

Descriptions on Unidentified Species of Dibranchiate Cephalopods.

I. An Oegopsiden Squid belonging to the Genus *Architeuthis*

By

EIJI IWAI

(Laboratory of Fisheries Zoology, Faculty of Agriculture, Tokyo University)

In recent years some authors have reported on the Cephalopods found in Japan and its adjacent waters. However since 1929, no attempt has yet been made to present a monograph of the species found in these areas. Furthermore, as the preliminary records, treated only the species of the coast and bay and a few pelagic members, it is believed that many unidentified species still exist in the ocean.

The present specimens belonging to Oegopsids have not been hitherto catalogued in Japan. In many respects, these specimens resemble the squids of the genus *Architeuthis* and it is thought to be a young type of *A. japonica*, but on the other hand striking differences were seen, especially on the structure of the gladius and the horny ring found on the arm suckers.

As mentioned by PFEFFER and ROBSON, it is very difficult to determine the species in Architeuthidae, because of the following reasons.

- (1) Only a few specimens belonging to the family were obtained up to the present.
- (2) Almost all the squids described were those found, either partially digested or destroyed in the digestive canal of the whale, or those found stranded in the storm.
- (3) Most of the reports are limited to the description of giant, mature squids.
- (4) In some of the species, sexual dimorphism etc. are seen.

From the above reasons, PFEFFER stated that the fifteen known species of Architeuthidae could better be divided into 3 groups, i. e. *Nordpazifische*, *Nordatlantische* und *Südliche Formen*, and discussed from the viewpoint of geological variations. In the North Pacific, only a single species was reported by PFEFFER and others.

The two specimens described here were found in the digestive canal, perhaps in the stomach of the sperm whale, captured near the Bonin Islands in the summer of 1952. In this paper the author has tried to describe the specimens, by discussing their resemblances and differences with *A. japonica* and other Oegopsids.

The author has much pleasure in acknowledging his indebtedness to Dr. M. NISHIWAKI, who kindly supplied the specimens, to Prof. M. ISHIKAWA and Y. SUYEHIRO for their invaluable advice and guidance, and to Assoc. Prof. T. HIBIYA for his kind assistance in reading the proofs of this paper.

General Observations

Mantle: Body rather small, subfusiform as seen in general squids and its length reaches $3\frac{1}{2}$ to 4 times the maximum breadth taken at the anterior orifice. From the opening the mantle gradually tapers posteriorly, forming a straight line at each lateral margins to the origin of the fin, whence it becomes much narrower and continues to the extremity as a slender spit-like process, but not conical as seen in *Ommastrephes* (plates I and II). According to SASAKI's description on *Architeuthis japonica*, the maximum breadth of the mantle is at about one-third of the length from the anterior end; however, PFEFFER described that it is broadest at the orifice.

Actual measurements of the specimens after preservation in formalin are given in table 1.

The mantle is rather thick, fleshy and smooth; on all its surface,

Table 1. Morphological measurements of the two specimens

Body portion		No. 1		No. 2	
Mantle:	dorsal length (mm)	92		104	
	maximum breadth (")	26		26	
Head :	dorsal length (")	24		26	
	breadth (")	25		26	
	height (")	17		18	
Arms :	length of the first (")	left	right	left	right
	the second (")	53	56	54	54
	the third (")	65	66	61	60
	the fourth (")	63	65	61	60
	the fourth (")	58	58	56	56
	formula	2=3>4>1		2=3>4>1	
Fin :	length (")	44		52	
	breadth (")	64		61	
	length/breadth (%)	69		85	
Fin length/Body length (")	48		50		
Tentacle:	length (mm)	left	right	left	right
	club (")	105	*166	121	119
		23	23	23	22

* most elongated

devoided of any kinds of tubercles or folds. Purple-coloured chromatophores are as common as in any other squids. No luminous organs are present. Antero-ventral margin of the mantle is slightly concaved between the faint projections of the either sides of the funnel base; dorsally the margin forms an obtuse angle of about 170° at the middle, while in SASAKI's description it is said to form an angle of 120° .

