon's figure 342 is a poor copy of one of Lesueur's, without credit.

If the European form be really identical with the American, its distribution is very anomalous, for while the former is a southern European form, inhabiting the Mediterranean and scarcely extending north of the southern waters of Great Britain, where it appears to be rare, our species is strictly a northern, cold water form, rarely found south of Cape Cod, even in winter. Its range extends quite to the Arctic Ocean.

Notes on Habits.

When living, this is a very beautiful creature, owing to the brilliancy of its eyes and its bright and quickly changing colors. It is also very quick and graceful in its movements. This is the most common 'squid' north of Cape Cod, and extends as far south as Newport, R. I. It is very abundant in Massachusetts Bay, the Bay of Fundy, and northward to Newfoundland. It is taken on the coast of Newfoundland in immense numbers, and used as bait for cod-fish. It occurs in vast schools when it visits the coast, but whether it seeks those shores for the purpose of spawning or in search of food is not known. I have been unable to learn anything personally in regard to its breeding habits, nor have I been able to ascertain that anyone has any information in regard either to the time, manner, or place of spawning. At Eastport, Me., I have several times observed them in large numbers, in midsummer. But at that time they seem to be wholly engaged in the pursuit of food, following the schools of herring, which were then in pursuit of shrimp (*Thysanopoda Norvegica*), which occur in the Bay of Fundy, at times, in great quantities, swimming at the surface. The stomachs of the squids taken on these occasions were distended with fragments of *Thysanopoda*, or with the flesh of the herring, or with a mixture of the two, but their reproduc-

* According to Jeffreys (Brit. Conch., V, p. 129, pl. 5) the English *O. sagittatus* has the fin "from $\frac{2}{3}$ to nearly $\frac{1}{2}$ the length of the mantle;" and the form of the pen, as figured by him, is different from that of our species.

tive organs were not in an active condition. The same is true of all the specimens that I have taken at other localities in summer. From the fact that the oviducts are small and simple, and the nidamental glands little developed, I believe that it will eventually prove that this species discharges its eggs free in the ocean, and that they will be found floating at the surface, either singly or in gelatinous masses or bands, not having any complicated capsules to enclose them. Nothing is known as to the length of time required by this species to attain its full size. It probably lives several years.

This squid is an exceedingly active creature, darting with great velocity backward, or in any other direction, by means of the reaction of the jet of water which is ejected with great force from the siphon, and which may be directed forward or backward, or to the right or left, by bending the siphon. Even when confined in a limited space, as in a fish-pound, it is not an easy matter to capture them with a dip-net, so quick will they dart away, to the right and left. When darting rapidly the lobes of the caudal fin are closely wrapped around the body* and the arms are held tight together, forming an acute bundle in front, so that the animal, in this condition, is sharp at both ends, and passes through the water with the least possible resistance. Its caudal fin is used as an accessory organ of locomotion when it slowly swims about, or balances itself for some time nearly in one position in the water.

The best observations of the modes of capturing its prey are by Messrs. S. I. Smith and Oscar Harger, who observed it at Provincetown, Massachusetts, among the wharves, in large numbers, July 28, 1872, engaged in capturing and devouring the young mackerel, which were swimming about in 'schools,' and at that time were about four or five inches long. In attacking the mackerel they would suddenly dart backward among the fish with the velocity of an arrow, and as suddenly turn obliquely to the right or left and seize a fish, which was almost instantly killed by a bite in the back of the neck with their sharp beaks. The bite was always made in the same place, cutting out a triangular piece of flesh, and was deep enough to penetrate to the spinal cord. The attacks were not always successful, and were sometimes repeated a dozen times before one of these active and wary

* This position of the fins is well shown in Plate 26, fig. 341, of Binney's edition of Gould's *Invertebrata of Massachusetts*. This figure was probably drawn by Mr. Burkhardt from living specimens formerly kept in Cutting's Aquarium, in Boston, about 1860 to 1862. This figure is very good, in most respects, except that the clubs of the tentacles have been confounded with the ventral pair of the sessile arms, and thus the suckers are made to continue along the whole length of the tentacles.

fishes could be caught. Sometimes, after making several unsuccessful attempts, one of the squids would suddenly drop to the bottom, and, resting upon the sand, would change its color to that of the sand so perfectly as to be almost invisible. In this position it would wait until the fishes came back, and when they were swimming close to or over the ambushade, the squid, by a sudden dart, would be pretty sure to secure a fish. Ordinarily, when swimming, they were thickly spotted with red and brown, but when darting among the mackerel they appeared translucent and pale. The mackerel, however, seemed to have learned that the shallow water was the safest for them, and would hug the shore as closely as possible, so that in pursuing them many of the squids became stranded, and perished by hundreds, for when they once touch the shore they begin to pump water from their siphons with great energy, and this usually forces them farther and farther up the beach. At such times they often discharge their ink in large quantities. The attacks on the young mackerel were observed mostly at or near high-water, for at other times the mackerel were seldom seen, though the squids were seen swimming about at all hours; and these attacks were observed both in the day and evening.

It is probable, from various observations, that this and other species of squids are partially nocturnal in their habits, or at least are more active in the night than in the day. Those that are caught in the pounds and weirs mostly enter in the night, evidently while swimming along the shores in 'schools.' They often get aground on the sand-flats at Provincetown, Massachusetts, in the night. On the islands in the Bay of Fundy, even where there are no flats, I have often found them in the morning, stranded on the beaches in immense numbers, especially when there is a full moon, and it is thought by many of the fishermen that this is because, like many other nocturnal animals, they have the habit of turning toward and gazing at a bright light, and since they swim backwards, they get ashore on the beaches opposite the position of the moon. This habit is also sometimes taken advantage of by the fishermen, who capture them for bait for cod-fish; they go out in dark nights with torches in their boats, and by advancing slowly toward a beach, drive them ashore.

They are taken in large quantities in nets and pounds, and also by means of 'jigs' thrown at random into the 'schools' and quickly drawn through them. They are also sometimes taken by lines, adhering to the bait used for fishes.

Their habit of discharging an inky fluid through the siphon, when irritated or alarmed, is well known. The ink is said to have caustic and irritating properties.

This squid, like the *Loligo*, is eagerly pursued by the cod and many other voracious fishes, even when adult. Among its enemies while young, are the full grown mackerel, who thus retaliate for the massacre of their own young by the squids. The specimens observed catching young mackerel were mostly eight to ten inches long, and some of them were still larger.

From the rapidity with which the squids devour the fish that they capture, it is evident that the jaws are the principal organs used, and that the odontophore plays only a subordinate part in feeding. This is confirmed by the condition of the food ordinarily found in the stomach, for both the fishes and the shrimp are usually in fragments and shreds of some size, and smaller creatures, like amphipods, are often found entire, or nearly so; even the vertebræ and other bones of herring are often present. On the other hand, in some specimens, the contents of the stomach are finely divided, as if the odontophore had been used for that purpose.

Notes on the Visceral Anatomy.

PLATE XXXVIII, FIGURE 2. PLATE XXXIX, FIGURE 2.

This species, in common with others of the same genus, is very different from *Loligo Pealei* in the form and structure of many of its internal organs. The branchial cavity is larger and the gills (*g, g*) originate farther back and are much larger than in *Loligo*, their length being about two-fifths the entire length of the body; they originate back nearly at the middle of the body. The liver (*l, l*) is much larger and more conspicuous, consisting of two large, oblong, lateral lobes or masses, closely united together in the median plane, with a groove along the dorsal side, in which lies the œsophagus. The ink-bag (*i*) is elongated-pyriform, with a silvery luster externally, but blackish when filled with the 'ink.' The size and form of the stomach and its cœcal lobe (*s, s'*) vary greatly according to their degree of distention with food. When well filled they are large, thin, saccular, and more or less pyriform; the cœcal lobe extending back nearly to the end of the body. The intestine (*h*) has two spatulate papillæ, one on each side of the anal orifice.

The heart (*H*) is large, somewhat irregular, and unsymmetrical, with four points, the two lateral continuous with the afferent vessels

(*bo*) of the gills; the anterior passing into the anterior aorta (*ao*); the posterior, median one, continuous with the posterior aorta, gives off, first a small ventral branch, which supplies the reproductive organs, and then later a median ventral artery (*o*), going to the mantle; while much farther back it divides into two branches (*o'*, *o'*) which supply the sides of the mantle and caudal fin. The branchial auricles (*au*) are large and ovate, with a small round capsule at the posterior end.

The urinary organs or 'kidneys' (*r*, *r*) are voluminous, lobulated organs, intimately connected with the venæ cavæ, and mostly situated below and in front of the heart, but there is a more compact glandular portion (*r'*) extending, as usual, backward along each of the posterior venæ cavæ (*vc''*) in the form of a long pyriform gland. Just in front of the bases of the gills, on each side, there is a circular opening (*u*) through the peritoneal membrane, which probably gives exit to the urinary excretions.

The reproductive organs of the female, however, present the greatest divergence from *Loligo*, and allied forms. Instead of having a single large oviduct, on the left side only, and opening far forward, we find, in this genus, two small oviducts (*od*) symmetrically placed and opening much farther back. Moreover, instead of the large and very conspicuous, unsymmetrical nidamental glands, situated in front of the heart, as in *Loligo*, we find in *Ommastrephes* much smaller and simpler glands (*xx*) situated much farther back, side by side, near the median line.

The ovary (*ov*) is a long, pyriform, lobulated organ; its anterior end is attached to the posterior end of the stomach, and is divided into several short lobes, which clasp the end of the stomach; its small posterior end extends backward into the concavity of the hooded portion of the pen (*p''*).

The spermary or testicle of the male (Plate XXXVIII, fig. 2, *t*) occupies the same position as the ovary; it is a more compact organ, with a smoother surface, and the anterior lobes are longer and narrower and extend farther forward along the sides of the stomach. The prostate gland and other male organs resemble those of *Loligo* (see Plate XL, figures 1, 2).

It must be borne in mind, however, that none of the specimens examined were in their breeding season. Consequently the reproductive organs were all much smaller and less conspicuous than they would have been in breeding individuals. This is particularly the case with the ovaries and spermaries, but the same remark would

also apply to the nidamental glands, which might assume a different form, as well as greater volume, at the breeding season.

The specimens dissected had all been preserved in alcohol, which, also, would cause these organs to appear smaller than is natural.

Additional note on distribution.—After the previous pages were printed, additional specimens of this species were obtained, extending its range much farther southward, in the deep water, near the edge of the Gulf Stream. Although we cannot be certain that specimens thus caught in the trawl were living at the bottom, owing to the possibility of their entering it during its ascent, it is very probable that they do actually inhabit those depths. This is rendered more probable by the fact that we found adult specimens in the stomachs of fishes (*Lophius*), taken at stations 865 and 893. The most southern specimens known were taken by Mr. A. Agassiz on the "Blake," off Cape Hatteras, in 263 fathoms.

Additional Specimens Examined.

Locality.	Fath.	When Coll'd.	Rec'd. From.	Specimens. No. Sex.
865. N. L. 40° 05'; W. Lg. 70° 23'	65	1880	U. S. F. Com.	1 ad.
893. N. L. 39° 52' 20"; W. Lg. 70° 58'	372	1880	" "	1 ad.
CCCXXXII, N. L. 35° 45' 30"; W. Lg. 74° 48'	263	1880	"Blake" exp.	3 ♀ ad.

Sthenoteuthis megaptera Verrill.

This volume, p. 223, plate 21, figs. 1-9, Feb., 1880.

PLATE XXI. PLATE XXVII, FIGURE 6. PLATE XLV, FIGURES 5, 5a.

Since printing the description of this species, in the first part of this volume, when only two examples were known, some additional specimens have been obtained.

The most important of these consists of the tentacular club and the pharynx, with the jaws and odontophore complete (Plate XLV, fig. 5). These are from a specimen, of which the head and arms were found in the mouth of a eod-fish, on the eastern part of George's Bank, by Manuel D. Mitchel, and were by him presented to the U. S. Fish Commission. The portions of the specimen not saved were used as bait for eod. The arms were described as 18 inches long.

The part of the tentacular club in my possession, which does not include the proximal portion, is 175^{mm} long, 17 broad, in the middle; the distal portion, beyond the large suckers, is 62 long, breadth of its sucker-bearing face, 8; from front to back, including width of dorsal keel, but not the suckers, 18; diameter of largest suckers, 12, of horny rings, 11; of aperture, 8; height of horny ring, outer side,

including teeth, 6.5; length of pedicels, 5; distance between pedicels, 15^{mm}. The large suckers agree very well with those described and figured from the type-specimen (Pl. XXI, fig. 9); this portion of the club had nine of these large suckers in each row; their pedicels arise from the middle of deep squarish depressions, between which run thick transverse ridges, which bear the smaller marginal suckers toward their outer ends, and then support the marginal membrane. A part of the large suckers have retained their horny rings, but all the marginal and small distal suckers have lost them. The horny rings of the large suckers (fig. 5a) are oblique, much higher on the outer than on the inner side; the edge bears about 28 sharp, incurved, well-separated, unequal teeth; of these the largest is at the middle of the outer edge; another smaller one, but larger than its fellows, is at the middle of the inner edge; two others, in size similar to the last, occupy the middle of the lateral edges; thus the edge is divided into four equal parts, by the four larger teeth, between which there are five or six smaller, very acute teeth, separated by spaces greater than their breadth. The horny rings are amber-brown, the teeth are golden yellow at tip. The distal portion of the club is compressed, with the face narrow and tapering, but with an elevated dorsal keel; it bears four crowded rows of small, pedicelled suckers, the two rows on one side of the median line being composed of very much smaller suckers than the other two. At the very tip of the club there is a round cluster of small, smooth suckers, as in *Architeuthis*. The buccal mass is 52^{mm} in length and 42 in diameter. A thick buccal membrane, covered with low, irregular verrucae, surrounds the jaws. The jaws are sharp and strong; their exposed portions are black, the alae reddish brown. The beak of the upper jaw is long, strongly incurved, acute, its cutting edge regularly curved, with a deep notch at its base, from which a well-defined groove runs downward. The lower jaw is sharp, its cutting edge is most concave near the tip, below which it is nearly straight, sides covered with fine radiating lines; basal notch broad, shallow, angular; beyond the notch there is a broad, low angular tooth. The surface of the fleshy palate is covered with low rounded verrucae. The odontophore is broad, with sharp, pale amber-colored teeth, which agree well with those of the original specimen (Plate XXI, figures 3-7); outside of the lateral teeth there is a narrow, raised, chitinous ridge, apparently not divisible into plates.

Another specimen, consisting of the buccal mass and jaws, but without the odontophore, was presented to the U. S. Fish Commis-

sion (lot 797) by Captain Chas. Anderson and crew of the schooner "Alice G. Wunson," of Gloucester, Mass.

The jaws of this were slightly larger than in the one just described. They agree well in nearly every respect, but the notch at the base of the lower mandible is narrower and the tooth beyond it broad and rounded.

Measurements of jaws, in millimeters.

Number of Lot.	810	797
Upper jaw, tip to bottom of notch,	12	13
Transverse breadth, at notches,	9	10
Tip to end of frontal lamina,	38	41
Lower jaw, tip to bottom of notch,	11	13
Tip to notch of mentum,	11	14
Tip to ventral end of gular lamina,	--	25
Mentum to inner end of lateral alæ,	31	36
Breadth of lateral alæ,	15	15
Breadth of odontophore, across face,	5.5	

A fifth specimen, received in lot 879, Oct., 1880, consists of two of the sessile arms, but the suckers have lost their horny rings, so that the identification cannot be very positive. The largest arm, which is not quite entire, is 255^{mm} long, and 23^{mm} in diameter, at the larger end. It was taken from the stomach of a cod, on the Grand Banks, and presented to the U. S. Fish Commission by the Captain and crew of the schooner "Otis P. Lord."

Specimens Examined.

Lot.	Locality.	Fath.	When rec'd.	Name of vessel.	Received from.	Specimens.
	C. Sable, N. S. Beach.				Halifax Mus'm	1, entire.
	Sable I. Bank	280-300	Sept., 1878.	A. H. Johnson	U. S. Fish Com.	1, jaws, etc.
810	George's Bank	Cod stom.	Aug., 1880.	Sultana	"	1, jaws & arm.
797	E. slope G.'s B.	Cod stom.	Aug., 1880.	Al. G. Wunson	"	1, jaws.
879	Grand Banks	Cod stom.	Oct., 1880.	Otis P. Lord	"	1, arms.

Sthenoteuthis Bartramii Verrill.

Loligo sagittatus (pars) Lamarck, 1799; Anim. sans Vert., vii, p. 665.

Loligo Bartramii Lesueur, Journ. Phil. Acad., I, vol. ii, p. 90, plate 7, 1821.

Blainville, Dict. Sci. Nat., xxvii, p. 141, 1823.

Loligo sagittatus Blainv., Dict. Sci., Nat., xxvii, p. 140.

Ommastrephes Bartramii D'Orb., Voy. Amer. Merid., Moll., p. 55, 1838 (t. Gray);

Céph. Acétab., pl. 2, figs. 11-20.

Gray, Catal. Moll. Brit. Mus., Cephal. Antep., p. 62, 1849.

Verrill, Invert. Vineyard Sound, etc., p. 341 [635]. 1874 (*non* Binney, in Gould,

Invert. Mass.)

Tryon, Man. Conch., i, p. 180, pl. 80, figs. 361, 362 (from D'Orb.).

Sthenoteuthis Bartramii Verrill (continued).

Sthenoteuthis Bartramii Verrill, this volume, p. 223, Feb., 1880; Amer. Journ. Sci., xix, p. 289, Apr., 1880.

Ommatostrephes Bartramii Steenstrup, Oversigt Kongl. D. Vidensk. Selsk. Forhandl., 1880, (received Aug.), auth. sep. copy, p. 9, fig. 2, p. 11, fig. 3, p. 19.

Body cylindrical, elongated, slender, tapering but little in front of the fin; anterior edge of mantle with a very slight, median dorsal angle. Caudal fin short and transversely rhomboidal, with the outer angles acute, posterior angle obtuse, and the front edges rounded and projecting forward beyond the insertion. Length of fin (from insertion) to its breadth, as 1 : 2; length of fin to mantle, as 1 : 2.80, in a young female specimen with the body 3.25 inches long. Head short, as broad as the body; eye-opening angular, higher than long, with a narrow oblique sinus. Nuchal frills nearly as in *O. illecebrosa*, consisting of a low, transverse, undulated ridge extending around both sides to the dorsal line, and with three raised longitudinal membranes on each side. Siphon large, sunken in a deep pit; anterior border of the pit with a series of 6 to 12 or more (variable with age), small and short furrows, which extend inward only a short distance from the edge. Arms rather short, not very unequal; the dorsal ones are a little the shortest and smallest; the third pair are the longest, the second and fourth pairs are intermediate in length, and nearly equal; the arms of the second pair are furnished with a well-developed membrane along the lower outer angle, and with a thin marginal membrane of moderate width along the inner angles, outside the suckers, that on the lower side extending beyond the suckers. Those of the third pair are compressed, with a well-developed membranous keel on the median outer edge, beyond the basal portion; on the lower inner angle there is a broad, thin, marginal membrane, extending beyond the suckers, and a narrow one on the upper side; the dorsal and ventral arms have narrow marginal membranes. Suckers of the dorsal and lateral arms furnished with horny rings which have the edge divided into small, acute-triangular teeth, largest on the outer side; on the ventral arms the suckers are smaller, those on the proximal half of the arm having smooth-edged rings, while those on the distal portion are sharply toothed on the outer edge. Tentacular arms slender and moderately elongated, with distinctly broader clubs, which are keeled on the back side and furnished with a thin marginal membrane on each edge. The suckers consist of two median alternating rows of larger oblique, dentate suckers, of which seven to nine in each row are decidedly largest;

alternating with these, on each margin there is a row of smaller, more oblique, sharply denticulate, marginal suckers; distal narrowed face of the club covered with four rows of minute crowded suckers, and a small cluster at the tip; the proximal part of the club has an irregular group of few, small, denticulate suckers, beyond which, extending down on the upper margin of the arm, is a row of about five or six small, smooth-edged, connective suckers, alternating with small round tubercles, of corresponding size; along the lower edge of the arm, for about the same distance, there is a row of more minute pedicelled suckers. The horny rings of the larger median suckers are oblique, and the edge is divided into many small slender teeth, longer on the outer margin; the teeth of the marginal suckers are similar, but more unequal and more incurved.

Specimens in alcohol generally show a distinct, dark purplish brown dorsal stripe, where the chromatophores are very much crowded.

Total length to tips of lateral arms, 121^{mm}; tail to base of arms, 93; body, 82; length of caudal fin, to insertion, 29; its breadth, 58; diameter of body, 16; length of tentacular arms, 48^{mm}. Young.

Middle Atlantic and West Indies; common in the region of the Gulf Stream.

This is an exceedingly active species, swimming with great velocity, and not rarely leaping so high out of the water as to fall on the decks of vessels. On this account it has been called the "*flying squid*," by sailors.

It is a more slender species than *O. illecebrosa*, with a shorter fin, and it has but four rows of small suckers on the distal part of the club, instead of eight. The most important differences, of generic value, are the presence of connective suckers and tubercles on the tentacular arms, and the great development of the marginal membranes on the lateral arms. The grooves in the siphon-pit are of comparatively little importance.

Gonatus Gray.

Gonatus Gray, Catalogue Mollusca Brit. Mus., i, Cephal. Antep., p. 67, 1849, (characters inaccurate.)

Body slender, tapering; caudal fins short, broad, united posteriorly. Pen narrow anteriorly; thin and lanceolate posteriorly, with a terminal, hood-like expansion. Sessile arms with four rows of small, pedicelled suckers, those of the two median rows larger, with a horny ring, having a single large hooked claw on the outer edge; outer

suckers with larger pedicels, the horny ring with several small denticles. All the suckers have a circle of minute scales or plates around the aperture. Tentacles long and slender, the terminal part dilated into a narrow club, with a membranous keel; the club is covered with minute denticulated suckers, like the outer ones of the sessile arms; smaller suckers extend for some distance along the arm; center of the club, with one or two larger suckers, resembling the median ones of the sessile arms, their horny rings having a small aperture, and bearing, on the outside, a large claw-like hook.

Gray overlooked the free eyelids in this genus, and on that account placed it with *Loligo*.

Gonatus Fabricii Verrill.

Sepia loligo Fabricius, Fauna Grœnlandica, p. 358, 1780, (good description).

Onychoteuthis Fabricii Lichtenstein, Isis, xix, 1818, (t. Gray).

Möller, Krøyer's Tidss., iv, p. 76, 1842.

Loligo Fabricii Blainville, Dict. Sci. Nat., xxvii, p. 138, 1823.

Onychoteuthis ? amœna Möller, Ind. Moll. Grönl., Krøyer's Tidss., iv, p. 76, 1842, (young.)

Gonatus amœna Gray, Catal. Moll. Brit. Mus., i. Cephal. Antep., p. 68, 1849.

Gonatus amœnus G. O. Sars, Moll. Reg. Arct. Norvegiæ, p. 336, pl. 31, figs. 1-15 (excellent); pl. xvii, fig. 2 (dentition), 1878.

Tryon, Man. Conch., i, p. 168, pl. 73, fig. 290, (descr. from Gray, fig. from H. & A. Adams, Genera).

Verrill, Proc. Nat. Mus., iii, p. 362, 1880.

PLATE XLV, FIGURES 1-1b, 2-2d.

Body small, elongated, rather slender, tapering backward; front dorsal edge of mantle extending forward in a blunt lobe or angle. Caudal fin very short, but broad, nearly twice as broad as long, the front edges extending forward beyond the insertion, as rounded lobes, lateral angles subacute, posterior angle obtuse. Arms stout and rather long, the dorsal and ventral pairs stouter than the lateral. All the arms bear four rows of small suckers; those of the two median rows (2c, 2d) are larger than the outer ones, with shorter pedicels, and the very oblique horny ring, having a small opening, is developed into a single, large, hooked tooth on the outer side; around the inner side of the aperture there is a partial circle of small flat scales, in several rows. The suckers of the outer rows (2a, 2b) are about two-thirds as large, with longer and more slender pedicels, and with lateral apertures; the horny ring has about five acute-triangular teeth on the outer margin, and there are several rows of small scales forming a broad circle entirely around the aperture. The tentacular

arms are long and slender, with broader clubs, which bear a large number of minute suckers, much like the outer ones of the arms, arranged in many crowded rows, some of which extend beyond the club along the arm; in the middle (fig. 1*b*) there is usually one or two larger suckers (absent in our specimen) in which the horny ring has a small aperture and is developed into a large hook-shaped claw, on one side, and a complete circle of small plates surrounds the horny ring.

Pen, thin and delicate, narrow anteriorly, with slender lateral ribs; posteriorly, for more than half the whole length, expanded into a thin lanceolate form; posterior tip laterally dilated, with the edges involute (fig. 1).

A young specimen of this species, in nearly perfect preservation, was recently presented to the United States Fish Commission by Capt. William Demsey and crew, of the schooner "Clara F. Friend". It was taken from the stomach of a cod, off Seal Island, Nova Scotia.

Greenland (Fabricius, Möller). Porsangerfjord, northern coast of Norway (G. O. Sars). Coast of Finmark, in stomach of "coal-fish," abundant (G. O. Sars, Norwegian Exp. of 1878).

D'Orbigny, Gray, and other writers have erroneously referred the *Onychoteuthis Fabricii* (based on the *Sepia loligo* of Fabricius) to *O. Banksii*. The detailed Latin description given by Fabricius applies perfectly to the present species, and not at all to *O. Banksii*. He describes the four rows of suckers on the short arms; the small suckers and two large central hooks on the tentacles; the short caudal fin, etc.

Chiloteuthis, gen. nov.

Allied to *Enoploteuthis*, *Lestoteuthis* and *Abralia*, but with a more complicated armature than either of these genera. Sessile arms with sharp incurved claws, arranged in four rows on the ventral arms, and in two rows on the other arms, (distal portions have lost their armature). Tentacular arms long, with broad clubs, strongly keeled externally, and with series of convective suckers and tubercles extending for some distance along the inner surface of the arms. Tentacular club provided with a marginal row of connective suckers, alternating with tubercles, along one margin; with a central row of unequal hooks, some of them very large; with submedian groups of small, slender-pedicelled suckers (or hooks); with marginal series of small suckers; and with several rows of small suckers covering the prolonged distal portion of the face. Connective cartilages on the base of the siphon, simple, long-ovate; the corresponding processes of the mantle are simple longitudinal ridges. The caudal fin, pen, and many other parts are destroyed.

Chiloteuthis rapax, sp. nov.

PLATE XLIX, FIGURES 1-1 f.

A specimen of this remarkable squid, in very bad condition, was taken from the stomach of a fish, trawled at station 893, in 372 fathoms, about 100 miles south of Newport, R. I. It was accompanied by a specimen of *Ommastrephes illecebrosa*, in a similar condition. It had lost its pen, its epidermis, and most of the horny hooks and sucker-rings; the head was detached from the body and the caudal fin was nearly destroyed; the eye-lids were gone, but the eye-balls remained. The description must, therefore, remain imperfect till other specimens can be obtained.

The body was rather short and thick, tapering rapidly backward. The caudal fin appears to have been short-rhomboidal, but this is uncertain. The siphon is large, with an internal valve. The connective cartilages (fig. 1e) on the sides of the base of the siphon are long-ovate, with the posterior end widest and rounded. The corresponding cartilages on the inside of the mantle are simple longitudinal ridges. Head large, with very large eyes; pupils round. The arms are long and taper to slender tips; the dorsal ones are smaller and shorter than the others; the lateral and ventral pairs are nearly equal in length, and about as long as the mantle; the ventral arms are somewhat more slender than the lateral ones. All the arms appear to have borne slender-pedicelled claws or hooks with strongly incurved, horny points, but only the fleshy parts of these are left, in most cases, and the tips of the arms are bare. On the ventral arms these hooks were smaller, and in four rows; the fleshy portion of these consists of a small rounded head, with lateral lobes, running up, on one side, into an incurved beak, so that the shape is somewhat like a bird's head. On the other arms the claws were in two rows only, but they were much larger; in a few cases, on the lateral arms, the horny claws are left. These are strongly compressed and deeply imbedded in the muscular sheath, only the sharp, incurved point projecting (figs. 1c, 1d).

The tentacular-arms (fig. 1) are long and strong, their length being more than twice that of the sessile arms. The club is rather stout, long, decidedly expanded, and has an elevated, crest-like keel on the distal half of its dorsal surface; this keel rises abruptly at its origin, and is colored on the outer side, but white on the face next to the inner surface of the club. The club is broadest near its base, the distal third is narrow and the tip rounded. The armature is remarkable: in the middle line there is a row of six medium sized hooks (fig. 1, a"), followed by two much larger ones (fig. 1, a' a), situated near the mid-

dle; these have lost their horny claws; series of minute, slender-pedicelled suckers run along the club, either side of the median line, and beyond the large hooks these rows unite and entirely cover the face of the distal third of the club (fig. 1, *d*), there forming about eight rows; at the tip there is a circular group of minute suckers (*d'*); toward the base of the club the lower side is expanded and bears a row of five peculiar suckers (fig. 1, *e*), having a marginal series of slender, minute, incurved spinules; these suckers have very thick basal processes, which are appressed and directed toward the central line of the club, bearing the suckers on their inner ends, attached by short pedicels; round connective tubercles alternate with these suckers, in the same row; beyond these there is a triangular marginal group of slender-pedicelled suckers (*c*), of about the same size; other rows of minute pedicelled suckers (or hooks) occupied the sub-median area, between the marginal ones and the central line, which is indicated by a strong white cord. The opposite margin of the club appears to have borne several rows of small suckers, but this part is badly injured. A band of minute papillæ (*e'*), apparently the remnants of suckers and alternating connective tubercles, extends downward for more than half the length of the tentacular-arm; at first this band is like a continuation of the connective suckers and tubercles on the margin of the club, and the papillæ are apparently in a single row, while the surface near them is crossed by fine transverse grooves or furrows; but farther down the arms there may have been two or more rows of suckers, which have been destroyed.

The beak (fig. 1 *f*) is somewhat compressed, with very acute mandibles. The upper mandible has the point long and regularly incurved, with the cutting edge regularly arched, without a basal notch, and forming, with the anterior edge, an obtuse angle. Lower mandible, with a strongly incurved tip and regularly concave cutting edge, having no basal notch, and only a slight tooth on the anterior border, which forms a very obtuse angle with the cutting edge.

Color mostly gone, but where still remaining, as on the back of the tentacular club, it consists of minute purple chromatophores; inner surface of sessile arms purplish brown.

Measurements in millimeters.

Length of body.....	78	Breadth of club.....	7
Length of dorsal arms.....	58	Breadth of tentacular arms.....	5
Length of 2d pair of arms.....	86	Breadth of lateral arms, at base.....	6
Length of 3d pair of arms.....	87	Breadth of dorsal arms.....	5
Length of ventral arms.....	85	Diameter of eye-ball.....	19
Length of tentacular arms.....	225	Length of connec. cartilages on siphon.....	14
Length of club.....	29	Breadth of the same.....	4

Calliteuthis Verrill.

Amer. Journ. Sci., xx, p. 393, for Nov., 1880 (published Oct. 25); Proc. Nat. Mus., iii, p. 362, 1880.

Body short, tapering to a small free tip; fins small, united behind the tip of the body. Siphon united to the head by a pair of dorsal bands; not sunken in a furrow; an internal valve. Mantle united to the sides of the siphon by simple, linear, longitudinal lateral ridges, corresponding with connective cartilages on the sides of the siphon, which are long-ovate, with a raised margin all around. A dorsal elongated connective cartilage on the neck, opposite the pen. Arms long, not webbed; suckers in two rows, largest on the middle of the lateral and dorsal arms; horny rings of suckers smooth on most of the suckers, simply dentate on the distal ones. Eyes large, with rounded openings and thin, free lids. Buccal membrane simple, sack-like, with seven connective bridles. Internal anatomy of the female similar to that of *Ommastrephes*. Oviducts and nidamental glands symmetrically developed on the two sides. Oviducts opening in front of the bases of the gills, the openings simple, long, narrow, oblique. Two long, ligulate nidamental glands, with acute anterior ends, lie, side by side, and a little apart, on the middle of the visceral mass, behind and over the heart; each of these consists of two halves, folded together, and covered on the inner surface with fine transverse laminae; the space between them opens along the outer edge.

Calliteuthis reversa Verrill.

Amer. Journ. Sci., xx, p. 393, Nov., 1880; Proc. Nat. Mus., iii, p. 362, Dec., 1880.

PLATE XLVI, FIGURES 1-1b.

Body rather short, tapering backward, subacute posteriorly; front edge of mantle advancing somewhat in the middle, and forming an obtuse angle; considerably emarginate beneath. Caudal fin small, short, thin, each half nearly semicircular, attached subdorsally, posterior end emarginate and free from the tip of the body, but not extending much beyond it. Head large, flattened above. Eyes very large, with simple, thin, free, circular lids, without any sinns. Openings of the ears, behind the eyes, minute, with a small, erect, clavate, fleshy process of the skin. Arms long, tapering, equal to the length of head and body combined; the lateral pairs are equal; the dorsal and ventral nearly equal, somewhat shorter than laterals; suckers deeper than broad, well rounded, laterally attached by slender pedicels; horny rings with smooth, circular, thin edges, except on the

small suckers, toward the tips of the arms, in which the outer edge is divided into a number of small, narrow, blunt teeth. On the ventral arms, the suckers are much smaller. Basal web rudimentary; a narrow, thin, simple membrane along each side, outside the suckers. Tentacular arms rather slender, compressed, smooth at base, the ends absent. Color reddish brown. The ventral surface of the body, head, and arms is more ornamented than the dorsal surface, being covered with large, rounded verrucæ, their center or anterior half pale, the border, or posterior half, dark purplish brown; upper surface of body with much fewer and smaller scattered verrucæ; a circle of the same around the eyes; inner surfaces of sessile arms and buccal membranes chocolate-brown, tentacular arms lighter; suckers pale yellow with a light brown band. Caudal fin white, translucent. Iris, in the preserved specimen, brown. Gills with the free edge brown, and a brown line on the outer edges of all the laminae.

Total length, to end of lateral arms, 133^{mm}, to base of arms, 67^{mm}; mantle, 51^{mm}; of fin, 17^{mm}; breadth of fins, 24^{mm}; of body, 20^{mm}; diameter of eye-ball, 16^{mm}; length of dorsal arms, 58^{mm}; of second pair, 67^{mm}; of third pair, 68^{mm}; of ventral pair, 60^{mm}; breadth of dorsal arms at base, 5^{mm}; of lateral, 6^{mm}; diameter of largest suckers, 1.2^{mm}.

Dredged by the steamer "Fish Hawk," of the U. S. Fish Commission, at Station 894, about 100 miles south of Newport, R. I., N. Lat. 39° 53'; W. Long. 70° 58' 30", in 365 fathoms.

Mastigoteuthis Verrill.

Bulletin Mus. Comp. Zool., vi, 1881.

Body elongated, tapering to a point, confluent with the caudal fin posteriorly. Caudal fin very large and broad, rhomboidal, occupying about half the length of the body. Mantle fastened to the base of the siphon by an ovate, ear-shaped, elevated cartilage, on each side, fitting into corresponding deep, circumscribed pits on the base of the siphon. Siphon with a bilabiate aperture, an internal valve, and a pair of dorsal bridles. Eyes large, with round pupils; lids free, thin, apparently with a very small anterior sinus. Arms very unequal, the ventral ones much the longest. Suckers small, in two regular rows. Tentacular arms long and round, tapering to the tips, shaped like a whip-lash, without any distinct club; the distal portion is covered nearly all around with exceedingly numerous and minute suckers, which leave only a very narrow naked line along the outside. Pen narrow and bicostate anteriorly, very slender in the mid-

dle; posteriorly much larger, with a long tubular cone. This remarkable genus differs widely from all others hitherto described in the character of the tentacular arms and suckers. This, with the great size of the caudal fin, gives a very peculiar aspect to the species.

Mastigoteuthis Agassizii Verrill.

Bulletin Mus. Comp. Zool., vol. vi, pl. 1, fig. 1; pl. 2, figs. 2, 3-3*g*, 1881.

PLATE XLVIII. PLATE XLIX, FIGURES 2, 3-3*g*.

Body elongated, round anteriorly; posteriorly tapering rapidly to the slender, acute, terminal portion, which is confluent with the caudal fin, to the tip. Front dorsal edge of mantle emarginate in the middle. Caudal fin very large and broad, transversely rhomboidal, obtuse posteriorly, its length, from origin to tip, about equal to half the combined length of the head and body. Eyes large, with thin lids, which appear to have had a distinct but very small sinus in front; pupils circular; iris brown, in alcohol. Sessile arms very unequal; ventral arms much larger and longer than the others, about equal to length of head and body; dorsal arms very small, scarcely one-third the length of the ventral pair; two lateral pairs nearly equal, decidedly longer and stouter than the dorsal pair. A delicate thin, marginal membrane extends along the arms, outside the rows of suckers, to the slender tips. Suckers small, in two regular rows on all the arms, subglobular, with small oblique apertures, surrounded by small horny rings, which have a nearly entire margin, and by several series of minute plates (Plate XLIX, fig. 3*g*).

Basal web, between the arms, very small. In the smaller specimen, which is a male, the right ventral arm is longer than the left, and the tip appears to have been flattened, and the marginal membranes seem to have been wider, with the edges infolded, so as to form a sort of furrow on the outer side, but the suckers are mostly gone, and it is too much injured to be accurately described. Tentacular arms long, more than twice the combined length of the head and body, slender, round, gradually tapering to the tip, like a whip-lash, the distal half of their length covered with very numerous, crowded, minute, pedicelled suckers (fig. 3*l*), which cover nearly the entire surface along the terminal portion, leaving only a narrow naked line along the back, but farther from the tip this naked space becomes gradually wider and the band of suckers narrower, and after these crowded bands of suckers cease, scattered suckers, placed mostly two by two, extend for some distance along the proximal part of the arms. The suckers of the tentacular arms are so small that their form can-

not be seen with the naked eye; they are deep, cup-shaped, with a small circular aperture, supported by a horny rim, which is often armed with two or three sharp teeth on one side (fig. 3e).

Color of body and arms, so far as preserved, in alcohol, deep brownish orange; on the upper side of the back and caudal fin the color is better preserved, and shows small, ocellated, circular spots of orange-brown, with an inner circle of whitish, and a central spot of purplish brown. Similar spots also exist on the head and arms, and also on the lower side of the body, where the color is best preserved.

A considerable amount of a bright orange oily fluid, insoluble in alcohol, exuded from the viscera. Examined by means of the spectroscope this fluid absorbed part of the green, all of the blue, and most of the violet rays. The stomach contained fragments of small crustacea. The pen is pale yellow, thin, and slender anteriorly, with two sublateral costæ, and narrow delicate margins outside the costæ; in the middle it becomes still thinner and narrower, with the margin inrolled; beyond, the margins become much wider and then unite together ventrally, forming a long, hollow, conical portion, extending to the acute posterior tip; this portion is not so broad as deep, and has a slight dorsal keel and ventral groove.

Measurements in millimeters.

	Male.	Male.
Total length to end of sessile arms	137	232
Head and body combined	59	122
Length of body	46	99
Length of caudal fin, from origin	30	60
Breadth of caudal fin	42	75
Breadth of body	15	23
Length of dorsal arms	24	45
Length of 2d pair of arms	33	60
Length of 3d pair of arms	34	60
Length of ventral arms	80	112
Length of tentacular arms	--	312
Breadth of dorsal arms, at base	3	4
Breadth of ventral arms	6	7
Breadth of tentacular arms	2	4
Diameter of eye	7.5	9
Length of pen	--	198
Breadth of pen anteriorly	--	2.25
Breadth of pen posteriorly	--	2.50
Depth of pen posteriorly	--	4.50

Specimens examined.

No.	Locality.	Fath.	When Rec'd.	Name of Vessel.	Rec'd from	Spec. No.	Sex.
24	cccxxv. N.L. 33°25'20"W.Lg. 76°	647	1880	Blake	Mus.Comp.Zool.	1	♂
25	cccxxviii. N.L. 34°28'25"W.Lg. 75°22'50"	1632	1880	Blake	Mus.Comp.Zool.	1	♂

Chiroteuthis Bonplandi D'Orb. (?)

Loligopsis Bonplandi Verany. Acad. Turin, ser. II, vol. i, Pl. 5. (Specimen without tentacular arms, t. D'Orb.).

Chiroteuthis Bonplandi D'Orbigny, Céphal. Acétab., p. 226. (Description compiled from Verany).

Verrill, Bulletin Mus. Comp. Zoöl., vol. viii, Pl. 3, figs. 1-1b, 1881.

PLATE XLVII, FIGURES 1-1b.

A detached tentacular arm, belonging to a species of *Chiroteuthis*, was taken by the U. S. Coast Survey steamer "Blake," in the summer of 1880, at station CCCIII, lat. $41^{\circ} 34' 30''$, long. $65^{\circ} 54' 30''$, in 306 fathoms.

The arm is very long and slender; the length being 780^{mm} (or over 30 inches); its diameter being from 1.5 to 2^{mm}, except near the base, where it is 3^{mm}, and at the terminal club, which is 6^{mm} broad, and 54^{mm} long. The arm is white, with purplish specks, and is generally roundish, except at the club; along the greater part of its length there is a row of rather distant sessile suckers, the distance between them being usually from 12-18^{mm}; these suckers are larger than those of the club and have a nearly flat upper surface and no horny marginal rim. A row of small, simple, scattered pits, perhaps homologues of these suckers, extends up the back side of the club. These smooth suckers evidently serve to unite the tentacular arms together, when used in concert. The club is stouter than the rest of the arm, convex on both sides, and but little flattened; on each side it is bordered by a well developed, marginal membrane, supported by a series of transverse, thickened, but flat, tapering, acute, muscular processes, with their ends projecting beyond the edge of the membrane, as digitations; on the distal half of the club, these are separated by spaces greater than their breadth, but on the proximal portion they subdivide into two or three parts, which become crowded close together, showing only narrow intervals or merely a groove between them. At the tip of the arm there is a thick, ovate, dark purple, spoon-shaped, hollow organ, about 4^{mm} long, with its opening on the back side of the arm. This so strongly resembles the spoon-shaped organ of the hectocotylized arm of some Octopods, as to suggest the possibility of a similar use, for sexual purposes. The suckers are crowded in 4 to 8 indistinct rows. Their pedicels are long and slender, having beyond the middle a large, dark purple, fluted, swollen portion, beyond which the pedicel is more slender; the cup of the sucker is small and deep, with a very oblique, oblong-ovate, lateral opening; horny rim, not distinctly toothed (fig. 1b).

Histioteuthis Collinsii Verrill.

Amer. Journ. Sci., xvii, p. 241, March, 1879; xix, p. 290, 1880.

Tryon, Man. Conch., i, p. 166, 1879, (copied from preceding.)

Verrill, this vol., p. 234, Plate 22, Feb., 1879.

PLATE XXII. PLATE XXVII, FIGURES 3-5. PLATE XXXVII, FIGURE 5.

In addition to the original specimen, figured and described in Part I of this article (see p. 234), another specimen, represented by the jaws alone, has been received by the U. S. Fish Commission, from the Gloucester fisheries. (Lot 843.)

This was obtained on the Western Bank, off Nova Scotia.

Another beak was dredged by the "Fish Hawk," at station 893, south of Newport, R. I., in 372 fathoms.

These jaws agree well in size and all other characters, with those of the original specimen (Pl. XXVII, fig. 4).

Family.—**DESMOTEUTHIDÆ** nov.

For the reception of the genera, *Desmoteuthis* V. and *Tuonius* St., as defined below, I propose to establish this new family, which has hitherto been confounded with *Cranchidæ* and *Loligopsidæ*.

Body much elongated, pointed posteriorly; caudal fin narrow, terminal, mantle united to neck by a dorsal and two lateral muscular commissures. Pen lance-shaped, as long as the mantle, with a long narrow shaft; blade incurved or hooded posteriorly. Œsophagus and intestine very much elongated. Nidamental glands large, symmetrical. Eyes large, protuberant; lids free and simple. No auditory crests. Siphon large, with neither internal valve nor dorsal bridle. Arms with depressed suckers. Tentacular arms with a well-developed club, bearing suckers.

Desmoteuthis, gen. nov.

Tuonius (*pars*) Steenstrup, 1861.

Body very long, tapering backward to a long, slender, acute caudal portion. Caudal fin long, narrow, tapering to a long acute tip. Anterior edge of the mantle united directly to the head, on the dorsal side, by a commissure, so that there is no free edge, medially, and the surface is continuous, as in *Sepiola*; the dorsal commissure extends backward and diverges within the mantle; two additional muscular commissures unite the lateral inner surfaces of the mantle to the sides of the siphon. Eyes very large and prominent, with simple circular lids. No aquiferous pores. Siphon large and prominent, with neither valve nor dorsal bridles. Arms small and short,

subequal, with a basal web and lateral membranes; suckers smallest on the ventral arms, and urceolate; largest and flatish on the middle of the lateral and dorsal arms; feebly toothed. Pen extending the whole length of the body, very slender and of uniform width for more than half the length, then becoming broad-lanceolate, the terminal portion having the edges involute, forming a long slender cone, into which the ovary extends. Nidamental glands large, symmetrically developed on the two sides. Gills small, situated in front of the middle of the body.

The genus *Taonius* was proposed by Steenstrup to include this and *T. pavo* (Les. sp.), but he has never, to my knowledge, definitely defined the genus. As *T. pavo* appears to be generically distinct from the present genus, I propose to retain *Taonius*, with *T. pavo* for its type. By many writers *T. pavo* has been placed in *Loligopsis*, or *Leachia*. Steenstrup himself, formerly referred *D. hyperborea* to *Leachia*. By Tryon, both have been referred back to *Loligopsis*.

Loligopsis, as defined by D'Orbigny, in 1839, included *T. pavo*, as well as the type of *Leachia*, but he referred Lamarck's original type of *Loligopsis* to the genus, as emended by him, only with doubt.

It seems desirable, therefore, to explain this confusion, so far as possible.

Loligopsis Lamarck,* 1812 and 1822, was based only on an imperfect figure, made by Péron, of a small oceanic squid, which had lost its tentacular arms. The supposed character of having *eight arms* was, for him, the only basis for the genus, no others being mentioned. The species (*L. Peronii*) was, however, described very briefly as a small squid with eight equal arms and two posterior, distinct caudal fins, and it was compared to *Sepiola*. It has apparently not been rediscovered by later writers, unless *L. chrysophthalma* D'Orb., be the same species, which is quite possible. The latter, as figured, is a small, *short-bodied species, with distinct, separate, small, caudal fins, which are free from the end of the body*; its mantle-edge is also represented as free, dorsally. This evidently is a generic type distinct from *Taonius* and *Desmoteuthis*. Indeed, it probably will be found not to belong to the same *family*, when actually studied. Therefore it seems necessary to allow the name *Loligopsis* to remain connected with such small, short-bodied species, for which, alone, it was originally used. The genus, in its original sense, cannot yet be regarded as fully established.

* Extr. de Cours de Zoöl., p. 123, 1812 (t. D'Orb.); Animaux sans vert., vii, p. 659, 1822.

Leachia Lesueur, 1821* (= *Perothis* (Esch.) Rathke, 1835), was also based on an *imperfect figure* of a small Pacific Ocean squid, which had likewise lost its tentacular arms. The only generic character given was, as in Lamarek's case, the presence of only eight arms,—a purely fictitious character. The type of this genus was *Leachia cyclura* Les. It has a more elongated body, slender posteriorly, with a more or less rounded caudal fin, the two sides of the fin completely united together and to the posterior end of the body. The third pair of arms is much larger than the others. The anterior dorsal edge of the mantle is represented as *free*, in all the figures, but, according to D'Orbigny, there is an internal, dorsal commissure, and also two lateral ones. The visceral anatomy of one species of this group (*L. guttata* Grant), which D'Orbigny refers, probably correctly,† to the original *L. cyclura*, is pretty well known, and is widely different from that of *Desmoteuthis* (see Pl. XXXIX, fig. 1), as well as from that of *Taonius*, so far as the latter is known.

There can be no doubt whatever as to the generic distinctness of *Leachia*, if the *anatomy* be taken into account. (See the figures of Grant and D'Orbigny.)

Taonius Steenstrup, 1861, (type *T. pavo*). This differs from the two preceding genera in its more elongated form, narrow caudal fin, etc. From *Leachia* and *Desmoteuthis* it differs in the form of its pen. The dorsal edge of the mantle is represented and described as free by D'Orbigny. The anatomical characters are not known.

Desmoteuthis hyperborea Verrill.

Leachia hyperborea Steenstrup, Kongelige Danske Vidensk. Selsk. Skrifter, 5 r., iv, p. 200, 1856 (sep. copies, p. 16).

Taonius hyperboreus Steenst., Oversigt Kgl. Danske Vidensk. Selsk., Forhandlingger, 1861, p. 83.

Verrill, Amer. Journ. Sci., xvii, p. 243, 1879; xix, p. 290, 1880.

Loligopsis hyperboreus Tryon, op. cit., p. 162 (inaccurate translation, after Steenstrup).

PLATE XXVII, FIGURES 1, 2. PLATE XXXIX, FIGURE 1 (anatomy).

♀. Body very long, tapering gradually backward, and ending in a long, slender, acute tail; mantle soft and flabby, with a capacious branchial cavity; anterior dorsal edge advancing somewhat in the

* Journal Philad. Acad., ii, p. 89, pl. 2.

† Tryon criticizes this determination, because Lesueur "describes and figures a smooth species," while *L. guttata* has two rows of curious tubercles on the ventral side. But as Lesueur only described a figure of the dorsal surface, his objection to this identification is absurd.

middle and directly united to the head, so as to leave no free edge medially, by a rather wide commissural band, the sides of which diverge as they extend backward within the mantle. Caudal fin long, narrow, lanceolate, narrowly acuminate to a very long, acute tip; the anterior insertions are wide apart, and the anterior border is rounded. Head short and small, exclusive of the eyes, which are very large, globular, and prominent, their lower sides in contact beneath the head; openings round, looking somewhat downward; pupils large and round; lids thin and simple. Siphon very large and prominent, extending forward between the eyes, but without a special groove; dorsal surface firmly united to the head by a thick commissure, leaving about half the length free; opening large, without any valve.

Arms comparatively small and short, none of them complete, in our specimen, except those of the 3d and 4th pairs, which are nearly equal in length, the ventral ones a little the shortest and most slender; the dorsal and 2d pairs of arms have lost their distal portions, but the parts of the dorsal arms remaining correspond in size with the ventral ones; and those of the 2d pair with the 3d pair. The arms are all united together by a thin, delicate basal web, which extends up some distance between the arms (farthest between the dorsal pair), and then runs along the sides of the arms, as broad, thin, marginal membranes, to the tips. Suckers of the ventral arms smaller and different in form from those of the others, all of them being urceolate, with narrow apertures, surrounded by a slightly enlarged border, and having small horny rings with the edge entire, or nearly so, on the proximal suckers, but on the smaller ones, toward the tip, with a few broad blunt teeth on the outer edge. On the dorsal and lateral arms the basal suckers are ventricose and urceolate, like those of the ventral arms, but along the middle portion of these arms the suckers become much larger, and have a broad shallow form, with wide apertures and expanded bases; the horny rings of these larger suckers are divided into several broad, bluntly rounded teeth on the outer edge; toward the tips of the arms the smaller suckers again become deeper, with more contracted apertures, and with a few more prominent denticles on the rings.

Outer buccal membrane with seven obtuse angles, and united to the arms by eight bridles, or commissures, of which the upper one is double. Exposed part of the beak black; mandibles very acute, strongly incurved.

Pen very thin and narrow, and of nearly uniform width (4^{mm}) for more than half its length; at about four-sevenths of its length, from

the anterior end, it gradually expands laterally into a broad, very thin, lanceolate form, becoming, opposite the broadest part of the fin, 30^{mm} wide, with very delicate lateral expansions and with a pretty strong dorsal keel; farther back it tapers and is very acuminate, the lateral margins becoming involute, so as to form a very long, slender, acute, terminal, hollow cone, extending to the tip of the tail. The anterior end is obtusely rounded and thin; a short distance from the anterior end there are two thin lateral processes, directed forward, to which the commissural muscles were attached.

Color of entire body, siphon, and caudal fin, dark brown, thickly covered with large roundish unequal spots of darker brown, and paler brown, intermixed; head, eyes, arms, and web, dark brownish purple, with crowded chromatophores; suckers yellowish.

Total length, to end of lateral arms, 16 inches; to dorsal edge of mantle, 13; length of head, 1; diameter of eye, 1; length of caudal fin, 5; its breadth, 1.80 inches.*

Measurements in millimeters.

	A. ♀	B.
Length to tip of lateral arms.....	410	---
Length to base of arms.....	354	---
Length to edge of mantle, above.....	330	210
Length of caudal fin.....	127	103
Breadth of caudal fin.....	46	18
Diameter of body.....	57	---
Diameter of eye.....	25	26
Length of 3d pair of arms.....	56	63
Length of ventral arms.....	52	38
Diameter of largest suckers of lateral arms.....	3	5
Length of pen.....	330	---
Of anterior linear portion.....	180	---
Of posterior lanceolate part.....	150	---
Breadth of anterior portion.....	3	---
Breadth of lanceolate part.....	30	---

A. is the specimen described above; B. is the specimen described by Steenstrup from Greenland. The latter had the dorsal arms 40^{mm} long; 2d pair 50^{mm}; tentacular arms 68 and 70^{mm} respectively. The larger size of the suckers of the latter may indicate that it was a male.

Our specimen was taken near the northern edge of the Gulf Stream, W. long. 55°, by Thomas Lee, of the schooner "Wm. H. Oaks," Jan., 1879, and by him presented to the U. S. Fish Commission. Baffin's Bay, Northern Greenland (Steenstrup).

* Some of these measurements are slightly larger than those originally given. This is due to the fact that the specimen has been kept, since first received, in somewhat weaker alcohol, and has become more relaxed in consequence of this, combined with repeated handling.

Notes on the Visceral Anatomy.

PLATE XXXIX, FIGURE 1.

The only specimen of this species obtained had the internal organs considerably injured, but the anatomy is so unlike that of the more common genera of squids, that it seemed to me desirable to figure such parts as are preserved.

This specimen is a female and the large nidamental glands (x' , xx , xx') are symmetrically developed, on the two sides; these are swollen, voluminous organs, composed of great numbers of internal lamellæ; the anterior ones (x') occupy the region around, and in front of the bases of the gills, extending forward and having an oblique, oblong opening (op , op') on the outside of the anterior ends; the posterior ones (xx , xx') are behind the gills and cover the branchial auricles, the oblique, slit-like opening is on the outside of the posterior ends; the gland on the left side (xx') was mutilated; the posterior venacava, in front of r' , passes through the center of the posterior gland (xx). The ovary (ov) is a very long organ, attached to the stomach (s) and to the sides of its long cæcal appendage; it extends far backward to near the tip of the tail, occupying the concavity of the pen (p); it consists of great numbers of small clustered follicles; connected with its anterior end, and attached to the stomach, there is a convoluted tube, probably an oviduct, not shown in the figure; connected with the intestine, near its origin (between s and l), there is a firm, rounded organ (gizzard?), with internal lamellæ, opening into the intestine. The stomach was much mutilated, so that its form could not be certainly made out; its cavity is occupied by numerous longitudinal folds; a very long, sacenlar cæcal appendage, longitudinally plicated within, runs back, along the ovary, into the caudal cavity of the pen. The œsophagus had been destroyed. The intestine (l , h) is very long and slender, internally longitudinally plicated, and externally covered along nearly its whole length, on one side, by close groups of small, glandular follicles (l , l); the posterior portion is closely attached to the ventral edge of the smooth, compressed, oblong-ovate liver (i), and the free, stout, anal end (h) is provided with two slender, tapering cirri. Ink-sac small, pyriform.

The gills (g , g) are small and short, situated far forward, and connected to the ventricle of the heart (H), by long afferent vessels (bo); the branchial auricles (au , au) are rounded, without terminal capsules; the ventricle of the heart (H), as preserved, is small and four-lobed. The largest lobe directed forward and passing into the anterior aorta. The condition of the specimen did not permit the circulation to

be much studied. The two large, fusiform, cellular organs (r' , r') are probably renal in nature; their interior is filled with large, irregular cavities or lacunæ, which appear to be connected with the posterior venæ cavæ (vc'').

Taonius Steenstrup.

Loligo (pars) Lesueur, Journ. Philad. Acad., ii, p. 96, 1821.

Loligopsis (pars) D'Orbigny, Céph. Acétab., p. 320, (*non* Lamarck).

Gray (*pars*), Catal. Moll. Brit. Mus., i, p. 39, 1849.

Taonius (pars) Steenstrup, Oversigt Kgl. Danske Vidensk. Selsk. Forh., 1861, pp. 70, 85.

This genus seems to bear about the same relation to *Desmoteuthis* that *Rossia* does to *Sepiola*. Its relations with *Loligopsis* and *Leachia* have already been discussed (pp. 301, 302). The body is short-pointed posteriorly. The caudal fin is long-cordate, but not slender pointed. The pen is lance-shaped, the anterior portion being long, narrow, of nearly uniform width; posterior end broad-lanceolate, short-pointed posteriorly, and, according to the figures, without a cone at the tip. The anterior dorsal edge of the mantle is represented as free externally, but there is a dorsal commissure within the mantle-cavity, and a lateral one on each side. Arms short, subequal; suckers flat, denticulate; those of the tentacles with sharp, incurved teeth. Eyes large, globular, prominent, lids free and simple.

Siphon with neither valve, nor dorsal bridle. No external ears, nuchal crests, nor cephalic aquiferous pores.

Taonius pavo Steenstrup.

Loligo pavo Lesueur, Journal Acad. Nat. Science Philad., ii, p. 96, with a Plate, 1821.

Loligopsis pavo Ferussac and D'Orb., Céph. Acétab., p. 321, Calmars, Pl. 6, figs. 1-4, (after Lesueur); *Loligopsis*, Pl. 4, figs. 1-8 (details, original).

Binney, in Gould, Invert. Mass., ed. II, p. 309, (but *not* the figure, Pl. 26)

Verrill, Amer. Journ. Sci., xix, p. 290, 1880.

Tryon, Amer. Mar. Conch., p. 9, Pl. 1, fig. 3 (after Lesueur); Man. Conch., i, p. 163, Pl. 68, fig. 252, Pl. 69, fig. 253, 1879 (descr. from Gray, figures from Lesueur and D'Orb.).

Taonius pavo Steenst., Oversigt Kgl. Danske Vidensk. Selsk. Forh., 1861, pp. 70 and 85.

This species differs externally from the preceding in having a much shorter, obtuse, oblong-cordate, fin, instead of a long, slender, pointed one, and by its very distinct coloration. According to Lesueur the general color is carmine-brown, the mantle, head, and arms "covered on every part with very large ocellations, which are connected together by smaller intermediate ones." Length of mantle, 10 inches.

Sandy Bay, Mass. (Lesueur). Newfoundland (Steenstrup). Off Madeira (D'Orbigny).

No instance of the occurrence of this oceanic species on the New England coast has been recorded since the original specimen was described by Lesueur, in 1821. The circumstances connected with the history of his specimen are such as to render it not improbable that some interchange of labels had occurred in his case. Therefore, the New England habitat, for this species, needs confirmation.

Lesueur's statement (loc. cit., p. 94) is that when at Sandy Bay, Mass. (on Cape Ann), in 1816, he saw a "great number" of squids ("*Loligos*") that had been taken by the fishermen for bait, and that: "The beautiful color with which they were ornamented, induced me to take a drawing of one immediately, but not then having leisure to complete it, I took a specimen with me to finish the drawing at my leisure. But recently [in 1821] upon comparing this specimen with my drawing, I was much surprised to perceive that I had brought with me a very distinct species from that which I had observed [*O. illecebrosus*]. I mention this circumstance to explain the cause of the brevity of the following description [of *O. illecebrosus*] taken from my drawing." The drawing was also inaccurate, for the same reason.

Loligo Lamarek, 1779.

Loligo (pars) Lamarek, Syst. Anim. sans vert., p. 60, 1801.

Pteroteuthis (sub-genus) Blainville, Man. Malac., p. 367, 1825.

Loligo (restricted) D'Orbigny, Céph. Acétab., p. 305, 1848.

Body more or less elongated, tapering to a point behind; anterior edge of mantle free dorsally, and prolonged into a lobe, covering the end of the pen. Caudal fin elongated-rhomboidal, united to the sides of the body to the tip. Mantle connected to the neck by a dorsal and two lateral connective cartilages; lateral cartilages of the mantle simple, longitudinal ridges; corresponding cartilages, on the base of the siphon, irregularly ovate, with a median groove. Pen as long as the mantle, anteriorly narrow, with a central keel, and two lateral ridges; posteriorly broad, thin, lanceolate, concave, but not involute. Head rather large; eyes without lids, covered with transparent skin, pupil encroached upon dorsally by the iris; a small pore in front of the eyes; behind the eyes, on each side, there is an oblique transverse, and two longitudinal, erect, thin crests, in relation with the ears. Siphon situated in a shallow groove, united to the head by two dorsal bristles, and furnished with an internal valve. Six buccal aquiferous pores, and a pair of branchial pores, one on

each side, between the bases of the 3d and 4th pairs of arms. Buccal membrane with seven elongated points, covered on their inner surfaces with small suckers; in the female with a special organ (Pl. XXIX, fig. 4, s), below the beak, on the ventral side, for the attachment of the spermatophores.

Sessile arms angular; basal web rudimentary or none; suckers in two rows, oblique, deep cup-shaped; horny rings toothed on the broad side, and surrounded with a median ridge. Male with one of the ventral arms (usually the left) hectocotylized, near the tip, by an enlargement of the bases of the pedicels of the suckers and a decrease, or disappearance, of the cups. Tentacular arms long and strong, with an expanded club, provided with marginal membranes and a dorsal keel; suckers, on the widest part, usually in four rows, those in the two central rows larger, broad urceolate; smaller ones cover the proximal and distal portions; no connective suckers on the club or along the arm.

Oviduct large, developed only on the left side. Nidamental glands large, in front of heart. Eggs in fusiform, gelatinous capsules, attached by one end, and usually radially united into large clusters.

Loligo Pealei Lesueur.

Typical form.

Loligo Pealei Lesueur, Journ. Acad. Nat. Sci. Philad., vol. ii, p. 92, Plate 8, 1821.

Loligo Pealii Blainville, Dict. Sci. Nat., xxvii, p. 144, 1823.

Férussac and D'Orbigny, Céph. Acétab., p. 311, Calmars, Pl. 11, figs. 1-5, Pl. 20, figs. 17-21 (details).

Gray (*Pealii*), Catal. Moll. Brit. Mus., i, p. 71, 1849.

Binney in Gould's Invert. Mass., ed. 2, p. 514, Pl. 25, figs. 339, 340, (figure erroneously referred to *O. Bartramii*).

Verrill (*Pealii*), Report on Invert. Vineyard Id., pp. 440, 635 (sep. copies, p. 341), Pl. 20, figs. 102-105, 1877.

Tryon (*Pealii*), Man. Conch., i, p. 142, Pl. 51, figs. 133-140, (figs. from Fér. and D'Orb., and Dekay).

Verrill, Amer. Journ. Sci., iii, p. 281, 1872; Amer. Naturalist, viii, p. 170 (habits); Amer. Journ. Sci., xix, p. 292, 1880 (descr.).

Loligo punctata Dekay, Nat. Hist. N. Y., Mollusca, p. 3, Pl. 1, fig. 1. 1843 (young).

Binney, in Gould Invert. Mass., p. 513 (after Dekay).

Tryon, Amer. Mar. Conch., p. 14, Pl. 43, figs. 10, 11 (after Dekay).

Variety, borealis Verrill.

Loligo Pealei, var. *borealis* Verrill, Amer. Journ. Sci., xix, p. 292, 1880.

Variety, pallida Verrill.

Loligo pallida Verrill, Rep. Invert. Viney. Id., in Rep. U. S. Com. Fish and Fisheries, i, p. 635, [341], Pl. 20, figs. 101, 101a, 1874.

Loligo Pealei Lesueur (continued).

Tryon, Man. Coneh., p. 143, Pl. 52, figs. 141, 142, (deser., and figs. copied from preceding).

Verrill, Amer. Journ. Sci., xix, p. 292, 1880.

PLATE XXIX, FIGS. 1-4. PLATE XXXVII, FIGS. 1-3 (pens). PLATE XXXIX, FIG. 4 (odontophore). PLATE XL (anatomy). PLATE XLI (anatomy and young). PLATE XLV, FIGS. 3, 4 (young).

Body rather elongated, more or less stout, according to state of distention or contraction,* tapering backward to a moderately acute posterior end, more acute in the male than in the female. Caudal fin long-rhomboidal, with the outer angles very obtusely rounded; and varying, according to age, in the ratio of its length to its breadth, and greatly, also, in the proportion that its length bears to that of the mantle.† The length of the caudal fin, in proportion to that of the body (mantle), although variable, normally increases with age, even after sexual maturity. In this species, with specimens having the mantle from 100 to 125^{mm} long, the ratio of the fin to the mantle usually varies from 1:1.80 to 1:1.90; with the mantle 150 to 175^{mm} long, the ratio usually becomes 1:1.65 to 1:1.75; in the largest specimens, with the mantle, 260 to 400^{mm} long, the ratio varies from 1:1.50 to 1:1.65, rarely becoming 1:1.75. The ratio of the breadth of the caudal fin to the length of the mantle, in the larger male specimens, ranges from 1:2.12 to 1:2.40, varying considerably according to the mode of preservation; in the larger females it varies from 1:1.70 to 1:2.12.

The anterior ventral edge of the mantle recedes, in front of the siphon, in a broad curve, leaving an obtuse angle at either side, opposite the lateral cartilages; from these angles it again recedes, on the sides, in a concave line, and then projects considerably forward, forming a prominent, median, dorsal lobe, which gradually tapers from the base, and then rather suddenly narrows to a point, over the end of the pen; the point, when in its normal position, reaches as far

* The mantle, when the gill-cavity is distended with water, has a larger size than when the water is expelled by the contraction of its walls, which is usually the condition in which specimens die. Moreover, when the large stomach is distended with food, and when the ovary is distended, in the breeding season, with eggs, the form is stouter than usual.

† This variation is largely independent of sex, and is due partly to the ordinary changes during growth; partly to the condition of the muscular tissues at the time of death; and partly to the effects of the alcohol in which they have been preserved. These latter causes, in the case of preserved specimens, more or less obscure the effects of growth in causing the proportions to change.

forward as the posterior border of the eye, or even beyond it. Dorsal connective cartilage long, tapering backwards, with a very prominent, broad, dorsal keel; the anterior end is free and shaped like the end of the pen. Siphon large, rounded anteriorly, with a broad, bilabiate opening; lateral cartilages (Pl. XL, fig. 1, *f'*) long and narrow, subacute anteriorly, posterior end with a thin, rounded, outer lobe; median groove narrow. The connective cartilages of the mantle (fig. 1, *f''*) are simple, longitudinal ridges, fading out gradually posteriorly. Head moderately large, usually narrower than the mantle; smaller in the male than in the female; eyes large; nuchal crests (fig. 1, *ob*) above the ear, formed by longer upper, and shorter inferior, oblique, longitudinal membranes, the two united by a doubly curved, or V-shaped membrane, having its angle directed forward, the whole having a rude, W-shaped form.

Arms large, stout, the three upper pairs successively longer; the ventral ones a little shorter than the third pair, and a little longer than the second pair. All the arms have narrow, thin, marginal membranes, strengthened by strong, transverse, muscular ridges. The first and second pairs of arms are trapezoidal at base; third pair stouter, compressed, with a keel on the middle of the outer side. Suckers in two regular rows on all the arms, deep, very oblique; largest on the lateral arms; those on the ventral arms are smaller, but otherwise similar. Horny rings yellowish, or brownish (white when fresh), strong; on the larger proximal suckers the outer or higher side is divided into about six broad, flattened, incurved teeth, which are blunt, subtruncate, and sometimes even emarginate at tip, remainder of margin nearly even; the smaller suckers, toward the tips of the arms, have the teeth longer, much more slender, and more acute.

The tentacular arm (Pl. XXIX, fig. 2) with fresh specimens, in full extension, may reach back nearly to the end of the body; with preserved specimens it seldom extends beyond the middle of the caudal fin; it is rather slender, compressed, and has a narrow, thin, membranous keel along the outer edge, which becomes wider at the club; on the distal half of the club it is much wider and runs a little obliquely along the back part of the upper side, where it is usually folded down against the side, its inner surface being whitish. The club is rather broad and thick, with a wide, scalloped, marginal membrane along each edge; these membranes are strengthened by transverse muscular ridges, which commence between the large central suckers and fork at the pedicels of the marginal ones. Along

the center of the club there are two alternating rows of large, broad, depressed suckers, about seven in each, with a few smaller ones, of the same series, at both ends; along each edge, alternating with the large suckers, there is a row of smaller and more oblique marginal suckers, about half as large. The proximal part of the club bears only a few small denticulated suckers; the distal part bears a large number of small, sharply denticulated, pedicelled suckers, crowdedly arranged in four rows; close to the tips of the arms about twenty of the small suckers have smooth rims and very short pedicels, but are still in four rows. The large suckers vary greatly in relative size, according to age, sex, season, and locality; they are a little higher on one side than on the other, with a broad aperture, surrounded by a horny, marginal ring, which is divided all around into sharp, unequal teeth, which are larger on the outer side (Pl. XL, fig. 5); usually one minute, sharp tooth stands between two larger ones, and these sets of three stand between still larger and less acute ones; the horny ring is surrounded by a wide, thick, soft, marginal membrane; below the border, a groove surrounds the sucker, and below this there is a basal swelling, equalling or exceeding the margin in diameter. The smaller marginal suckers (Pl. XL, fig. 4a, 4b) have the aperture more oblique and the horny ring much wider on the outer side, with its outer, sharp, marginal teeth longer and more incurved; usually these have the teeth alternately larger and smaller.

The outer buccal membrane (Plate XXIX, fig. 4) is large, thin, with seven prominent, elongated, acute angles, all of which have a cluster of about ten to fifteen, small, pedicelled suckers, in two rows, on the inner surface (*a, b, c, d*). These suckers have horny rings, denticulated on one side. In the female there is a special thickened organ (*s*) in the form of a horse-shoe, on the inner ventral surface of the buccal membrane. This in the breeding season serves for the attachment of the spermatophores by the male.

The muscular pharynx (fig. 4, *e, f'*) containing the jaws can be protruded its whole length. The inner buccal membrane (*f'*) or sheath enclosing the beak (*m*), has a prominent, thickened, radially-wrinkled and puckered anterior margin. On the ventral side the pharynx bears, externally, two thin chitinous plates, not connected with the jaws. The points and exposed edges of the beak are hard and black, becoming dark reddish brown farther back; the alae, gular and palatine laminae are thin and pale yellowish or light amber-color, in alcoholic specimens. The upper mandible (Pl. XXXIV, figs. 4, 4a, *var. pallida*) has a sharp, strongly-incurved point; cutting edge regularly

curved, with a triangular notch at its base, followed by a prominent triangular tooth on the alar edge, beyond which the edge is nearly straight, but recedes somewhat. Lower mandible with a sharply incurved point and sinuous cutting edges, which have a slight tooth below the middle and only a slight rounded notch at base, which passes gradually into the very oblique and receding alar edge. The bilobed palate is covered with a chitinous membrane which bears transparent, small, sharp, recurved denticles.

Odontophore with pale amber-colored teeth, and thin transparent borders. The median teeth (Pl. XXXIV, fig. 3; Pl. XXXVII, fig. 6, *a*; Pl. XXXIX, fig. 4) are broad with a long acute median denticle, and a shorter curved and less acute lateral one, on each side; the inner lateral teeth are short, strongly incurved, with a longer acute central denticle and a smaller outer one, and with the inner angle of the base slightly prominent; the next to the outer lateral teeth (fig. 6, *c*) are much longer, broad, tapered, curved, acute; the outer teeth (fig. 6, *d*) are longer, more slender, more curved, triquetral, and very acute with a large basal lobe. A row of thin, distinct, roundish scales (fig. 6, *e*) forms a border, outside the teeth.

The pen is thin, translucent, pale yellowish, in fresh specimens, but brownish or amber-color in alcoholic specimens. It has a short, narrow, anterior shaft and a long, very thin, lanceolate blade, which is concave beneath, especially posteriorly, for the edges curve downward, but are not involute; the posterior tip is acute, slightly thickened and curved downward, so that the posterior end is shaped something like the forward part of a shallow canoe. In the male the pen is relatively longer and the blade narrower than in the female. The extreme anterior end is thin and flexible, and rather abruptly pointed, being shaped like a pen; the shaft is rather stiff, with a strong, regularly rounded keel, convex above and concave beneath; outside of the keel the marginal portion curves outward and then upward, so that its convex surface is below, and the edge slightly turns up. The shaft, with its central keel and marginal ridges, extends to the posterior tip of the pen, decreasing regularly in width beyond the commencement of the blade. The blade is at first very narrow, and gradually increases in width; it is marked by numerous slightly thickened ridges, which diverge from the central line as they extend backward; the edges are very thin.

In the larger males the proportion of the greatest breadth of the blade to the total length of the pen varies from 1 : 7.50 to 1 : 9.36. In the females it varies from 1 : 5.60 to 1 : 6.10.

The following description of the colors was made from a freshly caught, adult, male specimen (1 G); taken in New Haven Harbor, May 18, 1880.

Upper surfaces of the body, head and caudal fin thickly covered with rather large chromatophores, which are mostly rounded or nearly circular, except along the middle of the back, where they are more crowded and darker, and mostly have a long-elliptical form (perhaps accidental).

The chromatophores, when expanded, are light red to dark lake-red, varying to purplish red and pink; when contracted to small points, they become brownish purple.

On the head, behind the middle of the eyes, and toward the margin of the caudal fin, the spots are smaller and less numerous, the intervening bluish white ground-color showing more largely. Over most of the dorsal surface the chromatophores are arranged more or less evidently in circular groups; usually the central chromatophore is a large, round, dark purplish spot; this is surrounded by a circular space of whitish ground-color; and by a circle of roundish chromatophores, mostly of different shades of lake-red and pink, and a deeper lying circle of pale canary-yellow ones. On the lower side they are so thinly scattered that they leave much of the translucent bluish white ground-color visible between them; along the median ventral line the spots are more numerous, producing a distinct median stripe. The caudal fin is clear bluish white beneath, and very translucent, becoming almost transparent near the margin.

Exposed part of the siphon similar to the ventral surface of the body, but with the spots more sparse, and mostly disappearing near the margin and at the base; lower side of the head, in front of the eyes, sparsely spotted. Outer and upper sides of the upper arms, and outer surfaces of the ventral pair similarly, but somewhat more densely, specked; both sides of the ventral arms and lower sides of the lateral arms pinkish white and unspotted. Tentacular arms pale translucent, bluish white, with the outer surface, except at base, rather thinly specked with small purplish chromatophores; the inner surface and upper side of the tip and the suckers are translucent white; rings of suckers white.

On the inner surface of the dorsal and lateral arms, between the suckers, there are a few large chromatophores, and a double row of them runs out obliquely on the muscular thickenings of the marginal membrane, alternating with the suckers, on each side; suckers pure translucent, bluish white (becoming yellow or brown in alcohol).

The pupils of the eyes are deep bluish black; on the upper side they are encroached upon by a sinuous, downward extension of the iris, which is silvery or pearly white, with brilliant, green, opalescent reflections at the upper margin.

Sexual differences.

The sexes differ to a considerable extent, in proportions. If we compare specimens of equal length, the female will have the body relatively stouter and less tapered posteriorly than the male; the head is decidedly larger,* the arms are longer; the suckers are usually distinctly larger, especially those of the tentacular arms. But if we compare specimens having the head and arms of equal size, the male will be found to have a decidedly longer, more slender and more tapered body, and a somewhat longer and narrower fin. (See table B, for comparative proportions.)

In the adult male the circumference of the head to the mantle-length usually varies from 1:2.55 to 3.45, averaging about 1:3.10; in the female from 1:1.75 to 1:2.45, averaging about 1:2.25.

The ratio of the breadth of the fin to the mantle-length, in the male, varies from 1:2.12 to 1:2.45, averaging about 1:2.25; in the female, from 1:1.70 to 1:2.12, averaging about 1:1.90.

The ratio of the diameter of the largest tentacular suckers to the mantle-length varies, in the male, from 1:50 to 1:90, averaging about 1:65; in the female it varies from 1:36 to 1:54, averaging about 1:45.

The proportion of the length of the dorsal arms to the mantle-length, in the male, averages about 1:3.50; in the female about 1:2.75.

The most marked effect of strong alcohol is to reduce the diameter of the body and the breadth of the caudal fin to a proportionally far greater extent than it does the length of the mantle and fin. Therefore, specimens that have been preserved in too strong alcohol often look like a different species, and the females often resemble the males, on account of their apparently longer and narrower fins and unnaturally slender bodies.

The pen of the female is relatively broader and shorter than that of the male (see table A).

* Some of the nominal European species of *Loligo*, that have been based on the smaller size of the head, arms, and suckers are probably only the males of the common species. The sexual variations in this genus have apparently been very imperfectly understood by European writers generally.

The best and most positive external characters for distinguishing the sexes, are the hectocotylyzed condition of the left ventral arm of the male, near the tip (Plate XXIX, fig. 3, 3a); and the presence, in the female, of a horse-shoe shaped sucker, or place for attachment of the spermatophores, on the inner buccal membrane, below the beak (fig. 4, s). These characters, however, are not present in the very young individuals, and in those with the mantle two or three inches long they appear only in a very rudimentary state.*

A.—Sexual variations in the pen. (Measurements in inches).

	♂ P.	♂ 9V.	♂ 10V	♂ W.	♀ E.	♀ EE.	♀ 17V	♀ An.
Length of pen	10.50	10.20	9.55	8.50	7.75	7.65	7.55	7.50
Length of shaft	1.40	2.10	2.20	2.00	2.00	1.10	1.50	1.50
Length of blade	9.10	8.10	7.35	6.50	5.75	6.55	6.05	6.00
Breadth of shaft . . . . .	.50	.35	.40	.40	.15	.38	.35	.35
Breadth of blade	1.40	1.15	1.02	.98	1.00	1.35	1.25	1.30
<i>Proportions:</i>								
Greatest breadth to length. 1:	7.50	8.86	9.36	8.67	7.75	5.66	6.04	5.76

The specimen marked An. is from Cape Ann, Mass. (*var. borealis*); that marked ♀ E., is *var. pallida* from Astoria, N. Y.; the rest are from Vineyard Sound, Mass.

The adult males have the left ventral arm conspicuously hectocotylyzed (Plate XXIX, figs. 3, 3a) by an alteration and enlargement of the sucker-pedicels and a decrease in the size of the cups of the suckers, some of which usually disappear entirely, especially in the outer row. The modification commences at about the 18th to 20th sucker, by the swelling of the bases of the pedicels; on succeeding suckers this rapidly becomes more marked and the swollen bases of the pedicels become more elongated and gradually become compressed transversely, while the size of the cups rapidly decreases till at about the 28th to 30th they are very minute and rest at the summits of the large, flattened, acute-triangular supports; from the 30th to 35th the cups usually become mere rudiments or disappear, in large males; beyond this the cups again grow larger and the pedicels decrease in size, till the small suckers become normal on the tip of the arm. About twenty-five to thirty of the suckers of the outer row are thus

* Professor Steenstrup formerly advanced the opinion that the males of *Octopus* and other genera of Cephalopods were provided with the hectocotylyzed arm from the first, but this we have not found to be the case. The hectocotylyzed condition of the arm in *Loligo* is developed in proportion to the development of the internal sexual organs, and is first distinctly noticeable in the larger of the young ones taken in autumn, and in the spring, in the young ones that have survived their first winter.

modified in the larger males. Of the inner row, a somewhat smaller number of suckers show distinct alteration, and these are less extensively altered; their pedicels are swollen and their cups reduced, but not to so great an extent, and usually none of the cups are entirely absent.

In young males, with the mantle about 70^{mm} to 90^{mm}, (young of the previous year, or perhaps of the first year, when three to five months old,) these modifications of the suckers begin to appear, at first very indistinctly, by a slight enlargement of the bases of the pedicels and a scarcely noticeable decrease in the size of the cups. In specimens with the mantle 100^{mm} to 130^{mm} long (probably young of the previous year, nine months to a year old) the modification of the suckers, though much less marked than in the adults, is sufficiently distinct, the pedicels having become distinctly longer and stouter, while the cups are evidently reduced in size, but none of them are abortive in such specimens.

Loligo Pealei, var. *borealis* Verrill.

PLATE XXXVII, FIGURE 2 (pen). PLATE XLI, FIGURE 1, (anatomy).

Since this variety was described I have had opportunities to examine a much larger series of specimens from Cape Ann. These show very plainly that this form passes by intermediate gradations, into the typical form, so that it cannot be considered as anything more than a local or geographical variety. The differences in the proportion of the fin to the mantle, noticed in the original specimens, do not hold good, with a larger series. The only varietal character, of much importance, is the relatively smaller suckers, and this is much less marked in most of the later examples than in the former ones, and is a character that varies greatly in the specimens from every locality.*

In the original specimens the 'pen' (Pl. XXXVII, fig. 2) while having the general form of that of *L. Pealei*, tapers more gradually anteriorly, and has a narrower, more tapered, sharper and stiffer anterior tip. The variations in proportion are sufficiently indicated by the measurements given in tables A, B and C, in which those specimens designated as 2 G. to 5 G. were measured while fresh. The one marked An. ♀ is from the lot originally described as variety *borealis*, and illustrates the abnormally small size of the suckers.

* Probably those with abnormally small tentacular suckers are instances in which the arms, the clubs, or the suckers have been lost and afterwards reproduced, as explained below.

Loligo Pealei, var. *pallida* Verrill.

PLATE XXXIV, FIGURES 1-4. PLATE XXXVII, FIGURES 9-11, (suckers).

PLATE XL, FIGURE 1, (anatomy).

This geographical variety or sub-species is distinguished from the typical form chiefly by its shorter and stouter body, in both sexes, its broader and larger caudal fin, and the larger size of the suckers, especially those of the tentacular club.

The caudal fin is broad-rhomboidal, often as broad as long, or even broader than long, in adult specimens. The ratio of the breadth of the fin to the mantle-length, in the larger specimens (with mantle 150^{mm} to 225^{mm} long) is, in the males, from 1:1.75 to 1:2.00, while in *L. Pealei*, of corresponding size, the ratio is 1:2.15 to 1:2.30; in the females of var. *pallida*, of similar size, the ratio varies from 1:1.45 to 1:1.75 (see tables F, G). Tentacular arms long and slender, varying in length according to the amount of contraction, in extension longer than the body, the club or portion that bears suckers forming about one-third the whole length. In a few males the larger suckers on the middle of this portion are not so large as the largest on the other arms, but usually they are twice as large. In some females the principal suckers of the tentacular arms are very much larger than in others, and considerably exceed those of the males of equal length; they form two alternating rows, of eight to ten each, along the middle of the club; external to them there is a row of smaller suckers alternating with them on each side; the suckers toward the tips are very numerous, small and crowded in four rows; at the tip there is a group of about twenty minute, smooth-edged suckers, in four rows. Outside of the suckers, on each side, there is a broad marginal membrane, having the edges scalloped and strengthened between the scallops by strong, transverse, muscular ridges; another membranous fold runs along the back side, expanding into a broad membranous keel or crest near the end. The arms of the ventral pair are intermediate in length between those of the second and third pairs.

Ground-color of the body, head, arms and fins, pale, translucent yellowish white; the upper surface is covered with pale brown, unequal, circular spots, which are not crowded, having spaces of whitish between them; the spots are more sparse on the head and arms, but somewhat clustered above the eyes; entire ventral surface pale, with small, distant, brownish, circular spots, which are nearly obsolete on the siphon and arms. The general appearance of the animal, when fresh, is unusually pale and gelatinous. The pen is broad, quill-shaped, translucent and amber-colored.

A medium-sized male specimen, recently preserved in alcohol, measured 145^{mm} from the base of the dorsal arms to the posterior end of the body; length of body, 120^{mm}; length of caudal fin, 70^{mm}; breadth of fin, 75^{mm}; length of first pair of arms, 42^{mm}; of second pair, 50^{mm}; of third, 60^{mm}; of ventral pair, 53^{mm}; of tentacular arms, 150^{mm}. (For other measurements see tables B to E.)

Astoria, Long Island, 1870, (Robert Benner).

This form has been received, hitherto, only from the western part of Long Island Sound, where it is abundant with the schools of menhaden, on which it feeds.

Reproduction of lost parts.

I have observed in this species, as well as in *Ommastrephes illecebrosus*, numerous instances in which some of the suckers have been torn off and afterwards reproduced. In such examples new suckers of various sizes, from those that are very minute up to those that are but little smaller than the normal ones, can often be found scattered among the latter, on the same individual. It seems to me possible that some of the specimens having the suckers on the tentacular arms unusually small, may have reproduced all those suckers, or still more likely, the entire arm.

I have seen specimens of this species, and also of *O. illecebrosus*, which, after having lost the tips, or even the distal half of one or more of the sessile arms, have more or less completely reproduced the lost parts.* In such cases the restored portion is often more slender and has smaller suckers than the normal arms, and where the old part joins the new there is often an abrupt change in size. Probably this difference would wholly disappear, after a longer time.

An unquestionable and most remarkable example of the reproduction of several entire arms occurs in a small specimen taken off Newport, R. I., Aug., 1880. This has the mantle 70^{mm} long; dorsal arms 22^{mm}, 3d pair of arms 30^{mm}. The three upper pairs of arms are perfectly normal, but both the tentacular and both the ventral arms have evidently been entirely lost and then reproduced, from the very base. These four arms are now nearly perfect in form, but are

* Perhaps the *Dosidicus Eschrichtii* Steenstrup is only an *Ommastrephes* or *Sthenoteuthis* which had lost and partially reproduced the tips of all the arms. Aside from the solid cone of the pen, characters have not been given sufficient to distinguish it generically. My former reference of this species (p. 250) to the *Teuthidae*, was an error, due to the brevity of the original description.

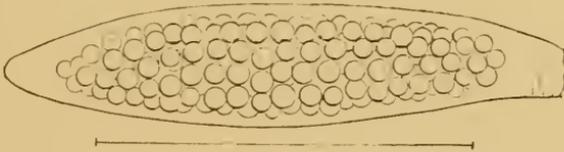
scarcely half their normal size on the left side, and still smaller on the right side. The left tentacular arm is only 24^{mm} long, and very slender, but it has the normal proportion of club, and the suckers, though well formed, are diminutive, and those of the two median rows are scarcely larger than the lateral ones, and delicately denticulated. The right tentacular arm is less than half as long (12^{mm}) being of about the same length as the restored ventral one of the same side; it is also very slender and its suckers very minute and soft, in four equal rows. The right ventral arm is only 14^{mm} long; the left one 15^{mm} long; both are provided with very small but otherwise normal suckers.

In another specimen from Vineyard Sound, a female, with the mantle about 150^{mm} long, one of the tentacular arms had lost its club, but the wound had healed and a new club was in process of formation. This new club is represented by a small tapering acute process, starting out obliquely from the stump, and having a sigmoid curvature; its inner surface is covered with very minute suckers. The other arms are normal.

Eggs and Young.

The eggs are contained in many elongated, fusiform, gelatinous capsules (cut 3), which are attached in clusters by one end to seaweeds or some other common support; from the point of attachment

3.



they radiate in all directions. These clusters are often six or eight inches in diameter, containing hundreds of the capsules, which are mostly from two to three inches long and filled with numerous eggs, the number varying from 20, or less, up to about 200. The transparent eggs are arranged, in the well-formed capsules, in six or more rows and are so closely crowded that they touch each other and often take polygonal forms, especially when preserved.

How many of these capsules are deposited by one female is very uncertain. Probably several females are concerned in the formation of the larger clusters. The eggs are mostly laid in June and July, but many are laid in August, and some even in September. By the

11th of June, in the vicinity of New Haven, many of these eggs contain embryos in advanced stages of development (Plate XLI, figs. 2, 3; Plate XLV, fig. 4). The embryos, before hatching, can swim around inside the eggs.

These embryos are very beautiful objects to observe under the microscope.

Even at this early period some of the chromatophores are already developed in the mantle and arms, and during life, if examined under the microscope, these orange and purple vesicles can be seen to contract and expand rapidly and change colors, as in the adult, but the phenomena can be far more clearly seen in these embryos owing to the greater transparency of the skin. In the young the chromatophores are very regularly and symmetrically arranged, on the arms, head, and mantle. At this stage of development the eyes are brown. In these embryos a remnant of the yolk-sac (*y*), appears to protrude from the mouth, but it is really connected with the space around the mouth and pharynx, and into this it is eventually absorbed.

The more advanced of the embryos were capable of swimming about, when removed from the eggs, by means of the jets of water from the siphon (*s*), which is developed at an earlier stage. The arms (*a''-a'''*) are then short, blunt, very unequal, with few minute suckers; the dorsal arms are very small, while those of the 2d and 3d pairs are successively longer, and have distinct suckers; the tentacular arms (*a'''*) are longer and larger than any of the others, and have larger suckers, which already, in some examples, can be seen to form four rows; the ventral arms (*a''''*) are about as long as the 2d pair, and bear several suckers. The mantle (*m*) is short, and the caudal fins (*f'*) are very small, short, lateral, and separately attached to each side of the blunt posterior end of the body, thus recalling their adult condition in *Rossia*. The eyes (*e*) are large and prominent; the rudimentary beak (*d*) and odontophore (*l*) are distinctly visible. The two otoliths (*o*) are very distinctly visible, as highly refracting ovate bodies, above the basal part of the siphon, one on each side. The ink-sac (*i*), attached to the rectum (*t*), is conspicuous on account of its dark color; the gills (*g*) are provided with a small number of transverse processes; the heart (*h*) and the branchial auricles (*h' h'*) are easily seen, while they continue to pulsate. The pen exists only in a rudimentary condition, as a thin cartilage.

During July and August the young (fig. 5) from less than a quarter of an inch to an inch or more in length, swim free at the surface, and may often be taken in immense quantities with towing

nets. They were particularly abundant in the summers of 1871 and 1873, in Vineyard Sound.

These young squids are devoured in inconceivable numbers by fishes of many kinds, and also by the adult squids of the same species, and by the larger jelly-fishes, and many other marine animals. The larger sizes, and even the adults, are also greedily devoured by blue-fish, black-bass, striped-bass, weak-fish, mackerel, cod, and many other kinds of fishes. Therefore these "squids" are really of great importance as food for our most valuable market fishes. They are extensively used as bait by the fishermen.

Rate of Growth.

I am not aware that any definite information has hitherto been published as to the rate of growth or length of life of any of our Cephalopods. By some writers it has been stated that the squids are all annual, but this seems to be a mere assumption, without any evidence for its basis.

Therefore, I have, for several years past, preserved large numbers of specimens of the young of *Loligo Pealei*, collected at different seasons and localities, in order to ascertain, if possible, the rate of growth and the size acquired during the first season, at least. One of the following tables (I) shows some of the data thus obtained.

There is considerable difficulty in ascertaining the age of these squids, owing to the fact that the spawning season extends through the whole summer, so that the young ones hatched early in June are as large by September as those that hatch in September are in the following spring. Owing to the same cause, most of the large lots of young squids taken in mid-summer include various sizes, from those just hatched up to those that are two or three inches long. They are often mixed with some of those of the previous year, considerably larger than the rest. Earlier in the season (in May and the first part of June), before the first-laid eggs begin to hatch, the youngest specimens taken (60 to 100^{mm} long) are presumed to belong to the later broods of the previous autumn, while those somewhat larger are believed to be from earlier broods of the previous summer, and to represent the growth of one year, very nearly.

Taking these principles as a guide, I have arrived at the following conclusions, from the data collected:

1. The young squids begin to hatch at least as early as the second week in June, on the southern coast of New England, and continue to hatch till the middle of September, and perhaps later.

2. By the second week in July, the first hatched of the June squids have grown to the size in which the body (or mantle) is 30 to 48^{mm} long; but these are associated with others that are younger, of all sizes down to those just hatched. But they begin to show a disposition to go in "schools" composed of individuals of somewhat similar sizes.

3. By the second week in August, the largest June squids have become 50 to 68^{mm} in length of body, and the later broods are 5 to 30^{mm} long. As before, with these sizes occur others of all ages down to those just hatched. It should be observed, however, that in those of our tabulated lots taken by the trawl, the very small sizes are absent, because they pass freely through the coarse meshes of the net.

4. By the second week in September, the June squids have the mantle 60 to 82^{mm} long. All the grades of smaller ones still abound. A few larger specimens, taken the last of August, and in September, 84 to 110^{mm} long, may belong to the June brood, but they may belong to those of the previous autumn.

5. In the first week of November, the larger young squids taken had acquired a mantle length of 79 to 85^{mm}, but these are probably not the largest that might be found. Younger ones, probably hatched in September and October, 8 to 20^{mm} in length of body, occurred in vast numbers Nov. 1, 1874. The specimens taken November 16, off Chesapeake Bay, having the mantle 70-90^{mm} long, probably belong to the schools hatched in summer.

6. In May and June the smallest squids taken, and believed to be those hatched in the previous September or October, have the mantle 62 to 100^{mm} long. With these there are others of larger sizes, up to 152 to 188^{mm}, and connected with the smaller ones by intermediate sizes. All these are believed to belong to the various broods of the previous season. In these, the sexual organs begin to increase in size and the external sexual characters begin to appear. The males are of somewhat greater length than the females of the same age.

7. In July, mingled with the young of the season, in some lots, but more often in separate schools, we take young squids having the mantle 75 to 100^{mm} long. These we can connect by intermediate sizes with those of the previous year, taken in June. I regard these as somewhat less than a year old.

8. Beyond the first year it becomes very difficult to determine the age with certainty, for those of the first season begin, even in the autumn, to overlap in their sizes those of the previous year.

9. It is probable that those specimens which are taken in large quantities, while in breeding condition, during the latter part of May and in June, having the mantle 175 to 225^{mm} long in the females and 200 to 275^{mm} long in the males, are two years old.

10. It is probable that the largest individuals taken, with the mantle 300 to 425^{mm} long, are at least three years, and perhaps, in some cases, four years old. The very large specimens generally occur only in small schools and are mostly males. The females that occur with these very large males are often of much smaller size, and may be a year younger than their mates.

11. When squids of very different sizes occur together, in a school, it generally happens that the larger ones are engaged in devouring the smaller ones, as the contents of their stomachs clearly show. Therefore it is probable that those of similar age keep together in schools for mutual safety.

12. Among the adult specimens of *var. pallida*, taken in autumn, at Astoria, there are several young ones, from 75 to 120^{mm} in length, with rudimentary reproductive organs. These may, perhaps, be the young of the year, hatched in June.

Distribution.

This species is found along the whole coast, from South Carolina to Massachusetts Bay.

It is the *common squid* from Cape Hatteras to Cape Cod. In Long Island Sound and Vineyard Sound it is very abundant, and is taken in large numbers in the fish-pounds and seines, and used, to a large extent, for bait. It is comparatively scarce, though not rare, north of Cape Cod. The young were trawled by us in many localities, in Mass. Bay, in 1878. Large specimens were taken in the pounds at Provincetown, Mass., August, 1879. It was taken in considerable quantities, in breeding condition, in the fish-pounds on Cape Ann, near Gloucester, Mass., May, 1880, (*var. borealis*). It has not been observed north of Cape Ann. Its southern limit is not known to me, but it appears to have been found on the coast of South Carolina.

In depth, it has occurred from low-water mark to fifty fathoms. The eggs have often been taken by us in the trawl, in great abundance, at many localities along the southern shores of New England, in five to twenty-five fathoms.

It is known to be a very important element in the food-supply of the blue fish, tantog, sea-bass, striped bass, weak-fish, king-fish, and many other of our larger market fishes.

B.—Table to show sexual variations. (Measurements in inches.)

<i>Loligo Pealei</i> ♂ and ♀.	♂ 1G	♂ 4V	♂ 6V	♂ 5V	♂ a'	♂ 9V	♂ 8V	♂ 10V	♀ 13V	♀ 1V	♀ 12V	♀ 2V	♀ 11V	♀ 5G	An. ♀	♀ 17V
Length to dorsal mantle edge.....	12.00	11.70	11.50	11.40	11.00	10.30	10.00	9.55	10.00	9.40	8.62	8.30	8.25	8.00	7.30	7.75
Length to base of dorsal arms.....	13.80	13.00	12.50	12.50	12.00	11.50	10.90	10.60	11.40	10.50	9.75	9.50	9.75	9.35	8.20	9.25
Length of dorsal arms.....	3.50	3.15	3.10	3.30	3.25	3.40	2.80	2.70	3.60	3.40	2.82	3.30	3.15	3.10	--	2.80
Length of caudal fin.....	7.90	7.40	7.00	7.10	7.00	6.20	6.10	5.30	6.35	6.20	5.50	5.10	4.75	4.80	4.50	4.80
Breadth of caudal fin.....	5.00	4.90	5.00	4.90	5.00	4.80	4.70	4.15	4.75	4.60	4.50	4.80	4.60	4.10	4.00	4.35
Breadth between insertions.....	1.70	1.10	1.20	1.30	1.50	1.12	1.00	.95	1.50	1.30	0.37	1.40	1.30	1.50	1.15	1.03
Breadth of body.....	--	1.75	1.90	1.70	1.80	--	1.70	1.10	1.90	1.85	1.70	2.00	1.75	--	1.20	1.45
Circumference of body.....	6.00	4.90	5.50	5.30	5.70	5.50	4.90	4.90	5.75	5.50	5.40	5.50	5.15	4.70	--	4.85
Breadth of head, at eyes.....	1.50	1.50	1.30	1.40	1.50	1.42	1.20	1.18	1.60	1.50	1.58	1.40	1.55	1.40	1.40	1.30
Circumference of head, in front of eyes.....	--	3.70	3.40	3.50	4.30	3.50	2.90	2.30	4.25	4.75	3.80	--	3.55	--	--	3.15
Diameter of largest tentacular suckers.....	.18	.19	.16	.18	.22	.20	.11	.11	.23	.20	.19	.21	.19	.15	.08	.15
Diameter of largest of 3d pair of arms.....	.11	.12	.12	.12	.11	.11	.08	.11	.15	.13	.13	.16	.12	.11	.06	.10
Length of pen.....	--	--	--	--	--	10.20	--	9.55	--	--	--	--	--	--	--	7.55
Breadth of pen.....	--	--	--	--	--	1.15	--	1.09	--	--	--	--	--	--	--	1.25
<i>Proportions:</i>																
Fin-length to mantle-length.....	1.51	1.58	1.64	1.60	1.57	1.66	1.63	1.79	1.57	1.51	1.56	1.50	1.73	1.66	1.62	1.61
Fin-breadth to mantle-length.....	2.40	2.38	2.30	2.32	2.20	2.14	2.12	2.28	2.10	2.04	1.91	1.72	1.79	1.95	1.82	1.79
Breadth to length of fin.....	1.58	1.51	1.40	1.44	1.40	1.29	1.29	1.27	1.34	1.34	1.22	1.06	1.03	1.17	1.12	1.10
Circum. of body to mantle-length.....	2.00	2.38	2.09	2.15	1.92	1.89	2.04	1.93	1.74	1.70	1.59	1.50	1.60	1.70	--	1.60
Circum. of head to mantle-length.....	--	3.11	3.38	3.25	2.55	2.91	3.44	4.13	2.35	1.98	2.26	--	2.32	--	--	2.46
Diam. large tent. suckers to length.....	66.66	61.04	71.87	63.33	50.00	51.50	90.90	86.36	43.50	47.00	45.36	39.52	43.42	53.33	91.25	51.66
Length of dorsal arms to length.....	3.43	3.71	3.70	3.45	3.38	3.01	3.57	3.51	2.78	2.76	3.05	2.51	2.61	2.58	--	2.77

The specimens in this table were selected from those that are best preserved. 1G is from New Haven, measured while fresh; 1V to 17V are from Vineyard Sound, recently preserved and in good condition; a' is from Noank, Conn.; 5G is from Cape Ann, Mass., measured before preservation; An. is a specimen from Cape Ann; the latter and 8V, 10V have abnormally small suckers.

C.—Table illustrating variations due to growth, sex, locality and state of preservation. (Measurements in inches.)

	♂ A 1.	♂ 1 G.	♂ a'.	♂ c'.	♂ 6 V.	♂ 3 G.	♂ 2 G.	♂ b'.	♂ 4 G.	♀ 5 G.	♀ g'.	♀ An.
<i>Loligo Pealei</i> ♂ and ♀.												
Typical form and <i>var. borealis</i> .												
Tail to tip of dorsal arms.....	20.75	17.30	15.20	15.75	15.50	15.20	14.70	14.60	13.10	12.20	9.75	10.20
Tail to tip of 2d pair arms.....	21.25	17.70	15.50	16.00	16.00	16.00	15.10	14.80	13.70	12.60	10.05	10.50
Tail to tip of 3d pair arms.....	21.75	18.00	16.00	15.70	16.50	16.30	15.80	15.30	--	13.40	10.50	10.85
Tail to tip of 4th pair arms.....	21.05	17.40	15.30	16.00	15.75	16.00	15.10	15.10	14.10	12.70	10.00	10.50
Tail to tip of tentacular arms.....	24.50	23.00	17.50	20.00	20.50	20.50	19.00	16.90	13.20	15.00	12.50	13.50
Tail to base dorsal arms.....	17.25	13.80	12.00	12.75	12.50	12.30	11.90	.90	10.10	9.35	8.00	8.20
Tail to center of eye.....	.25	12.60	11.20	12.00	11.70	11.75	11.00	10.70	9.50	8.75	7.20	7.50
Tail to mantle edge, above.....	16.25	12.00	11.00	11.00	11.50	11.00	10.50	10.60	8.90	8.00	7.20	7.30
Tail to mantle edge, below.....	15.00	11.00	10.25	--	10.50	10.25	9.75	9.75	--	7.30	6.55	6.70
Tail to insertion of fin.....	9.80	7.90	7.00	7.00	7.00	6.90	6.50	6.60	5.40	4.80	4.35	4.50
Tail to outer angle of fin.....	7.00	5.50	4.75	5.00	--	4.80	4.40	4.50	3.75	3.50	3.15	3.30
Breadth of fin.....	6.85	5.00	5.00	5.00	5.00	4.90	4.50	4.80	4.30	4.10	3.80	4.10
Between insertion.....	2.10	1.70	1.50	1.20	1.20	1.20	1.30	1.48	1.40	1.50	1.20	1.15
Outer angle to insertion.....	4.60	3.25	3.40	3.00	--	3.50	3.20	3.25	2.75	2.70	2.25	2.50
Circumference of body.....	7.20	6.00	5.70	--	--	4.40	4.75	5.30	4.10	4.20	4.25	4.80
Breadth of head, at eyes.....	1.75	1.50	1.50	1.35	1.30	1.30	1.30	1.30	1.40	1.40	1.20	1.40
Breadth of siphon, at cartilages.....	1.30	1.15	1.18	.98	--	--	1.05	1.10	1.95	--	.80	--
Aperture of siphon.....	.45	.35	.40	.40	--	--	.35	.40	.30	--	--	--
Length of dorsal arms.....	3.76	3.50	3.25	3.00	3.10	3.25	2.90	3.10	3.00	3.10	2.30	2.20
Length of 2d pair arms.....	4.20	4.10	3.50	3.20	3.40	3.50	3.30	3.35	3.50	3.30	2.30	2.50
Length of 3d pair arms.....	4.40	4.30	4.00	3.35	3.90	3.75	3.80	3.80	3.90	4.10	2.60	2.85
Length of 4th pair, from base.....	4.10	3.80	3.35	3.25	3.40	3.60	3.40	3.30	3.30	3.60	2.40	2.70
Length of tentacular arms.....	7.10	9.25	5.25	7.00	7.25	8.00	7.00	5.50	7.50	8.50	4.40	6.10

TABLE C.—Continued. (Measurements in inches.)

<i>Loligo Pealei</i> ♂ and ♀. Typical form and <i>var. borealis</i> .	♂ A. 1.	♂ 1 G.	♂ a'.	♂ c'.	♂ 6 V.	♂ 3 G.	♂ 2 G.	♂ b'.	♂ 4 G.	♀ 5 G.	♀ g'.	♀ An.
Length of tentacular club	2.90	2.80	2.60	2.00	2.40	2.60	2.50	2.55	2.50	2.50	1.50	1.85
Breadth of tentacular club	.90	.40	.75	.40	.50	.40	.35	.60	.40	.40	.35	.30
Breadth of dorsal arms	.35	.30	.31	.28	.24	--	.20	.27	--	--	.20	.23
Breadth of 2d pair arms	.50	.35	.33	.30	.34	--	.30	.37	--	--	.30	.33
Breadth of 3d pair arms	.50	.40	.45	.41	.35	--	.33	.43	--	--	.27	.30
Breadth of 4th pair arms	.40	.35	.35	.32	.35	--	.32	.30	--	--	.28	.28
Breadth of tentacular arm	.30	.15	.20	.20	.17	--	.12	.20	--	--	.18	.15
Diameter of eye (external)	1.20	1.10	1.00	--	--	.80	.80	1.00	.65	.65	--	--
<i>Diameter of suckers:</i>												
Largest of tentacular arms	.25	.18	.22	--	.16	.17	.15	.20	.19	.15	.12	.12
Largest of dorsal arms	.13	.08	.11	--	.10	.09	.09	.10	--	.10	.07	--
Largest of 2d pair arms	.15	.11	.13	--	.11	.11	.10	.12	--	.11	.10	--
Largest of 3d pair arms	.15	.11	.14	--	.12	.11	.11	.13	.10	.11	.10	.10
Largest of 4th pair arms	.12	.08	.10	--	.08	.08	.07	.09	.06	.08	.06	--
<i>Proportions:</i>												
Fin-length to mantle	1.65	1.51	1.57	1.57	1.64	1.59	1.61	1.60	1.64	1.66	1.65	1.62
Fin-breadth to mantle-length	2.37	2.40	2.20	2.20	2.30	2.24	2.33	2.20	2.06	1.95	1.89	1.78
Fin-breadth to fin-length	1.43	1.58	1.40	1.40	1.40	1.40	1.44	1.37	1.25	1.17	1.14	1.09
Dorsal arm to mantle	4.39	3.42	3.38	3.66	3.70	3.38	3.60	3.38	2.96	2.58	3.60	3.31
Circumference of body to length	1.1	2.00	1.92	--	--	2.50	2.20	2.00	2.17	1.90	1.69	1.52

A. 1, typical form from Cape Cod, the largest specimen seen; An, g', 2 G to 5 G, = *var. borealis*, from Cape Ann, Mass.; a', b', from Noank, Conn., typical; 6 V, from Vineyard Sound, Mass.; c', typical, from New Haven. Those marked 1 G to 5 G were measured while fresh; the rest, after preservation in alcohol.

D.—Table illustrating variations in the males, due mostly to age, and mode of preservation. (Measurements in inches.)

