
A REVIEW OF THE CEPHALOPODS OF WESTERN
NORTH AMERICA



By S. Stillman Berry
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INTRODUCTION.

The region covered by the present report embraces the western shores of North America between Bering Strait on the north and the Coronado Islands on the south, together with the immediately adjacent waters of Bering Sea and the North Pacific Ocean. No attempt is made to present a monograph nor even a complete catalogue of the species now living within this area. The material now at hand is inadequate to properly represent the fauna of such a vast region, and the stations at which anything resembling extensive collecting has been done are far too few and scattered. Rather I have merely endeavored to bring out of chaos and present under one cover a résumé of such work as has already been done, making the necessary corrections wherever possible, and adding accounts of such novelties as have been brought to my notice.

Descriptions are given of all the species known to occur or reported from within our limits, and these have been made as full and accurate as the facilities available to me would allow. I have hoped to do this in such a way that students, particularly in the Western States, will find it unnecessary to have continual access to the widely scattered and often unavailable literature on the subject. In a number of cases, however, the attitude adopted must be understood as little more than provisional in its nature, and more or less extensive revision is to be expected later, especially in the case of the large and difficult genus *Polypus*, which here attains a development scarcely to be surpassed anywhere.

In dealing with genera or higher groups I have nowhere endeavored to give complete diagnoses, but mention is made of such of their more salient characteristics as may serve for at least their temporary recognition by the student unfamiliar with cephalopods.

It has been an unfortunate fact that almost all the work on West American cephalopods has been more fragmentary and desultory than done with an idea to a careful elucidation of the fauna. Some of the early descriptions are so unsatisfactory that it would

seem much better to have left them unpublished and the majority of the species concerned are nearly or quite unrecognizable. The reason for this neglect is difficult to comprehend. In diversity of structure and the high specialization by which they are enabled to maintain themselves in harmony with the conditions of their environment, the cephalopods are surely without a parallel among the Mollusca. One need only call attention to the beauty of many of the species in life, their interesting habits, the powers of color change, of luminosity, and of vision, not to mention the curious secondary sexual organs and other minor contrivances, to reveal at a glance what an attractive field lies open to the student. It is to be hoped that it will not much longer remain practically untilled, as in the past, at least so far as American scholars have been concerned.

The advantages I have enjoyed while engaged in the preparation of this report have on the whole been quite exceptional, and a considerable amount of material has been gone over. This comprises some 600 specimens, which have been rendered available from the following sources:

1. The cephalopods obtained by the United States-Fisheries Steamer Albatross during the Alaska salmon investigations of 1903.
2. The specimens dredged by the Albatross off the California coast in 1904.
3. The miscellaneous series in the zoological collections of Stanford University.
4. The small collection possessed by the department of zoology of the University of California, which has already been reported upon. (Berry 1911a).
5. A small series of octopods sent through the kindness of Dr. William E. Ritter from the Marine Biological Laboratory at La Jolla, near San Diego, California.
6. The private collection of the writer.

Access has also been had to the collections of the Museum of Comparative Zoology and the Peabody Museum of Yale University.

A small preliminary paper containing brief diagnoses of seven supposedly new species has already been published (1911).

NOTE.—The work has been greatly facilitated throughout by the unflinching kindness of many friends and the writer greatly regrets that space does not permit him to state his full indebtedness to each. There are some, however, to whom grateful acknowledgment must be made.

First and foremost, he is indebted to Dr. Walter Kenrick Fisher, of Stanford University, under the general supervision of whom most of these studies have been carried on, and whose interest and unselfish aid have been indefatigable.

The Albatross collections were first placed in the hands of Dr. Harold Heath, of Stanford University, and, among other kindnesses, I am under great obligation to him for permitting me to work them up in his stead. Much encouragement has been given by Dr. Charles Henry Gilbert, of Stanford University, in the searching out of interesting specimens and helpful advice.

I am also indebted to Dr. William E. Hoyle, director of the Cardiff Museum, and to Prof. Addison E. Verrill for the gift of much valuable literature and other favors; to Mr. Samuel Henshaw and Dr. Edward Laurens Mark, of the Museum of Comparative Zoology, for kindly placing at my disposal the collections and other resources under their charge; and for divers kindnesses to many others.

Lastly the writer must state his obligation to Mr. Henry Varnum Poor, to Mr. John Howard Paine, and especially to Miss Lora Woodhead, all of Stanford University, for the patient and careful service they have rendered him in the preparation of the illustrations.

CLASSIFICATION.

Although the collections examined contain a fair supply of novel forms, the interest of these is mainly zoogeographical and as a rule they have little light to throw upon the broader problems of morphology and interrelationship. Consequently I have advanced no very new ideas of classification, but have been quite content to follow the general lines laid down in the various works of Hoyle, or in some cases that represented with certain slight modifications in Pfeffer's indispensable Synopsis (1900) and in the Nordisches Plankton Report (1908) of the same author.

For convenience in rapidly referring to any of the species here described, the following key is offered. It is perforce more artificial than natural, and it must be further remembered that the likelihood of the occurrence of forms not previously known to the region is still so great that no attempt should be made to rest an identification upon the key alone.

KEY TO THE CEPHALOPODA KNOWN TO INHABIT THE WESTERN COAST OF NORTH AMERICA.

- I. Tentacles absent; suckers sessile, without a horny ring. (OCTOPODA.)
1. A pair of lateral oar-shaped fins present; suckers in a single row. (Cirroteuthidæ.)
 2. Dorsal cartilage saddle-shaped; mantle opening wide. *Cirroteuthis macrops*, p. 273.
 - 2'. Dorsal cartilage horseshoe-shaped (?); mantle opening very small. *Stauroteuthis* sp. ?, p. 274.
 - 1'. No fins.
 3. Aquiferous pores present on the head; female with an external shell; hectocotylus involving the entire third arm of the left side and separable. *Argonauta pacifica*, p. 275.
 - 3'. No aquiferous pores; no external shell; hectocotylus confined to tip of arm. (Polypodidæ.)
 4. Suckers in a single row; body soft. *Eledonella heathi*, p. 276.
 - 4'. Suckers in two rows; body fairly firm. (Genus *Polypus*.)
 5. A prominent pigmented spot in front of each eye; hectocotylus very minute. *Polypus bimaculatus*, p. 278.
 - 5'. No definite oculations.
 6. Dorsal arms notably the longest; body with a peripheral fold of the integument. *P. leioderma*, p. 288.
 - 6'. Dorsal arms not usually the longest; body without a peripheral fold.
 7. Hectocotylized portion of arm relatively moderate in size—one-ninth to one-twentieth the total length. *P. hongkongensis*, p. 280.
 - 7'. Hectocotylized portion of arm extremely large—one-fifth to one-eighth the total length.
 8. Surface papillæ small, simple. *P. gilbertianus*, p. 284.
 - 8'. Surface papillæ large, soft, stellate. *P. californicus*, p. 286.

II. Tentacles present; suckers stalked, usually provided with a horny ring. (Decapoda.)

 1. Eyes covered by a continuous membrane. (Myopsida.)
 2. Body short, rounded, with ovate lateral fins; dorsal margin of mantle free from head; both dorsal arms hectocotylized. *Rossia pacifica*, p. 290.
 - 2'. Body elongate, pointed, with subterminal triangular fins; left ventral arm hectocotylized. *Loligo opalescens*, p. 294.

- 1'. Eye with a perforated lid. (ŒGOPSIDA.)
3. Suckers unmodified.
4. Funnel articulating with the mantle by a triangular cartilage having a L-shaped groove. (Ommastrephidæ.)
5. Tentacle bearing suckers for more than half its length; fixing apparatus poorly developed. *Ommastrephes sagittatus*, p. 298.
- 5'. Suckers extending for less than half the length of the tentacle; fixing apparatus a distinct carpal group of pads and suckers.
6. Mantle fused with the funnel on at least one side. *Symplectoteuthis oualaniensis*, p. 304.
- 6'. Cartilaginous articulation free.
7. Size moderate, arm tips normal. *Sthenoteuthis bartramii*, p. 298.
- 7'. Adult very large; arm tips attenuate, with very minute and numerous suckers. *Dosidicus gigas*, p. 301.
- 4'. Funnel articulating with the mantle by an ear-shaped cartilage having a simple groove; numerous luminous organs present on the ventral aspect. *Meleagroteuthis hoylei*, p. 305.
- 3'. Some of the suckers modified into hooks.
8. Sessile arms except ventral pair bearing two rows each of suckers and hooks *Gonatus fabricii*, p. 308.
- 8'. Hooks present on the tentacle club alone; sessile arms with two rows of suckers.
9. Body firm, loliginiform; cartilaginous articulation free. (Onychoteuthidæ.)
10. Animal gigantic; gladius terminating in a long solid cone. *Moroteuthis robusta*, p. 314.
- 10'. Animal small or of moderate size; point of gladius compressed and weak. *Onychoteuthis*, sp., p. 312.
- 9'. Body delicate; fins long and narrow; mantle margin fused with the body in three places. *Galiteuthis phyllura*, p. 315.

Phylum MOLLUSCA, Class CEPHALOPODA.

Order Dibranchiata.

OCTOPODA.

Family CIRROTEUTHIDÆ Keferstein, 1866.

Genus CIRROTEUTHIS Eschricht, 1836.

Cirroteuthis Eschricht, 1836, p. 627.

Sciedephorus Reinhardt and Prosch, 1846, p. 165.

Bostrychoteuthis Agassiz, 1846, p. 50, 87.

Cirroteuthis Hoyle, 1886, p. 55.

Cirroteuthis Hoyle, 1904, p. 3.

The members of this genus are deep-sea octopods, often of large size, with a rounded or ovoid body of rather gelatinous consistency and a paddle-like fin attached on either side. The web connecting the arms is exceptionally developed. The suckers are placed in a single series alternating with paired cirri on either side. A large saddle-shaped supporting cartilage is present in the medio-dorsal region of the body.

Type, *C. Mülleri* Eschricht, 1836, a species occurring off the coast of Greenland.

Cirroteuthis macrope Berry, 1911. (Pl. xxxii, fig. 1-3.)

Cirroteuthis macrope Berry, 1911,^a p. 589.

Animal (so far as known) of rather small size, subgelatinous in consistency. Body somewhat barrel-shaped, fairly elongate, with a short but very broad oar-like fin on either side near the posterior extremity. This fin comprises two portions: A thick, fleshy, and deeply inserted support, terminating outwardly in an acute point, and a delicate membranous margin. Mantle opening full and very wide, reaching to a point just behind each eye and leaving the funnel well exposed (pl. xxxii, fig. 1).

Head wide, flattened, broadly continuous with the body above, no distinct line of demarcation being visible. Eyes strongly asymmetrical, that of the left side being much the larger, spherical, very large and prominently protruding. Funnel large, broad, well immersed; its integument continuous with that of the head except at the slightly involute tip. Funnel organ very distinct, comprising a small whitish oval pad on either side of the dorsal wall near the apex (pl. xxxii, fig. 3).

Umbrella and arms very fragmentary in the specimen examined; web apparently thin and delicate, attached to the arms nearly if not quite to their tips; suckers minute; cirri arranged as usual but relatively large, having the appearance of long pointed papillæ.

Mandibles black and horny, but not massive.

Radula present and well developed. The arrangement and shape of the seven rows of teeth are shown in the accompanying figures (text fig. 1, and pl. xxxii, fig. 2).

Dorsal cartilage not removed, but it appears to be more or less saddle shaped, the posterior lobe rounded above, knob-like, and very prominent.

Color in spirits a subtranslucent milky white; the umbrella and scant traces of epidermis remaining on the rest of the body a dark purplish brown.

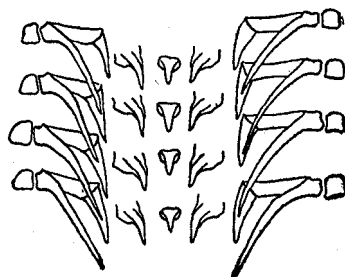


FIG. 1.—*Cirroteuthis macrope*, four rows of teeth from radula; camera outline. [120.]

MEASUREMENTS OF CIRROTEUTHIS MACROPE.^b

	Type.	Young.
	mm.	mm.
Total length.....	99	30
From tip of body to base of umbrella.....	58	18
From tip of body to mantle opening.....	36	14
Extreme width of body.....	26	10
Width of fin.....	27	4.5
Length of fin.....	9	1.0
Total width of head.....	36	10
Width between eyes.....	18	7
Median length of funnel (ventral).....	16	5

Type, no. 214317, U. S. National Museum (no. 120 of the author's register).

Type locality, station 4393, U. S. Fisheries Steamer Albatross, 2113-2259 fathoms, vicinity of San Diego, California; bottom of soft gray mud. Two specimens.

C. macrope is well characterized by its elongate shape, the extremely wide mantle opening, and the odontophore. As its reference to the present genus seems positive, it was certainly a surprise to discover the presence of an unmistakable radula, when the family has for years been supposed to lack the organ. I first found it in the smaller of the two specimens, and then surmised that it might prove to be

^a The references of particular importance in the synonymy of each species are indicated by bold-face type.

^b Where but one set of figures is given in respect to the length of the arms I have chosen for measurement that arm in each pair which for any reason appeared to me to be best preserved or most closely approaching the state which obtains in the living animal. It should be remembered that such data are more approximate than exact, a statement which is notoriously true in the case of the genus *Polypus*.

a juvenile character disappearing in the adult. The occurrence of a correspondingly larger radula in the more mature individual, however, quite disproves this hypothesis and indicates that it has either been previously overlooked, or that the structure is present in some species of the group and much reduced or wanting in others.

The apparently disproportionate development of the two sides of the head may be due to the bursting of the eyes, but if not, closely parallels the remarkable state described for the widely different *Meleagroteuthis hoylei* by Pfeffer and alluded to on page 305 of the present paper. Though attained independently in each species, it may be that the condition is due to some environmental feature or habit common to both. It is a curious fact that, in every individual seen it is the left eye which undergoes the enlargement and the right which is reduced.

Genus STAUROTEUTHIS Verrill, 1879.

Stauroteuthis Verrill, 1879, p. 468.

Verrill, 1881, p. 382.

Hoyle, 1904, p. 5.

A group closely allied to *Cirroteuthis*, but differing chiefly in the fact that the dorsal cartilage is posterior in position and horseshoe-shaped, with the free ends directed toward the head.

