

ART. XVI.—*Brief Contributions to Zoology from the Museum of Yale College.* No. XXX.—*The Gigantic Cephalopods of the North Atlantic*; by A. E. VERRILL.

THE existence of several distinct species of gigantic ten-armed cephalopods, belonging to more than one genus, has been well established by the researches of Steenstrup, Harting and others.

More recently attention has been repeatedly called to the frequent occurrence of these remarkable animals in the waters of Newfoundland. In an article on this subject, in this Journal, vol. vii, p. 158, Feb., 1874, I was able to enumerate five specimens from American waters, concerning which we had some reliable information.* Since that time much more material has been accumulated, and I am now able to cite twelve American examples. I have also had opportunities to study portions of five of these specimens. These evidently represent two distinct species, both of which belong to the genus *Architeuthis* of Steenstrup (or *Megaloteuthis* of Kent). The largest of these is represented only by the jaws of two specimens, one of which (No. 1 in my former article) was found floating at the Banks of Newfoundland, and the other (which

* See articles on this subject by the writer, in the *American Naturalist*, vol. ix, Jan., 1875; and vol. viii, p. 167; and letters from Mr. Alexander Murray in the *Naturalist*, vol. viii, p. 120, Feb., 1874.

we will designate as No. 10) was taken from the stomach of a sperm whale. The upper jaw of the latter was imperfectly figured by Dr. Packard in his article on this subject.* It is the largest jaw yet known. These belong to an apparently undescribed species, which I propose to name *Architeuthis princeps*,† and shall describe more fully farther on.

The second species, which I consider identical with the *Architeuthis monachus* of Steenstrup, is represented by parts of three individuals, and seems to be the species most commonly met with on the coasts of Newfoundland and Labrador.

The most complete specimen that has ever come under scientific observation 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 the front edge of the mantle were destroyed. 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 are now in my possession, and with the photographs have enabled me to present a restoration, believed to be quite accurate, of the entire creature (plate II, fig. 1). In this figure the eyes, ears, siphon-tube, and front edge of the mantle have been restored from a small squid (*Loligo pallida*), to which this gigantic species seems to be nearly allied in many respects. The other parts have been drawn directly from the photographs and specimens.‡

Mr. Harvey has published popular accounts of this specimen and the previously captured arm of a still larger one, in the Maritime Monthly Magazine of St. John, N. B., for March, 1874, and in several newspapers.§ To him we are, therefore,

* American Naturalist, vol. vii, p. 91.

† This species was named and characterized in a communication made to the Connecticut Academy of Sciences, Nov. 18, 1874, and will be described in greater detail in its Transactions. See also American Naturalist, Feb., 1875.

‡ The figure was originally made, from the photographs only, by Mr. P. Røetter, 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.

§ 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. 160; Nature, vol. ix, p. 322, February 26, 1874; and Appleton's Journal, Jan. 31, 1874.

mainly indebted for the latest and most important additions to our knowledge of these remarkable animals. The preserved parts of this specimen (No. 5) which I have been able to examine 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 the strong marginal rings: the two long tentacular arms, which are well preserved, with all the suckers in place; the tail; 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 plate II. From the great size of the large suckers on the long arms, I judge it to be a male. The body was relatively stout, and according to the statement of Mr. Harvey, it was, when fresh, about seven feet long and five and one-half feet in circumference. The "tail" or caudal fin (plate IV, fig. 9) is said by Mr. Harvey to have been 22 inches across, but the preserved specimen is considerably smaller, owing, undoubtedly, to shrinkage in the brine and alcohol. It is remarkable for its broad sagittate form. 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 23 inches; from the lateral insertions to the tip 19 inches; from the dorsal insertion 13.5 inches; total

* Mr. W. Saville Kent, from the popular descriptions of this species, has seen fit to give 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 identification is 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 perhaps still unpublished, though printed several years ago, and referred to even by Harting. Their agreement 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 in 1853. Mr. Kent was probably unaware 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."

His statement that *Architeuthis dux* Steenstrup is known from the beak alone appears to be erroneous, for Steenstrup, 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 by Prof. Steenstrup; Harting has also given a figure of the lower jaw, copied from a figure by Steenstrup. Steenstrup also mentions having the arm-hooks (Tandvæbningen), which would indicate a genus distinct from our species; in the proof-sheets which I have seen, this specimen is referred to as "*A. Titan*," but Harting cites it as *A. dux* Steenstrup. Possibly two distinct species are confounded under this name.