	Y.	N.	Z.	R.	Q.	B.	E.	D.	S.	P.	G.	oo.	H.	J.	F.	k.	O.
Tail to end of longest sessile arms.....	16.70	16.15	16.30	15.25	14.81	--	14.00	13.65	13.20	14.00	12.40	12.80	12.75	12.30	11.80	12.00	16.30
Tail to mantle edge, above.....	12.00	12.30	11.30	11.30	10.75	10.50	10.50	10.00	9.90	10.10	9.65	9.15	9.10	9.15	8.90	8.30	8.25
Tail to mantle edge, below.....	10.7	11.00	9.35	10.40	9.30	9.75	9.80	--	8.80	9.00	8.10	8.40	8.20	8.50	8.20	7.25	7.50
Tail to insertion of fin.....	7.50	7.90	6.70	6.80	6.90	6.60	6.50	6.35	6.30	6.50	5.80	5.70	5.65	5.60	5.50	5.00	4.95
Tail to eye.....	12.40	11.60	12.00	11.50	10.91	--	10.40	10.15	9.50	10.30	9.20	9.30	9.20	9.20	8.90	8.40	8.00
Tail to base of dorsal arms.....	13.10	11.90	12.75	12.10	11.50	--	11.00	11.00	10.50	11.10	9.95	9.70	9.95	9.95	9.60	9.20	8.60
Eye to end of dorsal arms.....	3.75	3.80	3.20	2.80	3.40	--	3.40	2.80	3.40	3.30	2.70	3.20	3.15	2.50	2.50	3.10	2.55
Eye to end of 2d pair arms.....	3.95	4.10	3.90	3.10	3.55	--	3.60	3.15	3.50	3.55	2.90	3.40	3.20	2.80	2.80	3.30	2.80
Eye to end of 3d pair arms.....	4.30	4.55	4.30	3.70	3.90	--	4.00	3.60	3.70	4.10	3.20	3.50	3.35	3.11	2.90	3.60	2.90
Eye to end of ventral arms.....	4.15	4.30	4.00	3.40	3.60	--	3.50	3.20	3.40	4.10	3.00	3.20	3.30	2.90	2.80	3.20	2.70
Eye to end of tentacular arms.....	7.10	7.80	7.60	6.25	5.60	--	5.00	5.00	5.50	7.00	4.40	4.90	4.65	4.75	5.00	6.80	4.70
Breadth of head, across eyes.....	1.55	1.65	1.45	1.65	1.35	1.30	1.50	1.30	1.30	1.75	1.10	1.30	1.20	1.28	1.25	1.10	1.05
Breadth of head, in front of eyes.....	--	1.45	1.40	1.50	1.35	--	1.15	--	1.20	1.40	.80	1.25	1.05	1.05	1.05	1.00	1.00
Breadth of body.....	--	1.75	1.70	2.70	1.70	1.75	1.60	--	2.60	1.50	1.40	1.60	1.30	1.50	1.40	1.50	1.15
Breadth of fins.....	5.50	5.45	5.60	5.25	5.10	4.50	4.30	4.20	4.30	5.30	4.00	4.20	4.25	4.10	4.25	3.50	3.80
Circumference of body.....	5.45	5.40	5.00	5.15	4.80	--	4.75	4.60	4.80	5.10	4.00	4.75	3.85	4.50	4.25	4.50	3.70
Length of tentacular club.....	2.60	3.85	2.20	2.25	2.00	2.55	1.80	1.75	5.80	2.20	1.60	2.10	1.75	1.70	1.40	1.90	1.30
<i>Proportions:</i>																	
Length of fin to mantle.....	1.60	1.55	1.68	1.66	1.55	1.50	1.61	1.67	1.57	1.56	1.66	1.60	1.61	1.62	1.61	1.66	1.66
Breadth of fin to mantle.....	2.18	2.25	2.01	2.15	2.10	2.33	2.44	2.40	2.30	1.90	2.41	2.17	2.14	2.23	2.09	2.37	2.17
Breadth of fin to its length.....	1.36	1.44	1.19	1.30	1.35	1.46	1.51	1.51	1.46	1.23	1.45	1.35	1.32	1.36	1.29	1.42	1.30

TABLE D.—(Continued). (Measurements in inches.)

<i>Loligo Pealei</i> (♂)	I.	La.	M.	N.	T.	a''.	W.	K.	f.	g.	h.	V.	b''.	c.	d.	e.
Tail to end of longest sessile arms.....	11-15	11-85	11-20	10-35	10-65	11-30	11-70	11-25	11-40	9-90	9-45	9-05	8-65	8-40	7-55	7-00
Tail to mantle edge, above.....	8-20	8-10	7-90	7-80	7-80	7-60	8-20	7-50	7-50	6-30	6-30	5-80	5-70	5-30	4-90	4-15
Tail to mantle edge, below.....	7-65	7-60	--	6-90	7-30	6-80	7-10	7-10	6-70	5-90	5-40	5-05	5-30	4-75	4-50	3-80
Tail to insertion of fin.....	4-95	4-90	5-00	4-80	4-60	4-55	4-40	3-75	3-50	3-75	3-60	3-40	3-20	3-00	2-60	2-20
Tail to eye.....	8-00	8-40	7-90	7-70	8-00	7-50	8-15	7-50	7-60	6-30	6-11	6-40	5-70	5-15	4-90	4-80
Tail to base of dorsal arms.....	8-30	7-90	8-40	8-40	8-40	8-90	8-70	8-25	8-10	7-00	6-55	6-75	6-40	5-75	5-25	4-95
Eye to end of dorsal arms.....	2-80	2-90	2-75	2-30	2-20	3-20	3-05	3-50	3-50	2-90	2-60	2-30	2-40	2-45	2-05	1-95
Eye to end of 2d pair arms.....	2-90	3-30	3-00	2-50	2-55	3-50	3-40	3-60	3-55	3-10	3-00	2-60	2-70	2-60	2-35	2-10
Eye to end of 3d pair arms.....	3-45	3-45	3-30	2-65	2-65	3-80	3-55	3-75	3-80	3-60	3-30	2-65	2-95	2-90	2-65	2-20
Eye to end of ventral arms.....	3-20	3-45	3-10	2-55	2-60	3-45	3-45	3-75	3-80	3-25	3-30	2-60	2-60	2-30	2-35	2-20
Eye to end of tentacular arms.....	6-10	6-30	6-00	3-60	4-20	7-00	6-20	5-65	6-30	6-80	5-30	5-10	6-80	5-45	4-60	4-60
Breadth of head, across eyes.....	1-30	1-00	1-20	1-10	1-15	1-40	1-25	1-20	1-25	1-10	1-10	1-10	1-00	1-10	1-10	1-10
Breadth of head, in front of eyes.....	1-10	1-00	--	.90	1-00	1-35	1-20	1-05	1-25	1-10	.90	.75	.95	.95	.95	.95
Breadth of body.....	1-35	1-35	--	1-30	1-20	1-60	1-50	1-40	1-60	1-25	1-30	1-00	1-40	1-15	1-10	1-00
Breadth of this.....	3-80	3-65	3-50	3-30	3-25	3-70	3-90	3-80	3-70	3-40	3-35	2-85	2-90	2-40	2-50	2-30
Circumference of body.....	4-20	3-80	3-15	3-60	3-40	4-65	4-60	4-05	4-30	3-80	4-15	3-40	3-45	3-35	3-20	2-90
Length of tentacular club.....	1-80	2-00	1-75	1-25	1-50	2-50	1-95	2-10	2-40	2-20	1-95	1-50	1-70	1-80	1-50	1-25
<i>Proportions:</i>																
Length of fin to mantle.....	1	1-65	1-58	1-62	1-62	1-64	1-64	1-64	1-70	1-75	1-77	1-70	1-78	1-76	1-88	1-90
Breadth of fin to mantle.....	1	2-16	2-21	2-25	2-36	2-40	2-06	2-10	1-97	2-03	1-85	2-18	1-96	2-20	1-96	1-86
Breadth of fin to its length.....	1	1-30	1-34	1-43	1-45	1-47	1-24	1-28	1-19	1-19	1-09	1-28	1-40	1-25	1-04	.96

Those marked D-W were taken in Vineyard Sound, May and June, 1876, and were preserved in too strong alcohol, some of them (as T-W) being very much contracted; X, Y, Z, were captured June 6, at the same place, and are in fair condition, though too much hardened by the alcohol. Those marked a-e were taken October 14, 1875, in the pounds at Wood's Holl, Vineyard Sound, and are well preserved; h and k are from Savin Rock, near New Haven; oo is from Noank, Conn.

E.—Table illustrating variations of the female, due mostly to age and mode of preservation. (Measurements in inches.)

	1V.	AA.	12V.	BB.	2V.	11V.	OU.	DD.	EE.	FF.	♀ U.	GG.	HH.
<i>Loligo Pealei</i> ♀. Typical variety.													
Tail to mantle-edge, above.....	9.40	9.10	8.62	8.60	8.30	8.25	7.70	7.95	7.20	7.65	7.40	5.95	6.10
Tail to mantle-edge, below.....	8.50	7.70	7.70	7.70	7.60	7.00	7.00	7.20	6.65	6.80	5.20	5.30	5.50
Tail to origin of fin.....	6.20	5.20	5.50	5.30	5.10	4.75	4.70	4.70	4.40	4.20	4.80	3.60	3.65
Tail to center of eye.....	9.60	9.75	9.00	8.20	8.70	9.15	7.80	8.10	7.60	8.00	3.00	6.00	6.05
Tail to base of dorsal arms.....	10.50	10.10	9.75	9.40	9.50	9.75	8.20	9.05	8.80	8.30	5.20	6.70	6.50
Length of dorsal arms.....	4.00	3.05	2.82	3.60	4.15	3.15	2.60	2.95	3.10	2.35	5.70	1.53	1.76
Eye to tip of dorsal arms.....	4.15	3.40	4.10	4.10	4.40	4.15	2.80	3.10	3.50	3.00	1.90	2.25	2.50
Eye to tip 2d pair of arms.....	4.90	3.55	4.15	5.20	4.85	3.20	3.20	3.40	3.60	3.20	2.20	2.40	2.80
Eye to tip 3d pair of arms.....	4.50	3.55	3.60	4.50	4.50	3.10	2.85	3.45	3.20	3.20	2.20	2.20	2.40
Eye to tip 4th pair of arms.....	10.00	5.30	8.25	5.70	9.00	9.50	4.40	4.45	5.30	5.10	3.05	3.70	5.20
Eye to tip of tentacular arms.....	2.15	2.00	2.30	2.35	2.10	2.55	1.65	1.60	1.75	1.90	1.00	1.30	1.55
Length of club.....	1.50	1.30	1.58	1.40	1.40	1.55	1.30	1.40	1.30	1.25	.90	1.10	1.05
Breadth of head at eyes.....	1.25	1.25	1.30	1.30	1.20	1.20	1.20	1.20	1.10	1.10	1.00	.95	.90
Breadth of head in front of eyes.....	3.80	3.80	3.80	3.80	3.80	3.55	3.55	3.55	3.55	3.55	3.55	2.90	3.00
Circumference of head in front of eyes.....	1.85	1.70	1.70	1.60	2.00	1.75	1.40	1.40	1.60	1.45	3.05	1.10	1.40
Breadth of body.....	4.60	5.15	4.50	4.70	4.80	4.60	4.10	4.10	4.00	3.60	.95	3.10	3.20
Breadth of caudal fins.....	1.37	1.37	1.37	1.37	1.37	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30
Breadth between insertions.....	5.50	5.30	5.40	4.90	5.50	5.15	4.30	4.30	4.80	4.30	3.45	3.45	3.90
Circumference of body.....	.20	.19	.19	.26	.21	.19	.15	.15	.18	.18	.11	.11	.15
Diameter of large tentacular suckers.....	.13	.12	.13	.14	.16	.12	.10	.10	.10	.12	.08	.08	.10
Diameter of largest of 3d pair of arms.....													
Proportions:													
Fin-length to mantle.....	1.51	1.75	1.56	1.62	1.62	1.73	1.63	1.69	1.63	1.82	1.73	1.65	1.67
Fin-breadth to mantle-length.....	2.04	1.82	1.91	1.82	1.72	1.79	1.87	1.95	1.80	2.12	2.03	1.90	1.90
Breadth to length of fin.....	1.34	1.00	1.22	1.12	1.06	1.03	1.14	1.14	1.10	1.16	1.17	1.16	1.14
Circumference to mantle-length.....	1.70	1.71	1.69	1.75	1.50	1.60	1.79	1.80	1.50	1.77	1.72	1.72	1.56
Length of dorsal arms to mantle-length.....	3.05	3.05	3.05	3.05	3.05	2.62	2.62	2.62	2.62	2.62	3.25	3.25	3.46
Tentacular suckers to mantle-length.....	47.00	49.47	45.36	33.07	39.50	43.42	51.33	40.00	42.50	40.00	51.09	40.00	40.66

AA to HH were taken in the fish-pounds at Wood's Holl, Vineyard Sound, in June, 1876, and have been preserved in somewhat too strong alcohol. 1V to 12V were taken at the same place, May 28, 1880, and have been carefully preserved in alcohol of about 80 per cent.

F.—Table illustrating variations of males of var. pallida, due to growth, to the states of contraction when preserved, and to individual peculiarities. (Measurements in inches.)

	I	B	b	Z	A	c	G	E	i	d	e	h	k
<i>Loligo Pealei</i> , var. <i>pallida</i> ♂.													
Tail to edge of mantle, above.....	9.15	9.3	9.	8.7	8.5	8.2	8.	8.	7.95	7.65	7.7	7.9	7.55
Tail to edge of mantle, beneath.....	8.5	8.65	8.25	8.1	7.7	7.6	7.3	7.2	7.35	7.	7.	7.2	6.8
Tail to origin of fin.....	5.8	5.8	5.4	5.25	5.2	5.	5.05	4.9	5.	4.75	4.65	4.7	4.5
Tail to center of eye.....	9.85	9.6	9.3	9.2	8.8	8.7	8.7	8.4	8.3	8.	7.8	8.05	7.8
Tail to base of dorsal arms.....	10.7	10.6	10.25	9.75	9.5	9.6	9.5	9.1	9.35	8.65	8.7	8.8	8.7
Eye to end of dorsal arms.....	4.15	4.45	4.1	3.8	4.2	4.1	4.0	3.8	4.05	3.55	4.	3.5	3.4
Eye to end of 2d pair arms.....	4.7	5.2	4.4	4.3	4.1	4.35	4.2	4.	4.35	4.	4.1	3.9	3.75
Eye to end of 4th pair arms.....	5.2	5.2	4.7	4.55	4.8	5.2	4.5	4.3	4.8	4.3	4.55	4.5	4.15
Eye to end of caudal fins.....	5.	4.7	4.45	4.05	4.5	4.8	4.35	4.1	4.45	4.	4.3	4.05	3.8
Eye to end of tentacular arms.....	10.8	10.3	9.3	9.9	10.15	9.1	9.5	8.9	9.9	9.	8.75	8.75	6.7
Length of club of tentacular arms.....	2.8	2.9	2.6	2.5	2.8	2.75	2.6	2.15	2.5	2.65	2.7	2.6	2.6
Breadth of head across eyes.....	1.5	1.6	--	1.35	1.6	1.45	1.3	1.2	1.2	--	1.4	1.45	1.2
Breadth of head in front of eyes.....	1.2	1.4	1.2	1.15	1.4	1.3	1.2	1.	1.15	--	1.15	1.25	1.05
Breadth of body.....	1.80	2.00	--	1.70	1.6	--	2.10	1.60	--	--	--	1.65	--
Breadth of caudal fins.....	5.00	5.15	4.5	4.60	5.00	4.6	4.50	4.50	4.5	3.9	4.1	4.30	3.75
Circumference of body.....	5.5	5.75	5.	4.9	5.15	5.25	5.25	4.7	5.1	5.	5.05	5.2	4.6
Diam. of largest suckers of club.....	.22	.24	--	.20	.21	--	.23	.18	--	--	--	.21	--
Diam. of largest suckers of 3d pair arms.....	.14	.13	--	.11	.13	--	.12	.12	--	--	--	.13	--
<i>Proportions:</i>													
Length of fin to length of mantle.....	1.57	1.60	1.66	1.65	1.66	1.64	1.58	1.63	1.59	1.61	1.65	1.68	1.67
Breadth of fin to length of mantle.....	1.83	1.80	2.00	1.88	1.70	1.78	1.77	1.77	1.76	1.96	1.87	1.79	2.01
Breadth of fin to its length.....	1.16	1.12	1.20	1.14	1.00	1.08	1.12	1.08	1.11	1.21	1.13	1.06	1.20
Large tentacular sucker to mantle.....	41.59	38.75	--	43.50	40.47	--	34.78	44.44	--	--	--	37.62	--
Circumference of body to mantle.....	1.66	1.61	1.80	1.77	1.65	1.56	1.52	1.70	1.55	1.53	1.52	1.51	1.64

All the specimens included in this table were taken nearly at the same time in the autumn of 1870, at Astoria, Long Island. The measurements are all from the specimens after they had been preserved in alcohol (of about 80 per cent.) for several years. They are only moderately contracted by the alcohol. They were sent to New Haven, in ice, before preservation, so that they were in a relaxed condition when put into alcohol.

TABLE F.—Continued. Table illustrating variations of males of var. pallida.

<i>Loligo Peleci, var. pallida</i> ♂.	J	f	V	W	I	a	K	L	M	Q	S	P
Tail to edge of mantle, above.....	7.3	7.1	6.6	7.	7.10	4.3	4.	4.	3.8	3.7	3.7	3.65
Tail to edge of mantle, beneath.....	6.7	6.5	6.1	6.2	6.30	3.8	3.4	3.4	3.2	3.2	3.3	3.2
Tail to origin of fin.....	4.4	4.	3.9	4.2	4.30	2.3	2.1	2.	2.	2.	1.8	2.
Tail to center of eye.....	7.7	7.55	7.	7.4	7.5	4.75	4.5	4.2	4.05	4.2	3.9	3.9
Tail to base of dorsal arms.....	9.15	8.3	7.3	8.15	1.8	5.2	5.	4.7	4.5	4.6	4.3	4.4
Eye to end of dorsal arms.....	3.7	3.7	3.1	3.5	3.7	2.3	2.	2.15	2.	2.1	1.8	1.8
Eye to end of 2d pair arms.....	4.	3.8	3.7	3.6	4.15	2.5	2.3	2.5	2.2	2.4	1.9	2.1
Eye to end of 3d pair arms.....	4.45	4.1	4.1	4.2	4.55	3.	2.55	2.7	2.5	2.7	2.3	2.6
Eye to end of 4th pair arms.....	4.3	3.8	3.6	4.	4.	2.7	2.2	2.65	2.45	2.4	2.3	2.2
Eye to end of tentacular arms.....	--	9.3	7.7	8.6	9.25	6.45	4.8	5.9	5.9	6.1	5.5	5.25
Length of club of tentacular arms.....	--	2.3	2.	2.4	2.60	1.5	1.3	1.45	1.3	1.2	1.2	1.
Breadth of head across eyes.....	1.1+	1.25	1.2	1.2	1.20	.9	.9	.9	.8	.8	.8	.8
Breadth of head in front of eyes.....	1.1	1.1	1.1	1.	.95	.75	.8	.75	.7	.7	.65	.7
Breadth of body.....	--	--	--	--	1.65	--	--	--	--	--	--	--
Breadth of caudal fins.....	4.1	3.95	3.3	4.	3.90	2.4	2.1	2.5	2.	2.	2.1	1.9
Circumference of body.....	4.7	4.45	4.6	4.75	4.80	3.6	3.3	3.6	3.1	3.25	3.35	3.25
Diam. of largest suckers of club.....	--	--	--	--	.21	--	--	--	--	--	--	--
Diam. of largest suckers of 3d pair arms.....	--	--	--	--	.13	--	--	--	--	--	--	--
<i>Proportions:</i>												
Length of fin to length of mantle.....1:	1.65	1.77	1.69	1.66	1.69	1.86	1.90	2.00	1.90	1.85	2.05	1.85
Breadth of fin to length of mantle.....1:	1.77	1.79	2.00	1.75	1.89	1.79	1.90	1.60	1.90	1.85	1.76	1.92
Breadth of fin to its length.....1:	1.07	1.01	1.18	1.05	1.12	.95	1.00	.80	1.00	1.10	0.85	1.05
Largest tentacular sucker to mantle.....1:	--	--	--	--	33.80	--	--	--	--	--	--	--
Circumference of body to mantle.....1:	1.55	1.59	1.43	1.47	1.47	1.19	1.21	1.11	1.22	1.13	1.10	1.12

G.—Table illustrating variations of females of var. pallidus, due to growth, etc. (Measurements in inches.)

	J	Y	I	X	D	g	m	C	T	U	II	u	F	? sex O	R	N
Tail to edge of mantle, above	8.4	8.15	7.	6.7	6.35	6.25	6.2	5.10	4.65	4.60	4.25	3.9	3.85	3.6	3.6	3.62
Tail to edge of mantle, beneath	7.65	7.35	6.3	6.	5.8	5.75	5.7	4.35	3.9	4.	3.7	3.4	3.35	3.2	3.2	3.1
Tail to origin of fin	5.15	4.8	4.3	4.2	3.9	3.7	3.60	2.8	2.55	2.5	2.30	2.	2.	2.	2.	1.95
Tail to center of eye	8.8	8.5	7.35	7.1	6.5	6.7	6.5	5.25	4.8	4.7	4.3	4.2	4.15	4.	4.	4.
Tail to base of dorsal arms	9.5	9.15	8.2	8.	7.3	7.4	7.15	6.	5.2	5.25	5.	4.45	4.6	4.5	4.3	4.3
Eye to end of dorsal arms	4.15	3.8	3.6	3.3	3.3	3.	3.	2.1	2.05	2.4	2.	1.3	1.9	1.6	1.8	1.8
Eye to end of 2d pair arms	4.5	4.4	4.	3.95	3.8	3.3	3.2	2.5	2.4	2.7	2.2	2.	2.2	2.2	1.9	1.9
Eye to end of 3d pair arms	5.	4.6	4.6	4.3	3.95	3.7	3.7	3.05	2.55	3.15	2.55	2.55	2.65	2.45	2.4	2.25
Eye to end of 4th pair arms	4.5	4.35	4.35	4.25	3.8	3.6	3.7	3.05	2.55	3.15	2.7	2.25	2.55	2.2	2.4	2.25
Eye to end of tentacular arms	10.1	9.3	9.8	9.1	8.9	8.3	8.3	7.1	5.5	6.5	5.45	5.15	5.9	5.2	5.3	5.1
Length of club to tentacular arms	2.9	2.45	2.7	2.6	2.2	2.	2.1	1.6	1.1	1.4	1.2	1.3	1.35	1.1	1.8	1.15
Total length, tail to end of tentacles	19.	17.8	17.1	16.2	--	14.45	15.	12.00	9	11.2	--	9.2	--	9.25	9.25	9.15
Breadth of head across eyes	1.45	1.4	1.3	1.3	1.4	1.1	1.15	1.00	.8	1.	.9	.95	.9	.8	.9	.85
Breadth in front of eyes	1.3	1.3	1.2	1.2	1.1	.9	1.	.85	--	.85	.75	.8	.6	.7	.75	.70
Breadth of body	1.90	1.85	--	--	1.55	--	--	1.40	2.70	--	1.35	--	1.20	--	--	--
Breadth of caudal fins	4.8	4.40	4.1	4.6	4.1	3.5	3.60	3.10	3.75	2.8	2.65	2.45	2.25	2.1	2.25	2.05
Circumference of body	5.5	5.5	4.8	4.9	4.6	4.4	4.4	4.2	4.	4.	4.	3.5	3.5	3.2	3.25	3.05
Diam. of largest suckers of club	.25	.20	--	.22	.17	.18	.16	.15	--	.12	--	--	.08	--	--	--
Diam. of largest suckers of 3d pair arms	.12	.13	--	.12	.10	.11	.11	.8	--	.08	--	--	.05	--	--	--
<i>Proportions:</i>																
Length of fin to length of mantle	1.63	1.69	1.62	1.59	1.62	1.68	1.72	1.82	1.82	1.84	1.84	1.95	1.92	1.80	1.80	1.85
Breadth of fin to length of mantle	1.75	1.85	1.70	1.45	1.64	1.78	1.72	1.65	1.72	1.64	1.60	1.59	1.71	1.71	1.60	1.76
Breadth of fin to its length	1.07	1.09	1.04	.91	.95	1.05	1.00	.90	.94	.89	.86	.81	.88	.95	.88	.95
Largest tentacular sucker to mantle	33.60	40.75	--	30.45	37.35	34.72	38.75	34.00	--	38.33	--	--	48.12	--	--	--
Circumference of body to mantle	1.52	1.48	1.45	1.36	1.38	1.42	1.40	1.21	1.24	1.45	--	1.41	1.10	1.12	1.10	1.18

The specimens included in this table were all taken at Astoria, Long Island. The measurements are all from alcoholic specimens, as in Table F.

1.—Table to illustrate rate of growth of *Loligo Pealei*, young.

Locality.	Depth.	Date.	Length of mantle, in millimeters.	
			Young of the year.	Young of previous year.
Vineyard Sound	Surface	1875-76, July 7	36=25-35mm; 3=45-48mm	10=75-100mm
Vineyard Sound	Surface	July 12	100+=10-20	9=70-100
Vineyard Sound	Surface	July 15	4=50-68	-----
Vineyard Sound	Surface	July 16	500+=10-25	-----
Vineyard Sound	Surface	July 28	500+=10-30	-----
Vineyard Sound	Surface	Aug. 2	200+=15-35	-----
Vineyard Sound	---	Aug. 21	26=27-52	-----
Vineyard Sound	---	Aug. 27	18=23-50	-----
Vineyard Sound	---	Aug. 28	38=25-50; 2=55-63	-----
Vineyard Sound	---	Aug.	30=25-45; 10=47-72	2♀=125-150; 1♂=175
Vineyard Sound	6-20	Sept. 15	3=45-50	2=125-138
Vineyard Sound	---	Oct. 13	-----	1=188
Vineyard Sound	---	Oct. 20	4=88-100	4=112-125
Vineyard Sound	Surface	Nov. 1	1000=8-20; 3=75-82	1=152
Vineyard Sound	Surface	May 15	-----	3=152-188
Vineyard Sound	Surface	June 3	-----	80=62-100; 10=100-152
Newport, R. I.	Shore	1880, July 27	4=28; 5=32-44	5=67-80; 1=95
Narragansett Bay	8	Aug. 6	5=45-50	3=84-100
Off Newport, R. I.	16-26	Aug. 7	54=15-33; 49=32-44; 5=50-62	3=89-108; 2=120-165
Off Newport, R. I.	16-19	Aug. 12	90=15-25; 15=30-40	-----

TABLE I.—Continued. Table to illustrate rate of growth of *Loligo Pealei*, young.

Locality.	Depth.	Date.	Length of mantle, in millimeters.	
			Young of the year.	Young of previous year.
Off Point Judith, R. I.	16	1880, Aug. 13	60=17-38; 90=38-55	1=115; 1=102
Off Point Judith, R. I.	19	Aug. 14	133=16-33; 8=38-44	2=86-87; 2 ♀=105-112
Narragansett Bay	4-12	Aug. 16	33=23-55; 14=50-70; 3=75-82	3=83-95
Off Buzzard's Bay	21	Aug. 17	72=12-28; 5=30-42	-----
Narragansett Bay	6	Aug. 23	2=48-53; 3=70-80	-----
Off Block Island	13	Aug. 24	9=24-36; 8=40-55	-----
Off Block Island	5	Aug. 27	1 ♂=84	1 ♀=110
Narragansett Bay	14	Aug. 31	7=38-46; 2=60-62	-----
Narragansett Bay	3-6	Sept. 1	2=32-46; 11=50-52	-----
Off Cuttyhunk Island	17	Sept. 3	23=32-50; 4=56-58; 1=82	2=130-140
N. lat. 39° 48' 30". W. long. 70° 54'	252	Sept. 13	14=16-30	-----
Off Block Island	-----	Sept.	20=42-55; 10=55-72; 1=110	-----
Off Chesapeake Bay	18	Nov. 16	32	-----
<i>Var. borealis:</i>		1878,		
Massachusetts Bay	10	Aug. 29	1=31	-----
Massachusetts Bay	42	Sept. 16	1=38	-----
Massachusetts Bay	47	Sept. 21	6=28-38; 1=50; 5=62	-----
Massachusetts Bay	43	Sept. 26	2=31-38	-----
		1879,		
Off Cape Cod	15½	Sept. 9	2=38	-----
Off Cape Cod	42	Sept. 26	1=75	-----
Cape Ann	Shore	Oct., '80	5 ♂ 3 ♀=110-156	-----

J.—Specimens examined, mostly adult. To illustrate distribution, etc.

[In last column *ad.* = adult; *br.* = breeding; *in.* = length of mantle in inches; *j.* or *juv.* = young; *lg.* = large.]

No.	Locality.	Fath.	When Collected.	Received from	Specimens.		
					Sex.	No.	
	<i>Typical variety.</i>						
--	New Haven, Conn.	--	1867	Mr. Hooes	1 ♂		
--	New Haven, Conn.	--	----	G. H. Perkins	1 ♂		
--	Near New Haven	Shore	1870	A. E. Verrill	4 ad.		
<i>h, k.</i>	Near New Haven	Shore	1874	A. E. Verrill	♂ 4 ad.		
<i>c'</i>	Near New Haven	Shore	1876	A. E. Verrill	6 ad.		
1G	New Haven harbor	Shore	May 18, 1880	A. E. Verrill	♂ 1 lg. br.		
--	Long Island	Shore	----	C. C. Byrne	1 juv.		
<i>a', b', oo</i>	Noank, Conn.	Shore	August, 1874	U. S. Fish Com.	♂ 3 large		
--	Noank, Conn.	3-4	August 5, 1874	U. S. Fish Com.	4 young		
--	Noank, Conn.	6-8	August 24, 1874	U. S. Fish Com.	8 juv.		
--	Vineyard Sound, Ms.	Shore	July and Aug., '71	U. S. Fish Com.	72 ad.		
--	Vineyard Sound, Ms.	5-8	July and Aug., '71	U. S. Fish Com.	30 ad.		
--	Menemsha	Shore	August, 1874	V. N. Edwards	♂ 1. ♀ 2		
--	Vineyard Sound	Shore	July and Aug., '75	U. S. Fish Com.	7 ad.		
--	Vineyard Sound	5-12	July 12-26, 1875	U. S. Fish Com.	Eggs & y'ng		
--	Vineyard Sound	5-16	Aug. 4, 5, 1875	U. S. Fish Com.	Young		
--	Vineyard Sound	6-20	Sept. 15, 1875	U. S. Fish Com.	5 young		
--	Vineyard Sound	Shore	October 13, 1875	V. N. Edwards	3=5-7.5 in.		
<i>f, g.</i>	Vineyard Sound	Shore	October 14, 1875	V. N. Edwards	3=5-7 in.		
<i>a-e</i>	Vineyard Sound	Shore	October 14, 1875	V. N. Edwards	♂ 5 large		
--	Vineyard Sound	Shore	October 20, 1875	V. N. Edwards	5=4-5 in.		
--	Vineyard Sound	Shore	Nov. 1, 1875	V. N. Edwards	1=6 in.		
--	Vineyard Sound	Shore	April 30, 1876	V. N. Edwards	♂ 10 : ♀ 3		
--	Vineyard Sound	Shore	May 15, 1876	V. N. Edwards	3=6-7 in.		
D-W	Vineyard Sound	Shore	May and June, '76	V. N. Edwards	♂ 15: ♀ 4 ad.		
--	Vineyard Sound	Shore	June 3, 1876	V. N. Edwards	♂ 3=5-6 in.		
X. Y. Z.	Vineyard Sound	Shore	June 6, 1876	V. N. Edwards	♂ 3 large		
AA-HH	Vineyard Sound	Shore	June, 1876	V. N. Edwards	39 ad : ♀ 12		
1V-60V	Vineyard Sound	Shore	May 28, 1880	V. N. Edwards	♂ 48: ♀ 12 br.		
--	Narragansett Bay	Shore	1880	Samuel Powell	10 ad.		
A1	Hyannis, Mass.	Shore	August, 1880	----	♂ 1 very lg.		
--	Narragansett Bay	Shore	July 27, 1880	U. S. Fish Com.	6 j.=3-3.7 in.		
--	Off Newport, R. I.	16-26	August 7, 1880	U. S. Fish Com.	5j.=3.5-6.5 in.		
--	Off Pt. Judith, R. I.	19	August 14, 1880	U. S. Fish Com.	2j.=1.1-1.4 in		
--	Off Cuttyhunk Island	17	Sept. 3, 1880	U. S. Fish Com.	2=5.1-5.5 in.		
--	South of Block Island	252 (?)	Sept. 13, 1880	U. S. Fish Com.	14 juv.		
--	Off Chesapeake Bay	18	Nov. 16, 1880	Z. L. Tanner	32 juv.		
	<i>Variety borealis.</i>						
An.1-3.g	Annisquam, Mass.	Shore	July, 1878	A. Hyatt	♀ 3 ad. br.		
--	Glouce'r, M., tide-pool	Shore	July, 1878	A. E. Verrill	2 juv.		
--	Massachusetts Bay	47	Sept. 21, 1878	U. S. Fish Com.	11 juv.		
--	Off Cape Cod	42	Sept. 26, 1879	U. S. Fish Com.	1 juv.		
--	Provincetown, Mass.	Shore	July, 1879	J. H. Blake	3 large		
2G-15G	Cape Ann, Mass.	Shore	May 18, 1880	A. H. Clarke	15 ad. br.		
--	Cape Ann, Mass.	Shore	October, 1880	A. H. Clarke	♂ 5: ♀ 3 juv.		
--	Salem, Mass.	Shore	----	J. H. Emerton	♂ 1: ♀ 2 ad.		
	<i>Variety pallida.</i>						
A-Z	Astoria, N. Y.	Shore	Nov.-Dec., 1870	Robt. Benner	♂ 17: ♀ 9		
<i>a-t</i>	Astoria, N. Y.	Shore	Nov.-Dec., 1870	Robt. Benner	♀ ♀ 20 ad.		
1-10	Astoria, N. Y.	Shore	Nov.-Dec., 1870	Robt. Benner	♂ ♀ ad.		
--	Gr't Egg Harbor, N.J.	Shore	1872	A. E. Verrill	1, bass stom.		

K.—Specimens examined. Eggs and recently hatched young of *Loligo Pealei*.

Locality.	Fath.	When collected.	Received from	Eggs or Embryos.
Near New Haven	Shore	June 19, 1871	J. E. Todd	Well developed.
Vineyard Sound	5-10	July, Aug. '71	U. S. Fish Com.	All stages.
Long Island Sound	4-8	August, 1874	U. S. Fish Com.	Well developed.
Fisher's Sound	Surf'ce	July 28, 1874	U. S. Fish Com.	Just hatched.
Nantucket Sound	8-12	July 26, 1874	U. S. Fish Com.	Partly developed.
Vineyard Sound	8-16	Aug. 5, 1875	U. S. Fish Com.	Partly developed.
Vineyard Sound	5-10	July, Aug. '75	U. S. Fish Com.	All stages.
Vineyard Sound		Sept. 6, 1875	U. S. Fish Com.	New-laid.
Near New Haven	Shore	June 11, 1880	S. I. Smith	Near hatching.
Off New Haven		Aug. 3, 1880	J. F. Fowle	Half developed.
Gardiner's Bay		June 28, 1880	Sch. G. H. Bradley	New-laid.
Off Newport, R. I.	8	Aug. 6, 1880	U. S. Fish Com.	Fresh and well developed.
Off Newport, R. I.	22-26	Aug. 7, 1880	U. S. Fish Com.	New-laid and hatching.
Off Newport, R. I.	4½	Aug. 16, 1880	U. S. Fish Com.	New-laid and partly dev.
Narragansett Bay	6	Aug. 23, 1880	U. S. Fish Com.	Fresh-laid.
Narragansett Bay	12½	Aug. 31, 1880	U. S. Fish Com.	Partly developed.

In the Gulf of Mexico, this species appears to be replaced by another species (*Loligo Gahi* D'Orbigny). Of this we have several specimens, collected on the west coast of Florida, at Egmont Key, near Tampa Bay, by Col. E. Jewett and Mr. W. T. Coons. This species is closely allied to *L. Pealei*, but has a more slender form, with the caudal fin shorter and narrower in proportion to the length of the mantle. The pen has a shorter and broader shaft and a narrower and more oblong blade, which has parallel, thickened and darker colored portions between the midrib and margins. The tentacular suckers have their horny rings more coarsely and equally toothed, there being only a partial alternation of larger and smaller teeth.

Along our southern coast, from Delaware Bay to Florida, a much shorter and relatively stouter species (*Loligo brevis* Bv.) occurs, which might be mistaken, by a careless observer, for the present species. In addition to its shorter body, it has very different large tentacular suckers, with the teeth on the horny rim coarser and all of similar form and size. Its pen is also shorter and relatively broader, and different in structure.

Notes on the Visceral Anatomy.

PLATE XL, FIGURES 1-3a. PLATE XLI, FIGURE 1, ♀.

The gills (*g*) are large and highly organized in this species, although considerably smaller than in *Onomastrephe*s. The bases of the gills are situated somewhat in advance of the middle of the mantle-cavity, and their tips, in fresh specimens, extend forward nearly to the base of the siphon (*f*). The branchial chamber, behind the heart,

is divided into two chambers by a median, thin, membranous partition.

The branchial chamber is separated from the visceral cavity by a thin, translucent membrane, through which there are two circular openings (*u*), one a short distance in advance of the base of each gill; through these the secretions of the urinary organs (*r*, *r'*) are doubtless discharged. Internally the visceral cavity is divided into several compartments by folds of thin membrane. The largest of these chambers contains the stomach and its cœcal lobe (*S*, *S'*). When the branchial cavity is opened on the ventral side, as in Pl. XL, fig. 1, and the thin membranes covering the viscera are removed, the renal organs (*r*, *r'*) are seen, as large and conspicuous organs, especially if the venous system has been injected with a colored fluid. These organs are situated below, above, and in front of the heart, but two pyriform glands (*r'*, *r'*), which are firmer and have a more compact structure than the rest, extend along the posterior venæ-cavæ. The anterior ones, in front of the heart, consist of a number of groups or clusters of lobulated glandular follicles, developed upon the posterior part of the anterior vena-cava and upon its saccular divisions, on the hepatic veins, on the intestinal veins, and on other large veins going toward the branchial auricles (*au*). Two of the larger divisions (*r*, *r*), which are elongated, and lie below and across the heart and large efferent vessels (*bo*) returning from the gills, arise as direct forks of the vena-cava, which divides just in front of the origin of the intestine; these forks pass each side of the intestine and each gives off a dorsal branch, which runs up along the basal part of the intestine and joins the large saccular renal vessels that lie above the heart, on each side. These dorsal, renal vessels extend backward beyond the heart; they receive the blood from the gastric veins posteriorly and from two hepatic veins anteriorly; laterally, they communicate directly with the branchial auricles.

The ventricular heart (*H*) is a rather large, muscular, median, somewhat unsymmetrical organ, varying in shape according to the state of contraction. Usually it is more or less obliquely four-cornered, with the right side largest and the posterior end more or less conical. From the posterior end arises a large artery, the posterior aorta, which gives off, close to its origin, two small arteries; one of these is median, and goes forward to the ink-sac, passing below the heart; two branches, close to its origin, go to the renal organs (*r*, *r*), on each side; the other, arising laterally, goes to the prostate gland and other organs connected with it, (Pl. XL, fig. 2, *po*). A little farther back

the posterior aorta divides into three large arteries: one of these (*o*) is situated in the median plane, and crossing the branchial cavity in a curved line along the edge of the thin median membrane, supplies the ventral and lateral portions of the mantle, sending branches both forward and backward; the other two main branches (*o'* *o''*) diverge as they go backward and supply the caudal fins and adjacent parts of the mantle. The anterior aorta (*ao*) arises from the right anterior corner of the heart, and goes forward to the head, on the right side of the median line, by the side of the œsophagus, giving off from its sides various small branches. Near its origin it is somewhat bulbous.

The first branch, the gastric artery, arising not far from its origin, sends a branch to the renal organs, and running backward over the dorsal side of the heart, ramifies over both lobes of the stomach. During its passage through the substance of the liver, and along the groove on its dorsal side, the aorta gives off several branches which supply that organ with blood, while one artery, of considerable size, emerges from the postero-dorsal side of the liver and supplies the muscles of the neck; others go out from the anterior part of the liver, laterally and ventrally, to various parts of the head. Ten large branches go to the arms, one running through the center of each to the tip, sending off numerous lateral branches to the suckers and other parts. Other branches supply the various organs of the head. A small artery (fig. 2, *go*) arises from the anterior side of the heart, and turning backward, supplies the spermary (*t*). The large efferent vessels (*branchio-cardiac*) from the gills (*bo*) enter the antero-lateral corners of the heart, their dilated basal portions serving as auricles.

The branchial auricles (*au*), situated just behind the bases of the gills, are nearly globular, with a small, rounded, whitish elevation on the free posterior end; dorsally they receive the blood from the saccular divisions of the anterior and posterior venæ-cavæ (*vc*, *vc'*) and from the veins (*v*, *vc'*) coming from the lateral portions of the mantle, behind the gills; and they give off the large afferent vessels (*bv*) which go to and run along the dorsal side of the gills.

The anterior vena-cava (*vc*) receives the venous blood from a large cephalic venous sinus, which surrounds the pharynx, at the bases of the arms,* and is connected with another large sinus situated at the

* The greater part of the venous system can be easily injected by inserting a canula into this sinus, through the fold of the buccal membranes between the bases of the arms and the jaws, or between the outer and inner buccal membranes. It can also be easily injected through the vena-cava in the lower side of the head.

back of each eye-orbit. This cephalic sinus receives the blood from a large vein in the median line and near the inner surface of each arm. Numerous small veins from the head and eyes also enter this and the ophthalmic sinuses; others, entering the anterior vena-cava, from each side, along its course, come from the muscles of the head, neck and siphon, from the ink-sac, anterior part of the liver, etc. Two veins of considerable size, which become sacculated posteriorly, arise from the intestine and ink-sac and run back to the sacculated divisions of the vena-cava. A small vein also extends along the dorsal side of the efferent sperm-duct (p). Two large pallial veins, uniting together close to the branchial auricles, on each side, come from the sides of the mantle (v, v'); one of these (v') runs from the anterior part backward, and receives a branch (fig. 1) from the gill; the other (v), from the middle and posterior parts forward. The posterior venæ-cavæ (v'') arise mostly in the caudal fins and posterior lateral portions of the mantle; each one receives two large branches, one anterior and the other posterior, just at the point where it leaves the inner surface of the mantle. From this point they run forward parallel with the two posterior arteries, and converge to the region of the heart, where they join the great sacculated venous vessels (r); along a considerable portion of their course they expand and become large, elongated, fusiform organs (r'), probably renal in function, but much firmer, more definite in form, and finer in structure than the more anterior renal organs.

The gills (g) are long, triquetral, acute, in section they are nearly triangular, with the free ventral sides convex, and the dorsal side flat or concave, except along the middle, where a thin median membrane (g) arises from the central stem and unites the gill to the inner surface of the mantle. The gills are composed of large numbers of thin, transverse branchial laminae, which extend outward symmetrically on each side from the large median blood vessels (bo, bv), each lamina having a long-ovate or crescent-shaped outline. A somewhat firm central axis or column gives support to the laminae and the large blood vessels. The great afferent vessel (fig. 1, bv) starts from the branchial auricle (au) and runs along the median-dorsal side of the gill, on the inner edge of the axial column; a parallel vein (fig. 1), near the dorsal edge of the column, runs back and joins the lateral pallial vein (v'). Each branchial leaf receives from the afferent vessel (bv), a branch which runs along the dorsal edge, giving off at regular intervals small, transverse, parallel branchlets, which in turn give off minute capillary vessels along their sides, and fade out near

the ventral border of the laminæ. Parallel with these arise small, capillary, efferent vessels, which join larger transverse vessels, between and parallel with the afferent ones; these in turn join the larger efferent vessel that runs along the ventral edges of the laminæ, and these marginal vessels pour their contents into the large branchio-cardiac vessel (*bo*) which runs along the middle of the gill, on the ventral side, and carries the purified blood to the heart.

The buccal membranes, the pharynx, with its horny jaws, the odontophore, armed with seven rows of recurved teeth on the radula, and the thin, chitinous, lining membrane, which has numerous sharp, scattered, recurved teeth, both on the palate and in the throat, have already been described (pp. 311, 312). The œsophagus is a long, narrow, but dilatable tube, having two oblong salivary glands attached to it, within the bilobed anterior end of the liver (*l*); it then runs backward in a groove along the dorsal side of the liver, to a point beyond its middle, where it passes obliquely through the liver, accompanied by the aorta (*ao*), and dorsally enters the stomach (*S*). The stomach consists of three parts, which are often sufficiently distinct externally, when the stomach is empty, or nearly so, but when it is greatly distended with food (as often happens), the apparent divisions almost disappear and the whole becomes one great, long-pyriform sac. The first division (*S*) or 'true stomach,' is plicated internally and has thickened glandular walls. It is supplied with blood by a conspicuously ramified vessel, the gastric artery (*so*). This lobe of the stomach is sometimes contracted into a firm glandular mass, strongly constricted where it joins the more saccular second stomach; but I have seen specimens greatly distended with food in which it was scarcely or not at all distinguishable as a lobe, and seemed as thin and saccular as the other parts. The remainder of the stomach (*S'*) usually has the form of a long, more or less swollen, ovate sac, tapering backward to a somewhat acute posterior end, which reaches back nearly to the end of the body; anteriorly its most swollen portion is about opposite the junction with the first stomach, and just behind the heart; from this swollen portion it narrows rapidly, but extends forward along the posterior part of the liver, above and in advance of the heart, where it gives off the intestine. The more swollen anterior portion (*k*), of this sac, the second stomach, has a glandular lining and is distinctly radially plicated, and is, therefore, clearly anatomically distinguishable from the thin and non-plicated posterior portion, or cæcal lobe, (*S''*) which seems to serve mainly for the temporary storage of large quantities of food.

The intestine (*h*) is a rather wide and thin tube, of moderate length; the anal orifice is provided with two slender, clavate papillæ. The ink-sac (*i*) is large, long-pyriform, with a long tapering duct (*i'*) terminating just within the anal orifice. The liver (*l*) is a long, rather narrow, somewhat fusiform organ, slightly bilobed anteriorly and pointed posteriorly; along about two thirds of its length, from the anterior end, there is a deep dorsal groove, in which the œsophagus and aorta are situated, before they pass through its substance; the posterior end is simple and pointed.

In the appearance and structure of the internal reproductive organs the sexes differ greatly. In the female (pl. XL, figs. 3, 3*a*; pl. XLI, fig. 1), the single large oviduct (*od*, *od'*), situated on the left side, passes over the dorsal side of the base of the gill and terminates in a large ear-shaped external orifice (*op*), nearly surrounded by a broad membranous flap. The portion of the oviduct behind the base of the gill is enveloped by a large, swollen, bilobed, nidamental gland (*x'*), which is abundantly supplied with blood-vessels, and internally is composed of a large number of thin, close, parallel lamellæ. Two very large, oblong, accessory nidamental glands (*xx*) lie, side by side, loosely attached, nearly in the middle of the ventral side, covering and concealing the heart and most of the renal organs; each of these has a groove along the ventral side and a slit in the anterior end; internally they are composed of great numbers of thin lamellæ. In front of, and partially above the anterior ends of these, and attached to the intestine and ink-sac, there is another pair of accessory glands (*x*), roundish in form, with a large ventral opening, and having, in fresh specimens, a curiously mottled color, consisting of irregular red and dark brown blotches, on a pale ground. Their internal structure is made up of fine follicles.

The ovary (*ov*) is large and occupies a large portion of the cavity of the body posteriorly, running back into the posterior cavity of the pen, and in the breeding season, extending forward nearly to the heart. In the breeding season, the thin convoluted portion of the oviduct (*or'*) is found distended with great numbers of eggs. At the same time the large glands (*x'*), around the oviduct, and the accessory nidamental glands (*x*, *xx*), destined to furnish the materials for the formation of the egg-capsules, and for their attachment, are very turgid and much larger than at other times.

The male (Pl. XI, figs. 1, 2) has no organs corresponding in position to the two pairs of accessory nidamental glands of the female, but the single efferent spermatic duct or 'penis' (*p*) occupies the same

position, on the left side, as the terminal part of the oviduct of the female. It is, however, a much more slender tube, extending farther forward beyond the base of the gill, and its orifice is small and simply bilabiate. It extends backward, over the dorsal side of the base of the gill, to a bilobed, long-pyriform organ, consisting of a spermatophore-sac (*ss*) and a complicated system of glands and ducts (*pr*, *vd*), united closely together and enclosed in a special sheath; in these the spermatophores are formed. These organs consist of the following parts:

1. The vas-deferens (*vd*), which starts posteriorly from a small orifice (not figured) in the thin sheath of peritoneal membrane (*pt*) investing the testicle (*t*); it passes forward along the side of the spermatophore-sac, to which it is closely adherent, and throughout most of its length it is thrown into numerous close, short, transverse, flattened folds; anteriorly it joins the vesiculæ-seminales.

2. The vesiculæ-seminales (fig. 2, *pr*, in part) consist of three large curved vesicles, closely coiled together, and having thickened, glandular walls; the first two are short and broad, the third is elongated; from the latter goes a short duct, which unites with the duct from the prostate gland to form the spermatic duct.

3. The prostate gland (*pr*, in part) is broad-ovate and consists of two rounded lobes, one large and the other small, which are closely united to and enclosed between the vesiculæ-seminales.

4. The spermatic duct, formed by the union of the ducts from the vesiculæ-seminales and prostate glands, is a nearly straight tube; it passes backward between the prostate glands and spermatophore-sac, close alongside of the vas-deferens (*vd*), to which it is closely bound down; it enters the spermatophore-sac (*ss*) near its posterior end, at an acute angle. Even at its origin it contains spermatophores.

5. The spermatophore-sac (*ss*) is a long, capacious, pyriform or somewhat fusiform, thin-walled sac, pointed at its posterior end; its anterior end is directly continuous with the long efferent duct (*p*), which is often rather wide at its origin, but tapers to a narrow anterior end. The terminal orifice is slightly bilabiate.

These organs receive blood through a special artery (fig. 2, *po*) which arises from the posterior aorta just back of the heart. After reaching the genital organs it divides into several branches: one goes forward along the side of the efferent duct; one to the prostate glands and vesiculæ-seminales; one to the vas-deferens and adjacent parts.

Specimens taken in May, in the breeding season, have the efferent

duct and the spermatophore-sac crowded with the spermatophores. In the spermatophore-sac, which is then much distended by them, they lie closely packed in a longitudinal position, with their larger ends pointing somewhat outward toward the surface, and can be plainly seen through the transparent walls of the sac.

The spermatophores are slender, club-shaped, with the larger end rounded, tapering gradually to the smaller end, which is usually a little expanded at the tip and has a very small filament. They vary (in alcohol) from 8 to 10^{mm} in length and from .4 to .5^{mm} in the greatest diameter. They contain a coiled rope of spermatozoa in the larger end, and a complicated apparatus for automatically ejecting this rope, in the smaller portion.

The 'testicle,' or spermary (*t*), is a compact, pale yellow, long, flattened organ, extending from the stomach (*S*) nearly to the end of the pen, in the posterior concavity of which it lies; a band of fibrous tissue, continuous with its sheath, extends from its posterior end into the hollow tip of the pen, to which it is attached. An arterial vessel, the spermatic artery (Pl. XL, fig. 2, *go*), which arises directly from the anterior edge of the heart, runs along the median dorsal line of the spermary and sends off numerous branches to the right and left (fig. 2, *t*). This artery is accompanied by a spermatic vein which is closely united to it.

Loligo brevis Blainville.

Loligo brevis Blainv., Journ. de Phys., March, 1823 (t. D'Orb.); Diet. des. Sci. nat., vol. xxvii. p. 145, 1823.

D'Orbigny, Céphal. Acétab., p. 314. *Loligo*, pl. 13, figs. 4-6 (copied from Lesueur), pl. 15, figs. 1-3 (orig.); pl. 24, figs. 14-19 (orig.)

Tryon, Man. Conch., i, p. 142. pl. 52, figs. 143, 144 (after D'Orbigny.)

Loligo brevipinna Lesueur, Journ. Acad. Nat. Sci. Philad., vol. iii, p. 282, plate 10, figs. 1-3, 1824.

Tryon, Man. Conch., i, p. 142, pl. 51, figs. 128-130 (after Lesueur.)

A small, short-bodied species, with short, rounded caudal fins, very short upper arms, and large chromatophoric spots. Body short, thick, well-rounded, rather blunt posteriorly. Anterior edge of mantle with a well-developed median dorsal lobe, and well-marked lateral angles. Fins broad transversely, short, less than half the length of the mantle; outer edges well-rounded; posterior end very obtuse. Arms all short, the two upper pairs much shorter than the two lower, the dorsal pair very short, considerably shorter than the upper lateral ones; ventral and lower-lateral arms nearly equal in length. The dorsal arms are strongly compressed, with a well-marked thin dorsal keel; those of the second pair squarish at base,

without a keel; those of the third pair are strongly compressed, bent outward at base, and furnished with a high median keel, starting from the base, but highest in the middle; ventral arms triangular at base, with a wide membrane on the upper angle, which expands at the base, and connects them with the third pair; a narrower membrane runs along the ventral margins. Tentacular arms rather stout at base; compressed farther out, in extension about as long as the body; club well-developed, about twice as broad as the rest of the arm; its dorsal keel is thin, elevated, oblique, commencing at about the middle of the club and extending to the tip. The larger tentacular suckers are very regularly arranged in four rows, of 8 to 10 each, the lateral ones being not very much smaller than the median ones. The distal part of the club is covered with four regular rows of small suckers, and there is a terminal group of smaller, smooth-rimmed ones. The larger median suckers are broad cup-shaped, rather larger than the largest suckers of the lateral arms; their horny rims are armed with regular, sharp, incurved teeth, smaller on the inner side of the sucker, but there are few or no small teeth alternating with the larger ones. The lateral suckers are relatively large, deep cup-shaped, oblique, with very sharp incurved teeth on the outer margin. The membranous borders of the large suckers are covered with minute, sharp, chitinous scales.

The suckers of the short arms are very deep and oblique, cup-shaped; their rims are much the highest on the outer and distal side, where the edge is divided into several broad, bluntly rounded denticles, separated by narrow intervals.

The pen is short, with a broad-lanceolate blade; the narrow part of the shaft is short; a thin border, widening backward to the blade, commences about half way between the tip and the proper blade; the latter is broad and thin, marked with divergent lines; posterior end obtuse.

The color is peculiar. It consists, in alcoholic specimens, of dark purplish chromatophores, pretty uniformly and regularly scattered everywhere on the body, on a pale ground-color; when expanded the chromatophores are large and rounded; above the eyes they are so closely crowded as to form dark blotches; they also cover the outer surfaces of all the arms; under side of caudal fin white.

In alcohol, a medium-sized specimen measures, from tip of tail to base of dorsal arms, 80^{mm}; total length of mantle 71^{mm}; breadth of body, 22^{mm}; breadth of caudal fin, 52^{mm}; length of fin, 39^{mm}; length of dorsal arms, from base, 17^{mm}; of second pair, 23^{mm}; of 3d pair, 31^{mm}; of ventral arms, 31^{mm}; of tentacular arms, 46^{mm}; of club, 22^{mm}.

One specimen (♀) from Charlotte Harbor, Fla., is much larger than usual. It has the mantle 130^{mm} long; diameter of body, 36^{mm}; length of dorsal arms, 45^{mm}; of 2d pair, 55^{mm}; of 3d pair, 65^{mm}; of tentacular arms, 145^{mm}.

This species appears to have a wide distribution along the warmer parts of the American coast. The original specimen, described by Blainville, was from Brazil. D'Orbigny records it from Rio Janeiro. It extends northward to Delaware Bay. I have also seen specimens from Florida and from Mobile Bay, Alabama.

Loligo brevis.—Specimens examined.

No.	Locality.	Collected by	When rec'd.	Rec'd from.	Specimens. No.	Sex.
	Hampton, Va.	Dr. Marmion	1880	U. S. Nat. Mus.	1	♀
	St. John's River, Fla. . . .	S. F. Baird	----	" " "	1	♀
41	Charlotte Harbor, Fla.	-----	----	Mus. Comp. Zoöl.	2	♀
641	Mobile, Alabama	Dr. Nott	Jan. 1857	" " "	3	♀
	Texas	Wurdeemann	----	" " "	6	

Sepioteuthis sepioidea D'Orb.

Loligo sepioidea Blainville, Dict. Sci. Nat., xxvii, p. 146, 1823.

Sepioteuthis sepioidea D'Orbigny, Céph. Acétab., p. 298, *Sepioteuthes*, pl. 7, figs. 6-11; Hist. L'île de Cuba, Moll., p. 34, 1853.

Gray, Catal. Moll. Brit. Mus., i, p. 81, 1849.

Tryon, Man. Conch., i, p. 153, pl. 63, fig. 216. (Description copied from Gray; figure from D'Orbigny).

Although this species has not been recorded from north of Cape Hatteras, it is introduced here, because its common occurrence at the Bermudas and Florida renders it probable that it will, at times, be found farther north.

It differs from the related species in having a pen without any marginal thickenings; the lateral fins commence at a short distance behind the mantle edge (5^{mm} to 8^{mm}) and, taken together, have a long-rhomboidal figure, broadest nearly in the middle, and obtuse posteriorly; the sessile arms have wide marginal membranes; the dorsal arms are compressed, and much shorter than the others; the lower lateral arms are much the largest, with a strong dorsal keel; the suckers on the sessile arms are so crowded as to appear almost as if in four rows.

The tentacular club bears four regular rows of large suckers, the median ones but little larger than the lateral; small distal suckers in four regular rows, the lower ones largest. The larger suckers have regular, rather long and slender teeth, those on the inner edge

smaller. The suckers of the sessile arms are deep, very oblique, with a high rim, which has on the outer margin a number of regular, long, slender teeth, rather close together.

The whole surface is rather regularly and closely spotted with purple chromatophores.

The eggs are large, 5^{mm} to 8^{mm} in diameter, and comparatively few in number. In one female (No. 379) taken in July, the oviduct was distended with the eggs, which have a reticulated surface before reaching the glandular portion. This female had spermatophores attached to and around an elevated area on the inner ventral surface of the inner buccal membrane.

The oviduct is large and its external orifice has a wide ear-shaped border, more complicated than in *Loligo*. The nidamental glands correspond nearly with those of *Loligo*, but are relatively larger. In some of the males, taken in July, the spermatophore-sac and a saccular dilation near the orifice of the efferent duct, were filled with spermatophores, much like those of *Loligo*.

The male has the left ventral arm hectocotylized much as in *Loligo*. The stems of the suckers, for a considerable distance, toward the tip of the arm, become long, stout, conical, and many of them, in both rows, lack the rudimentary suckers.

This species is widely distributed along the tropical coasts of America, and throughout the West Indies. Martinique (Blainville); Honduras (Gray).

Specimens examined.

No.	Locality.	Collector.	Date.	Rec'd from	Specimens. No. Sex.
	Bermudas	G. Brown Goode	1878	G. B. G.	1
44	Key West, Fla.	Dr. J. B. Holder	1861	Mus. C. Zool.	2 l. ♂, br.
379	Fort Jefferson, Fla.	D. P. Woodbury	July, 1859	" "	1 l. ♀, br.
62	Cuba	Professor Poey	----	" "	2 ♀, juv.

The genus *Sepioteuthis* is closely related to *Loligo* in all external characters, but its fins extend along nearly the whole length of the mantle, and the body is stouter, more ovate, and less pointed behind than in *Loligo*, so that the form is somewhat like that of *Sepia*. The pen is thin and lanceolate, nearly as in *Loligo*, but in many species the blade is thickened toward the margins. The internal anatomy is, however, very different from *Loligo*, in several respects. The ovary is short and thick, and confined more to the posterior portion of the body. The eggs are comparatively few and very large, being 5^{mm} to 8^{mm} in diameter, in our species.

Family SEPIOLIDÆ Keff.

Keffersstein, in Bronn, Thier-Reich. iii. p. 1443. 1866.

Gill, Arrangement of Families of Mollusca. p. 2. 1874.

Tryon, Man. Conch. i, pp. 102. 155, 1879.

Body short, thick, bluntly rounded posteriorly. Fins large, separate, laterally attached, on the middle of the sides of the body. Siphon with small internal valve; no dorsal bristles. A large brachial cavity, extending back beneath the eye, into which the tentacular arms can be more or less retracted. Pen little developed, lanceolate, not reaching the end of the mantle. Integument beneath the eye thickened so as to be used as a false eye-lid, in addition to the transparent skin over the eye. A lachrymal pore in front of each eye; a brachial pore between the third and fourth pairs of arms. Eggs large, few, not enclosed in capsules. Accessory nidamental glands well developed. Branchial chamber divided into two cavities by a median partition or septum, which extends forward to the base of the siphon. This family is, in many respects, closely related to *Loliginidæ*, but differs widely from the latter in its visceral anatomy.

SEPIOLA Leach.

Sepiola Leach. Zool. Miscel., iii. p. 137, 1817 (t. Gray).

D'Orbigny. Céph. Acétab., p. 224.

Gray, Catal. Moll. Brit. Mus., i, p. 91. 1849.

Body short, stout, rounded posteriorly. Fins large, narrowed at base. Mantle united directly to the head by a large, dorsal commissure; lateral connective cartilages of the mantle elongated, fitting into elongated margined pits on the base of the siphon. Siphon with an internal valve. A brachial aquiferous pore between the bases of the third and fourth pairs of arms, on each side. A lachrymal pore in front of each eye. Buccal membrane with seven lobes, without suckers. Tentacular arms more or less retractile into large cavities below the eyes; club with numerous, very small, nearly equal, long-pedicelled suckers, in eight or more rows; rims not toothed. The males differ from the females in having some of the middle suckers of the lateral arms much enlarged.

Sepiola leucoptera Verrill. (Butterfly Squid.)

Verrill, Amer. Journ. Sci., vol. xvi, p. 378, 1878.

Tryon, Man. Conch., i, p. 158, 1879. (Description copied from preceding).

Verrill, Amer. Journ. Sci., xix, p. 291, pl. 15, figs 4 and 5. April 1880.

PLATE XXXI, FIGURES 4, 5. PLATE LIV, FIGURE 4.

Species rather small; the largest specimens observed are probably

full-grown. Body short, thick, swollen, with the mantle smooth. Ventral surface, in the middle, with a large, somewhat flattened, brown, heart-shaped or shield-shaped area, bordered with blue, and surrounded, except in front, by a silvery white band, having a pearly or opalescent luster. Eyes large, with roundish pupils. Fins large, thin, broadly rounded, in the living specimens nearly as long as the body; the posterior lobe reaches nearly to the end of the body; the anterior edge extends beyond the front of the mantle to the eye. The anterior edge of the mantle is emarginate beneath; it recedes laterally to a great extent; above, it is broadly attached to the head. Sessile arms, largely webbed, short; upper ones shortest; third pair longest; suckers in two rows. Tentacular arms slender, tapering, extending back to the end of the body; club not wider than the arm, with very minute suckers, in many rows.

Upper surface of the body opalescent in some lights, thickly spotted with orange-brown, spots most numerous in the middle line and extending to the upper surface of the head; some also occur on the outer surfaces of the arms; anterior part of the head white; fins, arms and extremity of body translucent bluish white; upper surface of the eyes opalescent, with silvery blue and red tints; head, below the eyes, silvery white; above the eyes, blue.

The largest specimen, (δ) taken in 1879, (Pl. XXXI, fig. 5), when living had the head, above, in front of the eyes, whitish, with a few chromatophores; back and the base of the fins thickly spotted with brown; posterior part of the back with an emerald-green iridescence. Sides of the body, below the fins, and posterior end of the body, silvery white. A large shield-shaped ventral area of brown, with a bright blue iridescence, and bordered with a band of brilliant blue, occupies most of the lower surface. Fins, transparent whitish, except at base. Lower side of head, siphon and outer bases of the arms, light brown. Eyes blue above, green below. The fins are large, nearly as long as the body.

Length of the original type-specimen (φ), to the base of the arms, 14^{mm}, in alcohol; of mantle, above, 8^{mm}; breadth, 7^{mm}; breadth across fins, 16^{mm}. The largest specimen, of 1879, is 31^{mm} (1.25 inch) long from end of body to base of arms; breadth of body, 25^{mm} (1 inch); length of arms, 19^{mm} (.75 inch).

The male (fig. 5) of this species differs from the female in having a group of three or four decidedly and abruptly larger suckers on the middle of the third pair of arms, (Pl. LIV, fig. 4); the other suckers, along the middle portion of these arms, are also larger than on the other arms.

This species is an exceedingly beautiful one, when living, owing to the elegance and brilliancy of its colors and the gracefulness of its movements. In swimming it moves its fins in a manner analogous to the motion of the wings of a butterfly. This fact, and its bright colors, suggested the English name that I have applied to it.

Three specimens, two very young, were taken by the writer and party, of the U. S. Fish Com., in the trawl-net, 30 miles east from Cape Ann, Mass., in 110 fathoms, August, 1878. One larger male was taken by us off Cape Cod in 122 fathoms, with the bottom temperature 41° F., August, 1879. The largest specimen seen was a male, taken in the same region, Sept. 10, 1879, in 94 fathoms. It was associated with *Octopus Bairdii* and *Rossia sublevis*.

Station.	Locality.	Fath.	When Collected.	Received from	Specimens. No. Sex.
194	Gulf of Maine	110	Aug. 31, 1878	U. S. F. Com.	3 j.
303	Off Cape Cod	122	Aug. 21, 1879	U. S. F. Com.	1 ♂
342	Off Cape Cod	94	Sept. 10, 1879	U. S. F. Com.	11. ♂

ROSSIA Owen.

Rossia Owen, Trans. Zool. Soc. London, 1828 (t. Gray); Owen, in J. Ross, Second Arctic Voyage, Appendix, p. xcii, pl. 100, 1835.

D'Orbigny, Céphal. Acétab., p. 242.

Gray, Catal. Moll. Brit. Mus., i, p. 88, 1849.

Mantle-edge free from the head dorsally, adhering by a longitudinal, ovate or horse-shoe-shaped connective cartilage, having a median and two lateral grooves, fitting into corresponding grooves on the cartilage of the mantle; two lateral, oblong, ridge-like cartilages, one on each side, also fit into ovate cartilage-pits on the base of the siphon. No olfactory crests. Pupils oblong or crescent-shaped, longitudinal. A false eye-lid below the eye. A pore in front of each eye, and one, on each side, between the bases of the third and fourth pairs of arms. Tentacular arms more or less retractile into large cavities at their bases, extending back beneath the eyes; club well developed, with numerous, nearly equal suckers, forming eight or more rows; rims not toothed; borders sealed. Buccal membrane with only six lobes, without suckers. The males differ from the females in having larger suckers on the middle of the lateral arms.

Rossia megaptera, sp. nov.

PLATE XXXVIII, FIGURE 1 PLATE XLVI, FIGURE 6.

Body short, broad, depressed, covered with a soft, flabby integument,

which forms a loose border posteriorly; the front edge of the mantle extends forward dorsally into a prominent angle, but recedes very much ventrally. Fins very large and broad; their anterior insertions being but little back of the antero-lateral edge of the mantle, and their posterior insertions close to the end of the body; the free borders of the fins are thin and undulated, extending forward anteriorly beyond the edge of the mantle, while the length, from base to outer edge, is about equal to the breadth of the back between the bases of the fins.

Head very large and broad, the width exceeding that of the body. Eyes very large and prominent; lower eyelids well developed, but not much thickened. Tentacles remarkably long and slender, in extension about twice as long as the head and body together. The tentacular club is somewhat thicker than the rest of the arm, rather long, narrow-lanceolate, tapering to the tip, and covered with numerous minute, globular suckers, arranged in many rows (Pl. XLVI, fig. 6, *b-d*). Sessile arms of moderate length, rounded, very slender at tip; the 1st, 2d and 3d pairs are successively longer, while the 4th or ventral pair is about equal to the first. Suckers, (Pl. XLVI, fig. 6, *a*), rather small, arranged in two rows on all the arms. On all the arms the suckers are similar but are a little larger on the 3d pair. They are nearly globular, with a rather wide aperture, which is surrounded by a border covered with numerous small scales, arranged in many rows; the scales of the marginal series are larger and project as fine denticles around the aperture. Color purplish brown, with rather large chocolate-brown chromatophores; outer portion of fins pale, thin and translucent; edges of mantle, siphon, under side of head and arms, and greater part of tentacular arms whitish, with only minute chromatophores.

Measurements of Rossia megaptera.

	Inches.	Millimeters.
Length, end of body to dorsal edge of mantle, exclusive of membrane,.....	1.25	32
Length, end of body to ventral edge of mantle,.....	.95	24
Length, end of body to base of dorsal arms,.....	2.25	57
Length, end of body to tip of dorsal arms,.....	3.40	86
Length, end of body to tip of 2d pair,.....	3.75	95
Length, end of body to tip of 3d pair,.....	4.08	103
Length, end of body to tip of 4th pair,.....	3.75	95
Length, end of body to tentacular arms,.....	7.45	188
Breadth of body and fins together,.....	2.50	63
Breadth of body between bases of fins,.....	.85	22
Breadth of body beneath fins, exclusive of membrane,.....	1.10	28

Measurements of *Rossia megaptera*. (Continued.)

	Inches.	Millimeters.
Breadth of head, across eyes,-----	1.40	36
Breadth of fins, antero-posteriorly,-----	1.08	27
Length of fins, base to outer edge,-----	.85	22
Diameter of eyes,-----	.75	19
Diameter of larger suckers of lateral arms,-----	.06	1.5
Diameter of larger suckers of club,-----	.01	.25
Breadth of club,-----	.16	4
Length of club,-----	.95	24

Off the southern coast of Newfoundland, in 150 fathoms, Capt. K. Markuson and crew, schooner "Notice," June, 1880.

This species is remarkable for the great size of the fins and eyes, and for the length of the tentacular arms. It appears to be a species specially adapted for inhabiting greater depths than the species hitherto discovered. It has the same soft, flabby integument observed in *Octopus lentus* and *Staurotenthis syrtensis*, found at similar depths. But the looseness of the skin may be due in part to the condition of the specimens when preserved. The suckers on the tentacular arms are remarkably small.

Rossia Hyatti Verrill.

Verrill, Amer. Journ. Sci., vol. xvi, p. 208, 1878.

Tryon, Man. Conch., i. p. 160, 1879. (Description compiled from preceding).

Verrill, Amer. Journ. Sci., xix, p. 291, pl. 15, figs. 1 and 2, April, 1880.

PLATE XXVII, FIGS. 8, 9. PLATE XXX, FIG. 1. PLATE XXXI, FIGS. 1, 2. PLATE XLVI, FIG. 5.

Body subcylindrical, usually broader posteriorly; in preserved specimens, variable in form according to contraction. Dorsal surface covered with small, conical, scattered, whitish papillæ, which are also found on the upper and lateral surfaces of the head and bases of the arms; those around the eyes largest; one on the mantle, in the median line, near the front edge, is often elongated. Front border of mantle sinuous, slightly advancing in the middle, above. Fins moderately large, nearly semicircular, attached from the posterior end for about four-fifths the whole length, the front end having a small, rounded free lobe. The distance from the posterior junction of the fins to end of body is less than that from the anterior junction to edge of mantle, the center of the fin being at about the middle of the body. Siphon elongated, conical, with a small opening. Head depressed, more than half the length of the body. Eyes large, the lower eyelid prominent, but not much thickened. Sessile arms short, united at

their bases by a short web, which is absent between the ventral arms; the dorsals are shortest; the third pair the longest and largest; the second pair and ventrals about equal in length. Suckers, (Pl. XLVI, fig. 5, *a*), numerous, sub-globular, not very small, the margin bordered with several rows of minute scales; near the base of the arms they are biserial, there being usually four to six thus arranged in each row; then, along the rest of the length of the arms they become more crowded and form about four rows, those in the two middle rows alternating with those in the marginal rows; toward the tip they become very small and crowded, especially on the dorsal and ventral arms. The number of suckers varies with age, but on one of the larger specimens they were as follows: on each dorsal arm, sixty; on one of second pair, fifty-five; of third pair, fifty-three; of ventral, sixty-five. In this specimen (♀), the third arm of the right side and ventral arm of left side were abruptly terminated (accidentally), while the others were tapered to acute points. The tentacular arms, in preserved specimens, will extend back to the posterior end of the body; the naked portion is smooth, somewhat triquetral, with the outer side convex and the angles rounded; terminal portion widening rather abruptly, long ovate-lanceolate, curved and gradually tapered to the tip; the sucker-bearing portion is bordered by a wide membrane on the upper and a narrow one on the lower margin; the suckers (Plate XLVI, fig. 5, *b*, *c*), are very small, sub-globular, crowded in about eight to ten rows in the widest portion.

The males differ from the females in the relatively greater size of the suckers on the middle of the lateral and ventral arms, those toward the tips becoming somewhat abruptly smaller, while in the female they decrease more gradually.

Color, pinkish, thickly spotted with purplish brown above, paler and more sparsely spotted beneath and on the outside of the long arms; the inner surface of the arms and front edge of the mantle are pale.

Length from bases of arms to posterior end of body, 40^{mm}; of body, 25; of head, 15; breadth of body, 17; of head 17; length of fins, 15; of insertion, 11; breadth of fin, 8; front of fin to edge of mantle, 5; length of free portion of dorsal arms, 12.5; of second pair, 15; of third pair, 18; of ventrals, 13; of tentacular arms, 40; breadth of dorsal arms, at base, 3.5; of second pair, 3.5; of third pair, 4; of ventrals, 3.5; of tentacular arms, at base, 2; at expanded portion, 3.5; length of latter, 10.5; diameter of largest suckers of sessile arms, 0.9; length of free portion of siphon, 7^{mm}.

One of the largest alcoholic specimens (♀), from station 218, has the mantle 31^{mm} long, dorsally; greatest breadth beneath the fins, 20^{mm}; length of fins longitudinally, 18^{mm}; transverse breadth of fins, 11^{mm}; length from end of body to tip of dorsal arms, 57^{mm}; to tip of second pair of arms, 59^{mm}; of third pair, 64^{mm}; of fourth pair, 59^{mm}.

Rossia Hyatti.—Specimens examined.

No.	Locality.	Fath.	Bottom.	When coll'd.	Rec'd from	Specimens. No. Sex.
				1877	U.S.F.C.	
30, 31	Off Salem, Mass.	48	mud	Aug. 13	"	2 j.
33	Off Cape Ann, 13 m.	90	mud	Aug. 14	"	1 l. ♂
42-46	Off Cape Sable, N. S., 30 m.	88-90	sand and mud	Aug. 21	"	1 ♂:1 ♀:3j.
48	Off Cape Sable, N. S., 20 m.	59	rocky	Aug. 21	"	1 j. ♀
85-86	Off Halifax, N. S., 26 m. ...	101	fine sand	Sept. 6	"	2 l. ♀
<i>Gulf of Maine and Massachusetts Bay.</i>						
				1878		
130	Off Cape Ann, 14 m.	49	mud	July 23	"	3 j.
156	Off Gloucester, Mass., 8 m.	42	sand and mud	Aug. 15	"	2 j.
163	Off Cape Ann, 6½ m.	73	fine sand	Aug. 16	"	1 ♂:2 j. ♀
164	Off Cape Ann, 7 m.	75	fine sand	Aug. 16	"	1 ♀
181	Off Gloucester, Mass.	45	mud	Aug. 29	"	4 ♀
184	Off Gloucester, Mass., 5 m.	45	mud	Aug. 29	"	1 j.
211	Off Cape Ann, 6 m.	60	soft dark-br. mud	Sept. 17	"	1 j. ♂:1 j. ♀
214	Off Cape Ann, 7 m.	57	fine mud and sand	Sept. 17	"	1 ♀
217	Off Cape Ann, 6 m.	45	soft dark-br. mud	Sept. 18	"	1 l. ♂
218	Off Cape Ann, 6 m.	45	soft dark-br. mud	Sept. 18	"	1 l. ♀:1 j.
223	South of Cape Ann, 7 m. .	47	soft brown mud	Sept. 21	"	1 ♂
234	Off Gloucester, Mass., 5½ m.	43	soft brown mud	Sept. 24	"	1 ♀
238	Off Gloucester, Mass., 4½ m.	43	soft brown mud	Sept. 26	"	2 j.
				1879		
264	Off Cape Cod, 15 m.	80	blue mud	July 29	"	1 l. ♂
276	Off Cape Cod, 6½ m.	47	blue mud	Aug. 1	"	1 l. ♀
324	Off Cape Cod, 11 m.	45	sand	Sept. 1	"	1 l. ♂
364	Off Cape Cod, 15 m.	70	sand	Sept. 18	"	1 l. ♀:3j. ♀
372	Off Chatham, Mass., 21 m. .	70	sand	Sept. 19	"	1 ♂ 1 l. ♀
<i>Gloucester Fisheries.</i>						
				1878.		
241	N. Lat. 44° 20' W. Long. 59°	60	-----	Dec.	"	1 j.
372	Off Miquelon I.	7	-----	July '79	"	1 j.
39 Gl.	Off Gloucester, in Cod.	--	-----	-----	"	1 l. ♀

This species has been taken in numerous localities, by the dredging parties of the U. S. Fish Commission, in 1877, 1878 and 1879, off Cape Cod; in Mass. Bay, 40-50 fathoms; off Cape Ann, in the Gulf of Maine, 50-100 fathoms; off Cape Sable, N. S., 88-92 fathoms; off Halifax, N. S., 57-100 fathoms, on a fine compact sand and mud bottom. It occurs in from 40 to 100 fathoms. It has also been received through the Gloucester halibut fishermen, from the Banks, off Nova Scotia. One specimen (lot 241), presented by Capt. Chris. Olsen, and crew, of the schooner "William Thompson" was from N. Lat. 44° 20';

W. Long, 59°, in 60 fathoms; another from 7 fathoms, off Miquelon I., (lot 372), was presented by Capt. C. D. Murphey and crew, of the schooner "Alice M. Williams." Its relatively large eggs (Pl. XXVII, fig. 9) are laid in August and September, in small clusters, slightly attached together, in the large oscules or cavities of several species of sponges.

It is frequently associated with *Octopus Bairdii* V., and the following species.

This species has a strong general resemblance to *R. glaucopsis* Lovén, as figured in the admirable work of G. O. Sars but the latter has shorter lateral arms, and the suckers of the sessile arms are in two rows, while they are four-rowed in our species.

Rossia sublevis Verrill.

Rossia sublevis Verrill, Amer. Jour. Sci., vol. xvi, p. 209, 1878.

Tryon, Man. Conch., i, p. 169, 1879. (Description compiled from preceding.)

Verrill, Amer. Journ. Sci., xix, p. 291, pl. 15, fig. 3, Apr., 1880; Bulletin Mus.

Comp. Zool., viii, p. 104, pl. 3, figs. 2-4: pl. 7, fig. 4, 1881.

PLATE XXX, FIGURE 2, ♀. PLATE XXXI, FIGURE 3, ♀. PLATE XLVI, FIGURE 4.

PLATE XLVII, FIGURES 2-3, ♀. FIGURE 4, ♂.

Larger and relatively stouter than *Rossia Hyatti*, with the fins larger and placed farther forward, the rounded front edge of the large free lobe reaching nearly to the edge of the mantle. Head large and broad. Eyes very large.

Sessile arms more slender and less unequal in size than in the preceding species, and with the suckers arranged in two regular rows throughout the whole length. Anterior edge of the mantle scarcely simons, advancing but little dorsally. Upper surface of the body and head nearly smooth, but in the larger specimens, especially the males, usually with a few very small whitish papille, most numerous near the front edge of the mantle. Color, nearly as in the preceding species.

The pen (Plate XLVI, figure 4) is small and thin, much shorter than the mantle. The shaft is narrow; the blade is rather abruptly wider and rather shorter than the shaft; its posterior portion is very thin, with the edge ill-defined.

The males, when adult, can be easily distinguished from the females, by the larger size of the suckers along the middle of the two lateral pairs of arms (Plate XLVII, figure 4), and, to a less extent, of the ventral pair. These large suckers are oblong, with a groove or constriction around the middle, the part below the groove larger

than that above it; the aperture is small, ovate, with a smooth rim; their pedicels are short and laterally attached. In the female the corresponding suckers are not only smaller but are differently shaped, the basal portion being smaller than the upper portion. The suckers of the tentacular arms are very numerous, minute, shallow, cup-shaped, with oblique rims and slender pedicels; they are nearly equal and appear to form eight to twelve rows.

Young specimens, with the mantle less than 12^{mm} in length, can scarcely be distinguished sexually by external characters, and are not easily distinguished from the young of *Rossia Hyatti*, of similar size.

One of the original specimens (♀) measured, from the base of the arms to the end of the body, 46^{mm}; length of body, 31; of head, 15; breadth of body, 22; of head, 23; length of fins, 20; of their insertion, 16; breadth of fins, 10; front edge of fin to edge of mantle, 2.5; length of free portion of dorsal arms, 16; of second pair, 17; of third pair, 20; of ventrals, 15; of tentacular arms, 25; breadth of dorsal arms at base, 3; of second pair, 3; of third, 3.5; of ventrals, 3.5; of tentacular arms, 3.5; of the terminal portion, 3.75; its length, 10; diameter of the largest suckers of sessile arms, .8; length of free portion of siphon, 7^{mm}.

Measurements of *Rossia sublevis* and *R. Hyatti*, in millimeters.

	R. sublevis.		R. Hyatti.	
	♂	♀	♂	♀
Sex	879	894	324	218
Station	879	894	324	218
Length of mantle, above.....	29	32	21	31
Breadth of mantle.....	22	25	17	19
Breadth across head.....	26	30	15	20
Diameter of eyes.....	16	16	8	9
Length of a fin.....	21	24	11.5	17
Length of its base.....	17	19	10	12
Transverse breadth of a fin.....	14	15	7	10.5
Length to base of dorsal arms*.....	45	47	31	45
" " " third pair.....	46	47	32	43
" " " ventral arms.....	41	43	26	39
" tip " dorsal arms.....	64	71	42	58
" " " second pair.....	65	75	43	59
" " " third pair.....	66	78	46	64
" " " ventral pair.....	61	74	42	60
Length of tentacular club.....	9	15	7	10
Its breadth.....	2.5	3	2	2.5
Diameter of largest suckers of lateral arms.....	2.2	1.1	1.5	.8

* The length to the 'bases' of the arms, is from the posterior end of the body to the free edge of the basal web, between the arms; that of the third pair is to the edge of the web, between the second and third pairs. The measurements are all from well preserved alcoholic specimens.

One of the specimens (No. 16), taken by Mr. Agassiz, in 357 fathoms, is a young female differing somewhat from the others in having the arms shorter, with the suckers more crowded, so that they apparently form more than two rows. Possibly this should be referred to *R. Hyatti* Verrill. Its back is smooth. All three specimens from this same region differ somewhat from those taken farther north, in shallower water, in having larger eyes and shorter and stouter arms.

Rossia sublevis.—Specimens examined.

Stat.	Locality.	Fath.	Bot'om.	When coll'd.	Rec'd from	Specimens. No. Sex.	
				1877	U.S.F.C.		
84	Off Halifax, N. S., 26 miles	101	fine sand	Sept. 6	"	1 l. ♀; 1 j.	
85, 86	Off Halifax, N. S., 26 miles	101	fine sand	Sept. 6	"	1 ♂; 1 j. ♀	
100	Off Halifax, N. S.	42	fine sand	Sept. 15	"	eggs & juv.	
				1878			
161	Off Cape Ann, 6 miles	54	-----	Aug. 6	"	1 l. ♂	
194	Off Cape Ann, 33 miles	110	muddy	Aug. 31	"		
				1879			
264	Off Cape Cod, 15 miles	80	blue mud	July 29	"	1 ♂; 1 l. ♀; 3 j.	
324	Off Cape Cod, 11 miles	45	sand	Sept. 1	"	1 l. ♂	
364	Off Cape Cod, 15 miles	70	sand	Sept. 18	"	1 j.	
	<i>Off Newport, R. I.</i>						
	N. lat.	W. long.					
				1880			
869	40° 02' 18"	70° 23' 06"	192	fine sand and mud	Sept. 4	"	1 ♂; 5 ♀
870	40 02 36	70 22 58	155	fine sand and mud	Sept. 4	"	1 ♂; 1 ♀
880	39 48 30	70 54 00	252	fine sand and mud	Sept. 13	"	1 l. ♂
893	39 52 20	70 58 00	372	mud. fine sand	Oct. 2	"	1 j.
894	39 53 00	70 58 30	365	mud. fine sand	Oct. 2	"	1 l. ♂; 1 j. ♀
895	39 56 30	70 59 45	238	mud. fine sand	Oct. 2	"	1 l. ♂; 1 l. ♀; 5
897	Off Chesapeake Bay	157	-----	Nov. 16	"	"	1 l. ♂ [eggs
	<i>Blake Exped.</i>						
	<i>U. S. Coast Survey.</i>						
310	39° 59' 16"	70° 18' 30"	260	-----	1880	A. Agas.	1 ♀ ad.
320	32 33 15	77 30 10	257	-----	1880	"	1 ♀ ad.
321	32 43 25	77 20 30	233	-----	1880	"	1 ♀ j. ?
	<i>Gloucester Fisheries.</i>						
265	42° 49'	62° 57'	250	-----	Jan. '79	U.S.F.C.	1 j.

This has been taken, by the dredging parties of the U. S. Fish Commission, in the trawl-net, at various localities, in 1877, 1878, and 1879, in 45 to 110 fathoms, off Massachusetts Bay, off Cape Cod, and off Halifax, N. S. It has been brought in by Capt. J. W. Collins and crew, of the schooner "Marion," (lot 265) from the banks off Nova Scotia. It was trawled in some numbers, and of both

sexes, by the U. S. Fish Commission, in 1880, off Newport, R. I., in 155 to 372 fathoms; and in November, 1880, by Lieut. Z. L. Tanner, on the "Fish Hawk," off the mouth of Chesapeake Bay, in 157 fathoms. It was taken by Mr. Agassiz, on the "Blake," in 233-260 fathoms, and as far south as lat. $32^{\circ} 33' 15''$.

This species very closely resembles the *Rossia glaucopsis* Lovén, of Northern Europe, as figured by G. O. Sars. The latter is, however, more papillose, and has smaller eyes and head, if correctly figured.

HETEROTEUTHIS Gray.

Heteroteuthis (sub-genus) Gray. Catal. Moll. Brit. Mus., i, p. 90. 1849.

The body is short, thick, rounded posteriorly. Fins large, with narrower bases, attached near the middle of the sides of the mantle. Head and eyes large. Anterior border of the mantle-edge free, dorsally. Connective cartilages on the base of the siphon, with an ovate pit; lateral cartilages of mantle, simple, longitudinal ridges. Pen much shorter than the mantle, narrow anteriorly; posterior blade small, slightly expanded laterally. Club of the tentacular arms well developed, with numerous suckers, in about eight rows, those in the lower marginal rows decidedly larger than the rest; rims of the suckers with smooth edges; the membranous edge of the aperture is denticulated by small, acute scales. Middle suckers of the lateral and ventral arms distinctly larger in the female; in the male abruptly very much larger than on the others; these suckers are deep, with a small, round, smooth rim, and with a raised zone around the middle. In the male the left dorsal arm is hectocotylized by having much smaller and more numerous suckers, arranged in four rows, and by the development of the marginal membrane.

Heteroteuthis tenera Verrill.

Amer. Jour. Sci., xx, p. 392, November, 1880; Proc. Nat. Mus., iii, p. 360. 1880:
Bull. Mus. Comp. Zool., viii, p. 103, pl. 3, figs. 5-5*b*, pl. 8, figs. 2-2*d*, 3-3*b*, 1881.

PLATE XLVI, FIGURES 2-2*d*, 3-3*b*. PLATE XLVII, FIGURES 5-5*b*.

A small and delicate species, very soft, translucent, and delicately colored when living.

Body short, cylindrical, scarcely twice as long as broad, posteriorly; usually round, but in strongly contracted, preserved specimens, often narrowed and even obtusely pointed; front edge of mantle sometimes with a slight dorsal angle, in most cases emarginate. Fins very large, thin, longer than broad, the outer edge broadly rounded, the

anterior edge extending forward quite as far as the edge of the mantle, and considerably beyond the insertion of the fin, which is itself well forward. The length of the fin is about two-thirds that of the body; the base or insertion of the fin equals about one-half of the body-length; the breadth of the fin is greater than one-half the breadth of the body. Head large, rounded, with large and prominent eyes; lower eyelid slightly thickened. Arms rather small, unequal, the dorsal ones considerably shorter and smaller than the others. In the male, the left dorsal arm is greatly modified, and very different from its mate. Lateral and ventral arms are subequal.

In both sexes, and even in the young, the suckers along the middle of all the lateral and ventral arms are distinctly larger than the rest, but in the larger males this disparity becomes very remarkable, the middle suckers (Pl. XLVI, figs. 3*a*–3*b*) becoming greatly enlarged and swollen, so that eight to ten of the largest are often six or eight times as broad as the proximal and distal ones; they are deep, laterally attached, with a raised band around the middle, and a very small round aperture, furnished with a smooth rim. In the female the corresponding suckers on the lateral arms are about twice as broad as the rest. The suckers are in two regular rows, on the lateral and ventral arms, in both sexes. In the male, the left dorsal arm becomes thickened and larger from front to back, and is usually curled backward; its suckers become smaller and much more numerous than on the right arm, being arranged in four crowded rows, except near the base, where there are but two; the sucker-stalks also become stout and cylindrical, or tapered, their diameter equalling that of the suckers (Pl. XLVI, fig. 3; Pl. XLVII, fig. 5). The right arm remains normal, with two alternating rows of suckers, regularly decreasing to the tip, as in both the dorsal arms of the female. Tentacular arms long, slender, extensible; club distinctly enlarged, usually curled in preserved examples (Pl. XLVI, figs. 2*a*, 3). The suckers on the club are numerous, unequal, arranged in about eight close rows; those forming the two or three rows next the upper margin (Pl. XLVII, figs. 5*a*–5*b*) are much larger than the rest, being three or four times as broad, and have rows of small scale-like denticles around the rims, the marginal ones larger.

Color, in life, pale and translucent, with scattered rosy chromatophores. In the alcoholic specimens, the general color of the body, head, and arms is reddish, thickly spotted with rather large chromatophores, which also exist on the inner surface of the arms, between the suckers, and to some extent on the tentacular arms and bases of the

fins; outer part of fins translucent white; anterior edge of mantle with a white border.

Pen small and very thin, soft, and delicate. It is angularly pointed or pen-shaped anteriorly, the shaft narrowing backward; a thin lanceolate expansion, or margin, extends along nearly the posterior half (Pl. XLVI, fig. 2*b*).

Upper jaw with a sharp, strongly incurved beak, without a notch at its base. Lower jaw with the tip of the beak strongly incurved, and with a broad, but prominent, rounded lobe on the middle of its cutting edges (fig. 2*c*).

Odontophore with simple, acute-triangular median teeth; inner laterals simple, nearly of the same size and shape as the median, except at base; outer laterals much longer, strongly curved forward (fig. 2*d*).

Length of body 25 to 40^{mm}. One of the larger males measures, in alcohol, from the posterior end of the body to the dorsal edge of the mantle, 21^{mm}; to the free bases of the dorsal arms, 48^{mm}; to the interval between bases of second and third pairs, 49^{mm}; to bases of ventral arms, 46^{mm}; to tip of dorsal arms, 48^{mm}; of second pair, 51^{mm}; of third pair, 49^{mm}; of ventral arms, 46^{mm}; diameter of largest suckers of lateral arms, 2^{mm}; length of fin at base, 11^{mm}; extreme length of fin, 15.5^{mm}; transverse breadth of fin (lower side), 10^{mm}; diameter of eye, 9^{mm}; breadth of body, below fin, 17^{mm}; breadth of head, 17^{mm}.

Twenty-seven specimens of this species were obtained by Mr. A. Agassiz, on the "Blake," in 1880, from six stations, ranging in depth from 71 to 233 fathoms. Later in the same season, over 200 specimens were secured by the writer and others of the dredging party on the United States Fish Commission steamer "Fish-Hawk." It was particularly abundant at stations 869, 870 and 871, in about 125 to 192 fathoms, on the rapidly sloping outer bank, off the coast, under the inner edge of the Gulf Stream, where the bottom consists of fine compact sand, with mud and shells. Both sexes occurred in about equal numbers, and also the young, of various sizes. It was also taken in considerable numbers at stations 865 to 867, in 65 fathoms; 872 to 880, in 85 to 252 fathoms. It was also dredged off the mouth of Chesapeake Bay, in November, by Lieut. Z. L. Tanner, on the "Fish Hawk," in 18 to 57 fathoms.

It is easily distinguished from all the species of *Rossia* by the larger size of the suckers along the middle of the lateral arms; by the inequality of the suckers on the tentacular clubs; and by the peculiar hectocotylized condition of the left dorsal arm of the male. The ex-

istence of large chromatophores on the inner surface of the arms, between the suckers, is also a good diagnostic mark, by which to distinguish it from our species of *Rossia*, which have the corresponding parts nearly white, or with few and small chromatophores.

Heteroteuthis tenera.—Specimens examined.

Stat.	N. Lat.	Locality.	W. Long.	Depth, Fathoms.	When received.	Specimens. No.	Sex.
<i>U. S. Fish Com.</i>							
<i>Off Martha's Vineyard.</i>							
					1880		
865	40° 05'	70° 23'		65	Sept. 4, U. S. F. C.	3 ♂	7 ♀
866	40 05 18"	70 22 18"		65	" " "	3 ♂	6 ♀
867	40 05 42	70 22 06		64	" " "	4 ♂	10 ♀
869	40 02 18	70 23 06		192	" " "	20+	♂ & ♀
870	40 02 36	70 22 58		155	" " "	15 ♂	17 ♀
871	40 02 54	70 23 40		115	" " "	18 ♂:11 ♀:	32 j
872	40 05 39	70 23 52		86	" " "	1 ♂	2 ♀
<i>Off Newport, R. I.</i>							
873	40° 02'	70° 57'		100	" 13, " "	5 ♂	1 ♀
874	40 00	70 57		85	" " "	10 ♂	6 ♀
875	39 57	70 57 30"		126	" " "	1 ♂	
876	39 57	70 56		120	" " "	8 ♂	6 ♀
877	39 56	70 54 18		126	" " "	6 ♂	4 ♀
878	39 55	70 54 15		142½	" " "	1 ♂	1 ♀
879	39 49 30"	70 54		225	" " "	6	
880	39 48 30	70 54		252	" " "	2 ♂	
<i>Off Chesapeake Bay.</i>							
899	37° 22'	74° 29'		57½	Nov. 16, " "	3 ♂	2 ♀
900	37 19	74 41		31	" " "	1 j.	
901	37 10	75 08		18	" " "	21 ♂	3 ♀
<i>Blake Expedition,</i>							
<i>U. S. Coast Survey.</i>							
313	Off Charleston, S. C.			75	1880	7 ♂	5 ♀
314	32° 24'	78° 44'		142	1880	2 ♂	1 ♀
316	32 7	78 37 30"		229	1880	1 ♀	j.
321	32 43 25"	77 20 30		233	1880	5 ♀	
327	34 0 30	76 10 30		178	1880	1 ♂	3 ♀
345	40 10 15	70 4 30		71	1880	2 ♀	j.

Order II.—OCTOPODA Leach.

Cephalopoda octopoda Leach, Zool. Miscel., iii, 1817 (t. Gray).

Férussac Tableau Syst., p. 18, 1821.

D'Orbigny, Tab. Method., p. 45, 1825; D'Orbigny, Céphal. Acétab., p. 1.

Octocera Blainv., Dict. Sci. Nat., vol. xxxii, 1824.

Octopia Gray, Cat. Moll. Brit. Mus., i, p. 3, 1849.

Arms eight, similar, all furnished with suckers in one or two rows; often more or less united by a web, without natatory crests. Suckers sessile, not oblique, destitute of horny rings or hooks. No tentacular arms. Head often larger than the body. Body short and

thick, obtuse posteriorly, usually destitute of fins. Fins, when present, small, lateral, supported by an internal transverse cartilage. Mantle usually extensively united to the head by a dorsal commissure. Siphon without an internal valve. Branchial cavity divided into two parts by a median septum, extending forward to the base of the siphon, but interrupted posteriorly. No olfactory crests. Eyes united to the internal lining of the sockets, so as to be immovable, usually furnished with lids. No outer buccal membrane. Aquiferous pores and cavities usually absent; cephalic pores sometimes present. Internal longitudinal shell or pen absent. An external shell is present only in the genus *Argonauta*. In this case it is formed as a secretion from the inner surface of the expanded distal portion of the two dorsal arms, of the female only, and serves mainly as a receptacle for the eggs. The right arm of the third pair is hectocotylized in the male. Sometimes the entire arm is modified and sometimes the tip only.

Family PHILONEXIDÆ D'Orbigny.

Philonexidæ (pars) D'Orb., Moll. Viv. et Fos. i. 199, 1845 (t. Gray).

Gray, Catal. Moll. Brit. Mus., i, p. 24, 1849.

Kefferstein, in Bronn, Thier-Reich., iii, 2 B., p. 1449, 1866.

Body stout, oval, destitute of lateral fins. Branchial opening large. Edge of mantle united to the base of the siphon laterally by a complicated prominent cartilage or button fitting in a corresponding pit on the inner surface of the mantle. Dorsal commissure narrow. Head with aquiferous pores communicating with large aquiferous cavities. Arms simple, more or less united by webs. Suckers prominent.

In the male, the hectocotylized arm is developed in a sac, the entire arm being modified, and usually, when perfected, it becomes detached from the body. Probably this arm is lost and regenerated each year.

Parasira Steenstrup.

Parasira Kefferstein, in Bronn, Thier-Reich., iii, p. 1449, 1866.

Tryon, Man. Conch., i, p. 104.

Body short, thick, pouch-like, usually ornamented with raised ridges. Mantle united directly to the head dorsally; laterally connected to the base of the siphon by a pit and raised cartilaginous tubercle on each side, which fit corresponding pits and tubercles, near the base of the siphon (something as a button fits into a button-hole), so that it can be separated only with considerable difficulty.

Gill-opening very wide, extending upward beyond the eyes. Arms long, slender; web rudimentary. Suckers prominent, in two alternating rows. Siphon large, intimately united to the whole length of the lower side of the head; its free extremity is situated far forward, between the ventral arms.

The sexes are widely different. The hectocotyized arm of the male is developed in a pedunculated sac.

There is a large aquiferous pore just behind the base of each-ventral arm, at the sides of the siphon; these connect with large, cephalic, aquiferous cavities. The connective cartilages on each side of the base of the siphon consist of a prominent button, with an expanded and recurved anterior edge, which fits into a corresponding deep pit in the mantle-cartilage; and a deep, triangular pit, in front of the button, which receives the pointed, angular, cartilaginous tubercle of the mantle-cartilage. The posterior border of the base of the siphon forms a broad collar, within the mantle border. The lateral openings to the gill-cavity, on the sides of the neck, extend up as far as the upper side of the eyes; opposite and below the eyes, they are large, but internally are interrupted by two muscular bands on each side, one running back from the head to the mantle and one going back from the base of the siphon, opposite the connective cartilage.

The median septum of the gill-cavity is strong, but short, commencing a little behind the base of the siphon and extending only a short distance back, but expanding in length as it joins the ventral surface of the mantle; behind it the two halves of the gill-cavity are connected by a wide opening. The peritoneal membrane is strong, and specked with dark chromatophores.

Parasira catenulata Steenstrup.

Octopus tuberculatus Risso (?), Hist. nat. de l'Eur. mérid., iv, p. 3, 1826 (t. d'Orb.)

Octopus catenulatus Férussac, Poulpes, pl. 6, bis, ter., 1828 (t. D'Orbig.)

Philonexis tuberculatus Fér. and D'Orb., Céph. Acét., p. 87, pl. 6, bis, ter.

Parasira catenulata Steenstrup.

Verrill, Amer. Journ. Sci., xix, p. 293, Apr., 1880.

PLATE XXXIII, FIGURES 2, 2a.

Female: Body relatively large, swollen, rather higher than broad, dilated below, larger in front, obtusely rounded posteriorly; upper surface smooth or finely wrinkled; lower surface covered with prominent, rounded verrucæ or small hard tubercles, which are connected together by raised ridges, five (sometimes six) of which usually run to each tubercle, thus circumscribing angular depressed areas, each

of which usually has a dark-colored spot in the center; on the sides, these tubercles are less prominent and less regular, gradually fading out above. The head is decidedly smaller than the body, and smooth both above and below. The eyes are prominent, but the external opening is small, round, with simple border. The gill-opening is large, and extends upward on the sides of the neck to the level of the upper sides of the eye-balls. The siphon-tube is completely united by its basal portion to the lower side of the head; its free portion is large and elongated, standing out well forward, between the bases of the ventral arms. There is a conspicuous aquiferous pore at each side of the base of the siphon, just back of the ventral arms. The arms are stout, not very long; the inner surface is broad, with two rows of rather widely separated suckers, which run along the margins of the arms; the suckers are rather large, and considerably raised on stout bases; the first suckers form a regular circle around the mouth; two or three basal suckers are nearly in a single row. The suckers are cup-shaped, with a deep central pit, around which there are strong radial ridges; toward the base of the arms the soft swollen rims of the suckers are wrinkled and lobulated; farther out they are smooth and even. The beak is black, with sharp tips. It is surrounded by a thick, wrinkled buccal membrane.

The arms are slightly united at their bases by a narrow web, which also runs along each of the outer angles of the six upper arms, forming more or less wide marginal membranes, according to the state of extension, and by their contractions causing the arms to curl in various directions; one of these membranes frequently disappears, if the other be so stretched as to become wide, when the arm is strongly recurved; on the ventral arm the upper membrane becomes strongly developed, while the lower one is abortive. There is also a slight marginal membrane along the inner margins, running between the suckers and connecting them together. The dorsal and ventral arms are considerably larger and longer than the two lateral pairs, the dorsal ones are the stoutest. The two lateral pairs are about equal in size and length. On the dorsal arms there are about 96 suckers; on the lateral ones about 80, that can be counted with the naked eye. The tips are very slender and covered with very minute suckers.

Color of the body and head, above, and of the upper arms, deep brownish purple; lower surfaces of body and head, with the siphon and ventral arms, pale yellowish.

The total length of our specimen is 203^{mm}; of mantle, 51;

ference of body, 152; length of dorsal arms, from eye, 137; second pair, 94; of third pair, 84; of fourth pair, 134·5.

A specimen of this interesting species was taken in Vineyard Sound, Mass., by Mr. V. N. Edwards, in 1876. It was not known previously from the American coast, and has been regarded as peculiar to the Mediterranean and West Indies.

Measurements of Parasira catenulata.

			Left Side.	
	mm.	inches.	mm.	inches.
From base of arms to tip of tail.....	70	2·75		
From base of arms to mantle.....	20	·80	81	3·2
From edge of mantle to tip of tail.....	51	2·00		
From edge of mantle to tip of tail (below)....	81	3·2		
Tail to eye.....	66	2·60		
Circumference of body.....	152	6·00		
Breadth of body.....	51	2·00		
Circumference of head.....	109	4·30		
Breadth of head.....	38	1·50		
Diameter of eyes.....	2·5	·10		
Diameter of largest suckers.....	3·5	·14		
Length of dorsal arms, first pair, from eye....	134	5·30	109	4·30
“ “ “ second “ “	93	3·70	96	3·80
“ “ “ third “ “	92·5	3·68	89	3·50
“ “ “ fourth “ ventral....	149	5·88	134	5·30
Breadth of first pair of arms at base.....	7·5	·30	8·75	·35
“ “ second “ “ “	7	·28	7	·28
“ “ third “ “ “	6·25	·25	6·25	·25
“ “ fourth “ “ “	7·5	·30	7·5	·30
Length of siphon.....	58	2·30		
Breadth of base of free part.....	11·25	·45		
Breadth at tip.....	7·5	·30		

The remarkable tubercles of the ventral surface mostly have five ridges converging to each, rarely six. In all other respects it agrees with the figures of Férussac and D'Orbigny. According to Targioni-Tozzetti, *P. catenulata* is distinct from *P. tuberculata*. If so, our species should bear the former name.

Family ARGONAUTIDÆ Cantr.

Cantraine, Mall. Médit., p. 13, 1841; H. & A. Adams, Genera, i, p. 23.

Ocythoidæ Gray, Catal. Moll. Brit. Mus., i, p. 28.

Argonauta argo Linné.

Shells of this species, some of them entire, were taken by the "Fish Hawk" at several of the stations 70 to 115 miles south of Martha's Vineyard and Newport, R. I., in 64 to 365 fathoms. At least nine specimens were dredged. At Station 894, in 365 fathoms, two entire and nearly fresh shells were taken, and another

nearly complete. They belong to the common Mediterranean variety. Fragments were also taken at Stations 865-7, 871, 873, 876, 892, 895.

The capture of a living specimen, probably of this species, on the coast of New Jersey, has been recorded by Rev. Samuel Lockwood, Amer. Naturalist, xi, p. 243, 1877.

Family ALLOPOSIDÆ Verrill, nov.

Body thick, obtusely rounded; arms extensively webbed; mantle-edge united directly to the head, not only by a large dorsal commissure, but also by a median-ventral and two lateral longitudinal commissures, which run from its inner surface to the basal parts of the siphon.

The male hectocotylized right arm of the third pair is developed in a cavity in front of the right eye and, when mature, protrudes from an opening on the inner surface of the web, between the second and fourth pairs of arms, and finally becomes detached. It is furnished with two rows of large suckers, and with a fringe along the sides. The mode of attachment of the mantle to the head is similar to that of *Desmoteuthis*, among the ten-armed cephalopods.

Alloposus Verrill.

Amer. Journ. Sci., xx, p. 393, Nov., 1880; Proc. Nat. Mus., iii, p. 362, Dec., 1880; Bulletin Mus. Comp. Zool., viii, p. 112, March, 1881.

Allied, in some respects, to *Philonexis* and *Tremoctopus*. Body thick and soft, smooth; arms (in the male only seven) united by a web, extending nearly to the ends; the length of the arms decreases from the dorsal to the ventral ones; suckers sessile, simple, in two rows; mantle united firmly to the head by a ventral and two lateral muscular commissures, the former placed in the median line, at the base of the siphon; free end of the siphon short, well forward.

In the male, the hectocotylized right arm of the third pair is developed in a sac in front of the right eye (Plate L, figs. 1, 1a); as found in the sac, it is curled up and has two rows of suckers; the groove along its edge is fringed; near the end, the groove connects with a rounded, obliquely placed, broad, flat or slightly concave lateral lobe, with transverse wrinkles or plications on the inner surface; the terminal portion of the arm is a long fusiform process.

Alloposus mollis Verrill.

Amer. Jour. Sci., xx, p. 391, Nov., 1880; Proc. Nat. Mus., iii, p. 363, 1880; Bulletin Mus. Comp. Zool., viii, p. 113, pl. 4, fig. 4; pl. 8, figs. 1-2*a*, March, 1881.

PLATE L, FIGS. 1, 1*a*, 2, 2*a*. PLATE LI, FIG. 4.

Body stout, ovate, very soft and flabby. Head large, as broad as the body; eyes large, their openings small. Arms rather stout, not very long, webbed nearly to the ends, the dorsal much longer than the ventral arms; suckers large, simple, in two alternating rows. Color deep purplish brown, with a more or less distinctly spotted appearance. Total length of a medium sized specimen, 160^{mm}; of body, to base of arms, 90^{mm}; of mantle, beneath, 50^{mm}; of dorsal arms, 70^{mm}; breadth of body, 70^{mm}. Other specimens are about one-third larger. The sexes scarcely differ in size.

One mature, detached, hectocotylyzed arm (Plate LI, fig. 4) was taken November 16. This has two rows of large, six or seven-lobed suckers, a very long fringe, composed of thin, flat, lacerate processes, along each side; the terminal process is fusiform, acute, and loosely covered with a thin, translucent membrane, beneath which the inner surface, bearing chromatophores, can be seen. Length of this arm, 200^{mm}; its breadth, 20^{mm}; length of terminal process, 30^{mm}; its diameter, 7^{mm}; diameter of largest suckers, 6^{mm}; length of fringe, 15^{mm}.