Type, *S. syrtensis* Verrill, 1879, from off Nova Scotia.

? *Stauroteuthis* sp., juv. (Pl. xxxiii, fig. 1.)

A single individual obtained by the Albatross at station 4325, 191-292 fathoms, in the vicinity of San Diego, Cal., is so young that to name it might lead to little but confusion in the future, yet it is so remarkably well preserved that a brief description at least seems well worth while.

Body short, plump, subgelatinous, slightly compressed above and below; on either side a small paddle-like fin which is slightly constricted and thickened at the base.

Head apparently larger than the body, but so intimately connected with the latter that no exact line of demarcation can be drawn. Eyes relatively enormous, appearing as prominent swellings; eyeball dark bluish in color, with a very large white lens. Funnel very small, broadly triangular in shape, very blunt at the tip. Opening of the branchial cavity much reduced, forming only a small semicircle below the funnel and not extending beyond it on either side.

Arms subequal, the ventral ones somewhat the shortest; connected almost to their extreme tips by the enormously thick and fleshy umbrella; intermediate web absent. Suckers of exceeding minuteness, in a single row, and supplemented by the usual row of paired cirri on each side.

Not wishing for the present to mutilate the specimen seriously, I am unable to add sufficient particulars definitely to settle its generic position, but refer it provisionally to *Stauroteuthis*. In general it suggests Verrill's figure of *Cirroteuthis plena*, but has larger eyes, smaller suckers, and the arms are more immersed in the web. The illustration given by Joubin of *Cirroteuthis umbellata* (= *Stauroteuthis hippocrepium* Hoyle ?) also offers many points of resemblance, but the above remarks as to the arms and web would apply here as well; nor does the small specimen described by Hoyle as *Cirroteuthis meangensis* appear to be the same.

The unique specimen is in the U. S. National Museum (no. 119 of the author's register). Its measurements as contracted in spirits are given below.

MEASUREMENTS OF STAUROTEUTHIS SP., JUV.

	mm.
Total length.....	30
From tip of body to mantle opening.....	11
Width of body.....	14
Width of fins.....	7
Length of fins.....	4
Width of mantle opening.....	5
Width across eyes.....	20
Diameter of eye.....	8.5

Family ARGONAUTIDÆ Cantraine, 1840.

OCYTHOIDÆ Gray, 1849.

Genus ARGONAUTA Linné, 1758.

Argonauta Linné, 1758, p. 708.

Ocythoe Gray, 1849, p. 30 (not of Rafinesque).

Pelagic octopods of moderate size, the male much smaller than the female and with the hectocotylus involving the entire third arm on the left side, which is developed in an oval sac, much enlarged, and separable. In the female the tips of the dorsal arms are greatly expanded, wing like, and their function is to secrete the large fragile external "shell" or egg case. Mantle connectives well developed. Aquiferous pores present on the head.

No other group at all approaches *Argonauta* in its assemblage of utterly distinctive characters, the nearest being the genera *Ocythoe* and *Tremoctopus*, which are not known to be represented in our waters. The genus comprises the familiar and beautiful "argonauts" found in all warm seas. The delicate egg case is the greatly prized shell popularly known as the "paper nautilus."

Type, *A. Argo* Linné, 1758, a common Mediterranean and Atlantic species.

***Argonauta pacifica* Dall, 1872.**

?*Argonauta Argo* Reeve, 1861, pl. III, fig. 2d.

Argonauta Argo Carpenter, 1864, p. 613, 664 (merely listed).

Argonauta Argo Stearns, 1867, p. 345 (merely listed).

Argonauta pacifica Dall, 1869, p. 237 (no description).

Dall, 1872, p. 95.

Argonauta Argo (pars) Tryon, 1879, p. 139, pl. 49, fig. 120 (? fig. 121, after Reeve).

Argonauta pacifica Hoyle, 1886, p. 5 (no description).

Hoyle, 1886a, p. 213 (9), (no description).

Argonauta argo Yates (err. typ.), 1889, p. 178 (merely listed).

Argonauta Argo Yates, 1890, p. 45 (merely listed).

Argonauta pacifica Williamson, 1892, p. 217 (merely listed).

Keep, 1904, p. 271, 350 (no description).

Argonauta pacifica Dall, 1908, p. 225.

Argonauta argo pacifica Dall, op. cit., p. 226, 228.

Argonauta pacifica Dall, 1909, p. 193 (merely listed).

Keep, 1910, p. 296 (no description).

The essence of the original diagnosis is as follows, comparison being made with the Mediterranean *A. argo*:

"The animal of the Californian species is orange, with a sprinkling of fine purple dots, more crowded and larger on the back. The proportions of the arms are different from those of the *A. argo*. The first pair are a little the longest, the second next in length, while in *A. argo* they are the shortest; the third pair are the shortest and the fourth equal to the third. The web extends along only one-half of the fourth pair, and is proportionately smaller than in *A. argo*; the siphon is shorter with a blunt elbow. The dentition also differs. The central tooth is proportionately larger, much broader, and slightly convex in the middle line in front. The first lateral is smaller and the inner corner produced into a denticle. The second lateral is proportionately larger and the third narrower and smaller than in *A. argo*. The shell is more ventricose, and the arrangement of the sculpture and tubercles is different from that of the Mediterranean species." (Dall, American Journal of Conchology, vol. VII, p. 96, 1872.^a)

Distribution: Monterey, California (Dall); Santa Rosa Island, California (Yates); Santa Cruz Island, California (Cooper, Stearns); Santa Catalina Island, California;^b San Pedro, California (Tryon); Gulf of California (Dall); Gulf of Panama (Albatross, Dall); near the Galapagos Islands (Albatross, Dall).

^a For a popular account see the article entitled "A tame nautilus," by Charles F. Holder in the Scientific American for October 16, 1909.

Argonauta pacifica is the common "paper nautilus" of the Southern California coast. Although of more than frequent occurrence, especially in the neighborhood of the Channel Islands, this graceful species is not represented in any of the collections at my disposal, and hence I am unable to describe it further or to represent it by figures. On the authority of Cooper, Carpenter speaks of "Hundreds on beach at Sta. Cruz Is.," and this seems to have been no exaggeration, although the species is somewhat sporadic in occurrence. The beautiful shells are very commonly met with in curio stores, being usually held for fancy prices in the hope of ensnaring the unwary tourist. This is in large part an explanation of the rarity of specimens in the coast museums. Living examples are sometimes to be seen in the aquarium at Avalon, and it is somewhat surprising that no complete description of even the external features of the animal has found its way to print.

The range of the species appears to be a wide one, for it has been reported to occur from Monterey Bay as far to the southward as the Galapagos Islands. We may well expect to hear of its occurrence in even more distant waters, for like all other members of the genus, its habits are pelagic.

Family POLYPODIDÆ Hoyle, 1904.

OCTOPIDÆ D'Orbigny.

OCTOPODIDÆ auctt.

Genus ELEDONELLA Verrill, 1884.

Eledonella Verrill, 1884, p. 144.

Hoyle, 1886, p. 106.

Body of moderate size, soft and saccular, without fins. Mantle opening very wide. A median septum present in the branchial cavity. Arms slender, the third pair much the largest; suckers in a single row, usually large and urceolate; umbrella short. Right third arm hectocotylized.

This genus comprises a small number of deep-sea octopods having a very anomalous distribution, as is to be noted later. The genera *Bolitana* "Steenstrup" Hoyle and *Japelella* Hoyle are united with *Eledonella* by Chun, but under the name given by Steenstrup, although *Bolitana* was not diagnosed until two years after the description of *Eledonella*.^a

Type, *E. pygmaea* Verrill, 1884, a deep-sea species of the North Atlantic.

Eledonella heathi Berry, 1911. (Pl. XXXII, fig. 4; pl. XXXIII, fig. 2-4.)

Eledonella heathi Berry, 1911, p. 589.

Mantle smooth, saccular, inflated, of a subgelatinous to membranous consistency, recalling the condition seen in many of the Cranchiidæ; mantle opening extremely broad and full, extending upward on either side to a point above and slightly past the center of each eye.

Head short, broad, greatly compressed above and below, well defined from the body. Eyes very large, dark in color, rounded and prominent; sessile, the lens much protruding. Funnel broad, thin walled, not extending past the eyes or quite to the base of the umbrella. Funnel organ comprising a flattened Λ -shaped pad, or rather two diverging ovate pads connected in front by a transverse median pad, the anterior point of which is free and flap-like, to a cursory glance having very much the appearance of a valve; the whole apparatus is very loosely adherent to the dorsal wall of the funnel, and in the type became entirely detached while the specimen was being examined. (It is shown in situ in pl. XXXIII, fig. 4.)

Arms of moderate length, rather stout at the base, but their tips slender; decidedly unequal, the third pair much the largest and longest, the others nearly of a length, their order 3, 2, 4, 1. Umbrella present, but thin and delicate widest between the second and third, and third and fourth arms, but extending between all for about a third the length of each. Suckers in a single row on all the arms, large (especially those of the third pair), much elevated, urceolate, and constricted below the aperture,

^a Since the above was put in type Chun has published a further paper in which he reinstates *Eledonella* and differentiates it from *Bolitana* on anatomical grounds. A new family, Bolitænidæ Chun 1911, is erected for the reception of both genera.

in a characteristic fashion, so that the general shape is not unlike that of the conventional money bag or a small bean pot. (Pl. xxxii, fig. 4; pl. xxxiii, fig. 3.)

Gills very large and prominent, comprising about eight or nine "lamellæ." A narrow delicate ridge runs along the median ventral line of the interior of the mantle, and I am inclined to regard this as a remnant of a median septum in the branchial chamber, but the membranes are so delicate that the torn surfaces are extremely difficult to identify, and this is by no means certain.

Color in alcohol everywhere nearly white, with a few sparsely scattered brown chromatophores; on the head and outer surfaces of the arms these are very minute and more or less longitudinal in arrangement. Eyes nearly black with white lenses.

The measurements of the unique type are as follows:

MEASUREMENTS OF *ELEDONELLA HEATHI*.

	mm.
Total length.....	117
Length of mantle (dorsal).....	50
Width of mantle (in wrinkled state).....	37
Width of head.....	29
Length of—	
Dorsal arm.....	33
Dorso-lateral arm.....	36.5
Ventre-lateral arm.....	49
Ventral arm.....	34.5
Umbrella between—	
First arms.....	11.5
First and second arms.....	12
Second and third arms.....	15
Third and fourth arms.....	15.5
Fourth arms.....	12

Type, catalogue no. 214318, U. S. National Museum (no. 118 of the author's register).

Type locality, Albatross station 4396, 2,228 fathoms, red mud bottom, off Santa Catalina Island, Cal. But one specimen, a female, obtained.

Owing to the very unusual range of all the species closely allied to this one, as attested by such weighty authority as Dr. Hoyle, it was with considerable diffidence that I described the present form as new. However, the alleged distribution is so extraordinary that one feels impelled to question whether some of the apparently slight characters have not more value than has generally been vouchsafed to them; or whether, since the form and facies of such creatures is so very different when living from the dismal objects like the limp rag to which they are reduced in the bottle before me, the true differences have not been obscured or annihilated. Therefore one feels bound to regard such variation as appears with the greatest respect until further material comes to hand.

The near relatives of the present form are four in number, belonging to no less than three different genera, although the latter have of late been united by Professor Chun (1902, p. 167). In brief, the essential differences they have to offer are as follows:

1. *Eledonella pygmaea* Verrill, described from a specimen obtained at a depth of nearly 3,000 fathoms in the North Atlantic and not since reported, so far as I am aware. It differs in that the eyes are not very prominent, the dorsal arms are much shorter than the others, and the umbrella is reduced ventrally until it is quite lacking between the ventral arms.

2. *Eledonella diaphana* Hoyle, described from off the north of Papua, but since reported from the vicinity of the Marshall Islands, the Galapagos, off Acapulco, and near the Cape Verde Islands. In this species the third arms are nearly twice as long as the fourth, which are the shortest, the siphon extends for two-thirds of the distance to the umbrella margin, and there is a well-developed median septum in the branchial cavity. I am also unable to reconcile the funnel organ of the California specimen with the description and illustration given for that of *E. diaphana* by Hoyle (1904, p. 22, pl. 5, fig. 11).

3. *Japetella prismatica* Hoyle, type dredged by the Challenger off the Rio San Francisco, Brazil, but a second specimen obtained by the Albatross from 2,232 fathoms, off Tehuantepec, Mexico, was

described by Hoyle in 1904. The order of length of the arms is 3, 4, 2, 1; the siphon extends almost to the margin of the umbrella; the ventral region of the body is prominently ridged, giving it a very characteristic shape, and the funnel organ, although agreeing in the \wedge -like form, seems very dissimilar in detail.

4. *Bolitæna microcotyla* "Steenstrup" Hoyle, originally noted from the Atlantic, but also obtained by the Albatross from the region of the Galapagos Islands. This species differs in numerous particulars. It is brownish purple in color, the relation of the head to the body is more intimate, the arms are not so long, their suckers smaller, the umbrella more extensive, the funnel organ W-shaped besides appearing different in structure, and the gills are stated to have but six lamellæ. Furthermore, in *E. heathi* the latter are much longer and larger, and the siphon does not appear to possess any ligaments uniting it on either side with their apices.

Our species more resembles some figures of "*Bolitæna (Eledonella)* n. sp.," given by Chun, but not exactly, and a diagnosis of the latter has not yet been published.

It is with much pleasure that I have associated the name of my friend Dr. Harold Heath, of Stanford University, with this interesting form.

Genus POLYPUS Schneider, 1784.

Polypus Schneider, 1784, p. 116.

Octopus Lamarck, 1799, p. 18.

Hoyle, 1886, p. 74.

Polypus Hoyle, 1901, p. 1-5.

Body more or less rounded and compact, variously colored and ornamented, a marginal membrane sometimes present, but no fins. Branchial cavity separated into two chambers by a median septum. Mantle connectives poorly developed, consisting only of shallow folds or grooves.

Arms variable, usually provided with a more or less extensive umbrella. Suckers in two rows except at the extreme base. Hectocotylus confined to the tip of the third arm on the right side.

Polypus is by all odds the largest, most cosmopolitan, and one of the most puzzling genera of living cephalopods. Within it are included most of the common shore devilfishes of almost every coast.

Type, *Octopus vulgaris* Lamarck, a generally distributed species in European waters.