Should the *Architeuthis dux* prove to belong to a genus distinct from this, it might perhaps be taken as the type of *Architeuthis*, and in that case the generic name given by Kent could be retained, and the two species here described would then be called *Megaloteuthis monachus* and *M. princeps*, if my identification of the former species be correct.

breadth about 15 inches; width of lateral lobes 6 inches. The eight shorter arms, when fresh, were, according to Mr. Harvey's measurements, six feet long and all of equal length, but those of the different pairs were respectively ten, nine, eight and seven inches in circumference. They are three-cornered or triquetral 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, marginal rings, armed with strong, acute teeth around their entire circumference, but largest and most oblique on the outside (plate III, fig. 10). These suckers gradually diminish in size to the tips of the arms, where they become very small, but are all similar in form and structure. 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 .65 of an inch in diameter at the serrated edge, and .75 beneath. The rings of the smaller suckers are more oblique and more contracted at the aperture, with the teeth more inclined inward, those on the outside margin being largest. 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 24 feet long and 2.75 inches in circumference when fresh. In the brine and alcohol they have shrunk greatly, and now measure only 13.5 feet in length, while the circumference of the slender portion varies from 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 three-cornered or triquetral in form, with the outer angle round, 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 30 inches in length and expands gradually to the middle, where it is 4.5 to 5 inches in circumference (6 inches when fresh), and 1.5 to 1.6 across the inner face. The sucker-bearing portion may be divided into three parts. The first region occupies about seven inches, in which the arm is 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. They have narrow marginal

rings, with the thin edges nearly smooth, or minutely denticulate, and $\cdot 10$ to $\cdot 12$ of an inch in diameter, surrounded by a thick and prominent marginal membrane. These suckers are at first distantly scattered, but become more crowded, finally covering the whole width of the inner face, which becomes here $1\cdot 6$ inches broad. Scattered among the suckers are about as many 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 they can be used unitedly. By this means they must become far more efficient organs for capturing their prey than if used separately. Between these smooth suckers and the rows of large ones there is a cluster of about a dozen small suckers, with serrate margins, mostly less than a quarter of an inch in diameter, attached by slender pedicels.

The second division, 14 inches in length, succeeds the small suckers. Here the arm is well rounded on the back and flattened on the face, where it bears two alternating rows of very large serrate suckers, and an outer row of small ones on each side, alternating with the large ones. The inner edge is bordered by a rather broad, regularly scalloped, marginal membrane, the scallops corresponding to the large suckers. On the other edge there is a narrower and thinner membrane, which runs all the way to the tip of the arm. In one of the rows of large suckers there are eleven, and in the other ten, above half an inch in diameter, but each row has at either end one or two smaller ones, from half an inch to a quarter of an inch in diameter. The largest suckers (plate IV, fig. 11, *a*) are from 1 to $1\cdot 15$ inches in diameter at the margin. These are attached by strong, though slender, pedicels, so that their margins are elevated about an inch above the surface of the arm. Each one is situated in the center of a pentagonal depressed area, about an inch 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 obliquely campanulate; the marginal ring is strong, and sharply serrate all around. The small marginal suckers (fig. 11, *b*) are similar in structure, but more oblique, and mostly only $\cdot 3$ to $\cdot 4$ of an inch in diameter; they are attached by much longer and more slender pedicels, and their marginal teeth are relatively larger and more incurved, especially on the outer margin. The terminal division of the arm is 9 inches 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 3.5 inches. The face is narrow and bears a large number of small serrate and pedicellate suckers, arranged in four regular alternating rows, and gradually diminishing in size to the tip of the arm, where the rows expand into a small cluster. These suckers are much like the marginal ones of the previous division, and at first are about .25 of an inch in diameter, but decrease to about .10 of an inch near the tip of the arm. The color, 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 III, figs. 3 and 4. When in place, these jaws constitute a powerful 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 III, fig. 3) measures 3.85 inches in total length; 1 inch in greatest breadth; and 2.50 from front to back. The lower jaw (fig. 4) is 3 inches long, 2.75 broad, and 2.65 from front to back.