Taken by the "Fish Hawk," at Stations 880, 892, 893, 895, about 100 to 115 miles south of Newport, R. I., in 225 to 487 fathoms. Also, off the mouth of Chesapeake Bay, at Station 898, November 16, in 300 fathoms, by Lieut. Z. L. Tanner.

Specimens examined.

Station.	Locality.	Fath.	When received.	Received from.	Specimens.
OFF NEWPORT, R. I.					
	N. lat. W. long.				
880	39° 48' 30" 70° 50' 00" ..	252	Sept. 13, 1880	U. S. Fish Com.	2 ♂ : 1 ♀
881	Farther southward	325	Sept. 13, 1880	.....do.....	1
892	39° 46' 00" 71° 05' 00" ..	487	Oct. 2, 1880	.....do.....	1
893	39° 52' 20" 70° 58' 00" ..	372	Oct. 2, 1880	.....do.....	2
895	39° 56' 30" 70° 59' 45" ..	238	Oct. 2, 1880	.....do.....	1
OFF CHESAPEAKE BAY.					
898	37° 24' 00" 74° 17' 00" ..	300	Nov. 16, 1880	.....do.....	4

Family OCTOPODIDÆ D'Orbigny, (restricted).

Octopodidæ (pars) D'Orbigny, Moll. Viv. et Fos., i, 159, 164, 1845 (t. Gray); (*pars*)
Céphal. Acétab., p. 3.

Octopidæ (pars) Gray, Catal. Moll. Brit. Mus., i, p. 4, 1849.

Body short, thick, rounded posteriorly, destitute of lateral fins and internal cartilages. Mantle united to the head by a broad dorsal commissure. Head very large. Connection between the mantle and base of siphon simple, without cartilages. Opening to the gill-cavity narrow. Median septum of branchial cavity short, extending forward to the base of the siphon, but running back only a short distance. Siphon large, simple. Arms with either one or two rows of suckers, and with a more or less developed basal web. No cephalic aquiferous pores. Eyes furnished with an internal translucent lid, and also capable of being covered with the external integument. Sexes similar externally, except that the right arm of the third pair in the male is hectocotylyzed by the formation of a spoon-shaped organ at the tip.

OCTOPUS Lamarck, 1799.

Octopus (pars) Lamarck, Syst. des Anim. sans Vert., p. 60, 1801.

Cuvier, Rég. Anim., ii, 1817.

D'Orbigny, Céphal. Acétab., p. 3.

Gray, Catal. Moll. Brit. Mus., i, p. 4, 1849.

Body short, thick, more or less rounded, usually flattened, often tubercular or warty, but sometimes smooth, usually with one or more tubercles or cirri situated above the eye. Mantle directly united to the head, dorsally, by a broad commissure, extending below the eyes to the base of the siphon. Base of the siphon without any complicated connective cartilages. Arms united by a more or less extensive basal web. Suckers sessile, in two alternating rows. Siphon not intimately united to the whole length of the under side of the head, the free terminal portion situated behind or beneath the eyes. No aquiferous pores, nor brachial pouches.

The sexes are similar in form. In the male the right arm of the third pair is hectocotylyzed, its terminal portion being changed into a spoon-shaped organ, smooth on the outer convex side and furnished with a series of transverse ridges on the inner concave side, and with a basal angular lobe from which a groove or furrow extends along the lower margin of the arm to the basal web. In some species of *Octopus* this modified tip is very small, but in others very large.

The female has oviducts on both sides. Eggs comparatively few

and large, elongated pyriform, attached singly or in clusters by the small end.

In addition to the several small species described here, a much larger rough-backed species has been taken several times at Fort Macon and near Beaufort, N. C. This is probably *Octopus rugosus* Bosc, a West Indian species.

Octopus Bairdii Verrill.

Octopus Bairdii Verrill. Amer. Jour. Sci., v, p. 5. Jan., 1873; xix, p. 294, 1880; American Naturalist, vii, p. 394, figs. 76, 77, 1873; Am. Assoc. Adv. Sci. for 1873, p. 348, pl. 1, figs. 1, 2, 1874.

G. O. Sars. Mollusca Regionis Arcticæ Norvegiæ, p. 339, pl. 33, figs. 1-10 (♀), pl. xvii, figs. 8a to 8d (dentition and jaws), 1878.

Tyron. Man. Conch., i, p. 116, pl. 32, figs. 37, 38 (description and figures from the papers by A. E. V.).

Verrill, Bulletin Mus. Comp. Zool., viii, p. 107, pl. 2, figs. 4, 4a; pl. 4, figs. 1, 1a, 1881.

PLATE XXXIII, FIGS. 1, 1a. PLATE XXXIV, FIGS. 5, 6. PLATE XXXVI, FIG. 10.
PLATE XXXVIII, FIG. 8; PLATE XLIX, FIGS. 4, 4a; PLATE LI, FIGS. 1, 1a.

The body is short, thick, somewhat depressed, broadly rounded posteriorly, separated from the head only by a slight constriction at the sides. Head almost as broad as the body, swollen above and around the eyes, concave in the middle above; around the eyes, and especially in front and above, there are numerous small, conical, often irregular and rough tubercles; a little removed from the upper side of each eye, is a much larger, rough, irregularly conical, erectile cirrus, which has some small, more or less prominent, conical papillæ on its surface; the whole upper surface of the body, head, and arms is also covered with minute scattered papillæ, which are usually but little prominent, but in some of the larger males they become much larger and more numerous, and have the form of small prominent warts.

The jaws (Plate XLIX, fig. 4a) have rather blunt, slightly incurved tips, with the angle at the bases of the cutting edges round and without any distinct notch. The odontophore, (Plate XLIX, fig. 4) has a median row of large, acute teeth, with broad bases without lateral denticles; the inner lateral teeth are much smaller, with curved acute-triangular points; outer lateral teeth longer and more acute; marginal plates large and distinct.

Siphon large, tapering, capable of being bent in all directions, so as to be used for swimming either forward, backward, or sideways, according to its direction.

Arms subequal, relatively short, stout, tapering to slender points, connected for about one-third of their length by a web, which extends as a narrow membrane along their margins to near the ends. Suckers small, not crowded, alternating pretty regularly in two rows; in the original type-specimen, which was not full grown, the arms of the first pair each had about sixty-five suckers; those of the fourth pair about sixty. In a large example (♀) the dorsal arms have about 94; third pair about 100; fourth pair about 90.

In the male, the right arm of the third pair has its terminal portion, for about a third of its entire length, modified for reproductive purposes into a large spoon-shaped organ (Plate XXXIII, figs. 1, 1*a*, *b*), broadly elliptical in outline, with the sides incurved and the end somewhat tri-lobed; its interior deeply concave with ten to twelve, and occasionally, in the largest examples, thirteen, elevated transverse folds; at the base, there is a fold bent into an acute angle, the apex directed forward, leaving a deep V-shaped sinus behind it, which is a continuation of a shallow groove formed by a thickening of the web along the lower side of the arm, and terminating midway between it and the fourth arm. At the end, this arm terminates in a small conical tip, between the two broadly rounded lobes of the spoon-shaped organ; at the base of this organ there is a slight constriction; the basal portion of the arm bears 30 to 37 suckers, like those on the other arms. The modified portion of the arm is considerably longer than the distance between the constriction at its base and the interbrachial web, and about equal to one-half the total length of the part which bears suckers. The corresponding arm on the left side is of the ordinary form and has, in a medium sized example, about fifty-one suckers. The female differs but little from the male, externally, except in lacking the modification of the third right arm.

Length of the original male specimen, in alcohol, exclusive of the arms, 44^{mm}; breadth of the body, 31^{mm}; between eyes, 18^{mm}; length of the arms, of the first pair, from mouth, 18^{mm}; from mouth to edge of the web, 57^{mm}; length of modified portion of third right arm, 18^{mm}; breadth of this organ when expanded, 11.5^{mm}. Subsequently somewhat larger specimens, both male and female, have been taken.

One of the largest males (Station 878) measures from tip of dorsal arms to end of body, 163^{mm}; from edge of dorsal web to end of body, 75^{mm}; from edge of mantle, beneath, to end of body, 38; breadth of body, 48; of head, 41; length of dorsal arms to beak, 110; of second pair, 112; of third pair, 115; of fourth pair, 110; of hectocotylied arm, 85; length of terminal spoon, 33; its breadth, 17. This specimen has thirteen transverse lamellæ in the spoon.

One of the largest females (Station 895,) in breeding season and filled with eggs, measures, from tip of dorsal arms to end of body, 170^{mm}; edge of dorsal web to end of body, 90; mantle, beneath, 46; breadth of body, 55; of head, 41; length of dorsal arms from beak, 125; of second pair, 120; of third pair, 115; of fourth pair, 115^{mm}.

When living, the ground-color was usually pale, translucent, bluish white, above thickly specked with light orange-brown and dark purplish brown. Its colors were changeable, but apparently less actively so than in the squids.

The spermatophores (Pl. XXVI, fig. 10, A, B) are remarkably large in proportion to the size of the animal, being from 50 to 75^{mm} in length and 4 to 5^{mm} in diameter. The form is club-shaped, with the narrow portion little longer than the thickened part. They are almost perfectly transparent, and the milk-white, coiled string of spermatozoa can be plainly seen in the interior. There is a slender, thread-like filament at each end, that of the small end much the longest. When they begin to discharge their contents (as in fig. 10, A), the form changes rapidly. In several instances I have observed these spermatophores escaping from the siphon of recently captured specimens, taken at various dates, from July 23 to Sept. 21, at stations 138, 161, 163, 223, etc.

This species was first discovered by the writer, while dredging in 1872, on the U. S. steamer "Mosswood," in the Bay of Fundy, off Eastport, Me., in 75 to 80 fathoms. Although so recently discovered, it proves to have a very extensive range, both geographically and in depth. It is one of the most common and characteristic inhabitants of the bottom, in 100 to 500 fathoms, along our entire coast, from South Carolina to Newfoundland. It was taken in the trawl, by the U. S. Fish Commission, in 1872, 1873, 1874, 1877, 1878, 1879, and 1880, in depths ranging from 50 to 500 fathoms, at numerous localities, from off Halifax, N. S., and in the Bay of Fundy, to the region 90 to 100 miles south of Newport, R. I., where it is common and of large size. It was obtained by Mr. A. Agassiz, on the "Blake," in 1880, at various stations, from N. lat. 41° 34' 30", to 32° 43' 25", in 178 to 524 fathoms.

In November, 1880, it was taken by Lient. Z. L. Tanner, on the "Fish Hawk," off the mouth of Chesapeake Bay, in 157 to 300 fathoms.

The Gloucester fishermen have brought in several specimens from the banks off Nova Scotia and Newfoundland.

Professor G. O. Sars has taken it off the Norwegian coast, in 60 to 300 fathoms.

It occurs both on soft muddy bottoms and on hard bottoms. Both sexes often occur together, but the males are usually the most numerous.

Recently hatched young have been taken in August and September, in the Bay of Fundy, off Halifax, N. S., and off Cape Ann, Mass. (at stations 45, 85, 234, 238, etc.).

One of the specimens obtained by Mr. Agassiz is remarkable for the length and slenderness of the cirrus above the eyes (Plate LI, fig. 1, 1a). This is an immature male, and does not appear to differ in any other way from ordinary specimens, of similar size. The appendage of the hectocotylied arm is small and not fully developed (as is always the case in young males), and has an ovate-triangular form, a slightly concave surface, and only a few transverse lamellæ.

Octopus Bairdii.—Specimens examined.

Stat.	Locality.	Fath.	Bottom.	When coll'd.	Specimens. No. Sex.
<i>U. S. Fish Com.</i>					
	Bay of Fundy -----	75	----	1872	2 ♂: 1 j. ♀
	Bay of Fundy -----	80	----	1872	1 l. ♂
	Bay of Fundy -----	60	----	1872	1 ♂
	Off G. Menan I. -----	97-110	gravel	1872	2 j. ♂
	Casco Bay -----	64	----	1873	1 med.
				1877	
30, 31,					2 l. ♂: 2 juv.
32, 33	Gulf of Maine, off Cape Ann	90	mud	Aug. 14	5 ♂
45	Off Cape Sable, 30 m.	91	fine sand	Aug. 21	1 l. ♂: 4 j. ♂: 4 j. ♀
85, 86	Off Halifax, 23 m.	101	fine sand	Sept. 6	2 ♂: 2 l. ♂: 4 ♀
<i>Gulf Maine and Mass. Bay.</i>					
<i>Off Gloucester, Mass.</i>					
				1878	
130	S. of Cape Ann, 13 m.	49	mud	July 23	1 ♂
138	Off Cape Ann, 9 m.	59	muddy	July 29	1 j. ♂: 2 l. ♂: 2 ♀
156	Off Cape Ann, 5½ m.	42	mud	Aug. 15	1 j.
161	Off Cape Ann, 6 m.	54	sand	Aug. 16	1 l. ♂: 1 j. ♂: 1 j. ♀
163	Off Cape Ann, 6½ m.	73	fine sand	Aug. 16	5 j. ♂: 3 l. ♂: 1 j. ♀
164	Off Cape Ann, 7 m.	75	fine sand	Aug. 16	2 ♂: 3 j. ♂: 2 l. ♀: 3
182	South of Gloucester -----	45	----	Aug. 29	4 j. ♀ [j. ♀
199	Off Cape Ann, 13½ m.	58	muddy	Sept. 2	1 j. ♂: 2 l. ♂: 1 l. ♀: 2
184	Off Gloucester, Mass., 4½ m.	45	mud	Aug. 29	3 j. ♀: 1 j. ♂ [j. ♀
207	Off Gloucester, Mass., 4¾ m.	42	soft mud	Sept. 16	1 j. ♂
211	Off Cape Ann, 6 m.	60	mud	Sept. 17	4 j. ♂: 2 j. ♀: 1 ♀
213	Off Cape Ann, 5½ m.	68	mud	Sept. 17	1 l. ♂
214	Off Cape Ann, 6 m.	57	fine sand	Sept. 17	1 m. ♀
223	Off Cape Ann, 7 m.	47	soft mud	Sept. 21	2 ♂: 1 ♀: 1 l. ♀
233	South of Gloucester, 4¾ m.	45	soft mud	Sept. 24	1 j. ♂
234	South of Gloucester -----	43	soft mud	Sept. 24	2 j. ♂: 1 j. ♀
238	Off Gloucester, 4½ m.	43	soft mud	Sept. 26	2 ♀

Octopus Bairdii—Continued.

Stat.	Locality.	Fath.	Bottom.	When coll'd.	Specimens. No. Sex.
				1879	
264	Off Cape Cod, 15 m. -----	80	mud	July 29	2 j. ♂: 1 l. ♀: 1 j. ♀
342	Off Cape Cod, 14 m. -----	94	mud	Sept. 10	2 m. ♂: 1 j. ♀
364	Off Cape Cod, 15 m. -----	70	hard sand	Sept. 18	3 l. ♂: 2 j. ♂: 2 l. ♀
372	Off Chatham, Mass., 21 m.	70	sand	Sept. 19	1 l. ♀
<i>Off Newport, R. I.</i>					
	N. Lat. W. Long.			1880	
869	40° 02' 18"; 70° 23' 06"	192	mud, fine sand	Sept. 4	1 l. ♀: 3 j. ♀
870	40 02 36; 70 22 58	155	fine sand	Sept. 4	1 l. ♂: 3 j.
874	40 ; 70 57	85	mud	Sept. 13	1
878	39 55 ; 70 54 15	142½	mud	Sept. 13	1 l. ♂
879	39 49 30; 70 54	225	fine sand	Sept. 13	1 ♂: 1 ♀
880	39 48 30; 70 54	252½	mud	Sept. 13	1 ♂: 1 ♀
892	39 46 ; 71 05	487	mud	Oct. 2	1 l. ♀
893	39 52 20; 70 58	372	mud	Oct. 2	2 ♂: 2 ♀
894	39 53 ; 70 58 30	365	sand	Oct. 2	3 l. ♂: 3 ♀
895	39 56 30; 70 59 45	238	mud	Oct. 2	2 ♂: 2 ♀
<i>Off Chesapeake Bay.</i>					
897	37 25 ; 74 18	157½	sand	Nov. 16	1 ♂
898	37 24 ; 74 17	300	mud	Nov. 16	2 ♂: 4 ♀
<i>Blake Exp.—U. S. Coast Survey.</i>					
	N. Lat. W. Long.				
303	41° 34' 30"; 65° 54' 30"	306	----	1880	1 ♂ (fig'd)
332	35 45 30; 74 48	263	----	1880	4 ♂: 1 j. ♀
327	34 0 30; 76 10 30	178	----	1880	1 ♂: 1 ♀
310	39 59 16; 70 18 30	260	----	1880	1 ♂
336	38 21 50; 73 32	197	----	1880	1 ♂ j.
321	32 43 25; 77 20 30	233	----	1880	1 ♂: 1 ♀ j.
306	41 32 50; 65 55	524	----	1880	1 ♂ j.
Lot.	<i>Gloucester Fisheries.</i>		<i>Schooner.</i>		
264	Lat. 42° 49'; long. 62° 57'	200-300	Marion	Jan. '79	1 l. ♀
351	N. lat. 44° 17'; W. long. 58° 10'	120	Grace L. Fears	June '79	2 ♀
372	Off Miquelon I. -----	7	A. M. Williams	July '79	1
421	Banquereau, off N. S. -----	300	Commonw'lth	Aug. '79	1 ♀
501	N. lat. 43° 14'; long. 61° 7'	250	A. M. Williams	Oct. '79	1 ♀
605	Brown's Bank, N. S. -----	---	Barracouta	Jan. '80	1 mutilated
771	Off St. Peter's Bank -----	80	Epes Tarr	July '80	1 ♂: 1 ♀
792	-----	---	G. P. Whitman	Aug. '80	1 l. ♂
917	Banquereau, N. S. -----	---	A. M. Williams	1880	1 l. ♂
721	Grand Bank -----	---	Guy C'ningham	July '80	1 l. ♀

In the last column. *j.* = young; *l.* = large; *m.* or *med.* = medium size.

Specimens of this species were kept alive for several days, in order to observe its habits. Several characteristic drawings, three of which are now reproduced (Plate XXXIV, figs. 5, 6; Plate XXXVIII, fig. 8), were made from life by Mr. J. H. Emerton, showing its different attitudes.

When at rest it remained at the bottom of the vessel, adhering firmly by some of the basal suckers of its arms, while the outer portions of the arms were curled back in various positions; the body was held in a nearly horizontal position, and the eyes were usually half-closed and had a sleepy look; the siphon was usually turned to one side, and was long enough to be seen in a view from above.

When disturbed, or in any way excited, the eyes opened more widely, especially at night; the body became more contracted and rounded, and was held more erect; the small tubercles over its surface and the larger ones above the eyes were erected, giving it a very decided appearance of excitement and watchfulness.

It was rarely, if ever, observed actually to creep about by means of its arms and suckers, but it would swim readily and actively, circling around the pans or jars, in which it was kept, many times before resting again.

In swimming backward the partial web connecting the arms together was used as an organ of locomotion, as well as the siphon; the arms and web were alternately spread and closed, the closing being done energetically and coincidently with the ejection of the water from the siphon, and the arms after each contraction were all held pointing straight forward in a compact bundle, so as to afford the least resistance to the motion (fig. 8). As the motion resulting from each impulse began to diminish sensibly, the arms were again spread, and the same actions repeated. This use of the arms and web recalled that of the disk of the jelly-fishes, but it was much more energetic.

The siphon was bent in different directions to alter the direction of the motions, and by bending it to the right or left side, backward motions in oblique or circular directions were given, but it was often bent directly downward and curved backward, so that the jet of water from it served to propel the animal directly forward. This, so far as observed, was its only mode of moving forward. The same mode of swimming forward has been observed in cuttle-fishes (*Sepia*) and in squids (*Loligo*).

This species was much more active and animated in the night than during the day, and is probably largely nocturnal in its habits, when at liberty. None of the specimens could be induced to take food, and none survived more than four or five days, although the water was frequently renewed to keep it cool and pure. They had been rather roughly handled by the dredges and trawls, without doubt. But the unavoidable exposure to the higher temperature of the water, near and

Measurements of northern species of *Octopus* (in inches).

Name.	<i>O. piscatorum</i> ♀.		<i>O. leahus</i> ♀.		<i>O. obsesus</i> ♂.		<i>O. Bairdii</i> .		
	Left.	Right.	Left.	Right.	Left.	Right.	♂.	♂.	♀.
Total length, to tip of arms, 1st pair.....	6.20	5.80	7.18	7.76	7.90	8.50	2.50	6.25	7.00
Total length, to tip of arms, 2d pair.....	6.30	5.90	7.12	7.40	7.98	7.98	2.40	6.20	6.50
Total length, to tip of arms, 3d pair.....	5.75	5.30	7.52	7.76	7.86	6.90	2.45	5.50	6.40
Total length, to tip of arms, 4th pair.....	5.25	5.00	7.16	6.94	7.10	7.46	2.50	5.25	6.25
Length to web between dorsal arms.....	3.25	--	--	--	4.40	--	1.35	3.96	2.55
Length to edge of mantle (beneath).....	1.20	--	2.40	--	1.96	--	--	1.56	1.82
Length to center of eye.....	1.55	--	--	--	2.88	--	--	1.50	2.00
Breadth of body, in middle.....	1.25	--	1.60	--	1.81	--	.95	1.90	2.17
Breadth of head (across eyes).....	1.20	--	1.28	--	1.52	--	.85	1.62	1.62
Breadth of arms, near base.....	.22	--	.30	--	.32	--	--	.28	.35
From beak to web, between dorsal arms.....	1.10	--	--	--	--	--	--	1.00	1.35
Length of spoon of hectocotylized arm.....	--	--	--	--	--	1.40	.30	1.30	--
Its breadth.....	--	--	--	--	--	.64	.15	.68	--
Rest of arm, to beak.....	--	--	--	--	--	2.60	--	2.25	--
Length of dorsal arms, from beak.....	4.25	4.00	4.20	4.48	--	--	--	4.25	4.95
Length of 2d pair arms, from beak.....	4.35	3.20	3.84	4.12	--	--	--	4.35	4.60
Length of 3d pair arms, from beak.....	3.85	3.75	4.24	4.48	--	--	--	4.00	4.35
Length of 4th pair arms, from beak.....	3.15	3.20	3.88	3.76	--	--	--	3.85	4.15

at the surface, especially in summer, is sufficient to kill many of the deep-water animals, while others that live for a short time never recover entirely.

This species resembles *O. lentus*, but has a much larger and rough or lacerate cirrus above the eye. The modified arm of the male is also different. It is somewhat related to *O. Greenlandicus* Dewh., but the male of the latter has the third right arm much longer, with the modified spoon-shaped portion relatively very much smaller and quite different in form, and with more numerous folds, and the basal part bears 41 to 43 suckers; the other arms also have more numerous suckers; the web is less extensive and the body is more elongated and appears to be smooth and destitute of the large cirrus above the eyes, if correctly figured.

O. obesus has the spoon-shaped part of the third right arm relatively larger, and several of the basal suckers of the other arms are in a single row. It also differs in other respects.

Octopus lentus Verrill.

Verrill, Amer. Jour. Sci., xix, p. 138, Feb., 1880: p. 294, April, 1880; Bulletin Mus. Comp. Zool., viii, p. 108, pl. 4, fig. 2, ♂.

PLATE XXXV, FIGURES 1, 2, ♀. PLATE LI, FIGURE 2, ♂.

Female (type specimen): Body broad, stout, depressed, slightly emarginate at the posterior end, rather soft to the touch, and in some specimens gelatinous in appearance; a thin, soft, free, marginal membrane runs along the sides and around the posterior end of the body, becoming widest (about 12^{mm}) posteriorly; in some of the more strongly contracted specimens this membrane is but little apparent. Head large, broad, depressed, with the eyes large and far apart; above each eye there is a small, simple, conical, acute, contractile cirrus. A well-developed thin web connects the arms, considerably above their bases, and then runs up to the tips as broad margins to each arm.

The arms are rather large, stout at base, with a broad inner face, and taper gradually to very slender tips; the first and third pairs are nearly equal in length; those of the second are also about equal in length to the fourth pair, but are somewhat shorter than the first and third. The arms on the right side, in the type-specimen, were all somewhat longer than the corresponding ones on the left. The arms, measuring from the beak, are more than twice as long as the body. The suckers are arranged in two distinct rows, to the base.

Color of head and body above, and of body beneath, deep reddish

brown, closely specked with darker brown, and with many small roundish spots of whitish on the body and arms.

Length of the type-specimen (♀) from the beak to the end of the body, not including the marginal web, 60^{mm}; breadth of web, 22; total length, 194; breadth of body, 40; breadth of head, across eyes, 32; of eye-openings, 10; of eye-balls, 17; length of mantle, beneath, 38; length of arms of first pair, 112 and 105; of second pair, 103 and 96; of third pair, 112 and 106; of fourth pair 94 and 97; breadth of those of the three upper pairs, 8; of the ventral pair, 7^{mm}.

Male: Body depressed, rounded posteriorly, with only a trace of the lateral and posterior fold; surface soft and nearly smooth, but showing a small number of minute white papillæ sparsely scattered over the dorsal surface. Cirrus above the eye small and simple, usually contracted into a small, wart-like papilla. Head broad and flattened; eyes large. Arms rather long and slender, with slender tapering tips, their bases united by a rather wide web. Suckers small, very prominent, forming two regular rows, quite to the base.

The first two pairs of arms are nearly equal and somewhat longer than the two lower pairs, which differ but little between themselves. The hectocotylized arm (third of right side) bears thirty-five suckers, in two rows, and a remarkably large, terminal spoon-shaped organ, which occupies more than a third of the total length of the arm; its sides are bent up and the edges inrolled, so as to form a deep cavity; its outer end is broadly rounded laterally, and terminates in a central, narrow, acute lobe; internally there are nine large, high, oblique lamellæ, with deep fossæ between them; the proximal end has a large, acute, triangular lobe, with involute margins; from this lobe a broad groove runs along the lower edge of the arm to the margin of the web; where it terminates there is a distinct thickening of the bounding membrane.

The two males of this species, described above, were dredged by Mr. A. Agassiz, on the "Blake," in 1880, in 464 and 603 fathoms. They agree well in the peculiar characters and large size of the appendage of the hectocotylized arm. The females, only, were previously known. Although these males have a mere trace of the loose membranous fold of skin, along the sides and around the posterior end, so conspicuous in the original female specimen of this species, they agree so well in other characters that I unite them without much hesitation. It is probable that the presence or absence of the membranous fold, in this and other species, may be due merely to differences in the state of contraction when they die, or even to differences in the strength of the alcohol.

Measurements in millimeters.

	♂	♂	♀	♀
	Right Side.	Left Side.	Right Side.	Left Side.
Total length	95	--	194	--
Posterior end to center of eye.....	34	--	--	--
Eye to tip of dorsal arms.....	64	--	--	--
Breadth of body.....	28	--	40	--
Breadth of head.....	22	--	32	--
Length of dorsal arms, from mouth...	65	61	112	105
" second pair	61	--	103	96
" third "	--	52	112	106
" hectocotylized arm, from mouth.....	58	--	--	--
" fourth pair	--	53	94	97
" spoon-shaped appendage.....	23	--	--	--
Breadth of the same	16	--	--	--

The first specimen of this species was taken off Nova Scotia, near Le Have Bank, in 120 fathoms, by Captain Samuel Peeples and crew of the schooner "M. H. Perkins," and presented to the U. S. Fish Commission. A few others have since been brought in by the Gloucester fishermen, from the Bank Fisheries. Mr. A. Agassiz, dredged it on the "Blake," in 1880, as far south as N. lat. 33° 42' 15". It ranges in depth from 120 to 602 fathoms.

Specimens examined.

No.	Stat.	Locality.	Fath.	When coll'd.	Specimens. No. and Sex.
7	326	N. Lat. 33° 42' 15"; W. Long. 76° 0' 50" (Blake)	464	1879	1 ♂; 1 ♀
10	329	N. Lat. 34° 39' 40"; W. Long. 75° 14' 40" (Blake)	603	1879	1 ♂ (fig'd.)
	553	Le Have Bank, N. S. (sch. M. H. Perkins)	120	1879	1 ♀ (fig'd.)
	718	S. of Newfoundland (sch. Proctor Brothers)	150	Jn '80	1 sm. ♀
	737	St. Peter's Bank (sch. Augusta H. Johnson)	200	1880	1 l. ♀
	807	Banquereau (sch. Epes Tarr)		Au. '80	1 ♀
	808	N. Lat. 44° 32'; Gr. Bank (sch. Gny Cunningham)		Au. '80	1 ♀

In the soft consistency of the flesh and skin, this species resembles *O. obesus*. It differs in the shorter and posteriorly emarginate body, and especially in the arrangement of the suckers, which, in that species, are in a single series toward the bases of the arms.

Octopus piscatorum Verrill.

Verrill, Amer. Jour. Sci., vol. xviii, p. 470, Dec., 1879; xix, p. 294, Apr., 1880.

PLATE XXXVI. FIGURES 1, 2, ♀.

The body of the female is smooth, depressed, about as broad as long; rounded posteriorly, not showing any lateral ridges, nor dorsal papillae; a small simple papilla above the eyes. Arms long, rather slender, tapering to long, slender, acute tips, the upper ones a little (2.5^{mm}) shorter than those of the second pair, which are the longest;

those of the third pair are about 12^{mm} shorter than those of the second; the ventral pair about 6^{mm} shorter than those of the third. In our type-specimen, all the arms on the right side are somewhat shorter than those on the left, and the web between the first and second arms is narrower, due, perhaps, to recovery from an injury. The web between the arms, except ventrally, is of about equal width, and scarcely more than one-fourth the length of the arms, measuring from the beak. Between the ventral arms the web is about half as wide as between the lateral.

The suckers are moderately large, decidedly prominent, alternating in two regular rows, except close to the mouth, where a few stand nearly in a single line; about fourteen to sixteen are situated on the part of the arms included within the interbrachial web. The whole number of suckers on one arm is upwards of seventy.

Color of one alcoholic specimen is deep purplish brown, due to very numerous crowded minute specks; eye-lids, whitish. The front border of the mantle, beneath, and the base of the siphon and adjacent parts are white; end of siphon, brown. Lower side of head and arms lighter than the dorsal side.

Total length, from posterior end of body to tip of arms, of 1st pair, 158^{mm}; 2d pair, 160^{mm}; 3d pair, 146^{mm}; 4th pair, 133^{mm}; to web between dorsal arms, 82^{mm}; between ventral arms, 63^{mm}; to edge of mantle, beneath, 30^{mm}; to center of eye, 39^{mm}. Breadth of body, 31^{mm}; of head across eyes, 30^{mm}; breadth of arms, at base, 5.5^{mm}; diameter of largest suckers, 2.5^{mm}; length of arms beyond web, 1st pair, 76^{mm}; 2d pair, 82^{mm}; 3d pair, 71^{mm}; 4th pair, 69^{mm}.

Two specimens of this species, both females, have been obtained. The first was from Le Have Bank, off Nova Scotia, in 120 fathoms, taken by Captain John McInnis and crew, of the schooner "M. H. Perkins," October, 1879; the second was taken by Captain David Campbell and crew, of the schooner "Admiral," (lot 590), near the Grand Bank, N. lat. 44° 07'; W. long. 52° 40', in 200 fathoms, December, 1879.

This species resembles *O. Grönländicus*, of which only the males appear to have been described, and it may eventually prove to be the female of that species.

This species is easily distinguished from *O. Bairdi*, by its more elongated body, its much longer and more slender and tapered arms, with shorter webs; by the absence of the large, rough, pointed papilla, or cirrus, above the eye, and by its general smoothness. The white color of the underside of the neck, siphon and mantle-border also appears to be characteristic.

Octopus obesus Verrill.

Verrill, American Jour. Sci., vol. xix, p. 137, Feb., 1880; vol. xix, p. 294, Apr., 1880.

PLATE XXXVI, FIGURES 3, 3a, δ .

Male: Remarkable for the great size of the spoon-shaped organ of the right arm of the third pair. Body relatively large, stout, oblong-oval, somewhat flattened above, obtusely rounded at the posterior end; soft and somewhat gelatinous in texture; skin, so far as preserved, smooth, soft. No cirrus exists above the eye, in our specimen, but the skin is not so well preserved in that region as to render it certain that a small one may not have existed in life. Eyes very large.

Arms moderately long, the dorsal longest, others successively shorter; all somewhat laterally compressed at base, tapering to long, slender tips; a moderately developed web connects them together at base. The hectocotylized arm (third of right side), bears at the end a very large, broad and thick, but not very deep, spoon-like organ, occupying more than a third of the total length of the arm; its inner surface is crossed by eleven oblique, thick, rounded folds or ribs, ten of them converging backward to the median line and at their outer ends joining a marginal thickening. The distal end terminates in a median, pointed lobe, or tip, with a thin, rounded, lateral lobe each side of it; the proximal border is formed by the last (eleventh) fold, which is V-shaped, with the apex pointing distally. A broad, thin, marginal membrane extends along the lower side of the arm, from the terminal organ to the base. The suckers have been partly detached from this arm.

The suckers of all the arms are moderately large, nearly globular in form, rather numerous; the first six to ten, at the base, are nearly in one line, except on the left arm of the second pair, and appear to form only a single row; in this part the inner face of the arm is narrow, most so on the right arm of the second pair, and least on the left arm of the same pair; farther out this face becomes broader and the suckers are in two distinct rows. The suckers are destroyed on the distal portion of all the arms.

The color of the body and arms is mostly destroyed, but so far as preserved, is pale pinkish, more or less thickly specked with distinct reddish brown spots, most conspicuous at the base of the arms and above the eyes, (elsewhere the color is probably not so well preserved).

Length of body, from the posterior end to the base of arms, 82^{mm}; to center of eye, 72; to edge of mantle, beneath, 49; to tip of right

dorsal arm, 213; left, 198; to tips of second pair, 200; to tip of right arm of third pair, 173; of left, 197; to tip of right, of fourth pair, 187; of left, 178; to edge of web, 110; breadth of body, in middle, 46; breadth of head, across eyes, 38; breadth of dorsal arms, at base, 8; diameter of largest suckers, 3; length of spoon-shaped end of right arm of third pair (hectocotylized), 35; breadth, 16; length of rest of arm, to mouth, 65^{mm}.

Taken from the stomach of a halibut, 36 miles east from the N. E. Light of Sable Island, in 160 to 300 fathoms, by Charles Ruckley, of the schooner "H. A. Duncan," and presented by him to the U. S. Fish Commission, 1879. A smaller, mutilated specimen was also taken from the stomach of a halibut, from Banquereau, off N. S., in 150 fathoms (lot 678), and presented to the U. S. Fish Commission, by Captain Charles Markuson and crew, of the schooner "Notice," April, 1880. The latter specimen was, however, in too poor condition to afford any additional characters, and may, perhaps, belong to *O. lentus*.

This species differs from *Octopus Bairdii* V., *O. lentus* V. and *O. piscatorum* V., from the same region, in its longer and larger body, and especially in having the basal suckers in a single row. The 'spoon' of the hectocotylized arm is very much larger than in *O. Grönländicus*, and considerably larger and flatter and more deeply trilobed at the end than in *O. Bairdii*.

Eledone Leach.

Octopus (pars) Lamarck; Cuvier; Blainville, etc.

Eledone Leach, Zool. Misc., iii, 137, 1817 (t. Gray); D'Orbig. Céphal. Acétab., p. 72 (subgenus); Gray, Catal. Moll. Brit. Mus., i, p. 21, 1849.

Body, mantle, and siphon as in *Octopus*. Suckers in a single row on all the arms. In the male the right arm of the third pair is hectocotylized by the formation of a small spoon-shaped tip and a lateral groove, nearly as in some species of *Octopus*.

Eledone verrucosa Verrill.

Bulletin Mus. Comp. Zool., viii, p. 105, pl. 5, 6, March, 1881.

PLATES LII, LIII.

A stout species, covered above with prominent, rough, wart-like tubercles, and with a circle of the same around the eyes; four or five of those above the eyes are larger and more prominent. Body thick, broad-ovate, swollen beneath, moderately convex above, obtusely rounded posteriorly.

Male: Head as broad as the body, whole upper surface of body and head to base of arms covered with prominent and persistent, unequal warts, which are roughened by sharp, conical papillæ, eight or ten on the larger warts, but only two or three on the smaller ones; the warts diminish in size anteriorly, and on the sides, before they disappear; around the eyes they form irregular circles; just above each of the eyes there are two much larger ones, bearing more than twenty conical papillæ; there is one before and one behind these, of somewhat smaller size. Eyes large, the lower lid purple and thickened, overlapping the upper one, which is thin and whitish.

Arms considerably longer than the head and body, not very stout, compressed, bearing a single crowded row of large whitish suckers, which are mostly separated by spaces less than half their diameter; margins of suckers soft and much thickened. The three lower pairs of arms are very nearly equal in length and size; the dorsal ones are a little shorter and smaller. A thin web unites all the arms for about one-fourth of their length, and runs up along their sides for about half their length. The male has the third right arm (Plate LII, fig. 1, 1a) hectocotylized at the tip; the modified tip is preceded by forty-five suckers, and is bordered ventrally by a broad membrane, having a white groove along its inner surface; the terminal organ (fig. 1a) consists of a small, ovate-triangular, fleshy disk, with its inner surface slightly concave and finely wrinkled transversely, and terminating proximally in a small point.

Color dark purplish brown, darker purple beneath. Chromatophores small and densely crowded.

The female is considerably larger than the male, and has the warts over the back and around the eyes relatively smaller, but of the same character. The arms appear to be larger than those of the male, but this is probably due to the fact that the male has become more contracted by the stronger alcohol in which it was placed.

This female specimen illustrates well the uselessness of the attempts to divide the species of *Octopus* and allied genera into groups or sections, according to the relative length of the arms, as J. E. Gray and others have done, for in this and many other cases the proportions of the arms of the right side would throw it into one section; those of the left side into another. The male would have to be put into a third section.

The two known examples of this species were taken by Mr. A. Agassiz, while dredging on the United States Coast Survey steamer "Blake," in 1880.

Measurements in millimeters.

	No. 12.	No. 13. ♀	
	♂	Right Side.	Left Side.
Total length	202·	360·	
End of body to center of eye	58·	100·	
Breadth of body	55·	65·	
Breadth across eyes	49·		
Length of dorsal arms, from mouth	135·	255·	260·
Length of second pair of arms	155·	260·	235·
Length of third pair of arms		225·	240·
Length of hectocotylized arm	130·		
Length of modified tip	4·5		
Length of ventral arms	145·	210·	225·
Greatest breadth of lateral arms	12·	18·	18·
Diameter of largest suckers	3·	5·	5·

Specimens examined.

No.	Stat.	Locality.	Fath.	When rec'd.	Specimens.	
					No.	Sex.
12	305	N. Lat. 41° 33' 15" ; W. Long. 65° 51' 25"	810	1880	1	♂
13	312	N. Lat. 39° 50' 45" ; W. Long. 70° 11'	466	1880	1	♀

Family CIRRHOTEUTHIDÆ Keff.

Kefferstein, in Bronn, Thier-Reich, iii, p. 1448, 1866.

Body somewhat elongated, furnished with a short, thick tapering fin on each side, supported by an internal transverse cartilage. Mantle extensively united to the head. No connective cartilages. Arms united together nearly to the tips by a broad umbrella-shaped membrane or web. Suckers in a single row, alternating with slender cirri.

Stauroteuthis Verrill.

Verrill, American Journal of Science, vol. xviii, p. 468, Dec., 1879.

Allied to *Cirrhoteuthis*, but with the mantle united to the head all around, and to the dorsal side of the slender siphon, which it surrounds like a close collar, leaving only a very narrow opening around the base of the siphon, laterally and ventrally. Fins long-triangular, in advance of the middle of the body. Dorsal cartilage forming a median angle, directed backward. Body flattened, soft, bordered by a membrane. Eyes covered by the integument. Web not reaching the tips of the arms, the edge concave in the intervals. Suckers in one row, with a pair of slender cirri alternating with them along most of the arm. Cirri absent between the basal and terminal suckers.

Stauroteuthis sirtensis Verrill.

Amer. Jour. Sci., vol. xviii, p. 468, Dec., 1879; xix, p. 294, pl. xvi, Apr., 1880.

PLATE XXXII, FIGURES 1-5.

Female: Head broad, depressed, not very distinct from the body. Eyes large. Body elongated, flattened, soft or gelatinous, widest in

the middle, narrowed but little forward, but decidedly tapered, back of the fins, to the flat, obtuse, or subtruncate tail. The sides of the head and of the body, forward of the fins, are bordered by a thin soft membrane, about 12^{mm} wide. The fins are elongated, sub-triangular, obtusely pointed, placed in advance of the middle of the body; supported by internal cartilages, which unite with a transverse dorsal V-shaped one, situated behind the fins. Siphon elongated (about 12^{mm}), slender, round, with a small terminal opening. Mantle edge is contracted and thickened around the base of the siphon so as to show only a very small opening, and is united to its anterior or dorsal commissural band. Eyes large, distinctly visible through the integument. Arms long, slender, sub-equal, each united to the great web by a broad membrane developed on its outer side, widest (about 38^{mm} or 1.5 inches) in the middle of the arm, while the edge of the web unites directly to the sides of the arms and runs along the free portion toward the very slender tip, as a border. This arrangement gives a swollen or campanulate form to the extended web. Edges of the web incurved between the arms, widest between the two lateral pairs of arms. The arms bear each fifty-five or more suckers, in a single row. Those in the middle region are wide-apart (12^{mm} or more), with a pair of slender, thread-like cirri, about 25 to 32^{mm} long, midway between them. The cirri commence, in a rudimentary form, between the 5th and 6th suckers, on the dorsal arms, and between the 7th and 8th, on the lateral and ventral ones. They cease before the 23d sucker on the dorsal and lateral arms, and before the 22d on the ventral ones, which bear each 14 pairs of cirri. Near the mouth, and beyond the last cirri, on the free portion of the arms, the suckers are more closely arranged. The jaws are small, with a deep cavity. Beyond the last cirri, on the dorsal arms, there are 33 to 35 small suckers. The 2d arm on the right side appears to be imperfect. On this arm there are but 19 suckers beyond the last cirri; then follow minute, wart-like tubercles, extending to the tip. Color, in alcohol, generally pale with irregular mottlings and streaks of dull brownish; inner surface of arms and web, toward the base, and membrane around the mouth, deep purplish brown. Length from end of body to base of arms, 160^{mm}; length to posterior base of fins, 63^{mm}; to anterior base, 101^{mm}; width across fins, 126^{mm}; in advance of fins, 53^{mm} (not including lateral membrane); across eyes, 44^{mm}; across end of tail, 30^{mm}; diameter of eye, 25^{mm}; width of fins, at base, 33^{mm}; their length, 44^{mm}; length of arms, 330^{mm} to 355^{mm}; portion beyond web, 63 to 76^{mm}. Edge of extended web, between upper arms, about 101^{mm}; between lateral

arms, about 203^{mm}; entire circumference of web, about 1218^{mm}, but its exact extent cannot be ascertained, because, in our specimen, the web between the ventral arms was badly torn.

The only known example of this remarkable species was taken by Capt. Melvin Gilpatrick and crew, schooner "Polar Wave," in N. lat. 43° 54'; W. long. 58° 44', on Banquereau, about 30 miles E. of Sable I., N. S., in 250 fathoms. Presented to the U. S. Fish Commission, Sept. 1879 (lot 472).

Notes on the Visceral Anatomy.

The anatomy of this species is very peculiar, but as the original specimen still remains unique, and is not in very good preservation, internally, I do not propose to give more than a few anatomical notes on this occasion. The ventral wall of the mantle cavity is extensively bound down to the visceral mass over a wide central area, by connective and muscular tissue, which does not form a definite septum, found in most other Dibranchiata. This central area underlies, especially, the large nidamental glands and oviduct. Farther back the two sides of the branchial cavity are in communication.

The gills are very peculiar. Each one consists of a short and broad, ovate group or cluster of very much folded or convoluted lamellæ attached directly to the inner surface of the mantle by one edge, and having the free edge much frilled and crisped.

These lamellæ have, however, a somewhat transverse arrangement, and one or two of those nearest the base of the gill, on each side of its median line, are more simple, and are separate from the rest, but those farther out become confluent across the median line, and lose their distinctness. There appears to be about four or five principal lamellæ on each side of the middle line of the gill.

The oviduct is single and nearly median, its orifice being a little to the left of the median line. A large nidamental gland, consisting of a posterior, yellowish portion, and a much larger, round, dark brown, anterior portion, surrounds the oviduct; the portion behind these glands is thin, tubular, and contains large round ova.

The anterior portion, in front of the glands, is large and much thickened, and terminates in a slightly bilabiate orifice, at the base of the siphon. From the portion of the oviduct in front of the large glands I took a large mature egg, covered with a hard, dark reddish brown case. This egg, seen endwise, has a broad elliptical outline, and while the two ends are truncated and smoothish, the sides are ornamented with numerous regular, roughened, elevated ribs. Greatest breadth of the egg, 11^{mm}; lesser breadth, 7^{mm}; length, 6^{mm}. The anal orifice is not raised on a distinct elevation. A small urethral papilla arises in front of the base of each gill.

APPENDIX.

Since the earlier parts of this article were printed, a number of additional specimens of some of the species have been received. Some of these are of importance, as affording additional information in regard to the genera and species, and will, therefore, be mentioned here.

I have also received from Professor J. Steenstrup two recent pamphlets,* relating to the *Ommastrephidae* and *Teuthidae*, printed subsequently to the publication of the pages relating to those families in this article. As these refer directly to the genera and species herein described, they may well be briefly noticed here.

Ommastrephes, Sthenoteuthis, Illex, etc.

Professor Steenstrup, in the first paper referred to, has given a revision of the Ommastrephes-group. He divides the old genus *Ommastrephes* into three genera, viz: I. ILLEX, which includes *O. illecebrosus*, with *Coindetii*, the closely allied Mediterranean form; II. TODARODES, which includes only the well-known *Ommastrephes todarus* of the Mediterranean, to which he restores the name *sagittatus* Lamarck, which has been otherwise employed by other authors during half a century past; III. OMMATOSTREPHEST† (restricted), which corresponds exactly with *Sthenoteuthis*‡ previously established by me. (These Trans., p 222, February, 1880).

* De Ommatostrephagtige Blæksprutter indbyrdes Forhold <Oversigt over d. k. D. Vidensk. Selsk. Forhandl., 1880. Presented, April, 1880. [Author's edition received Aug., 1880].

Professor A. E. Verrils [sic] to nye Cephalopodslægter. Sthenoteuthis og Lestoteuthis. Bemærkninger og Berigtigelser, 1 pl. ["avec un résumé en Français." not received]. From the same, 1881. Advance copy received by me, through the kindness of the author, is dated, in MSS., March 3, 1881.

† I can see no necessity for the proposed reformation of the original spelling of this word by changing it to "*Ommatostrephes*," for usage justifies the elision of a syllable in so long a name. The original spelling has been in good use for over forty years.

‡ Professor Steenstrup also quotes *Cyberia* Gray, 1849 (ex Leach MSS.), as a synonym of *Ommastrephes* as restricted, = *Sthenoteuthis*. But in reality it was evidently intended for a group equivalent to *Ommastrephes*, in the extended sense, and as a complete synonym, never in use, it should be dropped. *Hyaloteuthis* Gray, if used at all, should be used in the limited sense, for a minor group, as originally intended.

In another part of this article he refers* to my paper, which had been promptly sent to him, but he makes no reference whatever to the genus *Sthenoteuthis*, nor to the species, *S. megaptera*, which, as a species, had been described by me still earlier (1878) and in far greater detail than most of the other species which he mentions, and which should, under his system of classification, bear the name of *Ommaastrephes megaptera*. Nor does he point out any new characters for distinguishing this generic group other than those first given by me, viz: the presence of connective suckers and tubercles on the tentacular arms proximal to the club, and the great development of the membranes on the lateral arms.

Under the ordinary rule of nomenclature, by which the first correct subdivision made in an older genus shall be entitled to priority, while the original name shall be retained for the remaining group, the name *Sthenoteuthis* ought to be maintained for the division first established by me, while *Ommaastrephes* (restricted) should be retained for a part or all of the remaining species.† While I very much regret this confusion of names, I perceive no way to remedy it except by the application of the usual rules of priority.

As for the distinction between *Illex* and *Todarodes*, it seems to me very slight and scarcely of generic importance. *Illex* is characterized by having eight rows of small suckers on the distal part of the club, and a smooth siphonal groove. *Todarodes* is characterized by having four rows of distal suckers and some small grooves or furrows at the anterior end of the siphonal groove.

But I have a species (which I refer to *O. Sloanei* Gray), from Tasmania, which agrees with *Illex* in having a smooth siphonal groove, but with *Todarodes* in having only four rows of distal tentacular suckers, and in the sharp denticulation of its large suckers. According to Steenstrup's system this would have to be made still another genus, or else his generic characters would have to be greatly

* In discussing (p. 233, foot note) my statements in respect to the sexual differences in proportions. It is to be hoped that Prof. Steenstrup will find in the tables of measurements given in the preceding pages all the data needed to settle this matter more satisfactorily.

† Professor Steenstrup considers *O. Bartramii* as the "typical" species of *Ommaastrephes*. But in fact D'Orbigny did not give any particular species as the type of his genus. His description applies better to such forms as *O. todarus* and *O. illecebrosus*, for he does not mention the connective tubercles and suckers of the tentacular arms. Nor is it certain that *O. gigas*, one of the earliest species referred to this genus, has such structures. The species thus named, even by Professor Steenstrup, is so called only with a mark of doubt.

changed in order to admit it into either of his groups. The existence of eight rows of suckers in '*Illex*' seems to be due merely to the crowding together of the ordinary four rows; nor can we attach much importance to the superficial furrows in the siphon-groove. Therefore, my own opinion still is that *Illex* and *Todarodes* should be reunited, and should retain the name *Ommastrephes*, in a restricted sense. The absence of connective suckers and tubercles on the tentacular arms will be the most important diagnostic character to distinguish it from *Sthenoteuthis* and *Architeuthis*.

In this paper, Professor Steenstrup gives figures (cuts) which, with the descriptive remarks, will, at last, enable others to identify his *S. pteropus* with more certainty. He has given diagrammatic cuts of the base of the tentacular clubs, showing the arrangement of the connective suckers and tubercles of *S. pteropus*, *S. Bartramii*, *S. gigas*, *S. pelagicus*, *S. oualaniensis*, and *Dosidicus Eschrichtii* [p. 11], and cuts [p. 9], showing the siphonal grooves of *Sthenoteuthis pteropus*, *S. Bartramii*, *S. pacificus*, *Ommastrephes sagittatus* (= "*O. todarus*"), and *O. Coindetii* (= "*O. sagittatus*," auth.). On pp. 19 and 20 he has given a synoptical table of the several genera that he recognizes in this group, which he names, *Ommatostephini* (= *Ommastrephidae* Gill, Tryon, Verrill). On plate 3, he figures "*Illex Coindetii*," female, with the gill-cavity opened, showing a large cluster of spermatophores attached to the inner surface of the mantle, behind the base of the gill, and a smaller one, in front of the gill.

In the second article referred to, Professor Steenstrup discusses the genus *Sthenoteuthis* versus "*Ommatostrephe*." He recognizes the identity of *Sthenoteuthis* and his restricted genus *Ommatostrephe*, as well as the priority of date of the former. He also refers to *S. megaptera*, as "*Ommatostrephe megaptera*."

Lestoteuthis = *Cheloteuthis* = *Gonatus* Steenst. (non Gray).

The second of Professor Steenstrup's papers contains a detailed discussion of *Gonatus Fabricii* Steenst., with which he also unites *Oncychoteuthis Kamtschatica* Midd., the type-species of my genus *Lestoteuthis* (see p. 250). He may be correct in uniting these forms, for he states that he has received specimens that agree with *Gonatus Fabricii*, from the North Pacific.* Moreover, taking the characters of the genus *Gonatus*, as now understood, by Professor

* The figures, however, show differences in the form of the pen and rostral fin, which, if correct, may still indicate specific differences.

Steenstrup, the description and figures of Middendorff's species apply well to that genus, and my description of *Lestoteuthis* well defines *Gonatus* Steenst., except for the mistake in regard to the tip of the pen. But when I proposed the genus *Lestoteuthis*, no writer had ever so described *Gonatus*, and the data necessary for the correlation of the two species *did not exist* in the literature of the subject. I have already alluded (pp. 290-292 and elsewhere), to some of the very serious errors of Gray, H. & A. Adams, and others, as to the *generic* and even *family* characters of *Gonatus*.* Professor Steenstrup, in his last paper, has exposed a greater number of errors, some of which are questionable. He has, however, been fortunate in securing specimens of larger size and in better condition than those examined by other writers, and has given good figures and a very full exposition of the characters of this very interesting species. Two excellent specimens were taken by our party, this season, on the "Fish Hawk." One of these is an adult male; the other is young, with the mantle 30^{mm} long. The latter agrees well in size and form with the specimen described and figured by G. O. Sars, as *Gonatus amœnus*, while the former† agrees with Steenstrup's figure of the adult *G. Fabricii*. But both differ decidedly from a Cumberland Gulf specimen, which is doubtless the *real* *Gonatus amœnus* Gray, and has four rows of true suckers on all the arms, and no hooks. It does not appear that Steenstrup has seen this form.

The fortunate acquisition of these specimens has enabled me to ascertain, for myself, not only that Professor Steenstrup is correct in considering two forms that have been described from the North

*The genus *Gonatus*, as established by J. E. Gray, if we judge by his description, was a very different group from what Steenstrup understands by it. Among the false characters given by him are the following: 1, It was said to have no eyelids; 2, to have no valve in the siphon; 3, to have no siphonal dorsal band. But he also says that it has nearly equal and similar suckers in four series, on all the arms, "all with small circular rings"; and the club was said to have "ranges of small, nearly sessile, equal-sized cups," with one "large sessile cup, armed with a hook in the middle of the lower part." From the fact that he received his specimens from Greenland (coll. Möller), we must believe that he actually had before him the real *G. amœnus*! My specimen from Cumberland Gulf has true suckers, as described by Gray, *on all the arms*.

Most of Gray's errors have been copied and adopted by Woodward, H. & A. Adams, Tryon, and many other writers.

† I have had figures of the larger specimen made by Mr. Emerton, for my Report on the Cephalopods, now printing in the Report of the U. S. Fish Commission, for 1879. Some of these are also reproduced on Plate LV, figs. 1-1d.

Atlantic, as simply the young and adult of the same species, but also that all the essential and peculiar features of the armature, both of the sessile and of the tentacular arms, including the special, lateral connective suckers and tubercles of the club, are present, though minute, even in the very young individuals, such as described by G. O. Sars. The fact that these characters have been overlooked is undoubtedly due, in many cases, to the imperfectly preserved specimens that have been examined. This was, at least, the case with the only American specimens seen by me until this year. They had all been taken from fish stomachs, and had lost more or less of their suckers and hooks.

A careful direct comparison of the adult *G. Fabricii*, with the mutilated specimen which was last year described by me as *Cheloteuthis rapax*, has convinced me that they are identical, and, therefore, *Cheloteuthis* becomes a synonym of *Lestoteuthis*. Two of the characters, viz: the supposed presence of two central rows of hooks on the ventral, as well as on the lateral arms, and the supposed absence of the small marginal suckers on the lateral arms, relied upon for characterizing *Cheloteuthis*, were doubtless due to post-mortem changes. The ventral arms had lost the horny rings of the suckers, and the soft parts had taken a form exceedingly like that of the sheaths of the hooks of the lateral arms. But by the careful use of reagents I have been able to restore the original form of some of the distal ones sufficiently to show that they actually were sucker-sheaths. The third character, originally considered by me as more reliable and important, was the existence of the peculiar, lateral connective suckers and alternating tubercles on the tentacular club. This is now shown by Professor Steenstrup to be a character of his *Gonatus*. But no one had previously described such a structure in connection with that genus. Even in the recent and excellent work of G. O. Sars, in which "*G. amœnus*" is described in some detail, and freely illustrated, there is no indication of any such structure, although the armature of the club is figured (see my Pl. 45, fig. 1*b*), nor is the difference between the armature of the ventral and lateral arms indicated.*

I add a new description of the genus *Lestoteuthis*, and also of my largest example of *L. Fabricii*.

*According to Gray, in *Gonatus* all the sessile arms bear four rows of similar and nearly equal suckers; according to G. O. Sars they all have two central rows of sucker-hooks. My description (p. 290) was based mainly on the figures and description of G. O. Sars, my only specimen, at that time, being an imperfect young one.

Lestoteuthis Verrill. (revised).

Gonatus Steenstrup, op. cit., pp. 9-26. (non Gray).

Gonatus Verrill, this volume, pp. 250, 290, 1880. (non Gray).

Lestoteuthis Verrill, this volume, p. 250, Feb., 1880.

Cheloteuthis (*Chiloteuthis* by typ. error) Verrill, this volume, p. 292, Jan., 1881.

Cheloteuthis Verrill, Bulletin Mus. Comp. Zool., viii, p. 109, March, 1881.

Odontophore with only five rows of teeth.* Mandibles very acute, strongly compressed. Lateral connective cartilages of the mantle are simple ridges; those of the siphon ovate. Nuchal olfactory crests one or more on each side, longitudinal. Caudal fin, of adult, large, spear-shaped. Ventral arms with four rows of denticulated suckers. No trace of hectocotylyzation detected.† Lateral and dorsal arms with two marginal rows of small suckers and two median rows of large hooks. Tentacular arms with a central row of hooks, the two distal ones largest; with a large distal and two lateral groups of small suckers, in numerous rows; and with a lateral group of peculiar connective suckers, alternating with tubercles, near the lower margin, and a row of smaller ones extending for a long distance down the margin of the arm; upper margin of the arm with a band of small, pediceled suckers along about half its length. Pen narrow, with a short, hollow, posterior cone.

Gonatus Gray, typical, (non Sars, Steenst.) differs in having four rows of true suckers, similar on all the arms. This may be a sexual character, but the two forms should be kept separate, awaiting farther evidence. Steenstrup does not give the sex of his specimens.

Lestoteuthis Fabricii (Licht.) Verrill. (See pp. 291-294.)

‡ *Onychoteuthis Kamtschatica* Middendorff, 1849.

Gonatus Fabricii Steenstrup (*pars*), in Mörch, Faunula Molluscorum Ins. Færøerne, Vid. Meddel. nat. For., 1867, p. 102; Faunula Mollusc. Islandiæ, Vid. Meddel. nat. For. Kjöbenhavn, 1868, p. 227.

Gonatus Fabricii Mörch (*pars*), in T. R. Jones, Arctic Manual, p. 130, 1875.

Steenstrup, Oversigt over d. Kongl. D. Vidensk. Selsk. Forh., 1881. [Sep. copy, p. 26.] pl. 1, figs. 1-7.

Verrill, (*pars*) this volume, p. 291.

Cheloteuthis ropax Verrill, this volume, p. 293, pl. 49, figs. 1-1^f; Bulletin Mus.

Comp. Zool., viii, p. 110, pl. 2, figs. 1-1^f, 1881; Report U. S. Fish Com. for 1879, p. [76], pl. 15, figs. 3-3^f, 4, dentition, 1881.

Lestoteuthis Fabricii Verrill, Report of U. S. Fish Com. for 1879, p. [79], pl. 15, figs. 1-1^f, 2-2^A, pl. 45, figs. 1-1^f, 1881.

* The dentition of the type-specimen of *Cheloteuthis ropax* was figured and described by me several months ago, in the report of the U. S. Fish Com., for 1879.

† My largest specimen, although apparently adult, is not sexually mature. An older specimen might be hectocotylyzed.

PLATE XLV, FIG. 1-2*d*. PLATE XLIX, FIG. 1-1*f*. PLATE LV, FIG. 1-1*d*.

Body elongated, tapering to an acute posterior end; anterior edge of mantle nearly even dorsally, with a slight median emargination; lateral angles well-marked, in line with the internal connective cartilage, which forms a long, simple, longitudinal ridge. Caudal fin broad spear-shaped, broadest in advance of the middle; the lateral angles are well rounded; the tip is very acute; the anterior lobes are broadly rounded, projecting forward beyond the insertion. Head large, short and broad; eyes large, occupying most of the sides of the head; eye-lids well developed, thickened, with a narrow, oblique sinus. Siphon large, in a deep groove, with two stout, dorsal bristles; lateral connective cartilages large, long-ovate, posterior end broadest. One olfactory crest on each side, behind the eye, in the form of a low, longitudinal membrane; slight indications of another, lower down; a small, fleshy, flattened, projecting papilla near the auditory opening. The outer buccal membrane has seven distinct angles. Arms rather long and strong; trapezoidal in section. The dorsal arms are considerably shorter than the others; order of length is 1, 2, 4, 3; the 3*d* is but little longer than the second pair; ventral arms decidedly more slender than the others.

Ventral arms with four rows of denticulated suckers, those of the two inner rows larger; lateral and dorsal arms with two marginal rows of small suckers and two inner rows of larger incurved hooks, enclosed, except at the sharp tips, in muscular sheaths, which have lateral basal expansions and short pedicels (Pl. LV, fig. 1*b*). Tentacular arms* long and strong, quadrangular; in my specimen they reach back beyond the base of the fin; the club is large and broad, with a long, narrow distal portion, having a strong dorsal keel; in the middle are two very large, curved hooks (fig. 1, 1*a*), the distal one smaller; proximal to these there is a row of five smaller hooks, decreasing proximally, and between these and the large hooks there is, on one arm, a single small sucker; on the other arm a single sucker takes the place of the proximal hook, while an odd, small sucker stands to one side of the row; along the upper margin of the club there is a broad band of small, denticulated suckers, on long pedicels, arranged in oblique, transverse rows of five or six; this band of suckers is interrupted opposite the large hooks; beyond the hooks

*The figure given (pl. XLIX, fig. 1.) of the somewhat injured tentacular club of the type of *Cheloteuthis rapax*, represents the structure nearly correctly, but many of the small suckers and tubercles on the arm, below the club, had been destroyed, the edge above *e'* is injured, and of the large hooks (*a*, *a'*) only the sheaths remain.

a large group of similar small suckers covers nearly the whole distal portion of the club (Pl. LV, fig. 1); at the tip of the club there is a circle of small smooth suckers; along the lower margin of the middle portion of the club there is a band of small suckers, like those on the other margin; along the basal third of the margin and supported on a thickened marginal expansion of the club, there is a row of six special, smooth, connective suckers, at the inner ends of transverse, muscular ridges (fig. 1, *e*); between and alternating with these suckers, there are deep pits and as many small, round tubercles, destined to fit the suckers and ridges of the other club; continuous with these a row of similar, but smaller, sessile, connective suckers and tubercles extends down along the margin of the inner face of the arm, for about half its length, becoming smaller and more simple proximally; an irregular band, formed of two or three rows of small, pediceled and denticulated suckers, extends down the other margin of the arm, with some scattered ones along the middle.

The pen (Pl. LV, fig. 1*d*) is thin, long and narrow; anterior part about half as wide as the middle portion, slender, concave, with thickened margins; the anterior end is very thin, acute; the two marginal ribs converge gradually, as they run backward, and unite near the posterior end; the widest part of the pen is a little behind the middle; the thin margins begin at about the anterior third, gradually increasing in width to the widest part, when they still more gradually decrease posteriorly; but toward the end they expand into the obliquely hooded portion, or terminal hollow cone; this portion is strengthened by a dorsal mid-rib, and by numerous small ribs which radiate forward from the tip, one on each side being stronger than the rest. In life, the cone contained part of the testicle, and at the tip a cartilaginous core. Length of pen, in alcohol, 133^{mm}; greatest breadth, 7^{mm}; of shaft, 2.5^{mm}; length of cone, on shortest side, 7^{mm}.

General color of body, fins, head and arms, deep reddish brown, tinged with purple; back darkest; the color is due to large chromatophores rather uniformly and closely scattered over the whole surface; on the arms and siphon they are smaller, but they cover all the surfaces of the arms, except the lower side of the tentacular arms and the face of the club. Total length, 263^{mm} (10.25 inches); length of mantle, 153^{mm} (6 inches); length of dorsal arms, 57^{mm}; of 2d pair, 71^{mm}; of 3d pair, 77^{mm}; of 4th pair, 70^{mm}; of tentacular arms, 100^{mm}; length of tail, from insertion, 63^{mm}; from anterior lobe, 70^{mm}; greatest breadth, 68^{mm}; breadth of head, 29^{mm}.

Notes on the visceral anatomy of the male.

In its anatomy this species resembles *Ommastrephes*. The branchial cavity is very large, extending back nearly to the base of the fin; the median longitudinal septum is far back, gills very long, but not reaching the margin of the mantle, attached nearly to the tip; its structure is like that of *Ommastrephes*. Liver orange-brown, very large, massive, nearly as in *Ommastrephes*, but larger, extending back farther than the base of the fin. The circulatory and renal systems are similar to those of *Ommastrephes*, in most respects. The posterior aorta goes back some distance before it divides, about opposite the base of the fin, into the medio-ventral artery of the mantle, and a caudal artery. Two large ventral renal organs lie below and to each side of the heart, and blend together, in front of it, into a large mass, which has a pointed lobe extending forward; posteriorly two lobes extend back, as usual, along the posterior venæ-cavæ. The first stomach is rounded and the second stomach is a large, long-pyriform sac; the intestine is long, the ink-sac is long-pyriform. The reproductive organs are small, indicating that the specimen is still immature, and probably only one year old. The spermary or "testicle" is small (length 18^{mm}, diameters 2^{mm} and 4^{mm}), flattened, tapering backward, partly enclosed by the hooded portion of the pen, and with the anterior end attached laterally to the posterior end of the cæcal lobe of the stomach. The prostate gland, vesiculæ-seminales and spermatophore-sac are small; the efferent duct is long and slender, extending forward over and beyond the base of the left gill.

Moroteuthis, gen. nov.

Type, *Onychoteuthis* (or *Lestoteuthis*?) *robusta*, this vol., pp. 246-250.

Moroteuthis robusta Verrill, Report of the U. S. Fish Commission for 1879, pp. [65-71], pls. 13 and 14, 1881.

After referring the type of *Lestoteuthis* to *Gonatus* (not of Gray), Professor Steenstrup admits that the gigantic species, *L. robusta* V., is the representative of a distinct genus, to which he would restrict the name *Lestoteuthis*.

But *L. Kamtschatica* was specially given by me as the type of *Lestoteuthis*, and the characters of the genus were derived entirely from that species, while *L. robusta* was referred to it only with great doubt, owing to the fact that its armature is almost unknown. Therefore, if *Lestoteuthis* hereafter becomes a complete synonym, it should be dropped, when it cannot be kept for its special type-species. For the gigantic species I have proposed (Am. Jour. Sci., xxii, p. 298, Oct., 1881,) a new genus, *Moroteuthis*.

This genus will have, as known characters: A long, narrow, thin pen, terminating posteriorly in a conical, hollow, many-ribbed, oblique cone, which is inserted into the oblique, anterior end of a long, round, tapering, acute, *solid*, cartilaginous terminal cone, composed of concentric layers, and corresponding to the solid cone of *Belemnites* in position and relation to the true pen; elliptical connective cartilages on the base of the siphon; nuchal, longitudinal crests, three, much as in *Ommastrephes*; eye-lids with a distinct sinus; caudal fin large, broad, spear-shaped, ventral arms with smooth-rimmed suckers at the base. The rest of the armature is unknown.

Moroteuthis robusta is the only known species.

Architeuthis Harting, 1861. (See pp. 197, 238, 239.)

Architeuthus Steenstrup, Förhandl. Skand. Naturf., 1856, vii, p. 182, 1857 (no description).

The characters of this genus, as given on p. 197, must be modified, so far as the *pen* is concerned, in accordance with the description given below.

Professor Steenstrup, in the second of the papers above cited (see p. 385) criticises me (and others) for writing *Architeuthis* instead of *Architeuthus*, as he originally spelled the word. So far as I am personally concerned, I am free to confess that I had always supposed that his original spelling was a typographical error, and as the genus at that time was merely *named*, but in no sense *established* nor *defined*, as a matter of necessity I adopted the name as spelled in the earliest published work (that of Harting), in which the characters of the genus were so far indicated as to make it possible to recognize it. Harting states that he was in correspondence with Professor Steenstrup, in regard to this genus, and that he had received from him drawings and proofs of unpublished plates of *Architeuthis*. Therefore, the blame, if any, for the change in spelling, must rest mainly with Harting. Moreover, Gervais, who had seen and briefly described Professor Steenstrup's specimens, also wrote *Architeuthis*, and that has been the general practice with nearly all European writers, for twenty years. Therefore, I do not see the propriety of specially criticising Mr. Tryon and myself for using this spelling, which has been so extensively adopted in Europe.

That the original form of the word would have been preferable, I do not deny. But that there is any special impropriety in the termination *teuthis*, even for a *large* cephalopod, it is useless to insist upon, for that termination has been generally adopted by many writers, and during many years, for several genera, living and fossil,

of both large and small cephalopods. Thus Professor Steenstrup, himself, notwithstanding his demonstration of the etymological absurdity of the names, uses "*Enoploteuthis*," "*Lestoteuthis*" for genera that include species about as *large* and *powerful* as *Architeuthis*. Although *teuthis*, in classical Greek, may signify a *small* and *weak* cephalopod, as a zoological term it no longer has that meaning. But if the change had not been made by others, apparently with good reasons, I should certainly not have adopted it, for it is not in accordance with my practice to change or "reform" the original spelling of generic or specific names, unless for very urgent and obvious reasons.

On the tentacular club of this and numerous other related genera, there is a peculiarity that I have not seen definitely described. Between the rows of large suckers there is, as described already, a central zigzag ridge, which sends off transverse ridges between the suckers, defining shallow pits around each sucker-pedicle. These pits are lined, however, with a thin, partially free membrane, which surrounds the base of the pedicle, like a collar, leaving an open space on all sides, except the inner, where it is attached to the pedicle. The space beneath this membrane freely communicates with the spaces beneath the other sucker-pits, by means of open spaces beneath the zigzag central and transverse ridges.

A similar structure, but less developed, exists in *Ommastrephes*, *Histioteuthis*, *Loligo* and other genera. These collar-like membranes are probably able to embrace and support the pedicles, when the suckers are in action.

Architeuthis Harveyi Verrill. (See pp. 197, 259.)

Since the publication of the descriptions of this species I have made a more thorough examination of the various mutilated fragments of the pen, and have compared them more fully with the corresponding parts of the pen, in other genera. From these studies I became convinced that the portions of the pen formerly supposed by me to belong to the anterior, really belong to the posterior end.* Consequently the description on pages 206-208, should be corrected by substituting posterior for anterior, throughout, with other concordant changes. The explanation of the figure (Pl. XV, fig. 3) should also be corrected, in the same way. To correct this mistake

* The description of the pen was corrected in my Report on Cephalopods (pp. 31-33) in the Report of the U. S. Fish Commissioner, put in type last year.

more effectually, I here give a new description of the pen, based on these fragments, arranged as I now understand the form and structure.

New description of the pen of Architeuthis Harveyi V.

The parts preserved all belong to the posterior blade, which is now flattened and much mutilated, but it was very thin and broad, running out to attenuated borders; and it apparently had a small, acute, hooded terminal portion, or thin hollow cone, perhaps only two or three inches long, while the broad blade itself must have been more than two feet long and upward of a foot wide, when flattened out. No part of the narrow anterior shaft, which probably existed, is preserved.

The extreme posterior end is gone, but the convergent ribs indicate that it tapered to a point; each edge of the present end, for rather more than an inch, is thickened by a more divergent marginal rib, running into the edge and disappearing, while the edges here appear to have been torn apart, and this portion appears to have constituted the hooded portion; beyond this the margins run out to a very thin and ill-defined edge. The midrib, or dorsal keel, is at first sharply angular with a triangular section, and the slender lateral costae are completely confluent with it, but a little farther forward these begin to become distinct and slightly divergent, till at about ten inches from the end they are about an inch from the midrib; except close to the posterior end, the midrib is regularly rounded, or nearly semi-cylindrical. Near the posterior end there are three or four other slightly thickened, divergent ribs, on each side, between the midrib and the margin, but all these, except the inner ones, soon run obliquely to the margins and disappear; probably these mark the portion that was incurved or partially hooded. The surface is marked by fine striae between and parallel to the ribs, but the oblique, divergent striae, so conspicuous in *Sthenoteuthis*, are scarcely apparent. The midrib has nothing of the double or grooved character seen in that of *Sthenoteuthis* and *Ommastrephes*, the divergent ribs are much less numerous, and the whole structure is much more thin and flexible and the marginal portions much more ill-defined and membranous.

Architeuthis abundant in 1875 at the Grand Banks.

From Capt. J. W. Collins, now of the United States Fish Commission, I learn that in October, 1875, an unusual number of giant-squids were found floating at the surface on the Grand Banks, but

mostly entirely dead, and more or less mutilated by birds and fishes. In very few cases they were not quite dead, but entirely² disabled. These were seen chiefly between north latitude 44° and $44^{\circ} 30'$, and between west longitude $49^{\circ} 30'$ and $49^{\circ} 50'$. He believes that between 25 and 30 specimens were secured by the fleet from Gloucester, Mass., and that as many more were probably obtained by the vessels from other places. They were cut up and used as bait for codfish. For this use they are of considerable value to the fishermen. Captain Collins was at that time in command of the schooner "Howard," which secured five of these giant-squids. These were mostly from 10 to 15 feet long, not including the arms, and averaged about 18 inches in diameter. The arms were almost always mutilated. The portion that was left was usually 3 to 4 feet long, and at the base, about as large as a man's thigh.

One specimen (No. 25), when cut up, was packed into a large hog-head-tub having a capacity of about 75 gallons, which it filled. This tub was known to hold 700 pounds of codfish. The gravity of the *Architeuthis* is probably about the same as that of the fish. This would indicate more nearly the actual weight of one of these creatures than any of the mere estimates that have been made, which are usually much too great. Allowing for the parts of the arms that had been destroyed, this specimen would probably have weighed nearly 1,000 pounds.

Among the numerous other vessels that were fortunate in securing this kind of bait, Captain Collins mentions the following :

The schooner "Sarah P. Ayer," Captain Oakley, took one or two.

The "E. R. Nickerson," Captain McDonald, secured one that had its arms, and was not entirely dead, so that it was harpooned. Its tentacular arms were 36 feet long (No. 26).

The schooner "Tragabigzanda," Captain Mallory, secured three in one afternoon. These were 8 to 12 feet long, not including the arms.

These statements are confirmed by other fishermen, some of whom state that the "big squids" were also common during the same season at the "Flemish Cap," a bank situated some distance northeast from the Grand Banks.

The cause of so great a mortality among these great Cephalopods can only be conjectured. It may have been due to some disease epidemic among them, or to an unusual prevalence of deadly parasites or other enemies. It is worth while, however, to recall the fact that these were observed at about the same time, in autumn, when most of the specimens have been found cast ashore at New-

foundland in different years. This time may, perhaps, be just subsequent to their season for reproduction, when they would be so much weakened as to be more easily overpowered by parasites, disease, or other unfavorable conditions.

I have heard of no authentic instances* of the occurrence of specimens of this species since the finding of the small specimen (No. 24), in April, 1880. [See p. 259.]

Large Species from New Zealand.

Architeuthis Mouchezi? (See p. 243.)

Mr. T. W. Kirk, in the Transactions of the Wellington Philosophical Society, for October, 1879, p. 310, has published accounts of the occurrence of five specimens of "giant cuttle-fish" on the coast of New Zealand:

No. 1. The first of these was cast ashore at Waimarama, east coast, in September, 1870. Of this the beak was preserved and sent to Mr. Kirk by Mr. Meinertzhagen, whose account of the occurrence, with a rather crude description and some measurements made by an eye-witness, Mr. Kirk has printed. He gives no description of the beak, unfortunately. The dimensions given are as follows: Length from tip of tail to root of arms, 10 feet 5 inches; circumference, 6 feet; length of arms, 5 feet 6 inches. "The beast had eight tentacles, as thick as a man's leg at the root; horrid suckers on the inside of them, from the size of an ounce bullet to that of a pea at the tip; two horrid goggle eyes; and a powerful beak between the roots of the arms. His head appeared to slip in and out of a sheath. Altogether he was a most repulsive looking brute."

It is probable that this specimen had lost its two tentacular arms before death, and that it was actually of the same species as the other specimens recorded by Mr. Kirk. Mr. Kirk, however, seems to think that the above description refers to an Octopod.

No. 2. "The beak of number 2 was deposited in the Colonial Museum by Mr. A. Hamilton. The animal was captured at Cape Campbell by Mr. C. H. Robson, a member of this society, who very kindly furnished me with the following information. Writing on the 19th of June, 1879, he says:

* A purely fictitious and sensational account of an imaginary capture of an *Architeuthis* has been published in Lippincott's Magazine, for Aug., 1881, p. 124, by Mr. Charles F. Holder.

“In reply to yours of the 12th about the cuttle-fish, I may state that while stationed at Cape Campbell I found several specimens of large size, all, however, more or less mutilated, except one, the beak of which I gave to Mr. Hamilton. It was alive and quite perfect, the body being 7 feet long, eight sessile arms 8 feet long, and two tentacular arms 12 feet long. I am, however, only writing from memory. Mr. Hamilton has the exact measurements, and I remember distinctly that the total length was close on 20 feet.’

“I am sorry to say that Mr. Hamilton has mislaid the notes and measurements, but those given above cannot be far out.”

No. 3. The third specimen was examined and measured by Mr. Kirk, personally, where it lay on the beach. He made a drawing of it, which has not yet been published, to my knowledge. It was found on the beach at Lyall Bay, May 23, 1879, by three boys. Mr. Kirk states that it had been somewhat mutilated by the natives before he saw it, and the pen or bone had been cut across; but he preserved all the pieces of the pen, the beak, tongue, and some of the suckers. Most of the suckers had been torn off.

“The length of body from tip of tail to anterior margin of the mantle was 9 feet 2 inches, and 7 feet 3 inches in circumference; the head from anterior margin of mantle to roots of arms, 1 foot 11 inches; making the total length of the body 11 feet 1 inch. The head measured 4 feet in circumference. The sessile arms measured 4 feet 3 inches in length, and 11 inches in circumference. Each of these arms bore thirty-six suckers, arranged in two equal rows (as shown by the sears), and measuring from $\frac{1}{16}$ to $\frac{1}{4}$ of an inch in diameter. Every sucker was strengthened by a bony ring armed with from forty to sixty sharp incurved teeth. The tentacular arms had been torn off at the length of 6 feet 2 inches, which was probably less than half their original length.”

“The fins were posterior, and were mere lateral expansions of the mantle. They did not extend over the back, as in the case with *Onychoteuthis*, &c. Each measured 24 inches in length and 13 inches in width.

“The cuttle-bone, when first extracted, measured 6 feet 3 inches in length and 11 inches in width, but has since shrunk considerably. It was broadly lanceolate, with a hollow conical apex $1\frac{1}{2}$ inches deep.”

No. 4. “Another specimen, measuring 8 feet in length, was lately caught by a fishing party near the Boulder Bank, at Nelson, concerning which I have only seen a newspaper cutting, and have not been able to obtain particulars.”

No. 5. "A fifth was found by Mr. Moore, near Flat Point, east coast. A description was sent to Mr. Beetham, M. H. R., who, I believe, intends communicating it to this society."

From the above descriptions, alone, it is not possible to decide with certainty whether these specimens belong to the *Architeuthis*-group, or whether they are more nearly allied to the *Onychoteuthis*-group, like *Moroteuthis*, for the armature of the tentacular arms is not known. The broad-lanceolate form of the pen, with a small conical hood at the end, would seem to indicate affinities with *Architeuthis*, and the presence of true suckers, on the sessile arms, and small size of the fins, are favorable for that view. Altogether, the descriptions indicate that this New Zealand species is related to, and perhaps identical with, the one discovered at the Island of St. Paul, and first named by M. Vélain *Architeuthis Mouchezi*. It is to be hoped that Mr. Kirk will soon give detailed descriptions and figures of the portions in his possession.

Plectoteuthis grandis Owen = *Architeuthis grandis*.

Plectoteuthis grandis Owen, Descriptions of some new and rare Cephalopoda, Part II. <Trans. Zool. Soc. London, xi, part 5, p. 156, pl. 34, 35, June, 1881.

Professor Owen, in the paper quoted, has given a somewhat detailed description, with figures, of the large cephalopod arm, long preserved in the British Museum, and which had previously been pretty fully described by Mr. Saville Kent, in 1874, whose description has already been quoted by me (see pp. 241, 242). Professor Owen, like Mr. Kent, fails to state to which pair of arms the specimen belongs. This is a very important omission, for in *Architeuthis*, as in many other genera, the arms belonging to different pairs differ in form and structure. The describers of this arm would doubtless have been able to ascertain to which pair it belonged by a direct comparison with the arms of *Ommastrephes*, or any other related form.

For this arm, Professor Owen endeavors to establish a new genus and species (*Plectoteuthis grandis*). The genus is based mainly on the fact that there is a marginal crest along each outer angle, and a narrow protective membrane along each side of the sucker-bearing face. These peculiarities are precisely those seen in the *ventral arms* of *Architeuthis*, and have already been described by me in former articles, and in this report (see pp. 214, 261, 262), both as found in *A. Harveyi* and *A. princeps*. Similar membranes or crests are found

on the dorsal arms of *Sthenoteuthis pteropus* (see Pl. XXXVI, fig. 7, a) and other related species.

The suckers on the arm, as described and figured by Professor Owen, are like those of *Architeuthis*. Therefore, there is no ground whatever for referring this arm to any other genus, and *Plectoteuthis* must, therefore, become a synonym of *Architeuthis*.

Whether the arm in question belongs to a species distinct from those already named, I am unable to say. There is, apparently, nothing to base *specific* characters upon except the form of the suckers and of their horny rings. But the description of the horny rings is not sufficiently precise, nor the figures sufficiently detailed, to afford such characters. If the arm is one of the ventral pair, as seems probable, the suckers as figured by Professor Owen, and especially as more fully described by Mr. Kent, agree very closely, but not perfectly, with those of either of the Newfoundland specimens, for in the latter the suckers of the ventral arms are strongly toothed externally, but are either entire, or in some cases, only slightly denticulated on the inner side. But they also agree well with those of the *Architeuthis Hartingii*, as figured by Harting. Those of the original *A. dux* Steenst., have neither been described nor figured. In Owen's figures the large suckers are represented as denticulated pretty evenly all around the edge. As this arm cannot, at present, be referred with certainty to any of the named species, it may be best to record it as *Architeuthis grandis*, until better known.

In the same article Professor Owen has given a good figure (pl. 33, fig. 2) of the tentacular arm of the Newfoundland specimen (my No. 2) copied from the same photograph described by me (see pp. 182, 208, 209). To this he applies, doubtless by mistake, the name, *Architeuthis princeps*,* without giving any reason for not adopting my conclusion that it belongs to *A. Harveyi*. But he does not, in any way, refer to the latter species, although he mentions the specimen (my No. 5), or rather the photograph of the specimen, on which that species was based. He apparently (on page 162) supposes that both photographs and all of Mr. Harvey's measurements refer to the same

* By a singular mistake, Professor Owen, on page 163, states that this species was named *A. princeps* by Dr. Packard, in February, 1873. But according to his own statement, on page 161, the specimen was not actually obtained till December, 1873, at least nine months after Dr. Packard's article was printed. In truth, the name *princeps* was first given by me in 1875, to designate a pair of large jaws, as explained on page 210. Neither this nor any other name appears on the cited page of Dr. Packard's article, though he elsewhere referred these jaws doubtfully to *A. monachus*.

specimen, which is by no means the case, as had been sufficiently explained by me in several former papers.*

The brief account given by Professor Owen of the large Cephalopods described by others, includes none additional to those noticed by me in this report. On the other hand, he omits those described by Harting; those described by Mr. Kirk, from New Zealand; those from Alaska; and several others.

Sthenoteuthis Verrill (see pp. 222, 286.)

Xiphoteuthis (sub-genus) Owen, op. cit. p. 104, pl. 28, figs. 1, 2, June, 1881 (*non* Huxley).

In the paper referred to above,† Professor Owen has described a cephalopod, without locality, under the name of *Ommastrephes ensifer*, for which he proposes the sub-generic name *Xiphoteuthis*. His species is a typical example of my genus *Sthenoteuthis* (1880) and appears to be identical, in every respect, with *S. pteropus* (see p. 228, Pl. XXXVI, figs. 5-9, and Pl. LIV, figs. 2, 2a), as described by me. But Professor Owen fails to mention one of the most characteristic features of this group of squids, viz: the connective tubercles and smooth suckers on the proximal part of the tentacular club, nor is his figure sufficiently detailed to indicate this character, nor even the actual arrangement and structure of the other suckers of the club. The high median crest and broad marginal web of the third pair of

* It seems incredible that Professor Owen could have made these mistakes had he examined either of my former papers in which these specimens have been described in detail, not only from the photographs, but from the preserved specimens. He does, however, refer to Part I, of this article, published in 1880. But as he states (p. 162) that in it "a brief notice is given of Mr. Harvey's squid" it is fair to suppose that the reference is taken at second-hand, for it is not to be supposed that he would have considered my description, covering over 20 pages, and accompanied by nine plates, as a "brief notice." None of my earlier papers are referred to, nor does he mention the large species, *Moroteuthis robusta*, in his account of the large Cephalopods hitherto described.

† Among other species figured and described in this paper, there is a handsome species from the China Sea, described as *Loligopsis ocellata*, sp. nov. (pp. 139-140, pl. 26, figs. 3-8, pl. 27, figs. 1, 2).

This is evidently not a true *Loligopsis* and belongs, in all probability, to my genus *Calliteuthis*. It agrees very closely, even to the coloration, and the form of the fins and pen, with my *C. reversa*, but differs in having serrate suckers. This species should, therefore, be called *Calliteuthis ocellata*. It is much larger than my specimen, but like the latter, had lost the tentacular arms. The genus probably belongs to the Chiroteuthide.

arms are well shown, but these are about equally broad in *S. pteropus* and *S. megaptera*, and are also present in all the related species of this group.

Owen's specimen had a total length of 3 feet; length of body, 15 inches; of head to base of dorsal arms, 3.7; of third pair of arms, 12; of tentacular arms, 21; breadth of caudal fin, 12.6; length of their attached bases, 6.6; breadth of body, 5; length of 1st, 2d, 3d, 4th pairs of arms, 8.9, 11, 12, and 9.6 inches, respectively. The specimen is a female. It agrees very closely in size with the Bermuda specimen described by me, and its proportions do not differ more than is usual with alcoholic specimens of any species, preserved under different circumstances, and in alcohol of different strength. The original specimen of *S. megaptera* is considerably larger.

Ommastrephes illecebrosus V. (See p. 268.)

This species was taken in many localities, this year, by the U. S. Fish Commission, in deep water, off Martha's Vineyard. Most of the living specimens were young, but large ones were often taken from the stomachs of bottom-dwelling fishes, in the same region, showing conclusively that it regularly inhabits those depths.

Additional Specimens examined.

Station.	Locality.	Fath.	Date.	Rec'd from	Specimens.	
					No.	Sex.
	Off Martha's Vineyard.		1881.	U. S. F. C.		
918	S. $\frac{1}{2}$ W. 61 m. f. Gay Head.	45	July 16.	"	1 l.	from fish.
919	" 65 "	51 $\frac{1}{2}$	"	"	2 l.	from Lophius.
923	" 78 $\frac{1}{2}$ "	96	"	"	3 juv.	
924	" 83 $\frac{1}{2}$ "	110	"	"	5 juv.	
925	" 86 "	224	"	"	1 juv.	
939	S. by E. $\frac{1}{2}$ E. 98	258	Aug. 4.	"	1 l. ; 1 juv.	
940	" 97 "	130	"	"	1 l. ; 1 juv.	
949	S. W. 79 $\frac{1}{2}$ "	100	Aug. 23.	"	1 l.	in Lopholatilus.
1025	S. S. W. $\frac{1}{4}$ W. 95	216	Sept. 8.	"	1 l.	in fish.
1033	S. S. E. $\frac{1}{4}$ E. 106	183	Sept. 14.	"	1 l.	in Merluceius.
1038	S. by E. $\frac{1}{4}$ E. 89 $\frac{1}{2}$	146	Sept. 21.	"	1 l.	
	Newfoundland.	Surf'e	1880.	Osborn	3 l. ♂ ; 10 l. ♀.	

Mr. H. L. Osborn, in the American Naturalist, vol. xv, p. 366, May, 1881, has given an account of the habits of this squid, at Newfoundland, and of the methods of capturing it there, for bait.

Enoploteuthis Cookii Owen. (See p. 241.)

Enoploteuthis Cookii Owen. Trans. Zool. Soc. London. xi. p. 150, pl. 30, figs. 1-3, pl.

31, figs. 1-4, pl. 32, figs. 1-6, pl. 33, fig. 1 (restoration). June, 1881.

Seppia uaguculota Molina. 1810 (no description).

Enoploteuthis Molina D'Orbigny, Ceph. Acctab., p. 339, 1845-1848.

? *Enoploteuthis Hartingii* Verrill, this vol., p. 241, pl. 24, figs. 4-4', 1880.

Professor Owen has very recently described in detail and has given excellent figures of most of the existing parts of this large and remarkable cephalopod, which have so long been preserved and have so often been referred to, but hitherto have never been scientifically described. (See p. 241). It is to be regretted, however, that Professor Owen has neither described nor figured the teeth of the radula, in a manner to enable it to be used as a systematic character. His statement in regard to it is only of the most general kind, and shows only that there are seven rows of teeth. It is also a matter of surprise that he has not compared any of the described portions with the corresponding parts of an equally large and very closely allied *Enoploteuthis* carefully described and figured by Harting in 1861 (see p. 241), and to which I have given the well-merited name, *E. Hartingii*.

It is not improbable that the two forms are really identical, but this cannot be certainly determined from the figures, because the corresponding parts are not always represented in the same positions, and it is uncertain whether the corresponding arm is preserved in the two cases.

Harting figures, rather poorly, the teeth of the radula, which appear to be very peculiar, if his figure is correct (see my Pl. XXIV, fig. 4b).

The shape of the mandibles appears to be different in the two species, however, and the large hooks also differ in form.

Histioteuthis Collinsii Verrill. (pp. 234, 300).

The teeth of the odontophore, originally described and figured (p. 237, Pl. XXXVII, fig. 5), were not the most developed of those on the same odontophore. On the middle and best developed parts, the bases of the central and inner lateral teeth, when seen in a front view, are broader than indicated in the former figures, in which they are seen nearly in profile. The median tooth has a long, acute, central denticle, but no distinct lateral denticles, the broad, short base having the outer angles only slightly prominent, or not at all so; the inner lateral teeth are nearly as large, with one similar large denticle,

but the broad base is oblique, and the outer border is sloping, without a prominent angle.

The pedicels of the larger suckers on the tentacular club are very peculiar. They are, when extended, long and remarkably stout, their diameter being more than half that of the sucker. They are cylindrical, and are capable of being invaginated, toward the summit, so that they can be lengthened out or very much shortened by a sort of telescopic motion. The upper end is thick, and fits the basal part of the broad sucker like a piston. (Pl. LV, figs. 6, 6a.)

Two additional examples of this interesting species have been received. They are not in so good condition as the one originally described. The head and arms alone remain, but these are well enough preserved to show the characteristic color-marks. The first is considerably smaller than the specimen taken by Capt. Collins. It was taken from a cod, on the western part of the Grand Bank, N. F., by Capt. Johnson and crew, of the schooner "Augusta Johnson," (lot 962). Presented to the U. S. Fish Commission, June, 1881. The last specimen was taken in 180 fathoms, near the N. E. part of George's Bank, and presented to the U. S. Fish Commission by Capt. Chas. Anderson and crew, of the schooner "Alice G. Wanson," October, 1881, (lot 980).

Brachioteuthis, gen. nov.

Allied to *Chiroteuthis*. Differs in having the lateral connective cartilages of the siphon simple, long-ovate, and the corresponding cartilages of the mantle in the form of simple, linear ridges; a rhombic caudal fin; pen with a simple, linear, anterior portion, suddenly expanding into a much broader, lanceolate, posterior portion, which is naturally infolded; arms slender, the ventral ones not distinctly obliquely compressed; tentacular club without a spoon-like cavity at tip.

The siphon has a valve and dorsal bridle as in *Chiroteuthis*, and the suckers, so far as preserved, are similar, but those of the club are more numerous, and their pedicels apparently had a less prominent bulb below the sucker.

In addition to the following new type-species, this genus probably includes the *Chiroteuthis Bonplandii* Verany, from the eastern Atlantic.

B. Bonplandii, as figured, has a very similar pen, but the shape of the caudal fin is different, and the arms are more nearly equal in length. The arms are also represented as having small swellings at the tips. Its tentacular arms are not known.

Brachioteuthis Beanii, sp. nov.

PLATE LV, FIGURES 3-3b; PLATE LVI, FIGURES 2-2a.

Male: Body rather small, tapering backward to an acute posterior end; dorsal mantle-edge with a broad obtuse angle; caudal fin large in proportion to the body, broad rhomboidal; outer angles prominent, anterior to the middle; the anterior lobes project forward considerably beyond the insertions, and are rounded. The form of the fin is much like that of *Ommastrephes*. Head thickened at the bases of the arms, not so large in proportion to the body as in *C. lucertosa*. Eyes large, eye-lids thin. Siphon large, with two strong dorsal bridles; internal valve broad, rounded, somewhat back from the orifice; connective cartilages long ovate, broadest behind (fig. 2a); dorsal cartilage of neck oblong, with a strong median ridge and two deep parallel grooves. Lateral cartilages of mantle (fig. 2) are simple linear ridges, extending to the edge of the mantle. Arms not very large, somewhat rounded, long and slender; the dorsal ones are much smaller and shorter than the others; two lateral pairs nearly equal in size and length, more than two-thirds the length of the mantle. Ventral arms shorter and much more slender than the lateral, more than half the length of the mantle; the ventral arms show but little of the compressed, oblique form, so conspicuous in the preceding species, and the crest or fold of skin along the outer-ventral angle is narrow, thin, and not very conspicuous; the suckers on the ventral arms are in two alternating, not distant, rows, often appearing almost as if in one row toward the base, where they become smaller, but are of the normal cup-shaped form, with finely denticulate rims and slender pedicels; the tips of both ventral arms are much injured, but small, normal, long-pedicelled suckers can be traced to the tip of the left arm; the right arm is denuded of its skin and suckers at the tip. The suckers of the four lateral arms are in two rather close rows, larger, oblique, low cup-shaped, attached by slender pedicels, which are somewhat swollen just below the suckers; most of them have lost their horny rings; marginal membranes rudimentary. Web between the arms, rudimentary. Tentacular arms very long and slender, in alcohol about twice the length of the mantle; a few scattered, sessile suckers are found along the whole length of the arms; tentacular club well-developed, long-ovate, oblique, with a thick wrist and flat or concave sucker-bearing face; suckers small and very numerous, crowdedly arranged in many rows (probably sixteen rows or more), some of the middle ones larger than the rest;

suckers not well preserved, but all appear to have been alike in form; pedicels long and slender, with a smooth and not very large swelling below the base of the sucker; the suckers have lost their horny rims, but the sheaths are shaped much like those of *C. lacertosa*, the distal portion being hood-shaped, with a lateral opening, while the basal part is swollen laterally. The tip of the club is simple, without any such spoon-shaped appendage as is found in the preceding species. Buccal membrane large, with a free thin edge, which scarcely forms angles.

Pen (Pl. LV, fig. 3a) has a narrow, linear anterior portion, consisting of more than half its length, decreasing in width backward, then suddenly expanding into the posterior portion, which is broad and thin, and infolded, so as to form a large, compressed posterior cavity; the anterior portion is concave beneath, with no midrib, the edges excurved and slightly thickened; when spread out and flattened the posterior portion has a lanceolate form, rather abruptly widening anteriorly and very gradually tapering backward, with a double midrib, and some delicate lines parallel to it, while the lateral expansions are very thin and delicate. Color of body mostly destroyed, in the typical specimens, but small, light purplish brown chromatophores are uniformly scattered over the parts best preserved; this is also the case on the head, siphon, and outer surfaces of the arms, where the skin is well preserved; scattered spots also occur on the inner surfaces, between the suckers.

A larger specimen (station 994), which has lost its head and pen, and, therefore, cannot be positively identified, has a much darker color. It is dark purplish brown over the whole body.

The male has the mantle 62^{mm} long; length of caudal fin, 31; its breadth, 36; end of tail to base of arms, 85; length of dorsal arms, 26; of second pair, 48; of third pair, 45 + (tips gone); of fourth pair, 35; of tentacular arms, 118; of sucker-bearing portion of club, 16; breadth of tentacular arms, 2; of club, 4; of lateral arms, at base, 3.5; of ventral arms, 3; diameter of eye-ball, 8; of the largest suckers of lateral arms, 1.2; length of pen, 62; of anterior, narrow portion, 38; its breadth anteriorly, where widest, 2; where narrowest, 1.25; length of posterior portion, 24; its breadth, 8^{mm}.

The teeth of the odontophore (Pl. LV, fig. 3b) form seven rows; the median ones have a large, acute central, and two small, lateral denticles; the inner lateral teeth have a large, acute, inner denticle and a very small outer one; the next to the outer lateral teeth are somewhat stouter than the outermost, which are slender, strongly curved, and very acute; no marginal plates were observable.

The supposed female has lost the tail, but the arms are in better condition than those of the male; it differs from the male in having distinctly smaller suckers on the lateral arms. Length of dorsal arms, 27^{mm}; of second pair, 44; of third pair, 46; of fourth pair, 37; of tentacular arms, 120; of club, 16^{mm}.

Two typical specimens were obtained off Martha's Vineyard, at stations 1031 and 1033, in 255 and 183 fathoms; one of doubtful identity, at 994, in 368 fathoms, by the U. S. Fish Commission, in 1881. All three were from fish-stomachs.

I take pleasure in dedicating this interesting species to Dr. T. H. Bean, the ichthyologist, who took charge of the fishes on the "Fish Hawk," this season.

Chiroteuthis lacertosa. sp. nov. (See p. 299.)

Chiroteuthis Bonplandii?, p. 299 (non Verany.)

PLATE LVI. FIGURES 1-17.

A nearly complete male specimen of a *Chiroteuthis*, lacking only the tentacular arms and the distal portion of the left ventral arm, was received after the preceding pages were put in type. The stumps of the tentacular arms, remaining, bear the same kind of unarmed sessile suckers as did the arm described on p. 299, and figured on pl. 47, figs. 1-1*b*. It appears to be a new species, and is very distinct from *C. Bonplandii*. The sessile arms are very large in proportion to the head and body, and the ventral arms are much larger than any of the others. The body is small, obconic, tapering rapidly backward to the origin of the caudal fin, where it becomes very small, and continues to taper to the very slender posterior end. The median dorsal angle of the mantle-edge projects far forward, as a broad angular lobe; lateral angles rounded and not prominent. Caudal fin relatively large, as compared with the body, broad-ovate in outline, widest near the middle, tapering backward to an acuminate, slender tip; very broadly rounded laterally, narrowing abruptly anteriorly; the anterior lobes are small, rounded, and project only slightly forward beyond the insertions. Siphon large, with a well-formed valve, far back from the orifice; dorsal bridles rudimentary. Connective cartilages on the base of the siphon, broad-ovate, ear-shaped, with two rounded prominent lobes projecting into its concavity, one posterior, the other ventral, so that the pit is three-cornered (fig. 1*b*). The corresponding connective cartilages of the mantle consist of two pits, separated by a prominent, triangular tubercle (fig. 1*c*). Head large, in proportion to the body, tapering backward from the

bases of the arms. Eyes large; lids thin and simple, without a distinct lachrymal sinus. Behind and below each eye there is a long (4^{mm}), slender, clavate, soft papilla (fig. 1*f'*), probably olfactory in function.

The sessile arms are large and, except the ventral, unusually rounded; the inner sucker-bearing faces are much less differentiated than usual, scarcely differing from the other sides in color, and bordered by only a slight or rudimentary membrane on each side; the rounded prominences from which the sucker-pedicels arise are also colored and not much raised. The dorsal arms are rather long and tapering, but much shorter and smaller than the others, slightly compressed and with a slight median crest distally. The next pair are similar in form and structure, but considerably longer and larger. The third pair are much longer and larger, with the outer angles well rounded, and a strong median crest extends nearly to the base, but is wider distally, where the arms are strongly compressed. The ventral arms are considerably longer and stouter than the third pair, and very different from all the others in form; they are strongly compressed in the direction parallel with the median plane of the head, and have the lower and outer angles well rounded, and the sucker-bearing face wide and scarcely differentiated from the lateral faces; but on the superior lateral side there is a wide and thick crest running the whole length of the arms, giving them a strongly and obliquely compressed appearance. The suckers on the ventral arms are smaller, fewer, and more distant than on any of the others; those at the bases are largest and three or four stand nearly in a single row; farther out, along the middle of the arm, they are distantly arranged in two rows and rapidly become small. The left ventral arm shows no signs of being hectocotylized; the right one, however, has lost half its length by mutilation. On all the other arms the suckers are regularly and much more closely arranged in two rows, and decrease more gradually in size from near the base to the tips.

The suckers *on all the arms* are similar in form; they are rather deep, narrowed at the rim, slightly constricted above the middle, and swollen below, and very oblique at the base; the pedicels are slender and nearly laterally attached; the horny rims are very deep and oblique, and strongly denticulated on the outer or higher side, but on all the arms they are *smooth on the inner side*; the median, outer denticles are long, slender, close together; laterally they become shorter, broader, acute-triangular and curved forward. On the larger suckers the outer teeth are obtuse, but on the distal ones they become

more slender and acute. The margins of the suckers are surrounded with small, elongated scales. (Pl. LVI, figs. 1*d*, 1*e*.)

The buccal membrane is thin and much produced, with the angles little prominent; it is attached to the arms by eight thin, but wide, bristles, the two superior ones united together near their origin. The web between the arms is rudimentary but distinct. The pen (fig. 1*a*) is very unlike that of *C. Veranyi*, as figured and described by D'Orbigny. It has a long, narrow shaft of nearly uniform width, and a long posterior portion, a little wider than the shaft, corresponding in length to that of the caudal fin; at the commencement, this portion expands into narrow, free, incurved margins, but these unite quickly so as to form a long, narrow, angular, tubular portion, tapering to a very slender tip; this portion (1*a''*) has a dorsal keel, with a groove each side of it, two dorsal angles and a ventral angle along each side; the narrow shaft has a dorsal keel, with the sides bent down abruptly, nearly at right-angles, and a little incurved, so as to produce a squarish keel above, with a deep angular groove below, while the very narrow margins bend outward abruptly (1*a'*); the shaft increases very slightly in width, to near the subacute anterior end, but preserves the same form, and there is no distinct dilation of the margin anteriorly, such as D'Orbigny figures in the pen of *C. Veranyi*, nor does the posterior portion resemble his figure, though if split open and flattened out, it would resemble it more nearly.

This specimen is an adult male, in the breeding condition, for its spermatophore-sac is much distended with spermatophores. The color is much like that of *C. Veranyi*. It is everywhere thickly specked with small, purplish brown chromatophores, except on the buccal membrane and the bases of the tentacular arms, where there are but few; the head around the eyes and the end of the siphon are darker; a row of very distinct, rather large, round, dark purple spots runs along the inner surface of the ventral arms, just outside of, and alternating with, the upper row of suckers, which they about equal in size.

Total length, to end of ventral arms, 383^{mm}; to end of third pair, 366^{mm}; to end of dorsal arms, 298^{mm}; tail to dorsal mantle edge, 125^{mm}; to base of dorsal arms, 178^{mm}; length of dorsal arms, 120^{mm}; of second pair, 150^{mm}; of third pair, 188^{mm}; of ventral, 205^{mm}; length of caudal fin, 60^{mm}; its greatest breadth, 41^{mm}; breadth of head at eyes, 20^{mm}; of dorsal arms, 7^{mm}; of third pair, 10^{mm}; of ventral arms, 13^{mm}; of bases of tentacular arms, 3^{mm}; diameter of largest suckers of lateral arms, 2.25^{mm}.

Brown's Bank, off Nova Scotia, taken from the stomach of a cod (lot 956). Presented to the U. S. Fish Commission by Capt. Wm. Dempsy and crew, of the schooner "Clara F. Friend," June, 1881.

The internal anatomy is somewhat peculiar in several respects, but will not be fully described in this place.

The gills are short and broad, with very long lamellæ. The reproductive organs occupy a large part of the visceral cavity. The testicle is a large, thick, broad-ovate organ, with the two sides folded together around and closely united to the large cæcal lobe of the stomach. The testicle does not extend back beyond the origin of the caudal fin, the visceral cavity being very narrow in that region. The prostate gland and vesiculæ seminales are large and swollen, and the spermatophore-sac is also large. The efferent duct is large and long, extending far forward; it expands at the end into a spade-like form, with an acute tip; its orifice is oblique ear-shaped, situated on one side, near the end, and is protected by a lobe or flap. The stomach is saccular and the large cæcal lobe is not very long. The liver is thick. The posterior aorta goes far back, nearly to the origin of the fin, before dividing, for the median septum of the branchial cavity is placed far back. The ink-sac has the ordinary pyriform shape.

A smaller, female specimen, probably belonging to this species, was taken by Captain Z. L. Tanner, on the "Fish Hawk," October 10, off Delaware Bay, in 435 fathoms, station 1048.

This specimen agrees nearly with the type specimen, described above, in the form and proportions of the body, head, arms, caudal fin, pen, etc., and in the structure and denticulation of the suckers. The caudal fin is slightly broader in proportion, while the suckers are deeper and relatively smaller, especially those on the ventral arms, which are decidedly smaller than those on the lateral ones. They are finely and sharply denticulated on the outer edge, as in the type.

The color is, however, quite different, for in this example the skin and flesh are translucent and beautifully specked with regular, round, often rather large, not crowded, dark brownish red chromatophores; the larger of these, especially on the under side of the fin and body, are ocellated; on the head and arms the chromatophores become smaller and more crowded, more nearly as in the type. The row of large dark purple spots, along the ventral arms, are, in this example, decidedly raised and wart-like. One of the tentacular arms is perfect. These are very long and slender, and bear, along their whole length, relatively large, rounded, wart-like, dark purple, sessile suckers, having a small central pit. These suckers are about two-

thirds as broad as the diameter of the arm, and from close to the base of the arm to the distal fourth they are separated by spaces mostly equal to about twice their diameter; distally they are less numerous. The tentacular club is well developed, with a broad marginal membrane along each side, having scalloped or notched edges. The club terminates in an ovate, subacute, dark purple, hollow organ, with its opening on the outer side of the arm. The suckers (Plate LV, fig. 5) are regularly arranged in four rows. The stalk is long, with a dark purple, fluted summit, surmounted by a very slender pedicel bearing the sucker, which is hooded, with a lateral opening; the horny ring bears several slender, sharp teeth on the outer side, the central one being much the longest;* the soft rim of the sucker is covered with many rows of small scales, the inner ones with acute tips. The lateral suckers do not alternate with the median, but the two arise close together, opposite each other, and in line with the teeth on the edge of the marginal membrane. The inner surface of the club is specked with brown chromatophores, and the marginal membranes are crossed by brown lines, corresponding to the notches in their edges.