Polypus bimaculatus (Verrill, 1883). (Pl. xxxiv; pl. xxxv, fig. 2; pl. xxxix, fig. 5.)

Octopus bimaculatus Verrill, 1883a, p. 121, pl. v, fig. 1-1a, pl. vi.

Hoyle, 1886, p. 8 (no description).

Hoyle, 1886a, p. 217 (13), (no description).

Brock, 1887, p. 610, 611.

Polypus bimaculatus Hoyle, 1904, p. 16 (mere note).

Berry 1911a, p. 301.

Body pyriform, as long or longer than wide, truncate and broadest posteriorly. Surface ornamented with numerous warty papillæ or tubercles nearly obsolete ventrally; above varying from a nearly smooth state where only the largest cirri can be made out, to the extremely rugose condition figured by Verrill, where the tubercles become unusually pronounced both in size and numbers. A large prominent conical warted cirrus, often accompanied by one or two other much smaller ones, appears just over each eye, persisting in all the specimens seen.

Head not very large, separated from the body by a slight constriction. Eyes moderately large. Funnel conical and rather long; free for much of its length.

Arms fairly stout, three to four times as long as the body, unequal, the dorsal and ventral pairs usually the shortest; extremities attenuate. Umbrella well developed, especially between the lateral arms; somewhat shorter between the dorsal, and ordinarily shortest of all between the ventral arms; continuing as a narrow, not very prominent web along the outer surface of each arm to its tip, although not always readily traceable so far. The outer surface of the web and arms is tuberculated in the same fashion as the body but in somewhat less degree. Hectocotylus of the male (pl. xxxv, fig. 2) excessively minute, involving only the extreme tip of the third right arm; marginal groove terminating in a small, much

flattened papilla, beyond which the minute conical tip is naked; its inner surface flattened, but little excavated, and provided with a few (3-5) distinct transverse grooves (in all the specimens examined). Suckers large at the base of the arms but rapidly diminishing in size after passing the margin of the umbrella; one of the suckers on each of the lateral arms near the junction of the umbrella frequently exhibits a considerable enlargement.

Beak strong and black as usual in the genus (pl., XXXIX, fig. 5).

Color in alcohol a dark brownish gray, heavily clouded and maculated with a blackish purple. On the base of the third arm, just in front of and below the eye on either side, is a large, distinct, round oculation, usually decidedly darker in tint than the rest of the animal. In most individuals this spot shows a dark center bounded firstly by a rather narrow dull-bluish ring, and secondly by a wider outer band of the same color as the center, a feature which seems to have been obscured in the specimens described by Verrill. The bluish ring has usually the appearance of being superimposed upon a uniform darker area, and some examples show further a surrounding region of a lighter color.

The young are readily to be distinguished from those of other species even when still of very insignificant dimensions. The most important difference from the adult which they exhibit is that the large cirri are relatively longer, seem very distinct from the other tubercles of the body, and show a strikingly definite bilateral symmetry (pl. XXXIV, fig. 1, 2). In addition to the postocular cirri, the following are usually very prominent: A conical tubercle at the base of each dorsal arm, a median one on the head just posterior to these, two along the median line of the body, and one large and several smaller lateral ones on either side of the latter. A single longitudinal row of small dark chromatophores, larger than those generally distributed over the body, may be seen on the ventral arms of extremely young individuals and there are a few similar ones on the ventral surface of the body. Further it may be added that the arms of juvenile specimens maintain with considerable constancy the relative length formula 2, 3, 4, 1, as given by Verrill.

Five specimens measure as follows:

MEASUREMENTS OF POLYPUS BIMACULATUS.

Sex.....	♀	♀	♂	♂	juv.
Author's register number.....	103	123	121	104	124
	<i>mm.</i>	<i>mm.</i>	<i>mm.</i>	<i>mm.</i>	<i>mm.</i>
Total length.....	^a 470	^a 490	^a 178	^a 225	65
Tip of body to base of dorsal arms.....	102	102	50	48	22
Width of—					
Body.....	58	56	35	29	12
Neck.....	29	24	24	21	10
Head.....	36	34	25	23	12.5
Length of—					
Funnel.....	35	32	17	17	7
Dorsal arm.....	^a 385	^b 235	109	^a 150	35
Second arm.....	^a 405	^b 150	128	^b 90	46
Third arm.....	^a 410	^a 390	118	^a 135	46
Ventral arm.....	^a 360	^a 370	124	125	42
Hectocotylus.....			2	2	
Umbrella between dorsal arms.....	^a 33	^b 55	22	22	8
Umbrella between ventral arms.....	^a 27	74	23	17	8

^a Figures only approximate. It should be remembered that in cephalopods of this type the arms are so elastic and the difficulty of maintaining a constant degree of tension for measurement so great, that the probability of error is relatively very large. Further, the tissues are very variously affected by the conditions of capture and preservation, but it is hoped that these measurements will prove sufficiently true for practical purposes.

^b Specimens mutilated.

Type locality, San Diego, California.

Distribution: San Pedro and vicinity, La Jolla and San Diego, California; south to San Salvador (Verrill) and Panama (Verrill).

Thirty-two specimens were examined, as follows:

SPECIMENS OF POLYPUS BIMACULATUS.

No.	Locality.	Collector.	Where deposited.	Sex.	Author's register number.
3	White's Point, Cal.	Univ. Cal. Mar. Lab., 1902.	Univ. Cal. coll.	1 ♂, 2 juv.	80
1	San Pedro, Cal.	July, 1895.	do.	♂	74
1	do.	Dec., 1905.	do.	juv.	86
2	La Jolla, Cal.	San Diego Mar. Biol. Assoc.	Stanford Univ. coll.	♀	102
1	La Jolla, Cal. (probably)	do.	do.	♀	103
3	La Jolla, Cal.	do.	Coll. S. S. B.	1 ♂, 2 ♀	104
6	San Diego, Cal.	E. C. Starks.	Stanford Univ. coll.	2 ♂, 2 ♀, 2 juv.	121
1	do.	do.	do.	(?)	122
1	do.	do.	do.	♀	123
4	do.	do.	do.	juv.	124
1	do.	D. S. Jordan.	Yale Univ. Mus.	♂	125
1	Off San Diego, Cal.	Univ. Cal. Sta. LXXX h. 3.	Univ. Cal. coll.	juv.	85
1	No locality.	(?)	do.	♀	70
5	do.	Various lots.	do.	juv.	75
1	do.	San Diego Mar. Biol. Assoc.	do.	do	78

This fine *Polypus* has undergone so complete and accurate description at the hands of Verrill that duplication here may appear a futile waste of space, but as his diagnosis is not always readily accessible, I have endeavored to be sufficiently full at least to enable the easy recognition of the species. This is especially important since in the local literature this form seems to have been frequently confused with the widely different *P. hongkongensis* (*Octopus punctatus*), so that some of the southern California citations which I have listed under the latter species may well have had reference to specimens of *P. bimaculatus*. South of Point Conception it becomes the most abundant littoral devilfish, judging from its frequency in collections from that region.

It does not appear to be closely allied to any of our other species. The curious ocular spots in front of the eyes are probably the most prominent distinctive feature. Although sometimes partially obscured by the surface coloration, I have never known this character to fail, so it would seem to be quite diagnostic. The hectocotylization is inconspicuous in the extreme and would be apt to escape a merely casual inspection. The customary component structures are greatly reduced, but I am unable to quite concur with Verrill in his statement that it is "without any appearance of the spoon-shaped cavity and transverse grooves found in other species," since in the majority of my (male) specimens a few such grooves are quite clearly to be made out. Possibly in larger individuals they become obscured.

The smooth and rugose states of *P. bimaculatus* are so different that at first sight they do not appear to represent the same species. The larger warty tubercles, however, seem to exhibit a remarkable constancy, and, although often reduced to mere concentrically lined or laminated callouses, can usually be made out. These structures, like the general relative dimensions, are probably greatly affected by the state of the animal when killed and the manner of preservation.

Polypus hongkongensis Hoyle, 1885. (Pl. xxxv, fig. 3; pl. xxxvi, fig. 1; pl. xxxix, fig. 3-4; pl. xl, fig. 1.)

Octopus punctatus Gabb, 1862, p. 170 (not *Octopus punctatus* Blainville 1826, p. 195, teste d'Orbigny).

Carpenter, 1864, p. 613, 632, 664 (merely listed).

Dall, 1866, p. 243, fig. 27 (dentition).

? Cooper, 1870, p. 70 (listed from Monterey).

Dall, 1873, p. 484 (large specimens from Sitka).

Tryon, 1879, p. 45, 86, 117, pl. 19, fig. 3; pl. 34, fig. 43.

Verrill, 1880, p. 252.

Verrill, 1882a, p. 282 (72).

Verrill, 1883a, p. 117, pl. iv, pl. v, fig. 2.

Dall, 1884, p. 341 (listed from Avatcha Bay, Kamchatka).

Orcutt, 1885, p. 535 (listed from San Diego).

? *Octopus hongkongensis* Hoyle, 1885, p. 224 (Japanese specimens).

Hoyle, 1885a, p. 99 (Japanese specimens).

Hoyle, 1886, pl. v (Japanese specimens).

Octopus punctatus Hoyle, 1886, p. 11, 100, (pl. v) (Japanese specimens).

Hoyle, 1886a, p. 220 (16) (no description).

Williamson, 1892, p. 217 (listed from San Pedro).

Taylor, 1895, p. 98 (listed from Victoria).

Joubin, 1897, p. 110-113, pl. ix.

Joubin, 1897a, p. 98.

Jenkins & Carlson, 1903, p. 262 (physiology of nerves).

Keep, 1904, p. 271, 351 (no description).

- Octopus punctatus* Kelsey, 1907, p. 45 (listed from San Diego).
 Baily, 1907, p. 93 (listed from La Jolla).
Polypus punctatus Hoyle, 1909, p. 260 (no description).
 Wülker, 1910, p. 7 (Japanese specimens).
 Keep, 1910, p. 296 (no description).
Polypus hongkongensis Berry, 1911a, p. 302.

Animal *a* most commonly of rather moderate size but sometimes attaining enormous dimensions; customarily littoral in habit. Body pyriform to subglobose, usually broadest behind; length and extreme breadth about the same. Opening of mantle cavity of moderate width, reaching on either side to a point about midway between the base of the funnel and the ocular aperture.

Head rather small, separated from the body by a slight constriction. Eyes fairly prominent. Funnel long and conical, its base immersed in the integument of the head, its distal half free.

Arms of considerable stoutness and length, ordinarily at least three to four times as long as the head and body taken together; in general subequal, but very variable, the second pair almost always slightly the longest and the ventral pair apt to be the shortest. Suckers small and not very closely placed about the mouth, alternating in a zigzag which shortly develops into two rows continuing to the tips of the arms. In the region where the umbrella joins the arm the suckers reach their maximum, becoming very large, flattened, and disk-like; inner surfaces prominently ornamented by about 20 more or less bifurcating radial ridges, with a lesser number of smaller and shorter ones interpolated between. The remaining suckers diminish rapidly in size and become very minute upon reaching the attenuate tips of the arms; they are likewise more elevated and develop fewer radial ridges. In some of the smaller males examined from a number of the more southern stations (e. g. no. 156, 134, 161) from one to two suckers on a part or all of the arms near the junction of the umbrella are considerably enlarged and much elevated (pl. xxxix, fig. 3). The condition does not appear to be a constant one and may be physiological.

Umbrella well developed, reaching between the lateral arms for about a quarter of their length, but less extensive between the dorsal arms and usually shortest of all between the ventral pair; margins of the umbrella continuing as a prominent marginal web along the ventral surfaces of all the arms nearly or quite to their tips. A similar but narrower membrane extends from the base for a little way along their dorsal margins as well.

Third right arm in the male hectocotylized; much shorter, stouter, and less attenuate than the others; terminating in a rather small copulatory organ (pl. xxxix, fig. 4), the relative dimensions of which may best be seen by a glance at the following table giving the measurements of 13 of the specimens examined.^b

RELATIVE DIMENSIONS OF SPECIMENS OF POLYPUS HONGKONGENSIS.

Author's register no.	Locality.	Length of third left arm.	Length of third right arm.	Length of hectocotylus.
		mm.	mm.	mm.
142	Uyak Bay, Alaska	265	210	14.5
145	Near Port Townsend, Wash.	238	187	9
162	do.	(?)	128	12
162	do.	185	140	14
156	do.	152	124	14
151	Point Reyes, Cal.	61	53	1.5
146	Monterey Bay, Cal.	145	103	11
158	do.	114	102	8
153	do.	130	99	5
161	do.	(?)	70	6
157	Off San Nicolas Island, Cal.	(?)	50	3
134	Near San Diego, Cal.	102	77	6
81	Off Los Coronados Island, Lower California	153	115	10

As in other *Polypus* the margin of the web on this arm is curled inward to form a tubular groove, which, after running the whole length of the arm, terminates in a minute acutely conical papilla at the base of the terminal organ. The remainder of the hectocotylus consists of a naked smooth tapering

^a Unless otherwise indicated by the wording or arrangement of the context, the description may be understood to have especial reference to author's number 142, a large male from Uyak Bay, Alaska.

^b As usual I consider a certain part of the variation shown to be due to the impossibility of accurate measurement.

point, the margins of its inner surface elevated to form two low parallel ridges inclosing a narrow, sharply marked groove; inner surface of groove usually showing a numerous series of small though distinct transverse wrinkles or furrows. I did not discover the longitudinal rows of granules described by Verrill, but suspect this to be a more or less variable feature.

Beak black; strong and powerful.

Surface in the best preserved specimens covered everywhere above by numerous papilliform tubercles with stellate bases, and many heavy, much interrupted, longitudinal wrinkles (pl. xxxv, fig. 3); above each eye a rather small conical cirrus with sometimes a smaller one in front of it, and always a very large pinnacle-like protuberance in a more or less erect condition just behind it. In addition there is usually a series of bilaterally arranged cirri very similar in every way to those of *P. bimaculatus*, those appearing with the greatest frequency being one on the base of each dorsal arm, one on the median line where the umbrella joins the head, one at the posterior point of the body, and four on the anterior part of the body inclosing a diamond-shaped space between them. A number of other cirri appear in some specimens with great regularity, but those above enumerated seem to exhibit the most constancy (see text fig. 2). However, the entire condition is extremely variable. In some specimens all or part of the cirri are reduced to mere callouses, while in many examples the skin is almost perfectly smooth and all surface ornamentation except the large supra-ocular cirri seems entirely wanting.



