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).

	Architeuthis Harveyi?									Architeuthis princeps?									
	No. 2.	No. 3.	No. 4.	No. 5. Fresh.	No. 5. Presv'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	660	--	--	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,	--	120	--	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,	--	--	--	82	--	--	--	--	--	--	--	--	--	100?	--	--	--	--	--
Circumference of body,	--	90?	72	66	--	--	--	--	--	56?	--	--	--	84	--	--	144	--	72
Circumference of head,	--	--	--	--	--	--	--	--	--	--	--	--	36	48	--	--	--	--	--
Breadth of head, across eyes,	--	--	--	--	--	--	--	--	18	--	--	--	--	--	--	--	--	--	--
Breadth of eye-openings,	--	--	--	--	--	--	--	--	7 × 9	--	--	--	--	8	--	--	--	--	--
Length of tail-fins, (tip to insertion),	--	--	--	18?	17	--	--	--	--	--	--	--	20?	19 p.	--	--	--	--	--
Breadth of tail-fins,	--	--	--	22	16	--	--	--	18	--	--	--	--	28 p.	--	--	--	--	--
From outer angle to tip of tail-fins,	--	--	--	27?	23	--	--	--	--	--	--	--	--	24·5p.	--	--	--	--	--
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	--	--	--	--	--	--	--	--	30·5p.	--	--	--	--	--
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	--	--	16?	17	--	--	--	--	--
Breadth of largest sessile arms (at base),	--	--	--	--	8	--	--	--	3·5?	--	--	--	--	6	--	--	--	--	--
Circumf. of tentacular-arms (middle),	4	--	--	2½–3	2·75	--	--	--	--	--	--	--	--	5	--	--	--	--	--
Circumference of 'club' of same,	6	--	--	--	4·5	--	--	--	--	--	--	--	--	6 p.	--	--	--	--	--
Diameter of largest suckers, of club,	1·28	--	·92	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	·71	·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, Förhandlinger 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, XVI*a*.

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 *Sthenoteuthis*.

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^{cm}

* 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 1639 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 dux*." 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,

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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^{cm} (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; XVI*a*, 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).

	a (alc.)	*b* (alc.)	*c* (alc.)	*d* (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-triquetral, 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 XVI*a*, figs. 9, 9*a*) 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^{cm} 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 XVI*a*, figs. 10, 10*a*) 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.

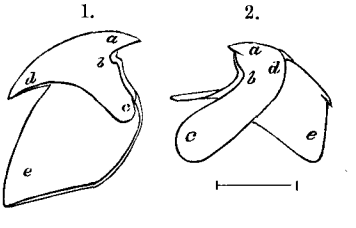

Figure 1. Upper mandible: *a.* rostrum or tip of the beak; *b.* the notch; *c.* the inner end of ala; *d.* the frontal lamina; *e.* the palatine lamina; *ab.* the cutting edge of beak; *bc.* anterior or cutting edge of ala.

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 laminæ, 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 *Ommastrephes* 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 XVI*a*, 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. Harveyi* 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^{cm} (19 feet). The circumference of the slender portion was 9 to 10^{cm}; of the enlarged sucker-bearing part, 15·24^{cm} (6 inches); length of the part bearing suckers, 76·2^{cm} (30 inches); diameter of the largest suckers, 3·17^{cm} (1·25 inches). Calculating from the photograph, the portion bearing the larger suckers was about 45·7^{cm} (18 inches) in length, and about 6·35^{cm} (2·5 inches) broad, across the face; distance between attachments of large suckers, 4·27^{cm} (1·68 inches); outside diameter of larger suckers, 2·95 to 3·18^{cm} (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, 5*a*) 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, 1875; American Naturalist, vol. ix, pp. 22, 79, figs. 25–27, 1875.

Ommastrephes (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 laminæ are relatively thicker than in *A. Harveyi*. 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, $42{\cdot}6^{mm}$ (1·68 inches); from tip of beak to posterior lateral border of alæ, $55{\cdot}9^{mm}$ (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, $6{\cdot}25^{mm}$ (·25 inch); breadth between teeth of opposite sides, 15^{mm} (·60 inch); breadth of gular lamina, in middle, $44{\cdot}5^{mm}$ (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 innner 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 laminæ 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. Harveyi*, 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. Harveyi* 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^{cm} in breadth, but when sketched by Dr. Holder its breadth was 71^{cm}; its length, from posterior tip to lateral insertions, 48·3^{cm}; from tip to end of lateral lobes, 61^{cm}.

The length of the body and head together, when fresh, was about 289^{cm} (9·5 feet); but when measured by me it was about 218^{cm}.

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^{cm} (11 feet) long, and 43·2^{cm} (17 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 mulitated 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 $15{\cdot}5^{mm}$ (·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 $3{\cdot}5^{mm}$ 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, $1{\cdot}5^{mm}$. 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,