Total length, to end of ventral arms, 194^{mm}; to end of third pair, 150; to end of dorsal arms, 127; tail to dorsal mantle edge, 59; to base of dorsal arms, 86; length of dorsal arms, 41; of second pair, 56; of third pair, 69; of ventral, 110; of tentacular arms, 180; of club, 17; breadth of club, 5; length of caudal fin, 27; its greatest breadth, 24; of dorsal arms, 4; of third pair, 5; of ventral arms, 8; of bases of tentacular arms, 15; diameter of largest suckers of lateral arms, 1.

This species differs widely from *U. Bonplandii* in the sessile arms, etc. It is much more nearly related to *U. Veranyi*, from which it differs decidedly in the pen; in the suckers; and in the caudal fin, if these parts are correctly described and figured, for the latter.

Desmoteuthis tenera, sp. nov.

PLATE LV, FIGURES 2-2*d*. PLATE LVI, FIGURE 3.

Two small, but perfect, specimens of this species were taken in the "trawl-wings"† this season, at station 952, in 388 fathoms.

* The arm, figured on Pl. XLVII, figs. 1-1*b*, does not agree with this, and may belong to a different species; but the difference in its suckers may be due to injury.

† The "trawl-wings," which were first invented and used by the U. S. Fish Commission, this summer, consist of fine nets attached to a support extending out from each end of the trawl-beam. When in use they are about two feet above the sea-bottom. They are provided with an interior funnel-shaped net to prevent the escape of animals captured. They have been of great value to us for capturing, and retaining in

The specimens are both males, but show no positive evidence of hectocotylyzation. The body is long, somewhat fusiform, slightly smaller in advance of the middle. The tissues are exceedingly thin, delicate, pale, and translucent, so that the pen and other organs can be seen through the mantle. Anteriorly the edge of the mantle is attached to the head, medially, by a muscular commissure, and there is *no free edge* (such as D'Orbigny figures in *T. pavo*) at the narrow middle portion of this band. This commissure is broader within the mantle, and there is another large, oblique, muscular commissure, extending forward to the edge of the mantle, on each side, extensively uniting the inner surface of the mantle to the sides of the siphon. These commissures leave only a rather narrow opening to the gill-cavity, on each side, and one small ventral one, and the interior ventral cavity is partitioned off from the lateral ones.

The siphon is large, projecting forward between the lower sides of the large eyes; it has no valve in the ordinary place, but toward the base, on the dorsal side, there are two erect, rounded, ear-like flaps, each with a small papilla (*i'*), and a rounded, valve-like, raised median fold and a central papilla (*i*) in front of them. (Pl. LV, fig. 2*d*.)

The caudal fin is comparatively small, narrow-ovate, tapering to a short, blunt posterior end, and with the anterior lobes narrowed and scarcely projecting beyond the insertions. The eyes are very large and prominent, occupying the whole of the sides of the head, wide apart dorsally, but nearly in contact beneath; eye-lids thin, entire.

Arms rounded, rather slender, tapering to slender tips; those of the third pair are much the longest, and like the second pair, bear along the distal half suckers much larger than the proximal ones; tips short, with few small suckers. The dorsal and ventral arms are about equal, and not much more than half as long as the third pair; they bear smaller suckers, in two rows, regularly decreasing distally. The second pair is intermediate in length between the 1st and 3d pairs, with two rows of larger suckers on the outer half, suddenly decreasing distally, with minute ones close to the tip. The large suckers (fig. 2*b*, *c*) on the second and third pairs of arms are much larger than the others,

excellent condition, many kinds of free-swimming deep-sea animals, not otherwise obtainable, or if taken in the trawl, crushed by the great masses of fishes, echinoderms, actiniae, etc., usually taken in every haul, in these waters.

Among the things captured in the "trawl-wings" are not only several cephalopods (including *Alloposus*, *Lestoterthis*, *Rossia*), but *Cymbulia calceolus* and other Pteropods; vast numbers of *Sagitta*, one of them bright orange-colored; numerous species of Copepod crustacea, some of them of great size; Schizopods; Salpae; Acalephs, including one very remarkable new form of Siphonophora, etc.

but similar in form, deep cup-shaped, convex in the middle, obliquely attached, with a smooth horny rim, except on the distal ones, which have blunt denticles externally. There are about sixteen of these suckers on each of the lateral arms, but eight or ten are decidedly larger than the rest. The large suckers commence nearly at the middle of the arms and extend to very near the tips. The suckers on all the arms are deep, urceolate, with somewhat contracted apertures; they mostly have the horny rim entire; the distal ones on the ventral arms are finely denticulated. The third pair of arms have a thin median carina on the outer side, along the distal third.

All the arms have a wide marginal or protective membrane along the inner edges, outside the suckers; these membranes are strengthened by transverse thickened, muscular processes, opposite each sucker; between these the membrane recedes so that the edge is scolloped. The ventral arms have also a membrane along the outer, ventral angle. I am unable to detect any positive signs of hectocotylization, either in the dorsal or ventral arms. Perhaps the presence of the very large suckers on the lateral arms may be a sexual character, but if so, they are symmetrical on the two sides.

The tentacular arms (Pl. LVI, fig. 3) taper from the thickened base, and in our specimens equal in size, and are not much longer than those of the third pair; club well developed, rather broader than the rest of the arm, with a dorsal keel and wide, marginal, protective membranes; the suckers are arranged in four regular rows; the larger suckers are about equal in size to the larger ones of the dorsal arms; of these there are eight or nine in each row, the marginal ones are scarcely smaller than the median ones and similar in shape, but more oblique; all these suckers are cup-shaped, obliquely attached, with long pedicels; the marginal ring is denticulated all around, the teeth on the outer or higher side being slender, sharp and incurved; those on the inner side minute. The distal part of the club is short, and covered with four rows of small suckers, similar to the larger ones in shape and armature; at the tip is a small group of minute suckers, apparently unarmed. At the proximal end of the club there is a group of small denticulated suckers; and four irregular rows of minute, connective suckers, attached by short pedicels, extend along the inner surface of the arm to the middle or beyond; these are interspersed with minute tubercles, more distinct distally, near the club. The outer buccal membrane is narrow, without distinct angles.

The pen is very thin, delicate, pale yellow; the anterior portion is very narrow and slender; the posterior third, commencing opposite the

origin of the fins, is lanceolate, with two faint, close ribs along the middle, and less distinct parallel lines each side of these; the tip is an acute hollow cone, about 10^{mm} long.

Color of mantle, pale yellowish white, translucent, with scattered, conspicuous, round, or more or less elliptical, purplish brown spots, 2 to 3^{mm} in diameter, and 5 to 10^{mm} apart. Eyes dark purplish or chocolate-brown; head, siphon, and outer surfaces of arms thinly specked with purplish brown chromatophores.

The length of the largest specimen is 163^{mm}, from end of tail to tip of 3d pair of arms; length of mantle, dorsally, 116^{mm}; mantle to base of dorsal arms, 11^{mm}; diameter of eyes, 17^{mm}; breadth of head across eyes, 30^{mm}; breadth of body, 26^{mm}; length of caudal fin, 45^{mm}; its breadth, 28^{mm}; length of dorsal arms, 20^{mm}; of 2d pair, 25^{mm}; of 3d pair, 32^{mm}; of 4th pair, 20^{mm}; of tentacular arms, 35^{mm}; of club, 11^{mm}; breadth of lateral arms, at base, 3.5^{mm}; diameter of largest suckers, 2.5^{mm}.

The teeth of the odontophore (Pl. LV, fig. 2*a*) form seven rows, as usual; the median teeth have a very large and long median denticle and a small one at each lateral angle; the inner lateral teeth have a large inner denticle and a very small outer one; the two outer rows are rather stout; there is also a marginal row of small, more or less elliptical plates, with their outlines rather indefinite.

Off Martha's Vineyard, 87½ miles from Gay Head, station 952, in 388 fathoms. U. S. Fish Commission, Aug. 4, 1881.

This species resembles *Taonius pavo* (for which I at first mistook it) in form, but is very different in color and other characters. The suckers, which are remarkably flat in *T. pavo*, and strongly serrate, are in this very deep, and the edge of the ring is generally entire. The pen is also different.

Notes on the visceral anatomy.

Anatomically, this species closely resembles *Desmoteuthis hyperborea*. (See Pl. XXXIX, fig. 1.) It has a similar short, thick, compressed, ovate liver, with the intestine in a groove along its ventral edge, and the small ink-sac imbedded in its antero-ventral surface. The gills are laterally placed, short, with long lamellae. The heart is small, irregularly tubular, oblique, with four angles or lobes where joined by the principal vessels. The efferent vessels from the gills are long and conspicuous, because the bases of the gills are distant from the heart. The alimentary tract consists of a short, narrow rectum, attached to the liver, and ending in a bilabiate aperture,

guarded by two slender papillæ; of a long, rather wide, tubular portion, extending back to the base of the caudal fin, and covered, along the ventral^{or} side, with lateral rows of clusters of small follicular glands, which, near the liver, diverge into two, separate, large, lateral clusters; posteriorly, where the rows of follicles cease, there is a small, firm, bean-shaped, glandular organ, lamellose within (? a gizzard); this is followed by a long tubular, or fusiform, more or less saccular stomach and cæcal appendage, running back nearly to the end of the body; a constriction at the origin of the cæcal appendage. The testicle is a rather small, slender, lanceolate organ, attached laterally, for its whole length, to the side of the cæcal appendage. The prostate gland and vesiculæ seminales have their usual position, at the base of the left gill, but they are small, and probably not fully developed; the efferent duct extends over and a short distance beyond the base of the gill, and is slender and pointed. The renal organs are very different from those of the common squids (*Loligo* and *Ommastrephes*). The posterior part of the anterior vena-cava becomes glandular in front of the heart; there it parts, sending a long, smooth vein to the base of each gill; there, each of these veins expands into an ovate renal organ, before joining the branchial auricles.

Family SEPIOLIDÆ (See p. 367.)

During the explorations made by the "Fish Hawk," the present season, we were fortunate in obtaining additional specimens, including both sexes, of the very interesting and beautiful species described by me in 1878, under the name of *Sepiola leucoptera*. These specimens have given me an opportunity to make dissections, which I had not done with the few specimens previously known. These studies show that it has no pen; that the presence of the remarkably enlarged suckers of the second pair of arms is not confined to the male; and that this species is the type of a very distinct genus, especially remarkable for being the only known genus, among *Myopsidæ*, that has round pupils and the eye-lids free all around. In fact, it shows quite conclusively that this division of the Decacera into two groups, based on the presence or absence of free eye-lids, is purely artificial and of little or no systematic value. Therefore the characters attributed to the family, *Sepiolidæ*, must be modified to a considerable extent, to include this genus.

In its internal anatomy this genus differs but little from *Sepiola*, *Heteroteuthis* and *Rossia*, notwithstanding its remarkable divergence in respect to the eyes and pen. Other genera of *Sepiola*-shaped

cephalopods agree with this in lacking a pen. Of such genera, Professor Steenstrup has recently [Vidensk. Selsk. Skr., 6 R., nat. math. Afd., i, 3, 1881, p. 213] described two: *Idiosepius* and *Sepiadarium*, both of which he associates with the Sepidæ, because the ventral arms are hectocotylized. One of these (*Idiosepius*) has the mantle free dorsally, as in *Rossia*, but with ovate connective cartilages on the sides; the other has a dorsal commissure, as in *Sepiola*, and lateral commissures, much as in *Taonius*. To me, these seem more nearly allied to *Loligo* than to *Sepia*. In addition to these, I have to add another genus,* from the Bay of Yeddo, Japan. Of this genus I have two species, collected by Prof. E. S. Morse.

Stoloteuthis Verrill, gen. nov.

Type, *Sepiola leucoptera* Verrill. (See p. 347.)

Body short and thick, well-rounded. Head large, united to mantle by a broad dorsal commissure. Eyes large; pupils round; eye-lids free all around. No pen. Mantle thick, extending farther forward

* *Iniotheuthis*, gen. nov. Body, lateral fins, and dorsal commissure of the mantle as in *Sepiola*; lateral connective cartilages of the siphon, oblong-elliptical, with the groove open behind, fitting a linear ridge on each side of the mantle. Eye-lids free below, adherent above. Pen absent. Arms webbed only slightly, at base; suckers, both on sessile arms and tentacles, as in *Rossia*. Left dorsal arm hectocotylized somewhat as in *Sepiola Rondeleti* (see description by Steenstrup), but more extensively, with a large, prominent, fleshy, concave, ear-like structure, near the base, extending across the inner surface of the arm and replacing both rows of suckers, their pedicels becoming confluent with the marginal membrane.

The outer side of this organ is divided by a median notch into two lobes; the distal one enclosing a large papilla, apparently formed of two confluent and modified sucker-pedicels.

Iniotheuthis Japonica V. This small species has the suckers in two rows on all the arms. It appears to be the *Sepiola Japonica* D'Orbigny. The suckers of all the arms, but especially those of the dorsal and upper lateral arms, are much larger in the male than in the female. Tentacular club narrow, with small suckers, in about eight rows. The fins are small, nearly semicircular.

Iniotheuthis Morsei V., sp. nov. This is easily distinguished from the preceding by the presence of four crowded rows of suckers on all the arms; the suckers are attached by slender pedicels, which arise from the top of prominent, thickened, basal stems. The tentacular clubs are well-developed, with exceedingly numerous, very minute suckers, in more than sixteen rows. Fins large, situated in advance of the middle of the body. Dorsal and ventral arms about equal; two lateral pairs longer, the third pair slightly longer than the second. Mantle edge, beneath, with a large emargination; dorsal commissure broad.

No males of this species are in the collection; therefore I refer it to this genus only provisionally. It has no pen.

beneath than laterally. Fins large, lateral. Siphon with an internal valve, in both sexes; connective cartilages oblong, with a central groove, fitting a linear ridge, on each side of the mantle; these do not extend to the edge of the mantle. Arms webbed for more than half their length, except between the ventral arms; second pair, in the male, and some females, with two or three much enlarged suckers near the middle. The suckers of all the arms are relatively larger in the male than in the female; dorsal arms of the male alike; their basal suckers are larger and more crowded than in the female; no other evidence of hectocotylization could be found.

Stoloteuthis leucoptera Verrill.

Sepiola leucoptera Verrill. (See p. 347.)

The largest specimen hitherto observed is an adult male, from station 947, in 312 fathoms. This differs but very little from the smaller male already described and figured (p. 348, Pl. XXXI, fig. 5), but it has, on the tips of both ventral arms, four rows of small suckers, while all the others, of both sexes, have but two rows, even to the extreme tips. The suckers on all the arms of this specimen are decidedly larger in proportion than on the females of nearly equal size, and the group of larger suckers on the second pair of arms is represented by one very large one, on each arm. More than half the female specimens also have the corresponding suckers much enlarged, but perhaps not so much so as the males. The large males appear to show some evidence of hectocotylization, in having the suckers near the base of both dorsal arms larger and more crowded than they are in the females, and the portions of the web bordering these arms appear to be somewhat thickened or swollen, a feature not present in the females. But I could detect no difference in the structure of the two dorsal arms, nor in the two ventrals. The tentacular arms are much swollen at base, especially the right one, while the club is narrower than the average width of the arm; just at the base of the club, along the upper edge of the 'wrist' there is a prominent free lobe or crest.

In alcohol, the integument appears very thick and rather soft. In life there appears to be a thick, gelatinous, transparent layer, outside the stratum containing the chromatophores.

The large male described above, in alcohol, is 40^{mm} long, from end of body to tip of lateral arms; breadth of body, 22; breadth of head, 20; breadth across extended fins, 38; length of lateral arms, from beak, 15^{mm}.

Stoloteuthis leucoptera.—Additional specimens examined.

Station.	Locality.	Fathom	When collected.	Received from.	Specimens. No. Sex.
947	Off Martha's Vineyard	312	Aug. 9, 1881	U S. F. C.	1 l. ♂ : 1 j.
952	" "	388	" 24, 1881	"	1 l. ♀
998	" "	302	Sept. 8, 1881	"	2 ♀
999	" "	266	" "	"	1 ♀
1026	" "	182	" "	"	3 j.

Rossia sublevis Verrill. (See p. 354.)

This species was dredged by the U. S. Fish Commission, in considerable numbers, during the season of 1881, off Martha's Vineyard, in 153 to 458 fathoms. The eggs were taken in August and September, containing large embryos. These eggs were laid in the oscules of sponges, and are scarcely distinguishable from those of *R. Hyatti*.

Rossia sublevis.—Additional specimens.

Station.	Locality.	Fath.	Date.	Rec'd from.	Specimens. No. Sex.
<i>Off Martha's Vineyard.</i>					
			1881		
924	S. $\frac{1}{2}$ W. 83 $\frac{1}{2}$ m. from Gay Head,-----	160	July 16	U. S. F. C.	1 l. ♀ : eggs
925	S. $\frac{1}{2}$ W. 86 m. from Gay Head,-----	224	"	"	2 l. ♂
939	S. by E. $\frac{1}{2}$ E. 98 m. from Gay Head,-----	258	Aug. 4	"	19 : eggs.
943	S.S.W. 83 m. from Gay Head,-----	153	" 9	"	1
945	S. by W. $\frac{3}{4}$ W. 84 $\frac{1}{2}$ m. from Gay Head,-----	202	"	"	1 l. ♂ : 4 ♀
946	S. by W. $\frac{3}{4}$ W. 87 $\frac{1}{2}$ m. from Gay Head,-----	241	"	"	2 ♂ : 3 ♀
947	S. by W. $\frac{3}{4}$ W. 89 m. from Gay Head,-----	312	"	"	6
951	S. 85 m. from Gay Head,-----	219	" 23	"	5 ♂ : 2 ♀
952	S. $\frac{1}{2}$ E. 87 $\frac{1}{2}$ m. from Gay Head,-----	388	"	"	2 ♀
997	S.S.W. $\frac{1}{2}$ W. 103 $\frac{1}{2}$ m. from Gay Head,-----	335	Sept. 8	"	1 ♂ : eggs.
1025	S.S.W. $\frac{1}{2}$ W. 95 m. from Gay Head,-----	216	"	"	3 ♀
1026	S.S.W. $\frac{1}{2}$ W. 93 $\frac{1}{2}$ m. from Gay Head,-----	182	"	"	2 ♀
1028	S.S.E. $\frac{3}{4}$ E. 108 $\frac{1}{2}$ m. from Gay Head,-----	410	" 14	"	1 l. ♂
1029	S.S.E. $\frac{3}{4}$ E. 109 $\frac{1}{2}$ m. from Gay Head,-----	458	"	"	1 j.
1032	S.S.E. $\frac{1}{2}$ E. 107 m. from Gay Head,-----	208	"	"	5
1033	S.S.E. $\frac{1}{2}$ E. 106 m. from Gay Head,-----	183	"	"	1 j. : eggs.
1045	Off Delaware Bay,-----	312	Oct. 10	"	3 l. ♂ : 1 j.

Heteroteuthis tenera Verrill. (See p. 357.)

During the dredging season of 1881, this species was again taken in many localities, off Martha's Vineyard, in 45 to 182 fathoms.

The eggs of this species, containing, in some instances, embryos so far developed as to permit specific determination, have been taken in many localities, in 65 to 130 fathoms, by the U. S. Fish Commission, in August and September, associated with the adults. These eggs were particularly abundant at stations 865-867, 872, 873, 874, in 1880; and at stations 922, 940, 949, in 1881. Some of those taken in August are nearly ready to hatch, while others, taken as late as September, are freshly laid. The eggs are directly and firmly

attached to the surface of various objects, such as dead shells (of *Pecten*, etc.), annelid tubes, hydroids, fragments of Echini, ascidians, etc. They are placed near together, or side by side, so as to form larger or smaller groups. They are pearly white, about 3^{mm} in diameter, nearly round, except that the attached side is somewhat flattened, and the upper surface has a small, conical process in the middle.

Heteroteuthis tenera.—Additional specimens.

Station.	Locality.	Fath.	Date.	Rec'd from.	Specimens. No.	Sex.
<i>Off Martha's Vineyard.</i>						
			1881			
918	S. $\frac{1}{2}$ W. 61 m. from Gay Head.	45	July 16	U. S. F. C.	1 ♂: 1 ♀	
919	S. $\frac{1}{2}$ W. 65 m. from Gay Head.	51 $\frac{1}{2}$	"	"	4 ♂	
920	S. $\frac{1}{2}$ W. 68 $\frac{1}{2}$ m. from Gay Head.	61	"	"	3 ♂: 5 ♀	
921	S. $\frac{1}{2}$ W. 73 m. from Gay Head.	65	"	"	6 ♂: 6 ♀	
922	S. $\frac{1}{2}$ W. 77 m. from Gay Head.	69	"	"	1 ♀: eggs.	
940	S. by E. $\frac{1}{2}$ E. 97 m. from Gay Head.	130	Aug. 4	"	1 ♀: eggs.	
944	S. S. W. 82 m from Gay Head.	124	" 9	"	1 ♂: 1 ♀	
949	S. 79 $\frac{1}{2}$ m. from Gay Head.	100	" 23	"	1: eggs.	
950	S. 75 m. from Gay Head.	69	"	"	1 ♂: 2 ♀	
1026	S. S. W. $\frac{1}{2}$ W. 93 $\frac{1}{2}$ m. from Gay Head.	182	Sept. 8	"	1 ♂	
1027	S. S. E. $\frac{3}{4}$ E. 105 $\frac{1}{2}$ m. from Gay Head.	93	" 14	"	1 ♂	
1038	N. lat. 39° 59'; W. long. 70° 06'.	146	" 21	"	5 ♂: 2 ♀	
1043	N. lat. 38° 39'; W. long. 73° 11'.	130	Oct. 10	"	1 ♂	

Argonauta argo Linné (p. 364.)

In the American Naturalist, xv, p. 908, another specimen of this species is reported by Rev. Sannel Lockwood to have occurred at Long Branch, N. J., September, 1881. The shell is stated to have been fresh. This is the third specimen obtained on the coast of New Jersey, since 1876.

Alloposus mollis Verrill. (See p. 366.)

Octopus (?) sp.. Verrill, Bulletin Mus. Comp. Zool., viii, p. 109, pl. 4, fig. 3, 1881.

PLATE L. PLATE LI. FIGURES 3, 4.

Two very large females of this species were taken by the U. S. Fish Commission, this season, off Newport, R. I. One was from station 937, in 506 fathoms, the other from 994, in 368 fathoms.

They were nearly equal in size. The weight of the first, when fresh, was found to be over 20 pounds. Length from the posterior end of the body to the tips of the dorsal arms 787^{mm} (31 inches); to tips of 2d pair, 812^{mm} (32 inches); to tips of 3d and 4th pairs, 711^{mm} (28 inches); length of mantle, beneath, 178^{mm} (7 inches); beak to tips of 3d pair of arms, 559^{mm} (22 inches); breadth of body, 216^{mm} (8.5 inches); breadth of head, 280^{mm} (11 inches); diameter of eyes, 64^{mm} (2.5

inches); of largest suckers, 10^{mm} (.38 of an inch). It was measured while living.

The body, when living, was short and broad, and so soft and gelatinous that, when out of water, it could not retain its natural form. When placed in a large pan, it flattened out and filled up the vessel, like a mass of rather stiff jelly. Color, in life, pale bluish white, speckled with rusty orange-brown chromatophores; inner surfaces of arms dark purplish brown; suckers white.

Two detached and somewhat mutilated arms, with portions of a third arm and of the basal web, of a large specimen, formerly described by me as *Octopus* ? sp., but which I now refer to this species, were taken by Mr. Agassiz, on the "Blake," in 1880, at station 336, N. lat. 38° 21' 50", W. long. 73° 32', in 197 fathoms.

The largest of these arms is 420^{mm} long and 36^{mm} broad. The suckers are large, prominent, subglobular, with a contracted aperture, and having a thin membrane around the outer margin. They form two alternating, rather distant rows, except near the base, where several that are somewhat smaller than those farther out, stand nearly in one row, with wide spaces between them. Diameter of largest suckers, 9 to 11^{mm}; distance between their centers, 20 to 35^{mm}. Color, dark purple. (Pl. LI, fig. 3.)

Smaller specimens were taken by us, this season, off Martha's Vineyard, in 310 to 715 fathoms; stations 938, 952, 953.

Alloposus mollis.—Additional specimens.

Station.	Locality.	Fath.	Date.	Rec'd from.	Specimens. No. Sex.
	<i>Off Delaware Bay.</i>				
336	38° 21' 50"; 73° 32',-----	197	1880	Blake Ex.	1 l. frag.
	<i>Off Martha's Vineyard.</i>				
937	S. by E. $\frac{1}{2}$ E. 102 m. from Gay Head,.....	506	Aug. 4	U. S. F. C.	1 l. ♀
938	S. by E. $\frac{1}{2}$ E. 100 m. from Gay Head,.....	310	"	"	1 j.
952	S. $\frac{1}{4}$ E. 87 $\frac{1}{2}$ m. from Gay Head,.....	388	" 23	"	1 j.
953	S. $\frac{1}{2}$ E. 91 $\frac{1}{2}$ m. from Gay Head,.....	715	"	"	1 j. ♀
994	S.S.W. $\frac{1}{4}$ W. 104 $\frac{1}{2}$ m. from Gay Head,.....	368	Sept. 8	"	1 l. ♀

Octopus Bairdii Verrill. (See p. 368.)

Numerous additional specimens of this species were dredged off Martha's Vineyard, in 120 to 410 fathoms, by the U. S. Fish Commission, this season.

Octopus Bairdii.—Additional specimens.

Station.	Locality.	Fath.	Bottom.	Date.	Specimens. No.	Sex.
				1881		
<i>Off Martha's Vineyard.</i>						
925	S. $\frac{1}{2}$ W. 86 m. from Gay Head.....	224	sand, mud	July 16	1 l. ♂ : 3 j. ♂	
939	S. by E. $\frac{1}{2}$ E. 98 m. from Gay Head,	258	"	Aug. 4	1 ♂ : 1 ♀ : 1 j.	
945	S. by W. $\frac{3}{4}$ W. 84 $\frac{1}{2}$ m. from Gay Head,	202	"	"	3 ♀ : 1 ♂	
946	S. by W. $\frac{3}{4}$ W. 87 $\frac{1}{2}$ m. from Gay Head,	241	"	"	4 ♀ : 5 ♂ ; 2 j.	
947	S. by W. $\frac{3}{4}$ W. 89 m. from Gay Head,	312	"	"	1 l ♀ : 4 ♂	
951	S. 85 m. from Gay Head,	219	mud	"	23	4 ♀ : 2 ♂
952	S. $\frac{1}{4}$ E. 87 $\frac{1}{2}$ m. from Gay Head,	388	sand, mud	"	4 ♀ : 2 ♂	
994	S.S.W. $\frac{1}{4}$ W. 104 $\frac{1}{4}$ m. from Gay Head,	368	mud	Sept. 8	1 l. ♂	
997	S.S.W. $\frac{1}{4}$ W. 103 $\frac{1}{4}$ m. from Gay Head,	335	"	"	1 j. ♂	
998	S.S.W. $\frac{1}{4}$ W. 102 $\frac{1}{4}$ m. from Gay Head,	302	"	"	1 ♂ : 1 ♀	
1025	S.S.W. $\frac{1}{4}$ W. 95 m. from Gay Head,	216	"	"	4 j.	
1026	S.S.W. $\frac{1}{4}$ W. 93 $\frac{1}{4}$ m. from Gay Head,	182	"	"	11. ♂ : 1 l. ♀	
1028	S.S.E. $\frac{3}{4}$ E. 108 $\frac{1}{2}$ m. from Gay Head,	410	"	"	14	1 ♂
1033	S.S.E. $\frac{1}{2}$ E. 106 m. from Gay Head,	183	sd., gravel	"	1 ♂	
1035	S.S.E. $\frac{1}{2}$ E. 103 $\frac{1}{4}$ m. from Gay Head,	120	sand	"	1 l. ♂	
1045	Off Delaware Bay,	312	mud	Oct. 10	1 l. ♂	
1047	Off Delaware Bay,	156	sand	"	1 ♀	

Architeuthis Harveyi Verrill. (No. 27).

After the preceding pages were put in type, another specimen of *Architeuthis* was secured.

This was found dead, floating at the surface, near the shore, at Portugal Cove, a few miles from St. John's, Newfoundland, November 10, 1881. It was obtained by Mr. Morris, who had a photograph of it made by Mr. E. Lyons, of St. John's, and then shipped it to New York, packed in ice, by the steamer "Catima," Capt. Davies. Mr. Morris has given a brief description of this specimen in an article in the New York Herald of Nov. 25, 1881. In Harper's Weekly of Dec. 10, accompanying an article on the same subject, apparently by the same writer, there is a wood-cut, apparently copied from the photograph.*

The specimen was purchased by Mr. E. M. Worth, and preserved, in alcohol, at his museum, 101 Bowery, N. Y., where I had a good opportunity to examine it about two weeks after it had been put in alcohol.

Although this is more nearly complete than any specimen hitherto brought to this country, the arms and suckers are not so well preserved, as in some of the other examples. All the sessile arms have lost more or less of their tips, so that the actual length cannot be given, and many of their suckers are either injured or lost; the

* This figure, though poor, gives a fair idea of the general appearance of the creature as it would look if lying flabby and collapsed on the shore. The peculiar appearance of the caudal fin was due to mutilation of that organ.

tentacular arms are also injured and most of the large suckers of the clubs are destroyed; the caudal fin was not only torn by handling, but one-half of it had, apparently, been destroyed and the wound healed before the death of the creature,* so that its true form cannot be determined; the eye-balls were burst; and most of the pen was gone.

The head, eye-lids, siphon, and front edge of the mantle are, however, in fair condition, and as these parts have not been well preserved in any of the previous examples, some new and valuable facts were learned in regard to the structure of those parts. Many of the following characters are of generic value.

The eye-lids were large, not much thickened, and only slightly angulated, and with a shallow sinus; diameter of opening 120^{mm} (4.5 to 5 inches). The transverse nuchal crests, behind the eyes, are distinct, but only slightly elevated; of the longitudinal ones only one, on each side, is distinct but is short and not very high, the others (unless they had been rubbed off) are rudimentary. The siphon is large and broad; aperture 102^{mm} (4 inches) broad, slightly bilabiate, with a broad valve within; dorsal bridles moderately developed. Siphon-pit shallow, *smooth*. Connective cartilages on base of the siphon simple, long-ovate, slightly oblique, and only a little concave. Connective cartilages on the sides of the mantle, short and close to the front edge, very simple, consisting of a simple, slightly raised, longitudinal ridge. The dorsal angle of the mantle-edge extends considerably forward, as an obtuse angle; the lateral angles are also distinct. The body is large and broad in the middle and anteriorly, but tapers very rapidly to the base of the caudal fin, which is relatively small.

This specimen, when examined by me, measured as follows: length of mantle to lateral angles of the front edge, 4.16 feet; from edge of mantle to anterior base of ventral arms, 1.25 feet; circumference of body, 4 feet; length of caudal fin, tip to end of lobe, 1.75; breadth of one-half, measured from median line, 8 inches; length of tentacular arms, 15 feet; of the club, 2 feet; from first of the large suckers to tip, 1.67 feet; length of ventral arms (minus tips), 4.66 feet; their circumference at base, 8.5 inches; length of the dorsal arms (minus tips), 4.5 feet; their circumference at base, 7.5 inches; circumference of 2d pair of arms, at base, 7.5 inches; of 3d pair, 8.5 inches; diame-

* Owing to this fact, which was not understood by those who saw and figured it, at first, some of the cuts that have been printed give the tail very peculiar and remarkable forms.

ter of largest suckers of sessile arms, .75 inch. The arms appear very stout, especially at base, and not very unequal in size. In form they agree well with those already described from previous examples. The ventral arms have the inner face broader than on the other arms, and the two crests along the outer angles are well developed. The suckers, so far as preserved, have the same characters as in the former examples; the more proximal of those on the ventral arms are closer together in a longitudinal direction, but the rows are farther apart than on the other arms. The mandibles are dark brown, the tooth on the anterior alar edge of the lower mandible is large and prominent.

The color, which is partially preserved, especially on the arms and on the ventral surface of the body, agrees pretty nearly with that of *Ommastrephes*, consisting of small purplish brown chromatophores, more or less thickly scattered over the surface. The back had a bleached appearance, as if the creature had laid upon the shore or floated at the surface, with the back exposed, for some time after death.

Owing to the mutilation of the tips of the ventral arms, hectocotylization could not have been detected, if it had originally existed. The sex, therefore, could not be determined without cutting open the mantle. By everting the edge of the mantle, as far as possible, I could see, owing to insufficient light, only the tips of the gills, which are situated rather far back, but the reproductive organs could not be seen.

*Conspectus of the Families, Genera and Species of Cephalopoda,
included in this paper.*

In the following synopsis the species that have actually been proved to belong to the fauna of the northeastern coast of America, or the waters adjacent, are numbered serially. They have all been personally studied by me, except *Taonius pavo*.

SUBCLASS DIBRANCHIATA.

Cryptodibranchiata Blainville, Dict. Sci. Nat., vol. xxxii, p. 172, 1824.

Acétabulifères Férus. & D'Orb., 1835; Céphal. Acétab., pp. v, xxxv, 1.

D'Orbigny, Hist. Cuba, Moll., p. 5, 1853.

Dibranchiata Owen, Trans. Zool. Soc. London, vol. ii, p. 103, 1838.

Antepedia Gray, Catal. Brit. Mus., Moll., vol. i, p. 3, 1849.

Branchial cavity large, containing a single pair of large, highly specialized gills, each having a muscular branchial heart at its base. Mantle very muscular. Siphon completely tubular, with or without an internal valve, and used in locomotion. The interior lateral or basal lobes of the siphon are flexible, and capable of acting as valves to close the opening of the branchial sac by pressing against the inside of the mantle when it contracts. The jet of water, thus forced through the siphon, by its reaction propels the animal backward or forward, or in any direction opposite to that in which its flexible extremity may be turned.

The body varies in form from subspherical to long-conical; sides often with fins. Mantle destitute of an external shell. The internal shell, when present, is dorsal, and may be either horny or calcareous. Sessile arms in four pairs, around the head, provided, on the inner surface, with suckers or with hooks (modified suckers). Eyes highly developed. Mouth with a sharp, horny beak, the upper jaw shutting into the lower one; mandibles hollow, supported by strong internal cartilages. Odontophore with seven (or rarely five) rows of sharp teeth. An ink-sac, which opens near the end of the intestine, at the base of the siphon.

This subclass includes two very natural divisions:

Decacera.—Having, inside the circle of eight sessile arms, two long tentacular arms, with suckers or hooks on the distal portion. Suckers

pediceled, with horny rims. Body usually elongated, always with lateral fins.*

Octopoda.—Having only the eight sessile arms. Suckers not pediceled, destitute of horny rings. Body usually short, obtuse, rarely finned.

ORDER I.—DECACERA.

Decapoda Leach, Zool. Miscel., vol. iii, 1817 (t. Gray) [non Latr., 1806].

H. & A. Adams, Genera, vol. i, p. 25.

D'Orbigny, Tabl. Méth. des Cephal., p. 57, 1826; Hist. Cuba, Moll., p. 30, 1853.

Decacera Blainville, Dict. Sci. Nat., vol. xxii, 1824; Man. Mal., p. 366, 1825.

Sephius Gray, Catal. Brit. Mus., Moll., vol. i, p. 35, 1849.

Body generally rounded and elongated, often acute posteriorly. Ten prehensile arms, bearing suckers or hooks, which are *pediceled*. Four pairs of these, called sessile arms, are tapered from the base and covered with rows of suckers along the whole length of the inner face; the fifth pair of arms, known as tentacular arms, differ from the rest, and arise from a pair of pits or pouches, situated between and inside the bases of the third and fourth pairs of sessile arms; they have a more or less slender and contractile peduncular portion and a distal, usually enlarged, sucker-bearing portion. Beak protractile, surrounded by an inner, and a loose outer buccal membrane, the latter usually with seven or eight angles, united to the arms by membranes. Eyes movable in the sockets, with or without lids. Head united to the mantle either by a dorsal commissure and two lateral, free, connective cartilages; by three free connective cartilages; or by three muscular commissures. Mantle usually supported by an internal, dorsal, horny 'pen,' or by a calcareous, internal, dorsal shell or 'bone;' sometimes the pen is absent; always with muscular fins on each side. Male, when adult, usually with one or two of the arms hectocotylized.

This group was divided by D'Orbigny into the following two tribes, which are more convenient than natural:

Oigopside.—Eyes naked in front, furnished with free lids, with or without an anterior sinus; pupils round.

Myopside.—Eyes usually covered by transparent skin, sometimes with a thickened fold, forming a lower lid, but in *Stoloteuthis* the lids are entirely free; pupils crescent-shaped, rarely round.

* The name *Decacera*, though not in so general use as *Decapoda* for this group, is retained because the latter was previously, and still is, in use for a group of Crustacea, and, therefore, cannot properly be used for these Cephalopoda.

OIGOPSIDÆ.

The division called *Oigopsidæ* includes two very diverse groups, differing very widely in their visceral anatomy, as well as in the structure of the eyes, siphon, and mantle connections. These may be called *Teuthidea* and *Tuonidea*.

The former will include all the *Oigopsidæ* described in this paper except the *Desmoteuthidæ*. The *Tuonidea* will include our *Desmoteuthidæ*, and also several allied forms, which have usually been carelessly referred to *Loligopsis*.

TEUTHIDEA Verrill.

Eyes with free lids, not stalked. Siphon with a subterminal valve. Mantle attached to the siphon by free connective cartilages. Stomach large, pouch-like; intestine short; liver very large; ink-sacs large. Pen horny, well developed, as long as the mantle. One of the ventral arms is usually hectocotylized in the male. Arms with suckers, or with claws, or with both.

Family TEUTHIDÆ Owen (restricted.)

Teuthidæ (pars) Owen, Trans. Zool. Soc. London, vol. ii, 1838.

Teuthidæ (pars) D'Orbigny, Céphal. Acétab., p. xxxvii (Introduction), p. 328, 1835-1848.

Onychoteuthidæ (pars) Gray, Catal. Brit. Mus., Moll., vol. i, p. 45, 1849.

H. & A. Adams, Genera, vol. i, p. 30.

Tentacular arms furnished with sharp, horny claws or hooks, which correspond with peculiarly and highly modified sucker-rings; true denticulated suckers usually accompany the hooks; tip of arm with a cluster of small suckers; proximal part of club usually with a mixed group of connective tubercles and smooth-rimmed suckers, by which the arms can be fastened together and used in concert. Sessile arms with hooks, with suckers, or with both. Eyes with free lids and a sinus. Mantle united to neck by three simple, movable, connective cartilages. Siphon with a valve and with dorsal bridles. Nuchal or olfactory crests well developed. Pen thin, usually lanceolate, generally with a posterior hooded portion, or hollow cone, and sometimes terminated by a solid cartilaginous cone. Hectocotylized arm not observed.

For a brief synopsis of the previously known genera of this family,* see pp. 250, 251.

Owen's family, *Teuthidæ*, included nearly all the *Decacera* having horny internal shells. As adopted by D'Orbigny, it included our *Ommastrephidæ* and *Teuthidæ*.

Enoploteuthis (See pp. 251, 404).

Enoploteuthis Hartingii Verrill. (pp. 240, 241, 404).

Enoploteuthis Molinæ D'Orb.=*E. Cookii* Owen. (pp. 241, 404).

Moroteuthis Verrill. (See p. 393).

Moroteuthis robusta (Dall) Verrill. (pp. 246, 393).

Gonatus Gray. (See pp. 290, 387, 390).

Gonatus amœnus Gray. (pp. 291, 388, 390).

Lestoteuthis Verrill. (See pp. 250, 387, 390).

1. *Lestoteuthis Fabricii* (Licht.) Verrill (pp. 291, 293, 387-390).

Family OMMASTREPHIDÆ.

Teuthidæ (pars) D'Orbig., Céphal. Acétab., pp. xxxvii. 328.

Onychoteuthidæ (pars) Gray, Catal. Brit. Mus., Moll., vol. i. p. 45, 1849.

Ommastrephidæ Gill, Classification Mollusca, p. 1, 1871.

Tryon, Man. Conch., vol. i, p. 107, 1879.

Body elongated, often very large (*Architeuthis*), tapering to a point posteriorly, shorter and less acute in the female. Sessile and tentacular arms without hooks, but provided with suckers, having denticulated, horny rings; tentacular arms with an expanded club, having four rows of suckers on its middle portion, those in the two central rows larger; proximal portion with or without smooth-rimmed connective suckers and tubercles; tip with a cluster of smooth-rimmed suckers. Siphon in a deep groove, attached by four bridles; an internal valve. Eye-lids with a distinct anterior sinus. Nuchal and olfactory crests consist of three longitudinal membranes on each side, united by a transverse one in front. Connective cartilages of the mantle

* The genus *Dosidicus* Steenst., should not have been there included. It belongs to the *Ommastrephidæ*, and is very closely related to *Sthenoteuthis*. The tentacular club bears denticulated suckers and the terminal cone of the pen is hollow.

Ancistroteuthis Krohnii appears to belong to *Onychoteuthis*. *Gonatus* and *Lestoteuthis* have since been restricted and their characters revised. (See pp. 388-394).

three; the lateral ones are usually T-shaped, formed by a longitudinal ridge, with a smaller transverse one across its posterior end; the corresponding cartilages on the siphon are long-triangular, with a longitudinal and a transverse groove. Two oviducts. Hectocotylized arm of the male may be either the right or left ventral.

Pen usually very narrow along the middle portion, and with three ribs; anterior and posterior portions expanded, the latter with the edges involute, and forming a terminal hood or hollow cone.

Ommastrephes (See pp. 267, 385).

Ommastrephes (pars) D'Orbigny, Voy. Am. Mérid., 1835; Céphal. Acétab., p. 341.

Illex and *Todarodes* Steenstrup, Oversigt k. Danske Videnske. Selsk. Forhand., 1880, p. 90.

2. *Ommastrephes illecebrosus* (Les.) Verrill. (pp. 268, 403).

Sthenoteuthis Verrill. (See pp. 222, 286, 385, 402).

Ommastrephes (pars) D'Orbigny, Voy. Amér. Mérid., Moll. (1835?); Céphal. Acétab., 1839-'48.

Sthenoteuthis Verrill, Trans. Conn. Acad., vol. v, p. 222, Feb., 1880; Amer. Journ. Sci., vol. xix, p. 289, April, 1880.

Ommastrephes Steenstrup, Oversigt k. Danske Vidensk. Selsk. Forhandl., 1880, p. 89 (sep. cop. p. 19, received Aug., 1880).

3. *Sthenoteuthis megaptera* Verrill. (pp. 223, 286).

Sthenoteuthis pteropus (Steenst.) Verrill. (pp. 228, 402).

4. *Sthenoteuthis Bartramii* (Les.) Verrill. (p. 288).

Architeuthis (Steenst.) Harting, 1881. (See pp. 197, 259, 394, 422).

Architeuthis Steenst., 1856, (no description).

5. *Architeuthis Harveyi* Verrill. (pp. 177-210, 259, 395, 422).

6. *Architeuthis princeps* Verrill. (pp. 181-189, 194, 259).

Architeuthis monachus (Steenst.) (pp. 238-245).

Architeuthis dux (Steenst.) Gervais. (pp. 238-240).

Architeuthis Hartingii Verrill. (p. 240).

Architeuthis Bouyeri Verrill. (p. 243).

Architeuthis (?) *Mouchezi* Vélain. (pp. 243, 398).

Architeuthis grandis (Owen) Verrill. (p. 400).

The number of the foreign species, mostly nominal and imperfectly known, will undoubtedly be much reduced when they become better known. Probably *A. dux* and *A. Bouyeri* are identical, but there is as yet no proper zoological description of either. The former has been very briefly described by Gervais, and Harting has published an outline figure of one of the mandibles.

Family MASTIGOTEUTHIDÆ, nov.

Body slender, pointed behind. Caudal fin large, rhombic. Mantle united to neck by three movable cartilages. Siphon with an internal valve and one pair of dorsal bridles. Eyes large, not prominent; lids free, simple. Buccal membrane 6-angled, without suckers. Arms free; suckers in two rows. Tentacular arms (in the typical species) not expanded into a club, the terminal portion round, tapering, covered with a multitude of minute suckers, in many rows. Neither auditory nor olfactory crests. Pen narrow, with a long, hollow posterior cone.

This family differs from *Ommastrephidæ* in lacking a distinct lachrymal sinus and olfactory frills, in the remarkable character of the tentacular arms, and in the simple connective cartilages.

Mastigoteuthis Verrill. (See p. 296).

7. *Mastigoteuthis Agassizii* Verrill. (p. 297).

Family CHIROTEUTHIDÆ Gray, (restricted).

Loligopsidæ (pars) D'Orb., Céphal. Acétab., p. 320. 1835-48.

Chiroteuthidæ (pars) Gray, Brit. Mus. Catal., Moll., vol. i, p. 42, 1849.

Body small; mantle with three movable connective cartilages. Eyes not prominent, with free, simple lids; no sinus. Siphon small, with an internal valve; no dorsal bridle. Olfactory crests absent. Buccal membrane seven-angled, without suckers. Buccal aquiferous openings six. Sessile arms large; web rudimentary; suckers with toothed horny rings, encircled by a groove. Tentacular arms very long and slender, with a large club; tip often with a spoon-shaped organ, opening backward; peduncle with sessile connective suckers; club with rows of singular small suckers, having a swollen bulb on the long pedicel. Pen with a long, narrow shaft, posterior portion involute, tubular.

It is somewhat doubtful whether *Calliteuthis* belongs to this family, its tentacular arms being unknown.

Chiroteuthis D'Orb. (See p. 299).

Chiroteuthis is the only genus in this family that has been hitherto recognized.

8. **Chiroteuthis lacertosa** Verrill. (pp. 299, 408).**Brachioteuthis** Verrill. (See p. 405).9. **Brachioteuthis Beanii** Verrill. (p. 406).**Calliteuthis** Verrill. (p. 295).10. **Calliteuthis reversa** Verrill. (p. 295).**Calliteuthis ocellata** (Owen) Verrill. (p. 402).**Family HISTIOTEUTHIDÆ**, nov.

Loligopsidæ (*pars*) D'Orbig., Céphal. Acétab., p. 320, 1835-48.

Chiroteuthidæ (*pars*) Gray, Catal. Brit. Mus., Moll., vol. i, p. 42, 1849.

Body small, short, with small caudal fins. Mantle united to the neck by three movable cartilages. Siphon with neither dorsal bridle nor internal valve (?).^{*} Head large. Olfactory crests absent. Eyes large, not prominent; lids free and simple; no sinus. Buccal membrane with six smooth lobes; buccal aquiferous openings four. Nine brachial openings at the bases of the tentacular arms. Six upper arms usually united by a very broad web; sucker-rings convex, with small, oblique apertures. Tentacular arms moderate, with a well-developed club, bearing large, normal, central suckers, and small marginal ones; proximal part of the club with connective suckers and tubercles. Pen broad, short, lanceolate, much like that of *Loligo*.

Histioteuthis D'Orbigny. (See p. 233).11. **Histioteuthis Collinsii** Verrill. (pp. 234, 300, 404).**TAONIDEA** Verrill.

Eyes large, stalked or prominent, having free lids, but no sinus. Mantle united to base of siphon and back of neck by three muscular commissures. Siphon large, without a true subterminal valve, but usually with special elevated processes, or flaps, in the basal portion. Stomach small, far back; intestine very long, covered with lateral

^{*} According to D'Orbigny there is no valve in this genus, nor in *Chiroteuthis*, but in the latter there is certainly a valve, and it may have been overlooked by him, also, in the former. My specimens lack the siphon.

follicular glands; liver small, far forward; ink-sac small. Pen slender anteriorly, as long as the mantle. Hectocotyized arm not observed. All the arms bear suckers.

Family DESMOTEUTHIDÆ Verrill. (See p. 300).

Body much elongated, mantle united to the neck by three muscular commissures. Siphon without a true valve, but with three peculiar, special thickenings, or raised processes* in its basal portion. Eyes prominent. Intestine very long; ink-sac small.

Desmoteuthis Verrill. (See p. 300).

12. *Desmoteuthis hyperboreus* (Steenst.) Verrill. (p. 302).

13. *Desmoteuthis tenera* Verrill. (p. 412).

Taonius Steenstrup, restricted. (See p. 306).

14. *Taonius pavo* (Les.) Steenstrup. (See p. 306).

MYOPSIDÆ D'Orbigny.

Eyes usually without regular lids; the integument of the head sometimes becomes transparent and extends continuously over the eye; in some genera (*Rossia*, &c.) there is a fold of skin below the eye, constituting a free lower eyelid, while the upper lid is adherent to the eye-ball; but in *Stoloteuthis* the lids are entirely free. The pupil is usually crescent-shaped, or indented on the upper side, but is round in *Stoloteuthis*. Sometimes a small pore in front of the anterior edge of the eye connects with the orbital cavity. Siphon usually with a valve.

This artificial division includes two very diverse groups, which not only differ widely in the condition of the eyes, but also in the nature of the hectocotyization of the arms, and in anatomical characters.

To one of these groups, containing the family *Sepiolidae*, I propose to apply the name *Sepiolidea*.

The other division, *Sepidea*, includes the families, *Sepidae*, *Loliginidae*, *Idiosepidae*, and perhaps *Spirulidae*; but the latter might, perhaps, be best placed with fossil forms in a division of which it is the sole surviving genus.

* Of these organs the median dorsal one is larger and more complicated than the others (see Pl. LV, fig. 2d. m; and fig. 4a). It seems to me probable that this organ is a true homologue of the foot of gastropods.

SEPIDEA Verrill.

The integument extends entirely over the eye and there is a pore in front of it. Pupil crescent-shaped. Body commonly elongated. Pen various, rarely absent, usually large, broad-lanceolate or ovate, either horny or calcareous (spirally coiled, tubular and chambered in *Spirula*, in which it is posteriorly situated.) One of the ventral arms of the male is usually hectocotylized.

Mantle usually with three connective cartilages, rarely with one (dorsal) or three muscular commissures.

Family LOLIGINIDÆ.

Teuthidæ (pars) Owen, Proc. Zool. Soc. London, p. 285, 1847.

Loligidæ D'Orbigny, Céph. Acétab., p. 297, 1848.

Loligidæ (pars) Gray. Catal. Moll. Brit. Mus., vol. i, p. 66, 1849.

Loliginidæ (pars) H. & A. Adams, Genera Moll., vol. i, p. 35.

Body more or less elongated, cylindro-conical. Fins elongated, united and acute posteriorly, sometimes extending the whole length of the body. Pen large, extending the whole length of the mantle, with an acute, short, pen-like anterior shaft, and a broader, thin, lanceolate blade. Connective cartilages of the mantle three, movable. Eyes without a thickened false lid. Siphon provided with an internal valve, and usually with a dorsal bridle. Olfactory crests, about the ears, well-developed. Tentacular club large, with four rows of denticulated suckers on the middle portion. Horny rings of the suckers encircled externally by a raised median ridge.

Loligo Lamarck. (See p. 307).

15. *Loligo Pealei* Les. (p. 308).

16. *Loligo (Lolliguncula) brevis* Blainv.* (p. 343).

Sepioteuthis D'Orbig. (See p. 346).

Sepioteuthis sepioidea D'Orb. (p. 345).

* Professor Steenstrup, in a recent paper (*Sepiadarium* og *Idiosepius*. <Vid. Selsk. Skr., 6 R., 1, 3, p. 242, note, 1881), has proposed to make this species the type of a new genus, *Lolliguncula*, because the female receives the spermatophores on the inner surface of the mantle,—a character that seems to be scarcely of generic value, unless it be reinforced by anatomical differences now unknown. Such characters may possibly exist in the unknown males.

SEPIOLIDEA Verrill.

In this group the eye-lids are either entirely free all around, or the upper one may be attached to the eye-ball. Pupil either round or crescent-shaped. Body short, obtuse. Fins lateral, separated. Pen small or rudimentary, sometimes absent. Sucker-rings smooth. Dorsal arms of the male are usually hectocotylized, one or both.

Family SEPIOLIDÆ. (See pp. 347. 416).

Stoloteuthis Verrill. (See pp. 347. 417).

17. *Stoloteuthis leucoptera* Verrill. (pp. 347. 418).

Iniotheuthis Japonica (D'Orb., sp. ?) Verrill. (p. 417).

Iniotheuthis Morsei Verrill, sp. nov. (p. 417).

Rossia Owen. (See p. 349).

18. *Rossia megaptera* V. (p. 349).

19. *Rossia Hyatti* V. (p. 351).

20. *Rossia sublevis* V. (pp. 354. 419).

Heteroteuthis Gray. (See p. 357).

21. *Heteroteuthis tenera* V. (pp. 357. 419).

OCTOPODA Leach. (See p. 360).

Family PHILONEXIDÆ D'Orb. (See p. 361).

Parasira Steenst. (See p. 361).

Vidensk. meddel. naturh. Forening. Kjöbenhavn. 1860, p. 333.

22. *Parasira catenulata* Steenst. (p. 362).

Family ARGONAUTIDÆ Cantr. (See p. 364).

Argonauta Linné.

23. *Argonauta argo* Linné. (pp. 364. 420).

Family ALLOPOSIDÆ Verrill. (See p. 365).

Alloposus Verrill. (See p. 365).

24. *Alloposus mollis* Verrill. (pp. 366. 420).

Family OCTOPODIDÆ D'Orb. (See p. 367).

Octopus Lam. (See p. 367).

25. *Octopus Bairdii* Verrill. (pp. 368, 421).

26. *Octopus lentus* Verrill. (p. 375).

27. *Octopus piscatorum* Verrill. (p. 377).

28. *Octopus obesus* Verrill. (p. 379.)

Octopus rugosus Bosc. (p. 363).

Octopus vulgaris. (p. 252).

Octopus punctatus Gabb. (p. 252).

Eledone Leach. (p. 330).

29. *Eledone verrucosa* Verrill. (p. 330).

Family CIRRHOTEUTHIDÆ Keff. (See p. 382).

Stauroteuthis Verrill. (p. 382).

30. *Stauroteuthis syrtensis* Verrill. (p. 382).

EXPLANATION OF THE PLATES.

All the figures were drawn from nature by Mr. J. H. Emerton, except when otherwise stated.*

PLATE XXVI.

- Figure 1.—*Architeuthis Harceyi* V. (No. 24). Young. Pharynx and beak, with odontophore; *o*, oesophagus, natural size.
- Figure 2.—The same. Distal part of tentacular arm, with club, natural size.
- Figure 3.—The same. Segment from distal portion of left arm of the third pair of sessile arms, front view; *3a*, the same, side view, natural size.
- Figure 4.—The same. Basal portion of right arm, of second pair. Front view, natural size.
- Figure 5.—*Architeuthis Harceyi* V. (No. 2). One of the marginal suckers of the club, side view; *5a*, the same, front view, enlarged 2 diameters.

PLATE XXVII.

- Figure 1.—*Desmoteuthis hyperborea* V. Ventral view of a female, $\frac{1}{2}$ natural size.
- Figure 2.—The same specimen. Dorsal view of head and arms. Part of the arms are imperfect.
- Figure 3.—*Histioteuthis Collinsii* V. Original type. One of the tentacular arms. Front view. $\frac{1}{2}$ natural size.
- Figure 4.—Beak of the same specimen; *a*, upper. *b*, lower mandible, natural size.
- Figure 5.—Suckers of the same specimen: *a*, side, and *a'*, front view of one of the larger suckers of lateral arm; *b*, side, and *b'* front view of a distal sucker, enlarged $2\frac{1}{2}$ diameters.
- Figure 6.—*Sthenoteuthis megaptera* V. Side view of jaws and odontophore, natural size.
- Figure 7 and *7a*.—*Sthenoteuthis pteropus* V. Upper and lower mandibles, natural size.
- Figure 8.—*Rossia Hyatti* V. Side view of young male, natural size.
- Figure 9.—The same. Egg containing an embryo; enlarged 6 diameters. The shaded portion represents the yolk still remaining unabsorbed.
- Figure 10.—*Onychoteuthis Banksii*. One of the large hooks from the middle of the club; *a*, side view; *a'*, front view; enlarged 4 diameters.
- Figure 11.—The same. Corresponding views of one of the smaller hooks of the club.
- Figure 12.—The same. Horny ring from one of the small suckers on the proximal cluster of connective suckers and tubercles of the club; *a*, side view; *a'*, front view, enlarged 4 diameters.

* Most of these figures were drawn in India ink, by Mr. Emerton, for the U. S. Fish Commission, to be engraved in relief, to illustrate a report on the Cephalopods by the writer, which has been printing nearly simultaneously with this article in one of the volumes of the report of Professor S. F. Baird, the Commissioner. To Professor Baird I am greatly indebted for the privilege of first using a large part of the drawings here, which has enabled me to illustrate this article more fully than would, otherwise, have been possible.

PLATE XXVIII.

- Figure 1.—*Ommastrephes illecebrosus* V. Young male from Provincetown, Mass. General figure of ventral side. $\frac{5}{8}$ natural size; 1a, club of the right tentacular arm, front view, enlarged $1\frac{1}{2}$.
- Figure 2.—The same. Club and part of tentacular arm, of a larger ♀ specimen, enlarged $1\frac{1}{2}$ diameters.
- Figure 3, 3a.—The same. Hectocotylied right ventral arm of a large male specimen, from Eastport, Me., showing the sexual modification of the suckers and their peduncles toward the end of the arm; 3a transverse section of the modified portion of the same.
- Figure 4.—The same. Pen of a young specimen; $\frac{5}{8}$ natural size.
- Figures 5 and 5a.—The same. Side and front views of a large sucker of the lateral arms, enlarged $3\frac{1}{2}$ diameters.
- Figure 6 and 6a.—Side and front views of a smaller, distal sucker of the lateral arms.
- Figure 7.—The same. ♀ Side view of the horny ring of one of the largest suckers of the club, enlarged $3\frac{1}{2}$ diameters.

PLATE XXIX.

- Figure 1.—*Loligo Pealei* Lesueur. Female from Vineyard Sound. Ventral view. $\frac{2}{3}$ natural size; 1, dorsal arms; 2, 3, 2d and 3d, lateral arms; 4, ventral arms; t, tentacular arms; a, nuchal olfactory crests, about the ear; e, eye; p, aquiferous pore; s, siphon.
- Figure 2.—The same. Tentacular arm of a large male, enlarged $1\frac{1}{2}$ diameters.
- Figure 3, 3a.—Front and side views of the hectocotylied left ventral arm of a male, showing the sexual modifications of the suckers and their peduncles, toward the tip, enlarged $1\frac{1}{2}$ diameters.
- Figure 4.—The same. Female. Front view of the beak and buccal membranes, natural size; m, mandibles; f, inner fold; f', second fold of the buccal membrane; a, dorsal; b, c, lateral; d, ventral angles of the outer buccal membrane, with their small suckers; s, peculiar horse-shoe shaped tubercle, or sucker, for the attachment of the spermatophores, during copulation.
- Figure 5.—*Ommastrephes illecebrosus*. Side view of the head and siphon, after removal of part of the mantle. $\frac{2}{3}$ natural size; 1, 2, 3, 4, bases of 1st to 4th pairs of sessile arms; ta, base of tentacular arm; m, mantle; b, b', olfactory crests around the ear; d, siphon; f, f', the connective cartilages for attaching it to the mantle.
- Figure 5a.—The same. Lateral connective cartilage, or 'button' on the inside of the mantle, which fits closely into the cartilage pit (f) on the base of the siphon.

PLATE XXX.

- Figure 1.—*Rossia Hyatti* Verrill. Female. Ventral view of the head and arms, enlarged 3 diameters.
- Figure 2.—*Rossia sublevis* Verrill. Female. Ventral view of the head and arms, enlarged 3 diameters.

PLATE XXXI.

- Figure 1.—*Rossia Hyatti*. Dorsal view, enlarged $1\frac{1}{2}$ diameters.
- Figure 2.—The same. A young specimen, enlarged $1\frac{1}{2}$ diameters.

Figure 3.—*Rossia sublevis*. Ventral view, enlarged $1\frac{1}{2}$ diameters.

Figure 4.—*Stoloteuthis leucoptera* Verrill. Female. Young, ventral view, enlarged 3 diameters.

Figure 5.—The same. Male. A larger specimen, taken in 1879, enlarged $1\frac{1}{2}$ diameters.

PLATE XXXII.

Figure 1.—*Stauroteuthis syrtensis* V. Dorsal view, $\frac{3}{10}$ natural size.

Figure 2.—The same. Lower side of head; *s*, siphon; *e*, eye; *a*, the auditory pore.

Figure 3.—The same. The siphon, turned back.

Figures 4 and 5.—The same. Superior and inferior mandibles, enlarged $2\frac{2}{3}$ diameters.

This plate was drawn by the author, from the alcoholic specimen, except figs. 4 and 5, which are by J. H. Emerton.

PLATE XXXIII.

Figure 1.—*Octopus Bairdii* Verrill. Male. Ventral view, natural size; *h*, terminal organ of the hectocotylyzed arm; *i*, the groove along the lower side of the arm.

Figure 1a.—The same specimen. Hectocotylyzed arm, enlarged two diameters.

Figure 2.—*Parasira catenulata* Steenst. Female. Front view, $\frac{1}{2}$ natural size.

Figure 2a.—The same specimen. Side view, $\frac{1}{2}$ natural size.

PLATE XXXIV.

Figure 1.—*Loligo Pealei*, var. *pallida* V. Male. Dorsal view, about $\frac{1}{2}$ natural size.

Figure 2.—The same. Pen, about $\frac{1}{2}$ natural size.

Figure 3.—The same. Portion of radula, much enlarged.

Figure 4.—The same. Upper mandible: *a*, rostrum or tip of the beak; *b*, the notch; *c*, the inner end of ala; *d*, the frontal lamina; *e*, the palatine lamina: *ab*, the cutting edge of beak; *bc*, anterior or cutting edge of ala.

Figure 4a.—Lower mandible: *a*, rostrum; *ab*, cutting edge; *bc*, anterior edge of ala; *d*, mentum or chin; *e*, gular lamina.

Figure 5.—*Octopus Bairdii* V. Young male. Side-view from a living specimen, nearly natural size.

Figure 6.—The same. Dorsal view, from life, nearly natural size.

Figs. 3, 4, 4a, were drawn by the author; the others by J. H. Emerton.

PLATE XXXV.

Figure 1.—*Octopus leutus* V. Female. Original specimen. Ventral view, $\frac{2}{3}$ natural size.

Figure 2.—The same specimen. Dorsal view, $\frac{2}{3}$ natural size.

PLATE XXXVI.

Figure 1.—*Octopus piscatorum* V. Female. Original type. Ventral view, $\frac{2}{3}$ natural size.

Figure 2.—The same specimen. Dorsal view.

Figure 3.—*Octopus obesus* V. Male. Original type. Basal portion of one of the lateral arms, to show the arrangement of suckers, natural size.

Figure 4.—The same specimen. Terminal portion of the hectocotylyzed arm, enlarged $1\frac{1}{4}$ diameters.

Figure 5.—*Sthenoteuthis pteropus* V., from Bermuda. Female. Anterior end of pen, natural size.

Figure 5a.—Posterior end of the same pen.

Figure 6.—The same specimen. Connective cartilage from base of the siphon, natural size.

Figure 7.—The same specimen. Transverse sections of arms; *a*, of dorsal; *b*, of 2d pair; *c*, of third pair, natural size. The suckers are omitted.

Figure 8.—The same specimen. Rims of suckers of sessile arms, enlarged $1\frac{1}{2}$ diameter; *a*, *a'*, side and front views of the 15th and 13th sucker of a ventral arm; *b*, *b'*, side and front view of one of the largest suckers of a lateral arm; *c*, *c'*, a dorsal sucker of a dorsal arm.

Figure 9.—Part of border of one of the larger suckers (12th) of the second pair of arms, more enlarged, showing part of the dentate edge of the horny rim, with a portion of the circle of small plates, attached to the membranous border.

Figure 10.—*Octopus Bairdii* V. Spermatophores. A, one with the inner sac (*S*) partly extruded; *i*, the point from which the extension commences, natural size; B, another spermatophore in its original condition; *a*, filament at large end; *b*, filament at small end.

PLATE XXXVII.

Figure 1.—*Loligo Pealei* Les. Female specimen from Vineyard Sound. Pen, natural size and represented as flattened to show the full width of the thin portion.

Figure 2.—*Loligo Pealei*, var. *borealis*. Female specimen, from Annisquam, Mass. Pen, natural size, represented in the same manner.

Figure 3.—*Loligo Pealei*. Pen of a young specimen from Vineyard Sound, natural size. Represented in the same way.

Figure 5.—*Histioteuthis Collinsii* V. Teeth of the odontophore, isolated and enlarged 25 diameters; *a*, median; *b*, inner lateral; *c*, and *d*, outer laterals; *e*, marginal plate; *h*, *g*, and *f*, other views of the lateral teeth. The teeth are not drawn in their natural positions.

Figure 6.—*Loligo pallida* V. Part of teeth of the odontophore, enlarged 50 diameters; *a*, median tooth, front view; *c*, next to outer lateral teeth; *d*, outer lateral teeth; *e*, marginal plates; all are in their natural positions, except *a*.

Figure 7.—*Sthenoteuthis pteropus* V., from Bermuda. Isolated teeth from odontophore, enlarged 25 diameters; *a*, median teeth, front view; *b*, inner lateral; *c*, middle lateral; *d*, outer lateral tooth.

Figure 8.—*Ommastrephes illecebrosus* Les., from Eastport, Me., part of the teeth of the odontophore in their natural positions, enlarged 25 diameters; *a*, median teeth; *b* and *b'*, inner lateral teeth; *c*, middle lateral teeth; *d*, outer lateral teeth.

Figure 9.—*Loligo Pealei*, var. *pallida* V. Female, from Ansonia, N. Y. Tenth sucker of the third pair of arms; *a*, lateral, and *b*, front view, enlarged 2 diameters.

Figure 10.—The same. Male, from Ansonia. Suckers enlarged 2 diameters; *a*, front view of tenth, from third arm; *b*, side view of same; *c*, side view of horny rim of fifth large sucker of tentacular club; *d*, front view of the same.

Figure 11.—*Loligo Pealei*, var. *pallida*. Female. (Same specimen as figure 9.) Fifth large sucker of tentacular arm; *e*, side, and *f*, front view. Enlarged 2 diameters.

Figures 5-8 are from camera-lucida drawings by the author; the others are by J. H. Emerton.

PLATE XXXVIII.

Figure 1.—*Rossia megaptera* V., sp. nov. Dorsal view, natural size.

Figure 2.—*Ommastrephes illecebrosus*. Male, $\frac{1}{8}$ natural size. Opened on the ventral side. The peritoneal membrane, most of the renal organs on the right side, and the reproductive organs, except the testicle (*t*), have been removed. M, mantle cut open; F, caudal fin; P, posterior part of pen; S, stomach; S', cœcal lobe; H, systemic heart; *c*, the eye; *b*, olfactory or nuchal crests; *d*, siphon; *f, f*, connective cartilages on the base of the siphon; *f', f'*, connective cartilages of the mantle, which fit into *f, f*; *m'*, lateral muscles of neck; *g, g*, gills; *l*, liver; *i*, ink-sac; *h*, intestine or rectum; *a o*, anterior aorta, going to head; *b o*, efferent branchial vessel; *o*, median ventral artery of mantle; *o', o'*, lateral arteries going to mantle and fins; *a u*, branchial auricles; *v c*, anterior vena-cava; *v c''*, posterior vena-cava of left side (the right one has been removed); *r, r*, saccular ventral renal organs; *r'*, more compact glandular (renal) organs, connected with the posterior vena-cavæ; *t*, testicle or spermary; *p''*, hooded posterior tip of pen, enclosing the end of the spermary. From an alcoholic specimen.

Figure 3.—*Architeuthis Harveyi* V. (No. 24). Sucker (50th) of lateral arm, second pair, showing the scales around the aperture, front view, enlarged about 4 diameters.

Figure 4.—The same specimen. Otolith; *a*, side-view; *b*, front-view.

Figure 5.—The same specimen. Portion of radula, showing most of three transverse rows of teeth; *a*, median teeth; *b, b'*, inner-lateral teeth; *c, c'*, and *d*, two outer-lateral rows of teeth, much enlarged.

Figure 6.—The same, more enlarged, lettered as in fig. 5.

Figure 7*c'*.—The same. One of the teeth from the outer-lateral row.

Figure 8.—*Octopus Bairdii* V. Male. Figured in the act of swimming, dorsal view; *a*, terminal spoon of hectocotylized arm. From a living specimen, nearly natural size.

PLATE XXXIX.

Figure 1.—*Desmoteuthis hyperborea* V. Female. Specimen opened on the ventral side. M, mantle; F, caudal fin; P, P', posterior part of pen; *c, c*, eyes; *d*, siphon; *d o*, aperture of same; *d''*, base and posterior entrance of same; *f'*, commissure attaching the siphon to the mantle laterally; *g, g*, gills; *h*, rectum; S, S, S, divisions of stomach and cœcal lobe; *l, l*, long tubular intestine, plicated within, and with rows of follicular glands along each side; *i*, liver and ink-sac; H, systemic heart or ventricle; *b o*, branchial efferent vessels; *a u*, branchial auricles; *v c''*, posterior vena-cava; *r'*, renal organs; *o v*, ovary; *o v'*, some ovules larger than the rest; *o p, o p*, right and left oviducts; *x'*, nidamental glands of the oviducts; *x x, x x'*, accessory nidamental glands. From a mutilated specimen.

Figure 2.—*Ommastrephes illecebrosus*. Female, less than natural size. Lettering as in Plate 38, fig. 2, with the following additional letters: *b''*, lower nuchal facet, with the auditory pore; *u*, urethral openings in the peritoneal membrane, communicating between the gill-cavity and the visceral cavity, containing the renal organs, *r, r*; *v c'*, lateral pallial veins, or vena-cavæ; *o v*, ovary; *o d, o d'*, right and left oviducts; *o p*, the anterior opening; *o x, x x*, nidamental glands.

Figure 3.—*Ommastrephes illecebrosus*. Jaws enlarged $1\frac{1}{2}$ diameters: *a*, superior; *b*, inferior mandible.

Figure 4.—*Loligo Pealei*. Portion of the radula, much enlarged.

PLATE XL.

Figure 1.—*Loligo Pealei*, var. *pollida*. Male. Ventral view, about $\frac{2}{3}$ natural size.

The mantle has been cut open, a little to one side of the median line; most of the peritoneal membrane has been removed. C, lower side of head; M, mantle; F, caudal fin; *a*, lachrymal pore; *b*, olfactory crests; *c*, eye; *d*, siphon, cut open; *d''*, cavity of siphon; *e*, valve of siphon; *f*, one of the connective cartilages of the siphon; *f'*, one of the connective cartilages of the mantle, in the form of a ridge, fitting into the siphonal cartilage; *g*, gill; *h*, termination of the intestine, or rectum; *i*, ink-sac; *i'*, duct of ink-sac; *l*, portion of liver, in position; *m'*, *m'*, muscular columns connecting the head and siphon with dorsal portion of the body; H, systemic heart, or ventricle, crossed by the artery of the ink-sac; *ao*, bulbous base of anterior aorta; *o*, ventral pallial artery, or median branch of the posterior aorta, supplying the ventral parts of the mantle; *o'*, one of the caudal arteries or lateral branches of the posterior aorta going to the caudal fin and posterior parts of the mantle; *au*, *au*, branchial auricles; *br*, afferent vessel going to the gills; *bo*, efferent branchial vessels, returning the blood to the ventricle, their swollen basal portions acting as auricles; *vc*, anterior vena-cava; *r*, *r*, ventral renal organs, two ventral sacculated branches of the vena-cava (on the left side, the vein from the ink-sac and rectum is shown); *r'*, *r'*, two pyriform renal organs, or sacculated and glandular portions of the posterior venæ-cavæ, directly connected with *r*, *r*; *v*, *vc'*, lateral pallial veins, going to the dorsal sacculated divisions of the venæ-cavæ; *vc''*, *vc''* two posterior venæ-cavæ, returning from the caudal fin and mantle; S, first stomach, or gizzard; S', large, saccular cœcal appendage of the stomach; *k*, glandular, plicated division of the stomach; *t*, spermary or testicle; *pr*, prostate gland, with the vesiculæ-seminales and spermatophore-sac; *p*, efferent sperm-duct or 'penis'; P, posterior portion of the pen.

Figure 2.—The same. Dorsal view of the reproductive organs, part of the renal organs, heart, etc., dissected out. The lettering is as in figure 1, with the following additions: *vd*, vas-deferens, closely folded upon itself; *ss*, spermatophore-sac; *po*, genital artery; *go*, spermatic artery and vein; S'', commencement of intestine; *pt*, part of peritoneal membrane.

Figure 3.—*Loligo Pealei*. Female in the breeding season. Oviduct, filled with ova, dissected out. Ventral view, about $\frac{1}{2}$ natural size; *vo*, commencement of convoluted, thin membranous portion of oviduct; *od*, entrance to glandular portion; *od'*, glandular portion of oviduct, surrounded by the large, laminated gland, *x'*, the arterial vessels of which have been injected; *op*, orifice of the oviduct.

Figure 3a.—The same specimen, seen from the dorsal side.

Figures 4a, 4b.—*Loligo Pealei*. Male. Side and front views of horny rim of one of the marginal suckers of the tentacular club, enlarged 10 diameters.

Figure 5.—The same. Portion of the rim and marginal denticles of one of the large median suckers of the tentacular club, much enlarged.

Figures 3, 3a are by the author; the others by J. H. Emerton, from alcoholic specimens.

PLATE XLI.

Figure 1.—*Loligo Pealei*, var. *borealis*. Female, in the breeding season. Ventral view, about $\frac{1}{2}$ natural size. The mantle has been cut open nearly in the median line and the peritoneal membrane partly removed. The lettering is the same as

in fig. 1 of Pl. XL, with the following additions: 1, 2, 3, 4, first, second, third and fourth pairs of sessile arms; *ta*, tentacular arms; *d'*, external orifice of siphon; *ov*, *ov'*, ovary, mostly concealed by the oviduct; *vo*, commencement of glandular portion of oviduct; *x'*, large gland surrounding the oviduct; *od'*, anterior portion of oviduct; *op*, orifice of oviduct; *xx*, pair of large, ventral, laminated, nidamental glands; *x*, pair of foliulated and mottled accessory nidamental glands; *u*, one of the urethral openings of the peritoneal membrane.

Figure 2.—*Loligo Pealei*. Embryo taken from the egg, ventral view, much enlarged; *a, a, a*, ventral arms, tentacular arms, and third pairs of sessile arms; *c, c*, eyes on stout peduncles or lobes from the sides of the head; *m*, mantle-edge; *h*, branchial auricles; *y*, unabsorbed yolk-mass.

Figure 3.—The same. An embryo, within the egg, somewhat more advanced than fig. 2, side view, less enlarged. The lettering is as in fig. 2, with the following additions: *a'*, second pair of arms; *a''*, third pair; *a'''*, tentacular arms; *a''''*, ventral arms; *s*, orifice of siphon; *o*, otolith; *f*, rudimentary caudal fins. Chromatophores are developed on the mantle.

Figure 4.—The same. An embryo at the period of hatching. Ventral view, enlarged about 25 diameters. The yolk-sac is nearly absorbed.

Figure 5.—The same. A somewhat older larva, taken swimming at the surface. Dorsal view, enlarged about 7 diameters. The dorsal arms are still very small; the tentacular arms are the largest; the chromatophores are large and symmetrically arranged, but only part of them are figured; the caudal fins do not reach the posterior end.

Figures 2 and 3 are from camera-lucida drawings of living specimens by the author; 4 is by J. H. Blake from life; 1 and 5 are by J. H. Emerton, from alcoholic specimens.

PLATES XLII, XLIII, AND XLIV.

These relate to the next article, which see.

PLATE XLV.

Figure 1.—*Lestoteuthis Fabricii* Verrill. Young. Pen, enlarged two diameters. Copied from G. O. Sars.

Figure 1a.—The same. Part of odontophore. Copied from G. O. Sars.

Figure 1b.—The same. Portion of tentacular club, front view, enlarged. Copied from G. O. Sars.

Figure 2.—The same. Young. General figure, dorsal view, enlarged two diameters. From an American example.

Figures 2a, 2b.—The same. Front and side views of one of the suckers from the outer rows of a lateral arm of the same specimen.

Figures 2c, 2d.—The same. Front and side views of a hook-sucker from the median rows of the same arm.

Figure 3.—*Loligo Pealei*. Young female. Dorsal view of a specimen taken at Newport, R. I., in August. Enlarged two diameters. From a fresh specimen.

Figure 4.—The same. Young, just hatched. Ventral view, seen as a transparent object from a specimen raised from the eggs, at Newport, R. I., August 5th. Much enlarged; *a''*, *a'''*, *a''''*, three of the pairs of arms, showing the suckers on *a''''*, the tentacular arms; *d*, the beak; *l*, odontophore; *e*, the eye; *f*, caudal fin; *g*, gill; *h*, ventricle of the heart; *h'*, *h''*, branchial auricles; *i*, ink-bag; *m*, mantle; *o*, otoliths; *s*, siphon; *s'*, base of siphon; *t*, end of intestine; *u*, stomach; *y*, portion of yolk-sac, not yet absorbed.

Figure 5.—*Sthenoteuthis megaptera* V. Beak and inner buccal membrane, front view, natural size.

Figure 5a.—The same. Large sucker from the tentacular arm of the same specimen, front view, enlarged two diameters.

PLATE XLVI.

Figure 1.—*Calliteuthis reversa* Verrill. Female. Ventral view, natural size.

Figure 1a.—The same. Beak, buccal membranes and base of arms, front view, natural size.

Figure 1b.—The same. One of the larger suckers from a lateral arm, enlarged.

Figure 2.—*Heteroteuthis tenera* Verrill. Dorsal view of female, enlarged two diameters.

Figure 2a.—The same. Tentacular club, enlarged four diameters.

Figure 2b.—The same. Pen, enlarged four diameters.

Figure 2c.—The same. Jaws, side view, enlarged four diameters; *a*, superior; *b*, inferior mandible.

Figure 2d.—The same. Part of the odontophore, much enlarged.

Figure 3.—The same. Front view of male, enlarged two diameters.

Figures 3a, 3b.—The same. Front and side-views of one of the suckers of the lateral arms of the same specimen.

Figure 4.—*Rossia subleris* Verrill. Pen from ♀ (see Plate 47, fig. 2), enlarged four diameters.

Figure 5.—*Rossia Hyatti* Verrill. Female. Suckers, enlarged fifteen diameters; *a*, one of the largest from third pair of arms, side-view; *b, c*, two forms of suckers from the tentacular club.

Figure 6.—*Rossia megaptera* Verrill. Female. Suckers, enlarged fifteen diameters; *a*, front view of one of the largest from third pair of arms; *b, c, d*, three suckers from the tentacular club.

Figures 5 and 6 are camera-lucida drawings by the author; the rest are by J. H. Emerton.

PLATE XLVII.

Figure 1.—*Chiroteuthis lucertosa?* Verrill. One of the tentacular arms, outer side, natural size.

Figure 1a.—The same. Front view of club, enlarged two diameters.

Figure 1b.—The same. One of the suckers, enlarged.

Figure 2.—*Rossia subleris, var.* Verrill. Female. Dorsal view, natural size.

Figure 2a.—The same. One of the suckers of the tentacular club, side-view, much enlarged.

Figure 2b.—The same. Marginal scales on the edge of the sucker, more enlarged.

Figure 3.—The same. One of the arms of the third pair, from another female example, enlarged two diameters.

Figure 4.—The same. Corresponding arm of the male.

Figure 5.—*Heteroteuthis tenera* Verrill. Dorsal view of male, enlarged two diameters.

Figure 5a.—The same. One of the larger marginal suckers of the tentacular club; front view, much enlarged.

Figure 5b.—The same. Portion of the margin of the sucker, more enlarged; to show the scales.

PLATE XLVIII.

Figure 1.—*Mastigoteuthis Agassizii* Verrill. Dorsal view, slightly enlarged.

PLATE XLIX.

Figure 1.—*Lestoteuthis Fabricii* V. (*Cheloteuthis rapax* Verrill.) Club of tentacular arm, front view, enlarged two diameters. The horny hooks are lost from the claws. *a, a', a''*; *b, c*, small lateral suckers; *d, d'*, small suckers of distal portion; *e, e'*, connective suckers and tubercles.

Figure 1*a*.—The same. One of the suckers corresponding to *c* of fig. 1, front view, much enlarged.

Figure 1*b*.—The same. A small sucker, corresponding to *d* of fig. 1.

Figures 1*c, 1d*.—The same. Front and side-views of one of the claws, with its enclosed horny hook or 'nail' from the middle of a lateral arm, enlarged eight diameters.

Figure 1*e*.—The same. Connective cartilage from base of siphon, front view, enlarged two diameters.

Figure 1*f*.—The same. Beak and pharynx, side view, enlarged two diameters.

Figure 2.—*Mastigoteuthis Agassizii* Verrill. Front view of the beak, buccal membranes (*b, d*), and bases of the arms; enlarged two diameters.

Figure 3*a*.—The same. Side view of head, siphon, and anterior part of mantle, showing the cartilage (*c*), on the inner surface of the mantle, which interlocks with *c'* on the base of the siphon; *e*, olfactory (?) papilla, near the ear; *p*, an aquiferous pore (?); *s*, siphon; *1 a*, base of tentacular arms; 1, 2, 3, 4, bases of corresponding pairs of arms.

Figure 3*b*.—The same. Pen, ventral view enlarged two diameters.

Figure 3*c*.—The same pen. Side view.

Figure 3*d*.—The same. Portion from near the end of one of the tentacular arms, enlarged sixteen diameters.

Figure 3*e*.—The same. Suckers from the tentacular arm, much enlarged: *a*, side view; *a'* and *a''*, nearly front views.

Figure 3*g*.—The same. One of the suckers from the middle of a lateral arm, front view, much enlarged.

Figure 4.—*Octopus Bairdii* Verrill. Portion of odontophore, much enlarged.

Figure 4*a*.—The same. Jaws: *s*, superior; *i*, inferior mandibles, enlarged two diameters.

PLATE L.

Figure 1.—*Alloposus mollis* V. Young male. Side view, showing the sac containing the hectocotylized arm cut open, so as to expose the partially developed arm. One-half natural size.

Figure 1*a*.—The same. Hectocotylized arm removed from the sac, enlarged two diameters.

Figure 2.—The same. Young female. Ventral view, one-half natural size.

Figure 2*a*.—The same specimen. Dorsal view, one-half natural size.

PLATE LI.

Figure 1.—*Octopus Bairdii*, var. Verrill. Side view of a young male, enlarged about two diameters.

Figure 1*a*.—The same. Terminal appendage of the hectocotylized arm, enlarged eight diameters.

Figure 2.—*Octopus leatus* Verrill. Side view of a male, enlarged about two diameters.

Figure 3.—*Alloposus mollis* Verrill. Portion of an arm, with suckers, from near the base, natural size.

Figure 4.—*Alloposus mollis* Verrill. Terminal portion of a mature, detached hectocotylized arm, natural size.

PLATE LIII.

Figure 1.—*Eledone verrucosa* Verrill. Side view of the male, natural size.

Figure 1a.—The same. Distal portion of the hectocotylized arm, to edge of basal web, showing the terminal appendage and the lateral groove.

PLATE LIII.

Figure 1.—*Eledone verrucosa* Verrill. Dorsal view of the male, natural size.

PLATE LIV.

Figure 1.—*Architeuthis princeps* V. Side view. Restored mostly from No. 13. One-twenty-fourth natural size.

Figure 2.—*Sthenoteuthis pteropus* V. Side view of the specimen from Bermuda. One-fourth natural size.

Figure 2a.—Candal fin of the same specimen. Dorsal view, one-fourth natural size.

Figure 3.—*Loligo Pealei* Les. Portion from the middle of the tentacular club of a specimen having unusually small tentacular suckers: *a, a'*, largest median suckers; *b, b'*, lateral suckers, enlarged 4 diameters.

Figure 4.—*Stoloteuthis leucoptera* V. Male. Second lateral arm, showing the greatly enlarged middle suckers, enlarged 4 diameters.

PLATE LV.

Figure 1.—*Lestoteuthis Fabricii* V. One of the tentacular arms; enlarged 2 diameters.

Figure 1a.—The same. The larger claw. Side view.

Figure 1b.—The same. Lateral arm; enlarged 2 diameters.

Figures 1b' 1b''.—The same. One of the hooks; enlarged 8 diameters.

Figure 1c.—The same. Portion of ventral arm; enlarged 2 diameters.

Figure 1d.—The same. Pen, ventral view; natural size.

Figure 2.—*Desmoteuthis tenera* V. General figure of male, dorsal view; natural size.

Figure 2a.—The same. Teeth of odontophore; enlarged 22 diameters.

Figure 2b.—The same. One of the larger suckers of the lateral arms, front view; enlarged 8 diameters.

Figure 2c.—The same sucker; side view.

Figure 2d.—Valve-like apparatus within base of siphon; natural size; *S*, orifice of siphon; *m*, median organ; *l'*, lateral papilla, and *i*, medio-dorsal papilla; *n, n'*, lateral cushions.

Figure 3.—*Brachioteuthis Beanii* Verrill. Dorsal view of the male; natural size.

Figure 3a.—The same. Pen, ventral view; enlarged slightly.

Figure 3b.—The same. Teeth of the radula; enlarged 22 diameters.

Figure 4.—*Desmoteuthis hyperborea*. Side view of one of the large suckers of the 3d pair of arms, side view; enlarged 8 diameters.

Figure 4a.—The same. Peculiar organs on the interior of the medio-dorsal side of the base of the siphon; enlarged 2 diameters; *i*, median, *l'*, lateral papillae.

Figure 5.—*Chiroteuthis lacertosa* V. Young female. One of the suckers of the tentacular arms, front view; enlarged 22 diameters.

Figure 6.—*Histioteuthis Collinsii*. One of the larger suckers of the median rows of the tentacular club, side view; enlarged 2 diameters.

Figure 6a.—The same. One of the suckers of the sublateral rows of the tentacular club.

PLATE LVI.

- Figure 1.—*Chiloteuthis lacertosa* Verrill. Dorsal view of the male; three-quarters natural size; 1a, stump of one of the tentacular arms, with a few of the sessile suckers remaining.
- Figure 1a.—The same. Ventral view of the pen; enlarged 3 diameters.
- Figure 1a'.—The same. Section of the anterior part of the pen; 1a'', section of the posterior part of the pen; much enlarged.
- Figure 1b.—The same. Connective cartilage of siphon; enlarged 3 diameters.
- Figure 1c.—The same. Lateral connective cartilage of mantle.
- Figures 1d, 1e.—The same. One of the larger suckers of the 3d pair of arms. front and side views; enlarged 6 diameters.
- Figure 1f.—The same. Papilla from behind and below the eye; enlarged 3 diameters.
- Figure 2.—*Brachioleuthis Beanii* V. Connective cartilage of the mantle; enlarged.
- Figure 2a.—The same. Lateral connective cartilage of the siphon; enlarged.
- Figure 3.—*Desmoteuthis tenera* V. Tentacular arm; enlarged 3 diameters.

ERRATA.

- Pages 185, 206–208, correct description of pen, as on p. 395.
- Page 187, line 11, for M. Gabriel, read E. Gabriel.
- Page 190, line 32, for 2.5, read 3.5.
- Page 193, line 11, for 1878, read 1879.
- Page 213, line 11, for '22, read 22.
- Page 214, line 25, and page 215, line 6 from bottom, for ventral, read lateral.
- Page 250, lines 22–25, omit the paragraph relating to *Dosidicus*; line 29, for median hook, read serrated ring; last line, for *A. Kamschatica*, read *L. Kamschatica*.
- Page 251, lines 18, 24, omit *Dosidicus*; lines 22, 25, for solid cartilaginous, read hollow; line 34, for *Kamschatica*, read *Kamschatica*.
- Pages 268, 277, 278, 279, 280, 281, 289, 290, 293, for *illecebrosa*, read *illecebrus*.
- Page 290, line 8 from bottom, for *Gonatus* Gray, read *Gonatus* G. O. Sars, Steenst., *non* Gray; omit quotation from Gray; line 3 from bottom, after sessile arms, insert except the ventral. [see p. 388].
- Page 291, line 12, for Verrill, read Steenstrup; lines 17–22, omit references to Möller, Gray, Tryon; line 7 from bottom, after developed, insert (except on those of the ventral).
- Page 292, line 26, and p. 293, line 1, for *Chiloteuthis*, read *Cheloteuthis* (= *Lestoteuthis*). [see p. 387].
- Page 299, line 1, for *Bouphandi* D'Orb., read *lacertosa*? Verrill, and omit synonymy.
- Page 305, line 10 from bottom, for posterior, read terminal.
- Page 338, line 26, for antero-, read antero-.
- Page 347, for *Sepiola*, read *Stoloteuthis*; omit references to Leach, Gray, [see p. 417].
- Page 379, line 4, for 3a, read 4.
- Page 385, line 23, for Oversight, read Oversight.
- Page 432, line 10, for **hyperboreus**, read **hyperborea**.

**VI. CATALOGUE OF MARINE MOLLUSCA ADDED TO THE FAUNA OF
THE NEW ENGLAND REGION, DURING THE PAST TEN YEARS.
BY A. E. VERRILL.**

THE following catalogue is intended to include all the Mollusca now known to inhabit the New England region that are not included in Binney's edition of Gould's Invertebrata of Massachusetts, published in 1870.

In the "New England Region" I include, on the north, the coasts of Nova Scotia and New Brunswick, and their outlying banks; while on the south, I include the entire region, about 100 to 120 miles wide, between the shore and the Gulf Stream, off the southern coast of New England, and embracing all depths down to 600 fathoms.* I have also included the free-swimming and floating forms, ordinarily inhabiting the same region, which may be considered as meeting and including the innermost edge of the Gulf Stream in summer, but most of these surface forms are usually to be found, in summer, far inside of the actual limits of the Gulf Stream. The Grand Banks of Newfoundland and the northern parts of the Gulf of St. Lawrence I have considered as extra-limital, for my present purposes. Those localities are inhabited by an extremely arctic fauna, including many species of mollusca that have not yet been found farther south. Among these are several species of *Buccinum* and allied genera. Some of these I have indicated in the following list, for convenience of reference, but have put their names in italic type to distinguish them from those considered as more properly belonging to the New England region, which are put in black-faced type. A few species that were known to inhabit New England, before the publication of Binney's Gould, but were erroneously omitted from that work, are also introduced into this list, in italic type.

No attempt is here made to give the complete, nor even the general synonymy of the well-known species. Except in special cases, only those references are given which are necessary to show the origin of the name adopted, together with references to at least one accessible work where a description or figure may be found.†

* Descriptions of the special features of this off-shore region may be found in the Amer. Journ. Science, vol. xx, p. 390, Nov., 1880; vol. xxii, p. 292, Oct., 1881; and Proc. National Museum, for 1880, p. 356.

† In this connection it gives me pleasure to highly commend the excellent recent work of G. O. Sars, viz: *Mollusca Arcticae Norvegiæ*. This is almost a manual for the northern New England Mollusca, and contains a profusion of accurate illustrations.

Table of Order Stations occupied by the "Fish Hawk" in 1880 and 1881.

Stat.	Locality.		Fath.	Bottom.	Date.	Temperature.		Hour.
						Bottom.	Surface.	
<i>Off Martha's Vineyard and Newport, R. I.</i>								
	N. Lat.	W. Long.			1880.	F.	F.	
865	40° 05' 00"	70° 23' 00"	65	fine com. sand	Sept. 4	73	73	5.40 A. M.
866	40 05 18	70 22 18	65	"	"	73	73	6.30 "
867	40 05 42	70 22 06	64	"	"	53°	73	7.04 "
868	40 01 42	70 22 30	162	"	"	47	75	8.23 "
869	40 02 18	70 23 06	192	mud, fine sand	"	76	76	9.27 "
870	40 02 36	70 22 58	155	fine sand, mud	"	77	77	10.50 "
871	40 02 54	70 23 40	115	"	"	49	76.5	11.40 "
872	40 05 39	70 23 52	86	shells, sponges	"	50.5	77	12.45 P. M.
873	40 02 00	70 57 00	100	fine sand, mud	Sept. 15	51	69.5	5.36 A. M.
874	40 00 00	70 57 00	85	"	"	51	70	6.26 "
875	39 57 00	70 57 30	126	"	"	53	70	7.51 "
876	39 57 00	70 56 00	120	"	"	53	70	8.45 "
877	39 56 00	70 54 18	126	"	"	71	71	9.40 "
878	39 55 00	70 54 15	142½	"	"	52	71	11.00 "
879	39 49 30	70 54 00	225	"	"	42	71.5	1.20 P. M.
880	39 48 30	70 54 00	252	mud, fine sand	"	43	71.5	3.12 "
881	39 46 30	70 54 00	325	mud	"	42	71	5.00 "
891	39 46 00	71 10 00	500	mud, fine sand	Oct. 2	67	67	6.00 A. M.
892	39 46 00	71 05 00	487	mud, f. sd. st.	"	65	65	8.46 "
893	39 52 20	70 58 00	372	"	"	40	64	11.23 "
894	39 53 00	70 58 30	365	fine sand	"	40	64	1.10 P. M.
895	39 56 30	70 59 45	238	f. sand mud	"	42	65	3.17 "
<i>Off Chesapeake Bay.</i>								
896	37° 26'	74° 19'	56	sand, shells	Nov. 16			
897	37 25	74 18	157½	sand, mud	"			
898	37 24	74 17	300	mud	"			
899	37 22	74 29	57½	sand	"			
900	37 19	74 41	31	"	"			
901	37 10	75 08	18	"	"			
<i>Off Martha's Vineyard.*</i>								
917	S. ½ W. 59½ m.		43	green mud	1881. July 16	42° F.	63° F.	4.10 A. M.
918	" 61 "		45	"	"	45	63	5.33 "
919	" 65 "		51½	"	"	42.5	66	7.00 "
920	" 68½ "		61	"	"	49	66	8.20 "
921	" 73 "		65	"	"	52	70	9.40 "
922	" 77 "		69	green m., sand	"	52	72	10.57 "
923	" 78½ "		96	sand	"	52	72	12.27 P. M.
924	" 83½ "		160	"	"	44.5	71	1.52 "
925	" 86 "		224	sand, mud	"	42	71	3.35 "
926	" 85 "		195	"	"	44	71	5.24 "
935	S. by E. ½ E. 106½ m.		770		Aug. 4	39.5	70	8.14 A. M.
936	" " 104½ "		705	mud	"	39.5	71	10.43 "
937	" " 102 "		506	green sd., mud	"	40.5	72	12.45 P. M.
938	" " 100 "		310	"	"	42	72.5	2.44 "
939	" " 98 "		258	"	"	47	73	4.25 "
940	" " 97 "		130	sand	"	52	72	5.30 "
941	" " 89½ "		76	sand, mud	"	52	71	7.45 "
942	S. by W. ¾ W. 81½ "		134	"	"	9.50	69	6.15 A. M.
943	S.S.W. 83 "		153	sand, m., shells	"	49	70	7.10 "
944	" 82 "		124	"	"	51	70	8.27 "

* The distances are measured from Gay Head Light, in geographical miles. The bearings are magnetic.

Table of Outer Stations occupied by the "Fish Hawk" in 1880 and 1881.

Stat.	Locality.		Fath.	Bottom.	Date.	Temperature.		Hour.	
						Bottom.	Surface.		
945	S. by W.	$\frac{3}{4}$ W.	84 $\frac{1}{2}$ m.	202	green m., sand	Aug. 9	44° F.	71° F.	12.05 P. M.
946	"	"	87 $\frac{1}{2}$ "	241	"	"	47	71	2.00 "
947	"	"	89 "	312	sand, mud	"	44	70	4.00 "
949	S.	"	79 $\frac{1}{2}$ "	100	yellow mud	" 23	52	66	4.20 A. M.
950	"	"	75 "	69	sand, sh., mud	"	52	65	5.50 "
951	"	"	85 "	219	mud	"	41	67.5	9.40 "
952	S.	$\frac{1}{4}$ E.	87 $\frac{1}{2}$ "	388	yellow m., sand	"	40	68	11.28 "
953	S.	$\frac{1}{2}$ E.	91 $\frac{1}{2}$ "	715	mud	"	39.5	68	2.30 P. M.
954	"	"	91 "	642	sand, mud	"	39.5	68	4.50 "
994	S.S.W.	$\frac{1}{4}$ W.	104 $\frac{1}{2}$ "	368	mud	Sept. 8	40.5	68	4.50 A. M.
995	"	"	104 $\frac{1}{4}$ "	358	yellow m., sand	"	40.5	68	6.32 "
996	"	"	104 "	346	"	"	40	67.5	7.35 "
997	"	"	103 $\frac{1}{2}$ "	335	yellow mud	"	40	67.5	9.03 "
998	"	"	102 $\frac{1}{2}$ "	302	green mud	"	40	68	10.34 "
999	"	"	100 "	266	"	"	40	68	11.48 "
1025	S.S.W.	$\frac{1}{4}$ W.	95 "	216	"	"	45	69	1.05 P. M.
1026	"	"	93 $\frac{1}{2}$ "	182	"	"	47.5	69	2.55 "
1027	S.S.E.	$\frac{3}{4}$ E.	105 $\frac{1}{2}$ "	93	fine sand	" 14	48 $\frac{1}{2}$	65	7.23 A. M.
1028	"	"	108 $\frac{1}{4}$ "	410	yellow mud	"	41	66	9.01 "
1029	"	"	109 $\frac{3}{4}$ "	458	"	"	40	68	12.13 P. M.
1030	"	"	108 $\frac{1}{2}$ "	337	"	"	41	66	1.52 "
1031	"	"	107 $\frac{1}{2}$ "	255	"	"	46	65	2.54 "
1032	"	"	107 "	208	"	"	46	65	4.00 "
1033	"	"	106 "	183	sand, gravel	"	46	63	4.55 "
1034	"	"	105 $\frac{1}{2}$ "	146	sand, y. mud	"	46 $\frac{1}{2}$	62	5.55 "
1035	"	"	103 $\frac{1}{2}$ "	120	sand	"	47	62	6.56 "
1036	"	"	102 "	94	"	"	51	61 $\frac{1}{2}$	7.54 "
	N. Lat.	W. Long.							
1038	39° 58'	70° 06'	146	sand, shells	" 21	47	67		
1039	39 59	70 06	136	"	"	50	67		
<i>Off Delaware Bay.</i>									
1043	38° 39'	73° 11'	130	sand	Oct. 10	49	65 $\frac{1}{2}$		
1044	38 37	73 12	224	gray mud	"	42 $\frac{1}{2}$	66		
1045	38 35	73 13	312	"	"	40	66		
1046	38 33	73 18	104	sand	"	51	66		
1047	38 31	73 21	156	"	"	49	66		
1048	38 29	73 21	435	mud	"	40	66		
1049	38 28	73 22	435	"	"	40	66		

In giving the distribution, on our coast, or in foreign waters, only a general statement of the range is usually made, for a very detailed paper is now in preparation,* on the distribution of our mollusca, in which all the available information of this kind will be given in the form of tables, and illustrated by charts.

As it will be necessary to refer very frequently to the stations, occupied by the "Fish Hawk," while dredging in the deeper waters off the southern coast of New England, for the U. S. Fish Commission, in 1880 and 1881, I give here a table of those stations.

* By Mr. Sanderson Smith and the writer, for the U. S. Fish Commission.

CEPHALOPODA.

DECACERA.

Teuthidea Verrill. (See p. 127.)

Lestoteuthis Fabricii (Licht.) Verrill (pp. 291, 293, 387-390).

Sthenoteuthis megaptera Verrill. (pp. 223, 286).

Architeuthis Harveyi Verrill. (pp. 177-210, 259, 395, 422).

Architeuthis princeps Verrill. (pp. 181-189, 194, 259).

Mastigoteuthis Agassizii Verrill. (p. 297).

Chiroteuthis lacertosa Verrill. (pp. 299, 408).

Brachioteuthis Beanii Verrill. (p. 406).

Calliteuthis reversa Verrill. (p. 295).

Histioteuthis Collinsii Verrill. (pp. 234, 300, 404).

Taonidea Verrill. (See p. 431).

Desmoteuthis hyperborea (Steenst.) Verrill. (p. 302).

Desmoteuthis tenera Verrill. (p. 412).

Sepiolidea Verrill. (See p. 434).

Stoloteuthis leucoptera Verrill. (pp. 347, 418).

Rossia megaptera V. (p. 349).

Rossia Hyatti V. (p. 351).

Rossia sublevis V. (pp. 354, 419.)

Heteroteuthis tenera V. (pp. 357, 419).

OCTOPODA Leach. (See p. 360).

Parasira catenulata Steenst. (p. 362).

Argonauta argo Linné. (pp. 364, 420).

Alloposus mollis Verrill. (pp. 366, 420).

Octopus Bairdii Verrill. (pp. 368, 421).

Octopus lentus Verrill. (p. 375).

Octopus piscatorum Verrill. (p. 377).

Octopus obesus Verrill. (p. 379).

Eledone verrucosa Verrill. (p. 380).

Stauroteuthis syrtensis Verrill. (p. 382).

GASTROPODA.

TOXOGLOSSA.

Pleurotoma Dalli Verrill and Smith, sp. nov.

PLATE LVII, FIGURES 1, 1a.

A slender, transversely ribbed species, remarkable for the deep notch, widest within, and the deeply concave subsutural band.

Whorls ten, somewhat angular and shouldered; nucleus smooth, rather large, subglobular, of about one and a half whorls, as broad as the next whorl, the first nuclear half-whorl is nearly covered by the next, the surface is glossy, marked on the lower half-whorl with rather indistinct spiral lines, which become more distinct on the next whorl. All the remaining whorls, except sometimes the last, are crossed by strongly marked, somewhat oblique, angular ribs, which are most elevated at the shoulder, below the strongly marked, concave, subsutural band; they do not extend on this band, and mostly fade out below, before reaching the suture; on the body-whorl the ribs are less distinct and sometimes absent, when present they extend only a little below the suture. The whole surface is covered with fine, wavy, spiral lines; fine, but rather conspicuous, lines of growth cover the surface, and recede strongly on the subsutural band.

Aperture small, ovate, rather narrow. Outer lip with a prominent, convex edge, which has a deep notch, situated a short distance below the suture. The notch is usually constricted or even nearly closed up at the edge of the lip, but is broadly rounded at its inner end; this gives it a button-hole like appearance. In some specimens it is but little constricted. Canal short, broad, slightly everted.

Color, brown of various tints; often deep brown, with one or two spiral bands of yellowish brown, and with streaks of light brown; or the ribs may be pale yellowish brown; aperture brown within; columella whitish in front. Animal not seen. Operculum not observed.

Length of the largest specimen, 19.5^{mm}; greatest diameter, 6^{mm}; length of body-whorl and canal, 10^{mm}; of aperture, 6^{mm}; breadth of aperture, 2.5^{mm}.

Off Martha's Vineyard, stations 1035, 1036, 1038, 1039, in 94 to 146 fathoms, 1881. Off Delaware Bay, station 1046, 104 fathoms, dredged by Lieut. Z. L. Tanner, Oct. 10, 1881.

This very curious and handsome species we have dedicated to Capt. W. H. Dall, of the U. S. Coast Survey, who has done much for American malacology.

Pleurotoma Carpenteri Verrill and Smith.

Pleurotoma Carpenteri Verrill and Smith. in Verrill, Amer. Journ. Sci., xx. pp. 391, 395. Nov., 1880; Verrill, Proc. U. S. Nat. Mus., p. 368, 1880.

PLATE LVII. FIGURE 2.

Shell rather small, solid, slender; surface glossy, without spiral lines, but with distinct lines of growth. Whorls eight, somewhat convex, scarcely shouldered, crossed by about twelve strong, elevated, decidedly flexuous, smooth, rounded, longitudinal ribs, which are highest just below the subsutural band, and extend entirely across the upper whorls, and on the body-whorl from near the suture to the middle, below which the surface is smooth; the interstices between the ribs are deeply concave, wider than the ribs, and perfectly smooth, except for the faint, but evident, lines of growth. Nucleus rounded, without sculpture, shining white. Outer lip thin, the edge sharp, projecting forward and rounded in the middle, with a broad, rounded sinus, a little below the suture. Aperture rather small, oblong-ovate; canal short, straight, a little narrowed by an incurvature of the lip, at its base; columella nearly straight, thickened by a layer of enamel, which forms externally a distinct ridge, or margin. Color, white or pale yellow, often with darker brownish orange ribs. Length, 7; breadth, 2.75^{mm}. Animal not seen.

Only a few specimens were taken in 1880, at stations 870 to 873, in 86 to 155 fathoms. Several were dredged in 1881, at station 949, in 100 fathoms.

Pleurotoma comatotropis Dall.

Pleurotoma (Mangilia) comatotropis Dall. Bulletin Mus. Comp. Zool., ix. p. 58, 1881.

Differs from all our other species in having strong spiral ribs and grooves on the lower whorls.

One dead specimen. Off Martha's Vineyard, station 949, in 100 fathoms. Off Cape San Antonio, 640 fathoms (Dall).

Daphnella limacina Dall.

Pleurotoma (Bela) limacina Dall. Bulletin Mus. Comp. Zool., ix. p. 55, 1881.

Pleurotoma (Daphnella?) limacina Verrill, Amer. Journ. Sci., xxii, p. 300, Oct., 1881.

Daphnella limacina Dall, op. cit., p. 102.

Shell delicate, translucent, glassy white, ovate-fusiform, acute at both ends. Whorls nine, slightly convex, with a small, nodulous,

subsutural shoulder. Nucleus small, brown, acute, of three whorls, which are obliquely sculptured. Other whorls polished and shining, but, in some lights, often showing faint, microscopic, oblique lines, and lines of growth; the nodules below the sutures are smooth and rounded, small, and separated by intervals about equal to their breadth; canal with a few spiral lines close to tip. Aperture fusiform; notch broad; canal short, narrowed to the end. Length, 9.5^{mm}; greatest breadth, 4.5^{mm}; length of body-whorl and canal, 6^{mm}; of aperture, 4.75^{mm}; breadth of aperture, 2^{mm}.

Four living specimens of this elegant shell were taken off Martha's Vineyard, at station 994, in 368 fathoms. Gulf of Mexico, 447–805 fathoms (Dall).

This species has no operculum; the eyes are minute. It is, therefore, not a *Bela*, as Mr. Dall admitted, after examining an alcoholic specimen, sent by me for comparison with his type. I have also had an opportunity to compare his specimens with my own.

Pleurotomella Verrill.

Amer. Journ. Sci., v, p. 15, Dec., 1872.

Shell elongated, with a high spire. Whorls usually angulated or shouldered; a large, concave, subsutural band; and usually with transverse sigmoid ribs. Canal slightly produced. Lip with a distinct, often deep notch, just below the suture. Operculum absent. Eyes none. Tentacles well-developed. Uncini nearly as in *Bela*.

Type, *P. Packardii* Verrill.

Pleurotomella Packardii Verrill.

Pleurotomella Packardii Verrill, Amer. Journ. Sci., v, p. 15, Dec., 1872; Trans. Conn. Acad., iii, p. 48, 1874.

PLATE XLIII, FIGURE 9: PLATE LVII, FIGURE 5.

The later examples are all smaller than the original type (fig. 9), but agree with it closely, in sculpture, except that some of the younger examples have the spiral lines coarser and more prominent, while the subsutured band is crossed by well-marked, strongly curved riblets. Some young shells have the transverse costae so prominent as to give the whorls a decidedly angulated or shouldered appearance. The two nuclear whorls are small, deep chestnut-brown, minutely decussated by fine oblique lines. The normal sculpture begins on the next whorl.

The color of all the specimens is delicate, pale, yellowish brown, or salmon, nearly uniform throughout, except for the darker brown nucleus.

The tentacles are tapered, with a swelling on the outer side, near the base, but have no eyes: the penis is very large and long, round, nearly cylindrical, except near the tip, where it tapers: in alcoholic specimens it is nearly as thick as the neck, from which it arises.