FIG. 2.—*Polypus hongkongensis*, outline sketch of a young animal, showing a nearly typical arrangement of the cirri. [76.]

Color in preserved specimens, as in life, very variable. Ordinarily a dark brownish or purplish black above, heavily blotched and maculated; below and on the inner surfaces of the arms and web the tone is paler and yellower. Chromatophores excessively numerous, very minute and dot-like.

The young usually possess essentially similar characters, often showing the arrangement of the cirri with great clearness. They are generally of a lighter and more variegated color, their chromatophores relatively fewer and larger, and are adorned by two rows of especially large, longitudinally elongated chromatophores running along the lower surfaces of the four ventral arms. (Pl. XL, fig. 1.)

The measurements of 12 specimens from various localities are given in the annexed table.

MEASUREMENTS OF POLYPUS HONGKONGENSIS.

Sex and locality.....	♂	♂	♂	♂	♂	♂	♂	♀	♀	♀	♀	♀
	Uyak Bay.	Uyak Bay.	Sta. 4220	Pacific Grove.	Pacific Grove.	Sta. 4349.	Off Coronado Is.	Sta. 4220.	Sta. 4222.	Pacific Grove.	Pacific Grove.	Pacific Grove.
Author's register.....	(142)	(145)	(162)	(146)	(153)	(134)	(81)	(162)	(144)	(143)	(153)	(164)
Total length.....	mm. 365	mm. 345	mm. 230	mm. 220	mm. 172	mm. 130	mm. 220	mm. 250	mm. 208	mm. 313	mm. 181	mm. 39
Tip of body to base of dorsal arms.....	81	76	45	52	37	32	49	57	58	80	38	13
Width of body.....	57	54	39	31	27	22	30	50	41	39	26	11
Neck.....	38	37	25	23	20	16	22	34	28	24	19	8
Head.....	42	39	30	25	22	20	28	37	32	27	21	10
Length of funnel.....	35	31	21	23	16	15	18	25	22	13	17	6.5
Dorsal arm.....	276	233	161	158	113	85	142	171	147	215	122	25
Second arm.....	278	265	165	168	125	95	155	188	149	225	137	26
Third arm.....	265	238	.....	145	130	102	153	192	140	212	130	26
Ventral arm.....	235	190	173	140	112	87	150	183	127	232	120	25
Hectocotylus.....	14.5	9	12	11	5	6	10	.....	.....	.....	.....	.....
Umbrella between dorsal arms.....	62	59	40	20	18	16	22	34	35	42	22	7
Umbrella between ventral arms.....	45	35	33	18	24	11	25	27	27	42	21	7

Type, a male in the British Museum (Natural History).

Type locality, 345 fathoms, off Ino Sima Island, Japan (H. M. S. Challenger), one specimen.

Distribution: China, Hongkong (Hoyle). Japan, off Ino Sima Island (Hoyle), Aburatsubo (Wülker). Kamschatka, Avatcha Bay (Dall). Alaska—Shumagin Islands; Humboldt Bay, Popoff Island; Karluk, Kodiak Island; Uyak Bay; Sitka (Dall). British Columbia, Victoria (Taylor). Washington, near Port Townsend. California—Crescent City; Point Reyes; San Francisco (Gabb); San Francisco Lightship; Oakland; Half Moon Bay; Monterey Bay at Monterey and Pacific Grove; Avalon and Isthmus Cove, Santa Catalina Island; off San Nicolas Island; San Pedro (Williamson); La Jolla (Baily); San Diego. Lower California, off Los Coronados Islands; Scammons Lagoon (Gabb).

Sixty-three specimens have been seen from various localities as set forth in the following table:

SPECIMENS OF POLYPUS HONGKONGENSIS.

No.	Locality.	Depth in fathoms.	Collector.	Sex.	Where deposited.	Remarks.	Author's register No.
1	Shumagin Islands, Alaska		W. E. Ritter, June, 1899	(?)	Univ. Cal.	Fragments	73
1	Humboldt Bay, Popoff Id., Alaska.		July, 1899	♀	do		169
3	Karluk, Kodiak Islands, Alaska.	Shore.	C. Rutter, 1903	♀	Stanford Univ. Coll	Juv	154
1	Uyak Bay, Alaska	Seine.	Albatross, 1903	♂	Cat. 214319, U.S.N.M.		142
1	do	do	do	♂	do		145
1	Vicinity of Port Townsend, Wash.	15-26	Albatross station 4205	♂	do	Juv	149
1	do	24-25	4209	♂	do	do	156
3	do	16-31	4220	2♂ 1♀	do		162
1	do	39	4222	♀	do	Juv	144
1	Crescent City, Cal.	Shore.	W. F. Thompson, June, 1911	♂	Stanford Univ. Coll	do	214
1	Point Reyes, Cal.	do	Nov. 17, 1892	♂	do	do	151
1	San Francisco Lightship, Cal.	do	Mr. Turkington, Dec., 1910	♂	Univ. Cal	do	168
1	Oakland Wharf, Oakland, Cal.	do	J. W. Wood	♂	do	do	170
2	Half Moon Bay, Cal.	Shore.	F. W. Weymouth, June, 1911	♂	S. S. B. coll	do	240
2	Monterey Bay, Cal.	49-51	Albatross sta. 4453	♂♀	U.S.N.M.	do	161
1	do	40-46	4457	♂	do	do	155
1	do	36-51	4464	♂	do	do	150
1	do	43-44	4482	♂	do	do	159
1	do	18-20	4489	♂	do	do	158
4	do	26-27	4492	♂	do	do	160
4	Pacific Grove, Cal.		(?)	1♂	Stanford Univ. Coll	3 juv	143
3	do	Shore.	H. Heath	1♂ 2♀	do	do	146
3	do	do	do	1♂ 2♀	do	do	153
4	do		(?)	♂	do	Juv	164
4	do	Shore.	S. S. Berry, June, 1906	♂	S. S. B. coll	do	394
1	Near Avalon, Santa Catalina Island, Cal.	46	Univ. Cal. sta. xxviii	♂	Univ. Cal.	do	82
1	Isthmus Cove, Santa Catalina Island, Cal.		xxviii	♂	do	do	77
1	Off San Nicolas Island, Cal.	32-33	Albatross sta. 4420	♂	U.S.N.M.	do	157
1	Vicinity of San Diego, Cal.	101-129	4364	♂	do	do	152
2	do	75-134	4349	♂♀	do	do	134
1	Off San Diego, Cal.	307	Univ. Cal. sta. LXVIII	♂	Univ. Cal.	do	83
2	do	307	do	♂	do	do	87
2	Near Los Coronados Islands, Lower California.	163-183	Univ. Cal. station LXII	♂	do	do	84
1	do	18-24	LVII	♂	do	do	76
3	do	15-18	LVIII	1♂ 1♀	do	do	81
1	(?)		Voy (?)	♂	do	do	167

The most abundant West American littoral devilfish has had a checkered history. Insufficiently described by Gabb under a preoccupied name from specimens not as well preserved as they might have been, it has remained unrecognizably figured for years (with the exception of the Japanese specimen in the Challenger Report) and local writers have suffered few qualms in using the name as a general term to cover all the species of *Polypus* on the coast. The first reasonably complete account of its characters is that given by Verrill (1883) and is scarcely to be improved upon except as regards his treatment of the surface papillation, which in his specimens was either ill preserved or else not typical. Hence in the Challenger Report (1886) Hoyle found it easy to regard the *Octopus hongkongensis*, described by him the previous year, as identical. In this respect I have had more difficulty, although on the whole I have

deemed it best as well as easiest to follow in the path already made for me. Examination of the well-preserved material in the Albatross collection has led me to incline strongly to the opinion that though closely related the two forms are in reality distinct. Although Prof. Joubin has described a supposed *P. punctatus* from Kamchatka, the habitats are still widely separated. If the Japanese specimens are typically like the excellent figure in the Challenger Report, I think they are clearly either a different species from the California-Alaska *Polybus* or at least a pretty well defined geographical subspecies. Should this view prove correct, I would suggest for the West American form the name *P. apollyon* (from the Greek ἀπολλών=destroyer),^a but for the present at least the safest course seems to be to lump them under *P. hongkongensis*, as given above. Further investigation of material from Japan may show the presence of bilaterally symmetrical cirri having the arrangement seen in their trans-Pacific brethren, but no specimens from the region have been available for comparison, so the whole question must be left unsettled.

It is a distressful fact that we find the time-honored name of Gabb to be untenable, but, unless the citation of d'Orbigny be in error, there would appear to be no alternative, even though the *Octopus punctatus* of Blainville seems really to have been an *Argonauta*, probably *A. hians* Solander. The use of the scarcely appropriate term *hongkongensis* affords but little consolation. In one way, however, it is fortunate that we are able to reject Gabb's name, since I am informed that his type shared the fate of so many other priceless zoological treasures in the San Francisco conflagration of 1906 and is no longer available.

Although the individuals commonly encountered in tide pools and crevices along rocky beaches are not especially remarkable in respect to size, their fellows inhabiting the more secluded nooks offshore are sometimes uninvitingly formidable, and, if all reports may be believed, we are here dealing with possibly the largest known species of the genus. It is not yet entirely certain whether the large examples reported from Alaska are really identical with this, but the following quotation from Dall (1873, p. 484-485) will give some idea of the size attained by them:

"The *Octopus punctatus* Gabb, which occurs at Sitka abundantly, reaches a length of 16 feet or a radial spread of nearly 28 feet, but the whole mass is much smaller than that of the decapodous cephalopods of lesser length. In the *Octopus* above mentioned, the body would not exceed 6 inches in diameter and a foot in length, and the arms attain an extreme tenuity toward their tips."

I have elsewhere remarked (1911a, p. 303) upon certain fragments of a very large specimen in the collection of the University of California, which probably belong to this species and were obtained at the Shumagin Islands, Alaska, by Dr. William E. Ritter. Remains of two almost equally large animals taken by Mr. F. W. Weymouth near Half Moon Bay, California, have since been examined by me. The entire buccal mass of the larger of these measures in alcohol 39 by 52 mm. Unfortunately no further parts were preserved so their reference to the present species can scarcely be taken as established.

Holder (1899) has reported an *Octopus (Polybus)* seen near Avalon, California, the arms of which had a radial spread of about twenty feet. There are frequent newspaper tales of conflicts with creatures even larger, which do not seem to belong entirely to the realms of fancy.

The affinities of *P. hongkongensis* are chiefly with *P. gilbertianus* and with the very nearly related *P. döfleini* Wülker from Japan. The latter species is stated to differ from *P. hongkongensis* chiefly in the relative shortness of its arms and the much larger hectocotylus.

***Polybus gilbertianus* new species.** (Pl. xxxv, figs. 4-5; pl. xxxvi, fig. 2; pl. xxxvii.)

Body of moderate size, rounded pyriform in shape, a little broader than long; surface covered everywhere with numerous minute rough papillæ (pl. xxxv, fig. 4), which give the skin a somewhat grainy texture; papillæ extending well over the arms and outer surface of the umbrella, but becoming obsolete ventrally; more numerous, more irregular, and larger in the region of the eyes than elsewhere, and there is a large soft flattened blunt tubercle above and slightly behind the center of each eye.

^a In which case the above-mentioned male specimen (no. 142) from Uyak Bay, Alaska, should be taken as the type.

Head short, very broad, and separated from the body by the usual slight constriction. Eyes rather large, somewhat protruding. Funnel broad at the base, tapering rapidly to a truncate nearly cylindrical extremity; free distally for a little less than half its length.

Arms rather long, attaining about three and one-half times the length of the body; slender, attenuate slightly unequal, the order of length in general being 2, 3, 4, 1; united at base for about a quarter of their length by the strong umbrella, which is best developed between the lateral arms, shortest between the ventral pair; membrane continuing from the umbrella along the outer surfaces of the arms very pronounced, wide, and traceable nearly or quite to their tips. Suckers in two rows, rather large, little elevated; in the male some four to eight suckers near where the web joins the arm are somewhat larger than the others. Third right arm in the male very much shorter than either its mate of the opposite side or any of the remaining arms, less attenuate, its marginal membrane much wider and furnished with a slightly incurved margin to form the usual narrow canal, terminating in a small conical papilla; hectocotylus relatively large and stout, deeply channeled, the groove narrow and abrupt at first, but widening and flattening distally to some degree; inner surface very rugose, rendering the transverse groovings quite obscure. (Pl. xxxv, fig. 5.)

Beak and radula not examined.

Color of preserved specimens a deep brownish claret slightly mottled with a darker shade above, paler below. Some of the color dissolves out in alcohol and the accompanying station label is stained a heavy pinkish brown.

Young unknown.

MEASUREMENTS OF POLYPUS GILBERTIANUS.

	♂ Type, station 4228.	♂ Cotype, station 4253.
	<i>mm.</i>	<i>mm.</i>
Total length.....	300	355
Tip of body to base of dorsal arms.....	65	79
Width of body.....	52	59
Neck.....	37	42
Head.....	44	45
Length of funnel.....	28	34
Dorsal arm.....	206	265
Second arm.....	232	275
Third arm.....	168	195
Ventral arm.....	213	265
Hectocotylus.....	21	33
Umbrella between dorsal arm.....	49	40
Umbrella between ventral arm.....	37	50

Type, catalogue no. 214,320, U. S. National Museum (no. 139 of author's register.)

Type locality, Albatross station 4228, vicinity of Naha Bay, Behm Canal, Alaska; depth 41-134 fathoms, gravel and sponge bottom.

Distribution, Behm Canal and Stephens Passage, Southeastern Alaska.

The type and one other specimen examined as given below:

No.	Locality.	Depth in fathoms.	Collector.	Sex.	Where deposited.	Author's register number.
1	Behm Canal, Alaska.....	41-134	Albatross station 4228.....	♂	U. S. Nat. Mus., cat. no. 214320.	139
1	Stephens Passage, Alaska.....	188-131	4253.....	♂	.....	140

The relationships of *P. gilbertianus* are all with the confusing group of species of which *Octopus punctatus* Gabb was the earliest described member, and I have been quite puzzled as to how best to deal

with it. In its red color, as well as its minutely and evenly warted surface without large cirri except over the eyes, it agrees with the description and figure of *P. hongkongensis* in the Challenger Report, but differs in the longer ventral arms and much more prominent hectocotylization. It may be that the old view is right and all these protean forms are referable to *P. hongkongensis*, but among all the Polypi from Alaska to San Diego which I have examined I have seen no specimens save the two noted above having features approximating any of the characters which I have taken to be distinctive of *P. gilbertianus*. For the present at least it seems that the greatest good will be accomplished by keeping them distinct.