Fin: Fin is typically terminal, and is about half the length of the mantle; its breadth is decidedly longer than its length. The shape of the fin is very characteristic. It is more or less heart-shaped, but with an acute posterior extremity and quite resembling that of *A. japonica*. Anteriorly its origin is somewhat auriculated on both sides of the body, and the antero-lateral margin is clearly convex, the convexity being continued to the round ear-shaped lateral angle too. The post-lateral margin is nearly straight except at the projected region.

Head: Head is roughly cubical in shape; the ventral surface is flat, whereas the dorsal and lateral sides are rounded. Breadth of the head is a little narrower than the mantle and its length is about one-fourth of the body length. The posterior end of the head is obviously marked off from the neck by a distinct constriction at both funnel bases. Eyeballs comparatively large, and the perforated openings are also wide; at the interspaces between the third arm and the tentacle, is situated a very distinct sinus, the dorsal wall of which is more or less thickened (fig. 11). According to MITSUKURI and IKEDA, the "lacrymal gland" of *A. japonica* is much smaller than in these specimens.

Funnel excavation is deep, and is limited by a clear-cut horse-shoe shaped fold, which widens into a broad thick membrane holding the funnel laterally at the posterior region. Olfactory crest is not conspicuous; this organ may be composed of more than 10 fold-like streaks running longitudinally at the lateral side of the head.

Nuckal cartilage: Nuckal cartilage spatulate, but on its structure a little difference was observed when compared with that of *A. japonica* given in SASAKI's description.

The anterior one-third of the nuckal cartilage is quadrangular in shape with its corners rounded, and its length is twice the breadth. The posterior end narrows gradually and finally ends in a spoon-shaped expansion. There are two median parallel ridges gently raised from the surface, which gradually flattens towards the posterior end. In the crest between these ridges a shallow groove was observed. The nuckal cartilage is 1.3 cm long and the maximum breadth is 0.4 cm.

Funnel: Funnel is relatively large, and especially expanded at the base; its distal end being somewhat tubular, and a little recurved ventrally. The funnel organ consists of dorsal and ventral pads. Among

these, the dorsal pads are remarkably distinct and are V-shaped. They are placed beyond the anus and form an apex in the central region of funnel. The ventral pads were not clearly seen in these samples. The funnel valve is wide, tongue-like and situated inside the siphon, a little distance from the orifice, sticking to the dorsal wall.

Articulations: The whole appearance of the funnel cartilage is slender as a bamboo-leaf, as shown in fig. 9, with a deep, broad groove at a little dorsal to the median line; the measurements are 1.3 cm in length and 0.3 cm in breadth. The ventral side of the crest is faintly elevated. Anterior end of the cartilage is more or less sharp pointed and a little recurved to the outside, but the posterior end of the cartilage is blunt and turned to the inside. Mantle cartilage almost the same with that of other species in Architeuthidae (fig. 10); its length nearly one and half times that of the funnel cartilage and is linear and keeled. Its posterior part is a little broad and gently decreased in height posteriorly.

Arms: Arms are more or less equal in length, shorter than the mantle and its length order is $2 \doteq 3 > 4 > 1$; while in *A. japonica* its length exceeds that of the head and body length, and its order is $4 \doteq 3 > 2 > 1$. All arms roughly quadrangular shaped in cross-section, tapering towards the tip evenly. At its lateral sides, slightly compressed, but clearly round on the aboral surface. The web only develops on the outer sides of the ventral arms; the dorsal side much broader than the ventral and widens towards the base. According to MITSUKURI and IKEDA, webs are not seen on all arms. Protective membranes which are well-developed in *A. japonica* are not recognized in these specimens, this may be the result of digestion.

Arm suckers: Arm suckers are large relative to the length of arms. They are subspherical in shape and arranged in two rows throughout.

On the whole, the suckers on the ventral arms are decidedly smallest, the diameter being about half that of the suckers of the other arms. The suckers, excepting those on the ventral arms are almost of the same size at particular levels. It may be said that the suckers are the largest on the two second arms, and consist of about 40 series of suckers. The proximal 20 series are recognized with the naked eyes and the rest are minute, in the distal region. The suckers on these arms become larger gradually and the largest on the 7th or 8th series, and then diminish in size distally. The number and arrangement of the suckers on the other arms are about the same with that of the second arms.