The uncini of the odontophore are long-lanceolate, acute, with a tooth on one side, near the middle, but without terminal barbs: basal process (manubrium) large, somewhat bilobed.

An immature female has the whorls somewhat more convex and more evenly rounded, or less shouldered, and the transverse ribs smaller and less elevated than in the example originally described, which was a male, (fig. 9). In this female, the spire is also slightly less acute, but otherwise the shell does not differ in the two sexes. The length of this specimen is 13^{mm}; greatest breadth, 6; canal and body-whorl, in front, 9.5. The original male is 21.5^{mm} long, 11.5 broad; canal and body-whorl, 15^{mm} long.

This shell is much thinner and far more delicate than the two following species, from which it also differs in having a much deeper sinus, more convex whorls, a narrower canal, and much finer sculpture.

Gulf of Maine, 110 fathoms (S. 89, Bache), 1872; 105 and 110 fathoms (S. 51, 54, B.), 1874; 85 fathoms (S. 189), 1878; off Cape Cod, 96 fathoms (S. 378), 1879.

Pleurotomella Agassizii Verrill & Smith.

Pleurotoma (*Pleurotomella*) *Agassizii* Verrill & Smith. Amer. Journ. Sci. xx, p. 394, for Nov., 1880 (published Oct. 25); Verrill, Proc. U. S. Nat. Mus., iii, p. 367, 1880.

PLATE LVII. FIGURES 3, 3a.

Shell rather large and solid: whorls eight or nine, convex, angularly shouldered, with sixteen to eighteen thick, rounded, oblique ribs, separated by concave interspaces; the ribs do not extend above the shoulder, leaving a rather broad, flattened, or concave, subsutural band, which is covered by fine, raised, revolving lines, more or less decussated by distinct lines of growth, and by many curved riblets, running down from the suture; the revolving lines become stronger, more elevated, and wider apart below the shoulder, and cross the ribs as well as their intervals: toward the base of the canal the ribs

fade out and the revolving lines become still more prominent, some of them often dividing, but on the canal they again become smaller and closer. The two nuclear whorls are very small, chestnut-brown, scarcely carinated, rounded, with the surface finely reticulated by lines running obliquely, in two directions, but close to the suture only the transverse lines appear. Outer lip with a wide and rather deep rounded sinus, a little below the suture: below this it curves strongly forward, and recedes again at the canal, which is rather short, narrowed, and a little excurved. Columella smooth, with a sigmoid curve, and obliquely narrowed at the canal. Aperture subovate, sinuous, rather large but narrow. Shell usually white when fresh, sometimes pink or pale yellow, often stained with dark ash-gray, even while still living: the columella is usually more or less deeply tinged with brownish red, or orange-brown, but is often white.

Uncini numerous, small, slender, oblong-linear, very acute, twisted close to the tip, scarcely barbed; base yellow, relatively large, thick, saddle-shaped, with two large subequal lobes and a smaller one, and with a long, pyriform appendage about one-fourth as long as the shaft. Length of the uncini, $.0166^{\text{mm}}$; of shaft, $.0104^{\text{mm}}$; diameter of shaft, $.0012$; breadth of base, $.0034$.

Length, of an average specimen, 31^{mm} ; breadth, 14^{mm} ; length of aperture, 16^{mm} ; breadth, 6^{mm} .

There is considerable variation in the proportions of the shells. In some specimens the spire is much longer and more slender than usual, and the whorls are flatter. In others, the shell is stouter, with a shorter and less acute spire. Among the shorter-spined ones I have found both sexes, but the females are more generally of this form, while the males are usually of the more elongated form.

One of the most elongated specimens is 30.5^{mm} long; 12 broad. One of the stoutest is 26^{mm} long; 13 broad. These are both dry shells, and the sex is not known. An ordinary male is 24^{mm} long; 10 broad. A female, of the longer form, is 26^{mm} long; 12 broad.

The animal, in alcohol, has a rather small head, with small, short, obtuse tentacles, slightly swollen at base, but without eyes. The penis is unusually small, and very much smaller than in *P. Packardii*; its diameter is about twice, and its length about three times that of the tentacles; it is slender, round, and tapers from near the base to the acute tip. The foot is rather large, with strong auricles at the anterior corners. No operculum.

This elegantly sculptured species occurred sparingly, living, in

many of the localities off Newport, R. I. and south of Martha's Vineyard, in 1880 and 1881 (stations 869, 871, 874, 877, 880), in 65 to 252 fathoms. It was taken in larger numbers at stations 891 to 895, in 238 to 500 fathoms. In 1881, it was taken in considerable numbers at stations 947, 994, 997, 998 and 1028, in 302 to 410 fathoms; and sparingly at stations 999 and 1025, in 216 and 266 fathoms; and at 1029, in 458 fathoms. Capt. Tanner also took five specimens, Oct. 10, off Delaware Bay, at station 1049, in 435 fathoms.

Pleurotomella Pandionis Verrill.

Pleurotoma (Pleurotomella) Pandionis Verrill, Proc. U. S. Nat. Mus., iii, p. 368, 1880.

PLATE LVII, FIGURES 4, 4a.

Shell large, elongated, thick, with an acute, elevated spire; whorls nine or ten, very oblique, moderately convex, not shouldered, with a broad, flattened, or slightly concave subsutural band; whole surface covered with close lines of growth, which recede in a broad curve on the subsutural band; numerous, rather fine, unequal, raised, spiral lines, separated by well-defined grooves, of about the same breadth, and decussated by the lines of growth, cover the whole surface, except the subsutural band. The upper whorls are also crossed by sixteen to eighteen blunt, transverse, oblique ribs, about as broad as their interspaces, most elevated on the middle of the whorls, fading out above and below, and not crossing the subsutural band, which is marked only by the lines of growth; on the body-whorl the ribs become nearly or quite obsolete. Aperture elongated, oblong-ovate; outer lip, in the adult, broadly rounded and somewhat flaring, not incurved at the canal; sinus broad and shallow, but well-marked, just below the suture; canal short, nearly straight, broad and open in the mature shell; but in the immature shells the aperture is narrower, and the outer lip curves inward at the base of the canal, making it narrower. Columella having a slight sigmoid curve, its inner edge receding to the left, at the canal. Color of the most perfect specimen, waxy white, tinged with pale orange-brown, with a faint, white band on the middle of the body-whorl, and another below the suture; the other specimens are stained dark gray or brown. Operculum absent.

Length, 43^{mm}; breadth, 14.5^{mm}; length of aperture, 19^{mm}; its breadth, 5.5^{mm}. The largest example is 48^{mm} long; breadth, 17^{mm}; length of aperture, 21^{mm}; its breadth, 7^{mm}.

The uncini are relatively large and strong, being four or five times larger than in *P. Agassizii*. They form two, regular, convergent rows. The shaft is oblong-linear, flattened and twisted near the tip, and strongly barbed on both edges, the barbs unequal; base amber-colored, short, flattened transversely to the shaft, with the edge somewhat recurved, and with an oblique, short, hood-shaped appendage on one side. Length of uncini, $.0426^{mm}$; of shaft, $.033^{mm}$; breadth of shaft, $.0027^{mm}$; of base, $.0087^{mm}$.

A living specimen was taken in 1880, at station 895, in 238 fathoms. Single specimens were also dredged in 1881, off Martha's Vineyard, at stations 938 and 947, in 310 and 312 fathoms. The last was living, but not quite mature. The animal in both living specimens was so far retracted that it could be extracted only by the use of potash, so that it could not be described.

Bela (Leach): H. & A. Adams: G. O. Sars, &c.

Pleurotoma (*pars*) Jeffreys, and many earlier authors.

The species of this genus are numerous on our coast, but their identification has been very difficult, mainly owing to the very poor and insufficient descriptions that have been given by many writers. Möller's Greenland species, especially, are so briefly and poorly described that it is impossible to identify most of them, without reference to his original specimens.*

Fortunately, the recent admirable work of Professor G. O. Sars contains excellent illustrations of the shells and odontophores of most of the northern European species, many of which are identical with our own. His work† is indispensable for the proper study of this group. Aside from the imperfections of the published figures and descriptions, the shells are themselves variable and difficult to determine satisfactorily, especially when one has large series of specimens from numerous localities. Most of the species change greatly, both in form and sculpture, during growth, and some examples often retain juvenile characters later than others of the same species. In Binney's edition of Gould's *Invertebrata of Massachusetts* there are included seven northern species of *Bela*. Of these, the figures are mostly inadequate, and some are entirely erroneous. Fig. 620, given for *B.*

* Möller's collection is now in the Museum of Copenhagen. Several of his species of *Bela* were previously and better described by Couthouy, Gould, and others, in this country.

† *Mollusca Regionis Arcticæ Norvegiæ*. Christiania, 1878.

turricula; Fig. 621, intended for *B. harpularia*; and Fig. 624, for *B. cancellata*, do not represent those species. Fig. 620 represent *B. harpularia* better than "*B. turricula*," for which it was intended. Fig. 624, badly represents some unrecognizable species, very unlike the one intended.

Each species of the genus seems to have a longer and a shorter form, which often differ decidedly in appearance. This variation, which is also seen in many other genera of spiral shells, is probably, to a certain extent, sexual;* but it is not entirely so, for while the males seem usually to be long-spined, with narrower and flatter whorls, I have also found males among the short-spined ones. Moreover, there are, evidently, geographical races or varieties, as well as irregular individual variations, and peculiarities due to injuries of various kinds.

Unfortunately, writers have, hitherto, almost invariably neglected to state the sexes of shells figured or described; and, until recently, they have very seldom endeavored to give any idea of the character of the upper whorls, or of the young shell. In many cases it is difficult, or even impossible, to ascertain, at once, the nature of the apical whorls of species of *Bela*, owing to the fact that a very large proportion of the specimens are nearly always badly eroded. But this difficulty can usually be overcome by collecting large numbers of specimens,† including series of the young. The upper whorls and apex of these and other shells often give more reliable characters than the later whorls. The neglect to ascertain the sex cannot be avoided, so long as conchologists mostly prefer to dry all their shells,

* As the oviducts in many gastropods, which form large egg-capsules, are very voluminous and have large glands, which are situated beneath the upper part of the whorls, we should expect that this part of the mantle, and therefore of the shell, would be more expanded, to accommodate these organs. This seems to be the case, ordinarily. In examining large numbers of examples of *Natica*, *Lunatia heros*, *Neptunaea Stimpsoni*, *N. decemcostata*, *Scolytus conaliculatus*, *S. caricus*, *Buccinum undatum*, etc., with reference to their sexual characters, I have found that the females, as a rule, are decidedly stouter, with the whorls more convex, or at least more swollen just below the suture, than the average males. But the difference is often not very marked, while each sex varies considerably in this respect, from other causes.

† Although I have made special efforts to collect and preserve as many specimens of *Bela* as possible, while engaged in dredging on our coast, nearly every season, during the past twenty years, I am free to confess that I have not yet been able to obtain a satisfactory series of all our species. For this and other reasons, this paper is not so far as this genus is concerned, to be regarded as complete, for our species, but only as preliminary to a more complete and more fully illustrated one.

without examining the animal, but it certainly would generally have been possible for malacologists to have determined the sex of such individuals as have been dissected for the odontophore, but even this much has not often been done, in the past. I regret that, in order to use the most perfect shells, I have been obliged to figure some of the shells, on the accompanying plates, from dried specimens of unknown sex. I have, however, determined the sex, whenever possible, by dissection.

I have often observed egg-capsules attached to the shells of several of our species of *Bela*, which probably belong to these species. The capsules are translucent, solitary, circular, convex, or even hemispherical, and attached by the flat side, which is surrounded by a narrow, thin border. They are from 1 to 2^{mm} in diameter. I have never found them with the young sufficiently developed for determination.

Bela hebes Verrill.

Bela hebes Verrill. Proc. U. S. Nat. Mus., iii, p. 367, 1880.

PLATE LVII, FIGURE 7.

Shell short-fusiform or subovate, with a short, blunt spire, and with five or six convex, but slightly angled or carinated whorls, which have a slightly flattened subsutural band; suture impressed and slightly channelled. Sculpture numerous small, regular, raised, spiral ridges, separated by wider grooves: usually one, just below the subsutural band, is stronger and more raised, forming a slight carina; on the subsutural band they are faint, or indistinct. The spiral lines are often decussated, more or less, by equally slender, transverse, raised riblets, coincident with the lines of growth, but not uniformly present; these may produce a slightly cancellated structure, on all the whorls, and extend as curved riblets, across the subsutural band. The nuclear whorls are not preserved in any of my specimens. Aperture short, narrow-ovate. Outer lip expanded below the suture, then regularly rounded, thin; the posterior sinus is broad and shallow; canal very short and rather broad, straight; columella sigmoid, regularly incurved. Epidermis thin, greenish white.

Length, 8^{mm}; breadth, 5^{mm}; length of aperture, 5^{mm}; its breadth, 1.80^{mm}; length of body-whorl, front side, 6.35^{mm}. The largest specimen is 9^{mm} long; 5.5^{mm} broad.

Off Newport, R. I., 1880; stations 880, 891 and 892, in 282 to 500 fathoms; five specimens. * Animal not observed.

Bela pygmæa Verrill, sp. nov.

PLATE LVII, FIGURE 8.

Shell very small, fusiform, or sub-ovate, with four or five convex whorls, a very short spire, and a large body-whorl; sculpture very finely cancellated or reticulated. The whorls are usually rather evenly rounded, moderately convex, but often have a very slightly marked, rounded shoulder; suture somewhat impressed, rather oblique. The nucleus is relatively not small, with the apex not prominent, so that it appears to be obtuse, or rounded, smooth, glassy. The whole surface below the nucleus, is covered by fine, raised, revolving cinguli, separated by slight grooves of about the same width, and by equally fine, slightly sinuous, transverse riblets, coincident with the lines of growth, and receding in a distinct curve on the sub-sutural band: the crossing of these two sets of lines produces a finely cancellated sculpture over the whole surface, but the transverse lines are usually more evident on the convexity of the whorls, while the spiral lines are more conspicuous anteriorly, and on the siphon. Aperture relatively large, oblong-elliptical, slightly obtusely angled posteriorly; sinus shallow, but distinct, evenly concave: outer lip elsewhere evenly convex. Canal short and broad, not constricted at base by any incurvature of the outer lip. Columella strongly concave or excavated, in the middle, sigmoid anteriorly. Color of shell pale greenish white, covered by a thin epidermis of similar color. Animal not observed.

One of the largest shells is 5.5^{mm} long; 2.75^{mm} broad; length of body-whorl, 4^{mm}; of aperture, 3^{mm}.

Only a few specimens have been taken off Martha's Vineyard, Stations 892 and 894, in 487 and 365 fathoms, 1880; station 947, in 312 fathoms, 1881.—U. S. Fish Com.

This little species appears to be a dwarf among the *Belas*. It bears some resemblance to *B. decussata*, but can be readily distinguished by the much finer and more uniform sculpture. It has a strong general resemblance to *B. tenuicostata* Sars, for which I at first mistook it. The latter is, perhaps, only a variety of *B. decussata*; it is a larger and stouter shell than *B. pygmæa*, with coarser sculpture.

Bela incisula Verrill. sp. nov.

? *Pleurotoma Trevelyant*, var. *Smithii* Jeffreys. Ann. and Mag. Nat. Hist., 1876, p. 332.

Bela impressa? Verrill. Proc. U. S. Nat. Mus., iii. pp. 365. 1880, (*non* Mörch.)

PLATE XLIII, FIGURE 12. PLATE LVII, FIGURE 14.

The shell is small, sub-fusiform, to short ovate, with about five or six turreted, flattened whorls, which are angularly shouldered just below the suture. The subsutural band arises abruptly from the suture, nearly at right angles, and its surface is flat or slightly concave, marked by strongly recurved lines of growth, but mostly without spiral lines. The shoulder is often nearly right-angled. The whorls are decidedly flattened in the middle. There are on the last whorl, about twenty rather broad, flattened or rounded ribs, which are nearly straight, a little prominent and usually slightly nodose at the shoulder, but they disappear a short distance below it. They are separated by well excavated, concave grooves, deepest close to the shoulder.

The most characteristic feature of the sculpture is that the surface is marked by rather fine, but regular and distinct, sharply incised, narrow, revolving grooves, which are rather distant, with flat intervals. Of these there are usually about three to five on the penultimate whorl, and about twenty to twenty-eight on the last, the greater number being below the middle, on the siphon, where they become coarser and closer, with narrower rounded intervals. One of the sulci, just below the shoulder, is usually more distinct, and cuts the ribs so as to give their upper ends a subnodulous appearance; below this there is usually a rather wide zone, without grooves; usually no revolving lines above the shoulder. The apex is usually eroded; when perfect it is acute. The nucleus has a very small and slightly prominent smooth apex; its first turn is marked with fine spiral lines; the next whorl has, at first, about three stronger, spiral, raised cinguli, which soon begin to be crossed by thin transverse riblets.

Aperture about half the length of the shell, narrow ovate, or elliptical, angulated above. Canal short, nearly straight, a little narrowed at the base by an incurvature of the lip. The outer lip has a decided angle at the shoulder, below which the edge is well-rounded, and projects strongly forward, in the middle; the sinus, above the shoulder, is rather deep, wide, and evenly rounded within. Colum-

mella strongly excavated in the middle, obliquely receding at the end.

The shell is commonly greenish white and covered by a thin, close, greenish epidermis; but some specimens are clear white, and rarely pinkish.

Ordinary specimens are about 6.5^{mm} long; 3.5^{mm} broad; aperture, 3^{mm} long. A rather large specimen measures 7^{mm} long; 4^{mm} broad; aperture, 4^{mm} long; body-whorl, 5^{mm} long. One of the largest, having six whorls, is 8^{mm} long; 4.5^{mm} broad; body-whorl, 6^{mm} long; aperture, 4.5^{mm} long.

Uncini small, numerous (30 to 40), narrow lanceolate, not very slender, acuminate, not barbed, but with strongly involute edges; base large, the terminal lobe obtusely rounded, about as broad as long.

This is one of the most common and generally distributed species of *Bela* found on the New England coast. It inhabits both muddy and sandy bottoms, and sometimes is found among gravel and rocks. It occurs from the region off Newport, R. I., northward to Labrador, and from very shallow water, in the Bay of Fundy and Casco Bay, to 500 fathoms, off Martha's Vineyard. It is very common from Massachusetts Bay to the Bay of Fundy and Halifax, N. S., in 10 to 50 fathoms.

It was sent to me, as from Labrador, mixed with "*B. eearata*" (= *B. concinnata*), by Dr. A. S. Packard, Jr. I have dredged it in Eastport harbor and the Bay of Fundy, at many localities, in 5 to 110 fathoms, in 1864–1872. George's Bank. Casco Bay and Gulf of Maine, 1873, many localities, in 10 to 40 fathoms,—U. S. Fish Com. Salem harbor, 5 fathoms, 1873; Gulf of Maine, at seven stations, 27 to 92 fathoms, 1874; Massachusetts Bay, 20–25 fathoms, 1877 and 1878; Halifax harbor, 16–21 fathoms, and off Nova Scotia, 42 fathoms, 1877; Massachusetts Bay and Cape Cod Bay, many localities, in 13–30 fathoms, and off Cape Cod, 26–67 fathoms, 1879; off Newport, R. I., stations 814, 880, 891, in 27, 252, and 500 fathoms; off Martha's Vineyard, station 987, 28 fathoms, 1881,—U. S. Fish Com. Gulf of St. Lawrence, off Shediac, 10 fathoms,—coll. J. F. Whiteaves.

This is a small, but well-characterized species, easily distinguished from all others of our coast by its short, turreted spire; angular and flattened whorls; short, straight ribs; deep, rounded sinus; short canal; and especially by the peculiar, fine, incised revolving lines. It has, probably, hitherto been confounded, most commonly,

with *B. decussata*, which is somewhat similar in size and form, and often occurs in the same localities, but the latter has more rounded whorls and a scarcely turreted spire, the transverse ribs are decidedly sinuous, or sigmoid, and more numerous and regular, while the spiral lines are raised cinguli, crossing the ribs so as to produce a finely cancellated sculpture.

It also resembles *B. Trevelyana* of Europe, in form and size. But the latter is more regularly and more conspicuously sculptured, and the spiral lines are raised cinguli, so that it has a strongly cancellated sculpture. The Greenland shell designated as var. *Smithii*, by Jeffreys (*non Smithii* Forbes), is, perhaps, identical with our *B. incisula*. His description is very brief.

Bela tenuilirata Dall.

Dall, Am. Journ. Conch., vii, p. 98. 1871.

Bela simplex Verrill, Proc. U. S. Nat. Mus., iii, p. 367, 1880, (*non* Middendorff).

A single immature specimen, referred to this species by Mr. Dall, was taken in 1880. Whorls six, including the nucleus, very convex and evenly rounded, nearly smooth, but covered with fine and close impressed spiral lines, which appear wavy, or subpunctate, and are separated by intervals of about equal width; these are crossed by still finer, distinct lines of growth; subsutural zone smoother, with fine curved lines of growth. The apex of the spire is acute; suture impressed. The nucleus, consisting of nearly three apical whorls, is chestnut-brown; their surface is finely decussated by equal lines running obliquely in opposite directions.

Aperture large, ovate; canal somewhat prolonged, straight, narrowed toward the end; sinus, apparently wide and shallow; columella, nearly straight.

The shell is pale flesh-color, covered with a thin, smooth, glossy, pale yellowish brown epidermis. Length, 9^{mm}; breadth, 5^{mm}; length of body-whorl, 7^{mm}; of aperture, 6^{mm}.

One dead, but fresh, specimen, from station 894, in 365 fathoms, off Martha's Vineyard. Alaska,—Dall.

This species is probably not a true *Bela*. The nucleus is not like that of a *Bela*. It more nearly resembles *Pleuotomella*, in several respects.

Bela Pingelii (Möller) H. & A. Adams.

Defrancia Pingelii Möller. Ind. Moll. Grönl., Krøyer's Tidss., iv, p. 86, 1842.

Bela Pingelii H. & A. Adams, Genera, i, p. 92, 1858.

G. O. Sars, Mollusca Reg. Arcticæ Norvegiæ, p. 223, pl. 16, fig. 5, 1878.

Verrill, Proc. U. S. Nat. Mus., iii, p. 364, 1880.

PLATE XLIII. FIGURE 16.

Shell slender, elongated, with a long, tapering, acute spire; whorls, seven or eight, the lower ones broadly and nearly evenly rounded, the upper ones more or less carinated in the middle; suture strongly impressed, unusually oblique. The lower whorls are crossed by numerous (about twenty-four) close, narrow, not very prominent, flexuous ribs, which are decidedly excurved on the subsutural band; on the body-whorl they fade out just below the middle. Strong, elevated, nodulous spiral lines, or cinguli, separated by narrower, deep grooves, cover the surface of all the whorls below the nucleus, crossing both the ribs and grooves; on the middle of two or three, or more, of the upper whorls, one of these spiral lines is stronger than the rest, forming a distinct carina; on the lower whorls the spiral lines are narrower in the grooves than where they cross the ribs, on which they are thickened, so as to form strong, elliptical nodules, with smoothish rounded tops; on the subsutural band the ribs and spiral lines are narrower and the nodules less distinct; on the anterior part of the body-whorl the spiral cinguli become more crowded, with narrower grooves, and are not nodulous, though roughened by the lines of growth; on the siphon they become much finer and closer. The nucleus is very prominent, the whorls separated by deep, very oblique sutures; the apical whorl is, at first, small and smooth, but two raised spiral lines commence on the first whorl; on the second there are three to four, the two middle ones forming stronger carinae; on the third there are four to five, one of the middle ones becoming a more prominent carina, and on this whorl they are crossed by transverse ribs, rendering them nodulous.

The aperture is rather small, oblong-ovate; the posterior sinus is broad and shallow, but distinct; below this the outer lip is evenly and broadly rounded; canal very short, straight, rather wide, but a little constricted by the incurvature of the lip, at its base; columella only a little curved, slightly sigmoid. Animal not observed.

Color of the shell, pale chestnut-brown, with the canal and columella, whitish,

Length of an average specimen, having seven whorls, 11.5^{mm}; breadth, 4.25^{mm}; length of body-whorl, in front, 7^{mm}; its breadth, 4^{mm}; length of aperture, 4.75^{mm}; its breadth 2.25^{mm}.

This very distinct species was dredged by me several times, in small numbers, at Eastport, Me., in 1864, 1868, 1870, in 20 to 90 fathoms. One specimen was dredged by Messrs. S. I. Smith and O. Harger, of the the United States Fish Commission, in 1872, on Le Have Bank, off Nova Scotia, in 45 fathoms. Off Cape Cod, 34 fathoms, 1879. It appears to be a very rare species, however, and none of my specimens have the animals preserved. Greenland,—Möller; Northern Norway,—G. O. Sars.

This has not unfrequently been confounded by authors with *B. cancellata*, and perhaps with *B. pyramidalis*. It is our most slender and elongated species, with broadly rounded whorls, strongly cancellated by numerous narrow transverse ribs and raised revolving lines, or cinguli, which are about equally prominent, and form small, oblong nodules where they cross the ribs.

Bela Gouldii Verrill (sp. or var. nov.)

?*Bela rugulata* (Möller, MSS.) G. O. Sars, op. cit., p. 230, pl. 23, fig. 6; pl. viii, figs. 13 a-c (dentition), 1878 (*non* Reeve.)

Bela rugulata Verrill. Proc. U. S. Nat. Mus., iii, p. 366, 1880.

?*Bela assimilis* G. O. Sars., op. cit., p. 231, pl. 23, fig. 8, pl. viii, fig. 17, 1878.

PLATE LVII. FIGURES 6, 6a.

Shell fusiform, with a rather high, regularly turreted, acute spire. Whorls six or seven, strongly flattened, abruptly and squarely carinate-shouldered; broadest at the shoulder; the carina rises into prominent, but small nodules where it crosses the ribs. Sculpture coarse and prominent. Above the carina, or shoulder, the surface descends with an abrupt slope to the suture, forming a rather broad subsutural band, which is crossed by the somewhat prominent, excurved continuations of the ribs; between these are smooth, concave interspaces; spiral lines do not occur, unless very rarely and sparingly, on the subsutural band. The suture is rather oblique. The ribs are about 15 on the last whorl, prominent, but narrow, rather acute, with a smoothish edge; they are nearly straight below the carina, and gradually fade out toward the base of the canal; the intervals between the ribs are broad, concave, much wider than the ribs, crossed by well-marked, raised, spiral lines, which are much less elevated than the ribs, and not crowded, often unequal, rather stronger and more distant at the base of the

canal; on the penultimate whorl there are usually four, rarely five, spiral lines visible, below the carina. The nuclear whorls are small and prominent; the apex is small and soon two strong spiral lines appear; the uppermost of these becomes a carina, on the whorl next to the nucleus, while above and below it thin transverse riblets appear; the normal sculpture then commences. But the upper whorls are usually badly eroded. The aperture is oblong ovate, angulated posteriorly at the shoulder, narrowed at the base of the canal, which is somewhat elongated and contracted; sinus shallow, broadly concave; outer lip thin, strongly flattened, below the shoulder in the middle, and incurved at the base of the canal. Columella nearly straight in the middle, a little excurved or sigmoid, anteriorly.

Color white, or greenish white, epidermis pale green, thin, glossy.

The uncini are remarkably broad and short, lanceolate, acute, with the edges involute, not distinctly barbed; basal process short, broad.

An ordinary example measures in length, 14^{mm}; breadth, 6·5; length of body-whorl in front, 9·25; its diameter, 5·5; length of aperture, 7; its breadth, 2·5^{mm}. Specimens ascertained to be males, by dissection, agree in proportions with these measurements.

This species is one of the most common in Massachusetts Bay, Cape Cod Bay, and the Gulf of Maine, in 15 to 115 fathoms. Off Cape Cod (sta. 304), 122 fathoms. It is most frequent in 25 to 60 fathoms, and occurs both on muddy and on gravelly and shelly bottoms. It was also taken by the U. S. Fish Commission in Casco Bay, in 17 to 30 fathoms, in 1873; Halifax harbor and Bedford Basin, in 16 to 41 fathoms, 1877. I have seen no specimens from farther north.

This shell has, undoubtedly, been generally confounded, under the name of "*B. turricola*," with several other related species. It closely resembles some forms of *B. scalaris* and of *B. exarata*, but differs greatly from both in its dentition. From both, the shell can usually be distinguished by the absence of spiral lines on the subsutural band, and by having fewer and more distant spiral lines on the middle of the whorls. *B. exarata* has decidedly more numerous and smaller ribs with smaller nodules, and also a shorter canal and differently shaped aperture. *B. scalaris* has nearly the same form of aperture and canal; but it is a stouter shell, with the whorls less flattened, and the aperture is broader.

With eroded specimens, such as often occur, it will not always be possible to distinguish these three species with certainty, without examining the odontophore. It is not possible, at present, for me to identify this shell positively with any of those described by G. O.

Sars and other European writers. It most resembles, so far as the shell is concerned, Sars' *B. assimilis*, but the uncini in the latter are more slender and more acute. In the uncini our shell agrees closely with Sars' *B. rugulata*, but the shell that he figures under that name is decidedly shorter, with a more obtuse spire and finer sculpture, and appears, by the figure, to have spiral lines on the subsutural band.* The *B. scalaroides* Sars also has similar uncini, but in form and sculpture the shell does not agree so well. I have, therefore, preferred to give this common and well-marked species a distinctive name. Even if it should, hereafter, prove to be conspecific with *B. rugulata*, or *B. assimilis* (if these be really distinct species), it will still be desirable to designate it as a marked variety, for which, var. *Gouldii* would be an appropriate name.

Bela exarata (Möller) H. & A. Adams.

Defrancia exarata Möller, Ind. Moll. Grönl., Krøyer's Tidss., iv. p. 85, 1842.

Bela exarata H. & A. Adams, Genera. i. p. 92, 1858.

? G. O. Sars, op. cit., p. 232, pl. 16, fig. 18; pl. ix, figs. 1 *a, b* (dentition, etc.)

Verrill. Proc. U. S. Nat. Mus., iii. p. 366, 1880. (in part.)

Several specimens taken in 5 to 8 fathoms, at Grand Menan Island, in 1872, agree accurately with Greenland specimens, sent under the name of *B. exarata* from the museum of Copenhagen.

These also agree with Möller's original description, so far as that goes, especially in having a short spire. The figure given by G. O. Sars represents a longer-spined shell, with more numerous revolving lines and ribs, and a wider canal.

Our shell is short-fusiform, with the spire short, turreted, acute, about as long as the aperture. Whorls six, swollen, nearly squarely carinate-shouldered, flattened below the shoulder, but constricted at the suture, which is well-impressed and only a little oblique. Ribs 14 or 15, thick and prominent, nearly straight, obtusely rounded, about as wide as their interspaces, which are deeply concavely excavated, especially near the shoulder; at the shoulder the ribs rise into small, compressed nodules, which are connected by the thin revolving carina; in crossing the abrupt subsutural band, the ribs are prominent and only slightly bent. The raised revolving cinguli are coarse, distinctly thickened in crossing the ribs, producing small nodules, so that the surface appears somewhat rough; the cinguli are

* It seems to me doubtful whether the "*Bela rugulata*" of other writers is the same as Sars' species.

usually rather coarser and more distant at the base of the canal, after the ribs disappear; between the carina and the base of the canal there are about 9 or 10 cinguli; the first is a little more distant from the carina; on the penultimate whorl there are usually but two, or rarely three, cinguli visible, and often but one; several fine cinguli cross the subsutural band. By the ribs and cinguli a deeply cancellated structure is produced, but the ribs are much stronger than the cinguli. The nucleus is very small and the normal sculpture commences very early.

The aperture is rather small, but is more than half the length of the shell; outer lip angulated at the shoulder and flattened below it, then broadly rounded, incurved at the base of the short canal, which is much narrowed, straight, or slightly excurved.

Color, yellowish white.

Length, 7.5^{mm}; breadth, 4^{mm}; length of body-whorl, 5.3^{mm}; breadth, 3.5^{mm}; length of aperture, 4^{mm}; its breadth, 1.5^{mm}.

Seal Cove, Grand Menan, 5 to 8 fathoms (8 specimens).—H. E. Webster, 1872. Halifax harbor, stations 72, 73, in 18 fathoms, 1877. —U. S. Fish Com. Massachusetts Bay, 16 fathoms, 1879. Greenland. Perhaps, northern Europe.

Bela concinnula Verrill, sp. nov.

Bela exarata (pars) Verrill, Proc. Nat. Mus., iii, p. 366, 1880.

PLATE XLIII, FIGURE 15. PLATE LVII, FIGURE 11.

Shell rather small and delicate, long-ovate, regularly turreted, with about six whorls, which rise almost at right angles from the suture, and have an angular, or squarish, nodulous shoulder, usually distinctly carinated by a thin, raised, spiral keel, which forms small, but prominent nodules where it crosses the ribs; below the shoulder the whorls are abruptly flattened. The subsutural band is usually little convex, or nearly flat.

The ribs are numerous (often 20 to 25) regular, nearly straight below the shoulder, but rounded, separated by concave intervals of equal or greater width; they extend entirely across the upper whorls, but fade out below the middle of the body-whorl; above the shoulder they are slightly excurved, and smaller across the subsutural band. Whole surface covered with regular and rather strong, rounded, elevated, revolving cinguli, which cross the ribs and produce on them small, rounded nodes, and give a pretty regularly and rather finely but strongly cancellated appearance to the whole surface. On the penultimate whorl there are four or five cinguli below the angle. The

abruptly flattened subsutural band, above the shoulder, is covered with numerous much finer and closer revolving lines; on the anterior part of the body-whorl the cinguli are rather stronger than on the middle, and separated by wider grooves, but they are only slightly roughened by the lines of growth; on the canal they become finer and closer; between the carina and the base of the canal there are 12 to 14 cinguli. The nucleus is small and regular; at first smooth, then two raised spiral lines begin on the first whorl, and soon become distinct carinae, on the second to third whorl, the upper one forming the shoulder; slender transverse riblets begin on the second, and become very evident on the third whorl.

Aperture narrow-ovate, angulated posteriorly; sinus broad and shallow; outer lip, in front of the sinus, distinctly flattened, then broadly rounded, very slightly incurved at the base of the canal, which is narrow, a little produced, and slightly curved; columella decidedly sigmoid, its inner edge excurved at the end.

Color of the shell white, or pale greenish white, covered with a thin, pale green epidermis.

The tentacles are short and obtuse in alcoholic specimens, with conspicuous black eyes; penis relatively large, bent back in a sigmoid form, flattened, broadest in the middle, tapering.

Uncini, linear, very acute, relatively large, long, slender, curved, with a short ovate basal appendage; length of uncini, $.052^{\text{mm}}$; breadth, $.0032^{\text{mm}}$.

A rather large male is 11.5^{mm} long; breadth, 5.25^{mm} ; length of body-whorl, 7^{mm} ; its breadth, 5^{mm} ; length of aperture, 5^{mm} ; its breadth, 2^{mm} . An ordinary specimen, measures, in length, 10^{mm} ; breadth, 4.5^{mm} ; length of aperture, 5.5^{mm} .

This species is common and widely distributed on this coast. It ranges from the region south of Martha's Vineyard, in deep water, to Labrador. By the U. S. Fish Com. it was dredged, off Newport, R. I. and Martha's Vineyard, in 252 to 487 fathoms (stations 880, 892, 947, 994, 1038), 1880 and 1881; Cape Cod Bay and off Cape Cod, 25 to 122 fathoms, 1879; Massachusetts Bay, 20 to 29 fathoms, 1877; Gulf of Maine, many stations, 25 to 88 fathoms, 1873, 1874, 1878; 150 fathoms, 1872; Casco Bay, 1873; George's Bank, 50 to 65 fathoms, 1872; south of George's Bank, 430 fathoms, 1872; Halifax harbor, 16 to 21 fathoms, and off Halifax, 42 fathoms, 1877.

The specimens from Labrador were sent as *B. esarata*, by Dr. A. S. Packard, Jr.

This shell is closely allied to *Bela esarata*, and may ultimately

prove to be only a variety of the latter, as I formerly supposed, but it differs much in appearance from the form that I have described, above, as the true *B. exarata*. The spire is much longer; the whorls are flatter and more regularly turreted, with more regular nodules on the shoulder: the ribs are smaller, more regular, and more numerous; the spiral cinguli are more numerous, and so nearly equal to the ribs as to produce a very regular cancellation: the aperture is larger and longer, with a narrower and decidedly longer canal.

The shell figured by G. O. Sars as *B. exarata* strongly resembles this species in general form and sculpture, and in the umbilici, but it has a shorter aperture and a wide, open canal, very unlike that of our shell. Whether Sars' shell is identical with the true *B. exarata* is doubtful, for that was described as having a short spire, while his shell has a long spire.

Bela concinnula, var. *acuta* Verrill, nov.

Bela mitrula? Verrill. Proc. Nat. Mus., iii, p. 366, 1880.

PLATE LVII, FIGURE 10.

Shell more slender than the preceding, with a longer and more acute spire, and narrower aperture. Whorls more flattened, with the nodules on the shoulder more prominent and sharper, and the carina higher. In other respects it is similar.

In some examples the ribs are fewer than usual. Sometimes the outer lip has a decided incurvature, just below the angle made by the shoulder.

The umbilici (Plate LVII, fig. 10) agree closely with those of *B. concinnula*, except that they were smaller in the specimen examined,—perhaps due to its being younger.

Length of one of the largest examples, 10^{mm}; breadth, 4.2^{mm}; length of body-whorl, 6^{mm}; its breadth, 3.75^{mm}; length of aperture, 5^{mm}; its breadth, 1.6^{mm}.

Casco Bay, 1873; Gulf of Maine, 88 to 118 fathoms, 1873, 1874, 1877; Massachusetts Bay and Cape Cod Bay, 16 to 20 fathoms.—U. S. Fish Com.

Specimens intermediate between this variety and *B. concinnula* have been found, so that it is, doubtless, only a slender form of that species.

This variety bears considerable resemblance to *Bela mitrula* Lovén, as figured by G. O. Sars, and its umbilici also agree well with those of the latter, so that I formerly thought it might be identical. But

B. mitrula, as figured, has a different aperture, a wider and more open canal, and its spire is more elevated, with the whorls more broadly exposed.

Owing to the great amount of confusion that exists, both in this country and Europe, in regard to our commoner species of *Bela*, I have given several new figures, and now add the following entirely new descriptions of those species contained in Binney's Gould and other works on New England Conchology, hoping that, in the future these details may aid others in the more accurate identification of our species of this difficult genus.

At present it seems useless to attempt to identify many of our species of *Bela* with those of other regions without a direct and extensive comparison of the specimens themselves, including not only their shells, but also their odontophores. Moreover, the confusion, as to names, is so great that no reliable data can be given as to the foreign distribution of these species. The same remark also applies to the recorded localities of such species, in the fossil state, whether in America or Europe.

Bela scalaris (Möll.) H. and A. Adams.

Defrancia scalaris Möller, Ind. Moll. Grönl., Kröyer's Tidss., iv. p. 85, 1842.

Fusus turricula Gould, Rep. on Invert. of Mass., 1st ed., p. 292, pl. 13, fig. 193, 1841, (non Montagu, sp.)

Maagelia turricula (pars) Stimpson, Shells New Eng., p. 48, 1851.

Bela turricula Gould, Rep. on Invert. of Mass., Binney's ed., p. 351, fig. 620, 1870.

Bela scalaris G. O. Sars, Moll. Arctique Norvegie, p. 229, pl. 23, fig. 5, pl. viii, fig. 16, (dentition).

Bela americana Packard, Mem. Boston Soc. Nat. Hist., vol. i, p. 285, pl. 7, fig. 11, 1866.

PLATE LVII, FIGURES 12, 12a.

Shell large, fusiform, regularly turreted, with a rather high, acute spire. Whorls seven or eight, strongly ribbed, angularly and nearly squarely shouldered; the shoulder is distinctly, but usually not strongly carinated, not at all nodulous, or but slightly so; the whorls are much flattened below the shoulder, but are still a little convex, narrowing somewhat at the suture; the subsutural band is broad, rising abruptly from the suture, and sloping slightly to the shoulder, which it joins at a slightly obtuse angle. The whorls are crossed by 14 to 20 strong, rounded, rather regular, nearly straight, prominent ribs; they are a little thickened and at the shoulder separated by broader, concave interspaces; the ribs are continued across

the subsutural band, nearly as strongly as in front of the shoulder, but in crossing it they are strongly excurved, with concave interspaces, circumscribed externally by the carination at the shoulder. The ribs extend nearly to the base of the canal. Numerous strong, close, well-defined, raised spiral cinguli, separated by grooves sometimes nearly or equally as broad, but usually narrower, crossing the ribs and their interspaces, cover the whole surface of the whorls, including the subsutural band, on which there are six or seven very distinct cinguli, somewhat finer than those below the shoulder; anteriorly, toward the base of the canal, the grooves are wider and the cinguli are usually coarser. The apex of the spire is acute, with a small, prominent nucleus; the nuclear whorls, except at the very first, have two strong, spiral carinæ, and then three, while on the next whorl riblets appear, and the whorl becomes carinate-shouldered.

Aperture rather large, oblong, or oblong-elliptical, angulated at the shoulder. Outer lip with a broad and very shallow sinus, broadly rounded below the shoulder, and distinctly incurved at the base of the canal. The canal is narrow and somewhat elongated, and a little excurved. Columnella sigmoid, considerably curved.

Color of shell white, pale greenish white, or yellowish white.

A medium-sized specimen, with seven whorls, is 18^{mm} long; breadth, 8^{mm}; length of body-whorl, in front, 13^{mm}; its breadth, 7·5^{mm}; length of aperture and canal, 9·5^{mm}; its breadth, 3·5^{mm}. A specimen, ascertained to be a male, by dissection, measures, in length, 20^{mm}; breadth, 9·5^{mm}, length of aperture 11^{mm}. Another male is 18·5^{mm} long, 8·5^{mm} broad; length of body-whorl, 12·5^{mm}; its breadth, 7·5^{mm}; length of aperture, 10^{mm}; its breadth, 3·5^{mm}. The largest specimen, from Eastport, Me., with the canal broken, must have been over 25^{mm} long; breadth, 11^{mm}; length of spire, from posterior end of aperture, 14^{mm}; this had over 8 whorls.

This is our largest species of *Beta*. Its range is from off Cape Cod to Labrador, Greenland and northern Europe. It is probably circum-polar. It is not uncommon at Eastport, Me., and in the Bay of Fundy, where I dredged it in 1864, 1865, 1868, 1870, 1872, at various localities, in 10 to 90 fathoms. By the U. S. Fish Com. parties it was dredged in Broad Sound, Casco Bay, and off Half-way Rock, in 14 to 29 fathoms, 1873; Gulf of Maine, 60 fathoms, near the Isles of Shoals, 25 fathoms, at Jeffrey's Ledge, 51 fathoms, 1873 and 1874; Massachusetts Bay, 29 to 40 fathoms, 1877, 1878, 1879; off Cape Cod, at nine stations, 15 to 32 fathoms, 1879; Halifax harbor, 25 fathoms, and off Halifax, 59 to 190 fathoms, 1877. Labrador specimens were

sent to me by Dr. A. S. Packard, Jr., as *B. turricula* and *B. americana*.

This species is one of the several shells that have usually been confounded under the name of *B. turricula*. The latter is European, and apparently does not occur on our coast.

Bela harpularia (Couth.) H. and A. Ad.

Fusus harpularius Couthouy, Boston Journal Natural History, vol. ii, p. 106, pl. 1, fig. 10, 1838.

Gould, Invertebrata of Mass., ed. i. p. 291, fig. 191, 1841.

Maagelia harpularia Stimpson, Shells of New England, p. 48, 1851.

Bela harpularia H. and A. Adams, Genera of Recent Mollusca, vol. i, p. 92, 1858.

Gould, Invertebrata of Mass., ed. ii, p. 352, fig. 191, (*non* G. O. Sars).

Verrill, Report Invert. Anim. of Vineyard Id., in 1st Rep. U. S. Fish Com., pp. 636, 508, pl. 21, fig. 108 (after Gould), 1874, (auth. cop., p. 342).

PLATE XLIII, FIGURE 14. PLATE LVII, FIGURE 9.

Shell solid, regularly fusiform, with a moderately high, acute spire. Whorls seven, with a sloping subsutural band, and the shoulder obtuse and scarcely carinated; the shoulder is farther in front of the suture than in the three preceding species, less raised, and not so abrupt; the whorls are flattened, but yet slightly convex in the middle. About 18 to 20 rather close, broadly rounded ribs cross the lower whorls; the ribs are separated by concave interspaces of about the same breadth, and are only slightly bent; at the shoulder they are more prominent and a little thickened; on the upper whorls often slightly nodulous; on the subsutural band they become fainter and are a little excurved; they fade out below the middle of the body-whorls. Fine, close, wavy, raised spiral lines, or cinguli, cover the entire surface, crossing equally the ribs and the interspaces; they are coarsest and most distinct on the middle of the whorls, becoming much finer and more wavy anteriorly, toward the base of the canal, and posteriorly toward the shoulder; on the subsutural band they are very fine and regular. The apex is acute and compact; the first nuclear whorl is very small, not prominent, smoothish; the second has at first two and then three thin carinae; riblets begin on the next.

Aperture narrow-elliptical, scarcely angulated. Outer lip broadly rounded, with a broad and very shallow, posterior sinus, and incurved at the base of the canal, which is short, straight, and narrow. Columella sigmoid.

Color, usually pale reddish brown, or rosy, with the anterior part of the body-whorl and canal whitish; often entirely white or yellowish white; sometimes yellowish brown.

A large example (sex unknown), measures, in length, 17^{mm}; breadth, 7.5^{mm}; length of body-whorl, 11.5^{mm}; its breadth, 6.4^{mm}; length of aperture, 9^{mm}; its breadth, 3^{mm}. A specimen ascertained to be a male is 14.5^{mm} long; breadth, 6.5^{mm}; length of body-whorl and canal, 9.75^{mm}; breadth of body-whorl, 6^{mm}; length of aperture, 8^{mm}; its breadth, 2.5^{mm}.

This species ranges from Long Island Sound to Nova Scotia, but is less common northward. It is the most common species south of Cape Cod, in moderate depths (18 to 30 fathoms), where it is usually unaccompanied by any other species, and occurs of large size and typical form. We took it off Gay Head, Martha's Vineyard, 18 to 29 fathoms, in 1871, 1880, 1881; off Block Island, 20 to 28 fathoms, 1874, 1880; eastern end of Long Island Sound, 1874; Massachusetts Bay, 8 to 29 fathoms, 1873, 1877, 1878, 1879; Cape Cod Bay, and off Cape Cod, 15 to 34 fathoms, 1879; Casco Bay, 1873; Eastport, Me., and Bay of Fundy, 10 to 50 fathoms, 1870, 1872; Halifax harbor, 20 fathoms, and off Halifax, 120 miles, 190 fathoms, 1877; off Martha's Vineyard, 104 miles, 368 fathoms, 1881. Messrs. Smith and Harger, on the "Bache," in 1872, took it at various localities on George's and Le Have Banks, in 25 to 60 fathoms.

Bela harpularia has often been confounded with *B. scalaris*, *B. cancellata*, and other species. It differs widely from the former in the shape of the aperture and in the brevity of the canal; in the more sloping and obtuse shoulder; in the closer ribs; and in the finer and peculiarly waved spiral lines, which are finer near the shoulder. *B. cancellata* has a higher and more acute spire, flexuous ribs, and coarser spiral sculpture, which becomes still coarser anteriorly, toward the canal.

Defrancia Woodiana Möller, from Greenland, has been considered identical with this species by several authors. Möller's description is of no value. I have seen no Greenland examples of *B. harpularia*, and as it becomes decidedly rarer to the northward, on our coast, its occurrence at Greenland seems to me doubtful. It becomes comparatively rare in the Bay of Fundy and off Nova Scotia, where it is mostly replaced by *B. cancellata*, *B. scalaris* and other more arctic forms. A somewhat similar shell, which I have identified as *B. Woodiana*, occurs on the coast of Greenland, from whence I have specimens, and on the coast of Nova Scotia; this is probably the Greenland shell that has been mistaken for *B. harpularia* by various writers.

The shells described and figured by Professor G. O. Sars as *B. harpularia* and its variety, *rosea*, do not appear to me to be identical with the true *B. harpularia*. His shell has a different aperture, the whorls are more decidedly and squarely shouldered and the ribs fewer and more distant. It is possibly the shell mentioned above as probably *B. Woodiana*.

Bela cancellata (Mighels) Stimpson, Check List, 1860.

Fusus cancellatus Mighels, Proc. Boston Soc. Nat. Hist., i, p. 50, 1841; Boston Journ. Nat. Hist., iv, p. 52, pl. 4, fig. 18, Jan., 1842.

Bela cancellata Gould, Invert. Mass., ed. ii, p. 355, description (but not the figure, 924), (non G. O. Sars).

Verrill, Proc. U. S. Nat. Mus., iii, p. 364, 1880.

PLATE XLIII, FIGURES 10, 11. PLATE LVII, FIGURE 13.

Shell elongated, with a long, tapering, acute, somewhat turreted spire. Whorls nine, somewhat convex, shouldered obtusely at some distance below the suture; the subsutural band is rather wide, and a little convex, sloping gradually to the obtuse shoulder, which is angular and more or less carinated on the upper whorls, but usually rounded and not at all carinated on the lower ones. Suture well-impressed, more oblique than in most species. The ribs on the body-whorl vary from 18 to 21; they are stout, prominent, broadly rounded, separated by concave grooves of about the same breadth, strongly flexuous, with a sigmoid curvature at the shoulder, less prominent and decidedly excurved in crossing the subsutural band; anteriorly they fade out before reaching the base of the canal. Coarse spiral cinguli cover the whole surface, except the subsutural band, on which they are usually few and faint, or absent; the cinguli are broad and separated by narrower furrows, or incised grooves, which are made wavy by the distinct lines of growth; on the body-whorl there are about 12 to 14 of the spiral grooves, between the shoulder and the base of the canal; the cinguli become coarser, with deeper, wider and more distant grooves anteriorly, toward the base of the canal, but on the latter they become finer and closer; on the penultimate and next preceding whorls there are about 5 or 6 spiral grooves visible. The spiral grooves are usually fainter in crossing the ribs, and in specimens somewhat worn they often do not show at all on the ribs; but on very fresh specimens they are usually perfectly distinct on the ribs.

The apical whorls are very prominent with deep, oblique sutures, the first nuclear whorl is angulated, apparently, from its origin, by two spiral lines, which quickly become raised, spiral carinæ; on the

second whorl a third, anterior carina appears, and these, before the third turn, begin to be crossed by thin, raised riblets; the succeeding upper whorls are more or less carinated at the prominent, angular, but obtuse shoulder, and have 12 to 14 prominent ribs.

Aperture, in the adult shell, relatively short and small, oblong-elliptical, outer lip broadly rounded, with a broad and shallow, but distinct, posterior sinus. Canal very short, straight, rather wide and open, usually not at all constricted at its base. Columella sigmoid. In immature shells the aperture is relatively longer and larger, and the canal is longer and narrower.

Color of the shell often white; sometimes pale rosy, or light chestnut-brown, with the canal and anterior part of the body-whorl white, as in *B. harpularia*.

Length of a large example, of the elongated form, 20^{mm}; breadth, 7.75^{mm}; length of body-whorl, in front, 12^{mm}; its breadth, 6^{mm}; length of aperture, 9^{mm}; its breadth, 3^{mm}. Another elongated specimen is 17^{mm} long; breadth, 6.5^{mm}; length of aperture, 7.5^{mm}; its breadth, 2.5^{mm}. One of the shorter form is 15.5^{mm} long; breadth, 7^{mm}; length of aperture, 8^{mm}; its breadth, 3^{mm}. The specimen of which the uncini are figured was a female, from Eastport, Me., and measured 14^{mm} in length; breadth, 6^{mm}; length of body-whorl, with canal, 9.5^{mm}; its breadth, 5^{mm}; length of aperture, 7^{mm}.

The uncini (Plate LVII, fig. 13), are relatively large, long, slender (but less so than in *B. ecarata*), very acute, not distinctly barbed; basal process longer than broad, narrowed and bluntly rounded posteriorly. Length of uncini, .0507^{mm}; breadth of shaft, .0066^{mm}; length of base, .0107^{mm}; its breadth, .0086^{mm}.

This shell extends from Martha's Vineyard, in 126 and 312 fathoms (stations 877, 947), north to Nova Scotia and Labrador; and probably to Greenland and Northern Europe. It is one of the most common species in the cold waters of the Bay of Fundy, near Eastport, Me., and Grand Menan I., in 10 to 100 fathoms, where I have often dredged it, in 1861, 1863, 1864, 1865, 1868, 1870, 1872. We have also taken it, on the various U. S. Fish Com. expeditions, off Nova Scotia; in the Gulf of Maine; Casco Bay; Massachusetts Bay; off Cape Cod, etc., in 12 to 92 fathoms. George's Bank, 50 fathoms, by Smith and Harger, on the "Bache," in 1872. Square Island, Labrador, 30 fathoms, sent by Dr. A. S. Packard, Jr., as *B. Vahlii*, *B. cancellata*, and *B. pyramidalis*.

This species is liable to be confounded, especially when eroded, with *B. harpularia*, *B. pleurotomaria* and *B. Gouldii*. From the

first it differs in being more elongated, but its coarser spiral sculpture, not becoming finer anteriorly, nor toward the shoulder, but disappearing on the subsutural band, gives a better diagnostic character; its ribs are also more sigmoid. From *B. Gouldii* it differs in having the whorls much more sloping, and not squarely carinate-shouldered, nor nodulous; in not having straight ribs; in the spiral sculpture, and in having a shorter aperture and canal. In *B. pleurotomaria* the spiral sculpture is much less developed, and the spire is usually more slender.

The positive identification of this shell with similar species described from Greenland and Northern Europe is not possible, at present. I have, myself, seen no specimens from those regions that could be called identical. Authors, both in this country and in Europe, have often mistaken other shells for this species, or have confounded several with it.* I have seen *B. decussata*, *B. pleurotomaria*, *B. exarata*, *B. Pingelii*, and other species labeled as "*B. cancellata*" in American collections. There is reason to believe that the confusion is even greater in foreign collections.

Mörch erroneously identified this species with *B. Pingelii* and *D. cinerea* Möller. Jeffreys, also, has identified this species with *B. Pingelii*.

Among the forms figured by Professor G. O. Sars, *B. elegans* Möller resembles closely some of the varieties of this species, and may be identical. Möller's description of *B. elegans* is very brief and indefinite, but, so far as it goes, applies well enough to this shell. Jeffreys records a "*Pleurotoma elegans*" from the Gulf of St. Lawrence, which is possibly this species. *B. angulosa* Sars also resembles the smaller and more slender varieties.

The shell named *B. cancellata* by Sars is a distinct species, to which I have elsewhere given the name, *B. Sarsii*. (See p. 484.)

It has a much coarser cancellation, produced by the more distant spiral lines, crossing very broad and nearly straight ribs. The shell itself is more narrow, and has flatter whorls. The meini also differ.

* The cut in Binney's Gould (fig. 924), was probably made from some other species, but the figure is too bad for identification. The original figure by Dr. Mighels is very much better.

Bela pleurotomaria (Couthouy) Adams.

Fusus pleurotomarius Couthouy, Boston Journal of Natural History, vol. ii., p. 107 pl. 1, fig. 9, 1838.

Fusus rufus Gould, Invert. of Mass., ed. i., p. 296, fig. 192 (non Montagu).

? *Buccinum pyramidale* Ström, N. A. Dan., iii., p. 296, fig. 22 (? non *Bela pyramidalis* G. O. Sars).

Defrancia Fahlii (Beck) Möller, 1842 (t. Lovén).

Mangelia pyramidalis Stimpson, Shells of New England, p. 49, 1851.

Bela pleurotomaria H. and A. Adams, Genera Recent Mollusca, i., p. 92, 1858.

Gould, Invert. of Mass., ed. ii., p. 355, fig. 625.

Verrill, Report Invert. Anim. of Vineyard Id., in 1st Rep. U. S. Fish Com., p. 837, 1874. (auth. cop., p. 343)

Shell long-tusiform, with a high, tapering, acute spire. Whorls seven or more, well-rounded, not distinctly shouldered nor carinated, constricted above the sutures, which are well-impressed and not very oblique; no distinct subsutural band. Ribs about 13 to 16 on the last whorl, rather prominent, rounded, sigmoid, strongly excurved on the upper part of the whorl, incurved and less prominent close to the suture; they fade out below the middle of the whorl; on the preceding whorls they are prominent at and above the middle, and decidedly sigmoid; the intervals between them are deeply concave and rather wider than the ribs. The spiral cinguli are numerous, fine, wavy, unequal, and inconspicuous, becoming more distinct, and rather coarser toward the anterior part of the body-whorl, and on the uppermost whorls; they are often absent across the ribs, and frequently are scarcely apparent, even with a lens, on the more convex part of the lower whorls, where they are always fine; they are also fine on the subsutural portion.

The nucleus is small, but prominent, with the whorls separated by deep sutures; the first half-whorl is smooth; then three raised spiral cinguli appear, which become strong carinæ on the second whorl; on the third and fourth whorls these are crossed by raised riblets, producing a cancellated sculpture.

The aperture is short and small, narrow-ovate; the outer lip has a very distinct, wide, shallow sinus; below this it is evenly rounded, a very little incurved at the base of the canal, which is short, straight, and narrow.

Color, when fresh, pale chestnut-brown to reddish brown, usually paler anteriorly.

A specimen of the stouter variety, having seven whorls, is 13.25^{mm} long; breadth, 6^{mm}; length of body-whorl, 9^{mm}; breadth, 5.15^{mm};

length of aperture, 6.5^{mm} ; its breadth, 2.3^{mm} . One, of the more slender variety, is 11.5^{mm} long; breadth, 4.5^{mm} ; length of body-whorl, 7.10^{mm} ; its breadth, 4^{mm} ; length of aperture, 5^{mm} ; its breadth, 2^{mm} .

This species is found off Martha's Vineyard to Labrador! It is not uncommon in Eastport harbor and the Bay of Fundy, where I dredged it in 1864, 1865, 1868, 1870, in 15 to 80 fathoms. By the U. S. Fish Com. it has been dredged in Halifax harbor, in 20 to 25 fathoms, 1877; George's Bank, 45 fathoms, 1872; Gulf of Maine at Cashe's Ledge, 30 to 40 fathoms, 1874; off Cape Ann, 38 to 40 fathoms, 1874; Casco Bay, 1873; Massachusetts Bay, 31 to 48 fathoms, 1877, 1879; off Cape Cod, 30 to 122 fathoms, 1879; off Chatham, Mass., 16 fathoms, 1881; off Martha's Vineyard, 255 fathoms, 1881. It appears to occur on the coast of Greenland: Jeffreys records it (as *P. pyramidalis*) from 5 to 57 fathoms.

This species, when eroded, is liable to be confounded with *B. cancellata*. It differs from the latter in having the whorls evenly rounded; in its much finer spiral sculpture; and in the shape of the aperture and canal.

Whether it can be identified accurately with any European species is doubtful. Many writers have considered it identical with *B. pyramidalis* (Ström). But the shell figured under that name by Prof. G. O. Sars appears to be quite different.

Mörch, in 1875, gave a subspecies, *pleurotomaria*, under *P. pyramidalis* Ström, from Greenland, and referred to it *Dejfrancia Vahlbi* Möller, as a synonym.

Bela decussata (Couth.) H. and A. Adams.

Pleurotoma decussata Couthouy, Boston Journ. Nat. Hist., 3, p. 183, pl. 4, fig. 5
1839 (non Lam., nec Macgill.)

Gould, Rep. on Invert. of Mass., 1st ed., p. 280, fig. 185, 1841.

Mangelia decussata Stimpson, Shells New Eng., p. 49, 1851.

Bela decussata Gould, Rep. on Invert. of Mass., Binney's ed., p. 354, fig. 523, 1870.

PLATE XLIII. FIGURE 15.

Shell small, ovate-fusiform, with a tapering spire of moderate length, scarcely turreted. Whorls six or seven, well-rounded, moderately convex, constricted above the sutures, round-shouldered, not carinated; subsutural band defined only by the curvature of the ribs, suture well-impressed, not very oblique. Ribs numerous, about 24, close, rounded, not very prominent, most so at the shoulder, about as broad as their interspaces, sigmoid, usually strongly excurved at the shoulder and abruptly incurved at the suture; they fade out

at about the middle of the last whorl. Fine, wavy, spiral cinguli cover the whole surface, crossing the ribs as well as their interspaces; on the subsutural band they are finer and often nearly obsolete; on the shoulder and more convex part of the whorls they are fine and close, separated by fine, deep grooves of about the same width; more anteriorly, and especially on the last whorl, they become a little coarser and more distant, with wider interspaces, in which a finer cingulum is often interpolated. The cinguli are roughened by fine lines of growth.

Aperture ovate-elliptical, its inner side expanded in the middle. Outer lip with a well-marked sinus close to the suture; below this, evenly convex, scarcely incurved at the canal, which is very short, straight, and open. Columella nearly straight in the middle.

Color white or pale pink.

A specimen of good size and average form is 9.10^{mm} long; breadth, 4.5^{mm}; length of body-whorl, 6.4^{mm}; its diameter, 4^{mm}; length of aperture, 4.5^{mm}; its breadth, 2^{mm}. An unusually large specimen, from Eastport, Me., is 12.5^{mm} long; breadth, 6^{mm}.

This shell is not uncommon on the New England coast, in moderate depths, mostly in 25 to 75 fathoms. Its range is from off Martha's Vineyard, in 34 fathoms, northward to Labrador. In the Bay of Fundy, where it is not rare, I have taken it in 20 to 100 fathoms, in 1868, 1870, 1872. It has been dredged by U. S. Fish Com. parties in Halifax harbor and off Nova Scotia, 16 to 59 fathoms, 1877; Gulf of Maine, in many localities, 27 to 86 fathoms, 1873, 1874, 1877; off Cape Ann, 38 to 75 fathoms, 1878; Massachusetts Bay, 25 to 26 fathoms, 1878, 1879; off Cape Cod, 28 to 30 fathoms, 1879; off Martha's Vineyard, station 991, 34 fathoms, 1881.

According to Dr. P. P. Carpenter, this species was identified from the North Pacific (Seniavine Straits and Awatska Bay, 10 to 20 fathoms, N. Pacific Expl. Exp.) by Dr. A. A. Gould.

Jeffreys formerly identified our shell with *B. Trevelyana*, but subsequently (Ann. and Mag. Nat. Hist., April, 1876, p. 329), he changed his opinion and considered it the same as *B. viridula* (Möller) of Greenland, and records it from Greenland, 5 to 100 fathoms (Valorous Exp.), and north of Scotland, 560 fathoms (Porcupine Exp.) I am unable to verify the Greenlandic and European localities. *B. viridula* of G. O. Sars seems to be a distinct species,

Variety, *tenuicostata*.

? *Bela tenuicostata* G. O. Sars, op. cit., p. 237, pl. 17, figs. 1 a, b, pl. ix, fig. 6 (dentition), 1878.

Bela tenuicostata (*pars*) Verrill, Amer. Journ. Sci., xx, p. 391, Nov., 1880.

Verrill, Proc. U. S. Nat. Mus., iii, p. 365, 1880.

This is closely related to *B. decussata* Couth., of which it is, perhaps, only a variety. It has smaller and more numerous ribs, and is, therefore, more finely and uniformly cancellated. It agrees with *B. decussata* very closely in size and form and in the flexuous character of the ribs.

Specimens apparently identical with this form were dredged by me, in moderate depths, at Eastport, Me., in 1864, 1868 and 1870. I am inclined to believe that these American examples, at least, are nothing more than a variety of *B. decussata*, with unusually regular and finely decussated sculpture.

Variety, *pusilla*, nov.

A small variety of this species occurs in which the ribs are less prominent and not so much bent at the shoulder, giving the shell a smoother appearance. In form of the whorls and aperture, and in the spiral cinguli it agrees with the ordinary form. It resembles the European *B. Trevelyana*, but is shorter and less decidedly cancellated.

This was taken in Casco Bay, 12 to 15 fathoms; Halifax harbor, 18 fathoms.

Bela decussata is a well-characterized species, but has, undoubtedly, been confounded with other species, especially with *B. incisula* V., which it resembles in size and somewhat in form, but from which it differs very decidedly in sculpture, and in lacking the angular shoulder of that species.

When eroded, small specimens are liable to be mistaken for *B. bicarinata*, or its variety, *violacea*, but it is generally stouter in form, with a shorter spire, and lacks the raised cinguli, usually seen in the latter.

Bela bicarinata (Couth.) Verrill.

Pleurotoma bicarinata Couthouy, Boston Journ. Nat. Hist., ii, p. 104, pl. 1, fig. 11, 1839.

Gould, Invertebrata Massachusetts, ed. i, p. 281, fig. 186, 1841; ed. ii, p. 349, fig. 618.

Verrill, Report Invert. Vineyard Id., p. 638 [344], pl. 21, fig. 106, (after Gould).

Mangelia bicarinata Stimpson, Shells of New England, p. 49, 1851.

Defrancia bicarinata H. and A. Adams, Genera Recent Mollusca, i, p. 95, 1858.

Bela bicarinata G. O. Sars, Mollusca Arcticæ Norvegiæ, p. 237, pl. 16, figs. 11, 12, pl. ix, fig. 7, (dentition), 1878.

Bela bicarinata (continued.)Variety, *violacea* (Mighels and Adams).

Pleurotoma violacea Mighels and Adams, Proc. Boston Soc. Nat. Hist., i, p. 50, 1841;

Boston Journal Nat. Hist., iv, p. 51, pl. 4, fig. 21, 1842.

Defrancia cylindracea, *D. Beckii* and *D. livida* Möller, Ind. Moll. Grönl., Krøyer's Tidss., iv, pp. 86, 87, 1842.

Mangelia violacea Stimpson, Shells New Eng., p. 49, 1851.

Bela violacea H. and A. Adams, Genera Recent Mollusca, i, p. 95, 1858.

Gould, Rep. on Invert. of Mass., Binney's ed., p. 353, fig. 622.

G. O. Sars, Mollusca Reg. Arcticæ Norvegiæ, p. 238, pl. 17, figs. 2, 3; pl. ix, fig. 8, (dentition), 1878.

Pleurotoma grælandica and *P. rugulata* Reeve, (t. Jeffreys).

PLATE LVII, FIGURES 16, 16a.

Shell rather small, ovate-fusiform, with a moderately high, tapering spire, varying considerably in the proportion of length to breadth. Whorls six or seven, rounded, slightly obtusely shouldered on the lower whorls, at some distance below the suture, but more decidedly carinate-shouldered on the upper ones; ribs rudimentary or absent. The subsutural band is well-marked, sloping regularly from the suture to the shoulder, and usually crossed by numerous more or less distinct riblets, which are strongly excurved, and coincident with the lines of growth; on the upper whorls these riblets are more evident, a little prominent, and often cross the carina and extend below the shoulder, but usually only to a small extent; on the lower whorl the riblets, even on the subsutural band, are obsolete or cannot be distinguished from the lines of growth, which are fine and wavy. On the upper whorls, below the nuclear ones, there are usually two strong, raised, spiral cinguli, the upper one forming the carina of the shoulder; the other is about midway between the shoulder and the suture; between and below these are others that are finer, but of the same character, the total number, on the penultimate whorl, being usually seven or eight; one of these occasionally becomes as large as the two carinæ; on the last whorls the cinguli become more uniform in size, and more numerous, so that usually only the carina at the shoulder is distinguishable from the rest of the cinguli, and in var. *violacea*, even this is not always distinctly larger; on the subsutural band, there are fine, spiral lines, either just above the shoulder, or over the whole surface. The spiral cinguli are usually alternately larger and smaller, and are everywhere crossed by the lines of growth, which are sometimes so strong as to produce a finely cancellated appearance, under a lens. On the lower whorls the cinguli are sometimes so close that they are only separated by fine, impressed or incised spiral grooves.

The nucleus is prominent, the apical whorl is distinctly raised and a little incurved, nearly smooth, pale; on the second whorl two spiral carinæ appear, and on the third these become strong and are crossed by ribs. Slight, but distinct, nearly straight ribs are often present on the upper whorls, below the shoulder.

Aperture small, narrow-elliptical; outer lip with a well-marked, concave posterior sinus, below which it projects forward and is broadly rounded, and is scarcely incurved at the base of the canal, which is very short, straight, and open, truncate at the tip. Columella decidedly excavated in the middle.

Color, when fresh, commonly deep chestnut-brown, varying to pale chestnut, sometimes more or less violaceous brown; the canal and columella are usually pale.

Variety, *violacea* (Mighels and Adams).

This differs from the typical form only in being a little larger and stouter and in having the two carinæ on the upper whorls somewhat less evident (partly owing to erosion). The variety is connected with the typical form by intermediate specimens of every degree.

I have collected numerous specimens of this form in Portland harbor, at the precise spot where it was first found by Dr. Mighels, in 1841, and have them now before me. They belong to the stouter and smoother form of this species, of rather large size, dark colored, with a slightly bluish tint, and all have the upper whorls more or less eroded, so as to appear smoother than is natural.

As a general fact, it may be said that the young of this species, when perfect, have been classed as *B. bicarinata*, while the adult, or eroded young, have been named *B. violacea* by conchologists. The names of the two forms, as figured by G. O. Sars, do not essentially differ.

An adult specimen, with seven whorls, form *violacea*, is 11^{mm} long; breadth, 5^{mm}; length of body-whorl with canal, 7^{mm}; breadth, 4·2^{mm}; length of aperture, 5^{mm}; its breadth, 2^{mm}. A specimen of the typical form is 8·5^{mm} long; breadth, 3·75^{mm}; length of aperture, 4^{mm}; its breadth, 1·5^{mm}.

This species has a very extensive distribution. On our coast it is found from Cape Cod to Labrador! And in depth, from just below low-water mark to 110 fathoms! Greenland, 5 to 57 fathoms,—Jeffreys; Spitzbergen,—Torell and others; Iceland,—Mörch and others; Norway,—G. O. Sars; north of Hebrides and west of Ireland, 170 to 420 fathoms, Lightning and Porcupine Expeditions,—Jeffreys.

I have often dredged both the typical form and the var. *violacea* in Eastport harbor and the Bay of Fundy, in 10 to 50 fathoms, 1864, 1868, 1870. Messrs. Smith and Harger took large specimens of var. *violacea* on George's and LeHave Banks, 45 to 60 fathoms, on the "Bache," 1872. It has also been taken by the U. S. Fish Com. parties in Casco Bay, 1873; Gulf of Maine, 110 fathoms, 1874 (typical form); off Cape Ann, 38 fathoms (typical), 1878; Massachusetts Bay and off Cape Cod, 27 to 31 fathoms, 1879; Halifax harbor, 16 to 33 fathoms (both forms), 1877; off Martha's Vineyard, 28 fathoms. The Gloucester fishermen have brought it in from the banks off Nova Scotia (lots 626, 642).

This species occurs mainly on hard bottoms, of sand, gravel, pebbles and shells; but I have also taken it on muddy bottoms. We have not yet taken it in our deep-water dredgings, off Martha's Vineyard, though it will probably be found there hereafter.

Except when eroded, this species is scarcely liable to be confounded with any other of our coast. Worn specimens may easily be confounded with *B. decussata*, which it often resembles in size and form.

The two following species probably have not actually been found on the New England coast:

Bela Trevelyana (Turton).

Bela Trevelyana H. and A. Adams, Genera Rec. Moll., i, p. 92, 1858.

Verrill, Proc. U. S. Nat. Mus., iii, p. 365, 1880.

Pleurotoma Trevelyana Jeffreys, British Conchology, vol. iv, p. 398, 1867; vol. v, p. 222, pl. 91, fig. 8, 1869; Ann. and Mag. Nat. Hist., p. 332, 1876.

? *Bela Trevelyana* G. O. Sars, Moll. Arcticee Norvegiæ, p. 235, pl. 16, fig. 13, pl. ix, fig. 4.

This European species has been recorded by Jeffreys from the Gulf of St. Lawrence (coll. J. F. Whiteaves). I have seen no American specimens that I can refer to it, without much doubt. A few small specimens, taken off Nova Scotia, in 1877, have a strong resemblance to some forms of the European *B. Trevelyana*, and may, possibly, prove to be identical.

Bela Sarsii Verrill.

Bela cancellata G. O. Sars, op. cit., p. 224, pl. 23, fig. 31, pl. viii, fig. 9 (non Coutouy).

Bela Sarsii Verrill, Proc. U. S. Nat. Mus., iii, p. 364, 1880.

The name, *Sarsii*, was proposed by me for the species described and figured by Professor G. O. Sars as *B. cancellata*. It is a small, strongly sculptured, elongated species, with moderately convex, ob-

tusely shouldered whorls, and is especially distinguished by its few broad and strong, nearly straight ribs, crossed by rather distant revolving grooves, giving it a coarsely cancellated, or tessellated, surface. The uncini differ decidedly from those of *B. cancellata*.

This species has not yet been found on the New England coast. I have a specimen from Labrador, in poor condition, that may be identical, but it is doubtful.

Tromso, 10 to 12 fathoms,—G. O. Sars.

The three following species are still doubtful:

Bela rosea Sars.

? *Defrancia Woodiana* Möller, Ind. Moll. Grönl., Krøyer's Tidss., iv, p. 86, 1842.

Pleurotoma rosea M. Sars.

Bela harpularia G. O. Sars, Moll. Reg. Arcticæ Norvegiæ, p. 234, pl. 16, fig. 17, pl. ix, fig. 3 a-c (dentition), 1878 (non Couthour).

Bela harpularia, var. *rosea* G. O. Sars, op. ult. cit., p. 234, pl. 23, fig. 10.

The shells that I refer to this species agree well with the figures and description by G. O. Sars. They resemble *B. harpularia*, but I think them clearly distinct. In this species the aperture is narrower; the straight canal is narrower and longer; the columella is more flattened; and the whorls are more distinctly and decidedly shouldered than in *B. harpularia*. The shoulder is, in fact, usually angularly carinated, and rendered more or less nodulous by the prominent ribs, which are fewer, and less rounded and thickened along the edge, their intervals being rather wide and concave; in crossing the subsutural band the ribs are smaller and excurved, though nearly straight below the shoulder. The spiral cinguli are coarser and less numerous than in *B. harpularia*. The spire is more acute at tip, the first nuclear whorls being small and prominent; the second turn has two prominent carinæ; the third has about three spiral carinæ crossed by small riblets. The posterior sinus of the lip is well-marked. The color is usually pink or pinkish-white. One of the larger specimens is 12^{mm} long; breadth, 5.5^{mm}; length of body-whorl, 8^{mm}; of aperture, 6^{mm}; breadth of aperture, 2^{mm}.

Halifax harbor, 15 to 25 fathoms; off Halifax, 9 miles, 57 fathoms,—U. S. Fish Com., 1877.

Bela elegans (Möll.).

Defrancia elegans Möller, Krøyer's Tidss., iv, p. 86, 1842.

Pleurotoma elegans Jeffreys, Ann. and Mag. Nat. Hist., April, 1876, p. 331 (non Donovan, nec Bv., nec Brown, nec Scacchi).

Bela elegans G. O. Sars, Moll. Arcticæ Norvegiæ, p. 225, pl. 16, fig. 15, pl. viii, fig. 12 (dentition).

Jeffreys records this species from the Gulf of St. Lawrence (coll. Whiteaves), and from Greenland and Iceland. The shell intended may be only a variety of *B. cancellata*. Jeffreys, in the paper quoted, erroneously referred the latter to *B. Pingelii*. He states, however, that he has examined Möller's original specimens.

Bela angulosa G. O. Sars.

Op. cit., p. 227, pl. 16, fig. 16, pl. viii, fig. 10, 1878.

From Principal J. W. Dawson I have received a shell, dredged by him off Metis, mouth of the St. Lawrence River, which agrees very closely with Sars' description and figure of this species.

It is a very slender species with six whorls; the whorls are carinate-shouldered, and crossed by rather distant, large, angular ribs, very prominent at the shoulder, strongly excurved just above the shoulder, and becoming small on the subsutural band. Spiral lines numerous and fine, not present on the subsutural band. Aperture long and narrow; outer lip angulated, with a distinct sinus. Canal rather long, narrow, straight. Color white.

Length, 10^{mm}; breadth, 4^{mm}; length of body-whorl, 7^{mm}; length of aperture, 5^{mm}; width, 1.5^{mm}. This resembles the preceding species, but is more slender, with a narrower canal. The spiral lines are absent from the subsutural band.

Taranis Mörchii (Malm) Jeffreys.

Trophon Mörchii Malm, Göteborgs Videns Vett. Samh. Hand., iii, pl. 2, fig. 5, 1863, (t. Norman).

Taranis Mörchii (Malm) Jeffreys, Ann. and Mag. Nat. Hist., v, 1870.

G. O. Sars, Moll. Reg. Arcticæ Norvegiæ, p. 220, pl. 17, fig. 8.

Taranis Mörchii? Verrill, Amer. Journ. Sci., xx, p. 391, Nov., 1880; Verrill, Proc.

U. S. Nat. Mus., iii, p. 368, 1880.

Dall, Bulletin Mus. Comp. Zoology, ix, p. 70, 1882.

Pleurotoma cirratum Brugnone, Mem. Fleur. foss., 1862 (t. Monterosato), (*non P. cirrata* Bellardi, 1847).

Taranis cirrata Monterosato, Enum. e Sinon., p. 41; Conch. della Zona degli Abissi, Bull. Soc. Malac. Ital., vi, p. 74, 1880.

Taranis cirratus Jeffreys, Rep. Brit. Assoc., 1880, [p. 9].

PLATE LVII, FIGURE 18.

Shell small, angular-fusiform, with a moderately elevated, acute spire. Whorls six, strongly angulated and slightly carinated near the middle; the wide subsutural band, above the carina, slopes regularly and is flat, or a little concave.

A young specimen (fig. 18), having five whorls, has five revolving, nodulous carinæ on the body-whorl: one close to the suture; the sec-

ond and most prominent forms the carina of the shoulder; the other three are on the anterior half; some faint additional ones appear on the canal; the three preceding whorls have the subsutural and the sharp median carina, and usually the third carina is more or less exposed at the suture. Between the first and second carinæ the surface is flat or slightly concave. The whorls are crossed by numerous thin, delicate, flexuous, regularly spaced, raised riblets, which are conspicuous between the carinæ, and produce sharp nodules where they cross them. The nucleus is small, rounded, light chestnut-brown, minutely cancellated with microscopic lines running in two directions. Sinus of the lip shallow, rounded. Length, 4^{mm}; breadth, 2^{mm}.

A larger specimen, with six whorls, has, on the last whorl, seven regular, thin, elevated, well-spaced, spiral cinguli, between the carina of the shoulder and the base of the canal, and additional finer ones on the canal; a faint one also appears on the middle of the subsutural band. The body-whorl is crossed by numerous, regular, distinct, but fine, curved riblets, or raised lines of growth, which are excurved on the canal, angulated and excurved at the shoulder, and incurved at the suture. The canal is a little curved, short, narrow, a little constricted at its base by the incurvature of the outer lip.

Length, 4.50^{mm}; breadth, 2.25^{mm}.

Two examples were taken at station 894, in 365 fathoms, off Newport, R. I., 1880; another was dredged at station 994, in 368 fathoms, 1881,—U. S. Fish Com. Gulf of Mexico, 805 fathoms,—“Blake” Exp. (t. Dall.)

Taranis pulchella Verrill.

Taranis pulchella Verrill, Proc. U. S. Nat. Mus., iii, p. 368, 1880.

PLATE LVII, FIGURE 17.

A smaller and more slender species than the preceding, with a much smaller nucleus, a more acute spire, and with the carinæ sharp, but not nodulous.

Whorls seven, angular, the lower ones carinated and shouldered. Body-whorl with six revolving carinæ, besides one or two on the canal; one is just below the suture; the three largest surround the middle; the median one is most prominent. Between the subsutural and second carinæ the space is concave and crossed by numerous elevated, thin, curved riblets, corresponding to the labial sinus; similar but less prominent and less curved riblets cross the interspaces between the other carinæ, but do not cross the carinæ themselves.

Penultimate whorl with the subsutural and two median carinæ. Preceding whorls without distinct carinæ, except the subsutural one, but with the curved, transverse, raised riblets well-developed. Nuclear whorls very small (surface eroded). Aperture narrow, angular; canal short, slightly turned to the left; outer lip with a distinct, evenly rounded sinus below the subsutural carina. Columella slightly curved and flattened.

Length, 2·20^{mm}; breadth, ·90^{mm}; length of body-whorl, 1·40^{mm}; of aperture, ·95^{mm}.

Off Martha's Vineyard, station 892, in 487 fathoms, one specimen, —U. S. Fish Com., 1880.

Mangilia cerina Verrill.

Pleurotoma cerinum Kurtz and Stimpson, Proc. Boston Soc. Nat. Hist., iv, p. 115, 1851; Stimpson, Shells of New England, p. 49, pl. 2, fig. 2, 1851.

Mangilia cerina Verrill, Amer. Journ. Sci., iii, p. 210, 1872; Verrill, Rep. Invert. Anim. Vineyard Id., in Rep. U. S. Fish Com., i, p. 637, description, 432, (auth. ed. p. 343), 1874.

This shell is easily distinguished by its slender form, with the whorls angularly shouldered, and having a wide, concave, subsutural band. The ribs are few, angular, thick, obtuse.

Fig. 1.



The whole surface is covered by fine, spiral lines, minutely decussated by the lines of growth. Lip with a well-marked sinus below the suture, near the shoulder. Nucleus with the apical whorl regular, smooth, and very small, depressed; the second whorl is crossed by fine riblets, then two spiral grooves appear around the middle; on the third whorl there are three spiral grooves, and the riblets are more prominent, producing a decussated sculpture. On the fourth whorl the normal sculpture appears.

This species was erroneously omitted from Binney's edition of Gould's Invertebrata.

It is found near Newport, R. I., and in Long I. Sound, Vineyard Sound, Buzzard's Bay, etc., in 3 to 12 fathoms. It extends southward to the South Carolina coast. On the New England coast it is a rare shell, only found in our warmest waters.

The animal has not been examined.

RHACHIGLOSSA.

Marginella carnea Storer (?).

Marginella carnea Storer, Journal Boston Soc. Nat. Hist., i, p. 465, pl. 9, figs. 3, 4, 1837.

Marginella roscida? Verrill, Amer. Journ. Sci., xx, p. 391, Nov., 1880; Proc. U. S. Nat. Mus., iii, p. 369, 1880.

Our shell has a somewhat higher and more acute spire than the one figured by Storer, and the callus does not reach its summit. There are four prominent folds on the columella, the two anterior ones very oblique. The color is not preserved.

A single dead specimen, closely resembling this species, was taken off Martha's Vineyard, at station 865, in 65 fathoms, 1880. Another specimen, also dead, but more perfect, was taken, in 1881, at station 949, in 100 fathoms. Key West, Florida,—Storer.

Buccinum Linné (restricted); Lam., 1801.

Tritonium (pars) Müller; Lovén; Mörch.

Gould recognized three species of this' genus in his report on the Invertebrata of Massachusetts, viz: *B. undatum*, *B. Donovanii*, and *B. ciliatum*. The last two he only knew from the Grand Bank. The first is very abundant on the northern coasts of New England, both between tides, as at Eastport, Me., and Grand Menan I., and at all depths down to 50 fathoms or more, on hard bottoms, of sand or stones. It extends southward, along the coast, in equal abundance, in moderate depths, as far as the region off Chesapeake Bay, where it was taken in great numbers, and of large size, in 31 to 57 fathoms, by Lieut. Z. L. Tanner on the "Fish Hawk," in 1880. It varies greatly in different localities, and many varietal names have been proposed by European writers for the corresponding European forms.*

Dr. Wm. Stimpson and others have considered our species distinct (as *B. undulatum*) from the European *B. undatum*. Our littoral northern variety is certainly very different, as a variety, from the common shallow-water form of Great Britain, but the latter can be almost exactly matched by our specimens dredged abundantly on the

* The various species of *Buccinum* are notoriously variable and difficult to identify. The nucleus and upper whorls often afford excellent characters for separating some of the difficult species. It is, therefore, unfortunate that conchologists have seldom accurately described or figured the apex. The operculum, also, often affords good characters, in this genus.

sandy bottoms, off Cape Cod and south of Martha's Vineyard, while our littoral variety seems to have its counterpart on the northern coasts of Norway and Finmark.

B. Donovanii, hitherto not known south of the Grand Bank, Stimpson and many others have regarded as a valid species. Jeffreys (Annals and Mag. Nat. Hist., 1880) considers it a variety of *B. glaciale* Linné, but he refers Gould's shell to *B. Grönlandicum* = *B. cyaneum*. Metis, R. St. Lawrence! (coll. Dawson.)

According to Dr. Stimpson, Gould had included, in his collection, three distinct species under the name of *B. ciliatum*, one of which is the true *ciliatum* (Fabr.), but his description and the figure (in ed. I) apply more particularly to *B. Gouldii* V. The new figure, in ed. II, represents a different form.

Two northern species, not previously supposed to occur so far south, have been dredged by us, living, in considerable numbers, in the New England region, viz: *B. cyaneum* and *B. tenue*.

All these species were described in detail by Dr. Wm. Stimpson, in his Review of the Northern Buccinums,* in 1865.

The following additional species, apparently undescribed, occurred in deep water off Martha's Vineyard.

Buccinum Sandersoni Verrill, sp. nov.

PLATE LVIII, FIGURE 9.

Shell elongated, brownish, translucent, rather thin and delicate, with a high spire; well-impressed suture; strongly convex, obliquely ribbed and strongly spirally sculptured whorls; a large smooth, mammillary nucleus; a small aperture; and a short, nearly straight columella.

Whorls, in our largest example, seven, a little flattened below the suture, strongly convex in the middle; the penultimate whorl with about 13, broadly convex, curved ribs or undulations, strongly excurved at the middle of the whorl; on the body-whorl the ribs are less prominent and fade out below the middle; on the three upper whorls they are absent. The spiral sculpture, on the lower whorls, consists of prominent, narrow, rounded cinguli, unequal in size and separated by narrow grooves; usually there are three or four smaller and lower cinguli, between two of the larger ones, and sometimes a narrow groove appears on the larger ridges, dividing them into two;

* Canadian Naturalist, ii, pp. 364-389, Oct., 1865.

on the anterior part of the body-whorl the cinguli become more uniform in size and more numerous. On the second and third whorls the cinguli are large, regular, very prominent, and nearly equal, separated by deep concave grooves or sulci, about twice as wide; on the second whorl there are about 9 of these spiral cinguli; on the third whorl a few smaller ones begin to appear in the interspaces near the suture, and on the fourth whorl most of the grooves, have one or two small cinguli; the nine or ten larger primary cinguli can still be distinguished on the body-whorl. The whole surface is covered with fine, distinct lines of growth which decussate the cinguli and mostly cross the ribs somewhat obliquely. The nucleus is rounded and remarkably large for the genus (2^{mm} in diameter), translucent glossy brown, nearly smooth for about one turn and a half; the apex is regular and not obliquely raised.

The aperture is unusually small and short, elliptical, a little contracted posteriorly; outer lip thin, well-rounded, the edge receding in a broad curve below the suture; canal short and narrow; columella rather straight, thin, with the folds slightly developed; the anterior end thin, rounded and projecting quite as far as the lip; the upper part of the columella-lip is not excavated, nor distinctly excurved. The operculum is small, pale yellow, rounded-elliptical, with the nucleus at about the middle of the length and a little to one side of the centre. Epidermis thin and smooth. Color of the shell, with epidermis, yellowish brown, to dark reddish brown, sometimes with small paler spots on the larger spiral ridges; columella whitish, inside of aperture pale orange-brown, or light amber.

Our largest example (female) is 46^{mm} long; breadth, 21^{mm}; length of body whorl 29.5^{mm}; length of aperture, 21.5^{mm}; its breadth (lip broken), 12^{mm}; length of operculum, 11.5^{mm}; its breadth 9^{mm}. A male has very nearly the same proportions.

Off Martha's Vineyard, station 939, in 258 fathoms; station 1032, in 208 fathoms, 1881; three living examples, male and female.

This species resembles some of the varieties of *B. undatum*, but besides its more slender and elongated form and more delicate texture, it differs decidedly in the character of the spiral sculpture, the shortness and small size of the aperture, and in the operculum; but the most striking differences are in the nucleus and upper whorls, for the nucleus is more than twice as large as that of *B. undatum* (fig. 10), and different in character, on the second and third whorls the spiral cinguli are fewer, and very much more prominent and coarser. The character of the nucleus and upper whorls will also distinguish

it from *B. cyaneum* and all the other species of our coast. In the form of the aperture and columella it resembles *B. cyaneum*.

I have named this interesting shell in honor of Mr. Sanderson Smith, of the U. S. Fish Commission parties, during these explorations.

Buccinum cyaneum Brug.

Buccinum cyaneum Bruguière, Encyc. Meth., Vers., i, 266, 1792, (t. Stimp., Jeffreys.)

Beck, in Möller, Krøyer's Tidsskrift, iv, 84, 1842.

Reeve, Conch. Icon., iii, Buc., ix, p. 69, 1846, (t. Stimp., Jeffr.)

Buccinum boreale Leach, Jour. de Phys., etc., lxxxviii, p. 464, 1819, (t. Stimp.)

Gray, Zool. of Beechey's Voy., p. 128, 1839, (t. Stimp., Jeffreys.)

Brod. and Sow., Zool. Journ., iv, p. 375, 1829.

Buccinum cyaneum Stimpson, Review Northern Buccinums, Canadian Nat., ii, p. [19], Oct., 1865.

Verrill, Amer. Journ. Sci., xvi, p. 210, 1878; Proc. Nat. Mus., iii, p. 371, 1880.

Buccinum sericatum Hancock, Ann. and Mag. Nat. Hist. [1], xviii, p. 328, pl. 5, fig. 6, 1846, (t. Stimp., Jeffr.)

Buccinum tenebrosum Hancock, Ann. and Mag. Nat. Hist. [1], xviii, p. 327, 1846, (t. Stimpson), (*non* Möller).

Tritonium grönlandicum Mörch, in Rink's Grönland, Tillæg, Aftr., 84, 1857 (t. Stimp., Jeffr.)

Buccinum grönlandicum G. O. Sars, Mollusca Reg. Arcticæ Norvegiæ, p. 259, pl. 13, figs. 9, 9a, pl. 25, figs. 1, 2, pl. x, fig. 11, a-b (dentition), 1878, (*non* Stimpson). Jeffreys, Ann. and Mag. Nat. Hist., Apr., 1876, p. 323 (animal described); Northern Species of *Buccinum*, Ann. and Mag. Nat. Hist. vi, p. 424, Dec., 1880.

Friele, Catal. Norweg. Nordm. Exp. Spitzb. Moll., p. 278, pl. 7, figs. 1-7 (dentition).

Variety, *Perdix*, or *Finmarchianum*.

Tritonium grönlandicum, var. *perdix* (Beck) Mörch, Faun. Moll. Islandiæ, p. 211, 1868.

Tritonium grönlandicum, var. *glabra* Mörch, Cat. Moll. Spitzberg, p. 14 (description), 1869.

Buccinum finmarchianum Verkrusen; G. O. Sars, Mollusca Reg. Arcticæ Norvegiæ, p. 262, pl. 13, fig. 10, pl. 25, figs. 3, 4, pl. x, fig. 12 (dentition), 1878.

Buccinum grönlandicum, var. *finmarchianum* Jeffreys, op. ult. cit., p. 424, 1880.

PLATE XLIII, FIGURE 5. PLATE LVIII, FIGURE 11.

This species was dredged by us in the summer of 1877, on the U. S. Fish Com. steamer "Speedwell," off Cape Sable, Nova Scotia, in 82 to 91 fathoms, fine, compact sand, where it was common, and off Halifax, in 100 fathoms. In 1879, we also took it about 15 miles east from Cape Cod, in 70 to 90 fathoms. This was the first instance of its occurrence on the New England coast. It was taken on Le Have Bank, in 45 fathoms, by Messrs. S. I. Smith and O. Harger, on the "Bache," in 1872. It has often been brought in from the banks

off Nova Scotia, and from the Grand Bank, by the Gloucester fishermen. Gulf of St. Lawrence, off Metis (coll. Dawson).

Some of our specimens belong to the dark variety, *tenebrosum* Han.; others are near the variety *Finnarchianum* Verkrusen. The variety *perdix* or *glabra* Mörch (Catal. Moll. Spitzberg, p. 14, 1869), is probably the same thing as the latter.

Our specimens vary considerably in color and in sculpture. They mostly have light shades of brown or yellowish brown, varied with lighter and darker tints, and mostly with the principal revolving cinguli darker brown, interrupted by pale spots, the whitish spots often wider than the spiral lines; interior light yellowish brown or salmon, the external colors often showing through; columella whitish. Epidermis thin, closely lamellose along the lines of growth, and in the freshest and young alcoholic specimens with rows of fine, short hairs along the revolving cinguli; these are usually rubbed off from dried specimens. Whorls seven, well-rounded, often obscurely shouldered; suture impressed.

Many of the specimens are entirely without undulations or ribs; others have 12 to 15 short but distinct ones, most prominent close to the suture, mostly only slightly flexuous, fading out on the convexity of the whorl, or passing insensibly into the lines of growth, which are usually raised and very distinct, receding strongly at the shoulder, or on the convexity of the whorls.

The spiral sculpture consists of numerous, close, unequal, wavy, slightly raised cinguli, separated by fine, narrow, impressed grooves; usually there are, on the lower whorls, ten to twelve larger and slightly more raised cinguli, between which there may be three to five smaller and lower cinguli, varying among themselves in size and height, and becoming still more numerous on the last whorl; the largest of these cinguli are not very prominent, and are more or less angular, and the grooves between are shallow and not sharply cut. These grooves are finely decussated by the thin, close, raised lines of growth, which also cross the cinguli, giving them a minutely wavy appearance.

The nucleus is a little prominent, with its suture impressed; the apical whorl is small, regularly spiral, smooth, glossy yellowish or chestnut-brown; about eight fine, spiral cinguli, with their interstices decussated by the lines of growth, begin on the second whorl; on the third whorl there are about twelve of these, and they begin to be alternately larger and smaller.

Aperture short, irregular, rather small; outer lip with a well-

marked sinus below the suture, in adult shells, and then a little ex-curved and thickened; below this, broadly rounded, often somewhat expanded anteriorly and usually extending somewhat beyond the end of the columella; canal short, obliquely truncated, not very wide; columella-lip regularly arched above the middle, not excavated; columella smooth, nearly straight in the middle, a little receding, thin and evenly rounded at the end; plications quite obsolete, or very nearly so. Operculum irregularly elliptical, obliquely narrowed at the right end, its nucleus excentric, nearest the broad end, and not far from the edge.

A female, of the ordinary size, from off Cape Sable, N. S., is 43^{mm} long; breadth, 25^{mm}; body-whorl, to end of columella, 30^{mm}; its breadth, 20^{mm}; length of aperture, 23^{mm}; its breadth, 13^{mm}; length of operculum, 11.5^{mm}; breadth, 9^{mm}.

Var. *patulum* (G. O. Sars).

Op. cit., p. 260, pl. 25, fig. 2.

From Murray Bay, mouth of the St. Lawrence River, Principal Dawson has sent me specimens, of a peculiar, rather small form, belonging, apparently, to this species. The aperture is unusually broad, with the lip expanded and patulous anteriorly, projecting decidedly beyond the columella. The surface is eroded, but was nearly smooth, without ribs, and with fine wavy, unequal, spiral lines, mostly indistinct; one specimen has several larger, distant, raised spiral lines. The color is dark brownish; inside of aperture purplish or livid brown.

This species appears to be circumpolar. It is common in Davis Straits and on the coasts of Greenland, Spitzbergen, Nova Zembla, Iceland, Finmark, Lapland, etc. Fossil in the Post-pliocene of Canada.

Mörch, in adopting *Grönlandicum* for this species, simply took up a part of the polynomial name used by Chemnitz, which has no claims to priority under the ordinary rules of binomial nomenclature. Stimpson, therefore, very properly rejected that name, as applied to this species, and adopted the first distinctive binomial name given to it. Jeffreys has followed Mörch in using *B. Grönlandicum*, and various other European writers have followed the same usage, apparently without sufficient reason. This has given rise to much confusion, because *Grönlandicum* has been extensively used for a very different species by Hancock, Reeve, Stimpson, and various other writers.

The *Tritonium Terræ-Novæ* (Mörch) has been referred to *B. Totteni* by Jeffreys, but Mörch himself suggested that it might be a

variety of the present species, to which some of the figures of it certainly bear a very strong resemblance.

Numerous examples of clusters of cylindrical, often very much elongated, clusters of egg-capsules have been brought from the Grand Bank by the Gloucester fishermen. These, I suppose, belong to this species, but I have no positive evidence. The clusters are usually about an inch in diameter and 3 to 5 inches long. By the fishermen, these are called "sea-corn" and "green-corn."

Buccinum tenue Gray.

Buccinum tenue Gray, Zool. of Beechey's Voy., p. 128, xxxvi, 19, 1839, (t. Stimpson).

Reeve, Conch. Ic., iii, Buc., iv, 27, 1846, (t. Stimpson).

Buccinum scalariforme Beck, in Möller, Krøyer's Tidsskrift, iv, p. 84, 1842, (t. Stimp., Jeffr.)

Packard, Canadian Naturalist, viii, 417, 1863.

Dawson, Canadian Naturalist, [2], ii, p. 88, 1845.

Tritonium scalariforme Mörch, in Rink's Grönland, Tillæg, Aftr., p. 84, 1857; Arctic Manual, p. 128, 1875.

Buccinum tenue Stimpson, Review Northern Buccinums, Canadian Nat., ii, p. [14], Oct., 1865.

Friele, op. ult. cit., pl. 7, figs. 11, 12, dentition.

Jeffreys, Ann. and Mag. Nat. Hist., Apr., 1876, p. 324 (animal described); Northern Species of *Buccinum*, Ann. and Mag. Nat. Hist., vi, p. 425, Oct., 1880.

PLATE XLIII, FIGURE 4.

Dredged alive, in considerable numbers, in 1877, by the U. S. Fish Com. steamer "Speedwell," off Cape Sable, N. S., in 88 to 91 fathoms, on a bottom of fine compact sand, associated with *B. cyaneum* and *Sipho pubescens*. Also off Cape Sable, 22 miles, 59 fathoms; mouth of Halifax Harbor, 21 fathoms, 9 living young; off Halifax, 9 to 12 miles, 42 to 92 fathoms. It had not been found so far south previously. These specimens all belong to a small race of the species. Gulf of St. Lawrence, Bradelle and Orphan Banks, 50 to 60 fathoms,—Whiteaves. Off Metis! (coll. Dawson.) Labrador, Greenland! Spitzbergen, Nova Zembla, Bering's Straits, (t. Stimpson). Spitzbergen, 20 to 125 fathoms,—Friele. Fossil in Post-pliocene beds at Rivière du Loup, Canada, Labrador, and coast of Hudson's Bay (t. Stimpson).

Among several specimens kindly sent to me by Principal J. W. Dawson, dredged by him off Metis, near the mouth of the River St. Lawrence, some are larger than those from off Nova Scotia. The largest is 62^{mm} long; breadth, 32^{mm}; length of aperture, 29^{mm}; its breadth, 16^{mm}.

In order to make this list more complete, I include here the following species of *Buccinum*, although they may not have been taken south of Newfoundland and the Gulf of St. Lawrence.

Buccinum Tottenii Stimpson.

Buccinum ciliatum (*pars*) Gould, Invert. Mass., p. 307, 1841; ed. II, p. 368, (*non* Fabr.)

Dawson, Canadian Nat., ii, p. 415, pl. 7, fig. 5, 1857, (*non* Fabr.)

Buccinum Tottenii Stimpson, Review Northern Buccinums, Canadian Nat., ii, p. [23], Oct., 1865.

Buccinum Tottenii Jeffreys, Northern Species of Buccinum, Ann. and Mag. Nat. Hist., vi, p. 425, Dec., 1880.

Friele, Catal. Norweg. Nordm. Exp. Spitzb. Moll., p. 278, pl. 7, figs. 11, 12 (dentition).

? *Tritonium terræ-novæ* Mörch, Catal. Moll. du Spitzberg, p. 14, (extract from Ann. Soc. Malacol. Belg., iv, 1869).

Buccinum terræ-novæ Leche, Kongl. Sv. Vet.-Akad. Handl., xvi, [p. 61], pl. 2, figs. 30a, b (shell), 30c, d (dentition), 1878.

Grand Bank, Newfoundland,—coll. Totten (t. Stimpson). Several specimens from the Grand Bank have been presented to the U. S. Fish Com. by the fishermen of Gloucester, Mass. Off Metis, R. St. Lawrence! (coll. Dawson.) Spitzbergen, 20 to 50 fathoms,—Leche, Friele.

By Jeffreys, *B. Terræ-Novæ* (Mörch) is regarded, after an examination of the original specimens, as identical with *B. Tottenii*. To judge from some of the descriptions and figures, it would appear to be a variety of *B. cyaneum*, as Mörch himself suggested. The figure given by Leche appears, however, to represent a carinated variety of *B. Tottenii*.

Buccinum tumidulum G. O. Sars.

Op. cit., p. 263, pl. 25, figs. 5, 6, pl. x, fig. 13.

This species is remarkable for the nearly smooth, ventricose whorls, for the wide extension of the enamel over the body-whorl (as in *B. hydrophanum*), and especially for the nearly round operculum, which has a central nucleus.

From the Grand Bank, I have a thin, white shell, which agrees exactly with Sars' figure in size and form, but it lacks the operculum. It has the same extension of the enamel, and is finely and closely spirally striated; close to the suture there are slight and short undulations. The columella-lip is excavated and curved as in Sars' figure.

It seems probable that this is identical with *B. tumidulum*, but I had considered it a variety of *B. hydrophanum*. Friele and Jeffreys refer *B. tumidulum* to *B. hydrophanum* Han., as a variety. The latter is described as smooth, with a smooth epidermis, and is a more elongated form, with less convex whorls. *B. Mörchi*, Friele (Nyt. Mag. Naturv., xxiii, [p. 4], pl., figs. 7, 7a, teeth and operculum, 1877), seems to be a closely related form, and also has a roundish operculum with a central nucleus. Jeffreys unites this, also, to *B. hydrophanum*. If *B. tumidulum* Sars be really a variety of *B. hydrophanum* Han., then the latter must, apparently, be added to the list of species inhabiting the Grand Bank.

Buccinum Gouldii, nom. nov.

Buccinum ciliatum (*pars*) Gould, Invert. Mass., ed. I, 307, fig. 209, 1841; ed. II, p. 368, fig. 635 (?).

Reeve, Conch. Icon., iii, Buc., i, fig. 1 (*non* O. Fabr.), 1846, (t. Stimpson).

Buccinum Humphreysianum Stimpson, Review Northern Buccinums, Canadian Nat., ii, p. [24], Oct., 1865, (*non* Bennett).

This name is proposed, provisionally, for the shell figured by Gould (ed. I) and described as *B. Humphreysianum** by Dr. Stimpson. It differs from the European species, of that name, as already mentioned by Jeffreys and others, in having a ciliated epidermis and in other characters.

This shell is remarkable for its swollen, rounded whorls, the deep excavation of the columella-lip, the anterior expansion of the rounded outer lip, and the thinness and nearly smooth surface of the shell.

This shell may, perhaps, prove to be only a variety of some previously known species. In that case, *Gouldii* may still be used as a variety name, to designate the form. It does not appear to correspond with any of the forms described by European writers.

* I add references to this European shell, which, probably, has not been met with on the American coast.

Buccinum Humphreysianum Bennett.

Buccinum Humphreysianum Bennett, Zool. Journ., London, i, 398, pl. 22, upper figures, 1825.

Forbes and Hanley, Brit. Moll., iii, 410, pl. 110, fig. 1.

G. O. Sars, Mollusca Reg. Arcticæ Norvegiæ, p. 264, pl. 25, figs. 7, 8, pl. x, fig. 14 (dentition), 1878.

Jeffreys, Northern Species of Buccinum, Ann. and Mag. Nat. Hist., vi, p. 424, Dec., 1880.

Ireland,—Bennett. Greenland, Lapland, Zetland, west coast of Norway,—G. O. Sars.

A specimen that I suppose to be the young of this species is a small, very thin, translucent, pale yellow, smooth shell, with an acute spire, a very small, regularly spiral nucleus, five convex whorls, impressed suture, and excavated columella-lip. The whorls are evenly rounded and with faint traces of shallow spiral lines, no undulations. This was dredged by Messrs. Smith and Harger, on Le Have Bank, 60 fathoms, in 1872. This may possibly be the young of *B. hydrophanum*.

Leche (op. cit., p. 59) has referred Gould's *B. ciliatum* to "*B. ovum* Turton," which he also unites to *B. Dalei* (= *Liomesus Dalei* Stimp., 1865,* or *Buccinopsis Dalei* Jeffreys, 1867), but this is doubtless an error.

Grand Bank (coll. Gould) and mouth of McKenzie River, (t. Stimpson.)

Buccinum ciliatum (Fabr.) Möller.

Tritonium ciliatum O. Fabr., Fauna Grönlandica, p. 401, 1780.

Mörch, in Rink's Grönland, Tilleg, Afr., p. 84, 1857; Arctic Manual, p. 128, 1875.

Buccinum ciliatum Möller, Krøyer's Tidsskrift, iv, p. 85, 1842.

Reeve, Conch. Ic., iii, Buc., v, 29, 1846, (t. Stimp.)

Gould, Invert. Massachusetts, ed. I, p. 307; ed. II, p. 368, (in part only, not the figures).

Stimpson, Review Northern Buccinums, Canadian Nat., ii, p. [11], Oct., 1865.

Jeffreys, Ann. and Mag. Nat. Hist., Apr., 1876, p. 324; Northern Species of Buccinums, Ann. and Mag. Nat. Hist., vi, p. 425, Dec., 1880.

Buccinum Mölleri Reeve, Icon., iii, 1846, (t. Stimpson, Jeffreys).

Grand Bank,—coll. Gould, (t. Stimpson). Murray Bay, mouth of St. Lawrence River, 112 fathoms, and Rivière du Loup!—coll. Dawson. Greenland, 5 to 175 fathoms,—Valorous Exp. (t. Jeffreys). White Sea, Spitzbergen, Lapland (t. Jeffreys). Bering's Straits and Arctic Ocean adjacent, and mouth of McKenzie River, (t. Stimpson).

Dr. Stimpson mentions a specimen from Nova Scotia, received from Mr. J. R. Willis, but the collection of Mr. Willis was largely

* I take this opportunity to state that *Liomesus* Stimpson should be retained for this genus, instead of *Buccinopsis* Jeffreys (Brit. Conch., iv, p. 297, 1867). The former was established in 1865 (Review Northern Buccinums, p. 4), on account of peculiarities of the dentition, which were stated, and *B. Dalei* was cited as the type. Jeffreys erred, therefore, in saying that the genus was not defined by Stimpson, as he also did in objecting to the meaning of the name, which clearly refers to the smoothness of the median plates of the radula,—not to the smoothness of the shell, as Jeffreys imagined. *Liomesus eburneus* (Sars) has, according to the figures of G. O. Sars, the same character of dentition given as distinctive of the genus by Dr. Stimpson.

derived from the bank-fisheries, and his specimen may have come from the Grand Bank.

Neptunea, Tritonofusus and Sipho.

Fusus (*pars*) Brug.; Lamarck, An. sans Vert.; Gould; Jeffreys, etc., (*non Fusus* Klein, 1753, *nec* Lam., 1801.)