It is a pleasure to be able to affix to this fine species the name of Dr. C. H. Gilbert, of Stanford University, as a slight recognition of the friendly aid he has so often lent to the writer.

***Polyopus californicus* Berry, 1911.** (Pl. xxxv, fig. 6-7; pl. xxxviii; pl. xxxix, fig. 1-2; pl. xl, fig. 2-3.)

Polyopus californicus Berry, 1911, p. 590.

Animal of moderate size; its body short, rounded, full, plump, truncate behind, slightly broader than long, its general consistency in specimens preserved in alcohol very firm and compact. Surface densely covered with numerous large stellate papillæ of a very characteristic form and appearance, the skin between them smooth; these are often so thickly palisaded together on the dorsal surface of the body in the adult that the spaces between them are reduced to mere crevices (pl. xxxv, fig. 7); on the head fewer and more distant (pl. xxxv, fig. 6), becoming again more numerous though smaller on the base of the arms; further out on the arms as well as over the entire ventral surface the papillæ are much smaller and often nearly obsolete, the transition taking place very suddenly in the lateral region.

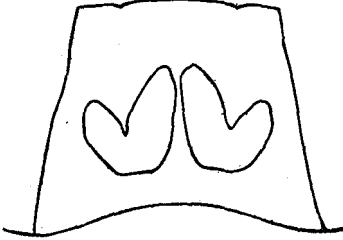


FIG. 3.—*Polyopus californicus*, outline sketch of the interior of the funnel viewed from below, showing the funnel organ, $\times 2.1$ [132].

Head short and broad, but narrower than the body, from which it is separated by a slight but definite constriction. Eyes of moderate size, each surmounted by a rather indistinct (due to flattening?) branched cirrus somewhat larger than the neighboring papillæ. Funnel rather long, conical, broadly adherent to the under surface of the head for the greater part of its length, the free extremity extending just past the origin of the arms. Funnel organ large and conspicuous, comprising two thickened, rather narrowly separated, V-shaped cushions, the inner arm of each larger and longer than the outer. Mantle opening broad, full, its margin rounded and thickened.

Arms stout, but only of moderate length, being usually from two and one-half to three times as long as the body and head; relative length very variable, the two sides rarely possessing the same formula, and an identical relative order persisting in hardly any two specimens examined except that the third right arm in the male is constantly less attenuate than the others and about a third shorter. Umbrella well developed, extending between the arms for about one-fourth of their length, and thence continuing along each arm to its extremity as a highly contractile fleshy fold or web; umbrella proper nearly even all around, but slightly shortest between the arms of the dorsal and ventral pairs.

Suckers rather large, in two apparent rows except two or three at the base which are in a single row. In the male some half dozen of the suckers near the junction of the umbrella with the arm are notably the largest, very large, flattened and disk-like (pl. xxxix, fig. 2). Hectocotylized portion of the third right arm in the male relatively enormous, thickened and massive; in general plan much like the figure given by Verrill for that of *Octopus punctatus*, but much more deeply, narrowly, and sharply channeled, and with the transverse grooving more pronounced; basal papilla very blunt, short, and conical (pl. xxxix, fig. 1).

Beak and radula not examined.

Color in alcohol a livid pinkish brown, lighter below; quite unlike that of any of the other species here described. Chromatophores numerous, small, round, brownish, and well distributed.

The distinctive characters of the species are assumed very early in the development of the young. In juvenile animals the papillæ are a little more sparsely scattered, the eyes exceedingly prominent,

the body more delicate, and the color lighter. Furthermore the chromatophores are relatively somewhat, fewer, but they are very small and do not show the definite arrangement so characteristic of the young of *P. hongkongensis*, *P. bimaculatus*, and other species. Two individuals exhibiting these features are shown in plate XL, figures 2 and 3.

The detailed measurements of eight specimens from the Albatross collections are given in the accompanying table.

MEASUREMENTS OF POLYPUS CALIFORNICUS.

Sex and locality.....	♂ Sta. 4325.	♂ Sta. 4325.	♂ Sta. 4325.	♂ Sta. 4339.	♀ Sta. 4369.	♀ Sta. 4323.	♀ Sta. 4323.	Juv. Sta. 4366.
Author's register.....	131	131	131	132	133	135	135	129
	<i>mm.</i>	<i>mm.</i>	<i>mm.</i>	<i>mm.</i>	<i>mm.</i>	<i>mm.</i>	<i>mm.</i>	<i>mm.</i>
Total length.....	308	290	265	350	277	250	260	68
Tip of body to base of dorsal arms.....	89	90	82	108	75	74	72	28
Width of body.....	67	62	58	68	73	62	63	19
Neck.....	46	47	42	44	54	48	46	16
Head.....	50	52	47	48	51	54	53	16
Length of funnel.....	36	34	33	36	29	29	26	10
Dorsal arm.....	^a 156	201	176	^a 166	203	190	185	49
Second arm.....	238	206	205	265	200	185	196	51
Third arm.....	159	149	140	208	203	^a 171	^a 180	50
Ventral arm.....	210	192	272	250	196	170	170	50
Hectocotylus.....	28	21	25	36	.....	.....	.....	.....
Umbrella between dorsal arms.....	50	47	43	62	50	40	50	15
Umbrella between ventral arms.....	52	40	41	45	28	29	38	14

^a Mutilated.

Type, catalogue no. 214321, U. S. National Museum; a male (from no. 131 of the author's register).

Type locality, Albatross station 4325, vicinity of San Diego, California, 191-292 fathoms, bottom of green mud and fine sand; three specimens, March 8, 1904.

Distribution: Offshore in rather deep water, Monterey Bay, off Santa Catalina Island, and in vicinity of San Diego, California.

Sixteen specimens from ten stations have been examined, as follows:

SPECIMENS OF POLYPUS CALIFORNICUS.

No.	Locality.	Depth in fathoms.	Collector.	Sex.	Where deposited.	Author's register.
1	Vicinity of San Diego, Cal..	95-135	Albatross station 4312	Juv.	.....	127
2	do.....	193-227	4323	.....	.....	135
1	do.....	191-292	4325	.....	U. S. Nat. Mus., cat. no. 214321 (type).	131
2	do.....	do	4325	.....	Cotypes.....	131
1	do.....	241-369	4339	.....	.....	132
1	do.....	167-191	4338	Juv.	.....	128
4	do.....	130-158	4365	Juv.	.....	126
1	do.....	176-181	4366	Juv.	.....	129
1	do.....	260-284	4369	.....	.....	133
1	Off Santa Catalina Island, Cal.	152-162	4413	Juv.	.....	130
? 1	Monterey Bay, Cal.....	1,006-1,041	4536	Juv.	.....	136

This species is well separated from any other form known to me by the color and consistency of its body, prominent hectocotylization, wide mantle opening, adherent funnel, characteristic funnel organ, and very distinctive surface ornamentation; features which enable even very young specimens to be recognized without difficulty. Indeed the very young of practically all our Polypi are apt to be more readily separable upon casual examination than the adults of the corresponding species. The surface papillation which is the subject of so great change and variation in other species is here surprisingly constant and strongly inclines one to the belief that at least within certain limits this should be regarded

as one of the most important diagnostic characters of the group, at least so far as distinguishing between species is concerned.

Polypus californicus appears to be the most common offshore *Polypus* of the Southern California coast, but no specimens have as yet been taken from a depth less than about 100 fathoms. The single abyssal specimen accredited in the above table to Monterey Bay is not only young but has undergone so much contraction that its identity must not be regarded as fully established, and hence the great extension in bathymetric as well as geographic range which it represents may be an error.

***Polypus leioderma* Berry, 1911.** (Pl. xxxv, fig. 1; pl. xl, fig. 4-5.)

Polypus leioderma, Berry 1911, p. 590.

Body of rather small size; very firm, short, plump, and compact; wider than long, broadest posteriorly; truncately rounded. Integument smooth except for a number of short, rather obscure, simple papillæ or cirri scattered over the dorsal surface of the head, neck, and anterior part of body; there is one such tubercle over each eye, the remainder likewise showing a bilateral arrangement and widely scattered, the most notable being a nearly equidistant row of four between the eyes, two along the median line just behind, and a number of lateral ones. Bounding the body laterally, and extending from a point just posterior to the mantle margin and above the gill on either side, is a narrow and thin but distinct keel-like fold of the integument, which, though somewhat obscured in places, is still clearly traceable all the way round. There are also a number of deep transverse folds in the nuchal region, but these seem due to contraction and not of a permanent nature.

Head short, broad, poorly defined by a slight constriction from the wider body. Eyes large and protruding. Funnel long, rather slender, extending well past the base of the arms.

Arms decidedly unequal, two to three times as long as the body, their order of length 1, 2, 3, 4; the dorsal arms decidedly the stouter and longer and the ventral arms the reverse. Umbrella well developed, extending between the first, second, and third arms for over a fourth of their length, and thence continuing along their outer margins to their tips as a very broad prominent contractile membrane; shorter between the third and fourth arms, and even more reduced between the ventral arms where it attains scarcely half its former length, although the webbing to the extremities of the arms is the same. Suckers in two rows, rather small, and relatively very numerous.

Beak and radula not examined.

Color over the body a very pale gray-buff, somewhat suffused with a purplish brown; arms and umbrella darker. Chromatophores small and pale in color; of two distinct types, one being larger, sparser, and darker than the other. The two largest specimens obtained have the following dimensions:

MEASUREMENTS OF POLYPUS LEIODERMA.

	♀ Type, station 4293.	♀ Station 4526.
Total length.....	210	92
Tip of body to base of dorsal arms.....	45	29
Width of body.....	40	20
Neck.....	36	17
Head.....	31	19
Length of funnel.....	25	14
Dorsal arm.....	150	65
Second arm.....	138	61
Third arm.....	129	55
Ventral arm.....	117	49
Umbrella between dorsal arms.....	47	18
Umbrella between ventral arms.....	17	10

Type, catalogue no. 214322, U. S. National Museum; a female (no. 137 of the author's register).

Type locality, Shelikof Strait, Alaska, Albatross station 4293, 112-106 fathoms, bottom of blue mud and fine sand; one specimen.

Distribution: Shelikof Strait, Alaska; Gulf of Georgia, British Columbia; Monterey Bay, California, in rather deep water.

Four specimens have been seen, all obtained by the Albatross.

No.	Locality.	Depth in fathoms.	Collector.	Sex.	Where deposited.	Author's register.
1	Shelikof Strait, Alaska	106-112	Albatross station 4293.....	♀	U. S. Nat. Mus., cat. no. 214322 (type).	137
1	Gulf of Georgia	111-170	4194.....	♀	U. S. Nat. Mus	173
2	Monterey Bay, Cal.....	204-239	4526.....	♀	U. S. Nat. Mus	138

After comparison with such specimens, figures, and descriptions as have been available, I have been unable to refer the four specimens upon which I have based this species to any of the named forms either from the west coast of America, from the Hawaiian Islands, or from Japan. From all its congeners in this region it differs strikingly in the carinated membrane surrounding the body and in the remarkable smoothness of its skin. The shortness of the arms relative to the body, their formula, and the reduction of the umbrella between the ventral arms are also to be noted. Probably none of the specimens at hand are quite mature. As there are unfortunately no males in the collection, the character of the hectocotylyzation and other sexual features are not yet known.

The smallest specimen, having a total length of but 32 mm., exhibits all the characters of the adult, although in a juvenile way. It is in every way more delicate, and the chromatophores are fewer, darker, and much more distinct.

Polypus (sp.) juv.-

There is a small specimen in the Albatross collection (my register no. 141) which is of uncertain identity, though clearly not the young of any of the species described in this paper.

It has a small ovoid body, more or less pointed behind, ornamented above with a few obscure, roundish, flattened papillæ; mantle opening wide and full. Head small; eyes large; funnel broad, compressed. Arms rather short, subequal, connected at the base by a delicate umbrella. Suckers elevated, in two rows. The tip of the third right arm appears to show faint traces of future hectocotylyzation.

Chromatophores numerous, of various sizes, very distinct; especially minute and dot-like on the ventral surface, where they are relatively fewer in number and show a bilaterally symmetrical arrangement; two alternating rows of similar small ones appear on the ventral arms. Parts of the animal show a slight metallic luster.

Total length, 28 mm.; length of body, 11 mm.

From Albatross station 4550, 50-57 fathoms, Monterey Bay, California, bottom of green mud and rock.

The specimen shows certain resemblances to one in the University of California collection from Catalina Harbor, California, which has already been noted by me (1911a, p. 303), but I doubt if they are identical. ^a

^a I am not acquainted with the *Polypus digueti* (Perrier and de Rochebrune), which I have treated as extralimital for the purposes of the present paper. The principal portion of the original description is as follows (1894, p. 770):

"OCTOPUS DIGUETI E. PERR. ET ROCHBR.

"Corps bursiforme, court; tête modérément large, assez brusquement tronquée en avant, au-dessus des yeux; ceux-ci d'une extrême petitesse; bras tous d'égale longueur, subquadrangulaires, se terminant en point aiguë; ombrelle étroite, envoyant des prolongements minces jusque vers la première moitié externe des bras; ventouses disposées sur deux rangs, celle de la base des

DECAPODA.

MYOPSIDA.

The eyes are without free lids, although sometimes with a thickened fold forming a pseudo-lid; their transparent covering membrane continuous with that of the head. The tentacles are usually completely retractile. The oviduct is developed on the left side only. In some cases glandular luminous organs are present.

Family SEPIOLIDÆ Leach, 1817 (em.).

Genus ROSSIA Owen, 1834.

Rossia Owen, 1834, p. 93.

Sepiolid decapods having the mantle free all round and (in addition to the funnel cartilages) articulating with the head in the nuchal region by an ovate cartilage. Sessile arms short, with two to four rows of spherical suckers. Tentacular arms almost entirely retractile. Both dorsal arms hectocotylized. Gladius present but much reduced.

A glandular luminous organ is known to be present in at least part of the species, situated just behind the funnel.

Type, *Rossia palpebrosa* Owen, 1834, a species of the Arctic region.