A remarkable difference with that of *A. japonica*, is that, on the horny ring of each sucker in *A. japonica* a row of teeth are present.

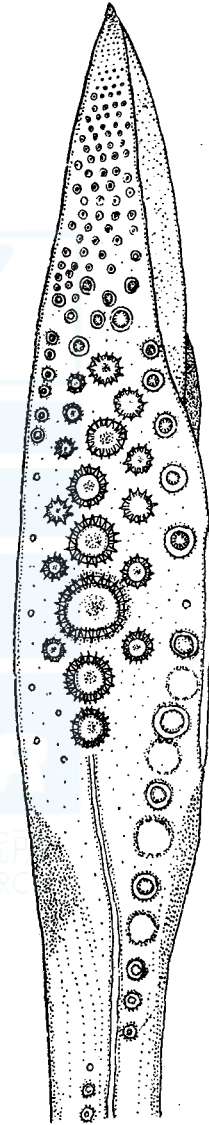
However, in these samples teeth are completely absent.

Tentacles: The structure of the tentacle is most characteristic and is not seen in other Oegopsids. The length of the tentacle reaches to that of the head and body, but much shorter than the tentacle of *A. japonica*. The width is a little narrower than the arms. The club is feebly expanded and somewhat lanceolate and sharp pointed at its distal extremity, protected by a flap of thin membrane at the edge. The length of the club is about $1/5$ to $2/9$ of the tentacle. Regarding the structure of the tentacle, the most striking characters are the arrangement and structure of suckers on the hand portion (fig. 5 and text-fig. 1).

Tentacular suckers: The suckers are arranged in 5 rows, and the middle ones are much larger than the lateral ones. Of the middle ones, the centro-basal 3 suckers are extraordinarily large, measuring up to 2 mm in dia. These suckers are flat typically basin-shaped, and each sessiled by a very short, but thick stalk. On the margins of the horny ring of the largest sucker, 26 teeth triangular in form are situated at regular intervals and it is all projected outside from the chitinous margin. Of these teeth, the ventral one is larger than the dorsal one.

Next in size to the horny ring in the middle row, the order is as second, first, fourth and fifth row respectively. i.e. the size of the horny rings becomes smaller gradually in the order of the rows shown above. The teeth too, found on these horny rings become proportionately smaller in relation to its horny ring. From the above description it is apparent that the suckers of the rows which are ventral most (i.e. the 5th row) are the smallest in size.

Further to this, the author observed that these suckers of the fifth row, towards the distal end, lose their proper positions and insert themselves more in the distal region



Text-fig. 1. The arrangement of variable suckers on each region of the tentacular club. $\times 5$.

in the company of the suckers of the fourth row. So the disposition of the suckers on the boarder line, between the hand region and the distal region, is more or less disturbed, and it becomes a question to determine to which region the suckers belong decisively. In respect to this character, these specimen agree with the squids of the genus *Meleagroteuthis*. In *A. japonica*, however, the hand of the tentacular club has suckers in 4 oblique rows, of which the suckers of the two median rows are much larger than those of the marginal rows. Nevertheless, they are all basin formed.

The suckers known as the fixing apparatus on the carpal organ (carpal region) are eleven in number. They have smooth horny rings and pads are found in the interspaces of these suckers. The suckers decrease in size proximally.

The distal region of the tentacular club is composed of about 40 series of minute suckers arranged in 4 or 5 rows. Its horny rings are toothless.

An interesting fact is that along the two-thirds of the linear groove, running in the median line inside the tentacular stem from the end of the carpal organ to the base are situated 14 suckers and pads, which are nearly equal in size to the distal suckers, with smooth horny rings.

Gladius: Gladius thin, feather-like as shown in fig. 8; the maximum breadth is a little shorter than one-eighth the length of the sample. Rhachis carinated on the back, but the keel does not appear through the mantle at its dorsal median line. The vane attached to the posterior seven-eighth of the rhachis, is much broad, its widest part being at a distance of one-fourth the length of the gladius from the anterior end. From here it becomes slender gradually towards the posterior end. Secondary development can be seen out of the lateral vanes. The tip of the given specimens being damaged, the structure of the posterior part was not observable. However the author doubts, whether the end cone distinctly recognized in *A. japonica* is also found in these specimen. Ribs are firm and are dark amber coloured in formalin solution.