The small squids of our coast have a very similar pair of jaws. Those of *Loligo pallida* (plate IV, figs. 5, 5a) are here figured twice the natural size, for comparison and to explain the terms used in describing the large jaws.

The most remarkable anatomical character observed in this specimen is found in the form and arrangement of the teeth on the "lingual ribbon," or *odontophore*, for in this respect it differs widely from all other known Cephalopods.

The ordinary squids and cuttle-fishes all have these teeth arranged in seven regular longitudinal rows; those of the three middle rows being generally two or three-pronged, as in *Loligo pallida* (plate IV, fig. 7), while the lateral rows have long, simple, fang-like teeth. But in this species (fig. 6) the teeth are very irregularly scattered over the surface of the broad thin membrane, and it is difficult to trace the rows, if such they can be called, for the arrangement seems to be somewhat in irregular quincunx. The number of rows, however, cannot be less than twenty. These teeth are all simple, but vary considerably in size and form. They are all attached by a more or less rounded, flattened base, and all are considerably curved; some are broad and tapering; others are slender and acute; but the different forms and sizes are irregularly intermingled across the whole breadth of the membrane. Irregular granules of silica are also scattered in great numbers over the membrane among the teeth, and similar grains are embedded in the membrane lining the mouth. This peculiar type of dentition must be regarded as an extremely generalized one.

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 III, fig. 2) 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 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 .5 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 .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.

The pen of our *Architeuthis* seems to resemble that of the ancient genus *Teudopsis*, found fossil in the Jurassic formations.

From the above description it will be seen that the most important and most characteristic features of this species, or rather of the *genus* to which it belongs, are to be found in the *lingual dentition*, in the *internal shell*, in the *form of the caudal fins*, and in the cluster of small suckers and tubercles on the long arms. As already stated, the first three of these peculiarities indicate a low or generalized structure, and therefore a low rank in our system of classification, unless it should be found to have some other characters not yet known and of greater importance, which might outweigh those here given. It will appear, therefore, that this genus of huge squids should be classed below *Loligo*, which, in its turn, would go below *Ommastrephes*, to which genus the common small squids of our northern coasts belong, for the latter genus has distinct eyelids, which are not found in *Loligo*, and the internal shell is also more specialized.

I have received through Professor Baird, of the Smithsonian Institution, a pair of jaws and two large suckers of the long arms, which were taken from a specimen (No. 4), cast ashore in Bonavista Bay, Newfoundland. These jaws agree precisely in form and size with those described above, so that the size of these two individuals must have been about the same. The suckers (plate IV, figs. 12, 13) had been dried, and have lost their true form, but the marginal rings are perfect, and only .92 of an inch in diameter, and 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 female, but they may not have been the largest of those on the arm.

EXPLANATION OF PLATES.

- Plate II.—Figure 1. *Architeuthis monachus* Steenstrup (No. 5); $\frac{1}{2}$ natural size.
 Plate III.—Figure 2. Anterior part of the "pen" of the same; $\frac{1}{2}$ natural size. The dotted lines indicate parts that are wanting.
 Figure 3. Upper jaw of the same; natural size.
 Figure 4. Lower jaw of the same, lacking a small piece at *a*.
 Plate IV.—Figures 5 and 5a. Jaws of *Loligo pallida*; *a*, the rostrum or beak; *a b*, the cutting edge, with a notch at *b*; *b c*, the anterior edge of the alæ or wings; *d*, the frontal lamina in the upper jaw, or chin-portion (*mentum*) in the lower jaw; *e*, the palatine lamina in the upper jaw, or gular lamina in the lower jaw; twice the natural size.
 Figure 6. Part of the lingual ribbon of *A. monachus*; enlarged.
 Figure 7. Ditto of *Loligo pallida*; much more enlarged.
 Figure 8. Ditto of *Loligo Hartingii*, copied from Harting; enlarged.
 Figure 9. Caudal fin of *A. monachus* (No. 5); $\frac{1}{11}$ natural size.
 Figure 10. Marginal ring of a sucker from one of the sessile arms; enlarged two diameters.
 Figure 11. *a*, A large sucker; and *b*, a small marginal sucker from the tentacular arms of same; natural size.
 Figure 12. Large sucker from tentacular arm of No. 4; natural size.
 Figure 13. Part of the marginal ring of the same; enlarged.

[To be continued.]