Neptunea Bolten. Mus. Bolt., 1798 (*N. antiqua*).

H. and A. Adams, Genera of Rec. Mollusca, i, p. 79, 1858.

Chrysodomus Swainson, 1840 (*C. antiquus*).

Atractus Agassiz (*A. corneus*), 1837 (*non* Lap., 1833, *nec* Wagl., 1828).

Sipho (*pars*) Klein, 1753; Mörch, Catal. Yoldi, i, p. 104, 1852; (subgenus) Mörch, Nat. Bidr. Beskr. Grönland, p. 85, 1857 (*F. Islandicus*, etc.), (*non* Brown, 1827).

Tritonofusus (subgenus) Mörch, op. ult. cit., p. 85, 1857; Catal. Moll. Spitzberg, p. 15, 1869 (*F. Kroyeri*, *F. latericeus*).

Nephtnella (subgenus) Verrill, Amer. Journ. Sci., vi, p. 439, 1873 (*N. pygmæus*); Rep. Invert. Vineyard Sound, p. 345 [639], 1874 (*non* Gray, *nec* Meek, 1864, fossil).

Siphonella (subgenus) Verrill, Preliminary Check List, p. 20 (*S. pygmæus*), 1879 (*non* Macq.).

Volutopsius (subgenus) Mörch, Nat. Bidr. Beskr., Grönland, p. 85, 1857 (*F. Norvegicus*).

The name, *Fusus*, was definitely restricted by Lamarck, in 1801 (Syst. des An. sans Vert., p. 82, type, *F. longicauda*), to the tropical group belonging to the Fasciolaridæ (*Colus* auth.), and for that group it should be retained.

This group undoubtedly includes three or more genera, but all these generic groups have not yet been clearly differentiated, nor satisfactorily defined. Among our species, we have two that belong to typical *Neptunea*, viz: *N. despecta*, var. *tornata*, (Gould), and *N. decemcostata*. The former was known to Gould only from the Grand Bank, and northward, but we dredged it, in 1881, off Martha's Vineyard, station 949, in 100 fathoms.

From the Gloucester fishermen the typical form of *N. despecta* has also been received (lot 861). In this, the spiral carinæ are much less prominent than in the var. *tornata*.

Of the group called *Sipho* by Mörch, G. O. Sars, and others, we have several species, three of which were known to Gould, viz: *S. Stimpsonii* (Mörch)* = *Fusus Islandicus* Gould (*non* Linné); *S. ven-*

* Mörch, in Faunula Moll. Ins. Feroënsium, Vid. Med. Nat. Forh., p. 83, 1867, named this species thus: "*Fusus Stimpsonii* (*F. corneus* Say, Am. Conch.)" This is, so far as known to me, the first distinctive name for the species. The name, *F. curtus*, was given by Jeffreys the same year (Brit. Conch., iv, p. 336, 1867), but it was then applied particularly to a fossil form, which may or may not be the same as a certain "North-American form" referred to in such an indefinite manner that no one but the author

tricosus (Gould); and *S. pygmaeus* (Gould). The first of these is abundant, at moderate depths, from off Long Island to Nova Scotia. It varies much in proportion of length to breadth, and in sculpture, sometimes being nearly smooth, at other times deeply and regularly spirally grooved.* *S. ventricosus* was known to Gould only from the Grand Bank, and I have seen several specimens recently brought from there by the Gloucester fishermen. Stimpson (Shells of New England) records it as from George's Bank and near Nantucket

could have been sure as to which of our three known species he had in mind. The passage referred to, which occurs in course of remarks on the distribution of *F. gracilis*, is as follows: "I do not consider the Crag specimens which have been referred to this species by Searles Wood, Woodward, and Nyst identical with the above [*F. gracilis*]. The last agree with the North-American form, which is smaller, more tumid, and has a short spire. If such prove to be distinct, it might be called *curtus*." Neither the name nor the characters given apply well to the ordinary form of *S. Stimpsonii*, which often grows to a larger size than Jeffreys gives for *S. gracilis*, and has a long, acute spire, though there is, as usual in the genus, a shorter and stouter variety. His description and name would apply better to another American form, the *Fusus ventricosus* of Gould.

For these reasons I consider it both desirable and necessary to adopt the name given by Mörch, about which there can be no doubt. Subsequently, this species was named *F. Americanus* by Bell.

As to the smaller size of the American shell, I think Mr. Jeffreys was mistaken. I give here a few measurements, to illustrate both the large size and the variations in proportions of *S. Stimpsonii*:

One male, out of a lot of very large specimens, from off Cape Cod, 45 fathoms, measures in length, 4.8 inches, or 121^{mm}; breadth, 2.1 inches, or 53^{mm}; length of body-whorl, 88^{mm}; its breadth, 43^{mm}; length of aperture, 71^{mm}; its breadth, 27^{mm}; length of operculum, 33^{mm}; its breadth, 20^{mm}. A large female, from the same region, is 115^{mm} long; 49^{mm} broad; length of aperture, 52^{mm}; its breadth, 25^{mm}.

An elongated specimen, of the variety *livatulus*, from off Martha's Vineyard, 183 fathoms, is 82^{mm} long; breadth, 31^{mm}; length of body-whorl, 56^{mm}; its breadth, 27^{mm}; length of aperture, 42^{mm}; its breadth, 14^{mm}.

A short, stout, lightly grooved specimen (var. *brevis* V.), from off Chatham, Cape Cod, (st. 978), 17 fathoms, is 55^{mm} long; breadth, 28^{mm}; length of body-whorl, 43^{mm}; length of aperture, 35^{mm}; its breadth, 14^{mm}.

* To the strongly grooved, deep-water variety, I gave the name, *Neptunea arata* (Proc. Nat. Mus., 1880, p. 370), thinking, at that time, that it could be distinguished specifically. A much larger series, obtained in 1881, in the same region, convinced me that it is only an extreme variety, which is connected by intermediate states with the faintly grooved or nearly smooth, shallow-water forms. I have collected the latter, in abundance, even at low-water, in the Bay of Fundy. The name, *Neptunea arata*, having previously been used by Gould, I propose to designate this variety as *Sipho Stimpsonii*, var. *livatulus*. If it be thought desirable to designate the shorter and stouter form of this species by a special varietal name, it may be called *S. Stimpsonii*, var. *brevis* V. All the intermediate forms occur, however.

Shoals. Probably the last-named locality is erroneous, and perhaps both are so. The short variety of *S. Stimpsonii* may have been intended.

The third species, *S. pygmaeus*,* is very abundant at moderate depths, from off Chesapeake Bay to Nova Scotia.

Several Arctic species, not mentioned in Gould's Report, have been discovered in the deeper parts of the Gulf of St. Lawrence, and in the deep channel near the mouth of the St. Lawrence River, at Murray Bay, etc., by Dr. J. W. Dawson, Mr. J. F. Whiteaves, and others, and also on the Grand Bank of Newfoundland.

The researches of the U. S. Fish Commission have added at least five species, of the *Sipho*-group, to the fauna of the New England coast. Two of these (*S. cœlatus* V. and *S. glyptus* V.) are small, transversely ribbed species, and may belong to a special division, or subgeneric group.

Sipho pubescens Verrill, sp. nov.

Neptunea propinqua Verrill, Amer. Journ. Sci., xvi, p. 210, 1878.

Neptunea (Sipho) propinqua Verrill, Amer. Journ. Sci., xx, p. 391, Nov. 1880; Verrill, Proc. U. S. Nat. Mus., iii, p. 370, 1880 (*non* Alder, Jeffreys, etc.)

PLATE XLIII, FIGURE 6; PLATE LVII, FIGURE 25.

Shell rather short, fusiform, regularly tapered, obtuse at the tip of the spire, with the suture deep and canaliculate. Whorls about seven, broadly rounded and somewhat flattened, narrowly but distinctly channeled at the suture. Sculpture, over the whole surface, regular and numerous, shallow, spiral grooves or sulci, separated by slightly raised, flat, or somewhat rounded cinguli, usually, but not constantly, wider than the sulci; on the penultimate whorl there are about 14 to 16 of the sulci; slight, but distinct, curved lines of growth cover the surface. Aperture narrow, ovate-elliptical; outer lip broadly and regularly rounded, the edge receding in the middle in a broad, concave curve; at the base of the canal the lip is decidedly

* For this species I established the subgeneric group, *Neptunella*, in 1873, and afterwards (1879) changed the name to *Siphonella*, the former having previously been used by Gray and by Meek. The principal reason for this separation was the character of the odontophore (pl. 57, fig. 21), contrasted with that of *S. Bernicensis*, taken as the type of *Sipho*. It cannot well be separated, even as a subgenus, from *S. Islandicus* and *S. gracilis*, by the dentition alone, according to the figures of these, given by G. O. Sars. The subgeneric group, *Siphonorbis* Möreh, based on the character of the nucleus, may be identical with *Siphonella*. The latter name also appears to have been preoccupied, and must be dropped.

incurved. Canal moderately long, somewhat contracted, spirally carved to the left and strongly bent backward at the tip. Columella very much bent, with a strong sigmoid curvature; the portion opposite the middle of the aperture greatly receding. Epidermis thin, but firm, yellowish green to olive-green, when fresh and uninjured covered with fine, short capillary processes, forming spiral lines along the cinguli.

The nucleus is moderately large (diameter 2.15^{mm}), somewhat mammillary; its first whorl is strongly turned up obliquely and incurved, smooth. The median tooth of the radula is broad, with three denticles, the middle one largest; the lateral teeth are large, with three sharp, curved denticles, the outer one much the largest, the middle one smallest; occasionally the inner one bears a small secondary denticle on its outer edge.

Operculum long, ear-shaped, with the nucleus at the tip of the small end, which is but little incurved; inner edge strongly convex, beyond the middle; outer edge broadly rounded; color, dark yellowish green. The verge is moderately large, sigmoid, flattened, tapering to an obtuse point, with a small conical papilla near the tip, on the dorsal side.

Color of the shell white; inside of aperture translucent bluish white.

A female of the ordinary adult size and form is 65^{mm} long; breadth 28^{mm} ; length of canal and body-whorl, 46^{mm} ; breadth of body-whorl, 25^{mm} ; length of aperture, 35^{mm} ; its breadth, 14^{mm} ; breadth of opening of canal, at base, 5^{mm} .

An average male is 56^{mm} long; breadth, 26^{mm} ; length of body-whorl, 40^{mm} ; its breadth, 17^{mm} ; length of aperture, 31^{mm} ; its breadth, 12^{mm} . A specimen more slender than usual, is 55^{mm} long; breadth, 22^{mm} ; length of aperture, 30^{mm} ; its breadth, 10^{mm} .

On the American coast, this species was first dredged by us in 1877, on the United States Fish Com. steamer "Speedwell," off Cape Sable, N. S., in 88 to 91 fathoms, fine compact sand, where it occurred in considerable numbers, living; and off Halifax, 42 fathoms, dead.

Off Martha's Vineyard this species is very common, in deep water; it occurred, at 45 stations in that region, in 1880 and 1881. Living specimens were taken, in 86 to 410 fathoms, but it is most abundant between 200 and 410 fathoms; at station 998, in 302 fathoms, 154 specimens were taken, 140 of them living. Dead shells, inhabited by *Eupiguri*, occurred in 64 to 85 fathoms, and also in 458 fathoms. It was taken by Lieut. Z. L. Tanner, on the "Fish Hawk," in 1880, off

Chesapeake Bay, in 56 to 300 fathoms: at station 898, in 300 fathoms, 165 specimens were taken, 115 of them living. Off Delaware Bay, in 156 and 435 fathoms, in 1881.

This shell is closely allied to *S. propinquus* (Alder) of Europe, to which I formerly referred it, with doubt. It agrees very well with that species in form and sculpture; in the canaliculate suture; and in the character of the epidermis, except that our shell seems to be constantly and more decidedly hairy. Our species is, however, a larger and more robust shell, and its nuclear whorls are totally different, for according to Jeffrey's description and figure, *S. propinquus* always has a regularly spiral nucleus, with the first whorl minute and not turned up; this is, also, the case with an authentic specimen, in my possession, received from the Rev. A. M. Norman.

S. turgidulus (Jeff.) Friele is also closely related to our species, in form, sculpture, epidermis, and in having a similar nucleus (as figured by Friele), but it has a shorter canal, and the form of the operculum and character of the dentition are very different.

Sipho Sabinii (Gray).

Buccinum Sabinii Gray, Supplement to Appendix of Capt. Parry's first Voyage, p. ccxl, 1824.

? *Fusus Sabinii* Friele, Prelim. Report on Moll. Norwegian N. Atlantic Exp., 1876, Nyt. Mag. Naturvid., xxxiii. [auth. cop. p. 7] pl., fig. 15, 15a (teeth and operculum). 1877, (non Hancock, nec Jeffrey).

Sipho Sabinii Leche, Öfversigt Svenska Exp. Hafs-Mollusker, Kongl. Svenska Vetenskaps-Akad. Handl., xvi. [auth. ed., p. 89] pl. 1, fig. 23a (shell) 23c, d (dentition). 1878.

PLATE LVII. FIGURE 23.

I refer to this species, with some doubt, a small species of *Sipho*, of which I have only two young specimens, taken on Cashe's Ledge, off the coast of Maine, by Dr. A. S. Packard and party, on the "Bache," while dredging there for the U. S. Fish Com., in 1873.

This shell is evidently distinct from all the other species found on our coast, but the absence of the operculum and soft parts, as well as the immature state of the shell, makes the identification somewhat uncertain, but it agrees well with Gray's original description, so far as that goes.* It also corresponds nearly with the figures given by Leche, except that it is younger than the shell figured by him.

The whorls are well-rounded; suture somewhat impressed; numerous (about 12 on the fourth whorl), fine, raised cinguli cover all the surface; these are separated only by narrow incised lines on the early whorls, but on the fifth the intervals are wider than the cinguli; the

intervals are crossed by very numerous epidermal lines of growth, in the form of thin, raised, very fine lamellæ, more or less fringed. The canal is a little recurved and narrow; columella somewhat sigmoid. Nucleus is very small and regularly spiral; spiral lines begin on the first whorl, and the normal sculpture on the second. Length of a specimen with five whorls, 10.5^{mm}; breadth, 5.5^{mm}; length of body-whorl, 8^{mm}.

Sipho parvus Verrill and Smith, sp. nov.

PLATE LVII, FIGURES 20, 20a, 20b.

Shell small, thin, delicate, translucent, subfusiform; with a rather slender, acute spire; a short, straight canal; and few raised, strong, revolving cinguli; suture impressed.

Whorls six to seven, convex, usually with three (rarely five or six) prominent, rounded cinguli, or carinæ, separated by much wider, broadly concave interspaces; the uppermost one is usually some distance below the suture, and is often stronger than the rest, producing a slight shoulder; on the last whorl, in specimens with six whorls, there are about seven to nine principal carinæ, occasionally with a smaller one interpolated, and becoming more crowded anteriorly; on one with seven whorls, there are thirteen principal cinguli; fine, delicate and close, raised lines of growth, or lamellæ, cover the interspaces and cross the raised cinguli. The nucleus is very small, smooth and glossy; the first turn is minute and regularly spiral, not upturned; three spiral cinguli appear on the second whorl. Aperture elliptical; outer lip thin, rounded, incurved at the base of the canal, which is narrow, but very short, and straight; columella nearly straight in the middle. The epidermis is thin, lamellose, but not ciliated.

Color yellowish or grayish white. Operculum ovate, with the outer or left end rounded and incurved, forming a small lobe, defined by a notch, and with the nucleus central to this small lobe.

*Gray's description of *Buccinum Sabini* is as follows:

"Canal short, open, bent to the left."

"Testa oblonga, ventricosa, alba; anfractibus quinque, convexis, longitudinaliter costatis; apertura ovata; canali brevi."

"Shell oblong; ventricose, white; whorls five, convex, slightly longitudinally ribbed, finely transversely wrinkled; epidermis thin, pale; aperture ovate, half the length of the shell, ending in a short open canal; columella smooth, outer lip thin, inside slightly crenated; axis, three-fourths of an inch, diameter three-eighths. It differs from *Buccinum corneum* (Murex corneus Lin.), by not being so long and slender, and the whorls more convex; the aperture ovate instead of roundish-ovate. The specimen brought home appears to be young."

The odontophore (fig. 20a) is very slender; the outlines of the median plates are indistinct; they bear three very small but distinct and nearly equal denticles; the lateral teeth have only two denticles.

Length of an ordinary sized specimen, 11^{mm}; breadth, 5^{mm}; length of body-whorl, 7·10^{mm}; length of aperture, 5^{mm}; its breadth, 2·15^{mm}. The largest specimen (with seven whorls) is 14^{mm} long; breadth, 6·5^{mm}; length of aperture, 7^{mm}; its breadth, 3^{mm}.

Off Martha's Vineyard, in 312 to 506 fathoms (stations 937, 947, 994, 997, 1029), 1881, fourteen specimens.

This delicate species is liable to be confounded with the young of *S. pygmaeus*, but it differs decidedly in its dentition, operculum, nuclear whorls, short and straight canal, and in the character of its spiral cinguli. The upper whorls of *S. pygmaeus* are much more angular, with coarser, and more prominent carinae or cinguli, which are separated by narrower, incised grooves.*

This species, by its spiral nucleus, would be referable to the group, *Siphonorbis*, and it also approaches *Mohnia* Friele, in the character of its dentition and operculum.

Sipho glyptus Verrill, sp. nov.

Tritonofusus latericeus Verrill, Amer. Journ. Sci., xx, p. 391, Nov., 1880; Proc. U. S. Nat. Mus., iii, p. 369, 1880 (*non* Möll., Mörch).

PLATE LVII, FIGURE 22; PLATE LVIII, FIGURES 1, 1a.

Shell long-fusiform, with a high, tapering, acute spire; with an impressed, oblique, undulated suture, with convex, transversely ribbed, and spirally grooved whorls; and with a narrow, rather long, nearly straight canal.

Whorls seven to eight, evenly rounded, crossed by about 13 slightly curved, regular, rounded, and prominent ribs, separated by rather wider, regularly concave interspaces; the ribs are lower and a little excurved just below the suture, and fade out before reaching the base

*There are two varieties of *S. pygmaeus* on our coast, which are often well-marked. The more northern and larger form has well-rounded whorls, covered with strong cinguli and sulci, and with a strongly ciliated epidermis; canal long and much curved. The other variety, which abounds off Martha's Vineyard, etc., in from 20 to 350 fathoms, on muddy bottoms, has the whorls flattened and much smoother; the cinguli often obsolete, in part, except on the upper whorls, and the epidermis is darker green or olive, and only slightly ciliated, more often nearly or quite smooth, and the canal is, perhaps, a little shorter and less curved. This may take the variety name, *S. pygmaeus*, var. *planulus*. The nucleus and apical whorls agree well, however, in the two forms.

of the canal; sometimes they are mostly obsolete on the body-whorl. The raised, spiral cinguli are numerous, regular and close, crossing equally the ribs and interspaces; they are mostly alternately larger and smaller, and are separated by narrow, impressed grooves; the cinguli are crossed by very fine, close, and delicate, raised lines of growth, giving them a minutely wavy appearance. Aperture narrow-elliptical; outer lip evenly convex, incurved at the base of the canal, which is narrow and elongated and but slightly bent to the left, and a very little bent back at the tip; columella slightly sigmoid.

The nucleus (fig. 1a) is small, consisting of two whorls; the first whorl is minute and turned obliquely upward and inward, with a smooth, glossy surface, crossed by a few small, transverse grooves; the next whorl is regular, smooth at first, then with fine spiral lines; the normal sculpture begins on the third whorl. Color of shell, grayish white. No obvious epidermis. The largest specimen is 30^{mm} long; breadth, 10.5^{mm}; length of body-whorl, 19^{mm}; its breadth, 9^{mm}; length of aperture, 15^{mm}; its breadth, 4.5^{mm}.

The median teeth of the radula have three small denticles; the lateral ones have only two denticles.

This species was dredged off Martha's Vineyard, by the U. S. Fish Com. steamer "Fish Hawk," in 1880 and 1881 (stations 894, 895, 925, 938, 951, 1028, 1029, 1032), in 219 to 458 fathoms.

This shell has a sculpture much like that of *S. cælatus*, but it has a longer and more acute spire, a longer canal, narrower aperture, and a different nucleus.

In general appearance it resembles *S. latericeus* Mörch, but it is a more delicately sculptured shell, with a different nucleus. It also somewhat resembles *S. pellucidus* (Hancock), in general appearance, but the latter has a much shorter and wider canal, and by Friele is considered identical with *S. latericeus*.

Sipho cælatus Verrill and Smith.

Neptunea (Sipho) cælatus Verrill and Smith, in Verrill, Proc. U. S. Nat. Mus., iii, p. 369, 1880.

PLATE LVII, FIGURES 19, 19a.

Off Martha's Vineyard and off Newport, R. I., stations 891 to 895, 238 to 500 fathoms, 1880; stations 947, 994, 997, 998, 1028-1030, in 302 to 458 fathoms, 1881; off Delaware Bay, station 1049, 435 fathoms,—U. S. Fish Com. steamer "Fish Hawk."

The following species, of this family, apparently do not belong to the New England region, but have been found in the Gulf of St. Lawrence, or on the Grand Bank of Newfoundland:

Sipho lividus (Mörch) ?

Fusus (*Sipho*) *lividus* Mörch, Journ. de Conch., x, p. 36, pl. 1, fig. 1, 1862, (*non* Philippi.)

? *Neptunea* (*Sipho*) *terebralis* Gould, Proc. Boston Soc. Nat. Hist., vii, p. 326, 1860; Oria Conch., p. 123.

This species was described from the Banks of Newfoundland. Mörch says that it much resembles *S. Spitzbergensis* Reeve. It may be the species that has been recorded under the latter name, from the Gulf of St. Lawrence, by Whiteaves.*

Mr. J. F. Whiteaves has kindly sent me a specimen of the shell called by him *F. Spitzbergensis*, from the Orphan Bank, Gulf of St. Lawrence, containing the animal. Principal J. W. Dawson has also sent me three specimens of the same shell, from off Metis.

This shell is of moderate size, solid, purplish brown, long-fusiform, with a high, tapering, subacute spire, eight or nine well-rounded whorls, covered with thick, coarse, elevated, rounded or flat, spiral cinguli, separated by deep, square-cut grooves, about as wide; about nine to eleven cinguli on the penultimate whorl. Aperture pyriform. Canal only moderately long, narrow, and nearly straight; columella sigmoid, nearly straight in the middle, not much excavated. Outer lip, in the largest specimens, broadly rounded and with the edge somewhat flaring or expanded in the middle, strongly crenate and ribbed within; inside of aperture pinkish, orange-brown, or bluish

* Mr. Jeffreys (in Ann. and Mag., April, 1876, p. 327) united both the *S. tortuosus* and *S. Spitzbergensis* (Reeve, Belcher's Voy., ii, p. 395, pl. 32, figs. 6a, b, 1855), with *S. togatus* Mörch, 1869, *S. ebur* Mörch, 1869, and *S. Pfaffii* Mörch, under the name of *Fusus Sabinii* (Gray), and gave the Gulf of St. Lawrence (coll. Whiteaves) as one of its localities. The Gulf shell examined by him was probably the same that I have here described as *S. lividus*?. I cannot believe that this is the shell named *Sabinii* by Gray (see p. 503), nor can I identify it positively with *S. Spitzbergensis*. Jeffreys has given no description of this shell, so far as I know, by which we could judge as to what he thinks its specific characters. In another article (Proc. Zool. Soc., London, xxv, p. 192, 1876) he gives us a different arrangement, for we read, "*Fusus tortuosus*; Reeve, 1855, = *F. Sabinii* (Gray), Hancock, 1846. Not *Buccinum* (*Fusus*) *Sabinii*, Gray," and *F. Spitzbergensis* was identified with *Neptunea terebralis* Gould. According to Friele and others there are several very distinct species in this set. *S. ebur*, as determined by Friele, is widely different from our shell, having a short and wide canal, while *S. tortuosus* Reeve is closely allied to *S. pygmaeus*.

white. Nucleus moderately large, not swollen, apical whorl turned up and incurved. Operculum narrow, long-ovate. Length of a shell (♀), 39^{mm}; breadth, 18^{mm}; length of body-whorl, 26^{mm}; length of aperture, 19^{mm}; breadth, 7^{mm}.

The largest example, from Metis, is 57^{mm} long; breadth, 26^{mm}; length of body-whorl, 37^{mm}; breadth, 22^{mm}; length of aperture, 29^{mm}; breadth, 13^{mm}.

In the form of the spire and in the sculpture this species resembles *S. Spitzbergensis*, but in the latter the spiral grooves are fewer and much coarser, as figured by Reeve; the outer lip is more expanded; and the columella and canal are more curved. *S. terebralis* Gould, from the Arctic Ocean, north of Bering's Straits, may be the same as *S. Spitzbergensis*, and in that case the latter name has priority.

Sipho Islandicus (Chemn.) Mörch.

Fusus (*Sipho*) *Islandicus* Mörch (*non Fusus Islandicus* Lovén, *nec* Gould).

Sipho Islandicus G. O. Sars, Möll. Reg. Arctice Norvegiæ, p. 270, pl. 15, fig. 3; pl. x, fig. 19 (dentition); pl. xviii, fig. 55 (operculum).

This has been recorded from the Gulf of St. Lawrence, 212 fathoms, by Whiteaves. Greenland; Iceland; Spitzbergen; Lapland; Norway. Lofoten to Vadsø, 50 to 100 fathoms,—Sars. British coast, 30 to 300 fathoms,—Jeffreys. I have seen no genuine examples from America.

From the Grand Bank (Gloucester fisheries, lot 620), I have a single specimen with the canal broken, but with the animal (♀) in alcohol, which resembles the true *S. Islandicus*, but the nucleus seems to have been small and the operculum is different.

The spire is high, with an acute apex, but with the nucleus, which appears to have been small and regular, somewhat eroded and broken. Whorls eight, flattened below the suture, rounded in the middle. Suture shallow, slightly impressed, very narrowly channeled. Sculpture rather coarse, strong, flat, spiral cinguli, separated by impressed grooves, which are narrower than the cinguli on the lower whorls, but of about the same width on the 5th and 6th whorls, on which there are about ten cinguli, becoming obsolete on the sub-sutural band; on the body-whorl the cinguli become broad and flat, separated by narrower, shallow grooves; they are made wavy by the lines of growth. Aperture broad-elliptical; outer lip broadly rounded and somewhat expanded in the middle, with the edge receding or concave; columella-lip regularly arched in the middle, not excavated; columella slightly sigmoid, and rather slender, so far as

preserved, and a little curved forward at base (the end of the canal is broken off). Epidermis greenish yellow, somewhat lamellose along the lines of growth, which are very distinct. Shell bluish white, thin, translucent. Operculum broad ear-shaped, or ovate, with a broadly rounded angle on the middle of the inner edge; small end somewhat incurved, subacute; larger end narrowed, obtuse.

Length, to base of canal, 55^{mm}; breadth, 27^{mm}; length of spire, from aperture, 33^{mm}; breadth of aperture, 13^{mm}.

Sipho latericeus (Möll.) Sars.

Fusus latericeus Möller, Krøyer's Tidss., iv, p. 88, 1842.

Fusus (Tritonofusus) latericeus Mörch, Rink's Grönland, p. 85, 1857.

Sipho latericeus G. O. Sars, Möll. Reg. Arct. Norv., p. 276, pl. 15, fig. 8; pl. x, fig. 24 (dentition).

This species, which inhabits Greenland and the northern coast of Norway and Finmark (20 to 30 fathoms), has been recorded from the Gulf of St. Lawrence by Dr. Dawson and by Whiteaves, but I have seen no American examples.

Bradelle Bank, G. St. Lawr., one living,—Whiteaves. Spitzbergen, 146 to 357 fathoms,—Friele.

Sipho Ossiani (Friele)

Neptunea Ossiani Friele, Catal. Norweg. Nordm. Exp. Spitz., Möll., p. 279, 1879, (by typ. error *Ossiania*.)

A very interesting shell, of large size, which appears to belong to this species, was obtained near the Grand Bank, in 180 fathoms, and presented to the U. S. Fish Commission by Capt. McCormick and crew, schooner "Wachusett," of the Gloucester fishing fleet. The outer lip and end of the canal are, unfortunately, badly broken.

Another example, of smaller size, has been sent to me by Principal J. W. Dawson, who dredged it at Murray Bay, in the mouth of the St. Lawrence River.

This shell has a rather long spire, the upper whorls increasing more slowly in size than the lower, so that the upper portion is somewhat cylindrical; the suture is impressed; whorls eight; lower whorls strongly convex, somewhat ventricose; spiral sculpture strong and rather coarse, flat, raised cinguli, often with a slight median groove, separated by square-cut grooves of about the same width on the sixth and seventh whorls, but broader than the cinguli on the body-whorl; on the lower whorls there are twelve or thirteen cinguli. Whole surface covered with strong raised lines of growth, which recede strongly on the convexity of the whorls. Nucleus rather

large, smooth; apical whorl smaller than the next, somewhat obliquely turned up, not inflated nor deformed. Aperture large and broad, irregularly elliptical (outer lip and canal of the larger specimen, broken). The columella-lip is incurved slightly near the posterior end of the aperture and again below the middle, the portion between being somewhat straight, giving that side of the aperture a crooked or thrice-bent outline; its surface is hollowed out, deeper than the spiral grooves. Columella much curved in a spiral direction, in a side-view receding strongly and then bending forward and outward, and becoming prominent and strongly twisted. Canal short, not very wide, twisted, bent forward. The back side of the canal, at base, is peculiarly swollen and gibbous, and curved forward.

The operculum of the Murray Bay shell is irregularly obovate, the small end considerably incurved, with the nucleus at the tip; large end broadly rounded; inner edge with an angle in the middle, where the rounded outline meets the concave outline of the smaller half; outer edge with an obtuse angle beyond the middle; lines of growth, strong; color yellowish brown.

Epidermis yellow, conspicuous, rather rough, rising into coarse lamellæ and scales along the lines of growth, both on the cinguli and in the grooves. Shell ivory-white within, canal tinged with salmon.

Length to base of canal, 70^{mm}; breadth, 36^{mm}; apex to aperture (across seven whorls), 41^{mm}; breadth of seventh whorl, 31^{mm}; breadth of aperture, 17^{mm}; breadth of apical whorl, 2^{mm}. The Murray Bay example is 65^{mm} long; breadth, 28^{mm}; length of body-whorl, 42^{mm}; length of aperture, 31^{mm}; its breadth, 14^{mm}.

This shell somewhat resembles *S. Islandicus*, but it differs in having a smaller and more regular nucleus; in the more ventricose lower whorls, and deeper suture; in the peculiar broad fold and spiral twist of the columella, giving the aperture an irregular outline on that side; and in the wider, short, and forward-bent canal.

This species would belong to the generic group, *Chrysodomus*, as defined by G. O. Sars. Friele has proposed to make it the type of a new genus.

Tritonofusus Krøyeri (Möll.) Mörch.

Fusus Krøyeri Möller, Krøyer's Tidss., iv, p. 88, 1842.

Fusus (Tritonofusus) Krøyeri Mörch, Rink's Grönland, Tillæg, p. 85, 1857; Catal. Möll. Spitzb., p. 15, 1869.

Fusus arcticus Philippi, Abbild., iii, p. 117, pl. 5, fig. 5, (t. Mörch).

Buccinum cretaceum (Reeve) Packard, Canadian Nat., viii, p. 417, pl. 2, fig. 6, 1863;

Mem. Boston Soc., Nat. Hist., i, p. 288, pl. 7, fig. 7, 1867.

Tritonium arcticum Schmidt (t. Leche).

Caribou I. and Square I. Labrador, 7 to 30 fathoms,—Packard. Gulf of St. Lawrence and Grand Bank. Metis! and Murray Bay,—Dawson; Orphan Bank,—Whiteaves. Greenland and Spitzbergen. Fossil in the Post-pliocene of Canada, Labrador, etc.

Tritonofusus syrtensis (Packard) Verrill.

Fusus syrtensis Packard, Mem. Boston Soc. Nat. Hist., i, p. 288, pl. 7, fig. 13, 1867.
Square Island harbor, Labrador, 30 fathoms,—Packard.

Volutopsis Norvegicus (Chemn.) Mörch.

Fusus norvegicus Jeffreys, Brit. Conch., iv, p. 329, v, pl. 85, fig. 3.
Fusus (Volutopsis) norvegicus Mörch, Rink's Grönland, Tillæg, p. 85, 1857; Catal. Möll. du Spitzberg, p. 16, 1869, (*Volutopsis*).
Fusus Largillierti Pettit, Journ. de Conch., (t. Mörch).
Volutopsis norvegica G. O. Sars, op. ult. cit., p. 268, pl. 15, figs. 1a, 1b, pl. x, figs. 17a, 17b (dentition), pl. xviii, fig. 54 (operculum).

A fine large specimen of this species, from 75 fathoms, on the "Flemish Cap," a bank east of the Grand Bank, was presented to the U. S. Fish Commission, by Wm. Garrett, of Gloucester, Mass. This specimen belongs to the broad, stout variety, with the last whorl very ventricose.

Newfoundland,—Pettit. Gulf of St. Lawrence, Bradelle Bank,—J. F. Whiteaves. Circumpolar. Greenland; Iceland; Spitzbergen; Northern Scandinavia; North Pacific. North of Hebrides, 189 fathoms,—Jeffreys.

This species was the type of the genus *Strombella* Gray, but that name had been preoccupied.

For those who prefer to follow the custom of Jeffreys and others, in using *Fusus* for this entire group, the following synopsis may be found convenient:

- Fusus (Sipho) Stimpsonii* (Mörch), p. 499.
Varieties, *viratulus* (V.) and *brevis* (V.), p. 500.
Fusus (Sipho) ventricosus (Gray, Gould), p. 500.
Fusus (Sipho) pubescens (V.), p. 501.
Fusus (Sipho) Islandicus (Chemn.), p. 508.
Fusus (Sipho) lividus (Mörch), p. 507.
Fusus (Sipho) latericeus (Mörch), p. 509.
Fusus (Siphonorbis) pygmaeus (Gould), pp. 500, 501.
Variety, *planulus* (V.), p. 505.
Fusus (Siphonorbis) parvus (V. and S.), p. 504.
Fusus (Siphonorbis) Sabinii (Gray), p. 503.
Fusus (Siphonorbis) glyptus (V.), p. 505.
Fusus (Siphonorbis) celatus (V.), p. 506.

Fusus (Tritonofusus) syrtensis (Packard), p. 511.

Fusus (Tritonofusus) Kröyeri (Möll), p. 510.

Fusus (Chrysodomus) Ossiani (Friele), p. 509.

Fusus (Neptunea) despectus (Linné), p. 499.

Variety, *tornatus* (Gould), p. 499.

Fusus (Neptunea) decemcostatus (Say), p. 499.

Fusus (Volutopsis) Norvegicus (Chemn.), p. 511.

The genus *Fulgur* (including *Sycotypus* Gill, non Gray) is closely allied to the preceding forms. It includes two common New England species: *F. caricus* and *F. canaliculatus*.

Nassa nigrolabra Verrill.

Nassa nigrolabra Verrill, Proc. U. S. Nat. Mus., iii, p. 371, 1880.

PLATE LVIII, FIGURE 12.

Off Martha's Vineyard, station 870, in 155 fathoms; one specimen. This species was referred to *Nassa*, only provisionally. The animal is not known.

A single fresh, but dead, specimen of a cancellated *Nassa*, resembling *N. incrassata*, of Europe, was dredged by us, off Halifax, in 1877. It may have been a ballast-specimen.

Trophon clathratus, var. *Gunneri* (Lovén).

Tritonium Gunneri Lovén, Index Moll. Lit. Scand. occid. hab., Ofversigt Kongl. vet. Akad. Förh. [p. 12], 1846.

Murex (Trophon) Gunneri Mörch, Faunula Ins. Færoënsium, Vid. Med. Nat. For., 1867, p. 84.

Trophon Gunneri H. and A. Adams, Genera, i, p. 77, 1858.

Verrill, Amer. Journ. Sci., v, p. 6, 1873.

Trophon clathratus, var. *Gunneri* G. O. Sars, Fauna Reg. Arct. Norvegie, p. 247, pl. 15, figs. 11, a, b.

PLATE XLIII, FIGURE 8.

Le Have Bank, 45 and 60 fathoms, Smith and Harger, on the "Bache," 1872. Off Cape Sable, N. S., 59 fathoms; mouth of Halifax harbor, 16 and 18 fathoms, 1877,—U. S. Fish Com. steamer "Speedwell." Gaspé Bay! (coll. Whiteaves). Metis! both forms, (coll. Dawson).

This is an arctic species, probably circumpolar, found at Greenland, Iceland, Nova Zembla, and the extreme northern parts of Europe. Finmark,—Lovén, Sars; Bergen,—Norman; Kariska Sea, 10 to 20 fathoms,—Leche.

By Jeffreys, G. O. Sars, Leche, and others this shell has been regarded as a mere variety of *T. clathratus* (Linné)=*T. scalariforme* Gould. Among a considerable number of specimens that I have examined from American waters I have seen few intermediate speci-

mens, and therefore prefer to keep them as distinct forms, for the present, but without doubting the observations of the excellent naturalists referred to.

Trophon Fabricii (Möller).

Tritonium craticulatum Fabr., Fauna Grönl., p. 400, 1780 (*non* Linne).

Trophon Fabricii (Beck) Möller, Krøyer's Tidsskr., iv, p. 87, 1842.

Trophon craticulatus G. O. Sars, op. cit., p. 248.

Gulf of St. Lawrence, Orphan Bank,—J. F. Whiteaves. Davis Straits,—Scudger, 1879.

This is a very arctic form, inhabiting Wellington Channel, Greenland, Iceland, Spitzbergen, Finmark, Bergen. Greenland, 35 to 80 fathoms, Valorous Exp.,—Jeffreys. Fossil in the Post-pliocene beds of England.

The specimen from Davis Straits is 33^{mm} long; breadth, 15^{mm}; length of aperture, 18^{mm}.

Anachis costulata (Cantraine) Verrill.

Fusus costulatus Cantraine (t. Monterosato), (*non* C. B. Adams).

Columbella Haliæti Jeffreys, British Conch., iv, p. 356, 1867; v, p. 219, pl. 88, fig. 3.

Anachis Haliæti Verrill, Amer. Journ. Sci., vii, pp. 405, 412, 503, 1874.

Pyrene costulata G. O. Sars, op. ult. cit., p. 252, pl. 23, fig. 16, pl. x, fig. 2 (dentition).

Anachis costulata Verrill, Amer. Journ. Sci., xx, p. 392, 1880; Proc. Nat. Mus., iii, p. 406, 1881.

PLATE XLIII, FIGURE 7.

Gulf of Maine, at Cashe's Ledge, Jeffrey's Bank, etc., 30 to 114 fathoms,—“Bache,” 1873. South of Halifax, N. S., 95 fathoms, 1877, and off Cape Cod, 67 to 96 fathoms, 1879,—U. S. Fish Com. steamer “Speedwell.” Off Newport, R. I. and south of Martha's Vineyard, 1880 and 1881, common in 146 to 506 fathoms,—steamer “Fish Hawk” (abundant at stations 894, 365 fathoms, and 1038, 146 fathoms). Off Chesapeake Bay, station 898, 300 fathoms. North of Hebrides, 170 to 650 fathoms, off Faroe I., and 25 miles N.N.W. of Unst, 85 to 95 fathoms,—Jeffreys. Lofoten I., 400 fathoms,—Sars. Fossil in the later European Tertiary deposits, Vienna, Messina, etc.,—Jeffreys.

Astyris diaphana Verrill, sp. nov.

Astyris rosacea (pars) Verrill, Proc. Nat. Mus., iii, p. 408 (*non* Gould).

PLATE LVIII, FIGURE 2.

Shell thin, delicate, translucent, white, nearly smooth, elongated,

with a long, tapering, acute spire. Whorls eight, broadly and evenly rounded; suture somewhat impressed, but not deep, frequently narrowly channelled. Surface, except anteriorly and on the canal, destitute of spiral lines, and of any indication of ribs, but covered with very close, almost microscopic lines of growth, which give the surface a dull appearance, when dry; on the canal and extending to the anterior part of the body-whorl are a number of distinct spiral lines, becoming faint opposite the middle of the aperture; fine, microscopic, spiral striations sometimes appear on the lower whorls. The nucleus is larger than in *A. rosacea*, rounded, depressed, and spiral, but somewhat mammillary. The aperture is small, oblong-ovate; the outer lip is sharp at the edge, but in adult shells has a distinct thickening a little back from the margin; the inner surface is usually smooth, but in some adult specimens there are four or five small, transversely oblong tubercles, back from the margin, and a larger, conical tubercle at the base of the canal. Columella sigmoid, a little excavated in the middle, and with a distinct, raised, spiral fold at its inner edge, anteriorly; canal short, open, very slightly curved. Epidermis thin, closely adherent, minutely lamellose along the lines of growth, pale greenish gray, or yellowish white.

Length of one of the largest specimens, 12^{mm}; breadth, 4^{mm}; length of body-whorl and canal, 7^{mm}; length of aperture, 5^{mm}; its breadth, 1.8^{mm}. Stouter and shorter examples occur.

Off Martha's Vineyard, in 65 to 487 fathoms, 1880 and 1881,—U. S. Fish Com. Off Chesapeake Bay, 300 fathoms,—Capt. Tanner. Taken at many stations. At 870 and 876, it occurred in considerable numbers.

This species resembles *A. rosacea*, of which I formerly supposed it to be a deep-water variety. A more careful examination of a larger and better series convinces me that they are distinct. The present species is a more slender and elongated, and far more delicate shell, and is destitute of the impressed spiral lines that cover the whorls, both in that species and *A. Holböllii*,* and is without any traces of transverse ribs, on the upper whorls. The fold on the columella-edge

*I regard *A. Holböllii* (Möller) of Greenland, as different from the true *A. rosacea* Gould, of New England. The latter is a stouter shell, with broader aperture, and is not distinctly transversely ribbed, like the former, except on the whorls next to the nucleus. Moreover, the nuclear whorls differ. I have compared Greenland specimens directly with our own. If not a distinct species, it is certainly a very marked variety. The true *A. rosacea* occurs from off Chatham, Cape Cod, 16 fath. ! to the Gulf of St. Lawrence ! Mass. Bay, 15 to 25 fathoms !

and the submarginal thickening of the outer lip are also good distinctive marks, but the great difference in the nucleus is, perhaps, of still greater importance. Fresh specimens, when wet, are so transparent that the internal form of the columella can often be seen, through the shell.

Astyris pura Verrill, sp. nov.

This shell is very abundant in many of our deeper dredgings, on muddy bottoms. It resembles the shallow-water species, *A. zonalis** (*=A. dissimilis* Stimp.), in form, except that it is somewhat shorter and stouter, with the whorls more convex, the columella more excavated, the aperture a little wider and the canal slightly bent back, at tip, but the shell is translucent and glossy, and the color is pure white, or pinkish white, except near the apex, where it is tinged with pale brown or pink, in fresh specimens. The surface is smooth, except slight lines of growth and a few faint spiral lines, on the canal, anteriorly. The nucleus is distinctly larger than in the typical *A. zonalis*. It is probable that this form is a distinct species.

Off Martha's Vineyard, 100 to 487 fathoms, 1880, 1881,—U. S. Fish Com.; off Chesapeake Bay, 300 fathoms,—Capt. Tanner. Abundant, living, at stations 892, 894, in 487 and 365 fathoms.

TÆNIOGLOSSA.

Dolium Bairdii Verrill and Smith.

Dolium Bairdii Verrill and Smith, in Verrill, Amer. Journ. Sci., xxii, p. 296, Oct., 1881 (description).

The apical or nuclear whorls are yellowish brown, smooth, showing only faint lines of growth, and consist of nearly four turns. The color and character of the surface changes abruptly beyond the nucleus, the normal sculpture suddenly appearing. The primary whorl is very small, regularly spiral, a little prominent. On the second whorl below the nucleus there are seven primary darker brown ribs, with seven smaller and paler ones, alternating with them, and some still smaller ones interpolated.

The largest specimen taken (♂) is 68^{mm} long; breadth, 56^{mm}; length of aperture, 53^{mm}.

Off Martha's Vineyard, station 945; 202 fathoms, one large living (♂), stations 1032, 1036, 1038, 1040, 94 fathoms; young specimens and fragments of several large ones.

* The true *A. zonalis* also occurs in this region, from the shore to 100 fathoms. The deep-water ones are highly colored and banded, like those from shallow water.

Off Delaware Bay, station 1046, 104 fathoms, one living (δ), 1881,
—Lieut Z. L. Tanner.

Lunatia nana (Möll.) Sars.

Natica nana Möller, Krøyer's Tidsskr., iv, p. 80, 1842.

Lunatia nana G. O. Sars, op. cit., p. 159, pl. 21, figs. 19 *a, b*; pl. v, fig. 14 (denti-
tion).

Verrill, Proc. Nat. Mus., ii, p. 197, 1879; iii, p. 371, 1880.

Mamma borealis Mörch, Moll. of Greenland, p. 127, 1857, (*non* Gray).

PLATE XLII, FIGURE 9.

This was taken by Prof. S. I. Smith and myself at Eastport, Me., in 1864; by Prof. H. E. Webster at Seal Cove, Grand Menan I., in 1872; on Le Have Bank, 45 fathoms, by Messrs. S. I. Smith and O. Harger, of the U. S. Fish Com.; on the "Bache," in 1872; by the Fish Com. party in Casco Bay, 1873; off Cape Ann, 115 fathoms, 1877; Halifax Harbor, and Bedford Basin, 16 to 33 fathoms, 1877; off Cape Cod, on Stellwagen's Bank, 26 to 32 fathoms, 1879; by our parties in 1880 and 1881, south of Martha's Vineyard and Block Island, in 22 to 29 fathoms.

Gulf of St. Lawrence! (coll. J. F. Whiteaves.)

Greenland and northern Norway. *Natica borealis* Gray (Beechey's Voy., Zoology, pl. 37 fig. 2, 1879), confounded with this species by Mörch, is an umbilicated shell, with a high acute spire.

Lunatia levicula Verrill.

Lunatia levicula Verrill, Proc. U. S. Nat. Mus., iii, p. 371, 1880 (description).

The largest specimen taken (station 985) is 40^{mm} long; breadth 37^{mm}; length of body-whorl, 39^{mm}; length of aperture, 33^{mm}; breadth, 19^{mm}.

This shell was first dredged by me, near Eastport, Me., in 1870. It has since been dredged by the United States Fish Commission parties in Casco Bay, Me., 1873; off Block Island, stations 812 to 815, in 26 to 29 fathoms, 1880; off Martha's Vineyard, station 873 to 985, 26 to 100 fathoms, 1880 and 1881. It is still a very rare species.

It has some resemblance to *Acrybia flava*, on account of the lightness and thinness of the shell, and in form, but the shape of the aperture is different, and there is a distinct umbilicus. The columella is also less incurved in the umbilical region.

Although a much thinner and far more delicate shell, this species has considerable resemblance to *L. heros*, externally, but the whorls are more swollen and the suture more impressed, while the lines of growth are more flexuous. The best distinctions are to be found in the nature of the columella margin and consequent form of the aperture, and in the umbilicus. In this species the upper part of the aperture is encroached upon by the swollen body-whorl, and then the columella margin rapidly recedes with a deep sinuous concave bend, above the umbilicus, causing a sudden widening of the shell-aperture at the middle; this incurvature of the columella is very conspicuous in a profile view, looking into the aperture, and renders the interior of the shell visible far within. In *L. heros* no such abrupt curvature of the columella occurs, its outline forming only a slightly flexuous curve. In *L. levicula* there is no thickened callous behind the umbilicus, the margin of the lip being then reflexed and thin. The umbilicus is well-marked and deep but not so large as usual, even in the shallow-water variety of *L. heros*.* Our best specimens of *L. levicula* have a rich, chestnut-brown interior.

In the localities where we have dredged this species we have also taken large egg-capsules, probably belonging to it, coated with sand and shaped like those of *L. heros*, but with the cells very much larger, and so prominent or swollen as to rise above the surface. Egg-capsules of the same kind were dredged on Stellwagen's Bank, in 14 to 42 fathoms, 1879, but we did not take this shell at those localities.

Amaura candida Möller.

Krøyer's Tidsskr., iv, p. 80, 1842.

H. and A. Adams, Genera, i, p. 214, pl. 22, fig. 9.

This Greenlandic species has been recorded from the Gulf of St. Lawrence, by Whiteaves.

Marsenina glabra Verrill.

Oxinoë glabra Couthouy, Boston Journ. Nat. Hist., ii, p. 90, pl. 3, fig. 16, 1838.

Lamellaria perspicua (pars) Gould, Binney's ed., p. 337, fig. 607 (?).

Marsenina micromphala (Mörch) Bergh, op. ult. cit., p. 121, 1857.

G. O. Sars, op. cit., p. 151, pl. 21, figs. 10 a-d.

Marsenina glabra Verrill, Proc. U. S. Nat. Mus., iii, p. 373, 1880.

PLATE XLII, FIGURES 1, 1a, 4.

This species is not uncommon at Eastport, Me., where I collected

*There is a small, deep-water variety of *L. heros*, very common in our dredgings south of Martha's Vineyard, which has the umbilicus larger and more open than in the ordinary form. Intermediate states also occur.

it in 1859, 1861, 1863, 1864, 1868, 1870, and 1872. It was dredged in 1879 by our party, on the U. S. Fish Commission steamer "Speedwell," off Cape Cod, in 34 fathoms. North Greenland,—Bergh.

Marsenina prodita (Lov.) Bergh.

Lamellaria prodita Lovén, 1846.

Marsenina prodita Bergh, Vid. Meddel. Naturh. For., Kjöbenhavn, 1857, p. 112, pl. 1, figs. 1-6, 8-24, (anatomy, etc.)

G. O. Sars. Möll. Reg. Arct. Norvegiæ, p. 151, pl. 12, figs. 5 a-c; pl. v, figs. 7 a, b (dentition).

Verrill, Proc. U. S. Nat. Mus., iii, p. 373, 1880.

PLATE XLII, FIGURES 2, 2a.

This species was taken living, at Eastport, Me., by Prof. S. I. Smith and myself, in 1864 and 1868. This is easily recognized by its comparatively prominent, acute spire, turned to one side, by its obliquely elongated aperture, and by the margin of the outer lip being slightly inflexed near the suture.

Marsenina ampla Verrill.

Marsenina ampla Verrill, Proc. U. S. Nat. Mus., iii, p. 374, 1880 (description).

PLATE XLII, FIGURES 3, 3a.

Eastport, Me. Dredged in 1868, by the writer.

Lamellaria pellucida Verrill.

Lamellaria pellucida Verrill, Amer. Journ. Sci., xx, pp. 391, 395, Nov., 1880 (description); Proc. U. S. Nat. Mus., iii, p. 372, 1880, (description).

PLATE LVIII, FIGURES 4, 5, 5a.

U. S. Fish Commission, stations 870 to 872, south of Martha's Vineyard, in 86 to 155 fathoms, fine sand (16 specimens, living), 1880; stations 940, 949, 1032, 1038, in 190 to 298 fathoms, 1881.

Off Delaware Bay, 130 to 156 fathoms.

Lamellaria pellucida, var. **Gouldii** Verrill, nov.

PLATE LVIII, FIGURE 3.

Closely related to *L. pellucida* V., of the same region. It differs in having the mantle shorter, broader, and higher, of a softer and thicker substance, with more or less numerous, low verrucæ on the dorsal surface; color pale yellow or yellowish white, more or less blotched or specked with brown, flake-white and yellow. The verge is different in form, the lateral papilla being larger and longer, and not so near the end, the portion beyond it forming a spatulate or obovate lobe, round at the end. The shell is very thin, delicate and

transparent, as in *L. pellucida*, but differs in being a little shorter, broader, with the spire lower, the apex less elevated, and the suture less impressed. The last whorl is more ventricose, and the outer lip and aperture are more broadly rounded. In alcohol, a specimen is 18^{mm} long; breadth, 12^{mm}; height, 10^{mm}.

Part of the differences in the soft parts may be due to variations in the amount of contraction. Both forms occur together, and some specimens are intermediate.

Off Martha's Vineyard, stations 925, 937, 938, 939, 946, 1029, in 224 to 458 fathoms. Several specimens of both sexes occurred. Off Chesapeake Bay.

Velutella cryptospira (Middend.).

Velutella cryptospira G. O. Sars, Möll. Reg. Arct. Norv., p. 149, pl. 21, figs. 9 a-c.

Verrill, Proc. U. S. Nat. Mus., iii, p. 374, 1880 (description.)

A good living example of this shell was taken by us, on the "Speedwell," in 1877, off Halifax, Nova Scotia, in 57 fathoms (station 82).

Northern Norway,—Sars. North Pacific and Bering's Straits.

Capulus Hungaricus (Linné).

Capulus hungaricus Jeffreys, Brit. Conch., vol. iii, p. 269, pl. 6, fig. 5; vol. v, pl. 59, figs. 6, 6a.

G. O. Sars, Möll. Arc. Norvegiæ, p. 145, pl. v, figs. 2 a, 2 b (dentition).

Two living specimens were obtained, in 1881, which appear to belong to this species. They are more delicate and have somewhat finer and more regular radiating ribs than the ordinary European form. It had not been recorded before from our coast.

Off Martha's Vineyard, stations 922, 1029, in 69 and 458 fathoms,—U. S. Fish Commission.

On the European side of the Atlantic, this species is found from Iceland to the Mediterranean.

Trichotropis conica Möller.

Trichotropis conica Möller, Krøyer's Tidss., iv, p. 85, 1842.

G. O. Sars, op. cit., p. 163, pl. 13, fig. 3.

Verrill, Proc. U. S. Nat. Mus., iii, p. 374, 1880.

A single dead, but large and characteristic specimen of this very distinct species was taken in the Gulf of Maine, off Cape Sable, Nova Scotia, in 75 fathoms, by the United States Fish Commission party, on the "Speedwell," in 1877. Greenland. Northern Norway.

It is easily recognized by its conical spire, and its flattened base, covered with revolving grooves and ridges. The revolving cinguli on the spire are stronger than those on the base, and unequal.

Torellia fimbriata Verrill and Smith, sp. nov.

PLATE LVII. FIGURES 27, 27a.

Shell thin, fragile, translucent, broader than high, with a short, depressed spire, the apex small and a little prominent, the last whorl large and ventricose, with spiral carinæ bearing divergent epidermal hairs.

Whorls five, very convex, rapidly enlarging; suture deep, slightly channeled; nuclear whorls smooth and glossy, regularly spiral, the first whorl minute. Sculpture, several raised, angular, spiral carinæ, separated by unequal intervals, on which are finer spiral lines; and numerous, very evident, thin, raised flexuous lines of growth, which cross both the intervals and carinæ, rendering the latter finely nodulous. On the last whorl there are about ten carinæ; each of which usually supports a spiral row of long epidermal hairs; the uppermost of these is just below the suture, and its epidermal processes are long and appressed against the preceding whorl; the next is separated by a wide space, while those on the convex part of the whorl are nearer together; the last defines the border of the umbilicus, which is deep, but not broad. Aperture large, roundish, the lip continuous in adult shells; in the umbilical region the lip is somewhat reflected, so as to partially conceal the umbilicus; within the lip the columella has a very obtuse lobe, projecting inward.

Epidermis thick, pale yellowish, or greenish yellow, more or less lamellose along the lines of growth, and usually rising into long and large divergent hair-like processes along the spiral carinæ. Shell yellowish white.

The median teeth of the radula (fig. 27a), have broad, truncated bases, with the lateral angles a little prominent and rounded; the free end is broad-triangular, with slightly concave lateral lines, bearing small sharp denticles, or sometimes merely crenulated; the median denticle is acute and prominent. The large lateral teeth have broad bases, of which the outer edge is oblique, with the anterior corner prominent and rounded; the tip is strongly obliquely curved, and very sharp. The outer lateral teeth are strongly hooked and very acute.

Length of the largest specimen (♂), 14.5^{mm}; breadth, 17^{mm};

length of body-whorl, 13^{mm}; length of aperture, 10^{mm}; breadth, 10·2^{mm}; length of hairs, 1–3^{mm}.

A variety (var. *tiarella*) occurred in company with the typical form, at station 1026, 182 fathoms, in which the subsutural carina is well-developed, and crowned by its row of long hairs, but the other carinæ are nearly obsolete, and only bear rows of short inconspicuous hairs; the epidermis is elsewhere thick and lamellose, not hairy. The spire is a little more elevated.

Off Martha's Vineyard, stations 869, 878, 939, 1025, 1026, 1033, 1038, in 142 to 258 fathoms, 1880 and 1881,—U. S. Fish Com. A small specimen was taken in 1873, at station 21B, 52 to 90 fathoms, near Cashe's Ledge, off the coast of Maine, by the party on the "Bache."

Twenty-three specimens, mostly preserved in alcohol, with the animals, are in the collection. They show considerable variation in the prominence of the spiral carinæ and in the length of the epidermal hairs on them. They also vary somewhat in the elevation of the spire, but in none is it so elevated as in the figures that Jeffreys and Sars give of *T. vestita*.

Torellia vestita Jeffreys.

Torellia vestita Jeffreys, Brit. Conch., iv. p. 244, pl. 4, fig. 1. 1867.

G. O. Sars, Moll. Reg. Arct. Norvegicæ, p. 162, pl. 22, figs. 1. a, b, pl. xviii, fig. 14.

Verrill, Amer. Journ. Sci., v. p. 15, 1873 (description).

Smith and Harger, Trans. Conn. Acad., iii, p. 49, 1874 (description).

PLATE XLII. FIGURE 5.

First taken, on our coast, in 1872, Gulf of Maine, 150 fathoms, by the Fish Com. party, on the "Bache." Off Martha's Vineyard, stations 871, 872, 1038, in 86 to 146 fathoms,—U. S. Fish Com.

Shetland,—Jeffreys, Lofoten I., 200 to 300 fathoms; west coast of Norway, 50 to 60 fathoms,—Sars.

The specimens that I refer to this species differ from the preceding in not being spirally carinated, and in having a thinner epidermis, which is covered pretty uniformly with small and short epidermal hairs, which often appear to be arranged in transverse rows, along the lines of growth. The form of the shell and aperture is similar, but the spire appears to be somewhat more elevated in this species, and the last whorl less swollen. The shell is thin and fragile. Possibly a larger series might show that they are only varieties of one species.

Cerithiella Whiteavesii Verrill.*Cerithiopsis costulatus* Whiteaves (non Möller).*Lovenella Whiteavesii* Verrill, Amer. Journ. Sci., xx, pp. 391, 396, Nov. 1880; Proc. U. S. Nat. Mus., iii, p. 375, 1880.

PLATE XLII, FIGURE 7.

The generic name, *Lovenella* G. O. Sars, having been preoccupied in Hydroida, I propose to use *Cerithiella* for the same group, with *C. metula* (Lov.) as the type-species. The dentition is peculiar.

Off Martha's Vineyard, stations 891, 892, and 894, in 365 to 500 fathoms, 1880; 947, 994, 997, 999, in 266 to 368 fathoms, 1881,—U. S. Fish Com. Gulf of Saint Lawrence! 200 fathoms, (coll. Whiteaves.)

Lacuna glacialis Möller.*Lacuna glacialis* Möller, Krøyer's Tidsskr., iv, p. 82, 1842.

PLATE XLII, FIGURE 6.

Gulf of St. Lawrence! (coll. J. F. Whiteaves). Greenland,—Möller.

Fossarus elegans Verrill and Smith. sp. nov.

PLATE LVII, FIGURE 28.

Shell small, ovate, with a short, acute, turreted spire, and five angulated and sharply carinated whorls, elegantly latticed between the carinæ. The whorls increase rapidly, the last being relatively large. On the last whorl there is a sharp angular carina at the shoulder, often with a smaller one just below it; a larger and more prominent one around the periphery; and three or four smaller ones on the anterior slope, besides a spiral fold around the umbilical region; on the larger specimens there are sometimes two or three strong, raised varices on the last whorl, and the edge of the lip is thickened. The intervals between the carinæ are concave. On the preceding whorls the two larger carinæ are visible, often with a small intermediate one. The nucleus is minute, regular, smooth, a little prominent. The rest of the shell is covered, between the carinæ, with numerous close, thin, oblique, raised lamellæ, or lines of growth; those on the subsutural band are flexuous. Aperture nearly round; lip continuous; outer lip thickened, and with denticles externally, where the carinæ terminate. Umbilicus spiral, very narrow, sometimes closed. Color white.

Length, 5.3^{mm}; breadth, 4^{mm}; length of aperture, 2^{mm}.

Off Martha's Vineyard, station 949, 100 fathoms, 1881,—U. S. Fish Com. Eight specimens, none living.

Litiopa bombix Rang.

Litiopa bombix Woodward, Manual Conch., p. 136, pl. 9, fig. 24, 1856.

H. and A. A. Adams, Genera, i. p. 324, pl. 34, fig. 5a, 1858 (*bombyx*).

Chenu, Man. de Conch., i. p. 304, fig. 2150, 1859.

Found attached to floating gulf-weed (*Sargassum*, sp.) at station 1038, off Martha's Vineyard, N. lat. 39° 58'.

The apex of this shell is slender and acute, consisting of about three whorls, which are distinctly decussated, in contrast with the succeeding whorls, which are smooth, or nearly so. The first whorl is very minute and prominent.

Hydrobia? lævis (Dekay) Verrill.

Cingula lævis Dekay, Nat. Hist. N. York, Mollusca, p. 111, pl. 6, fig. 118 (bad), 1843.

Littorinella lævis Verrill, Rep. Invert. Anim. Vineyard Id., in Rep. U. S. Fish. Com., i, p. 653, 1874, (auth. cop., p. 359).

This species has not been well studied and its generic position is doubtful. Perhaps it is not even distinct from *H. minuta*. The soft parts and dentition are not known.

According to the original description, the whorls are convex and there is a large umbilicus. The figure is very poor.

New York harbor, Long Island Sound. Littoral.

Rissoa Stimpsoni Smith.

Rissoa Stimpsoni Sanderson Smith, Annals Lye. Nat. Hist. New York, vii, p. 157, 1860; ix, p. 393, fig. 2, 1870.

This species may not be distinct from the preceding, but I have not seen authentic specimens.

From Wood's Holl, I have a similar elongated species, with six to seven very convex whorls and deep suture. The umbilicus is very small. Color chestnut-brown. I am not certain that it is identical with this.

Cingula harpa Verrill.

Rissoa (Cingula) harpa Verrill, Proc. U. S. Nat. Mus., iii, p. 374, 1880.

PLATE LVIII, FIGURE 6.

Dredged by the U. S. Fish Com., off Massachusetts Bay, 1877, station 34, in 160 fathoms; off Newport, R. I., and Martha's Vineyard, at stations 892 and 894, in 487 and 365 fathoms, 1880; and at 947, in 312 fathoms, 1881.

Cingula turgida ? (Jeff.) Verrill.

Rissoa turgida (Jeffreys), G. O. Sars, Moll. Reg. Arct. Norvegiæ, p. 183, pl. 10, figs. 12 a, b.

Cingula turgida Verrill, Amer. Journ. Sci., xx, p. 391, Nov., 1880; Proc. U. S. Nat. Mus., iii, p. 375, 1880.

A very small, white species, with smooth, rounded whorls and distinct umbilicus.

Station 892, in 487 fathoms, 1880.

Cingula globulus (Möll.) Verrill.

Rissoa globulus Möller, Krøyer's Tidsskr., iv, p. 82, 1842.

Cingula globulus Verrill, Amer. Journ. Sci., xvii, p. 312, 1879.

PLATE XLIII, FIGURE 3.

Gulf of St. Lawrence! (coll. Whiteaves.)

Cingula areolata (Stimp.) Verrill.

Turritella areolata Stimpson, Shells of New England, p. 35, 1851.

Cingula areolata Verrill, Amer. Journ. Sci., xvii, p. 311, 1879.

PLATE XLIII, FIGURE 2.

Omitted from Gould's Invertebrata of Massachusetts. Gulf of St. Lawrence, Trinity Bay, 96 fathoms! (coll. Whiteaves.) Mt. Desert, Me., 10 to 15 fathoms.

Off Martha's Vineyard, station 940, in 130 fathoms, 1881, (one young example).

This species belongs to the group, *Alvania*, but for those writers who do not recognize the sub-divisions of *Rissoa*, as of generic value, this will stand as *Rissoa areolata*.

Cingula Jan-Mayeni (Friele) Verrill.

Rissoa Jan-Mayeni Friele, Nyt. Mag. Naturv., 1877 (auth. cop., p. 4), fig. 4.

Cingula Jan-Mayeni Verrill, Amer. Journ. Sci., xvii, p. 311, Apr., 1879; Amer. Journ. Sci., xx, p. 391, Nov., 1880; Proc. U. S. Nat. Mus., iii, p. 375, 1880.

PLATE XLII, FIGURE 8.

First taken on the New England coast in 1880, at stations 891 to 895, in 238 to 500 fathoms; a single specimen occurred at station 880, 252 fathoms. In 1881 it was taken at several stations in 255 to 410 fathoms. Whiteaves had previously dredged it in the Gulf of Saint Lawrence, 200 fathoms!

This species belongs to the subgeneric group, *Alvania*, as defined by G. O. Sars.

Cingula castanea (Möll.) Verrill, Sars.*Rissoa castanea* Möller, Krøyer's Tidsskr., iv, p. 82, 1842.*Cingula castanea* G. O. Sars, Moll. Reg. Arct. Norvegiæ, p. 174, pl. 10, figs. 1, a, b, 1878.

Verrill, Amer. Journ. Sci., xvii, p. 312, 1879.

PLATE XLIII, FIGURE 1.

Eastport, Me., 1864! Mt. Desert, Me., 1861! Gulf of St. Lawrence!
(coll. Whiteaves). Greenland,—Möller. Norway,—Sars.

Assiminea Grayana Leach.*Assiminea Grayana* Jeffreys, British Conch., v, p. 99, pl. 4, fig. 1; pl. 97, fig. 5.

Verrill, Amer. Journ. Sci., xx, p. 250, Sept., 1880; Proc. U. S. Nat. Mus., iii, p. 379, 1880.

PLATE LVIII, FIGURE 7.

This was found in July, 1880, by the writer, living among decaying sea-weeds, at high-water mark, between the docks at Newport, R. I., where it was common, associated with *Truncatella* and *Alexia*. Common in similar localities on the British and other European coasts.

Truncatella truncatula (Drap.)*Truncatella truncatula* Woodward, Man. Conch., p. 137, pl. 9, fig. 25, 1856.

Jeffreys, British Conch., iv, p. 85, pl. 4, fig. 1.

Verrill, Amer. Journ. Sci., xx, p. 250, Sept., 1880; Proc. U. S. Nat. Mus., iii, p. 376, 1880.

PLATE LVIII, FIGURES 8, 8a, 8b.

This species was found by the writer, living in considerable numbers, and of all ages, among the docks at Newport, R. I., July, 1880. It occurred among decaying sea-weeds thrown up at high-water mark, both among the vegetable matter and on the under side of stones.

Common on the coasts of Europe in similar localities. Perhaps introduced on this coast by shipping, but it may have been hitherto overlooked. It was associated with *Assiminea Grayana* and *Alexia myosotis*.

Cæcum Cooperi Smith.*Cæcum Cooperi* Sanderson Smith, Annals Lyc. Nat. Hist., N. York, vii, p. 154, 1860; op. cit., ix, p. 393, fig. 3, 1870 (non Carpenter, 1864).

Verrill, Invert. Vineyard Sound, p. 649 [355].

Cæcum costatum Verrill, Amer. Journ. Sci., iii, p. 283, pl. 6, fig. 6, 1872.

Gardiner's Bay, Long Island, and Vineyard Sound, Mass., 4 to 10 fathoms.

The following species should have been inserted on p. 522 :

Cerithiopsis costulata (Möller) Sars.

Turritella ? costulata Möller, Krøyer's Tidsskr., iv, p. 83, 1842.

Cerithium arcticum Mörch, Prod. Faunæ Moll. Grœnl., Arctic Manual, p. 127.

Cerithiopsis costulata G. O. Sars. op. cit., p. 189, pl. 13, fig. 7, vii, figs. 5, a, b (dentition), xviii, fig. 28 (operculum).

A good, living example of this arctic species was dredged by me, in the Bay of Fundy, in 1870.

It may be easily distinguished by the elevated spire, having the whorls crossed by regular and strong, rounded ribs, nearly as in *Scalaria*, with a basal carina, in line with the outer lip, and with revolving lines crossing the furrows between the ribs. The canal is short, but deeply cut, and slightly recurved. The species recorded by Whiteaves as *C. costulata* from the Gulf of St. Lawrence is not this species, but *C. Whiteavesii*.

PTENOGLOSSA.

Scalaria (*Cirsotrema*) *Leeana* Verrill, sp. nov.

PLATE LXVII, FIGURE 34.

Shell small, slender, elongated, with well-rounded whorls and deep, oblique suture, (apex broken). Whorls crossed by numerous small, little-elevated, oblique ribs, and on each whorl one large, strong, oblique, varix-like rib, those on the three lower whorls nearly in one line, the last forming the greatly thickened margin of the lip. Both the ribs and the wider intervals between them are crossed by very numerous and fine spiral striæ. Aperture small, round-ovate, surrounded by a much thickened, continuous margin close to the edge; this rim around the outer lip is crossed by oblique striæ; base with spiral striæ, but without a distinct carina; no umbilicus. Size about the same as the preceding species.

Off Martha's Vineyard, station 1038, 146 fathoms, 1881.

Named in honor of Professor L. A. Lee, of Bowdoin College, and of the U. S. Fish Commission party, in 1881.

Scalaria (*Opalia*) *Andrewsii* Verrill, sp. nov.

Scalaria, undetermined sp., Verrill, Proc. Nat. Mus., iii, p. 376, 1880.

PLATE LVII, FIGURE 35.

Shell small, slender, elongated, with well-rounded whorls and deep suture. Whorls seven, crossed by about thirteen regular ribs, which are moderately elevated and evenly rounded and, on the lower

whorls, a little thickened, most so in the middle; their interstices are crossed by several distinct spiral cinguli, which also render the ribs a little nodulous; on the penultimate whorl there are about five cinguli; on the last whorl a strong, round, spiral carina surrounds the base or umbilical region, starting from under the upper margin of the outer lip and inclosing a space on which two or more faint spiral grooves can be detected. Aperture round; lips continuous; margin of outer lip thickened by a rib; inner lip with the edge reflected in the umbilical region; no umbilicus. Color white.

Length, 5.5^{mm}; breadth, 2^{mm}; diameter of aperture, 1^{mm}.

Station 873, off Newport, R. I., 100 fathoms, 1880. One specimen.

Named in honor of Mr. E. A. Andrews, an assistant with the U. S. Fish Commission parties, in 1880 and 1881.

Scalaria Dalliana Verrill and Smith.

Scalaria Dalliana Verrill and Smith, in Verrill, Amer. Journ. Sci., xx, pp. 391, 395, Nov., 1880; Proc. U. S. Nat. Mus., iii, p. 377, 1880.

PLATE LVII, FIGURE 33.

Off Martha's Vineyard, several specimens, from stations 869, 870, 871, 874, and 876, in 85 to 192 fathoms (living ones in 115 to 155 fathoms), 1880; stations 949 and 1038, in 100 to 146 fathoms, 1881.—U. S. Fish Com.

Scalaria Pourtalesii Verrill and Smith.*

Scalaria Pourtalesii Verrill and Smith, in Verrill, Amer. Journ. Sci., pp. 391, 395, Nov., 1880; Proc. U. S. Nat. Mus., iii, p. 376, 1880.

PLATE LVII, FIGURE 32.

Operculum black, round-ovate, spiral with nearly three turns, rapidly increasing, lines of growth very oblique; nucleus very excentric.

Off Martha's Vineyard, three fine specimens, one of them living, from stations 871, 873, and 874, in 85 to 115 fathoms; 876, 120 fathoms, fragments, 1880; stations 949, 1038, 100 and 146 fathoms, 1881.—U. S. Fish Com.

* For those malacologists who adopt the ancient generic names of Klein (1756), as was done by Messrs. H. and A. Adams, *Scala* Kl. displaces *Scalaria* Lam. In that case, following the Adamsian nomenclature, the preceding species would be named as follows: *Scala Pourtalesii*; *Scala Dalliana*; *Scala (Opalia) Andrewsii*; *Cirsotrema Leeana*.

Scalaria angulata (Say).

Scalaria clathrus, var. *angulata* Say, Amer. Conch., iii, pl. 27, upper figures, 1831.

Scalaria Humphreysii Kiener, Icon. Coq. Viv., p. 15, pl. 5, fig. 16, 1838-1839.

Scalaria angulata Verrill, Rep. Invert. Anim. Vineyard Sd., in Rep. U. S. Fish Com., i, p. 660 (auth. cop., p. 366), 1874.

Scala (Clathrus) angulata H. and A. Adams, Genera, i, p. 222, 1858.

Stonington, Connecticut, to Florida. Not often found north of Chesapeake Bay. Great Egg Harbor, N. J. ! Stonington.—Linsley. Greenport, Long I.,—S. Smith. Common at Beaufort, N. C. !

Acirsa gracilis Verrill.

Acirsa gracilis Verrill, Proc. U. S. Nat. Mus., iii, p. 377, 1880.

PLATE LVII, FIGURE 31.

Stations 873 and 894, in 100 to 365 fathoms, off Martha's Vineyard, U. S. Fish Com.

Aclis striata Verrill.

Aclis striata Verrill, Proc. U. S. Nat. Mus., iii, 377, 1880.

PLATE LVIII, FIGURE 13.

One specimen was dredged by me in the Bay of Fundy, near Eastport, Me., in 1868; another was dredged at station 873, in 100 fathoms, off Newport, R. I., in 1880, by the U. S. Fish Commission.

Aclis Walleri Jeffreys.

G. O. Sars, Moll. Reg. Arct. Norv., p. 196, pl. 11, fig. 18.

Aclis Walleri Verrill, Amer. Journ. Sci., xx, p. 391, Nov., 1880; Verrill, Proc. U. S. Nat. Mus., iii, p. 377, 1880.

PLATE LVII, FIGURE 36.

Three living specimens were taken at stations 892 and 894, in 487 and 365 fathoms, off Martha's Vineyard, 1880.

Aclis tenuis Verrill, sp. nov.

Eulimella ventricosa (pars) Verrill, Proc. Nat. Mus., iii, p. 380, 1880 (*non* Forbes, sp.)

PLATE LVIII, FIGURE 19.

Shell white, glossy, very slender, with a regularly tapered, acute spire. Whorls nine, evenly rounded, nearly smooth, but under the microscope showing slightly raised spiral lines, or obscure angles, on the lower whorls. Suture well-impressed. Aperture ovate-elliptical; outer lip well rounded, a little prolonged, or effuse, at the anterior

end; columella a little curved. Umbilicus a narrow chink. Nucleus small, regular, a little excentric, not prominent and not turned up. Length, 3.8^{mm}; breadth, 1^{mm}.

Off Martha's Vineyard, station 873, 100 fathoms.

Solarium boreale Verrill and Smith.*

Solarium boreale Verrill and Smith, in Verrill, Proc. U. S. Nat. Mus., iii, p. 376, 1880.

PLATE LVII, FIGURES 29, 30.

The largest example has four whorls; the last has a rounded peripheral carina, above which there are about ten low, rounded, unequal cinguli, separated by concave grooves; on the base there are about as many similar but closer cinguli. Breadth, 12^{mm}; height, 7^{mm}; breadth of aperture, 5^{mm}. Two living young specimens from station 871, in 115 fathoms, 1880; a much larger living specimen, from 1038, in 146 fathoms, 1881.—U. S. Fish Commission.

Omalaxis ? lirata Verrill, sp. nov.

Shell small, depressed, with a low spire, but showing all the whorls in a side view. Whorls about four and a half, very convex; suture impressed; upper whorls smooth; apical whorl small, regular; last whorl mostly covered with strong, elevated, spiral cinguli, separated by wider concave grooves; around the umbilical region there is a broad, smooth band, with lines of growth only; in the umbilicus are two or three spiral lines. Aperture small, nearly circular, oblique, the inner lip strongly receding or excavated opposite the umbilicus, which is large and circular. Height, 1^{mm}; diameter, 2^{mm}.

Off Newport, R. I., station 770, 8¼ fathoms, 1880.

HETEROPODA.

Atalanta Peronii Lesueur.

Atalanta Peronii D'Orbigny, Voy. Amér. Mérid., Moll., p. 171, pl. 12, figs. 1-15; Hist. l'Isle de Cuba, Moll., i, p. 102, 1853.

Verrill, Proc. U. S. Nat. Mus., iii, p. 391, 1880.

Several living examples, probably belonging to this species, were taken at the surface, near George's Bank, latitude 41° 25' north, longitude 65° 5' to 65° 30' west, by Messrs. S. I. Smith and O. Harger, in 1872, on the "Bache." With these were one, or perhaps two, other species of the genus, not yet determined satisfactorily.

Fragments of a *Carinaria*, perhaps *C. Atlantica*, were dredged off Martha's Vineyard, station 865, in 1880.

* Those malacologists who follow H. and A. Adams, in adopting the undefined generic names of Bolton (1798), will use for this shell the name, *Architectonica borealis*.

RHIPHIDOGLOSSA.

Calliostoma Bairdii Verrill and Smith.*

Calliostoma Bairdii Verrill and Smith. in Verrill, Amer. Journ. Sci., xx, pp. 391, 396, Nov., 1880; Proc. U. S. Nat. Mus., iii, p. 378, 1880.

Dall. Bulletin Mus. Comp. Zool., ix, p. 45, 1880.

PLATE LVII, FIGURE 26.

The animal has long, slender, acute tentacles, yellowish white with a dark central line. Lateral cirri four on each side, two of them anterior and two posterior, similar to the tentacles in color and form, but only about one-half as long, and more slender; a lateral crest-like ridge, with a denticulated margin, connects the cirri together on each side, and runs back on the posterior part of the foot, as a carina; between these there is a shallow groove. Eyes large, black. Foot long, acute posteriorly; in front the angles are obtuse. Color of foot and head white or yellowish, with streaks of dark brown.

South of Martha's Vineyard, at many localities, both in 1880 and 1881. Stations 865 to 874, in 65 to 192 fathoms, 1880, many living specimens; most common at stations 869 and 871, in 192 and 115 fathoms. Stations 921-923, 941, 944, 949, 950, 1036, 1038, 1040, in 65 to 146 fathoms, 1881. Off Chesapeake Bay, station 896, 56 fathoms. Off Delaware Bay, station 1047, in 156 fathoms. Gulf of Mexico and off Florida, "Blake" expedition (t. Dall).

Margarita regalis Verrill and Smith.

Margarita regalis Verrill and Smith. Amer. Journ. Sci., xx, pp. 392, 397, Nov., 1880; Verrill, Proc. U. S. Nat. Mus., iii, p. 378, 1880.

PLATE LVII, FIGURE 37.

Stations 870, 871, 880, 881, 891 to 895, from 115 to 500 fathoms, 1881. Most abundant at stations 891 to 894, 365 to 487 fathoms. Stations 925, 938, 939, 946, 947, 994, 997 to 999, 1028-29, 1032, in 224 to 458 fathoms, 1881. Off Chesapeake Bay, station 898, 300 fathoms. Off Delaware Bay, station 1049, 435 fathoms.

Margarita lamellosa Verrill and Smith

Margarita lamellosa Verrill and Smith. Amer. Journ. Sci., xx, pp. 391, 397, Nov., 1880; Proc. U. S. Nat. Mus., iii, p. 378, 1880.

? *Margarita ægleës* Watson, Journ. Linn. Soc., xiv, p. 704, 1879.

Dall. Bulletin Mus. Comp. Zool., ix, p. 40, 1880 [*ægleis*].

PLATE LVII, FIGURE 38.

Mr. Dall thinks that this species is only a variety of *M. ægleës* W.

* For those authors who do not adopt *Calliostoma*, this species will be *Trochus Bairdii* or *Ziziphinus Bairdii*.

I have myself examined Mr. Dall's series, which show considerable variation, indicating that his view is likely to prove correct. But none of his specimens agree very closely with mine.

Stations 869 and 871, 115 to 192 fathoms; 949, 100 fathoms. Six specimens obtained. Gulf of Mexico, 287 to 2,805 fathoms,—Blake Expedition (t. Dall). Off St. Thomas, W. I., 390 fathoms,—Challenger Expedition (t. Watson).

Machæroplax obscura, var. *bella* (Verkr.).

Margarita bella Verkrutzen, Jahrb. d. Mall. Gesellsch., 1875.

Machæroplax bella Friele. Archiv. for Math. Naturv., 1876. p. 314.

G. O. Sars, op. cit., p. 137, pl. 9, figs. 5 a-c.

Verrill. Proc. U. S. Nat. Mus., iii, 1878 (description).

This appears to be only a highly sculptured variety of *M. obscura*, but it seems to be identical with the form figured by G. O. Sars. It differs from the typical form chiefly in having the base covered with distinct, incised, spiral lines. In some specimens the curved radiating ribs or undulations on the base are well-marked, as in the typical form, in others they are more or less obsolete. The presence of a slight spiral carina, or angle, bordering the umbilicus, is variable in both forms, being, in some specimens, pretty well-marked, in others entirely absent. The sculpture on the upper whorls is also variable in both varieties. The transverse ribs are usually rather more evident in var. *bella*, but they are often equally evident in typical *obscura*, frequently they are almost obsolete, except on the earlier whorls.

The height of the spire varies greatly in both varieties.

Variety *bella* is the predominant form at Eastport, Me., and in the Bay of Fundy, where I dredged it in 1864, 1865, 1868, 1870, in 10 to 40 fathoms. Gulf of Maine, 67 to 86 fathoms, 1874; George's Bank, 43 to 45 fathoms, 1872; off Cape Cod, 1879.—U. S. Fish Com.

Var. *planula*, nov.

Another form of *M. obscura* frequently occurs south of Cape Cod, in 15 to 30 fathoms. In this the base is nearly smooth, with the radiating ribs obsolete, or indicated merely by bands of brownish color, while the spiral lines are entirely wanting, or occur only near the periphery, and often in the umbilicus, which may or may not be defined by an angular border. The body-whorl usually has three or four, more or less distinct, but low, angular, spiral cinguli, of which the first, just below the suture, usually forms only a slight ridge on the flattened subsutural band, and is often entirely absent; the sec-

ond, midway between the suture and periphery, is the largest, most prominent, and most constantly present; below this there may be two or three evident carinæ, or these may be absent, or replaced by several fine, spiral cinguli. Transverse, low ribs or undulations may be more or less distinct on all the whorls, but more frequently are present on the upper whorls, and obsolete, or nearly so, on the lower ones.

These varieties pass into one another by various intermediate forms.

Var. *carinata*, nov.

This form may prove to be a distinct species. It has the form and the large umbilicus of *M. obscura*, but its strong, spiral carinæ and the distinct spiral carina around the umbilicus cause it to resemble *Margarita cinerea*. The body-whorl has a distinct subsutural carina and three well-separated, strong, raised carinæ below it, the fourth forming a peripheral keel; sometimes smaller intermediate ones occur between the third and fourth, and two or more smaller ones below the periphery; in some examples distinct incised spiral lines cover the whole of the base and inner surface of the umbilicus, while a strongly marked carina, with a deeper groove each side of it, defines the umbilicus. Transverse undulations are usually well-marked on the upper whorls, and sometimes on the base. There are no lamellose lines of growth, so characteristic of *M. cinerea*; and the umbilicus is much larger than in the latter.

Off Martha's Vineyard, stations 997, 1032, 1038, in 146 to 335 fathoms, 1881.

Cyclostrema Dalli Verrill, sp. nov.

Cyclostrema trochoides Verrill, Proc. U. S. Nat. Mus., iii, p. 378, 1880 (*non* Friele, Sars).

PLATE LVII, FIGURE 39.

Shell small, pale, trochiform, with about three and a half whorls, the apical whorl a little prominent, visible in a side-view; whorls rapidly enlarging, well-rounded, the body-whorl ventricose; suture deeply impressed. Aperture nearly circular; lip with a slight angle anteriorly; columella evenly curved. Umbilicus entirely closed, or represented by a very narrow chink. Spiral, incised lines, seven or eight in number, cover the base of the shell and the umbilical depression; shell elsewhere nearly smooth, but covered with very fine striations, or lines of growth, which give the surface a dull appearance, the freshest specimens having only a slight luster. Color yellowish white.

Height, 2^{mm}; breadth, 2.25^{mm}.

A few specimens of this shell were taken in 1880, at station 892, in 487 fathoms.

Cyclostrema rugulosum (Jeff. MSS.) G. O. Sars.

Moll. Reg. Arct. Norvegiæ, p. 129, pl. 21, figs. 1a, 1b.

This is smaller than the preceding species, with a circular umbilicus. The spiral lines around the umbilicus are finer and more numerous.

Station 894, in 365 fathoms, 1880. Finmark; Lofoten I.; Norway, 80 to 200 fathoms (t. Sars).

Scissurella crispata Fleming.

Off Martha's Vineyard, stations 894-895, in 238-365 fathoms. A single specimen was found by Mr. Dall, in the aperture of a *Margarita*. Gulf of St. Lawrence,—coll. Packard (t. Dawson). On the European coast, from Finmark to the Mediterranean. Norway, 40 to 400 fathoms,—Sars.

Addisonia paradoxa Dall.

Addisonia paradoxa Dall, Proc. Nat. Mus., iv, p. 405, 1882 (descr., anatomy, dentition, etc.).

Off Martha's Vineyard, stations 923, 940, 950, 69 to 130 fathoms, 1881.—U. S. Fish Commission.

For this curious limpet-like species Mr. Dall has constituted a new genus and a new family, *Addisoniidae*, belonging to the Rhipidoglossa. The dentition is very peculiar. The shell is white, nearly smooth, with a rounded aperture and a prominent acute, excentric apex, turned obliquely to one side. The shape is something like that of *Crucibulum striatum*.

Cocculina Beanii Dall.

Aemæa rubella? Verrill, Proc. U. S. Nat. Mus., iii, p. 391, 1880 (*non* Fabr., Sars, etc.)

Cocculina Beanii Dall, Proc. Nat. Mus., iv, p. 403, 1882. (dentition, anatomy, etc.)

Off Martha's Vineyard, stations 871, 894, 115 and 365 fathoms, 1880; stations 947, 949, 997, 100 to 335 fathoms, 1881,—U. S. Fish Com. West Indies, 399 to 502½ fathoms, Blake Exp. (t. Dall.)

For this new genus, Mr. Dall has established a new family, *Cocculinidae*, allied to *Fissurellidae*, but with an imperforate and limpet-like shell, and a single asymmetrical gill. It has no lateral cirriform appendages, and probably no eyes.

Cocculina Rathbuni Dall, op. cit., p. 403.

Off Martha's Vineyard, station 937, 506 fathoms. West Indies, 399 and 502½ fathoms, Blake Exp. (t. Dall.)

DOCOGLOSSA.

Lepetella tubicola Verrill and Smith.

Lepetella tubicola Verrill and Smith. in Verrill, Amer. Journ. Sci., xx, pp. 391, 396, Nov., 1880; Proc. U. S. Nat. Mus., iii, p. 375, 1880.

Dall, Proc. Nat. Mus., iv, p. 408, 1882 (anatomy, dentition, etc.)

PLATE LVIII, FIGURES 29, 29a.

Off Martha's Vineyard, in old tubes of *Hyalinocia artifex* V. Stations 869, 870, 880, 894, 895, 938, 940, 945, 947, 952, in 130 to 388 fathoms.

Mr. Dall, in the article cited, has constituted for this genus, a new subfamily, *Lepetellinae*, in the family *Lepetidae*. The subfamily is characterized by the presence of eyes, and the peculiar nature of the dentition. Young and perfect specimens of this shell show that the nucleus is subspiral (fig. 29a).

POLYPLACOPHORA.

Leptochiton cancellatus (Sby.) Gray; H. and A. Adams.

Lepidopleurus cancellatus G. O. Sars, Moll. Reg. Arct. Norvegiæ, p. 111, pl. 7, figs. 6a-h.

Leptochiton cancellatus Verrill, Amer. Journ. Sci., xvii, p. 312, 1879.

Off Halifax, 95 fathoms, 1877; Bay of Fundy, 1872, seven specimens; LeHave Bank, station 87 B, 60 fathoms, 1872, "Bache," Cashe's Ledge, 30-40 fathoms, 1874. Gulf of St. Lawrence, 220 fathoms, coll. Whiteaves (t. Dall).

Leptochiton alveolus (Sars) Lovén.

Lepidopleurus alveolus G. O. Sars, op. ult. cit., p. 110, pl. 7, figs. 3, a-i.

Leptochiton alveolus Verrill, Amer. Journ. Sci., xvii, p. 312, 1879.

Gulf of Maine, 150 fathoms, "Bache," 1872.

Hanleyia Hanleyi (Bean) Carp.

Chiton Hanleyi G. O. Sars, op. cit., p. 109, pl. 7, figs. 5, a-i.

Off Cape Ann, Mass., 8½ miles, in 38 fathoms, 1878.

Perhaps only a variety of *H. mendicarius*.

GYMNOGLOSSA.

Stilifer Stimpsonii Verrill.

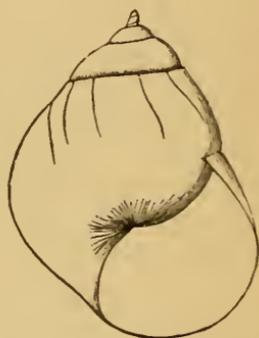
Stilifer Stimpsonii Verrill. Amer. Journ. Sci., iii, pp. 210, 283, 1872; Verrill, Report, Invert. Anim. of Vineyard Id., in 1st Rep. U. S. Fish Com., pp. 655, 460 (auth. cop., p. 361), 1874. [*Stylifer*.]

Verrill, in Smith and Harger, Trans. Conn. Acad., iii, p. 49, pl. 1, fig. 1, 1874.

FIGURE 2.

This species was taken in considerable numbers, at stations 814, 823, 824, off Block Island, in 13 to 27 fathoms, 1880. At station 1028, in 410 fathoms, 1881. It occurred, as usual, on the upper surface of *Strongylocentrotus Dröbachiensis*, between the spines, and partly imbedded in the skin. At these localities the eggs and young occurred with the adults. Some of the eggs were kept alive till they developed into the veliger-stage. The eggs are large, yellow, attached singly or in groups to the skin of the sea-urchin. Its previous localities were off New Jersey, 35 fathoms; George's Bank, 60 fathoms.

FIG. 2.



This shell varies greatly in the proportions of length to breadth. In some, the spire is elevated; in others, comparatively short.

Stilifer curtus Verrill, sp. nov.

Shell short and broad, depressed spheroidal, with the spire very low, rising but little above the body-whorl. Nucleus very small, a little prominent, in our specimen not forming a stiliform tip like that of *S. Stimpsoni* and other species. The rest of the shell has about two whorls, but is formed mainly by the large, ventricose body-whorl, which nearly encloses and conceals the rest. Aperture nearly as long as the shell, lunate, rather large; outer lip very convex, evenly rounded. Shell smooth and white. Height, 2.5^{mm}; breadth, 3.5^{mm}.

Off Martha's Vineyard, station 1028, in 410 fathoms.

Eulima intermedia Cantraine.

Eulima intermedia G. O. Sars, op. cit., p. 210, pl. 11, fig. 20; pl. xviii, fig. 41.

Verrill. Amer. Journ. Sci., xx, p. 392, Nov., 1830; Proc. U. S. Nat. Mus., iii, p. 379, 1880.

PLATE LVIII, FIGURE 20.

Several living specimens were taken at stations 870, 871, 874, 876,

and 877, in 85 to 155 fathoms, 1880, and at station 949, in 100 fathoms, 1881.

On the European coasts, from Finmark to the Canary Islands and the Mediterranean. Norway, 30 to 300 fathoms,—Sars.

Eulima stenostoma Jeffreys.

Jeffreys, Brit. Conch., iv, p. 207.

G. O. Sars, Moll. Reg. Arct. Norvegiæ, p. 211, pl. 21, fig. 21.

Gulf of St. Lawrence, coll. Whiteaves, (t. Jeffreys.)

Eulima distorta Deshayes.

Eulima distorta G. O. Sars, op. cit., p. 210, pl. 11, fig. 23.

Verrill, Amer. Journ. Sci., xx, p. 392, Nov., 1880; Proc. U. S. Nat. Mus., iii, p. 379, 1880.

A single living specimen of this curious little shell was obtained at station 871, in 115 fathoms, 1880. On the European coasts, from Lofoten to the Canary Islands and Mediterranean. Norway, 10 to 300 fathoms,—Sars.

Turbonilla Rathbuni Verrill and Smith.

Turbonilla Rathbuni Verrill and Smith, in Verrill, Amer. Journ. Sci., xx, pp. 392, 398, Nov., 1880; Proc. U. S. Nat. Mus., iii, p. 379, 1880.

PLATE LVIII, FIGURE 15.

Several fine living specimens were taken at stations 865 to 867, 869, 870, in 64 to 192 fathoms, and at stations 894, 895, in 238 to 365 fathoms, 1880; stations 925, 945, 947, 949, in 100 to 312 fathoms, 1881.

Turbonilla Emertoni Verrill.

PLATE LVIII, FIGURES 14, 14a.

Shell small, white, lustrous, elongated, with a very slender, acute spire. Whorls eleven, not very oblique, broadly rounded, a little flattened at the periphery; suture strongly impressed; surface very smooth and glossy, without any spiral lines, but with slight, rather indistinct and irregular longitudinal furrows, which are often absent. Apical whorl small, strongly upturned. Aperture small; outer lip flattened, projecting a little anteriorly (more or less broken in all my specimens). Columella nearly straight, with no trace of a fold.

Length, 4·8^{mm}; breadth, 1·2^{mm}.

Off Martha's Vineyard, station 895, in 238 fathoms, 1880. This

shell resembles *T. nivea* Stimpson, which also occurs in the same region, but the latter is a longer and larger shell with a decidedly smaller and more prominently upturned nucleus, and is strongly and regularly longitudinally ribbed.

Turbonilla Bushiana Verrill.

Turbonilla formosa Verrill and Smith, in Verrill, Amer. Journ. Sci., xx, pp. 392, 398, Nov., 1880; Proc. U. S. Nat. Mus., iii, p. 380, 1880 (*non* Jeffreys).

PLATE LVIII, FIGURE 16.

Shell lustrous, white, or pinkish white, often beautifully iridescent, elongated, with a regularly tapered, acute spire. Whorls eleven or twelve, somewhat flattened, rounded at the sutures, which are impressed. Numerous, low, broad, rounded, curved ribs cross the whorls; they are most evident just below the sutures, often obsolete above them. Aperture ovate, a little effuse anteriorly. Nucleus small, upturned, reversed. Length, 12^{mm}; breadth, 3·25^{mm}.

A few living examples of this elegant shell occurred at stations 891, 892 and 894, in 365 to 500 fathoms, 1880.

This species is named in honor of Miss K. J. Bush, an excellent assistant in the conchological work of the U. S. Fish Commission.

Turbonilla costulata Verrill.

Turbonilla costulata Verrill, Rep. Invert. Anim. Vineyard Sd., in Rep. U. S. Fish Com., i, p. 658, 1874 (auth. cop., p. 364).

Long I. Sound, off New Haven, to Vineyard Sound; 1 to 5 fathoms.

Turbonilla areolata Verrill.

Turbonilla areolata Verrill, Rep. Invert. Anim. Vineyard Sd., in Rep. U. S. Fish Com., i, p. 658, 1874 (auth. cop., p. 364).

Long I. Sound, off New Haven, to Vineyard Sound, 2 to 8 fathoms.

Turbonilla stricta Verrill.

Turbonilla stricta Verrill, Rep. Invert. Anim. Vineyard Sd., in Rep. U. S. Fish Com., i, p. 659, 1874 (auth. cop., p. 365).

Long I. Sound, near New Haven, Conn., 3 to 8 fathoms.

Turbonilla equalis Verrill.

Turritella equalis Say, Journ. Acad. Nat. Sci. Philad., v, p. 208, 1826.

Turbonilla equalis Verrill, Rep. Invert. Anim. Vineyard Sd., in Rep. U. S. Fish Com., i, p. 659, 1874 (auth. cop., p. 365).

Vineyard Sound, 6 to 8 fathoms. Southern coast.

Turbonilla elegans Verrill.

Turbonilla elegans Verrill, Amer. Journ. Sci., iii, pp. 210, 282, pl. 6, fig. 4, 1872; Rep. Invert. Anim. Vineyard Id., in Rep. U. S. Fish Com., i, pp. 418, 657, pl. 24, fig. 155, 1874 (auth. cop., p. 363).

FIGURE 3.

FIG. 3.



The accompanying figure is from a camera-lucida drawing of one of the original specimens, by the writer.

Long I. Sound, off New Haven, 2 to 6 fathoms; Vineyard Sound, 2 to 10 fathoms; Narragansett Bay.

D'Orbigny, in Hist. I. Cuba, Mollusques, 1853, described a shell under the name of *Chemnitzia elegans*. His shell has, however, a well-marked plication on the columella, and, therefore, should undoubtedly be referred to a genus distinct from *Turbonilla*. Otherwise, I would suggest the substitution of *T. elegantula*, for the name of our shell.

Eulimella Smithii Verrill.

Turbonilla Smithii Verrill, Proc. U. S. Nat. Mus., iii, p. 380, 1880.

PLATE LVIII, FIGURE 18.

This species belongs to *Eulimella*, rather than to *Turbonilla*, if these two groups be kept as distinct genera.

- Stations 871, 873, 874 and 876, in 85 to 120 fathoms, 1880; 949 and 1038, in 100 to 146 fathoms, 1881.

Eulimella polita Verrill.

Aclis polita Verrill, Amer. Journ. Sci., iii, pp. 210, 282, pl. 6, fig. 5, 1872.

FIGURE 4.

Whorls twelve, besides the nucleus, well-rounded, smooth and glossy, mostly without sculpture, but on some of the upper whorls faint, very slightly elevated, transverse ribs can be detected, with a lens; lines of growth very slight. Suture well-impressed, little oblique. Aperture short-ovate; the outer lip is broadly rounded, slightly effuse in front; the columella is smooth, a little excurved, bending to the left, from its junction with the body-whorl, and then joining the outer lip in a regular curve; in the umbilical region its edge is raised and very slightly reflexed. No umbilicus.

FIG. 4.



Length, 8^{mm}; breadth, 2^{mm}.

Eastport, Me., 20 fathoms, 1864,—A. E. Verrill and S. I. Smith.

The above description is from the original type. No

other good specimen has yet been found. The nucleus is broken, but it appears to have been upturned.

The figure is from a camera-lucida drawing of the original specimen.

This species appears to be closely allied to *E. ventricosa*, of Europe.

Menestho sulcata Verrill.

Odostomia (Menestho) sulcata Verrill, Proc. U. S. Nat. Mus., iii, p. 380, 1880.

Stations 871 and 894, in 115 and 365 fathoms.

This species differs from *M. sulcosa* (= *Plasianella sulcosa* Mighels, 1841) in having finer and more numerous sulci.

The apical whorl, in our specimens, is conspicuously turned up and reversed.

Menestho Bruneri Verrill, sp. nov.

Shell small, white, with an elongated, acute-conical spire, the apical whorl very small, upturned, and incurved. Whorls six, with a rounded shoulder close to the suture, the portion next the suture rising abruptly, nearly at a right angle; periphery flattened, or very slightly rounded; suture little oblique, impressed, or subcanaliculate. Aperture narrowly contracted posteriorly, narrow-ovate anteriorly; outer lip little convex, slightly produced anteriorly; columella excurved, flattened, with no fold nor tooth. Sculpture delicate, incised, spiral grooves, separated by wider intervals, and covering the anterior two-thirds of the body-whorl, extending a little back of the aperture, but mostly absent on the preceding whorls. No umbilicus. Length, 5^{mm}; breadth, 2.5^{mm}; length of body-whorl, 3.5^{mm}; of aperture, 2.5^{mm}; its breadth, 1^{mm}.

Off Newport, R. I., station 892, in 487 fathoms, 1880.

I have named this species in honor of Mr. H. L. Bruner, an assistant in the conchological work of the Fish Commission during the season of 1881.

Several additional species of this family, were taken, which I have not yet been able to determine. Among these is the following:

Odostomia (?), sp. A rather large, slender, elongated shell, with smooth, flattened whorls, and a strongly marked, elevated fold on the columella. The specimen is too much broken for description. Station 894, in 365 fathoms.

TECTIBRANCHIATA.

Actæon nitidus Verrill, sp. nov.

PLATE LVIII, FIGURE 21.

Auriculina insculpta Verrill, Proc. Nat. Mus., iii, p. 381, 1880, (*non Mont. sp.*)

Shell small, white, translucent, glossy, elongated, apex obtuse. Nuclear whorl rather large, regular. Whorls six, flattened at the periphery, gradually increasing, slightly roundly shouldered, sculpture delicate, wavy, incised spiral lines, more distant and distinct on the anterior part of the body-whorl, becoming finer, closer, and more wavy behind the middle, obsolete near the suture, except one fine, subsutural groove; suture impressed, or slightly canaliculate. Aperture narrow-ovate, much contracted posteriorly, a little produced anteriorly; columella spirally twisted, the inner edge forming a slightly raised fold.

Length, 8^{mm}; breadth 3^{mm}; length of body-whorl, 5·5^{mm}; length of aperture, 3·5^{mm}; its breadth, 1·8^{mm}.

Stations 892 and 947, in 487 and 312 fathoms, 1880 and 1881, south of Martha's Vineyard.

The shell formerly recorded as *Auriculina insculpta* was a young dead specimen of this species.

Ringicula nitida Verrill.

Ringicula nitida Verrill, Amer. Journ. Sci., III, vol. v, p. 16, 1872-3; Verrill, in Smith and Harger, Trans. Conn. Acad., iii, p. 48, pl. 1, fig. 2, 1874.

Dall, Bulletin Mus. Comp. Zool., ix, p. 97, 1881.

Gulf of Maine, 110 fathoms, "Bache," 1872.

Dredged at ten stations, off Martha's Vineyard, in 1880 and 1881, in 100 to 500 fathoms; stations 947, 949, 994, 997, in 100 to 368 fathoms, 1881.

Off Florida, 447 fathoms; Gulf of Mexico and Yucatan Straits, 339 to 640 fathoms (t. Dall).

Mr. Dall records specimens 7·5^{mm} long, 5^{mm} broad, which is larger than any of ours, which seldom exceed 5^{mm} in length.

CHORISTIDÆ, fam. nov.

The peculiar structure of the following shell, its animal, and the radula will not allow it to be placed in any established family. Therefore I propose to make it the type of a new family, *Choristidæ*.

This family may be characterized by the heliciform shell, with the perisotracia continuous between the whorls; lip continuous; columella

without a fold; operculum paucispiral. Animal, with frontal tentacles united by a fold, and with simple posterior tentacles. Head thick and short, with large retractile pharynx. Jaws well developed. Radula with three rows of rhachidian teeth; broad, bilobed, inner lateral teeth; and two rows of small, hook-shaped, outer lateral ones.

Gill large, attached to the inner surface of the mantle on the left side of the neck, and extending over to the right side, consisting of numerous lamellæ.

Choristes elegans Carp., variety *tenera* V.

Choristes elegans Carpenter, Canadian Nat., vi, p. 392, pl. 7, fig. 13, 1872.

PLATE LVIII, FIGURES 27, 27a.

Shell thin, fragile, heliciform, with a low spire and a very large, ventricose body-whorl. Whorls, in our largest examples, four to five, very convex and evenly rounded; apical whorl small, spiral, obliquely upturned and incurved, but not prominent; suture deeply impressed; surface smooth. (The epidermis is mostly destroyed and the surface of the shell eroded in all our living specimens.) The whorls are largely in contact and united well together, though the periostraca is continuous between them. Aperture large, forming more than a half-circle; the outer side is well rounded, the columella-margin nearly straight; lip sharp, continuous all around, raised up and with the edge slightly everted in the umbilical region, so as to partially conceal the umbilicus, which is rather large and deep, nearly circular within. Operculum thin, horny, pale yellow, round-ovate, spiral, with two to three rapidly enlarging whorls, the nucleus ex-centric.

The animals of several alcoholic specimens were examined. Head large, short, thick, rounded or truncate, with two short, flat, obtuse, anterior tentacles, wide apart, but connected together by a transverse fold; posterior tentacles, short, thick, conical, smooth; no eyes visible; proboscis short, thick, retractile; jaws crescent-shaped, strong, black. Verge situated just below the right posterior tentacle, small, papilliform, swollen at base; below this and farther back, a larger and thicker papilla with basal swelling; on each side, between the mantle and foot, at about midlength of the foot, a small mammiform papilla; and two small flat cirri, behind and beneath the operculum. Foot broad, ovate, with two tentacle-like processes in front. Gill large, consisting of numerous thin lamellæ, attached to the inner sur-

face of the mantle, over the left side of the neck, and extending obliquely across and over the neck to the right side.

The largest specimens are badly broken; some of them were about 10^{mm} in length; greatest diameter of operculum, 6^{mm}; breadth 4.5^{mm}. A perfect but small specimen is 6^{mm} long; breadth, 6^{mm}; length of body-whorl, 5.2^{mm}; length of aperture, 4^{mm}; its breadth, 3.2^{mm}.

Station 1031, off Martha's Vineyard, in 255 fathoms, 1881. About a dozen specimens, all living, were taken from the interior of an old egg-case of a skate (*Raia*, sp.). Most of them were badly broken.

I have compared these specimens directly with original specimens of the fossil *Choristes elegans*, found in the post-pliocene of Canada by Principal J. W. Dawson, who very kindly sent me specimens, both adult and young, for examination. I have figured a young fossil specimen for convenient comparison (pl. LVIII, fig. 28.)

Our specimens agree very closely with the smaller fossil ones, in form and structure. The principal difference is in the much thinner and more fragile texture of the recent shells. This may be due to mere local conditions. Therefore, until more specimens of the recent shell are obtained, I prefer to consider it a thin and delicate variety of the ancient type.

Cylichna Dalli Verrill, sp. nov. (Genus provisional).

Shell elongated, white, translucent, somewhat barrel-shaped, a little broader medially, but nearer the anterior end; considerably narrowed posteriorly, with a small pit at the apex. No umbilicus. Aperture as long as the shell, very much narrowed posteriorly, and ending in a narrow slit in the sutural line; anteriorly it increases gradually about to the anterior third, when it suddenly expands into an ovate anterior portion, by the strong excurvature of the columella-margin, and a slight expansion of the outer lip. The outer lip rises, posteriorly, slightly above the level of the body-whorl, in the form of a thin edge, separated from the body-whorl by a narrow, deep fissure; passing backward it forms a gently sloping shoulder, and is very slightly convex and divergent to the anterior end, where it is cut away for the entire width of the shell, and joins the columella-lip in a regular curve, with a sharp edge, not reflexed; the columella-margin is strongly excavated and sinuous, and in the larger specimen has a slight fold, anteriorly; a thin, white callus covers the inner lip. The body-whorl is broadly convex, rounded off gently anteriorly, and more abruptly posteriorly. The pit, at the apex, is well defined, showing some of the volutions, but is injured in both of my

specimens. Whole surface covered with fine, close, minutely wavy spiral lines, scarcely visible without a lens. Animal unknown.

Length of the largest, 10^{mm}; breadth in the middle, 5.25^{mm}. Stations 997 and 999, in 335 and 266 fathoms, 1881.

Diaphana gemma Verrill.

Diaphana gemma Verrill, Amer. Journ. Sci., xx, pp. 392, 399, Nov., 1880; Proc. U. S. Nat. Mus., iii, p. 382, 1880.

PLATE LVIII, FIGURE 22.