Discussion

As stated above, these specimen have similarities and agree very well with the descriptions of *A. japonica* in many points, i.e. (1) in the external appearance of the mantle and the fin, (2) the structure of the articulating cartilage, (3) in the arrangement of suckers on all arms, (4) the basemental structure of the tentacular club and its stem, and (5) the fixing apparatus. But on the other hand, many differences were also seen and are summarized in table 2.

Table 2.

	<i>A. japonica</i> (adult)	The specimens
Hand region of tentacular club	consists of 4 rows of suckers	consists of 5 rows of suckers and 3 ones of the central row much larger than the others
Arms	much longer than body length and arm formula; $4 \approx 3 > 2 > 1$	not longer than body length and arm formula; $2 \approx 3 > 4 > 1$
Horny rings of arm suckers	all with dentation	not any teeth
Fin	decidedly longer than breadth	length shorter than breadth
Gladius	forms an end-cone at the posterior extremity	not formed

In addition to this, some of the results, established by the comparison of these samples with *A. japonica* seem also to be applicable to other species of this genus.

It may be thought that these different characters, especially of the fin, arm order, and the arrangement of the tentacular suckers, could have originated as a result of morphological variations during growth of the same species. These samples were at first believed to be a young type of *A. japonica*, with resemblances to locality.

However, will it be possible to explain for the formation of teeth on the whole margins of the horny ring on all arm suckers, and for the fundamental difference on the structure of the gladius? In these respects, the author hesitated to draw a conclusion.

Still more, comparing these specimens with other Oegopsids, results obtained were as follows.

These specimens differ:

From Branchioteuthidae in:

- (1) The structure of the tentacular club.
- (2) The presence or absence of the fixing apparatus.
- (3) The teeth of the horny ring on the arm suckers.
- (4) The form of the gladius.

From Histioteuthidae in:

- (1) The mantle structure and (2) the body form.

From Enoploteuthidae and Onychoteuthidae in:

- (1) The horny ring of the arm suckers and (2) the surface structure of the mantle.

And from other families, differences are clearly recognized at a glance. It is very difficult to conclude to which species in *Architeuthis* these specimens belong at present and regards on this point, will be discussed and reported in some future.

References

- BERRY, S. S.: A Catalogue of Japanese Cephalopoda. Proc. Acad. Nat. Sci. 1912 Philadelphia, 380-444 (1912).
- MITSUMURI, K. and IKEDA, S.: Note on a giant Cephalopoda. Zool. Mag. Tokyo **7**, 39-50 (1895).
- PFEFFER, G.: Die Cephalopoden der Plankton-Expedition. Ergebnis. Plank. Exp. Humboldt., II. F. a, 1-815 (1912).
- RAE, B. B.: Descriptions of a Giant Squid stranded near Aberdeen. Proc. Malac. Soc. London **28**, 163-167 (1950).
- ROBSON, G. C.: On *Architeuthis clarkei*, a new Species of gigant Squids, with Observations on Genus. Proc. Zool. Soc. London 1933 (3), 681-697 (1933).
- SASAKI, M.: Notes on Oegopsida Cephalopodes found in Japan. Annot. Zool. Jap., **9**, 89-120 (1916).
- : A Monograph of the Dibranchiate Cephalopods of the Japanese and adjacent Waters. Jour. Coll. Agric. Hokkaido Imp. Univ., **20**. Suppl. Numb., 1-357 (1929).



一般財団法人 日本鯨類研究所
THE INSTITUTE OF CETACEAN RESEARCH

Plate I.