Rossia pacifica Berry, 1911. (Pl. XLI-XLII; pl. XLIII, fig. 1-4; pl. XLIV, fig. 1, 5.)

Rossia pacifica Berry, 1911, p. 591.

Body smooth, sepioliform, moderately large; the mantle full, somewhat flattened above and below; rounded behind; some specimens relatively short, others more slender. Fins large, subcordate, with a free anterior lobe, their attachment more or less oblique to the general plane of the body. Mantle margin free all round, articulating with the head by an elliptical cartilage in the nuchal region, and a deep elongate groove with a prominent raised margin on either side of the base of the funnel; the ridges corresponding to the latter on the inner surface of the mantle nearly straight and notably long and heavy.

Head very large, as wide as or wider than the body, and much flattened. Eyes large, the lower lids free. Funnel short, conical, broad at the base, the extremity truncate; interior capacious, transversely plicate, finely striate longitudinally; a delicate, rounded, flaplike valve on the dorsal wall near the tip. Funnel organ prominent, comprising a large median liver-shaped pad and two elongate-pyriform, flattened pads laterally placed on the interior surface of the ventral wall; the latter broad and curving inward at the base, the margins slightly raised, and the center apt to be occupied by a somewhat sunken triangular area (pl. XLIV, fig. 5).

Arms stout, thick, rather short, unequal, the order of length 3, 4=2, 1; third pair joined with the fourth by a well-developed web, functioning as a sheath for the tentacles; slight rudiments of an umbrella also to be detected between all the other arms except the ventral pair; obscure carinations

bras, larges, espacées, celles de la dernière moitié de ces organes, très petites et excessivement rapprochées. Couleur dans l'alcool, d'un violet sombre sur les régions supérieures, jaunâtre en dessous, finement pointillée de violet pâle. Longueur totale du corps y compris la tête σ^m , 033. Largeur maxima σ^m , 021. Longueur moyenne des bras σ^m , 055.

"Cette forme présente une certaine analogie avec *Octopus punctatus* Gabb., également de la basse Californie, mais il en diffère par une taille toujours petite, tandis que *O. punctatus* peut acquérir de fortes dimensions; également aussi par la longueur uniforme de tous les bras, par la petitesse exceptionnelle des yeux, la disposition de l'ombrelle et des ventouses, enfin par l'aspect plus trapu du corps et sa coloration, dont il faut tenir compte pour la distinction des espèces du genre *Octopus*."

It is stated to come from Lower California and to live as a commensal organism between the valves of certain lamellibranch mollusks inhabiting those coasts, very much after the manner of the common mussel-crab (*Raphonotus*). Should the truth of this be verified, the species and its unique habit are most remarkable.

or keels present along the outer surfaces of all the arms in some specimens, but prominent only on the third pair. Suckers spherical, oblique; in two rows at the base and tip of all the arms, but in the adult often extremely crowded along the middle, where they are apparently ranked in three to four rows; indications of this condition always present, at least in fully grown individuals, but in a few specimens (notably a female from Albatross station 4457) the two-rowed condition persists over all except a very small portion of the arm; sucker openings circular, minute; horny rings well developed, with entire margins.

The detailed structure of the arms in the two sexes differs greatly. In the female, the arrangement of the suckers on none of the arms is essentially unlike that on the others, and suckers occupying analogous positions in the different rows differ very little, if any, in form or size. The males present a greatly modified condition. Here both dorsal arms are hectocotylyzed; strongly recurved, their suckers greatly reduced; the latter usually in two rows^a until just before the tip is reached, when they become increased to four for a small space, then reduced to two again at the extremity; bases of the sucker pedicels (especially those of the outer row) much enlarged and transversely compressed to form a prominent series of transverse folds or ridges very similar to those already described by Steenstrup and others as obtaining in *R. macrosoma* (pl. XLIII, fig. 2). There is a narrow marginal membrane on the inner side of these arms and a much wider and more prominent one along the outer margin. Above the latter and constructed parallel with it so as to form a deep fossa is a second membrane extending distally from the base of the arms for more than half their length (pl. XLIII, fig. 3). The suckers of the remaining arms are much enlarged, but otherwise much as in the female; those of the second and third pairs best developed and most densely placed; largest at the middle of the arm, gradually decreasing in size toward the tips, but subequal in all the rows at the same point on the arm (pl. XLIII, fig. 2). In young males the suckers are two-rowed and very irregularly unequal in size.

Tentacles variable; sometimes longer than the body, but often completely retracted; stout, the inner surfaces flattened and with a distinct median groove. Tentacular club elongate; but little expanded; the sucker bearing area bordered by a narrow marginal membrane, outside of which dorsally and parallel is a second much larger and wider membrane, the latter when expanded nearly half as wide as the club itself (pl. XLIII, fig. 4). Suckers small, unequal; largest dorsally at the base, thence gradually decreasing in size ventrally and toward the tip; in but two to three rows at the extreme base, but thence multiplying to as many as seven or eight near the middle; cup-shaped, with wide apertures, moderately long peduncles, and horny rings furnished with numerous small blunt teeth.

Gladius slender, lanceolate, shorter than the mantle, very thin and delicate posteriorly.

Skin everywhere smooth, without papillæ, although some specimens show a number of definite but more or less obscure grooves or plicæ running longitudinally on the dorsal surface of the mantle.

Color in life unknown; in alcohol reduced to the usual brownish buff, heavily punctate above and in less degree below with purplish chromatophores, which extend even over the fins, though fewer on their under surfaces and margins.

The more important measurements of twelve specimens of both sexes are given in the appended table.

^a In a few specimens (station 4377) the four-rowed condition extends over the greater portion of the arm.

MEASUREMENTS OF ROSSIA PACIFICA.

Locality.....	Boca de Quadra, Alaska.	Admiralty Inlet, Alaska.	Behm Canal, Alaska.	Monterey Bay.	Monterey Bay.	Monterey Bay.	Monterey Bay.	Monterey Bay.	Monterey Bay.	Var. diegensis.		
										San Diego.	San Diego.	San Diego.
Sex.....	♀	♂	♂	♂	♂	♂	♀	♀	♀	♂	♂	♀
Station.....	Sta. 4223	Sta. 4220	Sta. 4234	Sta. 4446	Off Salinas R.	Sta. 4492	Sta. 4492	Sta. 4457	Sta. 4446	Sta. 4377	Sta. 4356	Sta. 4356
Total length, excluding tentacles.....	mm. 105	mm. 69	mm. 75	mm. 80	mm. 76	mm. 73	mm. 80	mm. 88	mm. 96	mm. 50	mm. 52	mm. 72
Length of mantle (dorsal).....	48	31	32	33.5	31	30	37	42	45.5	22	23	32.5
Width of body.....	31	19	18	22	21	22	26.5	27	25.5	16	14	19
Across fins.....	68	36	39	44.5	40	43	48	51	52	31	31	44
Length of fin (extreme).....	33	19	19	23	19.5	20	24	28.5	27	15	15	21
Length of fin at plane of attachment.....	25.5	17	15	17.5	15	16.5	19	22	23	11	11	16
Width between eyes.....	22	18	18	18	18.5	18	21	23	23	16	13	18
Length of dorsal arm.....	34	26	24	30	26	28	28	29	30	20	18	23
Second arm.....	36	28	29	32	32	31	30	37	34	22	20	24
Third arm.....	42	29	33	36	38	33.5	34	39	35	23	23	27
Ventral arm.....	39	25	29	33	32	29	30	35	34	20	21	23.5
Tentacle, excluding club.....	57	10	12.5	.....	53	15	11	45	9	15	15	9

Type, cat. no. 214323, U. S. National Museum.

Type locality, Albatross station 4233, Behm Canal, Alaska; 39-45 fathoms, bottom of soft gray mud and rock, July, 1903; 12 specimens.

Distribution: Alaska—Chignik Bay; Kasaan Bay; Behm Canal; Boca de Quadra. Washington—Admiralty Inlet; "Puget Sound". California—Monterey Bay and vicinity of San Diego (var. *diegensis*).

A very considerable amount of material has been examined, comprising in all some 122 specimens, as follows:

SPECIMENS OF ROSSIA PACIFICA.

No.	Locality.	Collector or station.	Depth in fathoms.	Sex.	Where deposited.	Remarks.	Author's register.
3	Alaska: Chignik Bay.....	Albatross station 4286.	57-63	2♂ 1♀	.....	.....	26
1	Kasaan Bay.....	4243.	42-47	♂	.....	.....	22
2	do.....	4242.	9-24	♂♀	.....	.....	12
7	Behm Canal.....	4234.	45	6♂ 1♀	.....	.....	29
11	do.....	4233.	39-45	7♂ 4♀	Cat. no. 214323, U.S. N.M.	Type lot.....	21
1	do.....	4227.	62-65	♂	.....	.....	8
5	do.....	4226.	31-62	2♂ 3♀	.....	.....	23
2	Boca de Quadra.....	4223.	48-57	♂♀	.....	.....	13
1	Washington: Admiralty Inlet.....	4222.	39	♂	.....	.....	14
1	do.....	4220.	16-31	♂	.....	.....	5
1	do.....	4218.	16	♂	.....	.....	6
16	Puget Sound.....	Shrimp fishermen, 1909.	.....	6♂ 10♀	Stanford Univ., Cal.	.....	55-56
7	California: Off Salinas R., Monterey Bay.....	H. Heath, June 25, 1908.	.....	2♂ 5♀	do.....	.....	24
2	do.....	Fish trawl.....	20-30	♀	do.....	.....	2
11	Monterey Bay.....	Albatross station 4492.	26-27	4♂ 7♀	do.....	.....	27
2	do.....	4480.	53-76	.....	.....	.....	4
1	do.....	4475.	58-142	.....	.....	.....	10
1	do.....	4473.	54-65	.....	.....	.....	3
3	do.....	4457.	40-46	.....	.....	.....	15
1	do.....	4455.	56-62	.....	.....	.....	7
2	do.....	4453.	49-51	.....	.....	.....	9
2	do.....	4452.	49-50	♂♀	.....	.....	25

SPECIMENS OF *ROSSIA PACIFICA*—Continued.

No.	Locality.	Collector or station.	Depth in fathoms.	Sex.	Where deposited.	Remarks.	Author's register.
4	California—Contd. Monterey Bay	Albatross station 4446.	52- 59	2 ♂ 2 ♀			28
1	Vicinity of San Diego	4377.	127-299	♂		Var. <i>diegensis</i> ..	20
11	do.	4305.	130-158	5 ♂ 6 ♀		do.	11
5	do.	4304.	101-129	2 ♂ 3 ♀		do.	18
1	do.	4358.	167-191	♀		do.	1
7	do.	4357.	134-155	4 ♂ 3 ♀		do.	17
9	do.	4356.	120-131	2 ♂ 7 ♀	Cat. no. 214376, U. S. N. M.	do., types..	19
1	do.	4310.	71- 75	♂		do.	16

It is strange that I can find no reference in the literature to any Pacific *Rossia*, especially since *R. pacifica* appears to be a most abundant species and has long been known to workers in this region, even appearing as "*Rossia* sp." in a few local lists and manuscripts (if I am correct in assuming that the animals so referred to are the same as those here described). At first some doubt was felt as to the proper status of the present form, but extended study of a very large series of individuals has convinced me that it is distinct from any of the species previously described. The characters relied upon are small and may seem trivial, but appear to be constant even in specimens from widely distant localities, so that no other view seems feasible. The genus is a remarkably homogeneous one, and though a large number of species have been described, many of them differ from one another only relatively and in slight degree. The true value of many of them is certainly not yet established beyond all doubt. Our species appears to be nearest to *R. macrosoma* (Delle Chiaje) d'Orbigny, originally described from the Mediterranean, but there are numerous small discrepancies, notably in the structure of the arms in the male. I have not had the opportunity to examine actual specimens of the European species, but in the excellent figures given by Jatta (1896, pl. 15, fig. 6) only the outer two rows of suckers on the lateral arm suffer enlargement, whereas in *R. pacifica* all are usually subequal. The hectocotylization is similar to that figured for *R. macrosoma*, but differs slightly in detail. Furthermore, the tentacular suckers do not seem to be so thickly distributed in *R. pacifica*, especially at the base of the club.

R. pacifica is one of the most abundant of the littoral West American cephalopods, and it is remarkable that it has escaped a diagnosis so long. The specimens taken show a wide range from southern Alaska to San Diego, and their abundance at both extremes indicates that they will eventually be found to extend far outside of these limits.

There is considerable variation in the shape of the body, the females as a rule being rather shorter and perhaps more plump than the males; but when sex is taken into consideration the measurements in the table (from specimens selected quite at random) are seen to be surprisingly constant, with the exception of the last three columns. The latter were taken from quite deep water in the vicinity of San Diego, California. None of the specimens observed from this region agree entirely with the type, and it is not impossible that they are incorrectly referred to this species. They differ in being uniformly much smaller, in every way more slender and delicate, the fins relatively larger, and the suckers of the sessile arms borne predominantly in two rows, only here and there (notably in the case of the hectocotylized arms) assuming the four-rowed condition. The constant character of these divergences may well be recognized to advantage, so that the subspecific name *diegensis* is here proposed. Should further material from the wide unexplored area intervening between Monterey Bay and San Diego fail to show intergrading forms it is likely that the southern specimens represent a new species. (Pl. XLII, figs. 2-6; pl. XLIII, fig. 1.)

A specimen from Albatross station 4377 is peculiar in that the body is extremely full and short, the head relatively larger than usual; the suckers, irregular in size and in two rows on all the arms, show that this too is only a slightly variant *diegensis*. It should be stated that the four-rowed state seems at best but a secondary one and more apparent than real.

Family LOLLIGINIDÆ d'Orbigny, 1835 (em.)

Genus LOLIGO Schneider, 1784.

Loligo Schneider, 1784, p. 110.
 Lamarck, 1799, p. 10 (pars).
 Verrill, 1881, p. 307.
 Hoyle, 1910, p. 410.

Ten-armed cephalopods of moderate size, with an elongate, tapering, cylindrical body and large terminal triangular or sagittate fins. Mantle connectives of simple structure, the funnel cartilages elongate with a median groove. Funnel attached to the head by a pair of muscular bridles and equipped with an internal valve. Sessile arms angular; umbrella rudimentary or lacking, but the swimming membranes along the arms usually well developed. Only the distal portion of the left ventral arm hectocotylized. Suckers in two rows, alternating, bowl-shaped, furnished with a toothed horny ring surrounded by a raised margin.