Stations 871 and 873, 100 to 115 fathoms, fine sand; south of Martha's Vineyard and Newport, R. I.

Diaphana conulus (Desh.).

Utriculus conulus G. O. Sars, op. cit., p. 287, pl. 17, figs. 17 a-c.

Diaphana conulus Verrill, Proc. U. S. Nat. Mus., iii, p. 382, 1880.

PLATE LVIII, FIGURE 25.

A perfect living specimen of this species was taken at station 870, in 155 fathoms, and a dead one at 949, in 100 fathoms. It had not been found before on the American coast. Our specimen differs somewhat from the figures of the European shell, especially in being stouter, and broader anteriorly.

Diaphana nitidula (Lovén) Verrill.

Cylichna nitidula Lovén, op. cit., p. 142, 1846.

Utriculus nitidulus G. O. Sars, op. cit., p. 286, pl. 17, fig. 13, pl. 26, fig. 3, pl. xi, figs. 6 a, 6 b (gizzard, &c.).

Diaphana nitidula Verrill, Amer. Journ. Sci., xx, p. 392, Nov., 1880; Proc. U. S. Nat. Mus., iii, p. 381, 1880.

This shell has been dredged by us in several localities, in deep water off the coast of New England and Nova Scotia, and by Mr. Whiteaves in the Gulf of Saint Lawrence. It was taken at stations 891, 892, and 894, in 365 to 500 fathoms, off Martha's Vineyard.

Amphisphyra globosa Lovén, 1846.

Diaphana globosa G. O. Sars, op. cit., p. 290, pl. 18, figs. 3 c, 4, pl. xi, fig. 12 (dentition).

Amphisphyra globosa Verrill, Amer. Journ. Sci., xx, p. 392, Nov. 1880; Proc. U. S. Nat. Mus., iii, p. 382, 1880.

Specimens agreeing in all respects with Sars's figures, referred to above, were dredged at stations 870, 871, and 894, in 115 to 365 fathoms, off Martha's Vineyard, 1880; station 947, in 312 fathoms, 1881.

Philine amabilis Verrill.

Philine amabilis Verrill, Amer. Journ. Sci., pp. 392, 398, Nov., 1880; Proc. U. S. Nat. Mus., iii, p. 383, 1880.

PLATE LVIII, FIGURES 23, 24.

Several living specimens were taken at station 876, about 100 miles south of Newport, R. I., in 120 fathoms, 1880; at station 940, in 130 fathoms, 1881, one living; off Delaware Bay, station 1047, in 156 fathoms, 1881.

Philine cingulata G. O. Sars.

Philine cingulata G. O. Sars, op. cit., p. 297, pl. 26, figs. 7 *a-c*, pl. xii, fig. 3.
Verrill, Proc. U. S. Nat. Mus., iii, p. 384, 1880.

Off Cape Sable, Nova Scotia, in 90 fathoms. Taken off Martha's Vineyard at station 892, in 487 fathoms, 1880.

Philine fragilis G. O. Sars.

Philine fragilis G. O. Sars, op. cit., p. 296, pl. 18, figs. 11 *a-c*, pl. xii, fig. 2 (dentition).

Verrill, Proc. U. S. Nat. Mus., iii, p. 384, 1884.

Off Cape Sable, Nova Scotia, 90 fathoms, fine, compact sand, 1877; Jeffrey's Ledge, Gulf of Maine, 88 to 92 fathoms, 1874, several large living specimens.

Philine Finmarchica M. Sars.

Philine Finmarchica G. O. Sars, op. cit., p. 296, pl. 18, figs. 10 *a-d*; pl. xii, fig. 1 *a, b* (dentition).

Verrill, Amer. Journ. Sci., xx, p. 392, Nov., 1880; Proc. U. S. Nat. Mus., iii, p. 384, 1880.

Off Cape Sable, Nova Scotia, 90 fathoms, fine sand, 1877; station 872, off Martha's Vineyard, in 86 fathoms, 1880; off Cape Cod, station 298, in 16 fathoms, 1879.

Philine tinctoria Verrill, sp. nov.

Shell broad, oblong, rather large for the genus, widest in the middle, very thin, tinged with smoky brown, not polished and without distinct spiral lines, but with very distinct, fine, close, sinuous, slightly raised, minutely wavy lines of growth. The apex is rounded and shows neither spiral whorls, nor a depression. The outer lip rises slightly above the body-whorl from which it is separated by a broad and deep notch; from the posterior shoulder to the anterior end

it is broadly flaring and convex, with a slight rounded angle about at the middle; anteriorly it is a little narrower and evenly rounded; the columella margin is slightly excurved, with a thin edge, in front of the middle, and is reflected against the body-whorl, where it joins it, leaving a slight groove behind it, and winding into the shell, it forms a distinct, raised spiral fold, separated from the more prominent, inner surface of the body-whorl by a concave groove.

Length, 10.75^{mm}; breadth, in middle, 8^{mm}; breadth of aperture, 7^{mm}.

Station 921, in 65 fathoms, two living specimens.

Koonsia, gen. nov.

Allied to *Pleurobranchæa*, with which it agrees in the character of the head, tentacles, proboscis, and gill. It differs in having the back swollen and overhanging both on the sides and posteriorly, and a distinct mantle-edge all around, with a wide groove between it and the foot posteriorly, as well as laterally; the foot is narrower and prolonged posteriorly, with a specialized glandular area, near the end, beneath, and a conical papilla above, near the tip. The external reproductive organs appear less complicated than in *Pleurobranchæa*. The verge is armed with small hooks, but the spicule, present in the latter genus, is not protruded in any of our specimens of *Koonsia*, if present; the urinal opening is at the anterior root of the gill; between this and the verge, some specimens show a small opening, and a low papilla, but none show the large opening and long flat papilla, present in *Pleurobranchæa*, and usually well displayed in alcoholic specimens. Anal opening behind the base of the gill. Gill large, bipinnate, fully exposed on the right side, between the mantle and the foot.

This genus is dedicated to Mr. B. F. Koons, of the U. S. Fish Commission, in 1880 and 1881.

Koonsia obesa Verrill, sp. nov.

Body large, stout, broad, with a large, swollen back, smooth and white in the preserved specimens, and defined by the mantle-edge, which forms a rim along the lateral and posterior borders. Head large and broad, with two short, flat, posteriorly grooved, anterior tentacles, one at each corner; the anterior mantle-border runs between them, and supports a row of small papillæ. Posterior tentacles short, stout, flattened, ear-like, with the outer edges incurved, form-

ing a large groove. Proboscis very large, retractile, purple at the end, showing, when extended, the very broad radula, covered with very numerous sharp, hooked teeth, in many long curved rows. Foot broad and rounded anteriorly, with small anrioles; long tapered, and acute posteriorly, extending some distance beyond the mantle; a conical papilla near the tip above; under side, near the end, with a narrow, elongated, depressed, glandular area, surrounded by a raised border; this is sometimes tinged with bright red, in alcohol; the rest of the foot is usually tinged with chocolate-brown. Gill large, bipinnate, deep purple. This species grows to a great size. One from station 939, was over 5 inches (128^{mm}) long; 4 inches (102^{mm}) wide; and about 2 inches (50^{mm}) high, even after preservation in alcohol. Off Martha's Vineyard, stations 895, 939, 946, 1025, in 216 to 258 fathoms. Off Delaware Bay, 1045, in 312 fathoms. At station 946, in 241 fathoms, seven young specimens were taken, some of them not over 1 inch long; these were associated with *P. tarda*.

Pleurobranchæa tarda Verrill.

Pleurobranchæa tarda Verrill, Amer. Journ. Sci., xx, pp. 392, 398, Nov., 1880;
Proc. U. S. Nat. Mus., iii, p. 384, 1880.

PLATE LVIII, FIGURE 26.

In the best preserved specimens the reproductive organs are often protruded, the forms of the different organs varying with the state of extension. The verge or most anterior organ, when fully extended, is long, cylindrical or a little clavate, with rows of minute recurved hooks near the end, and terminated by a slender, curved spicule. The most posterior opening (urinal) is just at the anterior base of the gill, in the form of a small papilla, with a central opening. Between these there are two organs, on a more or less swollen common base; the more anterior is a large opening with raised margin; a little behind and below this is a long, exsert, flat, usually tapered and acute, copulatory organ, varying much in size and form according to the state of extension. All these organs can be so retracted as not to be noticeable, but this seldom happens in alcoholic specimens, most of which show the organs more or less extended. The anal orifice is behind the base of the gill.

Taken in 1880, 20 miles south of Block Island (stations 814 to 817), in 38 fathoms; about 70 to 100 miles south and southwest from Martha's Vineyard (stations 865 to 879), in 65 to 192 fathoms, both on bottoms of mud and of fine, compact sand, very abundant

(240 specimens.) Off Chesapeake Bay, stations 896-900, in 31 to 300 fathoms. In 1881 it occurred at twenty-six stations, off Martha's Vineyard, in 28 to 310 fathoms. It was particularly abundant at stations 918 and 922, in 45 and 69 fathoms, (190 specimens). It is not common below 200 fathoms. Off Delaware Bay, stations 1043, 1047, in 130 and 156 fathoms.

With this species, and probably belonging to it, we often took gelatinous, but rather firm, cylindrical egg-clusters, about 20^{mm} long and 4^{mm} in diameter, with the eggs in several rows.

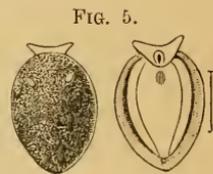
Closely resembles *Pleurobranchæa Nova-Zelandiæ* in form and color. The latter is a littoral species.

Doridella obscura Verrill.

Doridella obscura Verrill, Amer. Journ. Sci., i, p. 408, figs. 2, 3, 1870; Rep. Invert. Anim. Vineyard Id., in Rep. U. S. Fish Com., i, pp. 400, 664 (auth. cop., p. 370), pl. 25, fig. 173, a, b, 1874.

FIGURE 5.

Long Island Sound, near New Haven, low-water mark to 5 fathoms; Vineyard Sound, low-water to 10 fathoms; off Block Island, station 824, 13 fathoms, 1880; Great Egg Harbor, N. J., 1 to 2 fathoms, 1872.



NUDIBRANCHIATA.

Issa lacera (Müller) Bergh.

Triopa lacer Lovén, Index Moll. Scand. Occid. [p. 6], 1846.

G. O. Sars, op. ult. cit., p. 311, pl. 27, figs. 4, a-c, pl. xiv, figs. 12a, b.
Verrill, Amer. Journ. Sci., xvi, p. 211, Sept., 1878.

Issa lacera Bergh, Monog. Polyceraden, II, p. 20, pl. 14, figs. 4-12, 1881, in Verh. K. K. Zool.-Bot. Gesellsch., Wien, 1880.

PLATE XLII, FIGURE 11.

This was first taken on our coast in 1873, by the U. S. Fish Commission party on the "Bache," at Cashe's Ledge and off Cape Ann, in 25 to 80 fathoms. Off Halifax, Nova Scotia, 90 to 92 fathoms, and Massachusetts Bay, 35 to 48 fathoms, 1877; and off Cape Cod, in 70 fathoms, 1879.

Issa ramosa Verrill and Emerton.

Issa ramosa Verrill and Emerton, in Verrill, Amer. Journ. Sci., xxii, p. 301, 1881.

PLATE LVIII, FIGURES 36, 36a.

Stations 940 and 949, in 130 and 100 fathoms, 1881.

Polycerella Emertoni Verrill.

Polycerella Emertoni Verrill, Proc. U. S. Nat. Mus., iii, p. 387, 1880.

This species was first taken by me at Wood's Holl, in September, 1875, at the surface among eel-grass; and on hydroids from the piles of Long Wharf, New Haven, Conn., October, 1875. At Newport, R. I., it was found by Mr. J. H. Emerton and the writer, in July and August, on filamentous algæ, especially *Ceramium rubrum* and *Desmarestia viridis*, growing on the mooring buoys and piles of wharves in the harbor. In 1881, it was taken in considerable numbers in the harbor at Wood's Holl, among eel-grass, in August and September.

Idaliella pulchella Bergh.

Idalia pulchella Alder and Hancock, Brit. Nud. Moll., part 6, fam. 1, pl. 17, figs. 5-6.

G. O. Sars, op. cit., p. 313, tab. 28, fig. 1, *a-c*, tab. xiv, fig. 8, *a-d* (dentition), 1878. Verrill, Proc. Nat. Mus., ii, p. 198, 1879.

Idaliella pulchella Bergh, Arch. für Naturg., 47, i, [p. 7], 1881.

PLATE XLII, FIGURE 13.

This species was found, for the first time, upon the American coast, by Mr. J. H. Emerton, who discovered it at Salem, Mass., in 1879. His specimens agree very closely with Sars's description and figures, both in external characters and in dentition, but not so well with those of Alder and Hancock.

Idaliella modesta Verrill.

Idalia modesta Verrill, Amer. Journ. Sci., x, p. 41, pl. 3, fig. 3, July, 1875.

Block Island Sound and north of Little Gull Island, in 17 to 40 fathoms, 1874; Vineyard Sound and off No-Man's-Land, 1875.

Heterodoris Verrill and Emerton, gen. nov.

Form and general appearance somewhat like *Triopa* and *Triopella*, but stouter, and without any trace of gills. Mantle forming an edge all around the back; surface of the back with scattered papillæ; a longitudinal crest between and behind the dorsal tentacles, which are lamellose and retractile, without sheaths, but with a prominent fold of the mantle-margin in front of them. Head large, rounded, with a free, thin margin, which has a flat tentacular lobe, on each side. Foot broad, rounded in front. A large opening, apparently the anus, on the right side between the mantle and the foot, behind the middle. Verge, as protruded, stout, cylindrical, swollen and

rounded at the end, not armed; a short, stout, conical papilla just behind its base, and a lobe below it; farther back, nearer the anal (?) opening, there is a small, simple opening, probably urinal.

Odontophore broad, with very numerous small, strongly hooked, acute teeth in each row, all similar except a few near the center, which are less curved and not so acute; no median tooth.

This genus will probably have to be made the type of a new family, *Heterodoridæ*.

Heterodoris robusta Verrill and Emerton, sp. nov.

PLATE LVIII, FIGURES 35, 35a, 35b.

Body short, thickest anteriorly, back convex; head large and broad, rounded; foot broad, lanceolate. Dorsal tentacles stout, clavate, obtuse, lamellose. Longitudinal crest extending from front edge of mantle to some distance beyond the tentacles. Back sparsely covered with conical papillæ, unequal in size and irregularly placed. Mantle edge along the sides, undulated and crenulated. Radula with about 168 teeth in a transverse row.

Color in life, deep orange. Length of the preserved specimen, 28^{mm}; breadth, 15^{mm}; height, 11^{mm}.

Off Martha's Vineyard, station 1029, in 458 fathoms.

Doris complanata Verrill.

Doris complanata Verrill, Amer. Journ. Sci., xx, pp. 392, 399, Nov., 1880; Proc. U. S. Nat. Mus., iii, p. 386, 1880.

PLATE LVIII, FIGURES 34, 34a, 34b.

About 70 miles south of Martha's Vineyard, station 872, in 85 fathoms, among sponges (eleven specimens), 1880; stations 940, 949, 1038, in 100 to 146 fathoms, 1881, several large specimens. Off Delaware Bay, station 1043, in 130 fathoms, several specimens.

Acanthodoris ornata Verrill.

Acanthodoris ornata Verrill, Amer. Journ. Sci., xvii, p. 313, 1879.

PLATE XLII, FIGURE 12.

Eastport, Me., at low-water mark, August 19, 1872.

Acanthodoris citrina Verrill.

Acanthodoris citrina Verrill, Amer. Journ. Sci., xvii, p. 313, 1879.

Eastport, Me., at low-water mark, 1868, 1870.

This is closely related to *A. stellata* (= *A. pilosa*), which also sometimes occurs more or less marked with yellow colors. *A. bifida* V. is only a variety of *A. stellata*.

Adalaria proxima (Ald. and Han.) Bergh.

Doris proxima Alder and Hancock, Brit. Nud. Moll., Fam. i. pl. 9, figs. 10-16.

Adalaria proxima Bergh, Gatt. Nord. Doriden, Arch. für Naturgesch., 45, i, p. 362.

Verrill, Amer. Journ. Sci., xvii, p. 314, 1879.

Collected by the writer at Eastport, Me., at low-water mark, in 1864, 1868, 1870.

Lamellidoris muricata (Müller) Ald. and Han.

Lamellidoris muricata G. O. Sars, op. cit., p. 307, pl. xiii, fig. 6.

Bergh, op. ult. cit., p. 364.

Onchidoris muricata H. and A. Adams, Genera.

Verrill, Amer. Journ. Sci., xvii, p. 314, 1879.

Eastport, Me., at low-water mark. Specimens dredged at many localities, in 3 to 21 fathoms, from Block Island to Halifax, Nova Scotia, appear to belong to this species.

Lamellidoris diaphana Ald. and Han.

Onchidoris diaphana Verrill, Amer. Journ. Sci., xvii, p. 314, 1879.

Eastport, Me., at low-water mark, 1864, 1868, 1870.

Scyllæa Edwardsii Verrill.

Scyllæa Edwardsii Verrill, Amer. Journ. Sci., xvi, p. 211, Sept., 1878.

PLATE XLII, FIGURE 10.

Wood's Holl, Mass., in Little Harbor, attached to eel-grass and on *Sargassum*, autumn of 1877.—V. N. Edwards.

Dendronotus robustus Verrill.

Dendronotus robustus Verrill, Amer. Journ. Sci., vol. i, p. 405, fig. 1, 1870; Proc. Nat. Mus., ii, p. 197, 1879.

Dendronotus velifer G. O. Sars, Mollusca Reg. Arcticæ Norvegiæ, p. 315, tab. 28, fig. 2, tab. xv, fig. 4 (dentition), 1878.

The species well described and figured in the excellent work of Sars is identical with the American form. Our *D. robustus* was described from a specimen not fully grown; but we have since dredged it of larger size, agreeing with *D. velifer*, in numerous localities, Vineyard Sound to Nova Scotia, low-water mark to 98 fathoms; and south of Martha's Vineyard, station 869, in 192 fathoms. The dentition of our original specimen is like that of *D. velifer* figured by Sars.

Dendronotus elegans Verrill.

Dendronotus elegans Verrill, Amer. Journ. Sci.; Proc. U. S. Nat. Mus., iii, p. 385. 1880.

Off Cape Cod, station 330, in 26 fathoms, September 6, 1879.

Doto formosa Verrill.

Doto formosa Verrill, Amer. Journ. Sci., x, p. 41, pl. 3, fig. 4, July, 1875.

I took this species at Eastport, Me., and on the coast of Nova Scotia, in 1861. Long Island Sound to Breton Island, N. S.! From low-water mark at Eastport, Me., to 50 fathoms, usually on hydroids.

Fiona nobilis Alder and Hancock.

Fiona nobilis Alder and Hancock, British Nud. Moll., Eolidæ, Fam. 3, pl. 38A.

Verrill, Amer. Journ. Sci., xxii, p. 300, 1881.

Fiona Atlantica Bergh, Vidensk. Meddelelser naturh. Forening, Kjöbenhavn, 1857, pp. 273-335, plates 2 and 3, figs. 1-53 (anatomy.)

A large and handsome *Fiona*, apparently this species, was found in two instances, in large numbers, among Anatifers, on pieces of floating timber, at stations 935 and 995.

Head very changeable in form, usually broadly rounded in front and laterally. Tentacles large, stout, both pairs about equal, tapering, acute, smooth; the posterior ones are placed rather far back. The foot is broad, posteriorly thin, lanceolate, and extends far back (12 to 15^{mm}) beyond the end of the mantle, obtuse at the end; anterior angles broadly rounded. Branchiæ very numerous, crowded, in a broad band on each side, leaving the middle of the back naked; they are elongated, compressed, fusiform, and have a free-edged, frilled membrane, along each edge of the dorsal side.

General color grayish brown, orange-brown, or dull orange, corresponding closely with the dark colored stems of the barnacles among which they were found. Body translucent white, often with a tint of orange on the back, and on the posterior part of the head; foot milk-white; numerous irregularly branched, internal, dark brown ducts run between and among the branchiæ, showing plainly through the skin; branchiæ with the nucleus yellowish brown, the outer sheath and free membrane pale orange; posterior tentacles tinged with orange. No eyes were detected.

Some of our specimens were kept in confinement several days and laid numerous clusters of eggs. These are in the form of a broad ribbon, spirally coiled in about one and a half turns, so as to form a

bell-shaped or cup-shaped form, and attached by a slender pedicel, so as to hang from the under side of objects. The largest specimens were over 50^{mm} long.

Alder and Hancock recorded the occurrence of the species, in a single instance, at Falmouth, England. Bergh's specimens were from the North Atlantic, south of Newfoundland.

Coryphella nobilis Verrill.

Coryphella nobilis Verrill, Proc. U. S. Nat. Mus., iii, p. 388, 1880.

PLATE XLII, FIGURE 15.

Off Cape Cod, station 326, in 75 fathoms, mud and broken shells, 1879. One specimen only.

Coryphella rutila Verrill.

Coryphella rutila Verrill, Amer. Journ. Sci., xvii, p. 314, April, 1879.

Collected by the writer, at Eastport, Me., low-water mark, 1864, 1868, 1872. It occurs both under stones, and on algæ, etc., fully exposed to view, and very conspicuous on account of its brilliant red color and large size. It probably possesses netling cells powerful enough to protect it from the attacks of fishes. In that case its bright colors would serve as a protection, by warning off enemies, as is the case with bright colored Actiniæ.

Coryphella Stimpsoni Verrill.

Cuthona Stimpsoni Verrill, Amer. Journ. Sci., xvii, p. 314, 1879.

Coryphella Stimpsoni Verrill, Proc. U. S. Nat. Mus., iii, p. 388, 1880.

PLATE XLII, FIGURE 14.

This species occurs from Massachusetts Bay and Salem harbor, Mass., to Halifax, Nova Scotia, and from low-water, at Eastport, Me., to 51 fathoms, at Jeffrey's Ledge. This is closely allied to *C. salmonacea* (Couth.) V. (*non* Bergh).

Coryphella Mananensis (Stimp.) Verrill and Emerton.

Eolis mananensis Stimpson. Invert. Grand Manan, p. 26, 1853.

Coryphella mananensis Verrill, Proc. Nat. Mus., iii, p. 389, note, 1880.

This has bright red branchiæ, with white tips.

By Dr. Gould it was not distinguished from "*E. rufibranchialis*," and was, therefore, omitted from his report, as a genuine species. Whether the latter species actually occurs on our coast is doubtful.

This species sometimes occurs at low-water mark at Eastport, Me.,

and Grand Menan, but it is usually an inhabitant of rather deep water, on rocky bottoms. We have dredged it at many localities from off Fisher's Island and Block Island to Halifax, N. S., in 20 to 90 fathoms, among hydroids. It is the most common species at such depths.

Two or three related species of *Coryphella*, not yet characterized, are known to us, from the New England coast.

Cratena Veronicæ Verrill.

Cratena Veronicæ Verrill, Proc. U. S. Nat. Mus., iii, p. 389, 1880.

Off Cape Cod (stations 307, 328, 329, 331, 333), in 23 to 31 fathoms, among hydroids, September, 1879.

Galvinia exigua Alder and Hancock.

Æolis despectus (pars) Gould, ed. II, p. 248, pl. 16, figs. 222-225.

Salem and Boston, Mass., at low-water.

The genuine *Tergipes despectus* was first distinguished from *G. exigua* by Mr. J. H. Emerton, at Salem, Mass., in 1879. The species figured by Gould (Binney's edition) as *despectus*, is really the *Galvinia exigua* Alder & Hancock, differing widely in its dentition, there being three rows of teeth, instead of the single row, seen in *Tergipes*. But the *T. despectus* of my Report on Invertebrates of Vineyard Sound, 1873, was correctly named. Both species are found under the same conditions, on *Obelia*, etc., but, according to Mr. Emerton, *G. exigua* is found in the spring and early summer, while *T. despectus* occurs later in the summer and in autumn. *G. exigua* has not yet been found south of Cape Cod.

PTEROPODA.

Cymbulia calceolus Verrill.

Cymbulia calceolus Verrill, Amer. Journ. Sci., xx, pp. 392, 394, Nov., 1880; Proc. U. S. Nat. Mus., iii, p. 393, 1880.

PLATE LVIII, FIGURE 33.

The depth from which the specimens that were caught in the trawl came is uncertain, but as specimens have often been found in the stomachs of actiniae, starfishes, etc., it doubtless inhabits all depths, to the bottom. It grows to a very large size. Some of the living specimens were more than 3 inches across the wings, which are over one inch wide, and very delicate.

This was taken in large numbers at numerous stations, in 1880 and 1881, in the trawl. Living specimens were caught about 30 miles east-southeast of Block Island, at surface, October 2, 1880, by Messrs. Scudder and Edwards.

Cavolina tridentata (Forsk.) H. and A. Ad.

Hyalea tridentata Lamarck, Anim. sans. Vert., ed. II, vol. vii, p. 415.

Cavolina tridentata H. and A. Adams, Genera, i, p. 51, pl. 6, figs. 1, 1a.

Verrill, Rep. Invert. Anim. Vineyard Id., in Rep. U. S. Fish Com., i, pp. 444, 669 (auth. cop., p. 375), pl. 25, fig. 177, 1874.

FIGURES 6, 7.

Of this species I have received numerous specimens, with the animal in good condition, obtained by Mr. Samuel Powell, from the stomach of a blue fish, at Newport, R. I., several years ago. In 1880, two living specimens were taken a few miles off Block Island, by Messrs. V. N. Edwards and N. P. Scudder, of our party. The fresh shells of this species were dredged by us in 1871, near Martha's Vineyard. In 1880 and 1881, we found it in abundance and perfectly fresh, in all our outer dredgings, 70 to 100 miles off shore. It was particularly abundant at stations, 880, 892, 894, 947, 998.

It was associated with *Diacria trispinosa* Gray and several other species, named below, but was far more numerous than any of the others. I have often taken it from the stomachs of actinia, and from *Archaster*, and other starfishes, from the deep water stations.

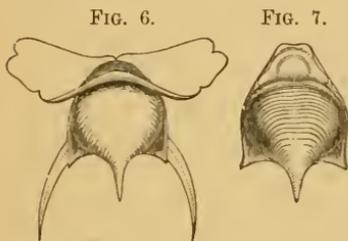
Cavolina uncinata (D'Orb.) Gray, 1850; H. & A. Ad.

Hyalea uncinata D'Orb, 1836.

Rang, Hist. Nat. Pterop., p. 37, pl. 2, figs. 11-14, 1852.

Cavolina uncinata Verrill, Amer. Journ. Sci., xx, p. 392, Nov., 1880; Proc. U. S. Nat. Mus., iii, p. 392, 1880.

This occurred with the last off Martha's Vineyard, 70 to 90 miles, stations 865, 867, 870, 876, 892, 894, 947.



Cavolina longirostris (Les. MSS., Bv.) H. & A. Ad.

Hyalæa longirostris Blainv., Dict. Sci. Nat., xxii, p. 81.

Rang. Hist. Nat. Pterop., p. 41, pl. 2, figs. 7-10, 1852.

Cavolina longirostra Gray, Catal. Moll. Brit. Mus., Pteropoda, p. 8.

Cavolina longirostris Verrill, Amer. Journ. Sci., xx, p. 392, Nov., 1880; Proc. U. S. Nat. Mus., iii, p. 392, 1880.

This small but elegant species occurred frequently in our dredgings, 70 to 105 miles off Martha's Vineyard, but not in large numbers (stations 867, 870, 871, 876, 891, 892, 894, 895, in 1880; 949, 994, 997, 999, 1038, in 1881).

Cavolina inflexa (Les.) Gray.

Hyalæa inflexa Lesueur; Blainv., Dict. Sci. Nat., xxii, p. 80.

Cavolina inflexa Verrill, Proc. U. S. Nat. Mus., iii, p. 392, 1880.

One perfect and full-grown specimen from station 894.

Clio pyramidata Browne; Linné; Gmelin.

Cleodora pyramidata Peron & Les.; Lamarck.

Cleodora lanceolata Rang, Ann. des Sci. Nat., xvi, p. 497, pl. 19, fig. 1.

Clio pyramidata Gray, Catal. Moll. Brit. Mus., Pteropoda, p. 12, 1850.

Verrill, Amer. Journ. Sci., xx, p. 392, Nov., 1880; Proc. U. S. Nat. Mus., iii, p. 392, 1880.

Several fresh but somewhat broken specimens of this species occurred at stations 865, 891 to 894, off Martha's Vineyard.

Pleuropus Harger Verrill, sp. nov.

Pleuropus sp., Smith & Harger, Trans. Conn. Acad., iii, pp. 26, 27.

Shell small, translucent, pale yellowish white, compressed, with the two lips of the aperture nearly equal, forming nearly a semi-circle in the larger specimens and more than half a circle in the younger ones. Back of the lateral angles, where the aperture terminates, the body of the shell is triangular, with slightly concave sides, and tapers off gradually posteriorly to a caudal process, about as long as the shell itself, subacute at tip, and often bent somewhat to one side. The animal has three long, slender, subfiliform processes on each side, which project from the lateral angles of the aperture; the younger specimens have but two of these.

Off George's Bank, N. lat. $41^{\circ} 25'$; W. long. $65^{\circ} 5'$ to $30'$, Sept. 15, 1872, taken both at 10 to 12 o'clock A. M. and at 2 P. M., by Messrs. S. I. Smith and Oscar Harger on the "Bache." I have dedicated the species to Mr. Harger.

Balantium recurvum Children.

Journ. Roy. Inst., xv, p. 220, pl. 7, fig. 107, 1829.

Gray, Catal. Moll. Brit. Mus., Pteropoda, p. 14, 1850.

Cleodora balantium Rang, Mag. Zool., 1834; Hist. Nat. Pterop., p. 52, pl. 5, fig. 12; pl. x, fig. 7, 1852.

Balantium recurvum Verrill, Proc. U. S. Nat. Mus., iii, p. 393, 1880.

Fresh fragments occurred at stations 865, 867, 869, and 895, off Martha's Vineyard.

Styliola vitrea Verrill.

Styliola vitrea Verrill, Amer. Journ. Sci., iii, p. 284, pl. 6, fig. 7, 1872.

Rep. Invert. Anim. Vineyard Id., in Rep. U. S. Fish Com., i, pp. 443, 668, pl. 25, fig. 178, 1874 (auth. cop., p. 374).

FIGURE 8.

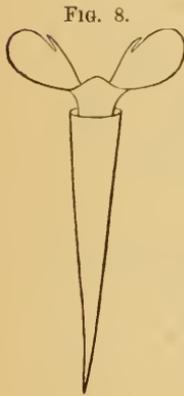


FIG. 8.

Shell long, conical, slender, gradually tapering, acute, slightly curved near the end, thin, transparent, white, and almost glassy, with the surface smooth and polished, without sculpture. Animal mostly white, fins obovate, broadly rounded at the outer end, bearing the slender, acute tentacles on the anterior edge, near the middle. Length, 11.5^{mm}; diameter, 2^{mm}.

Taken at the surface, in the afternoon, among *Salpa*, off Gay Head, mouth of Vineyard Sound, Sept. 9, 1871.

Styliola recta (Lesueur, MSS.) Blainv.

Styliola recta Blainv., Man. Malac., 1825.

Verrill, Proc. U. S. Nat. Mus., iii, p. 393, 1880.

Creseis acicula Rang, Ann. des Sci. Nat., I, xiii, p. 318, pl. 17, fig. 6, 1828.

Creseis clava Rang, Ann. des Sci. Nat., I, xiii, p. 317, pl. 17, fig. 5, 1828.

Creseis acus Esch., Zool. Atlas, iii, pl. 15, fig. 2, 1831.

Cleodora acicula Rang, Hist. Nat. Pterop., p. 56, pl. 7, figs. 5, 7, 1852.

This is an exceedingly slender, elongated, and delicate species.

Taken near George's Bank, N. latitude 41° 25', W. longitude 65° 5' to 65° 30', September 15, 1872, at surface, by Messrs. S. I. Smith and O. Harger, on the "Bache."

Styliola virgula (Rang) Gray.

Creseis virgula Rang, Ann. des Sci. Nat., I, xiii, p. 316, pl. 17, fig. 2, 1828.

Cleodora virgula Rang, Hist. Nat. Pterop., p. 57, pl. 13, figs. 20-24, 1852.

Styliola virgula Verrill, Proc. U. S. Nat. Mus., iii, p. 393, 1880.

Near George's Bank, September 15, 1872, "Bache," with the preceding.

Triptera columnella Rang.

Off Martha's Vineyard, station 947, 1881.

Spirialis MacAndrei Forbes and Hanley, ii, p. 384.

Spirialis retroversus (Flem.), variety ? *MacAndrei*, Jeffreys, Brit. Conch., v. p. 115, pl. 4, fig. 4; pl. 98, fig. 5.

G. O. Sars, Moll. Reg. Arct. Norv., p. 330, pl. 29, figs. 3 a-f, pl. xvi, fig. 19 (dentition).

Spirialis MacAndrei Verrill, Proc. U. S. Nat. Mus., iii, p. 393, 1880.

Several entire and perfectly fresh specimens, some living, occurred at station 894. Other specimens were taken at 891 and 947. At one station many living specimens were obtained in the trawl-wings, presumably, therefore, from close to the bottom.

SOLENOCONCHA or SCAPHOPODA.

Siphonodentalium vitreum M. Sars.

Siphonodentalium vitreum G. O. Sars, op. cit., p. 103, pl. 7, figs. 2 a-c, pl. i, figs. 2 a-f (dentition).

Verrill, Proc. U. S. Nat. Mus., iii, p. 394, 1880.

PLATE XLII, FIGURE 19.

A fine, large specimen (fig. 19), probably belonging to this species, but with the apex broken, was dredged by the party on the "Bache," in 1873, in the Gulf of Maine (station 12 B), in 60 fathoms, mud.

Another specimen, with the apical notches complete, and 10^{mm} long, 2.5^{mm} broad, was dredged in the Gulf of Maine, 107 fathoms (station 9 B), 1873.

Off Martha's Vineyard, at stations 892, 949, 994, in 100 to 487 fathoms, specimens were taken that probably belong to this species, but the apex is broken in every case.

Siphonentalis affinis (Sars).

Siphonentalis affinis G. O. Sars, op. cit., p. 104, pl. 20, fig. 12

Verrill, Proc. U. S. Nat. Mus., iii, p. 395, 1880.

PLATE XLII, FIGURE 20, a, b.

A specimen, which I refer to *S. affinis*, smaller and more slender than the preceding species, was dredged by us, in 1877, in Bedford Basin, near Halifax, Nova Scotia, 35 fathoms, soft mud.

It is a smooth, glossy, translucent shell, slightly curved, with a round aperture. The posterior aperture has only one slight notch.

Length, 6^{mm}; diameter, 1^{mm}.

Siphonentalis Lofotensis (M. Sars).

Siphonentalis Lofotensis G. O. Sars, Moll. Reg. Arct. Norv., p. 104, pl. 20, figs. 11 a, b, pl. i, fig. 3.

Verrill, Amer. Journ. Sci., xx, p. 392, Nov., 1880; Proc. U. S. Nat. Mus., iii, p. 395, 1880.

A few specimens, agreeing well with the figures and description of this species, were taken at station 871, in 115 fathoms, 891, in 500 fathoms, and 947, in 312 fathoms.

Cadulus Pandionis Verrill and Smith.

Cadulus Pandionis Verrill and Smith, in Verrill, Amer. Journ. Sci., xx, pp. 392, 399, Nov., 1880; Proc. U. S. Nat. Mus., iii, p. 395, 1880.

PLATE LVIII, FIGURES 30, 30a.

This large and highly polished species occurred at many of the stations, but most abundantly at 869 to 871 and 873 to 877, in 85 to 192 fathoms, and 949 in 100 fathoms. Other stations are 891, 894, 895, 898, 943, 945, 947, 949, 994, 997-999, 1028, 1038, in 100 to 500 fathoms.

Cadulus propinquus G. O. Sars.

Cadulus propinquus G. O. Sars, Moll. Reg. Arct. Norv., p. 106, pl. 20, figs. 15 a, b; pl. i, fig. 5 (dentition).

Verrill, Amer. Journ. Sci., xx, p. 392, Nov., 1880; Proc. U. S. Nat. Mus., iii, p. 395, 1880.

PLATE LVIII, FIGURES 31, 32.

This species, like others of the genus, varies considerably in form and proportions. I have figured two forms from camera-drawings.

This occurred in considerable numbers, living, at station 871, in 115 fathoms; it was also taken at station 873, in 100 fathoms; and at 949, 100 fathoms, 1881. It is a small, polished species, rather stouter and more swollen than the next.

Cadulus Jeffreysii Monterosato.

Cadulus subfusiformis? Jeffreys, British Conch., v, p. 196, pl. 101, fig. 3 (*non* Sars, teste Monterosato).

Cadulus Jeffreysii Verrill, Amer. Journ. Sci., xx, p. 392, Nov., 1880; Proc. U. S. Nat. Mus., iii, p. 395, 1880.

This is, perhaps, only a variation of the preceding species. Station 871, in 115 fathoms, off Martha's Vineyard.

LAMELLIBRANCHIATA.

Xylophaga dorsalis (Turton) Forbes and Hanley.

PLATE XLIV, FIGURE 9.

Many living specimens of this species have been found in bits of old wood, dredged by the U. S. Fish Commission, in Casco Bay, 1873; Gulf of Maine, in 100 to 110 fathoms, about thirty miles off Cape Ann, 1877; and in various parts of Massachusetts Bay and Cape Cod Bay. It had previously been recorded by Mr. J. F. Whitceaves from Gaspé Bay. Off Martha's Vineyard, stations 880 and 998, in 252 and 302 fathoms, 1880 and 1881. Found on the European coast south to the Adriatic.

Neæra multicostata Verrill and Smith.

Neæra multicostata Verrill and Smith, in Verrill, Proc. U. S. Nat. Mus., iii, p. 398, 1880.

Neæra alternata Dall, Bulletin Mus. Comp. Zool., ix, p. 110 (no description) 1881, (*non* D'Orbigny).

PLATE LVIII, FIGURE 40.

This fine, large species is easily distinguished from most others by the numerous fine radiating ribs, on the anterior half, changing posteriorly to much coarser and more distant ones, the largest close to the base of the rostrum. The rostrum itself is moderately long and decidedly narrow and pinched up, usually with a strong incurvature at the base, on the ventral side, and with the dorsal outline more or less concave, descending lower than the hinge-line. Anteriorly the dorsal margin rises above the beaks, and is broadly rounded. The cartilage-pit is broad, rounded-triangular, and is strongly bent downward from the hinge-margin, in the left valve; the posterior lateral tooth of the right valve is low and long, continuous with the cartilage-pit, and with a very obtuse summit, which is often strongly excurved. Commencing behind the beaks, beneath

the hinge-plate, there is a more or less marked rib, running outward and backward, at the base of the rostrum. The rostrum is somewhat variable in form and sculpture; it is usually slightly turned up at the end; commonly it is more or less covered with small, unequal, radiating ribs, stronger on the ventral half, and distinctly lamellose on the dorsal side, toward the end; sometimes the ribs are obsolete on the basal portion.

Variety, *curta* Jeffreys.

Nucera curta Jeffreys, Ann. and Mag. Nat. Hist., Dec., 1876, p. 495 (name, not described); Proc. Zool. Soc. London for Nov., 1881, p. 943, pl. 71, fig. 10, Apr., 1882.

Some specimens, from station 871, in 115 fathoms, agree so well with the form recently described and figured by Mr. Jeffreys, that I do not hesitate to consider the latter a variety of this species. Our specimens of this variety differ from the typical form in having a shorter and more upturned rostrum; in the radiating ribs on the anterior half becoming much finer, and sometimes almost obsolete; and in the somewhat shorter and rounder form of the shell, it being more abbreviated anteriorly.

Mr. Dall identifies our typical shells, which I sent him for comparison, with the species recorded by him, as probably *N. alternata* D'Orb. To me, D'Orbigny's shell appears to be a distinct, though allied, species.

Jeffreys, in the paper last quoted, suggests that our shell is identical with his *N. striata*, but the latter has numerous, nearly equal, small, radiating ribs, not becoming decidedly stronger and wider apart posteriorly, as they do in our shell, and as they were described in our original description. Perhaps all these forms may eventually prove to be varieties of one species.

In 1880, this was dredged at about 90 to 100 miles south of Newport, R. I., and Martha's Vineyard, in 85 to 120 fathoms, stations 871, 873, 874, 876. Several living specimens of various sizes. In 1881 it was taken at stations 949, 1035, 1038, 1040, in 93 to 146 fathoms.

Gulf of Mexico, 84-152 fathoms, "Blake" Expedition (t. Dall). Off the coast of Europe, "Porcupine" Expedition; off Bermuda, "Challenger" Expedition; off the Azores, "Josephine" Expedition (t. Jeffreys, as *N. curta*).

Neæra perrostrata Dall.

Neæra ornatissima (D'Orbigny), var. *perrostrata* Dall, Bulletin Mus. Comp. Zool., ix, p. 110, 1881.

This shell has been examined by Mr. Dall and identified with those from the "Blake" Exp., described by him. It seems to me a species quite distinct from the one figured by D'Orbigny, if his figures are at all reliable.

This species is related to the preceding one. It is a smaller shell, narrower and longer than the young of *N. multicosata* of the same size, less ventricose, and with a decidedly longer and straighter rostrum, which does not distinctly turn up at the end. The ribs are fewer in number and much higher and thinner, with perpendicular sides, while those on the anterior half of the shell become only a little and gradually smaller and closer. The rostrum has a diagonal keel, and in some examples the ventral half is covered with several ribs; while in others it is without any, below the keel.

Off Martha's Vineyard, stations 871, 874, 876, in 85 to 120 fathoms, 1880. Gulf of Mexico, 339 fathoms,—Dall.

Neæra lamellosa M. Sars.

Neæra lamellosa M. Sars, Chy. Vidensk-Selsk. Forhandl., 1868, p. 257 (name without description).

Neæra jugosa G. O. Sars, op. cit., p. 88, pl. 6, figs. 9 a-c (non S. Wood).

Verrill, Amer. Journ. Sci., xx, p. 392, Nov., 1880; Proc. U. S. Nat. Mus., iii, p. 398, 1880.

Neæra lamellosa Jeffreys, Moll. of Lightning and Porcupine Exp., in Proc. Zool. Soc. London for Nov., 1881, p. 940, Apr., 1882.

Jeffreys, in the paper last quoted, considers the fossil, *N. jugosa*, distinct from the recent species.

This species is easily distinguished from all others hitherto found on our coast by its raised, concentric lamelke. Stations 892, 894, in 487 and 365 fathoms, off Martha's Vineyard, 1880; station 947, in 312 fathoms, 1881.

On the European coast, it is found from Finmark and Bergen south to Palermo. Bay of Biscay,—Jeffreys.

Neæra rostrata (Spengler) Lovén.

Neæra rostrata Lovén, Ind. Moll. Scand. Occid., p. 47 (description), 1846.

G. O. Sars, op. cit., p. 89, pl. 6, figs. 7 *a, b*,

Verrill, Amer. Journ. Sci.,^f xx, p. 392, Nov., 1880; Proc. U. S. Nat. Mus., iii, p. 398, 1880.

PLATE LVIII, FIGURE 39.

This is easily distinguished from our other smooth species by its very long and narrow posterior rostrum, and by the oval form of the shell. It has a nearly smooth surface.

Several specimens of this species were dredged by us in 1880, about 70 to 75 miles south of Martha's Vineyard, stations 870-874, in 85 to 155 fathoms, and 90 to 100 miles south from Newport, R. I., stations 876, 892, 894, in 120 to 500 fathoms.

In 1881, it occurred at stations 921, 949, 1035, 1036, 1038, 1040, in 65 to 146 fathoms. At station 949, in 100 fathoms, 15 specimens were taken.

On the European coast, from Lofoten I. to the Adriatic Sea. North Sea; Bay of Biscay, etc. West Indies, off Barbadoes and Sand Key, 80 to 100 fathoms, "Blake" Expedition (t. Dall). Off Patagonia (t. Jeffreys).

Neæra glacialis G. O. Sars.

Neæra glacialis G. O. Sars, op. cit., p. 88, pl. 6, figs. 8 *a-c*.

Verrill, Proc. U. S. Nat. Mus., iii, p. 397, 1880.

Neæra arctica Verrill, Amer. Journ. Sci., vi, p. 440, 1873; vii, p. 412, 1874 (? *nou N. arctica* M. Sars.)

PLATE XLIV, FIGURES 10, *a, b*.

This is, by far, the commonest species of *Neæra* found on our coast. It occurs in 30 to 500 fathoms.

Among our numerous specimens there is considerable variation in the form and texture of the shell, character of the surface, size and form of the cartilage-pit (see fig. 10), and in the form of the lateral tooth. Moreover, the form of the cartilage-pit and lateral tooth is not closely correlated with the form of the shell and length of the rostrum.

I find among our shells, not only forms corresponding to the figures of *N. glacialis* (fig. 10, *b*) and *N. obesa* (fig. 10, *c*) by G. O. Sars, but many, also, that are intermediate between his *N. glacialis* and *N. arctica*. There are few, if any, that have the beak so short and broad as he figures it in *N. arctica*. But many of our larger shells (see fig. 10, *a*) have the form and size of cartilage-plate characteristic of *N. arctica*, as figured by Sars. The greater number of our larger

shells were, therefore, referred by me to that form, at first, and Jeffreys has, also, identified similar Gulf of St. Lawrence shells as *N. arctica*. It is possible, therefore, that *N. arctica* (Sars) is only another variation of the same species, with the beak shorter and broader than usual.

This species, in all its forms, is nearly smooth, except for the more or less evident, slightly raised lines of growth, but it is usually more or less covered, especially when large, with a thin coating of fine mud or sand, easily removed. Young shells are smoother, cleaner, and more or less transparent. The rostrum is moderately long, not separated from the body of the shell by any marked sinus, the shell gradually narrowing into the rostrum, which tapers more or less to the end, and has a somewhat concave outline below; tip more or less broadly truncated; dorsal edge nearly straight, and regularly sloping from the hinge to the tip. Anterior-ventral border of the shell somewhat expanded; the anterior end evenly rounded. Umbos swollen. The posterior lateral tooth, in the left valve, is a strong, elongated, raised ridge, variable in length, but not sharp-triangular as in the next species; it is continuous with the cartilage-pit, from which it is separated only by a small notch.

The several forms of this species are common on muddy bottoms, in 50 to 192 fathoms, off the coasts of northern New England and Nova Scotia. We have dredged it, since 1872, off Cape Cod, off Cape Ann, off Casco Bay, in the Bay of Fundy, and in numerous localities in the Gulf of Maine and off Nova Scotia. South of Newport and Martha's Vineyard, it occurred at thirty-four stations, in 65 to 500 fathoms, in 1880 and 1881.

Off Chesapeake Bay, station 898, in 300 fathoms, 1880. Off Delaware Bay, station 1049, in 435 fathoms, 1881. Gulf of St. Lawrence! (coll. Whiteaves). On the European coast, it is found from Spitzbergen and northern Norway to the Azores.

Neæra obesa Lovén.

Neæra obesa Lovén, Ind. Moll. Scand. Occid., p. 48, 1846.

G. O. Sars, op. cit., p. 86, pl. 6, figs. 4 a-c.

Verrill, Amer. Journ. Sci., v, p. 101, 1872; Proc. U. S. Nat. Mus., iii, p. 398, 1880.

Neæra pellucida Stimpson, Invertebrata of Grand Manan, p. 21, pl. 1, fig. 13, 1853.

PLATE XLIV, FIGURE 10, c.

This species differs from the preceding in the somewhat broader and rounder form of the shell, more swollen and convex ventrally;

in the shorter rostrum, with its dorsal outline concave, and the end more or less turned up, and often a little bent or twisted laterally; and in the posterior lateral tooth of the right valve, which is short-triangular, rising up into a distinct point, and usually distant from the cartilage-pit, which is small, and usually projects sharply inward from the margin, forming a distinct angle on each side. The nucleus is minute, round, glossy, not so closely appressed to the edge as in the preceding species. The shell is white, nearly smooth, translucent. The largest specimens are about 15^{mm} long.

Off Martha's Vineyard, stations 869, 891 to 895, in 192 to 500 fathoms, 1880; stations 938, 947, 994, 997, 998, 1028, in 302 to 410 fathoms, 1881. Off Chesapeake Bay, station 898, in 300 fathoms. Bay of Fundy, 1872; Gulf of Maine, stations 1B, 3B, 5B, 45B, 74B, 75B, in 52 to 92 fathoms, 1873, 1874; off Cape Cod, station 362, in 106 fathoms, 1879.

Some of our specimens approach *Neera subtorta* G. O. Sars, in the form of the shell, curve of the rostrum, and structure of the hinge, but I am unable to separate these, by any constant characters, from the ordinary forms. Perhaps the true *N. subtorta*, of Europe, may be only a variety of this species. *N. pellucida* Stimpson is a young shell, of the *N. obesa* pattern. I have dredged the same form, as well as larger examples, in the same localities where his were obtained.

Poromya granulata (Nyst) Forbes and Hanley.

Poromya granulata G. O. Sars, op. cit., p. 90, figs. 6 a, b.

Verrill. Trans. Conn. Acad., v. pl. 44, figs. 3, 4; Proc. U. S. Nat. Mus., iii, p. 396, 1880.

Dall, Bull. Mus. Comp. Zool., ix, p. 108, 1881.

Embla Korenii Lovén, Ind. Moll. Scand. Occid., p. 46, cuts, 1846.

PLATE XLIV. FIGURES 3, 4.

Several adult, living examples of this shell were dredged in 1872 by Dr. A. S. Packard and Mr. C. Cooke, on the Coast Survey steamer "Bache," in the Gulf of Maine, in 150 fathoms, mud. In 1880, it was taken at stations 865-867, in 65 fathoms, and 874 in 115 fathoms. In 1881, it occurred at stations 940, 949, 1035, 1036, 1038, 1040, in 93 to 146 fathoms.

Gulf of Mexico and W. Indies, 15 to 229 fathoms, Blake Exp. (t. Dall.) On the European coast, from Lofoten I. to Madeira and the Adriatic Sea.

Fossil in the Pliocene of England, southern France, Calabria, and Sicily (t. Jeffreys).

Variety, *rotundata* Jeffreys.

Poromya rotundata Jeffreys. Annals and Mag. Nat. Hist., Dec., 1876. p. 494 (Valorous Expedition Mollusca).

Verrill, Amer. Journ. Sci., xx, p. 392, Nov., 1880; Proc. U. S. Nat. Mus., iii, p. 396, 1880.

South of Martha's Vineyard, stations 865 and 871, 65 to 115 fathoms, living. North Atlantic, 1,450 fathoms (Jeffreys).

Having recently had opportunities to examine a larger series of specimens of this species, I am convinced that the form, *rotundata* Jeffreys, formerly recognized by me cannot be considered as specifically distinct. Intermediate forms are of frequent occurrence.

As a variety, it differs from the ordinary form only in being somewhat more rounded in form, and in having the surface more closely and uniformly covered with granules. In the last character, this species varies greatly.

Pecchiolia abyssicola G. O. Sars.

Pecchiolia abyssicola G. O. Sars. Remarkable Forms of Anim. Life, i, p. 25. pl. 3, figs. 21-43, 1872; Moll. Reg. Arct. Norv., p. 108, pl. 20, figs. 5 a-d, 1878.

Lyonsiella abyssicola M. Sars. 1858; Friele. Catal. Norv. N.-meer Exp. Spitzbergen. Moll., p. 268, 1879.

Verrill, Proc. U. S. Nat. Mus., iii, p. 396, 1880.

This little fragile shell may be distinguished by its quadrangular form, with the beaks incurved, and the surface covered with low radiating ribs, to which fine sand often adheres. The shell is very thin and somewhat pearly. The hinge-margin is thin, and the teeth obsolete.

Several good living specimens of this interesting addition to the American fauna were dredged by our party, in 1880, south of Martha's Vineyard and Newport, in 192 to 500 fathoms, fine, compact sand and mud, at stations 869, 880, 891, 892, 894. In 1881, it occurred at stations 947, 997, in 312 and 335 fathoms.

On the European coast from Spitzbergen (656 fathoms,—Friele), to Denmark. Davis Straits,—Valorous Exp. West of Ireland, 90 to 420 fathoms; off the English Channel, 557 fathoms; off the coast of Spain, 994 to 1095 fathoms, Porcupine Exp. (t. Jeffreys.)

Pecchiolia gemma Verrill.

Lyonsiella gemma Verrill, Proc. U. S. Nat. Mus., iii, p. 396, 1880.

Shell small, white, iridescent, broad-oval, widest and broadly rounded anteriorly, expanded and broadly rounded ventrally, pos-

terior end short, narrowed, and tapered to an obtuse point. The beak is subcentral, but a little nearer the anterior end, prominent, inflated, strongly curved inward and forward. Dorsal margin abruptly incurved opposite the beaks and decidedly expanded and excurved in front of them, so as to rise nearly to a level with the umbos; internally, opposite the tips of the beaks, there is a smooth swelling, within the margin. Hinge-margin thin, toothless, but with an internal scar behind the beaks, where the ligament was attached. Sculpture numerous, very delicate, slightly raised lines, which radiate from the beaks over the whole surface; they are separated by much wider interspaces, which are smooth and iridescent, and not at all excavated. Length, 4.5^{mm}; height (beak to ventral margin), 4^{mm}.

One perfect specimen, station 892, 487 fathoms, associated with *L. abyssicola*.

I have had no opportunity to examine the fossil shell which was the type of *Pecchiolia*, and therefore, in view of the differences of opinion among European authors, am very uncertain whether it is congeneric with the two preceding species. If not, then they should both be referred to *Lyonsiella* M. Sars. Jeffreys adopts *Pecchiolia* for this group, to which he also unites *Verticordia*.

Verticordia cœlata Verrill, sp. nov.

Shell small, pearly within, rounded-oblong, with the beaks acute, prominent, and strongly curved forward. Eleven strong, sharply elevated, radiating ribs, separated by wider, deep, concave furrows, cover rather more than the anterior half of the shell; the most posterior of these ribs are lower and wider apart; these are followed by a posterior-lateral area, without ribs, but covered with fine granules, beneath which the surface is finely, radially striated; close to the extreme posterior margin there are two small ribs. The whole surface between the ribs was probably finely granulated. The ribs project, as denticles, beyond the edge of the shell. The anterior border of the shell is a little prominent and convexly rounded, more broadly rounded ventrally; the posterior-ventral margin is subtruncated, with an angle where it joins the rounded posterior-dorsal margin; anterior-dorsal margin, in front of the beak, strongly indented. Right valve with a large, rounded, prominent, blunt tooth, just below the beak; in front of this, a deep, V-shaped notch or sinus, formed by a sharp inbending of the hinge-margin, which is thickened and forms a triangular tooth-like projection within. Behind

the beak there is a long, raised lateral tooth or lamina, separated from the margin by a deep ligamental groove.

Length of the shell, 3^{mm}; from beak to ventral margin, 2.5^{mm}.

Off Martha's Vineyard, station 949, in 100 fathoms, one dead specimen.

If *Verticordia* and *Pecchiolia* are to be united, and the latter name used for the entire group, as has been done by Jeffreys, in his paper last quoted, this species will have to stand as *Pecchiolia celata*. The two genera appear to me sufficiently distinct, however.

Mytilimeria flexuosa Verrill and Smith.

Verrill, Amer. Journ. Sci., xxii, p. 302, 1881.

PLATE LVIII, FIGURE 38.

Station 947, in 312 fathoms, 1881. One pair of valves, dead, but in good condition.

Kennerlia glacialis (Leach) Carpenter.

Carpenter, Proc. Zool. Soc. London, Nov., 1864, p. 603.

Pandora glacialis Leach, Ross's Voyage, appendix, p. 174.

Leche, Kongl. Vetensk.-Akad. Handl., xvi, p. 11, pl. 1, figs. 1 a, b, 1878 (author's copy).

Kennerlia glacialis Verrill, Amer. Journ. Sci., xx, p. 392, Nov., 1880; Proc. U. S. Nat. Mus., iii, p. 397, 1880.

This differs from the common *Clidiophora trilineata* Cpr. (= *Pandora trilineata* Say), in the absence of the internal radiating ridges, in its more inequilateral and irregular form, and in the greater convexity of the upper valve. The lower valve is very flat, or even concave, and is marked externally with several distinct radiating lines.

Living specimens of this arctic shell were dredged at stations 873, 918, 920, 949, in 45 to 100 fathoms, off Martha's Vineyard. It had previously been recorded from Gaspé, Gulf of St. Lawrence, by Whiteaves, and Murray Bay, by Dawson. Spitzbergen,—Friele, Leche.

Fossil in the Post-pliocene of Saco, Me., and St. John, N. B.

Pholadomya arata Verrill and Smith.

Pholadomya arata Verrill and Smith, in Verrill, Amer. Journ. Sci., xxii, p. 301, 1881.

PLATE LVIII, FIGURE 37.

Stations 940, 949, 950, in 69 to 130 fathoms, 1881, south of Martha's Vineyard. Three specimens, all dead, but one is very fresh. Length, 36^{mm}; height, 29^{mm}; breadth, 26^{mm}.

Syndosmya lioica Dall.

Dall, Bulletin Mus. Comp. Zool., ix, p. 133, 1881.

Station 871, in 115 fathoms, 1880, one broken specimen; 949, in 100 fathoms, three examples. Gulf of Mexico, 30 to 805 fathoms, "Blake" Exp. (t. Dall).

I have compared our shell with specimens sent to me by Mr. Dall.

Gastranella tumida Verrill.

Gastranella tumida Verrill, Amer. Journ. Sci., iii, p. 286, pl. 6, figs. 3, 3a, 1872.

Verrill, Rep. Invert. Anim. Vineyard Sd., in Rep. U. S. Fish Com., i, pp. 418, 678 (auth. cop., p. 384), pl. 27, fig. 190, 1874.

FIGURE 9.

FIG. 9.



This species has not been met with since it was originally dredged in Long Island Sound, off New Haven. It was found nestling in holes and cavities among sponges, bryozoa, and the roots of hydroids, on a shelly bottom, in 4 to 6 fathoms.

Abra equalis Say.

Abra equalis Say, Amer. Conch., iii, pl. 28, 1831.

Verrill, Rep. Invert. Anim. Vineyard Sd., in Rep. U. S. Fish Com., i, p. 679 (auth. cop., p. 385), 1874.

Recorded by Linsley from Stonington, Conn., from stomachs of cod. Its occurrence north of Cape Hatteras needs verification. It is abundant at Fort Macon, N. C.

Angulus tenellus Verrill.

Angulus modestus Verrill, Amer. Journ. Sci., vol. iii, p. 285, pl. 6, figs. 2, 2a, 1872 (non Carpenter, 1864).

Angulus tenellus Verrill, Rep. Invert. Anim. Vineyard Sd., in Rep. U. S. Fish Com., i, p. 677, pl. 30, fig. 224, 1874 (auth. cop., p. 383).

This may be only a variety of *Angulus tener*.

Long Island Sound, Narragansett Bay and Vineyard Sound, 1 to 10 fathoms.

Macoma inflata (Stimp. MSS.) Dawson.

Dawson, Canadian Naturalist, vi, p. 377, 1872.

Murray Bay,—Dawson; Gulf of St. Lawrence! (coll. Whiteaves.)

Fossil in the Post-pliocene at Rivière-du-Loup, Canada.

Cardium (Fulvia) peramabilis Dall.

Dall, Bulletin Mus. Comp. Zool., ix, p. 132, 1881.

Cardium, sp. Verrill, Proc. Nat. Mus., iii, p. 407, 1880.

Station 871, in 115 fathoms, 1880, one valve. Gulf of Mexico, 50 to 119 fathoms, "Bache" and "Blake" Exp. (t. Dall).

I have identified our shell by direct comparison with specimens sent to me by Mr. Dall.

Diplodonta turgida Verrill & Smith.

Diplodonta turgida Verrill & Smith, in Verrill, Amer. Journ. Sci., xxii, p. 303, 1881.

PLATE LVIII, FIGURE 42.

Station 950, in 69 fathoms, 1881, off Martha's Vineyard.

Loripes lens Verrill & Smith.

Loripes lens Verrill & Smith, in Verrill, Amer. Journ. Sci., xx, pp. 392, 400, Nov. 1880; Proc. U. S. Nat. Mus., iii, p. 400, 1880.

Dredged in 1879 in many localities off Cape Cod, in 50 to 100 fathoms. Common at many of the outer stations, in 60 to 192 fathoms, stations 865-877, 920-924, 943, 944, 949, 950, 1038, 1040, of 1880 and 1881.

Axinopsis orbiculata G. O. Sars.

Axinopsis orbiculata G. O. Sars, op. cit., p. 63, pl. 19, figs. 11a-d.

Azinus orbicularis (Wood) Friele, Jan Mayen Moll., p. 3, pl., figs. 3-3c.

Azinus orbiculatus Friele, Catal. Norweg. Nordmeer-Exp. Spitzbergen Moll., p. 268, 1879.

Broad Sound, Casco Bay, 15-30 fathoms, 1873; Halifax, N. S., 18 fathoms, 1877,—U. S. Fish Com. Vadsø, 60 to 100 fathoms,—G. O. Sars. Spitzbergen and Jan Mayen I., 10 to 15 fathoms,—Friele. Alaska,—Dall.

Cryptodon obesus Verrill.

Cryptodon obesus Verrill, Amer. Journ. Sci., iii, p. 287, pl. 7, fig. 2, 1872; Trans. Conn. Acad., iii, p. 11, pl. 1, fig. 11 (*non* G. O. Sars).

Verrill, Rep. Invert. Anim. Vineyard Id., in Rep. U. S. Fish Com., i, pp. 509, 687, pl. 29, fig. 214, 1874 (auth. cop., p. 393).

Verrill, Proc. U. S. Nat. Mus., iii, p. 399, 1880.

The form figured under this name by G. O. Sars, is not the true *obesus*, but is more like a large *C. Gouldii*.

Jeffreys considers both this and *C. Gouldii* varieties of the European *C. flexuosus*. It may be so, but this form is at least as

well-defined as some of the other so-called species, recognized by him and others, in this genus.

The original specimens were from off Martha's Vineyard, 19 fathoms, and east of Block Island, in 29 fathoms, 1871. It has also been dredged by us, of smaller size, in Massachusetts Bay, Casco Bay, and off Nova Scotia. Off George's Bank, 430 fathoms!—(Smith and Harger, 1872.) Labrador! (coll. Packard.) Gulf of Mexico,—Dall.

Very large specimens of the typical *C. obesus*, several of them more than 15^{mm} broad, but mostly dead, were frequently dredged in 1880, off Newport, R. I., in 12 to 20 fathoms; and at stations 865–871, 873, 876, and 877, 878, in 65 to 192 fathoms, south of Martha's Vineyard and Newport, R. I. In 1881, it occurred at stations 918, 919, 949, 991, 1035, 1038, 1040, in 34 to 146 fathoms. It is most common in 20 to 100 fathoms, but a dead shell occurred at station 894, in 365 fathoms.

Cryptodon Sarsii (Phil.).

Azinus Sarsii M. Sars, Reise i Lofoten og Finmarken, 1849, Nyt. Mag. Naturvid., vi, [p. 48] (anatomy, etc.).

G. O. Sars, op. cit., p. 60, pl. 19, figs. 5 *a*, *b*.

Cryptodon Sarsii Verrill. Proc. U. S. Nat. Mus., iii, p. 399, 1880.

This is also regarded, by Jeffreys, as a variety of *C. flexuosus*.

A single large dead specimen of a shell agreeing very closely with this form, as figured by G. O. Sars, was dredged by our party, in 1879, off Cape Cod.

Cryptodon subovatus? (Jeff.) Verrill.

Azinus subovatus Jeffreys, Proc. Zool. Soc. London, 1881, p. 704, pl. 61, fig. 8.

An exceedingly thin, delicate and very inequilateral shell, apparently identical with the species described by Jeffreys, occurred at station 891, in 500 fathoms. One specimen.

Cryptodon ferruginosus (Forbes).

Azinus ferruginosus G. O. Sars, Moll. Reg. Arct. Norv., p. 63, pl. 19, figs. 10, *a*, *b*.

Cryptodon ferruginosus? Verrill. Amer. Journ. Sci., xx, p. 392, Nov., 1880; Proc. U. S. Nat. Mus., iii, p. 400, 1880.

Off Martha's Vineyard, living specimens were taken at many stations. They were nearly all thickly encrusted with iron-oxide, which adheres very tenaciously; beneath this crust the shell is usually much

eroded, and very thin, and in many cases the shell-substance itself has entirely disappeared, leaving only the crust of iron-oxide, lined, perhaps, by a remnant of the epidermis. These encrusted specimens are rough, and mostly nearly circular in outline.

Off Martha's Vineyard, stations 891-895, 941, 943, 947, 997, 999, 1028, in 153 to 500 fathoms. Off Chesapeake Bay, in 300 fathoms, station 898.

Gulf of St. Lawrence. Greenland. Finmark to Great Britain and Portugal. Mediterranean and Adriatic. Off the Azores. At various depths to 1012 fathoms. Fossil in the Miocene, Pliocene and Post-pliocene of Europe.

Montacuta fabagella (Conrad) Verrill.

Lepton fabagella Conrad, Marine Conch., p. 53, pl. 11, fig. 3, 1831.

Verrill, Rep. Invert. Anim. Vineyard Id., in Rep. U. S. Fish Com., i, p. 688 (auth. cop., p. 394), 1874.

Rhode Island,—Conrad. I have no personal knowledge of this shell. It appears to be a species of *Montacuta*.

Montacuta Gouldii Thomson.

Thomson, Am. Journ. Conch., iii, p. 33, pl. 1, fig. 15, 1867.

I have not seen this species. Perhaps it is the same as *M. fabagella*.

Montacuta Dawsoni Jeffreys.

Jeffreys, British Conch., ii, p. 216; v, p. 178, pl. 31, fig. 7.

Newfoundland, coll. Verkruzen (t. Jeffreys).

Montacuta bidentata (Montagu).

G. O. Sars, op. cit., p. 69, pl. 19, figs. 17, *a, b* (non Gould.)

Long Island Sound, near New Haven, shore, 1868; Cape Cod Bay, 7 fathoms, 1879.

Montacuta ovata Jeffreys.

Proc. Zool. Soc., London, 1881, p. 698.

A few specimens of a species, which agrees well with this, were taken off Martha's Vineyard, in 100 to 153 fathoms, but, though living, they were all so much encrusted with iron-oxide that their identity is somewhat doubtful.

The same remark applies to an elongated ovate shell from the same region, resembling *M. (Tellinmya) ferruginosa*, to which I referred it, in a former paper. It may be identical with the last.

A shell, encrusted in the same way, dredged off Cape Cod, in 1874, was then identified as *Lascea rubra*, but I now doubt the correctness of that identification. The specimens are not at hand for further examination.

Venericardia borealis, var. *Novangliae* (Morse).

Actinobolus (Cyclocardia) Nova-angliae Morse, First Rep. Trustees Peabody Acad. Sci., p. 76, cut, 1869.

Cyclocardia Novangliae Verrill, Rep. Invert. Anim. Vineyard Sd. in Rep. U. S. Fish Com., i, pp. 418, 684 (auth. cop., p. 390), pl. 29, fig. 215, 1874.

This appears to be only an inconstant variety of the common *V. borealis*, and has a range coëxtensive with the latter.

Ledaunca Gould.

Ledaunca Gould, Proc. Bost. Soc. Nat. Hist., viii, p. 282, 1862; Otia Conch., p. 239 (=? *Leda acuta* Conrad, described as fossil).

Verrill, Amer. Journ. Sci., xx, p. 392, Nov., 1880; U. S. Nat. Mus., iii, p. 401, 1880 (description).

PLATE LVIII, FIGURE 41.

Mr. Dall has identified our shells with those taken in the Gulf of Mexico, by the "Blake" Expedition. He refers them to *L. Jamaicensis* D'Orbigny. I am not satisfied that this identification is correct, for D'Orbigny's figure is not very like our shells, of which we have taken large numbers.

Taken in abundance, alive and dead, at many of the stations, both south of Martha's Vineyard and south of Newport, R. I., in 85 to 155 fathoms, especially at stations 871, 873, 874 and 876, 1880. Additional localities, in 1881, were stations 921, 949, 951, 1038, in 65 to 219 fathoms.

Gulf of Mexico, 54 to 640 fathoms (t. Dall).

Leda pernula (Müller).

Leda pernula G. O. Sars, op. cit., p. 35, pl. 5, figs. 1, a-d.

Verrill, Proc. U. S. Nat. Mus., iii, p. 401, Jan., 1881.

A specimen that appears to be a typical example of this species was dredged by us in 1877, off Halifax, in 59 fathoms. Another was taken at station 1025, in 216 fathoms, off Martha's Vineyard, 1881.

Yoldia frigida Torell.

Yoldia frigida Torell, Spitz. Moll., p. 148, pl. 1, fig. 3, 1859.

G. O. Sars, Moll. Reg. Arct. Norv., p. 39, pl. 4, figs. 11, *a*, *b*.

Verrill, Amer. Journ. Sci., xx, p. 392, Nov., 1880; Proc. U. S. Nat. Mus., iii, p. 401, 1881.

PLATE XLIV, FIGURE 2.

Gulf of Maine, 1873, and Jeffrey's Ledge, off the coast of Maine, in 88 to 92 fathoms, "Bache" 1874. Off Cape Cod, 106 fathoms, 1879. Off Martha's Vineyard, stations 880, 894, 943, 947, 997-999, in 153 to 365 fathoms. Gulf of St. Lawrence, 200 fathoms! (coll. Whiteaves).

Spitzbergen. Nova Zembla. Lofoten I. to the Mediterranean. Northern Japan (t. Jeffreys).

Arca ponderosa Say.

Arca ponderosa Say, Journ. Acad. Nat. Sci. Phil., ii, p. 267, 1822.

Verrill, Rep. Invert. Anim. Vineyard Id., in Rep. U. S. Fish Com., i, p. 692 (auth. cop., p. 398), 1874.

Frequently found on the beach at Edgartown, Martha's Vineyard, and on the south side of Long Island, but it has not been found living north of Cape Hatteras. The beach shells may be from a submerged fossiliferous deposit, or it may possibly live in favorable localities, off shore.

Arca pectunculoides Scacchi, 1833.

Jeffreys, Brit. Conch., ii, p. 171; v, p. 175, pl. 30, fig. 3.

Verrill, Amer. Journ. Sci., v, p. 14, 1873.

G. O. Sars, op. cit., p. 43.

Arca grenophia Risso, 1826 (t. Jeffreys).

Arca glacialis Verrill, Proc. U. S. Nat. Mus., iii, p. 401, 1881 (? non Gray).

Variety, *grandis* Leche.

Öfversigt Svenska Exp. Novaja Semlja och Jenissej, 1875, 1876, Hafs-Mollusker, in K. Sv. Vet.-Akad. Handl., xvi, 2 [p. 30], pl. 1, figs. 9, *a-c*, 1878.

Variety, *septentrionalis* (G. O. Sars) Jeffreys.

Arca septentrionalis G. O. Sars, op. cit., p. 43, pl. 4, figs. 2, *a-c*,

Variety, **Frielei** (Jeffreys) Verrill.

Arca frielei (Jeff. MSS.) Friele. Mag. Naturvid., xxiii. p. 2, 1877.

Jeffreys, Proc. Zool. Soc., London, 1879, p. 573. pl. 45. figs. 4, 4a.

PLATE XLIV. FIGURES 5, 6.

This shell, as it occurs on our coast, is exceedingly variable in form and size. Our largest specimens are about 15^{mm} long. In outline it varies from an elongated oblong form, like fig. 5 (variety *grandis*) to a short-oblong (fig. 6); and from forms in which the anterior and posterior ends are nearly equally broad, to those in which the anterior end is very much narrowed, when the ventral edge becomes very oblique, and sometimes incurved, at the byssal notch. This elongated form, contracted anteriorly, is variety *septentrionalis*. It is one of the most abundant forms at most of the stations south of Martha's Vineyard, though forms intermediate, in various degrees, between this and the oblong-form (var. *grandis*) are equally abundant.

Another extreme variety is both short and oblique, combining the contraction of the anterior end with the shortening of the shell, so that the length is not greater than the distance from the dorsal to the ventral edge. In this form, the teeth are usually few, faint, and very oblique, confined to near the ends of the hinge-margin, and not uncommonly the teeth are nearly obsolete, and the shell is thinner and more delicate than usual, but the inner margin, as in the other varieties, is not crenulated. This form I regard as variety *Frielei*. It passes by insensible gradations into the variety *septentrionalis*.

In all these varieties the inner margin of the shell is plain, and the hinge-teeth are usually few and oblique, especially the posterior ones, which are more or less lamellose, sometimes running almost parallel with the hinge-plate. The median portion of the hinge-plate is destitute of teeth. The valves are more or less unequal in all the varieties, and are always finely decussated by slender, raised radiating ribs and concentric lines, while the epidermis is always, in fresh, living specimens, more or less pilose, the hairs arranged in radiating rows, along the ribs.

This shell attaches itself to pebbles or gravel-stones by a small, but strong, ventral byssus.

This species has been taken in numerous localities by the various dredging parties of the United States Fish Commission, since 1872: in the Bay of Fundy, 108 fathoms; off Casco Bay, 94 fathoms; Gulf of Maine, 110 to 150 fathoms; Cash's Ledge, 27 to 90

fathoms; off Cape Cod, 94 to 122 fathoms; on George's and Le Have Banks; and off Halifax, Nova Scotia, at various depths, from 70 to 430 fathoms.

It is very common south of Martha's Vineyard, in 200 to 506 fathoms, and is less frequently dredged in 76 to 150 fathoms, those from the shallower stations being mostly dead, or young. It occurred at 32 stations in this region. It was particularly abundant at 894, in 365 fathoms; 938, in 310 fathoms; 939, in 258 fathoms; 997, in 335 fathoms.

Gulf of St. Lawrence! (coll. Whiteaves). Gulf of Mexico, "Blake" Exp. Greenland; Spitzbergen. Lofoten I. to the Mediterranean; 20 to 1170 fathoms.

Fossil in the Pliocene and Post-pliocene of Europe, in Norway, Italy, and France.

Variety *Frielei* was taken by the Valorous and Norwegian Arctic Expeditions, in 459 to 1333 fathoms. Forms apparently identical with the latter, occurred, with the other varieties, off Martha's Vineyard, in 192 to 487 fathoms, stations 869, 892, 895, 1880; 949, in 100 fathoms, 1881.

Arca pectunculoides, var. *crenulata* Verrill, nov.

Shell with a regularly crenulated inner margin, small, short, inflated, somewhat oblique, having nearly the outline of variety *Frielei*, defined above, but somewhat more tumid. The posterior end is regularly and circularly rounded; the ventral margin is broadly and somewhat obliquely rounded, the curvature being continuous to the dorsal angle; the dorsal edge is straight, with a distinct angle at each end, but both ends curve outward beyond the angles. Umbos swollen; beaks acute, curved inward and forward, not coming very near together, but leaving a deep and rather broad, well-defined ligamental and lunular area between and in front of them. Hinge-margin thin, straight, in the larger specimens with about 9 or 10 posterior, and 6 or 7 anterior teeth, which are well-defined, small, regular, not very oblique, and not laminar. Smaller examples have about 4 or 5 anterior and 6 or 7 posterior teeth. The hinge-margin is a little wider anteriorly, where denticulated, and the anterior teeth are somewhat larger than the posterior ones, and a little more oblique. The middle of the hinge-margin is edentulous and narrow, for a short distance, below the beaks. The posterior series of teeth is longer, and extends nearly to the beaks. The crenulations of the

inner margin are small, regular, and clearly defined, and extend all the way round to the dorsal angles; the inner surface of the shell is faintly radiated. The exterior is finely and regularly decussated by raised concentric lines and radiating ribs. The epidermis is pale horn-color, lamellose, rising into scales and points along the ribs. Length, 5^{mm}; beaks to ventral margin, 4^{mm}; thickness, 3.25^{mm}; length of dorsal margin, 3.6^{mm}.

Off Martha's Vineyard, stations 871, 873, 874, 876, and 949, in 85 to 120 fathoms. About 75 specimens.

Although resembling some of the other short varieties of *A. pectunculoides*, this seems to be a well-defined form, differing in the crenulated margin, and in the character of the hinge-teeth, as well as in its tumid form.

Arca glacialis Gray, 1824.

Arca glacialis Torell, Spitzbergens Mollusk fauna, p. 153, pl. 2, figs. 7 a, b, 1859.

G. O. Sars, op. cit., p. 43, pl. 4, figs. 1 a-c.

Leche, op. cit. [p. 29], pl. 1, fig. 8, 1878.

This species has been recorded from the Gulf of St. Lawrence, by Jeffreys.

The New England specimens, formerly referred by me to this species, are only large and elongated specimens of *A. pectunculoides*, but they agree very well with Sars' figures, except that the teeth are not quite so numerous. The differences seem to me varietal, rather than specific, in so variable a group as this. But as I am uncertain whether I have seen a "true" *A. glacialis*, I have let it stand in this paper.

Mr. Dall records it from the Gulf of Mexico, and thinks it distinct from *A. pectunculoides*, but he refers to the latter all the New England shells, that I have sent to him.

Limopsis minuta (Philippi).

Pectunculus (Limopsis) minutus Philippi, Enum. Moll. Sicil., p. 63, pl. 5, fig. 3, 1836 (t. Norman).

Limopsis minuta G. O. Sars, Moll. Reg. Arct. Norv., p. 44, pl. 3, figs. 5 a-c.

Jeffreys, Proc. Zool. Soc. London, 1879, p. 585, pl. 46, fig. 9.

Verrill, Amer. Journ. Sci., xx, p. 392, Nov., 1880; Proc. U. S. Nat. Mus., iii, p. 402, Jan., 1881.

Limopsis borealis Jeffreys, Brit. Conch., ii, p. 164; v, p. 174, pl. 100, fig. 3.

Most of our specimens are rounder and more oblique than the figures of Sars and Jeffreys, but the form and degree of obliquity is variable.

This shell was taken in abundance, living, at stations 893, 894, 895, 925, 947, and 997, in 224 to 372 fathoms. It occurred less abundantly, at stations 870, 876, 880, 938, 939, 945, 946, 951, 953, 994, and 999, in 155 to 368 fathoms. In small numbers at 891, 892, 953, and 1028, in 410 to 715 fathoms. Dead shells occurred at several stations, in 93 to 130 fathoms.

Gulf of Mexico, 30 to 805 fathoms, Blake Exp. (t. Dall). On the European coast, from Finmark to the Azores and Mediterranean, in 70 to 790 fathoms. Cape of Good Hope (t. Jeffreys).

Fossil in the Miocene and Pliocene of Europe.

Limopsis cristata (?) Jeffreys.

Ann. and Mag. Nat. Hist., 1876, p. 434; Proc. Zool. Soc. London, 1879, p. 585, pl. 46, fig. 8.

Limopsis cristata? Verrill, Amer. Journ. Sci., xx, p. 392, Nov., 1880; Proc. U. S. Nat. Mus., iii, p. 402, 1880.

A few dead specimens, referred very doubtfully to this species, were taken at stations 865 to 867 and at 870 and 871, in 65 to 155 fathoms in 1880. No perfect living specimens have been noticed that seem certainly referable to it. In view of the great variability seen in our series, this form may very likely prove to be only a variety of *L. minuta*.

Gulf of Mexico, 640 fathoms, (t. Dall).

Modiola hamatus Verrill.

Mytilus hamatus Say, Journ. Acad. Nat. Sci. Philad., vol. ii, p. 265, 1822; Amer. Conch., Binney's ed., pp. 91, 204, pl. 50.

Modiola hamatus Verrill, Amer. Journ. Sci., iii, p. 211, pl. 7, fig. 3, 1872.

Verrill, Rep. Invert. Anim. Vineyard Id., in Rep. U. S. Fish Com., i, pp. 374, 475, 693 (auth. cop., p. 399), 1874.

Verrill, Amer. Journal Sci., x, p. 372, 1875 (fossil).

FIGURE 10.

This species frequently occurs in summer, in considerable numbers, living on the oyster-beds in New Haven harbor and in Long Island Sound, adjacent, but it is probable that most of these specimens have been imported with the southern oysters, planted here in spring. It is not certain that it lives through the winter in this latitude. It is abundant from Cape Hatteras to the Gulf of Mexico.

FIG. 10.



It occurs abundantly, as a fossil, in the Post-pliocene beds of Nantucket Island; also at Provincetown, Mass. In the Miocene of Virginia and North Carolina.

Modiola polita Verrill and Smith.

Modiola polita Verrill and Smith, in Verrill, Amer. Journ. Sci., xx, pp. 392, 400, Nov., 1880; Verrill, Proc. U. S. Nat. Mus., iii, p. 402, Jan., 1881.

Dall, Bulletin Mus. Comp. Zool., ix, p. 116, 1881.

? *Mytilus luteus* Jeffreys, French Expl. in Bay of Biscay, in Rep. Brit. Assoc., 1880 (no description); Ann. and Mag. Nat. Hist., Oct., 1880, p. 315 (no description).

Mr. Dall has compared his specimens with our original types.

Two living specimens were taken at station 895, in 235 fathoms, Gulf of Mexico, 339 fathoms, "Blake" Exp. (t. Dall). Bay of Biscay,—Jeffreys.

Mr. Dall thinks that *M. luteus* is certainly identical with this species, judging from a recent description in Journ. de Conch., which I have not seen. Our description has priority of publication.

If the genus *Modiola* is not to be considered valid, this species should be called *mytilus politus*.

Crenella decussata (Montagu) Macgillivray, 1843.

Modiola ? cicereula Möller, Krøyer's Tidsskr., iv, p. 92, 1842.

Crenella decussata Lovén, Ind. Moll. Scand. Occid., p. 32, 1846.

Jeffreys, Brit. Conch., ii, p. 133; v, pl. 28, fig. 6.

Verrill, Amer. Journ. Sci., vol. vi, p. 440, 1873; vol. vii, pp. 409, 412, 1874.

G. O. Sars, op. cit., p. 31, pl. 3, figs. 4, a, b, 1878.

PLATE XLIV, FIGURE 7.

This species has been taken in many localities, on muddy bottoms, by the U. S. Fish Com., on the northern coasts of New England. Grand Menan, 3 to 10 fathoms, 1872; Caseo Bay, 10 to 20 fathoms, 1873; off Martha's Vineyard, stations 865-7, 871, 949, 950, in 64 to 115 fathoms.

Gulf of Mexico, "Blake" Exp. (t. Dall). Gulf of St. Lawrence! (coll. Whiteaves). Greenland; Iceland; Nova Zembla; Spitzbergen. From Finmark and Lapland to Great Britain and the Mediterranean. Northwest coast of America. Corea, 35 to 40 fathoms (t. Jeffreys). It occurs from low-water mark to 1750 fathoms.

Fossil in the Pliocene and Post-pliocene of Europe.

Dacrydium vitreum (Möller) Torell.

Modiola ? vitrea Möller, Ind. Moll. Grönl., in Kröyer's Tidsskr., iv, p. 92, 1842.

Dacrydium vitreum Torell, Spitz. Mollusk fauna, p. 139, pl. 1, figs. 2, *a, b*, 1859.

G. O. Sars, op. cit., p. 28, pl. 3, figs. 2, *a, b*.

Verrill, Amer. Journ. Sci., vi, p. 440, 1873; vii, p. 409, 1874.

PLATE XLIV, FIGURES 8, 8a.

First taken, on our coast, by the Fish Com., in 1873 and 1874, in 60 to 142 fathoms, off the coast of Maine and off Cape Cod. Gulf of Maine, 160 fathoms; and off Nova Scotia, 102 fathoms, 1877; off Cape Cod, 106 and 118 fathoms, 1879. South of Martha's Vineyard, in 312 to 500 fathoms, stations 891, 892, 894, 947, 994, 997; off Chesapeake Bay, station 898, in 300 fathoms.

North Atlantic, 1450 fathoms,—Valorous Exp. Greenland; Nova Zembla; Spitzbergen, 30 to 40 fathoms,—Torell. Finmark and Lofoten I. to the coasts of Ireland, England, Spain, and the Azores, 164 to 2435 fathoms. Mediterranean, 30 to 600 fathoms. Has been taken in 30 to 2750 fathoms.

Idas argenteus Jeffreys.

Annals and Mag. Nat. Hist., Nov., 1876, p. 428; Proc. Zool. Soc. London, 1879, p. 570, pl. 45, fig. 3.

Variety?, *lamellosus* Verrill. (Perhaps sp. nov.)

Several living specimens of a species of *Idas* were taken by us. Our shell resembles *I. argenteus* in form and most other characters, but there are no radiating lines, such as are attributed to that species; but the surface is covered with well-marked, thin, distant, concentric, raised lamellæ, most distinct anteriorly.

The shell is thin, translucent, covered with a yellowish epidermis; umbos and hinge reddish brown; inner surface iridescent. Some of the specimens have several horny, sharp, stiff, beard-like processes projecting from the posterior and dorsal surfaces. One of the largest specimens is 5.5 long; greatest height, 2.2^{mm}.

Station 997, in 335 fathoms.

North Atlantic and Bay of Biscay, 1450 and 994 fathoms,—Jeffreys.

Our shells resemble, in form, the young of *Saxicava rugosa*.

Limæa subvota (Jeffreys).

Lima subvota Jeffreys. Annals and Mag. Nat. Hist., Nov., 1876, p. 427; Proc. Zool. Soc. London, 1879, p. 563, pl. 45, fig. 2.

Limæa subvota Verrill. Amer. Journ. Sci., xx, p. 392, Nov., 1880; Proc. U. S. Nat. Mus., iii, p. 402, Jan., 1881.

Off Martha's Vineyard, stations 880, 891 to 894, 947, 994, 997 to 999, in 252 to 500 fathoms, common; dead shells at station 949, in 100 fathoms.

North Atlantic, 1450 fathoms,—“Valorous” Exp.; Shetland and Färöe Is., 125 to 542 fathoms; west of Ireland, 664 to 1443 fathoms; off Azores, 1000 fathoms (t. Jeffreys). Mediterranean,—Monterosato.

Pecten glyptus Verrill. sp. nov.

Pecten, sp., near *opercularis* Verrill, Proc. Nat. Mus., iii, p. 403, 1881.

Shell large, rather thin, compressed, both valves a little convex, the lower one a little flatter; ventral margin evenly rounded; the dorsal edges are nearly straight and meet at rather more than a right angle; ears rather large, the anterior one with a triangular notch, beyond which the end is rounded to the dorsal angle; surface with eight or more unequal ribs; posterior one triangular, truncated at the end, with three or four thin ribs. Surface of the valves with about seventeen or eighteen large triangular ribs, separated by wider, broadly concave interspaces. The whole surface, both of the ribs and interspaces, is regularly covered with fine, radiating, raised lines; the interspaces between these are crossed by very regular, concentric scallops, formed by thin, raised lines. On the lower valve there are similar large radiating ribs, but the fine radii and concentric scallops are obsolete.

Color, of the upper valve, orange brown, paler between the ribs.

Diameter, more than 2 inches (50^{mm}). The larger specimens are all fragmentary; on some of these the distance from the crest of one rib to another is 7^{mm}.

Off Martha's Vineyard, stations 871, 873, 874, 876, 949, in 85 to 120 fathoms.

Pecten vitreus (Chemnitz).

Pecten vitreus Lovén, Ind. Moll. Scand. Occid. [p. 31]. 1846 (description).

G. O. Sars. op. cit., p. 21, pl. 2, figs. 5, a, b.

Verrill, Amer. Journ. Sci., xvi, p. 378, 1878.

Variety, *abyssorum* (M. Sars).

Pecten abyssorum Lovén; G. O. Sars, op. cit., p. 22, pl. 2, figs. 6, a-c.

PLATE XLII, FIGURE 21.

The variety *abyssorum* differs only in being smoother, with the scales more or less obsolete; both forms occur together.

South of Martha's Vineyard this species has been taken in considerable numbers, and at thirty stations it was living and attached to various objects, above the bottom, but chiefly to the gorgonian coral, *Acanella Normani* V., which is very abundant in this region. This shell occurred, living, at all depths, from 100 to 506 fathoms. It was particularly abundant at station 894, in 365 fathoms, and at 1029, in 458 fathoms. Dead valves were taken in 64 to 100 fathoms.

The halibut fishermen of Gloucester, Mass., have given many specimens of this species to the U. S. Fish Commission. These were taken on the fishing banks off Nova Scotia, and on the Grand Bank, where it mostly occurs adhering to gorgonian corals: *Prinuoa reseda*, *Paragorgia arborea*, *Acanella Normani*, *Keratoisis ornata* V., etc. It is often gregarious.

Arctic Ocean, generally; Greenland; Iceland. Northern Norway south to France, Portugal, Madeira, and the Mediterranean. West Patagonia (t. Jeffreys).

Pecten Grönlandicus Sowerby, 1845.

G. O. Sars, op. cit., p. 23, pl. 2, figs. 4, a-c.

Gulf of St. Lawrence! (coll. Whiteaves). Arctic Ocean; Greenland; Spitzbergen; Lapland; northern Norway. N. of Scotland; W. of Ireland; off the Bay of Biscay, in 358 to 630 fathoms,—Jeffreys.

Pecten Hoskynsi Forbes.

Pecten Hoskynsi Forbes, Rep. Brit. Assoc. for 1843, pp. 188, 192, 1844 (description very short and indefinite).

Wyville Thomson, Depths of the Sea, p. 465 (wood-cut, 79, no description).

Pecten imbrifer Lovén, Ind. Moll. Scand. Occid. [p. 31], 1846 (description).

Amussium Hoskynsi Jeffreys, Proc. Zool. Soc. London, p. 562, 1879.

PLATE XLIV, FIGURE 11.

Variety, *pustulosus* Verrill

Pecten pustulosus Verrill, Amer. Journ. Sci., v, p. 14, 1873; Trans. Conn. Acad., iii, p. 50 (description).

Pecten Hoskynsi G. O. Sars, op. cit., p. 20, pl. 2, figs. 1, a-d, 1878.

PLATE XLII, FIGURES 22, 22a.

The original specimens of var. *pustulosus* V. were from south of George's Bank, 430 fathoms, and Gulf of Maine, 150 fathoms, 1872. It was afterwards dredged by us, in 1877, in the Gulf of Maine, 115 fathoms, and off Nova Scotia, in 190 fathoms, associated with the non-pustulose form.

South of Martha's Vineyard it occurred at stations 876, 880, 881, 894, 947, 1038, in 120 to 365 fathoms, but only sparingly, and mostly dead.

Greenland; Spitzbergen; Jan Mayen I.; Nova Zembla. Northern Norway to the Azores and Mediterranean, in deep water, 30 to 650 fathoms.

Although this species is referred to *Amussium* by Mr. Jeffreys, our specimens do not have the internal ribs, regarded as the special character of this genus.

Amussium fenestratum (Forbes) Jeffreys.

Jeffreys, Proc. Zool. Soc. London, 1879, p. 561.

Pecten fenestratus Forbes, Rep. Brit. Assoc., for 1843, pp. 146, 192, 1844.

Verrill, Proc. Nat. Mus., iii, p. 403, Jan., 1881 (description).

Pecten inæquisculptus Tiberi (t. Jeffreys).

The upper valve is elegantly decussated, the lower one is concentrically lamellose. The upper valve is variously colored with beautiful tints of red, purple, brown and yellow, usually mottled.

This elegant species has been dredged, living, at several stations off Martha's Vineyard, in 86 to 310 fathoms. It was most numerous at stations 949 and 1040, in 100 and in 93 fathoms.

It occurs on the European coasts, off Portugal, and in the Mediterranean Sea; from 50 to 250 fathoms; a variety from 2435 fathoms (t. Jeffreys).

Avicula hirundo (Linné).

Avicula hirundo Jeffreys, Brit. Conch., ii, p. 99, pl. 3, fig. 1; v, pl. 26.

Variety, ***nitida*** Verrill.

Avicula hirundo? var. *nitida* Verrill. Amer. Journ. Sci., xx, p. 392, Nov., 1880;

Proc. U. S. Nat. Mus., iii, p. 402, Jan., 1881.

PLATE LVIII, FIGURE 43.

Some of our largest specimens agree well with the European forms figured by Jeffreys, and are conspicuously scaly. The largest are about 50^{mm} in the greatest diameter.

The variety is nearly smooth and somewhat lustrous (fig. 43). The largest is 42^{mm} in the longest diameter; hinge margin 36^{mm}.

This shell was found in considerable numbers adhering to hydroids, in 65 to 192 fathoms, south of Martha's Vineyard, at stations 865 to 867, and 869 to 873, in 1880; and at 949, 950, in 69 to 100 fathoms, 1881.

Southern England to the Azores, Canary Islands, and the Mediterranean.

EXPLANATION OF PLATES.

I am indebted to Professor S. F. Baird for permission to use in this place some of the drawings prepared for the illustration of the reports of the U. S. Fish Commission. They were mostly drawn from nature by Mr. J. H. Emerton, under the immediate direction of the author. Unless otherwise specially stated, they are from New England specimens. All are from the eastern coast of New England and Canada.

PLATE XLII.

- Figure 1.—*Marseniina glabra* V., p. 517, front view, x 2½ diameters.
 Figure 1a—The same. Dorsal view. Eastport, Me., 1864.
 Figure 2.—*Marseniina proclita*, p. 518, front view, x 2½ diameters.
 Figure 2a—The same. Dorsal view. Eastport, Me., 1868.
 Figure 3.—*Marseniina ampla* V., p. 518, front view, x 2¼ diameters.
 Figure 3a—The same. Dorsal view. Eastport, Me., 1868.
 Figure 4.—*Marseniina glabra*, ♀, p. 517, ventral view of the living animal, x 3 diameters. Eastport, Me.
 Figure 5.—*Torellia vestita*, p. 521, front view, x 2½ diameters. Gulf of Maine.
 Figure 6.—*Lacuna glacialis*, p. 522, front view, x 2½ diameters. Gulf of St. Lawrence.
 Figure 7.—*Cerithiella Whiteavesii* V., p. 522, x 6½ diameters. Gulf of St. Lawrence.
 Figure 8.—*Cingula Jan-Mayeni*, p. 524, x 10 diameters. Gulf of St. Lawrence.
 Figure 9.—*Lunatia nana*, p. 516, x 2½ diameters. Side view, from life. No. 1266.
 Figure 10.—*Seyllana Edwardsii* V., p. 550, ½ natural size.
 Figure 11.—*Issa lacera*, p. 517, dorsal view, from life; about natural size.
 Figure 12.—*Acanthodoris ornata* V., p. 549, dorsal view, from life; more than natural size. Eastport, Me.
 Figure 13.—*Blattella pulchella*, p. 548, side view, natural size, from life. Salem, Mass.
 Figure 14.—*Coryphella Stimpsoni* V., p. 552, ventral view of head and anterior part of body, from life, enlarged about 2 diameters. Eastport, Me.
 Figure 15.—*Coryphella nobilis* V., p. 552, two rows of teeth of the radula; much enlarged.
 Figure 16, a, b.—*Dentalium occidentale* St.: a, aperture; b, side view of a young example, x 5 diameters.

- Figure 17.—The same. Side view of another specimen. of the many-ribbed variety, x 6 diameters.
- Figure 18.—The same. Side view of a larger specimen. of a more curved variety. with fewer and stronger ribs, x 2 diameters.
- Figure 19.—*Siphonodentulum vitreum*, p. 557. side view of a large specimen with the apical denticles, or lobes, broken off, x $4\frac{1}{2}$ diameters.
- Figure 20. *a, b*.—*Siphonentalis affinis*, p. 558, aperture, *a*; and side view, *b*, x 5 diameters. Halifax, N. S.
- Figure 21.—*Pecten vitreus*, p. 581. lower side, natural size. Specimen from off Nova Scotia.
- Figure 22.—*Pecten Hoskyasi*, var. *rustulosus*, p. 581. upper side of one of the type-specimens from Gulf of Maine, 150 fathoms. Enlarged a little more than two diameters.
- Figure 22a.—The same. Lower side.
- Figure 10, drawn from life, and figs. 16 and 17, camera-drawings, are by the writer; the rest are by J. H. Emerton.
- Several of the numbers on this plate, indicating the amount of enlargement, are erroneous.

PLATE XLIII.

- Figure 1.—*Cingula castanea*, p. 525, x 16 diameters.
- Figure 2.—*Cingula arcuolata*, p. 524, x 14 diameters.
- Figure 3.—*Cingula globulus*, p. 524, x 16 diameters. From Gulf of St. Lawrence.
- Figure 4.—*Buccinum tenuis*, p. 495, small specimen, natural size; from off Cape Sable, N. S.
- Figure 5.—*Buccinum cyanum*, p. 492, natural size; from off Cape Sable, N. S.
- Figure 6.—*Sipho pubescens* V., p. 501, small specimen, natural size; from off Cape Sable, N. S.
- Figure 7.—*Anachis costulata*, p. 513, x about 4 diameters.
- Figure 8.—*Trochophora clathratus*, var. *Gunneri*, p. 512, somewhat enlarged. The outer lip is broken.
- Figure 9.—*Pleurotomella Packardii* V. ? , p. 453, from the original type-specimen, x 2 diameters. The shell is so turned that the lip partially conceals the aperture, in order to show the notch in the lip.
- Figure 10.—*Bela cancellata*, p. 475, slender variety, not full grown, x 4 diameters.
- Figure 11.—The same. Typical form, x 4 diameters.
- Figure 12.—*Bela incisula* V., p. 461, x 4 diameters.
- Figure 13.—*Bela decussata*, p. 479, typical form, x 4 diameters. The outer lip is somewhat broken.
- Figure 14.—*Bela harpularia*, p. 473, typical form, from off Cape Cod, x 4 diameters.
- Figure 15.—*Bela concinnula* V., p. 468, typical form, x 4 diameters. The outer lip is somewhat broken off.
- Figure 16.—*Bela Pingelii*, p. 464, x 4 diameters. Eastport, Me.

PLATE XLIV.

- Figure 1.—*Toldia lucida*, x 6 diameters. From a variety more narrowed posteriorly than usual.
- Figure 2.—*Toldia frigida*, p. 513, x 5 diameters.

- Figure 3.—*Poromya granulata*, p. 564. typical form. interior view. x 4 diameters. Gulf of Maine.
- Figure 4.—The same. Outside of left valve.
- Figure 5.—*Arca pectunculoïdes*, var. *grandis*, p. 574. x 4 diameters. Gulf of Maine.
- Figure 6.—*Arca pectunculoïdes*, p. 574. short, oblong form. x 4 diameters.
- Figure 7.—*Crenella decussata*, p. 578. x 12 diameters.
- Figure 8.—*Dacrydium vitreum*, p. 579, x 15 diameters.
- Figure 8a.—The same. Hinge, left valve.
- Figure 9.—*Xylophaga dorsalis*, p. 559, x 6 diameters. Casco Bay.
- Figure 10a.—*Neera glacialis*, p. 562. large form, with cartilage pit as in *N. arctica*. x 2½ diameters.
- Figure 10b.—The same. Commonest variety.
- Figure 10c.—*Neera obesa*, p. 563, a common variety. x 2½ diameters. Gulf of Maine.
- Figure 11.—*Pecten Hoskynsi*, p. 581. typical form, x 4 diameters. From off Nova Scotia, 190 fathoms.

PLATE LVII.

- Figure 1.—*Pleurotoma Dalli*, p. 451. x 1½.
- Figure 1a.—The same.
- Figure 2.—*Pleurotoma Carpenteri*, p. 452. x 4.
- Figure 3.—*Pleurotomella Agassizii*, p. 454. x 1½.
- Figure 3a.—The same. Uncini. x 250.
- Figure 4.—*Pleurotomella Pandionis*, p. 456. natural size.
- Figure 4a.—The same. Uncini. x 75.
- Figure 5.—*Pleurotomella Packardii*, ♂, p. 453. uncini from the original specimen. x 250.
- Figure 6.—*Bela Gouldii*, p. 463. x 3.
- Figure 6a.—*Bela Gouldii*, p. 465. uncini. x 75.
- Figure 7.—*Bela hebes* V., p. 459. x 4.
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ERRATA.

- Page 5, line 26, for *Tanystylum*, read *Tanystylum*.
Page 37, line 6 from bottom, for *cineria*, read *cinerea*.
Page 55, line 11, for *Situata*, read *Scituata*.
Page 55, line 16, for *S. stiryachus*, read *A. steirynchus*.
Page 55, line 20; p. 61, line 12 from bottom; p. 70, line 3 from bottom; p. 91, line 5 from bottom; p. 92, line 6 from bottom, and elsewhere, for *Æfversigt*, read *Æfversigt*.
Page 60, line 26; and p. 70, line 19, for east-south-east, read west-south-west.
Page 61, line 6 from bottom, for *Mere*, read *Meere*.
Page 69, line 9 from bottom, for *Tynside*, read *Tyneside*.
Page 103, line 11, for *mixta*, read *stenolepis*.
Page 106, line 16, for *Lophosetta*, read *Lophopselta*.
Page 135, line 19, for *Kiebsdyrfamilien*, read *Krebsdyrfamilien*.
Page 136, last line of errata, for 129, read 120.
Page 259, line 1, for VI, read V.
Page 432, line 10, for *hyperboreus*, read *hyperborea*.
Page 496, lines 14 and 17, for *pygmaeus*, read *pygmaea*.
Page 501, line 4 of note, for *Bernicensis*, read *Berniciensis*.
Page 504, line 22, for *lamallæ*, read *lamellæ*.
Page 507, end of line 10, of note, for *i*, read ,.
Page 511, line 12, for *Pettit*, read *Petit*.
Page 512, line 3 from bottom, for *scalariforme*, read *scalariformis*.
Page 537, line 5 from bottom, for *equalis*, read *æqualis*.
Page 580, line 1, for *subvota*, read *subovata*.
Plate XLII for correct numbers indicating amount of amplification, see pp. 583, 584.
For other errata, see pp. 136, 253, 446.