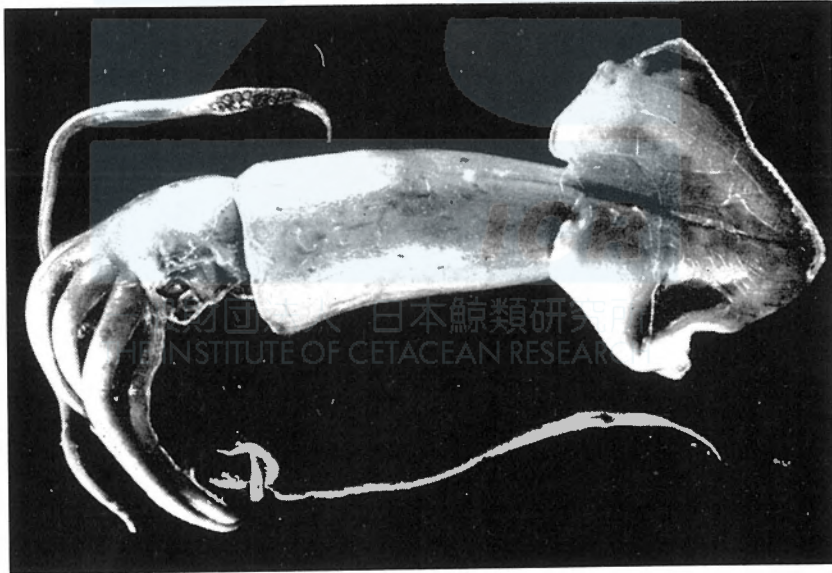


Fig. 1. Dorsal view of the specimen No. 1. $\times 4/5$.

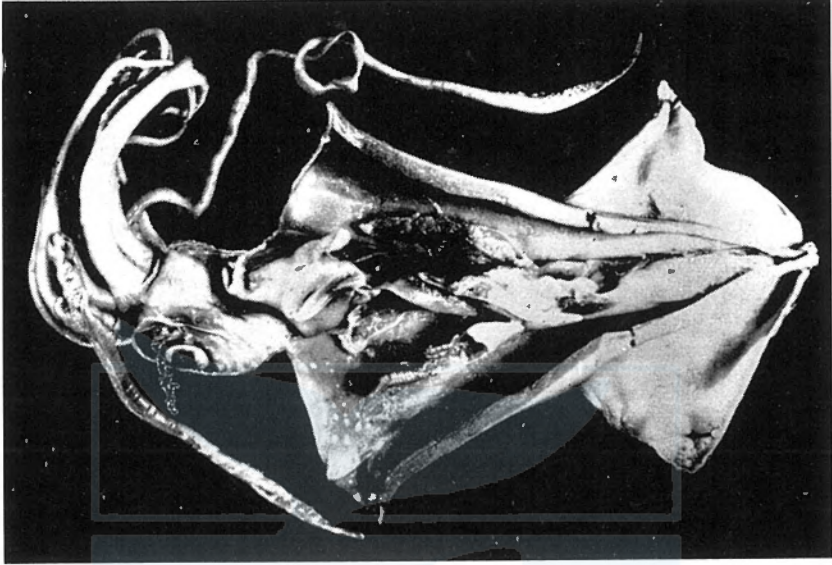


Fig. 2. The same, ventral view; dissected. $\times 4/5$.

Plate II.

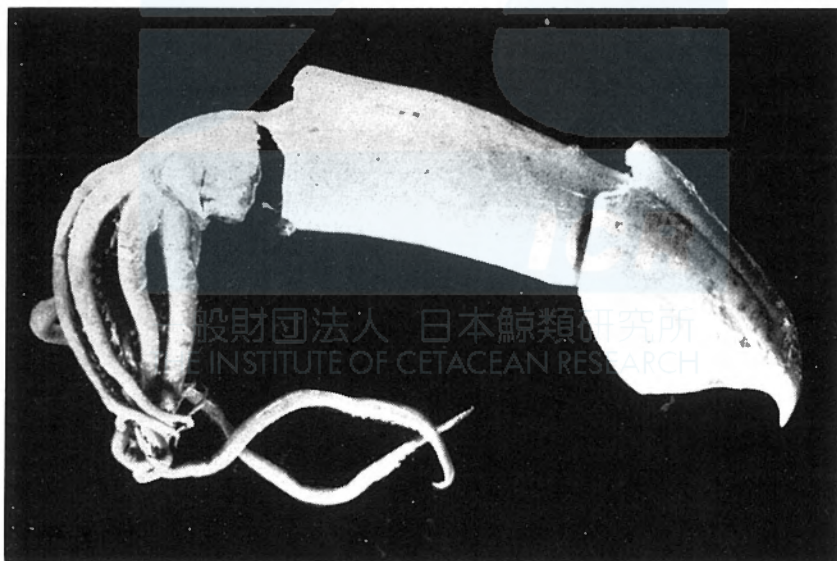


Fig. 3. Dorsal view of the specimen No. 2. $\times 3/4$.