Distinguished from its nearest ally, the West Indian and Panamic *Lolliguncula* (perhaps better to be regarded as a subgenus of *Loligo*), chiefly by the fact that the female receives the spermatophores of the male upon a specially developed pad below the mouth, whereas in the last-named group they are received upon a calloused patch within the mantle near the left gill.

Loligo is an important and abundant genus of cosmopolitan distribution, and in number of species is exceeded by *Sepia* alone among the decapods.

Type, *Loligo vulgaris* Lamarck, 1799, a common European species. It is still more or less of a mystery to me how any genus can logically take as its type a species not recognized at the time it was founded and only subsequently established by another author.

Loligo opalescens Berry, 1911. (Pl. XLIII, fig. 5-8; pl. XLIV, fig. 2-4; pl. XLV; pl. XLVI, fig. 4-5.)

? *Loligo Stearnsii* Hemphill, 1892, p. 51, (nomen nudum).

? Hoyle, 1897, p. 370 (8) (no description).

Ommastrephes tryoni Keep, 1904, p. 271, 351 (no description; not of Gabb).

Loligo pealii Jenkins & Carlson, 1903, p. 264 (physiology of nerves).

? *Loligo stearnsii* Williamson, 1905, p. 129 (mere note).

Kelsey, 1907, p. 42 (merely listed).

Ommastrephes tryoni Keep, 1910, p. 297 (no description).

Loligo opalescens Berry, 1911, p. 591.

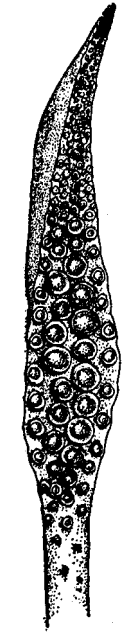


FIG. 4.—*Loligo opalescens*, inner aspect of tentacle club. [1911.]

Body of moderate size; firm, cylindrical, narrow, elongate, slightly swollen near the middle, thence tapering acutely to a rather sharp point behind. Fins large, about half as long as the mantle; sagittate; very slightly lobed in front, barely continuous behind, obtusely angled considerably in front of the middle; their margins thin, entire. Mantle margin truncate, deeply emarginate between the prominent lateral angles on either side of the funnel; produced above into a prominent, squarish, rostrum-like process, rounded at the extremity, which is made up chiefly of a continuation of the dorsal connective cartilage of the mantle around the tip of the gladius. Locking apparatus well developed, comprising the just-mentioned cartilage in the nuchal region, besides a prominent elongate cartilaginous groove and ridge on either side of the funnel; the latter simple, with a raised and reflexed margin (pl. XLIV, fig. 3, 4).

Head small, narrower than the body, squarish, ornamented above posteriorly by three parallel longitudinal folds of integument, the grooves between which correspond to the cartilaginous ribs of the rostrum. Eyes large, not protruding. Siphon rather large, broad, and plump, with dorsal bridles and a large terminal valve.

Arms stout and rather short in the male, sometimes a little longer in the female;^a unequal, the dorsal arms considerably the shortest, but the proportions of the others somewhat variable, usually

^a Perhaps due to the different preservation of the material.

3=2, 4, 1. Umbrella rudimentary between all the arms except the ventral pair, where it is totally lacking; continued upon the dorsal margins of the dorsal arms as a prominent membranous keel; inner margins of second arms bluntly carinate, third arms obscurely so; outer margins of second and third arms with a fleshy keel running to their tips; ventral arms provided with a very broad and prominent web along the outer margin, ensheathing the base of the tentacle, and thence gradually narrowing toward the tip; a similar but much less developed keel extends along the inner margins of the ventral arms. Along the sucker-bearing surface of all the arms runs a delicate membranous swimming web, strengthened by numerous slender transverse trabeculae of a muscular nature, occurring in alternation with the sucker pedicels. Save on the ventral pair, where it becomes much reduced, this web is exceedingly prominent on all the arms, but attains its maximum development on the third pair, where its diameter is seen in well-preserved specimens to be as great or greater than that of the arm itself (pl. XLVI, fig. 4, 5). Suckers small, somewhat kettle-shaped, regularly alternating in two rows, obliquely poised on rather short conical pedicels; margin of cupules hood-like, with a small sinus in the superior margin; horny rings with nine to twelve bluntly rounded, squarish teeth on the upper margin; papillary area wide and very prominent in microscopical preparations (pl. XLIII, fig. 8).

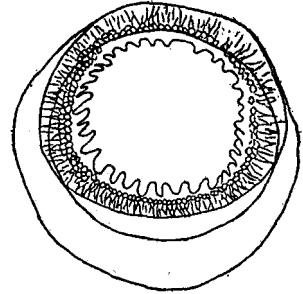


FIG. 5.—*Loligo opalescens*, camera drawing of oral aspect of tentacular sucker of ♀; from a mount in balsam. [101.]

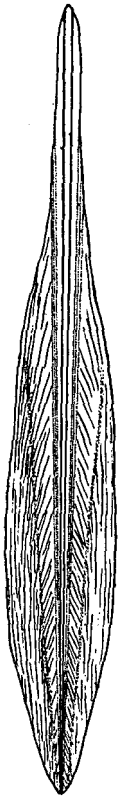


FIG. 6.—*Loligo opalescens*, dorsal aspect of gladius. [69.]

Left ventral arm in the male conspicuously hectocotylized; along the proximal two-thirds of the arm the suckers (about twenty pairs) are unmodified, but along the distal third their pedicels become transversely flattened and elongate, the cups showing a simultaneous diminution in size, a condition especially true of the suckers at the extreme distal end of the outer row, where the cups are reduced to mere rudiments. Toward the end of the inner row the pedicels decrease in size and resume their normal shape, the cups decreasing comparatively little, so that the suckers at the extreme distal end of the row are more nearly normal. The outer row is still further unique, in that some six to eight of the more proximal suckers undergoing modification are much more elevated and have broader pedicels than either those opposite or those succeeding or following them; indeed, throughout the modification of each pedicel and sucker in this row is more complete than that of the corresponding sucker of the inner row (pl. XLIII, fig. 7).

Tentacles of moderate but variable length, highly contractile; the club but slightly expanded, lanceolate, furnished with a pronounced keel and a narrow swimming membrane (text fig. 4). Suckers in four rows, those of the two outermost very small; those of the two median rows much larger, their horny rings armed all round with about thirty-five small, rather elongate, bluntly conical teeth (text fig. 5).

Buccal membrane seven pointed, each point bearing two distinct rows of very minute crowded suckers, seven to nine in a row. The latter have well-developed papillary areas and horny rings with five or six irregularly squarish teeth. There is also an inner buccal membrane like a thickened, radially rugose cushion surrounding the beak (pl. XLIII, fig. 6).

Gladius thin, broadly lanceolate; midrib slender; slight lateral but no marginal thickenings (text fig. 6).

Color in life not observed; color in alcohol a pale buff, with numerous very distinct and beautiful brownish chromatophores scattered profusely over the whole dorsal surface, and in somewhat less degree over the ventral as well.

The young are quite different in general appearance, but are not easily confused with any of the other species inhabiting the same region. Besides other features which are in the main obviously due to juvenility, they differ from the adults chiefly in the much shorter, broader, more rounded fins which gradually assume the typical sagittate outline as they increase in size. A well-advanced embryo is shown in plate XLIII, figure 5.

The more important dimensions of the type, two cotypes, and one other specimen, are appended in the annexed table.

MEASUREMENTS OF *LOLIGO OPALESCENS*.

	Puget Sound.			Off San Diego, station 4324.
	Type. ♂	Cotype. ♂	Cotype. ♀	Immature.
	<i>mm.</i>	<i>mm.</i>	<i>mm.</i>	<i>mm.</i>
Total length, excluding tentacles.....	177	181	222	114
Length of mantle (dorsal).....	132	126.5	146	80
Fins at plane of attachment.....	61.5	58.5	70.5	34
Width of body.....	23	21	25	16.5
Across fins.....	59	56	69	37
Of head.....	20	19	23	15
Length of dorsal arm.....	35	44	52	21
Second arm.....	41	49	63	24
Third arm.....	42	49	66	30
Ventral arm.....	40	46	59.5	26
Tentacle.....	40	41.5	113	49
Tentacle club.....	16	16.5	27	13

Type, no. 2076 of the invertebrate series in the collection of Stanford University, a male. Cotypes in the U. S. National Museum and in the author's collection.

Type locality, Puget Sound, Washington (shrimp fishermen), 3 specimens.

Distribution: Washington—Puget Sound, near Deception Pass. California—Monterey Bay, San Diego.

Three hundred and thirty-six specimens, mostly in a rather indifferent though recognizable state of preservation, have been inspected.

SPECIMENS OF *LOLIGO OPALESCENS*.

No.	Locality.	Collector.	Depth in fathoms.	Sex.	Where deposited.	Remarks.	Author's register.	
3	Puget Sound, Wash....	Shrimp fishermen.....		♂	Inv. ser. no. 2076, Stanford Univ. Coll.	Type.....	101	
				♀		U. S. Nat. Mus.....		Cotype.....
				♂		Coll. S. S. B.....		Cotype.....
1	Near Deception Pass, Wash.	Fish trap (C. H. Gilbert).		♂	Stanford Univ. Coll.		107	
3	Off Salinas River, Cal.	Paladini fish trawl....	20-30	Juv.	do.....		68	
24	Monterey Bay, Cal.....	San Francisco market (C. H. Gilbert).		♂ ♀	do.....		69	
2	do.....	Albatross station 4446.	52-59	Juv.	do.....		63	
3	do.....	4447.	42-52	Juv.	do.....		62	
2	do.....	4449.	22-29	Juv.	do.....		64	
6	Off Pacific Grove, Cal.	Albatross.....			Stanford Univ. Coll....	Embryonic.....	103	
		Stanford Univ. Mar. Lab.		3♂3♀	do.....		59	
282	do.....	do.....		♂ ♀	Not preserved.....		61	
6	Vicinity of San Diego, Cal.	Albatross station 4324.	10	Juv.	do.....		65	
2	San Diego, Cal.....	E. C. Starks.....		Juv.	Stanford Univ. Coll....	From stomach of a yellowtail.	66	
2	do.....	do.....		Juv.	do.....	From stomach of an albacore.	67	

Loligo opalescens is the common squid of the Pacific coast of the United States. It is in many ways suggestive of *L. pealii* Lesueur, its congener from the other side of the continent, and also in some respects recalls *L. gahi* from the Chilean coast, but appears sufficiently distinct from either. The hectocotylized arm in particular is extremely constant in its details, which are unlike those of any other species known to me.

A few words should be said in regard to the synonymy of this species. The first published reference which I have been able to find regarding the occurrence of any *Loligo* on the west coast of North America is a short paper by Hemphill in *Zoe* for 1892 (vol. III, p. 51-52). It is entitled "Note on a California *Loligo*" and, alluding to the occurrence of some species of this genus in the San Francisco markets, publishes the name *Loligo Stearnsii* Hemphill for its reception. The article would be of little importance to us now were it not for the fact that the name applied has found its way into print on a number of subsequent occasions; hence as a matter of interest the entire paper is reprinted in the Appendix following this report. It will be observed that the only "diagnosis" offered is to be found in the lines, "The arms are not webbed," and "it closely resembles *Loligo Gahi*." As it is upon these 10 words alone that the validity of the name *L. stearnsii* must rest, it would seem that Dr. Hoyle was fully justified in his refusal to recognize it as more than a mere *nomen nudum*. The present writer was at first inclined to rehabilitate Hemphill's name and furnish it with the needful description, especially since he could not but believe that the form in hand was really the one here dealt with, but in view of the suspicion that we have more than one *Loligo* on the coast, not to mention the obvious discrepancy in the statement that "the arms are not webbed," the safest course appeared to be to discard the title *L. stearnsii* entirely and adopt an entirely new name.

The known range extends from Puget Sound south to San Diego, Cal., and in its proper season is everywhere abundant, usually occurring in great shoals by the thousand. In Monterey Bay the squid appear to be chiefly abundant in the summer time, although hauls are sometimes sent into the San Francisco markets as late as the middle of November. It used to be taken in vast quantities by the Chinese of Monterey, who dried the animals on shore, packed them in bales, and exported them to China. The fishing was done by night, torches being used to attract the creatures to the surface, whence they were scooped in by wholesale.

ŒGOPSIDA.

The animals belonging to this division are characterized by having a perforate eyelid free all round, permitting the sea water to bathe the cornea without obstruction. The opening frequently has a pronounced indentation or sinus in front. Both oviducts are normally developed.

High specialization of minor organs seems characteristic of the Œgopsida. This is strikingly seen in the frequent modification of many of the suckers into hooks, and the development of more or less complex luminous organs showing an almost unparalleled variety of structural detail. Photophores have been described as occurring in over one-half of the recognized genera. The curious arrangement of modified suckers known as the "fixing apparatus" which is to be found on the tentacles is also to be noted.

Perhaps the best discussion of the group as a whole is that given by Pfeffer (1900, p. 147-154).

Family OMMASTREPHIDÆ Gill, 1871.

Genus OMMASTREPHES d'Orbigny, 1835.

Ommastrephes d'Orbigny, 1835, p. 45 (fide Hoyle).

Ommatostrephes Loven, 1846.

Todarodes Steenstrup, 1880.

Ommatostrephes Pfeffer, 1900, p. 178, 179.

Ommastrephes Hoyle, 1902, p. 198.

Animals of moderate size, much resembling *Loligo* in shape and general appearance. Funnel connective apparatus massive, subtriangular, with a deep \perp -shaped groove and corresponding ridges

on the inner surface of the mantle. Funnel groove with a foveola. Arms stout, angled, with marginal membranes; suckers in two rows, the horny rings strongly denticulate with nearly equal teeth, or a single median tooth enlarged. Terminal portion of left ventral arm hectocotylized. Tentacles long, bearing suckers for more than half their length; fixing apparatus poorly developed, comprising only a few pads and small suckers. Gladius narrow and elongate, lacking the broad wing-like lateral expansions of the *Loliginidæ*.

Type, *Loligo sagittata* var. *a* Lamarck, 1799 = *Ommastrephes sagittatus* (Lamarck) d'Orbigny; a widely distributed species, the typical form of which is from the Atlantic.