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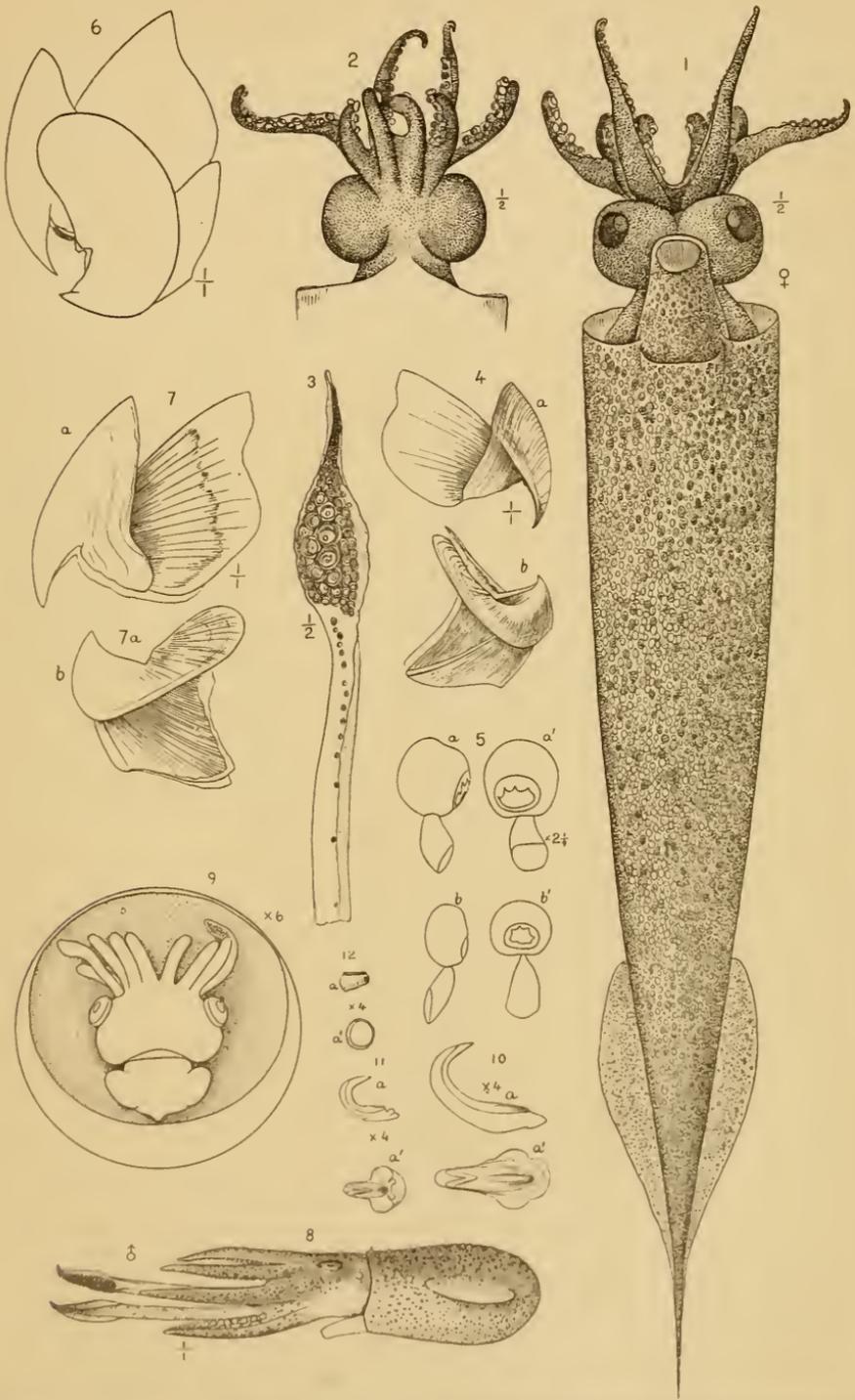
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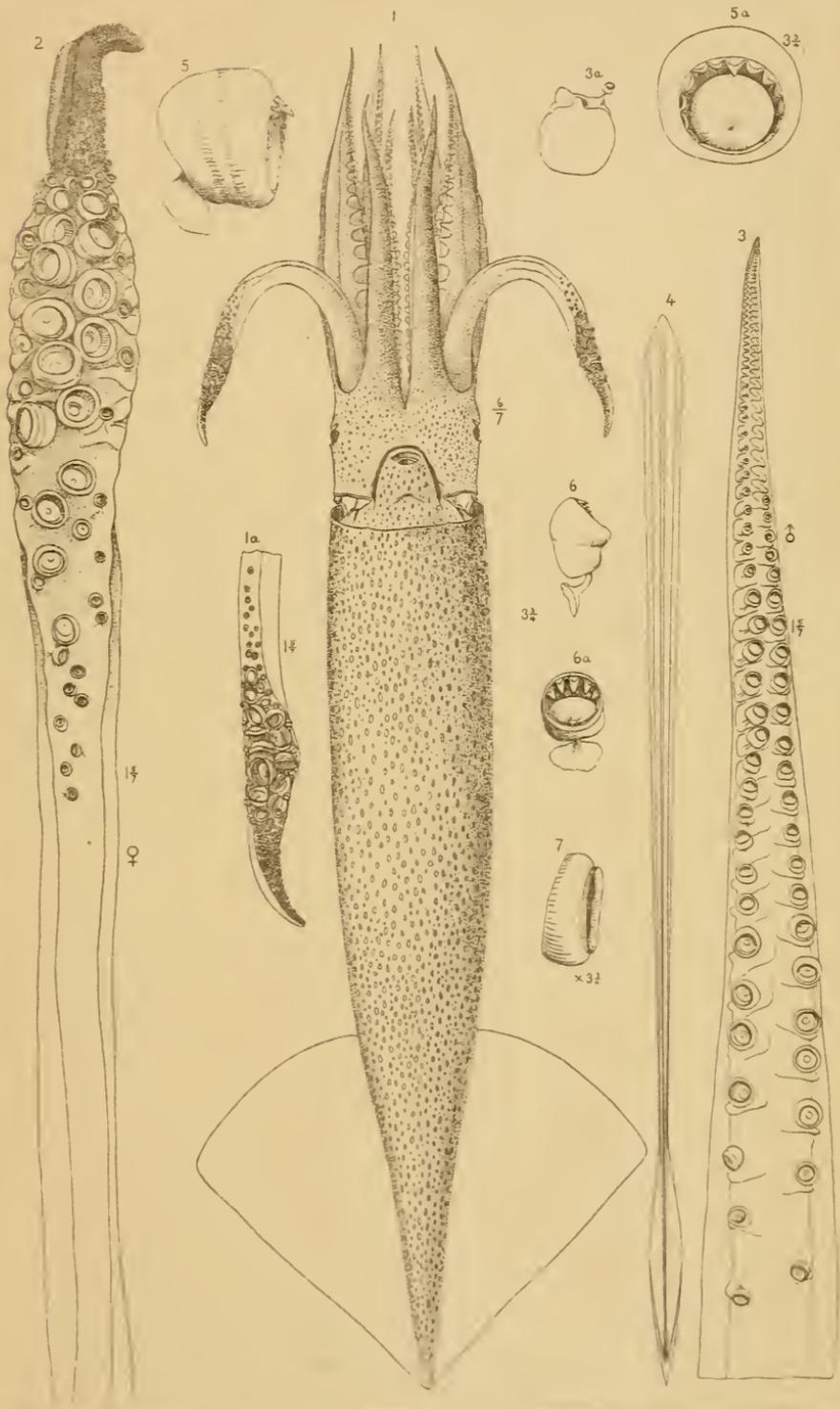
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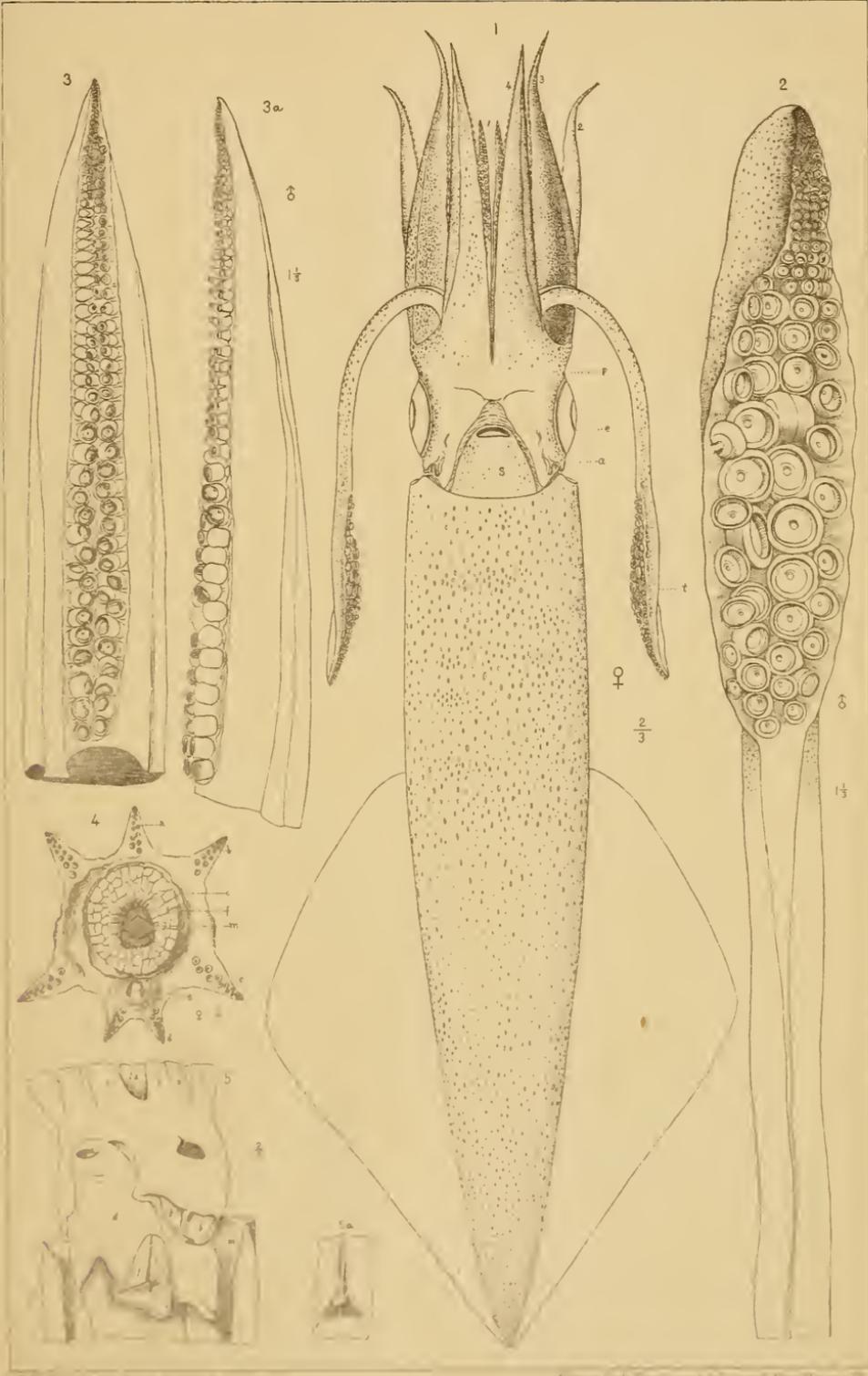




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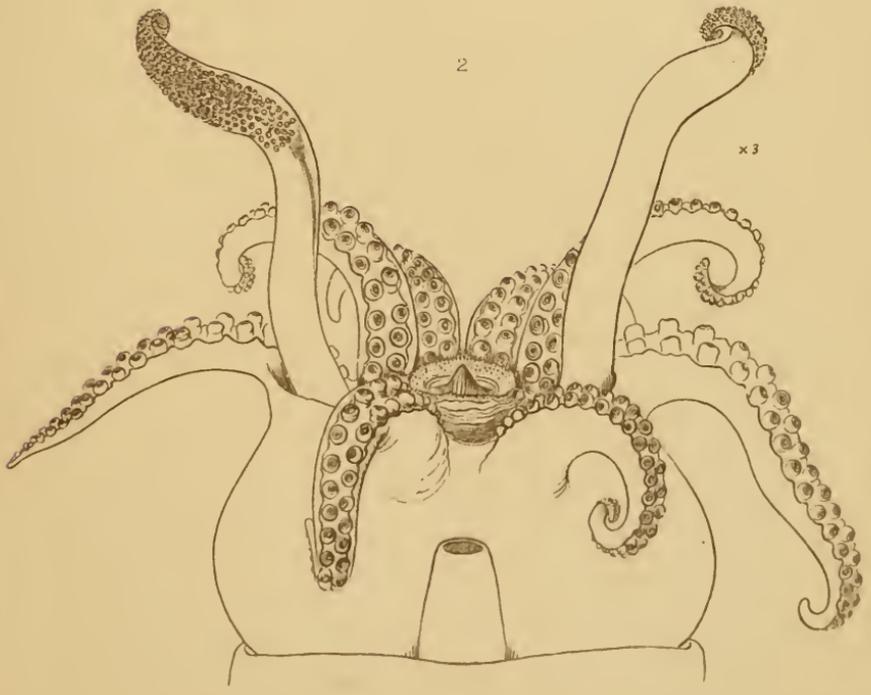
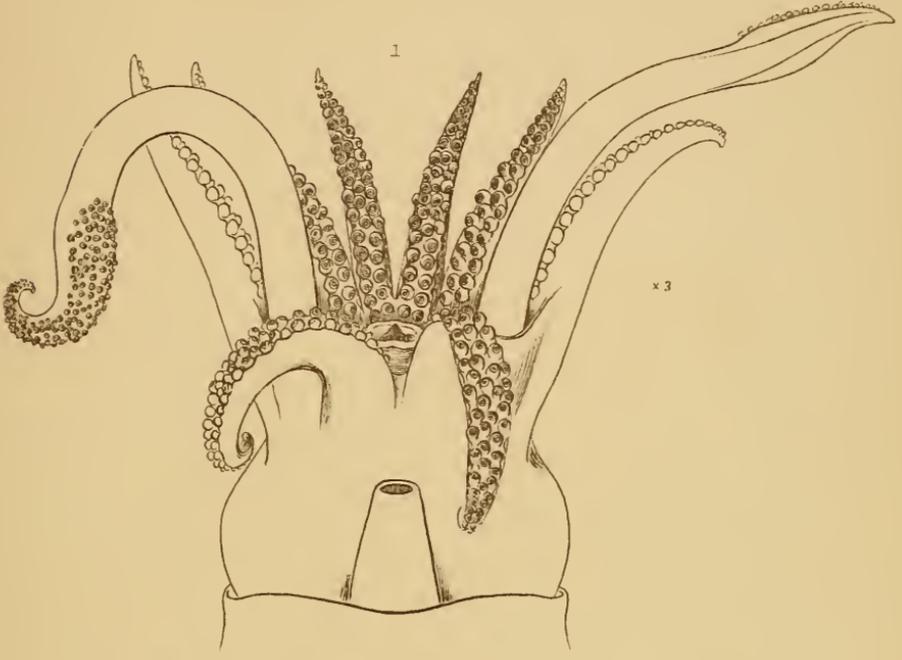
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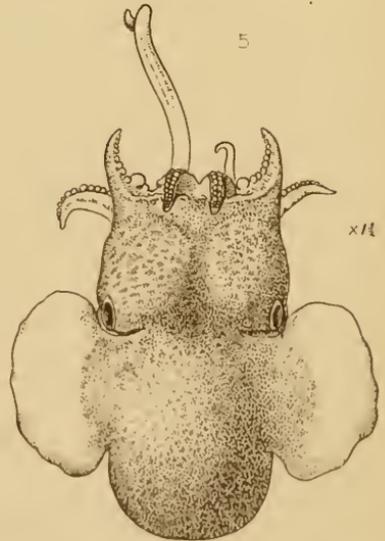
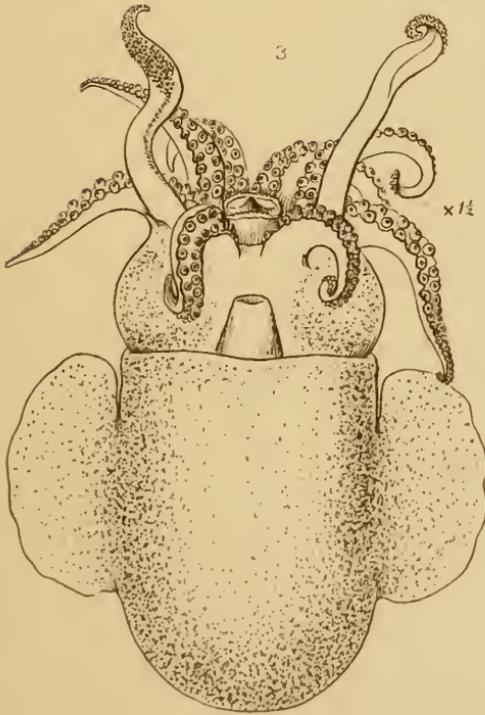
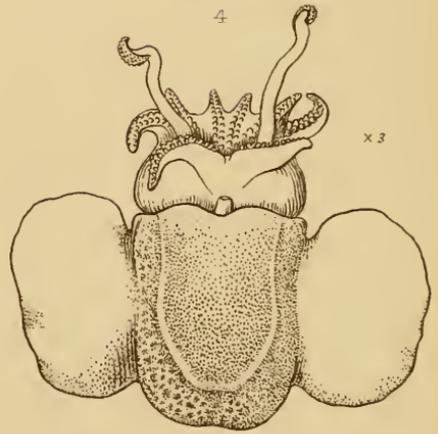
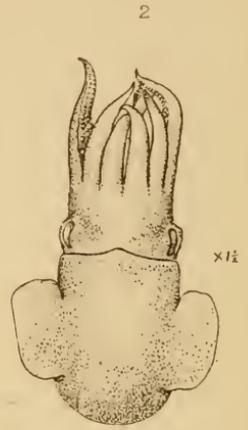
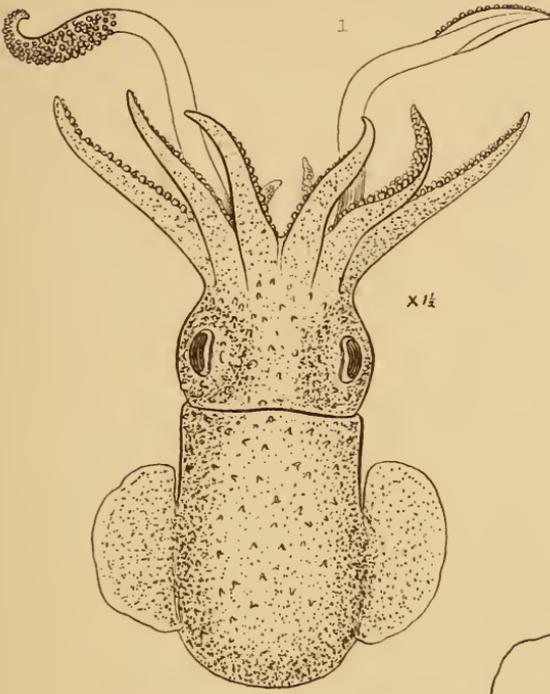
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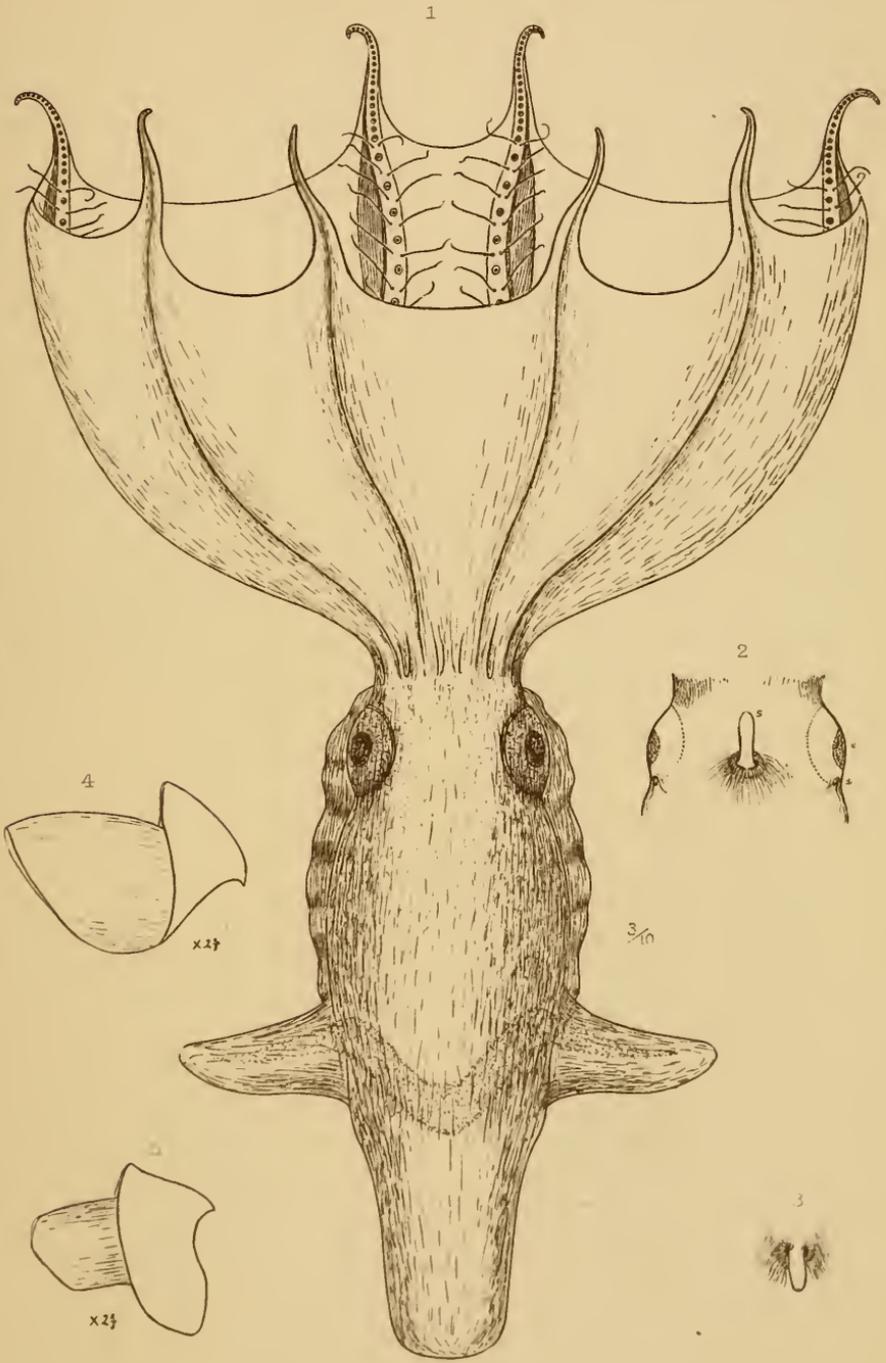


From Gilchrist and Howell, 'The Liver Fluke'

THE LIVER FLUKE AND UNMATURED STAGES



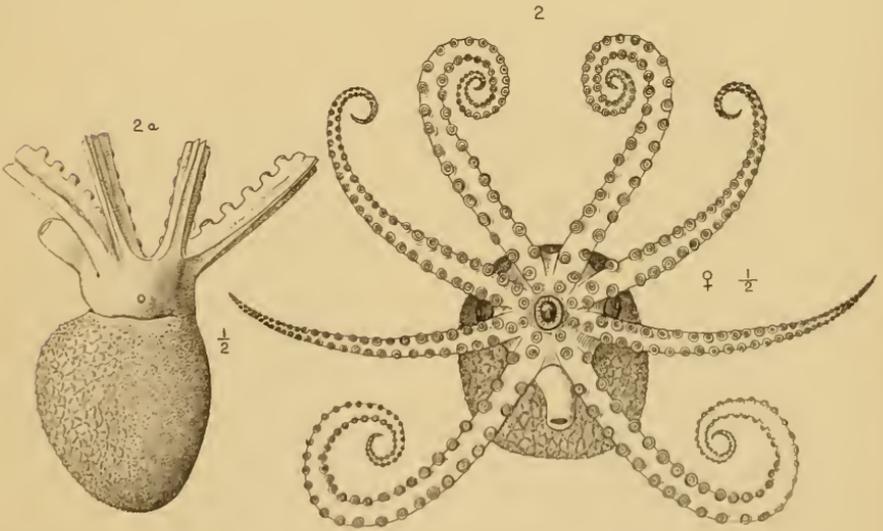
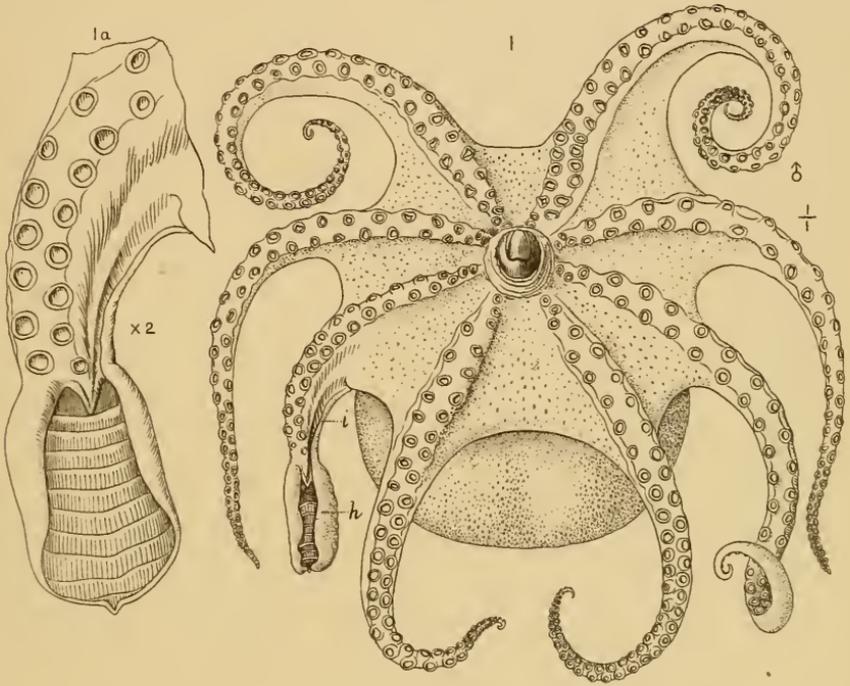




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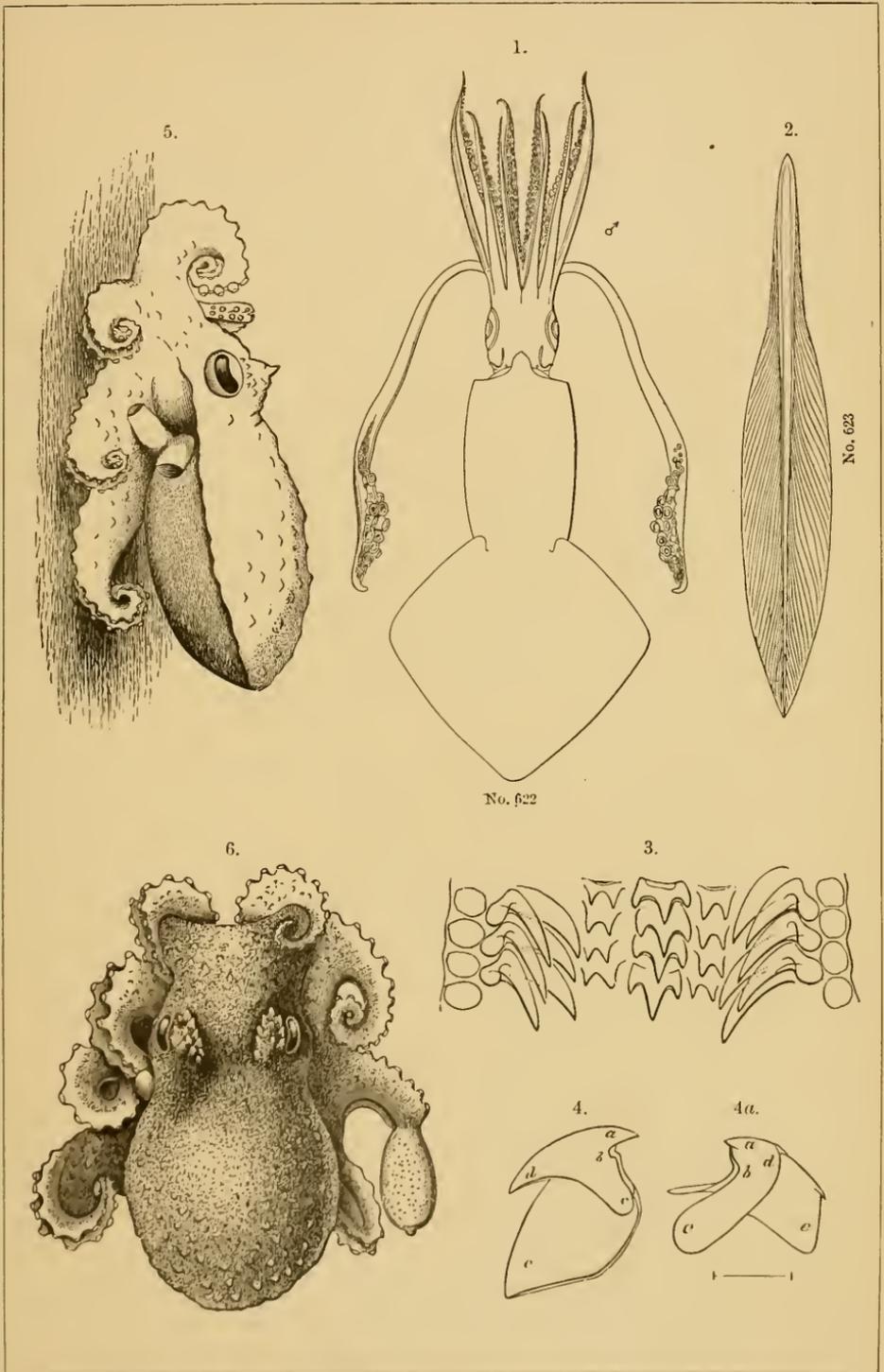
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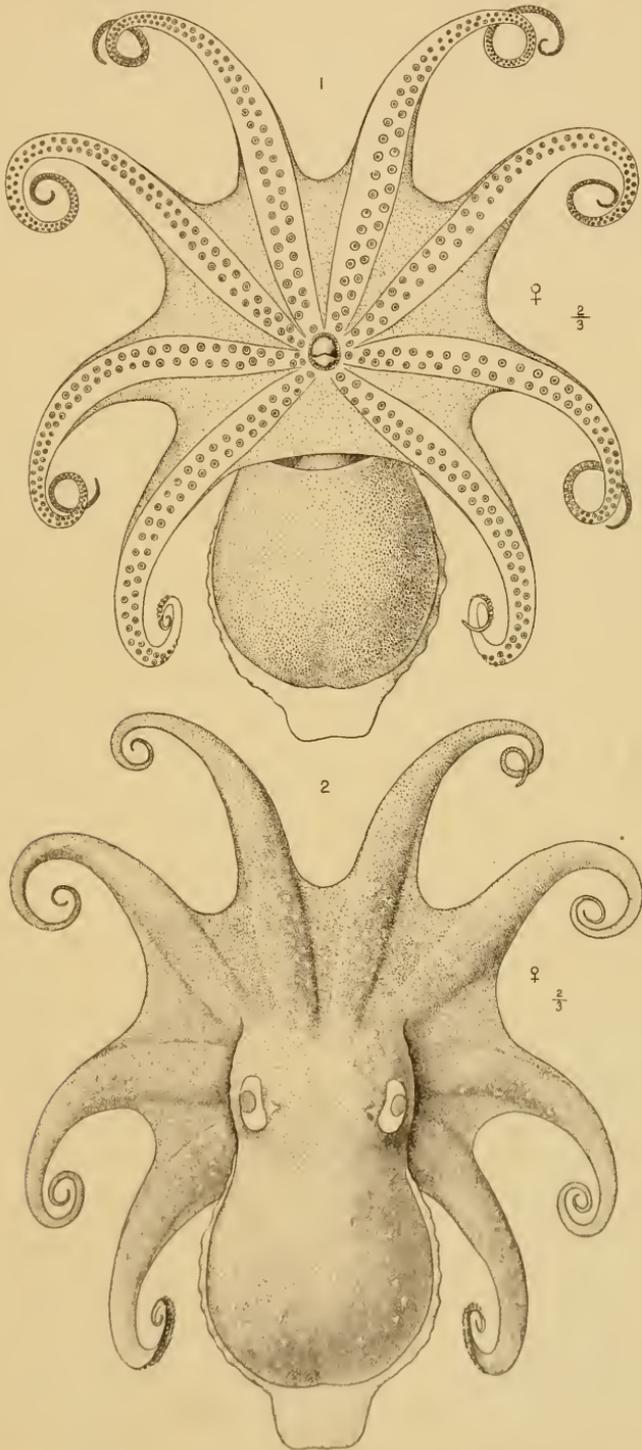
H. Baird from nature

Photo. L. du Fort from the collection of Dr. Ravenel

OCTOPUS BAIRDII V AND PARASTIRA CATENULATA ST.



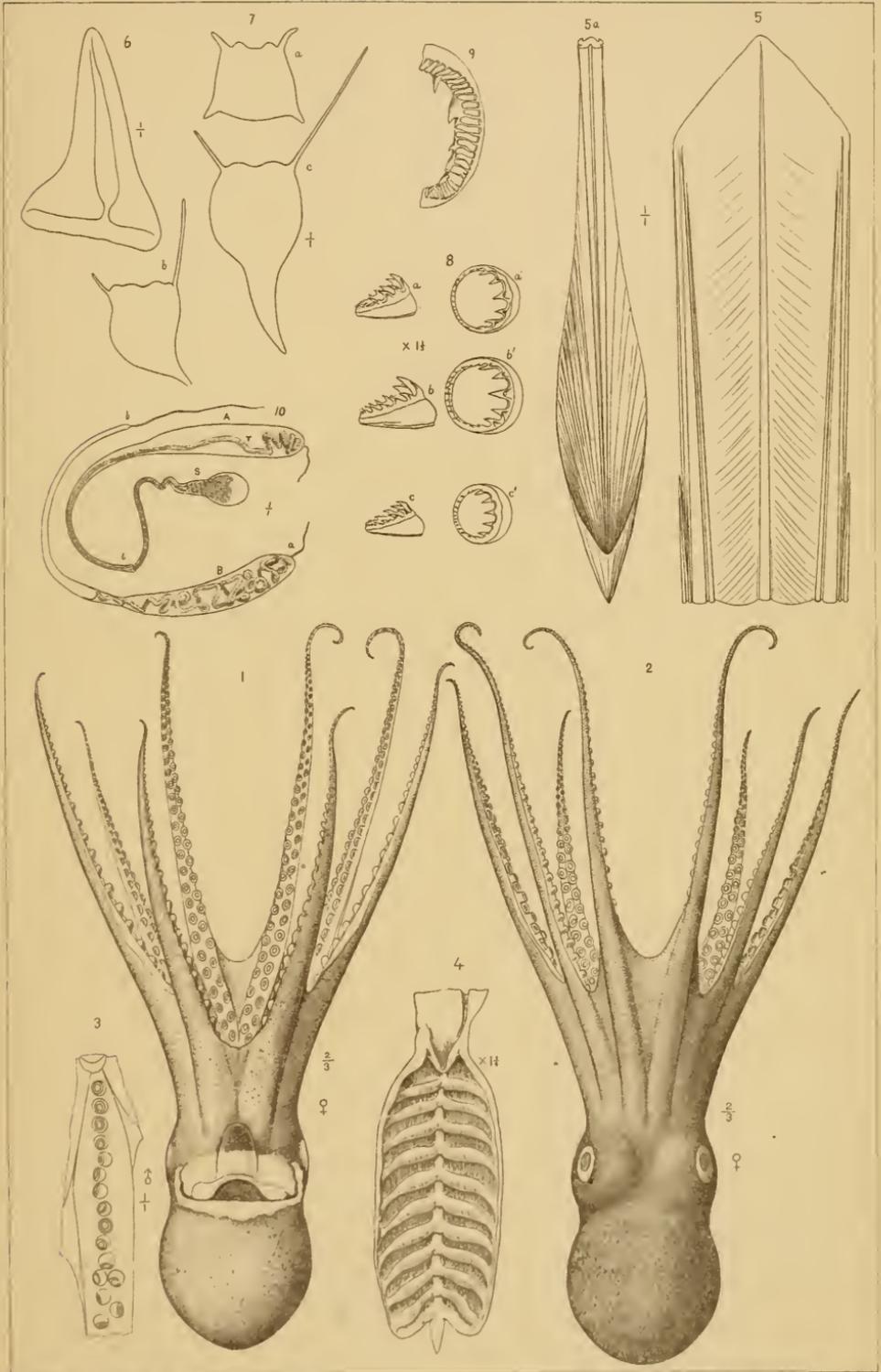
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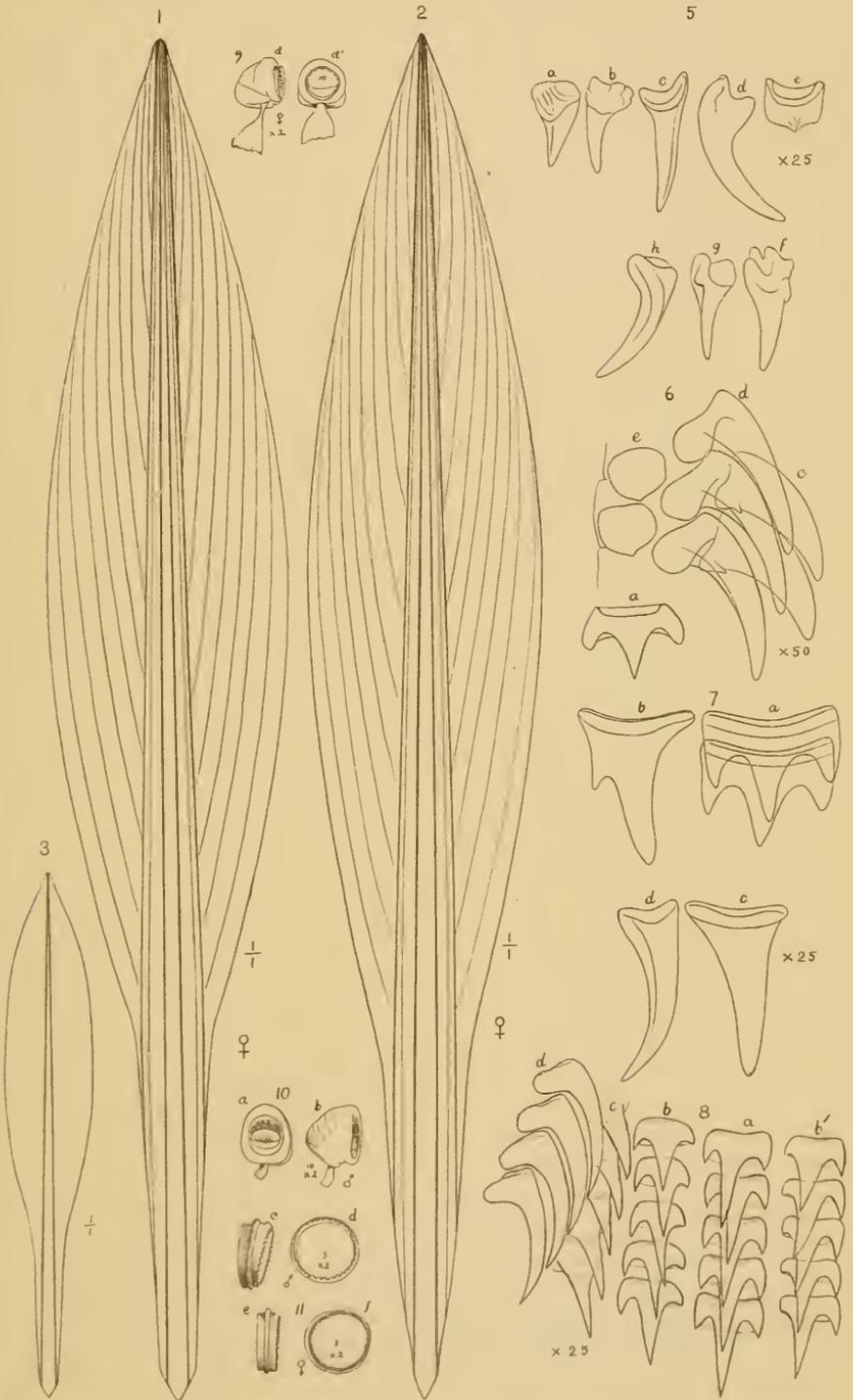
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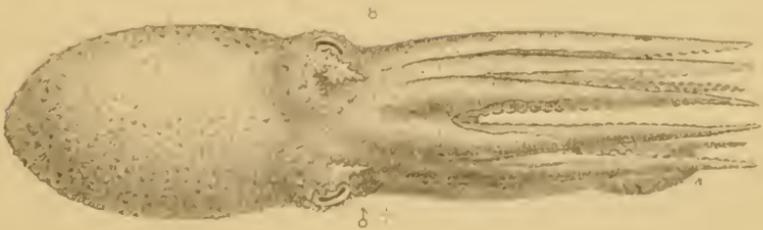
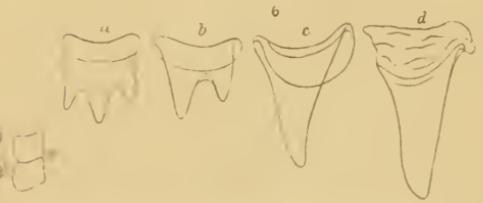
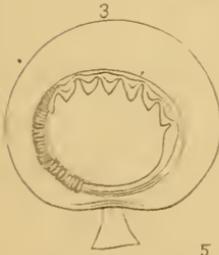
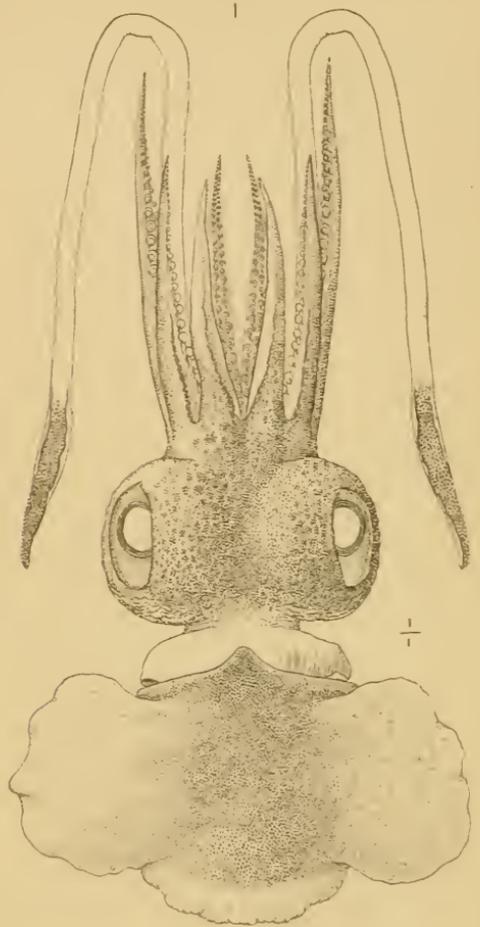
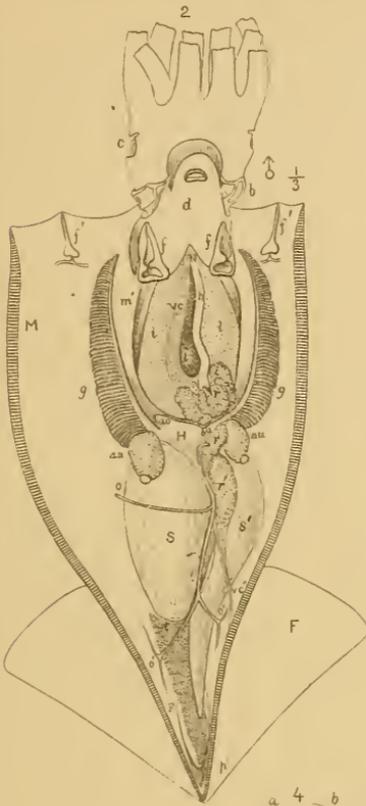
OCTOPUS LENTUS VERRILL.

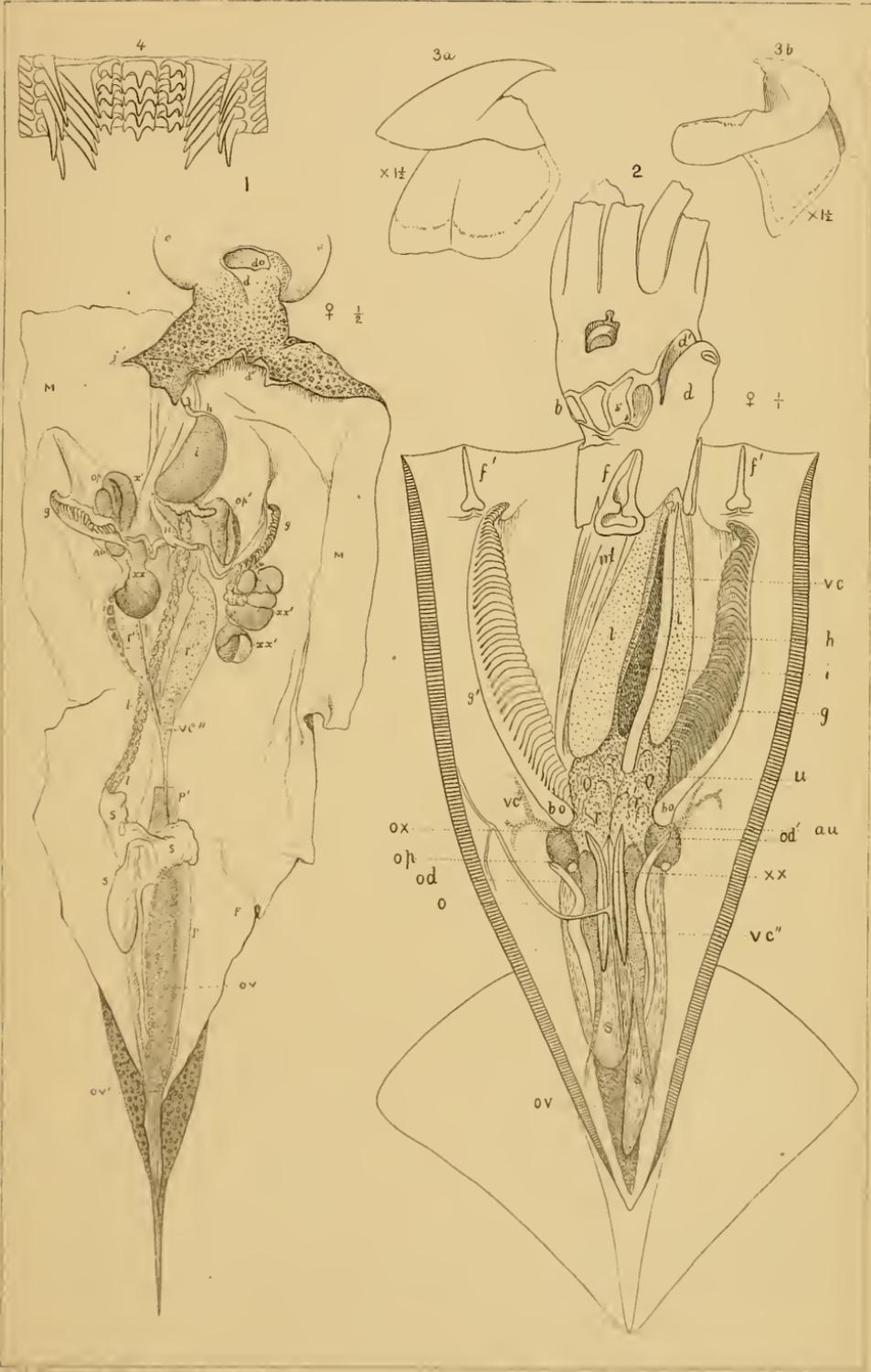


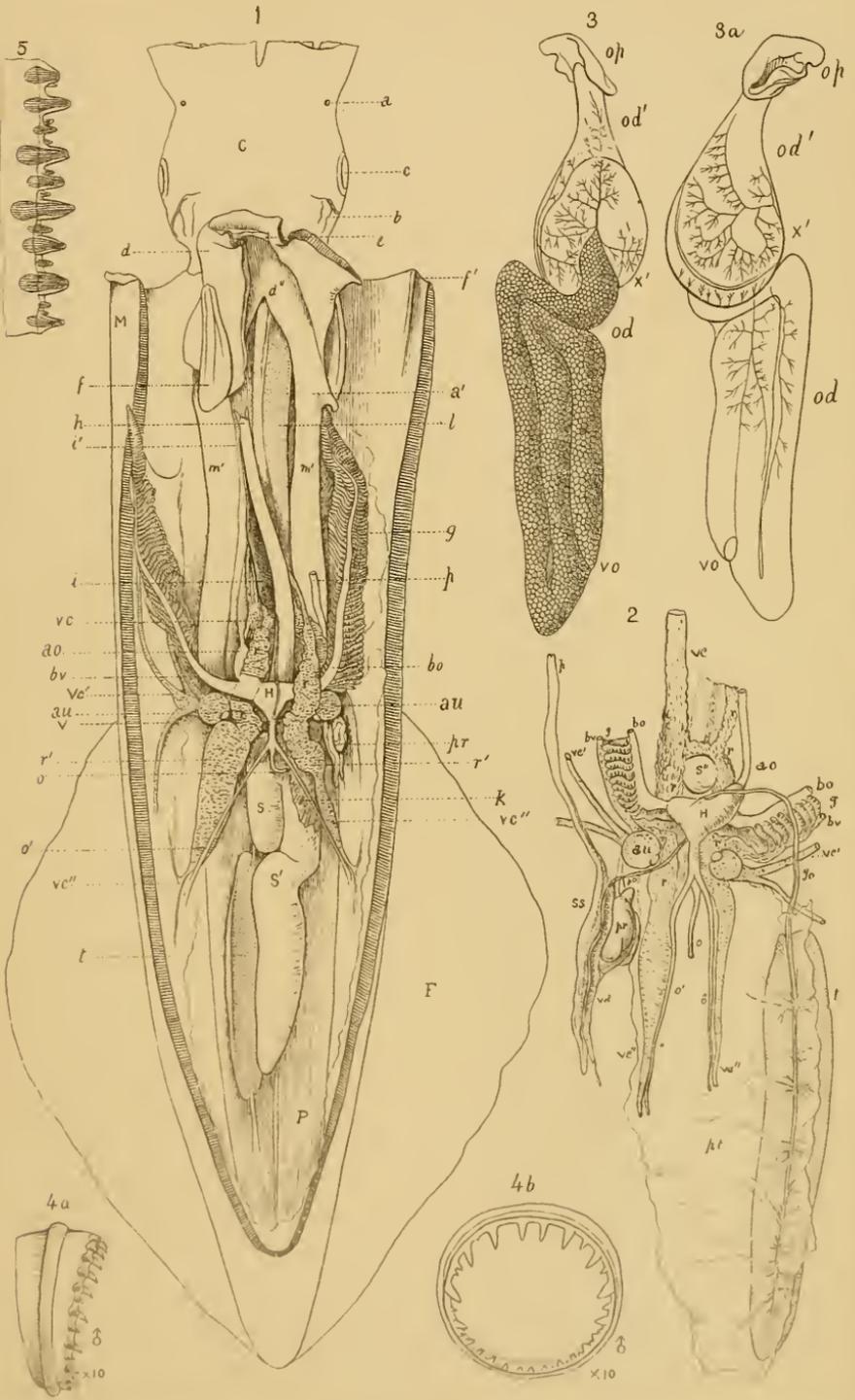
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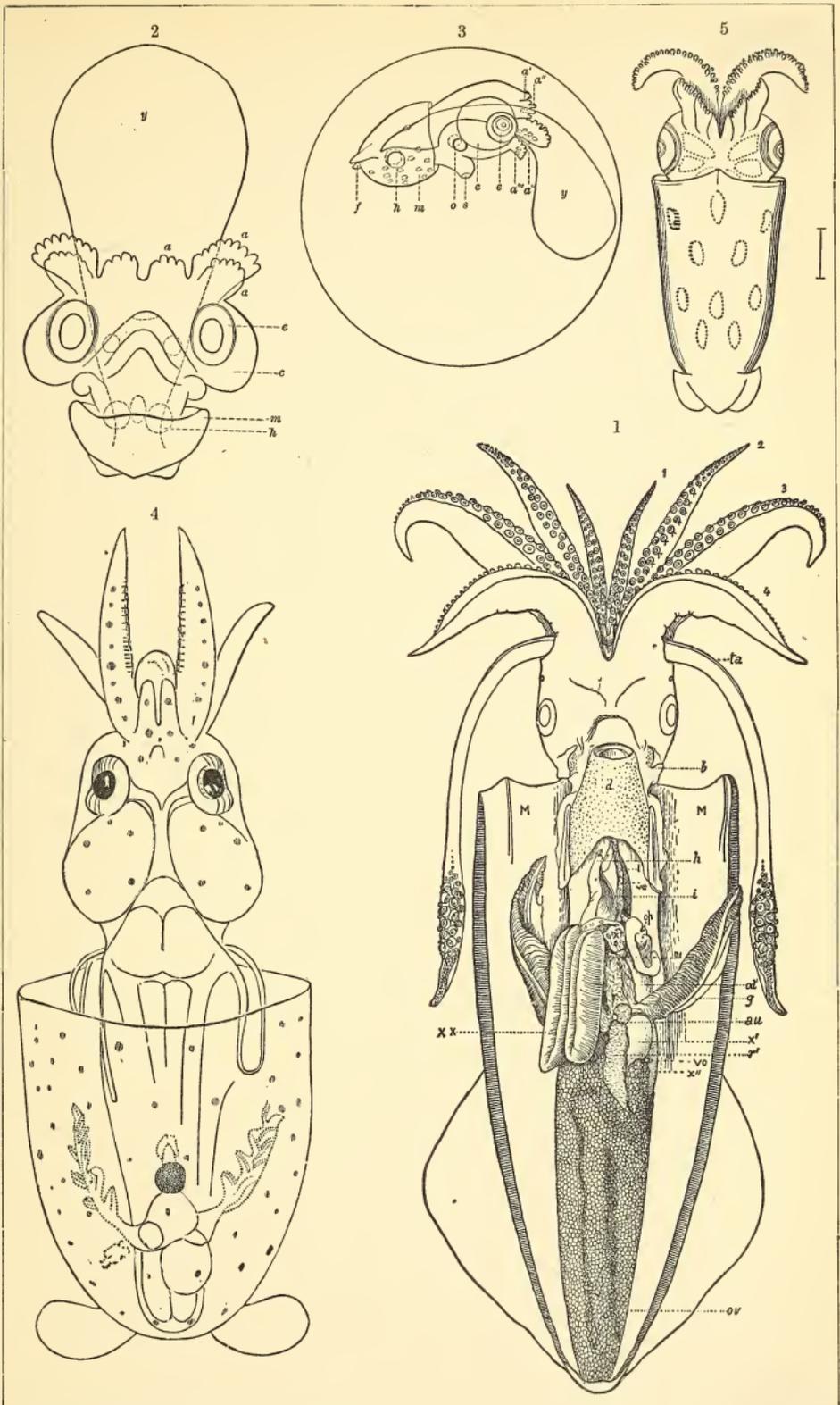






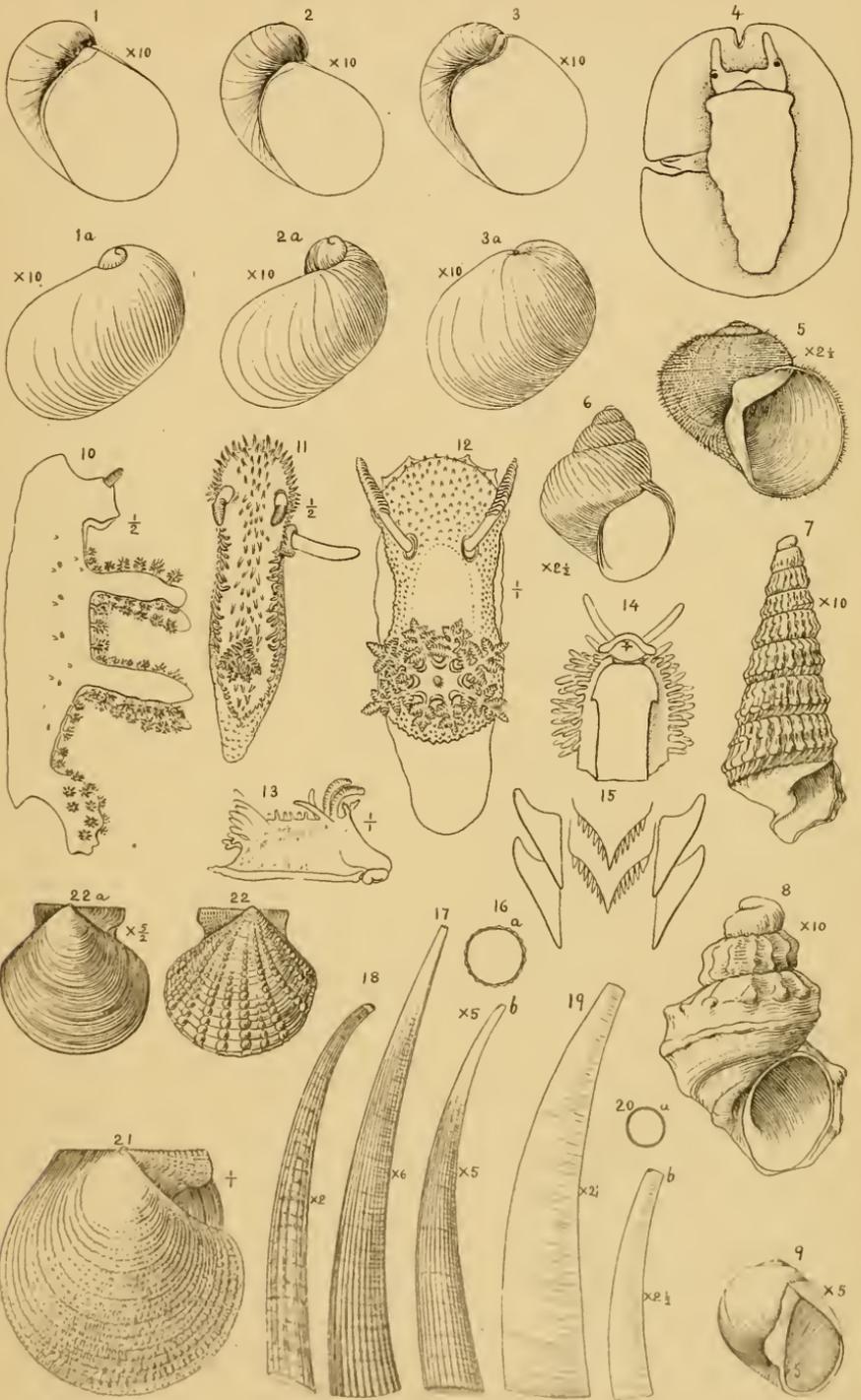


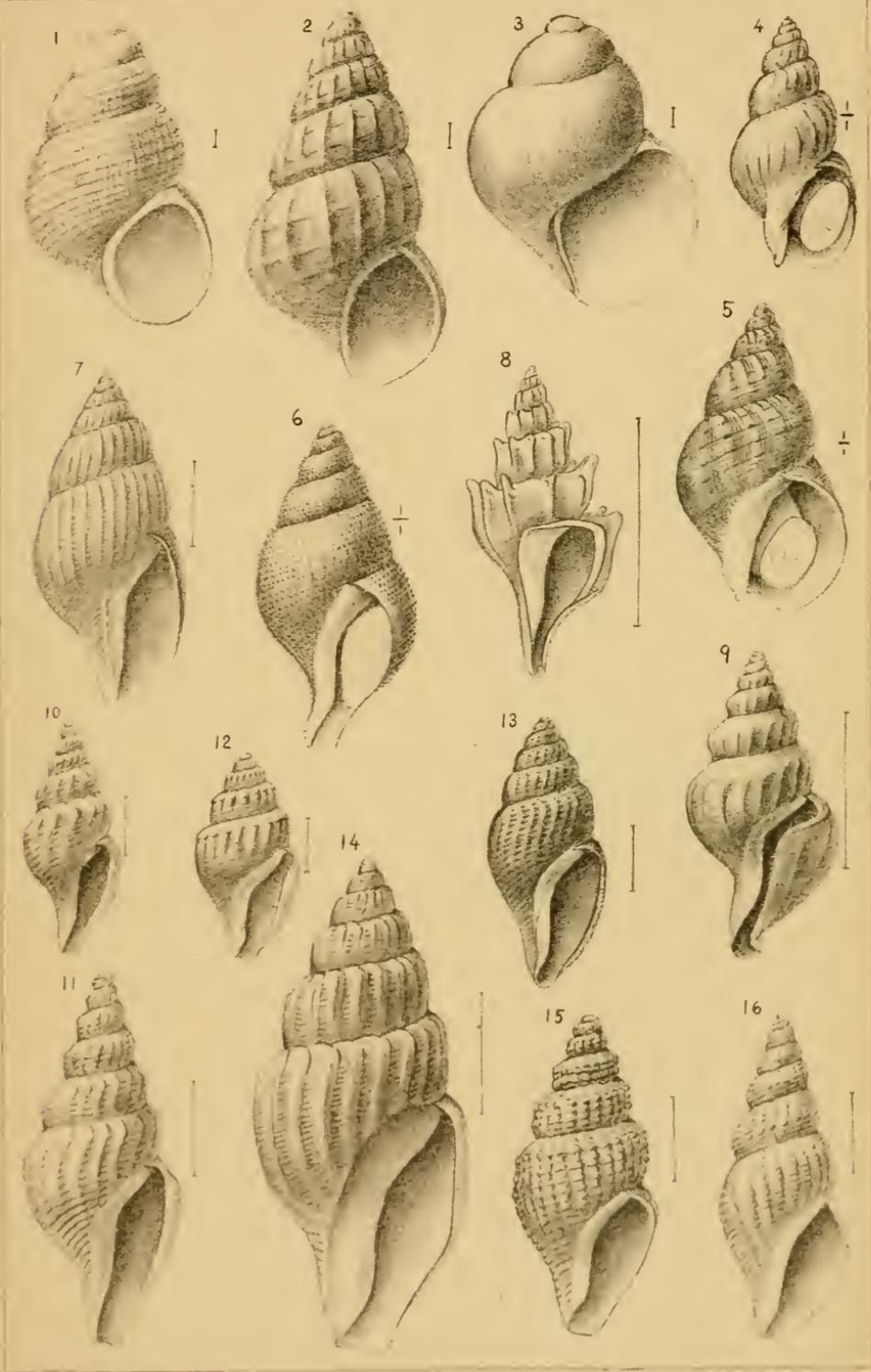




J. H. Emerton and A. E. Verrill, from nature.

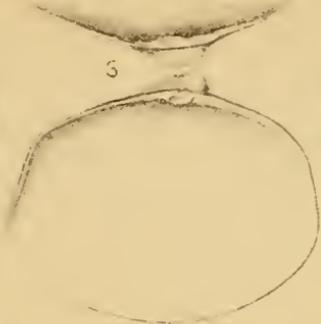
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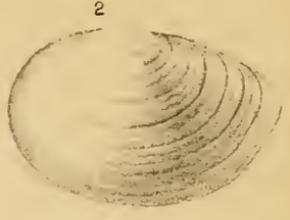




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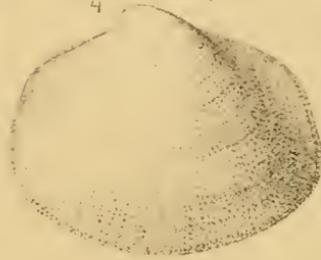


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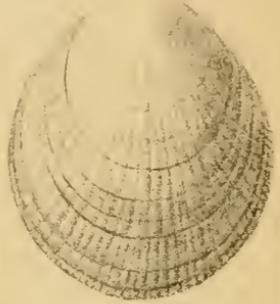
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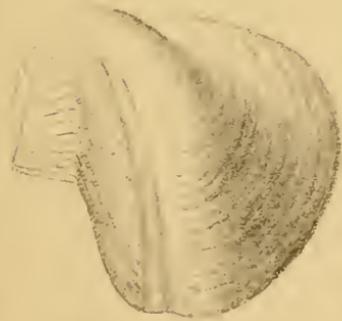


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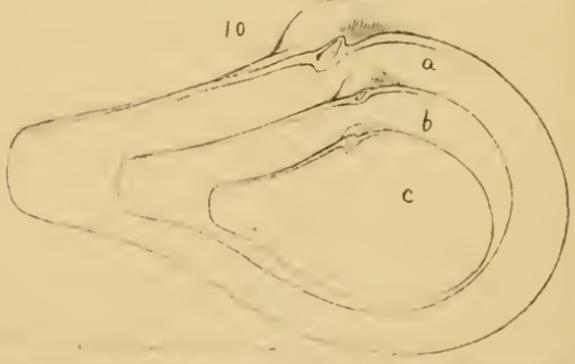
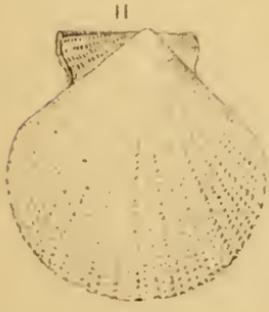
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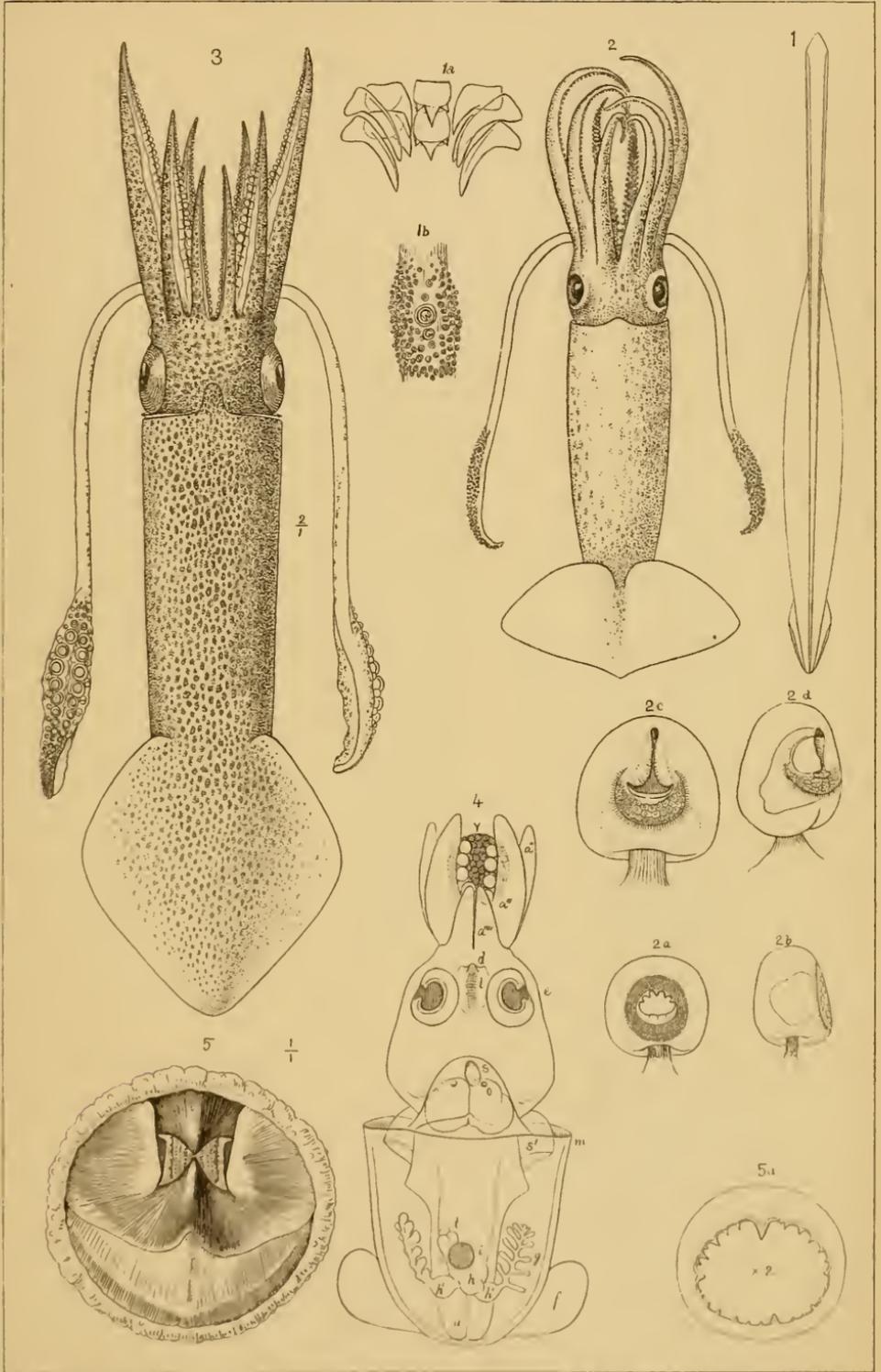


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J. H. Emerton, del.

PLATE XLV. SQUID. (See page 100.)

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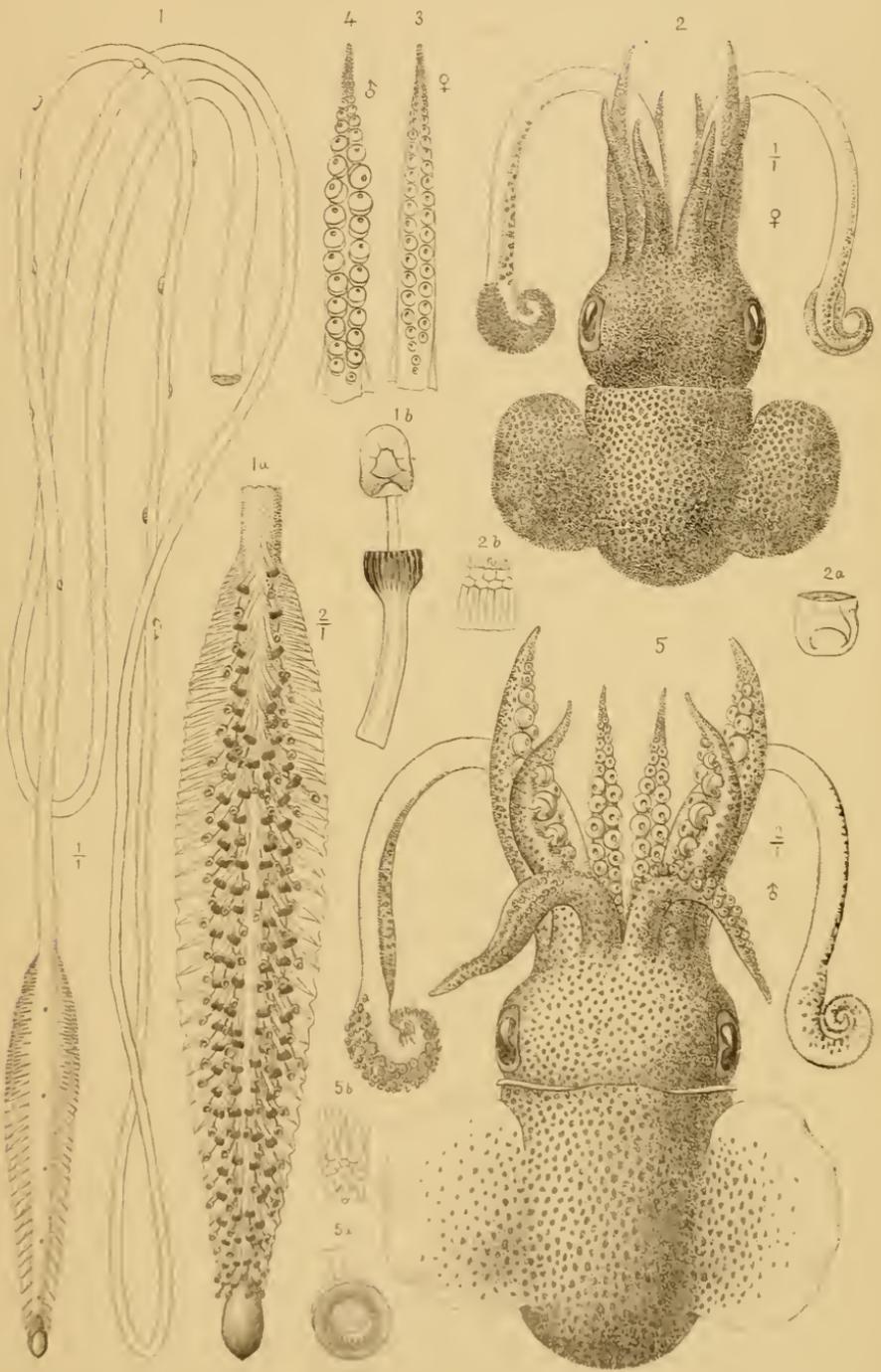
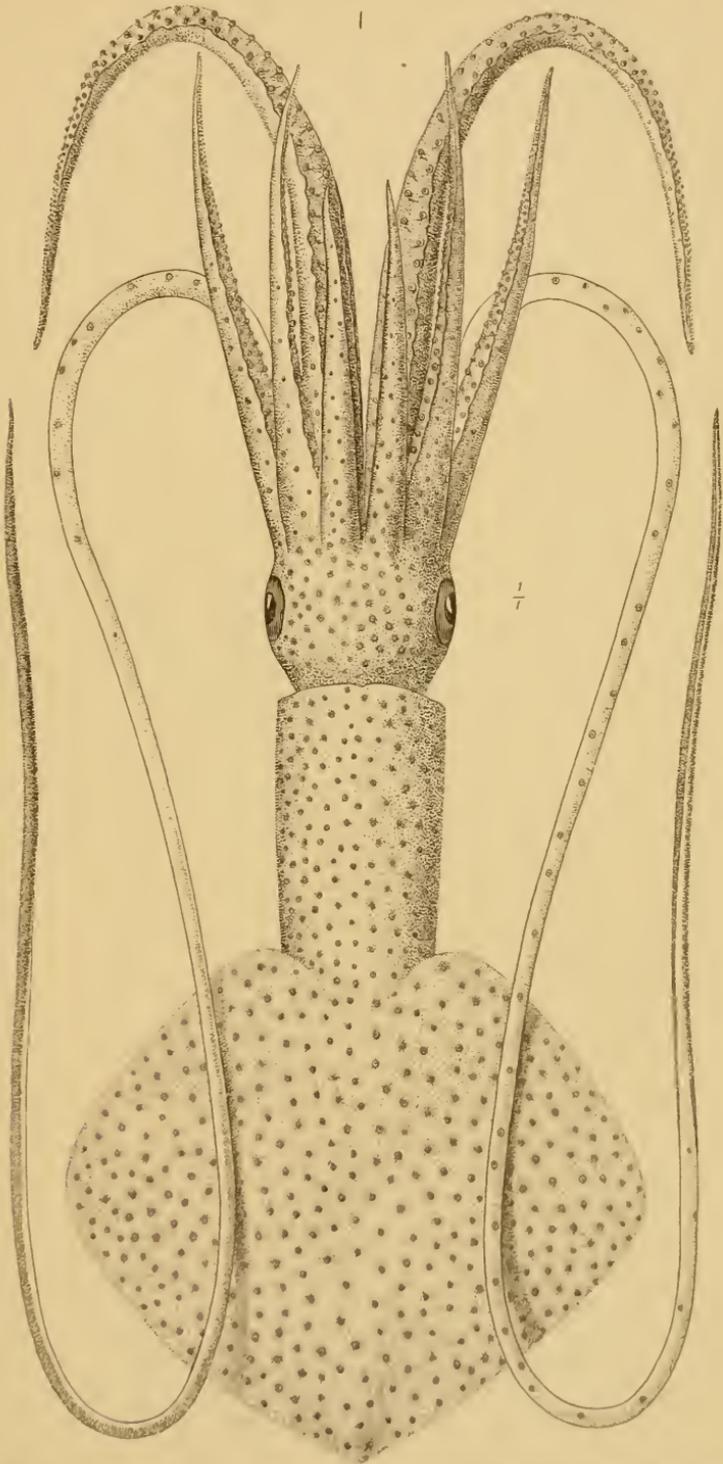
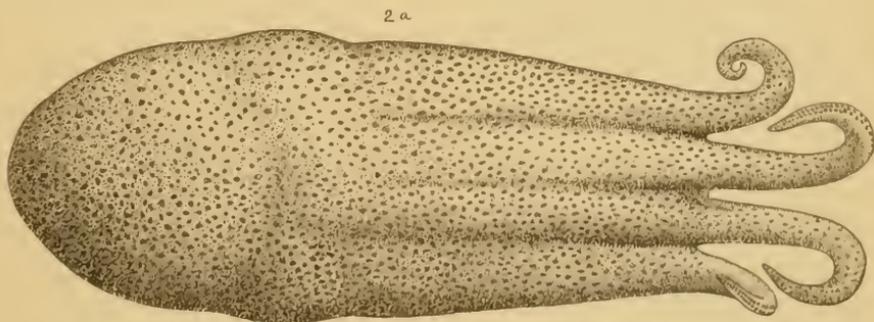
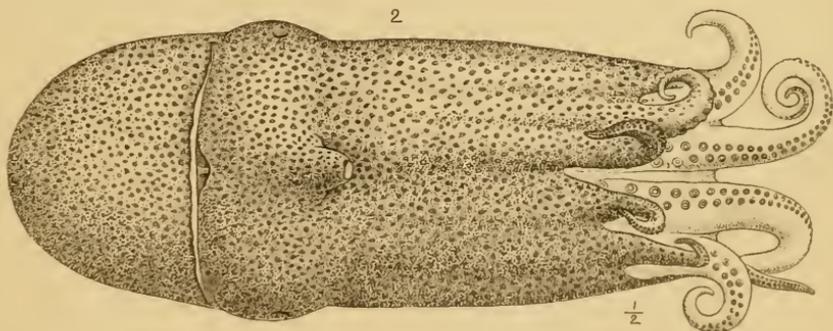
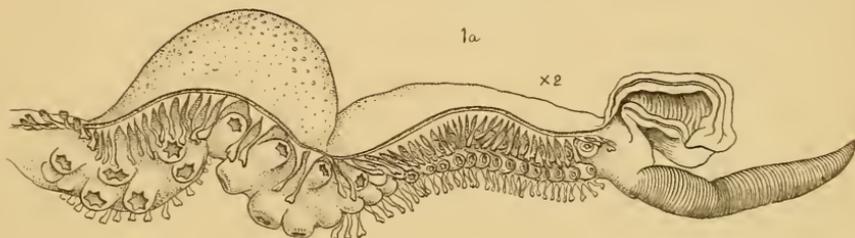
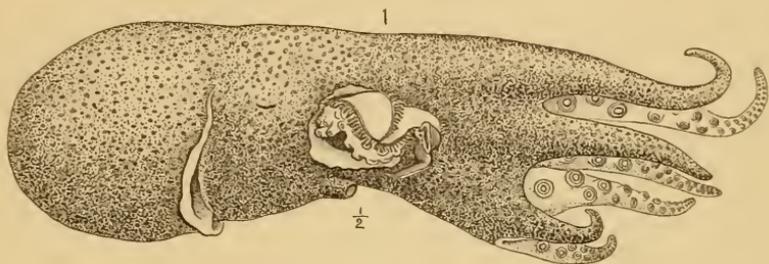


PLATE XLVII. *Chironomus tentus* (Fallén).

CHIRONOMUS TENTUS (FALLÉN) BOGGA SUBLEVIS HETTER. TENTUS TENETA

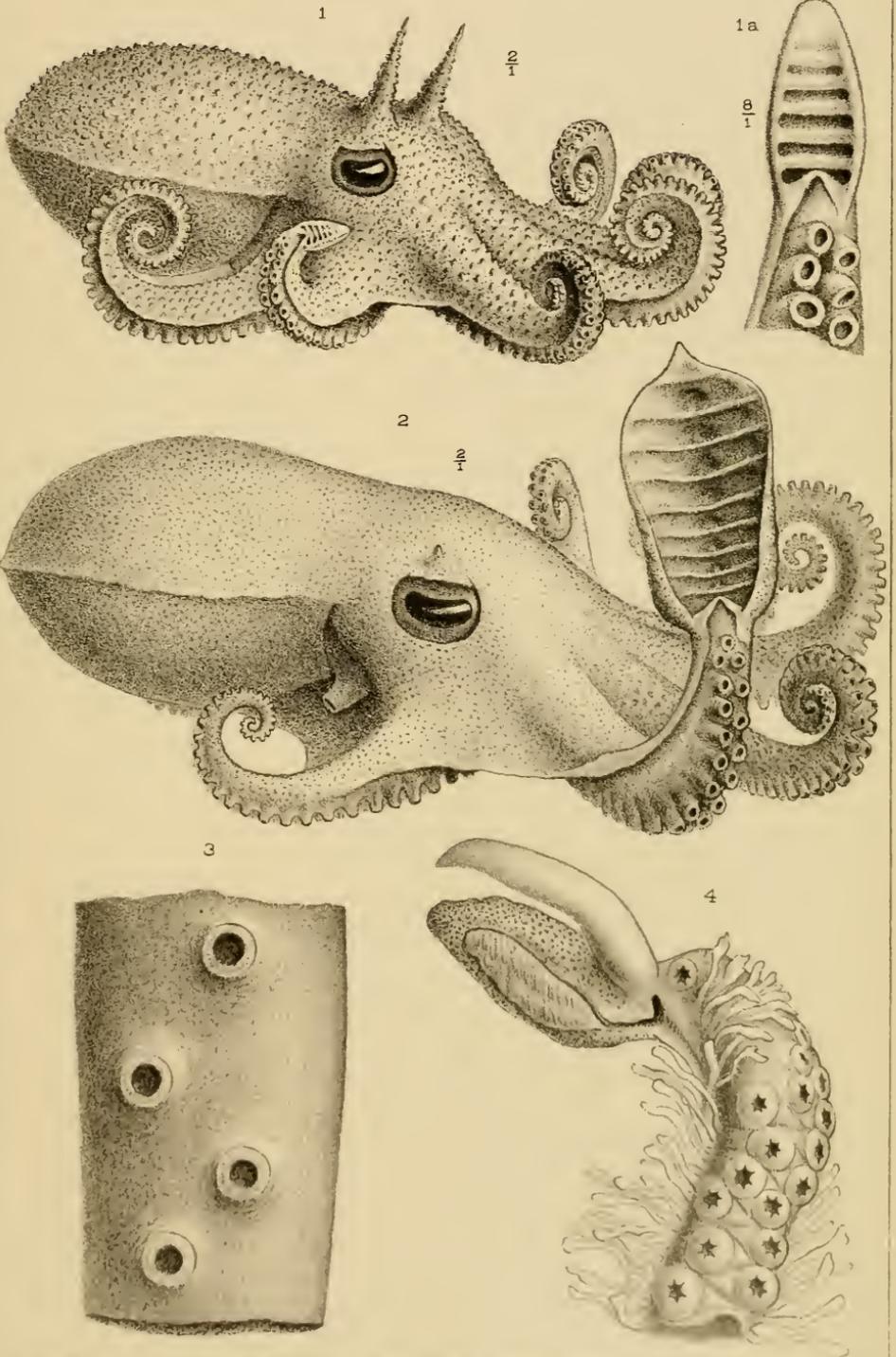


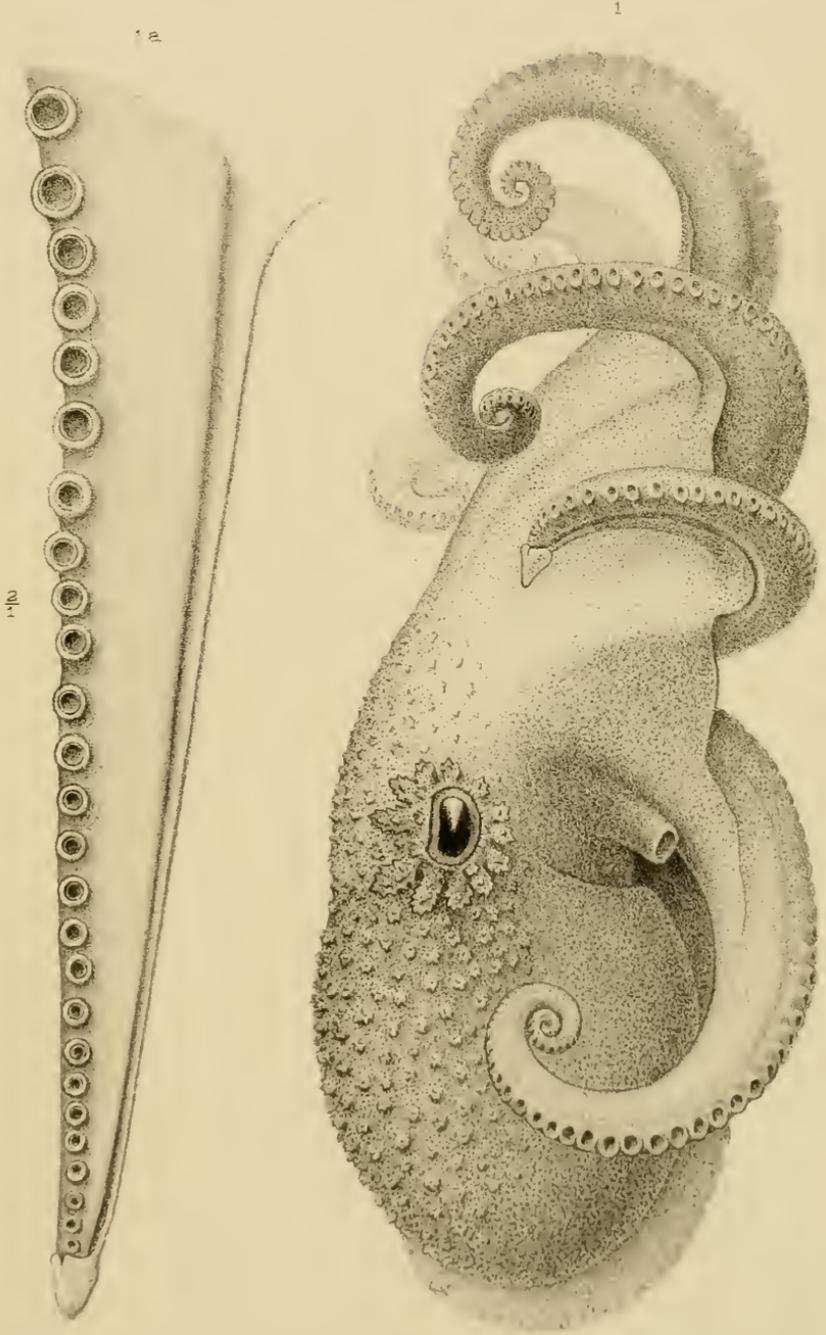


J. H. Emerton, from nature.

Plate L. 10th Period, Conn. Acad. Sci. New Haven, Ct.

ALLOPOSUS MOLLIS, VERRILL.

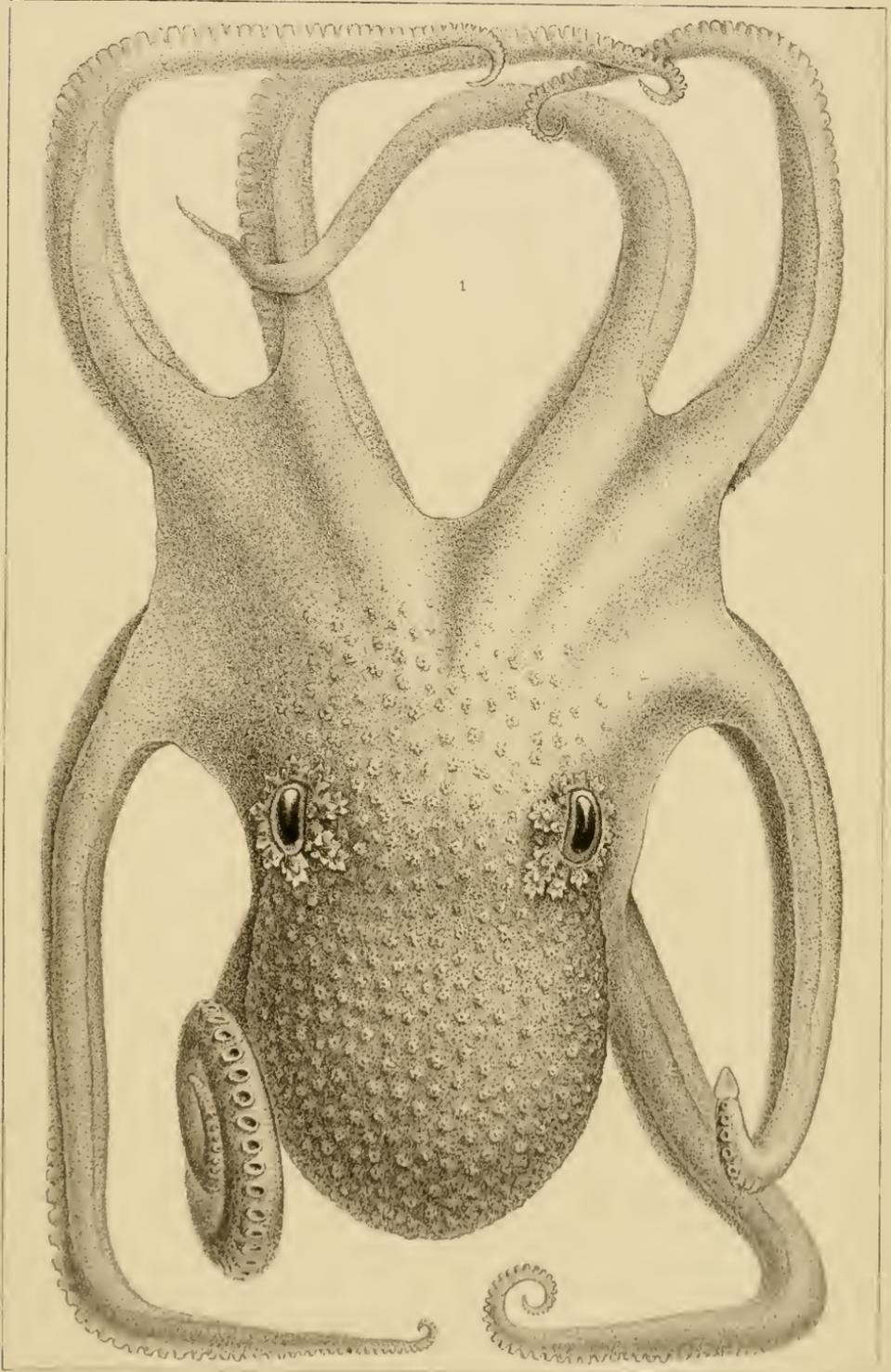




H. Eschscholtz from Eschscholtz

Eschscholtz, *Monographien* 2, Tafel 11

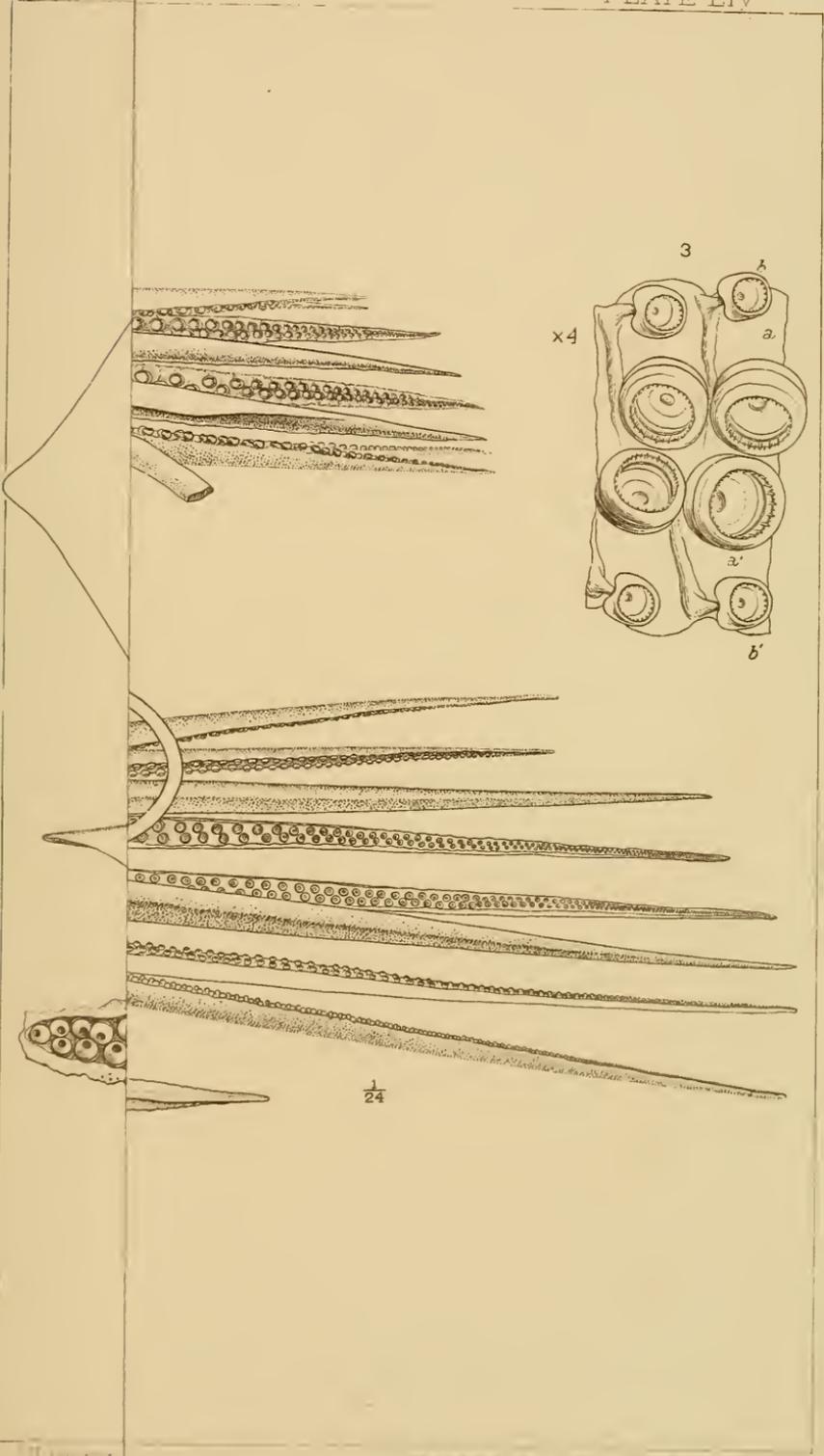
ESCHSCHOLTZ, *Monographien* 2, Tafel 11



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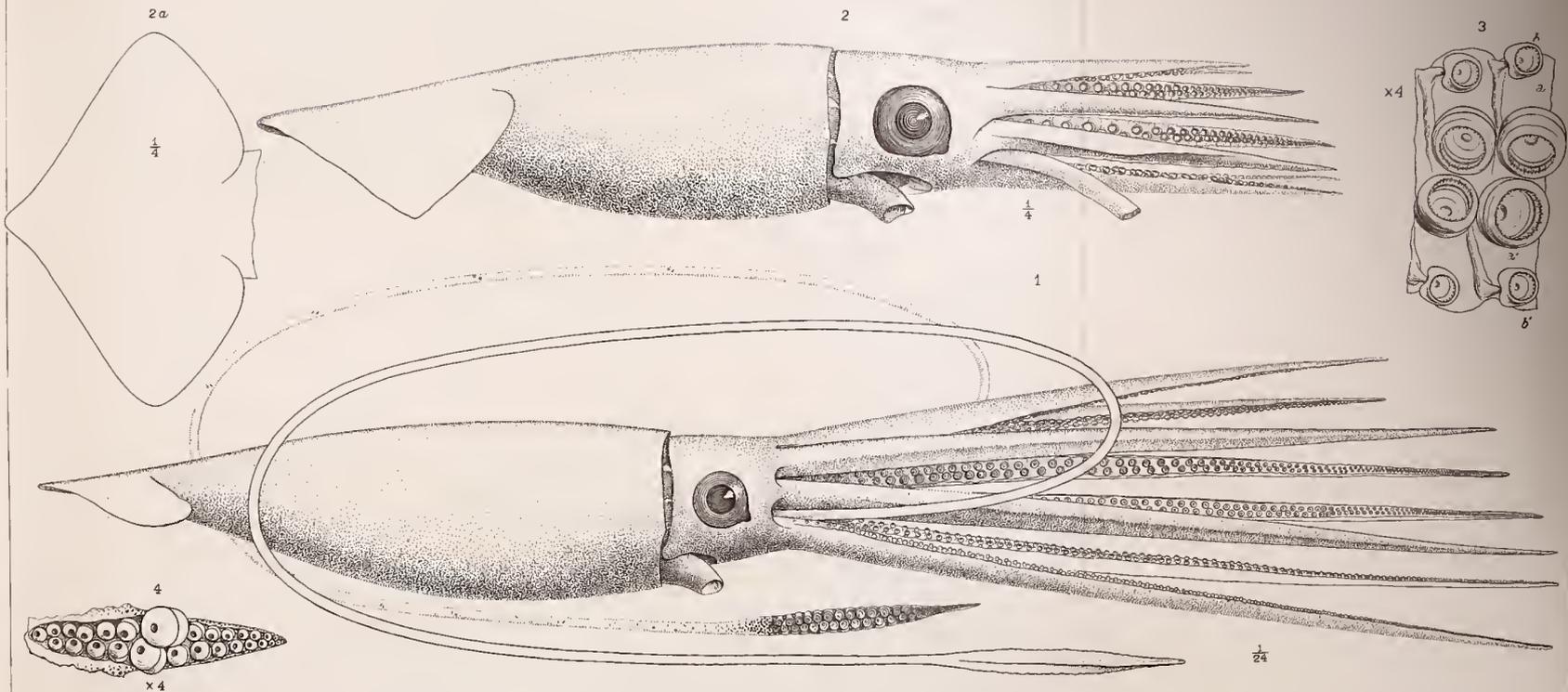
J. H. Emerton, from nature

PLECOGNE VERRUCOSA

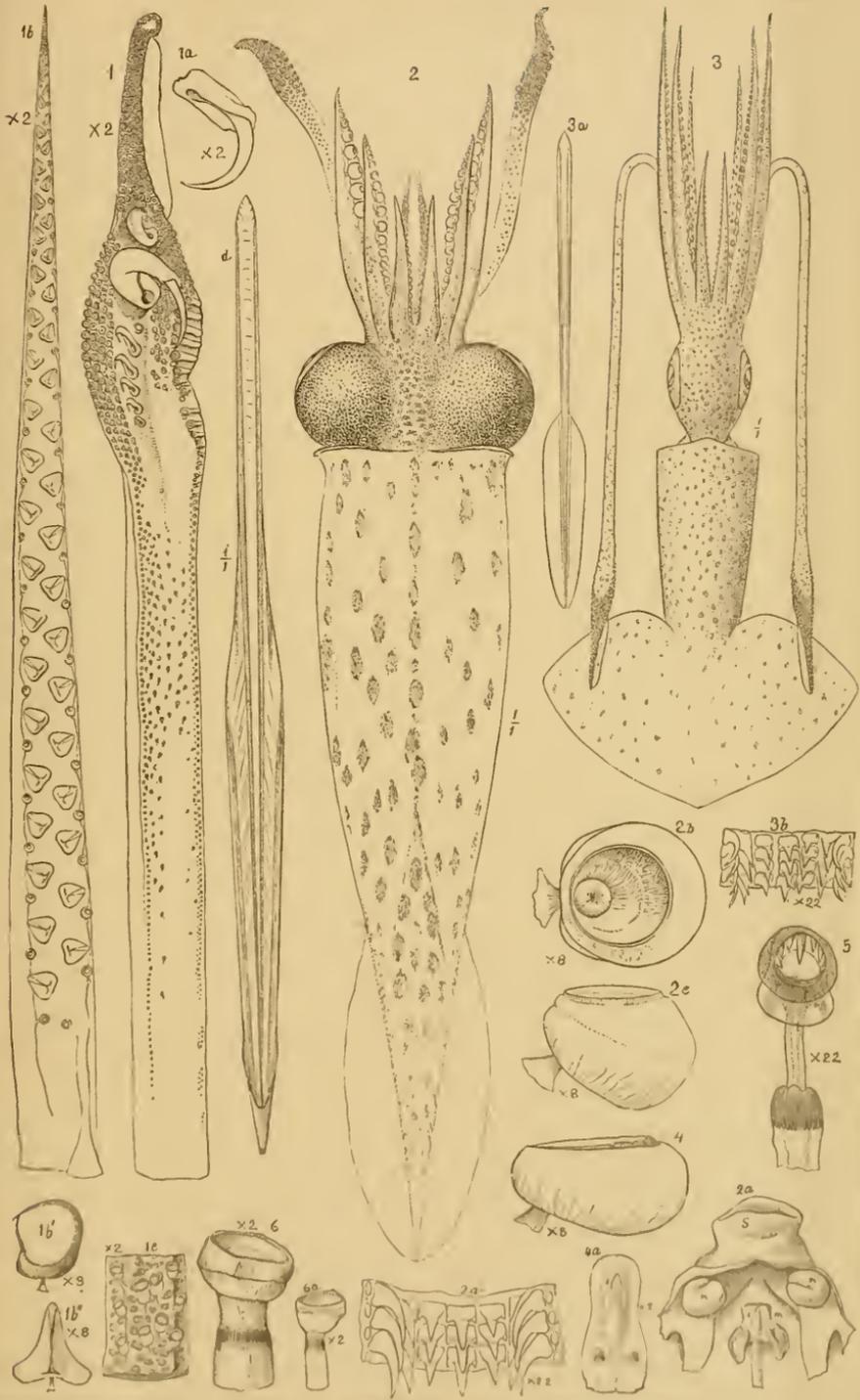


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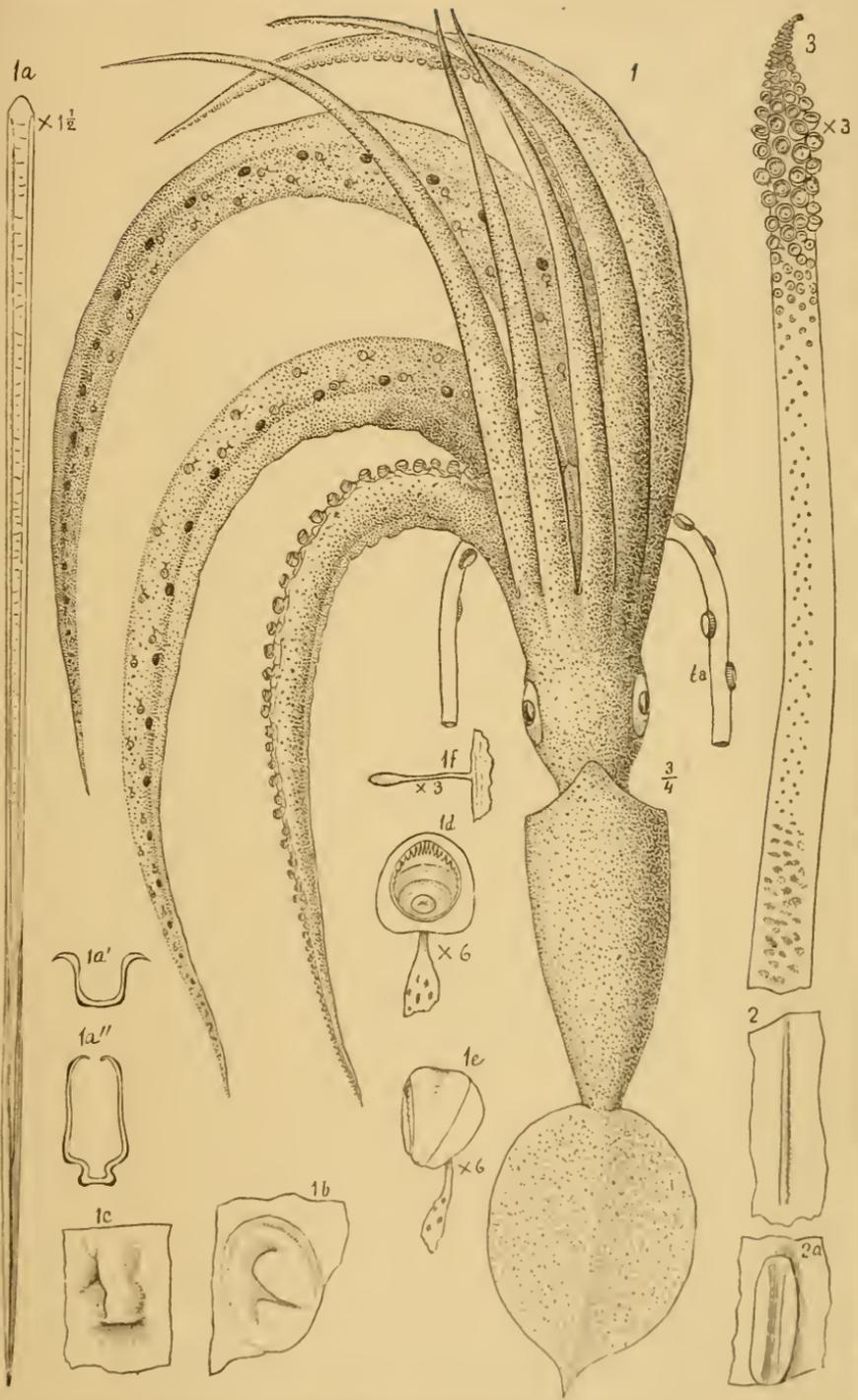
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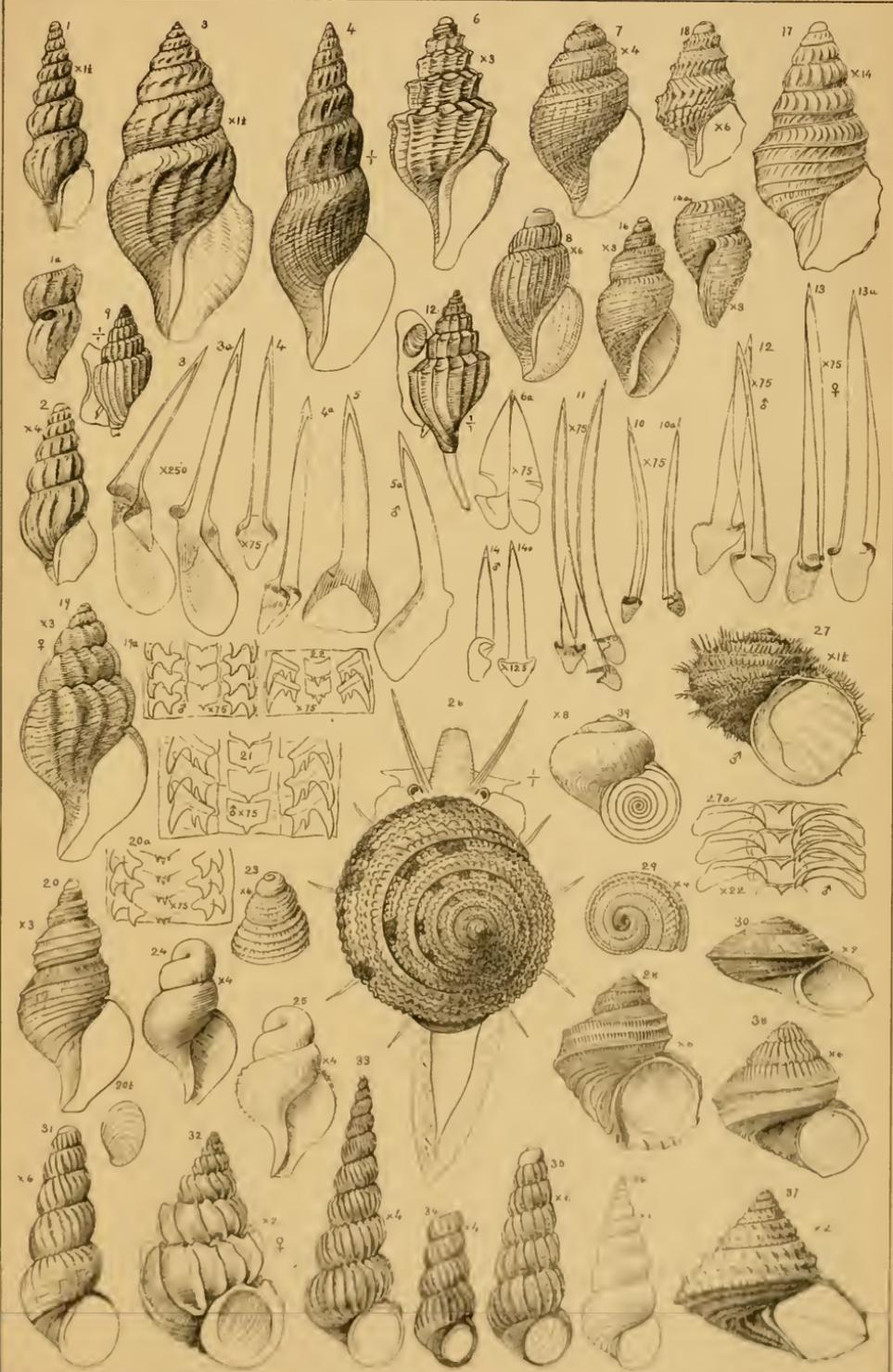


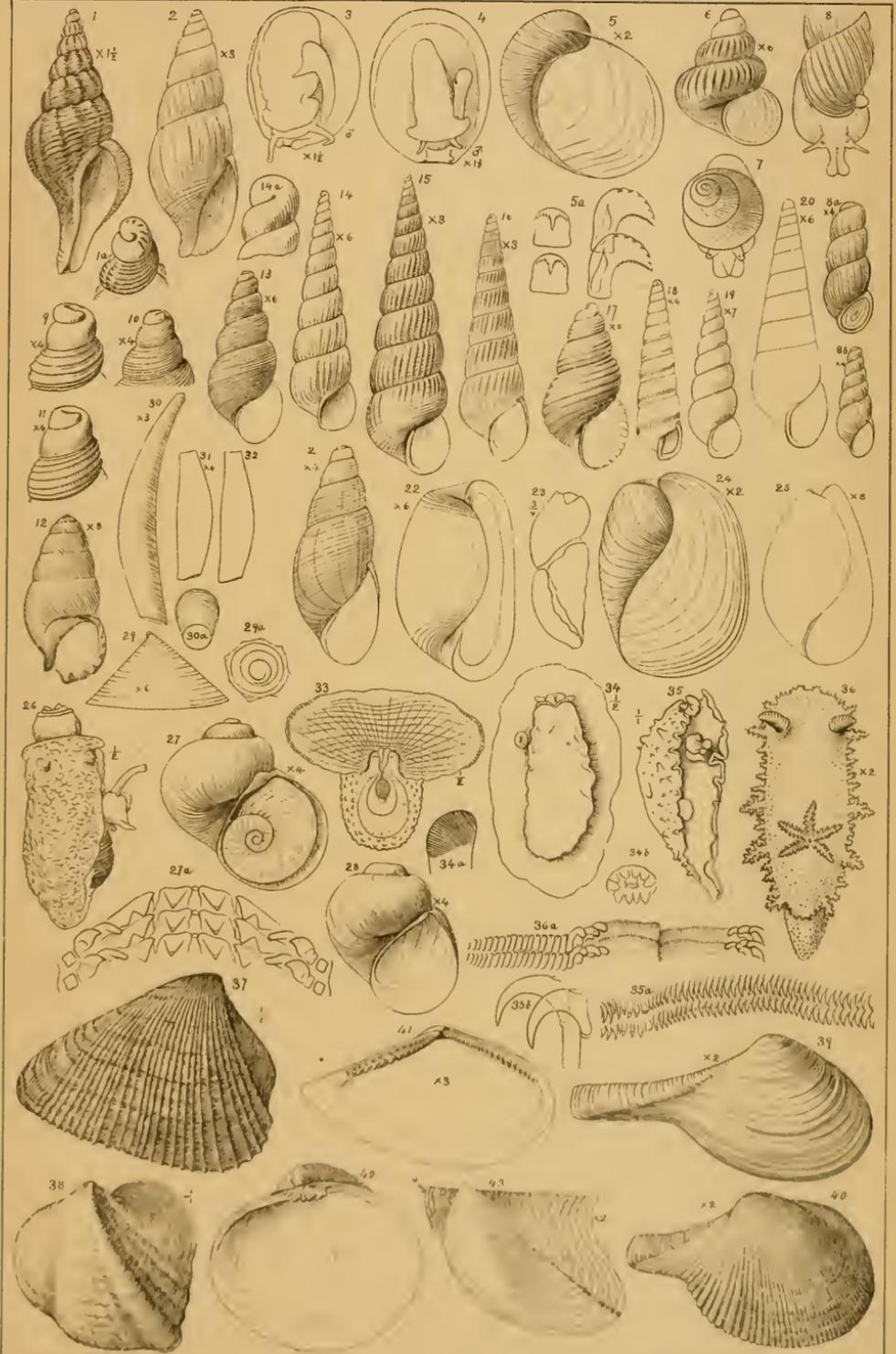
ARCHITEUTHIS, STHENOTEUTHIS, etc.



J. H. Eubank, from nature.







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