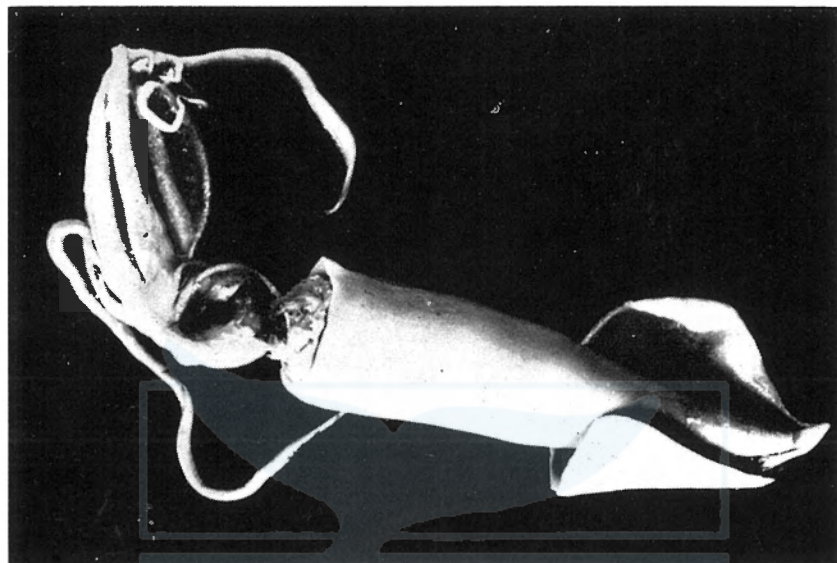


Fig. 4. The same, ventral view. $3/4$.

Plate III.

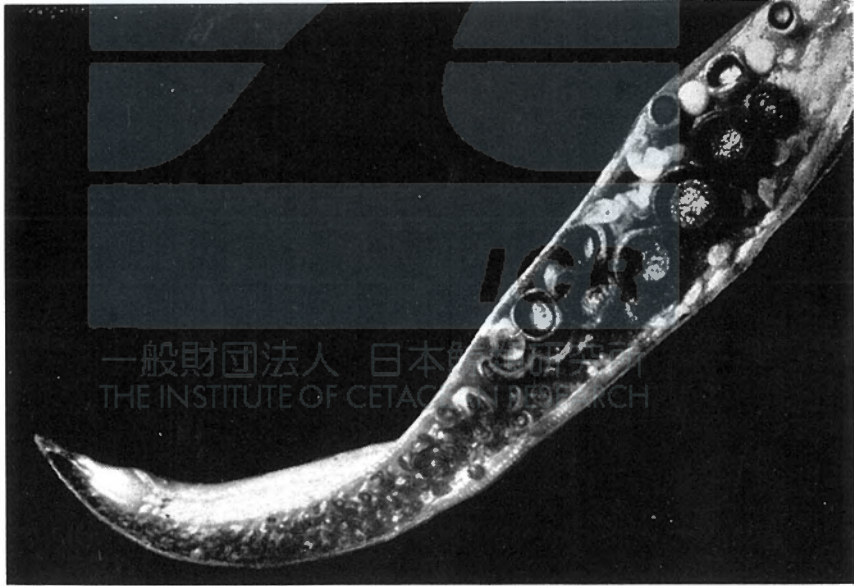


Fig. 5. Right tentacular club. $\times 5$.

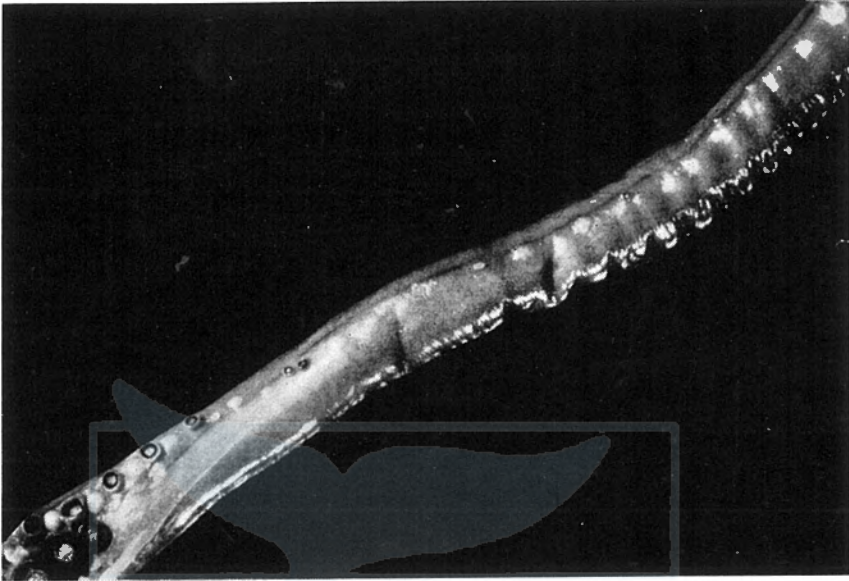


Fig. 6. Right tentacular stem. $\times 3\frac{1}{5}$.

Plate IV.



Fig. 7. Suckers of right arms. $\times 4$.

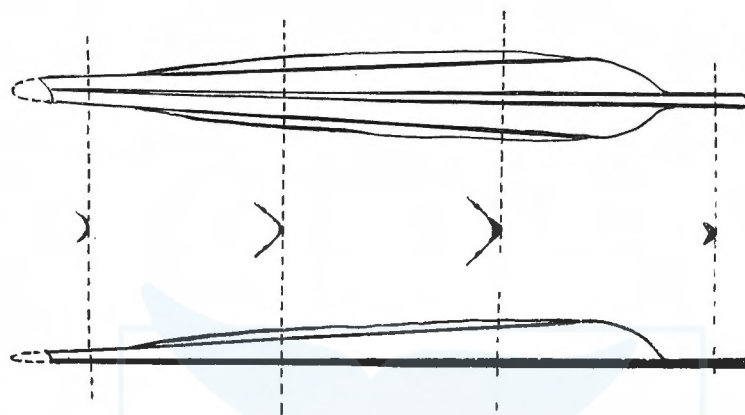


Fig. 8. Gladius. $\times 1$.

Plate V.



Fig. 9. Funnel cartilage. $\times 4$.

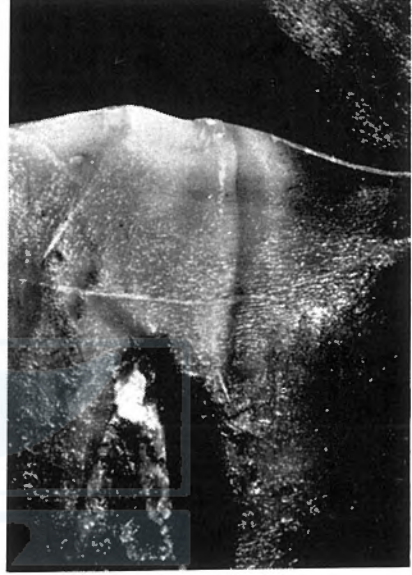


Fig. 10. Mantle cartilage. $\times 3$.



Fig. 11. Head, lateral view. $\times 2\frac{1}{2}$

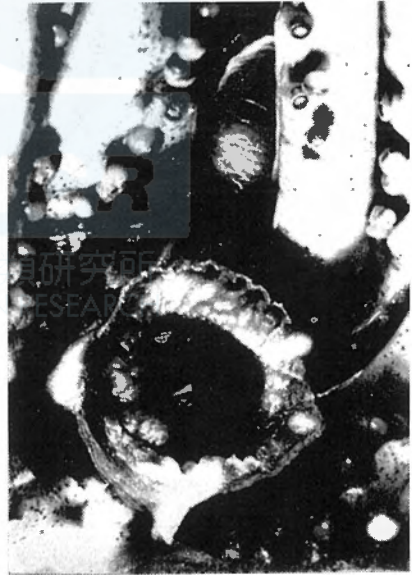


Fig. 12. Mouth part. $\times 3$.