Ommastrephes sagittatus (Lamarck, 1799) d'Orbigny.

Loligo sagittata Lamarck, 1799, p. 13 (fide Hoyle).

Ommastrephes sagittatus Tryon, 1879, p. 177, pl. 78, fig. 341 (after Forbes and Hanley), 345 (after Vérany); pl. 79, fig. 344 (after d'Orbigny), 346 (after Vérany).

Whiteaves, 1887, p. 134 (mere note).

Taylor, 1895, p. 99 (mere note).

Mention is here made of *O. sagittatus* on account of the statement by Whiteaves that three specimens of a squid collected at Victoria, British Columbia, by Dawson "correspond very well with Tryon's description and figures of this species in the first volume of his 'Manual of Conchology.'" The writer has personally encountered no specimens from the west coast of America which belong to this species or are even referable to the genus, but that is not proof that it may not well be expected to occur, especially since the same form, or rather its variety or subspecies *sloanei* Gray (*pacificus* Steenstrup), is known to be abundant in Japanese waters.

Genus STHENOTEUTHIS Verrill, 1880

Sthenoteuthis Verrill, 1880, p. 222.

Ommastrephes Steenstrup, 1880.

Stenoteuthis Pfeffer, 1900, p. 179, 180.

Very similar to *Ommastrephes* in almost every way, but the sucker-bearing area includes less than one-half the total length of the tentacles, and there is a well-developed fixing apparatus on the carpus which includes both pads and a number of small suckers with smooth horny rings. The larger suckers on the club itself are strongly toothed, one tooth in each quadrant being considerably greater than the others.

From the nearly related *Dosidicus* the genus is to be distinguished by its normal arm tips and the fact that the strongly developed swimming membranes are on none of the arms exceeded by the supporting lappets (trabeculæ, *Querbrücken*).

The species of *Sthenoteuthis* and *Dosidicus*, together with *Ommastrephes* s. s., *Symplectoteuthis*, *Illex*, *Hyaloteuthis*, and *Todaropsis*, were formerly considered to rank under the all-embracing *Ommastrephes*, but while undoubtedly involved in extremely close relationship with one another, all these groups are now dealt with by most authorities as separate entities. I have felt bound to follow the prevailing opinion.

Type, *Architeuthis megaptera* Verrill, 1878, a species of the New England region. Doctor Pfeffer considers it to be identical with the European *Sthenoteuthis pteropus* (Steenstrup, 1856).

Sthenoteuthis bartramii (LeSueur, 1821) Verrill. (Pl. XLVII; pl. I, fig. 4-5.)

The references belonging to *S. bartramii sinuosa* Lönnberg, *S. caroli* (Furtado), and *Loligo æquipoda* Rüppell, respectively included in the synonymy of *S. bartramii* by Pfeffer and Jatta, are omitted here. Otherwise the following bibliography is made as complete as the literature at my disposal will allow.

Loligo Bartramii LeSueur, 1821, p. 90, pl. VII.

Férussac, 1823, p. 67, no. 12 (fide d'Orbigny).

sagittata Blainville, 1823, p. 140 (fide d'Orbigny).

Bartramii Blainville, 1823, p. 141 (after LeSueur).

sagittata Blainville, 1823a, p. 128 (fide d'Orbigny).

Bartramii Blainville, 1823a, p. 129 (after LeSueur). Férussac, in d'Orbigny 1826, p. 63.

- Ommastrephes cylindricus* d'Orbigny, 1835, p. 54, pl. 3, fig. 3-4.
Bartramii d'Orbigny, 1835, p. 55.
cylindricus d'Orbigny, in d'Orbigny and Férussac, 1835, p. 54, pl. III, fig. 3-4 (fide Hoyle).
Loligo vitreus Rang, 1837, p. 71, pl. 36 (fide d'Orbigny).
Ommastrephes Bartramii d'Orbigny, 1838, p. 59, no. 15 (fide d'Orbigny).
cylindricus d'Orbigny, in d'Orbigny and Férussac, 1839, p. 347; Calmars, pl. II; Omnastr., pl. II, fig. 11-20 (fide Hoyle).
d'Orbigny, 1845, p. 420, pl. 29, fig. 1-2; pl. 30, fig. 7-8.
Gray, 1849, p. 62.
d'Orbigny, 1853, p. 59.
H. and A. Adams, 1854, I, p. 34 (name only); pl. 4, fig. 1-1a.
Tryon, 1873, p. 12, pl. II, fig. 8.
Verrill and Smith, 1874, p. 341 (635).
Ommastrephes Bartramii Tryon, 1879, p. 180, pl. 80, fig. 361-362.
Sthenoteuthis Bartramii Verrill, 1880, p. 223.
Ommatostrephes Bartramii Steenstrup, 1880, p. 79, 81, etc., fig.
Sthenoteuthis Bartramii Verrill, 1881, p. 288, 429.
Verrill, 1882a, p. 322 (112), 432 (222).
Verrill, 1883, p. 106 (dimensions).
Ommastrephes bartramii Hoyle, 1886, p. 32 (no description).
Bartramii Hoyle, 1886a, p. 242 (38), (no description).
Sthenoteuthis Bartramii Girard, 1890, p. 265 (mere note).
Ommastrephes Bartramii Joubin, 1894, p. 4 (merely listed).
bartramii Jatta, 1896, p. 64, pl. X, fig. 1-16.
Ommatostrephes bartramii Lonnberg, 1897, p. 705.
Gonatus amoenus Lucas, 1899, pl. XII, (fig. inaccurate in detail).
Sthenoteuthis bartrami Pfeffer, 1900, p. 180.
Sthenoteuthis bartrami Hoyle, 1902, p. 204.
Ommastrephes Bartrami Joubin, 1903, p. 4 (short note).
Sthenoteuthis Bartrami Rey, 1905, p. 172, fig.
bartramii Pfeffer, 1908, p. 97, fig. 109-115.
Sthenoteuthis bartrami Hoyle, 1909, p. 273 (no description).

Animal of rather large size, loliginiform. Mantle cylindrical, thick and heavy, tapering to an acute point between the fins; anterior mantle margin truncate, entire all round. Nuchal articulating apparatus a rather broad, elongate, cartilaginous plate with two very prominent longitudinal ridges and three smaller ones (pl. XLVII, fig. 2), the plate on the mantle having grooves to correspond; funnel locking apparatus more complex, comprising a massive triangular cartilage with a deep J-shaped excavation which fits closely over a heavy ridge of similar shape on the inner surface of the mantle (pl. XLVII, fig. 3). Fins large, broadly sagittate, very firmly attached.

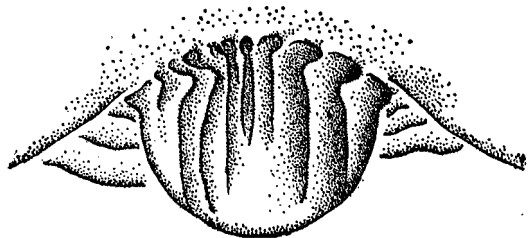


FIG. 7.—*Sthenoteuthis bartramii*, foveola. [114.]

Head large, somewhat elongate. Eyes large, with enormous apertures. Funnel large and wide, with stout dorsal supporting bridles and a large prominent valve; funnel groove broadly excavated and provided at the apex with the curious series of pocket-like folds termed the foveola (text fig. 7).

Arms stout, thick, unequal, the dorsal pair the shortest; all are furnished with a swimming membrane strengthened by strong transverse muscular trabeculae, and are outwardly keeled, a circumstance attaining its maximum development on the third pair of arms; here the ventral swimming web becomes an extremely broadened delicate membrane, far overreaching the transverse supports along the whole length of the arm (pl. XLVII, fig. 1). Umbrella very rudimentary. Suckers (pl. L, fig. 4) large, flattened, obliquely placed on stout pedicels in two alternating rows, larger horny rings with about 28 to 30 stout acute teeth differentiated in two sizes which occur in partial alternation.

Tentacles robust, of moderate length, laterally much compressed and keeled on the dorsal edge, inner surface flattened, bordered by a narrow swimming web with trabeculae similar to those of the sessile arms. Club elongate, attenuate distally, little enlarged; armed with two median rows of very large basin-shaped suckers and two lateral rows of very small ones, all becoming subequal and very minute at the extremity. The larger suckers have blackish horny rings armed with about 32 stout acute teeth, one tooth in each quadrant being very considerably larger than the others (text fig. 8). Fixing apparatus conspicuous, consisting of about three fleshy knobs alternating with the small suckers of the dorsal row along the carpal portion of the club, and succeeded proximally on each tentacle club of the specimen in hand by four small smooth-ringed suckers (pl. I, fig. 5.)

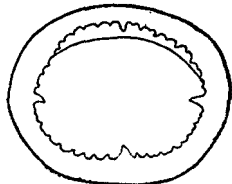


FIG. 8.—*Sthenoteuthis bartramii*, horny ring of large tentacular sucker. [114.]

Buccal membrane seven-pointed, the inner surface very rugose. Beak, gladius, and radula not examined. Color in alcohol a brownish buff, heavily clouded above with blackish purple, due to the great multitude and crowded condition of the chromatophores over the dorsal surface.

The above description is taken from a specimen in the Stanford University Collection (author's register no. 114), which was blown on board a vessel off Komandorski Island, Bering Sea. It is an adult in fair condition and does not appear in any way distinguishable from the specimens of this species I have seen from the tropical Pacific. Its chief measurements follow:

MEASUREMENTS OF *STHENOTEUTHIS BARTRAMII*.

	mm.
Total length, including tentacles.....	^a 435
Excluding tentacles.....	^a 380
Length of mantle (dorsal).....	^a 220
Width of mantle.....	^a 55
Length of fin.....	90
Width across fin.....	154
Of head.....	45
Length of dorsal arm.....	77
Second arm.....	87
Third arm.....	97
Ventral arm.....	96
Tentacle.....	163
Tentacle club (sucker-bearing portion).....	81

Distribution: Northern Europe to Mediterranean; Gulf Stream (Verrill); West Indies; Brazil; Uruguay (Museum of Comparative Zoology); Cape of Good Hope (Gray); Marshall Islands (Museum of Comparative Zoology); Fiji Islands (Museum of Comparative Zoology); off Komandorski Island, Bering Sea (Stanford University Collection).

Although I have seen no individuals captured within the actual limits of the geographical area under consideration, this species is so widespread in its habitat that there would be little doubt of its existence somewhere off our coasts. Furthermore, it is known to be abundant in Bering Sea, and, surprising as this may seem, appears to be at least in part the *Gonatus amœnus* of various Alaskan authors. According to Lucas, it is of considerable economic significance as one of the most important articles of food of the fur seal in that region. The figure given by this author, while yet leaving much to be desired, seems unmistakably to represent the present species. It is obviously not a *Gonatus*, the true importance of which form in such a connection is still not to be conjectured.

The data accompanying the Stanford specimen confirm Verrill's remark that "This is an exceedingly active species, swimming with great velocity, and not rarely leaping so high out of the water as to fall on the decks of vessels. On this account it has been called the 'flying squid' by sailors."

^a Estimated.

Genus **DOSIDICUS** Steenstrup, 1857.

Animals of large size, attaining a total length of several feet; general shape loliginiform; arms stout at the base, extremities very attenuate and bearing a large number of suckers very much reduced in size; swimming membrane in general much reduced, its trabeculae persisting as stout, tentacle-like processes from the margins of the arms. Other characteristics mainly as in *Sthenoteuthis*, which is undoubtedly very nearly allied.

But a single recent species is generally recognized.

Type, *Dosidicus Eschrichtii* Steenstrup, 1857 (= *Dosidicus gigas* (d'Orbigny) Pfeffer), originally described from the coast of Chile.

Dosidicus gigas (d'Orbigny, 1835) Pfeffer. (Pl. XLVIII-XLIX.)

Ommastrephes gigas d'Orbigny, 1835, p. 50, pl. IV.
giganteus d'Orbigny, in d'Orbigny and Férussac, 1839, p. 350, pl. 20 (fide Hoyle).
 d'Orbigny, 1845, p. 425, pl. 30, figs. 1-4.
 Gray, 1849, p. 60 (after d'Orbigny).

Dosidicus Eschrichtii Steenstrup, 1857, p. 11 (fide Pfeffer).
Ommastrephes giganteus H. and A. Adams, 1858, p. 35 (name only).
Ommastrephes giganteus Carpenter, 1864, p. 613, 664 (name only).
gigas Tryon, 1879, p. 179, pl. 80, fig. 357-360 (after d'Orbigny).
Dosidicus Eschrichtii Tryon, 1879, p. 175.

Steenstrup, 1880, p. 79, 80, 89, fig. (fide Hoyle)
Steenstrupii Pfeffer, 1884, p. 20, fig. 27.
Ommastrephes gigas Hoyle, 1886, p. 32, 214 (no description).
Dosidicus Eschrichtii Hoyle, 1886, p. 33, 217 (no description).
Steenstrupii Hoyle, 1886, p. 34 (no description).
Ommastrephes gigas Hoyle, 1886a, p. 242 (38), (no description).
Dosidicus Eschrichtii Hoyle, 1886a, p. 244 (40), (no description).
Steenstrupii Hoyle, 1886a, p. 244 (40), (no description).
Martialia Hyadesi Rochebrune and Mabille, 1889, p. H9, pl. I (fide Pfeffer).
Ommastrephes gigas Yates, 1889, p. 178 (merely listed).
Ommastrephes gigas Yates, 1890, p. 45 (merely listed).
Ommastrephes gigas Brazier, 1892, p. 16 (merely listed).
 Martens, 1894, p. 234 (dimensions).
 Plate, 1897, p. 213.
 Hoyle, 1897, p. 9 (merely listed).

Dosidicus gigas Pfeffer, 1900, p. 180.
 Steinhaus, 1903, pp. 44-45.
Ommastrephes gigas Keep, 1904, p. 271, 351 (no description).
 Kelsey, 1907, p. 46 (merely listed).
 Dall, 1909, p. 195 (merely listed).
Dosidicus gigas Hoyle, 1909, p. 273 (no description).
 Berry, 1910, p. 130 (no description).
 Berry, 1911a, p. 304, fig. 1-4, pls. 20-21.

Animal very large, when adult attaining a length of several feet; robust and massive. Body loliginiform, cylindrical in front, tapering to a fairly blunt point behind. Fins large, broadly sagittate. Mantle margin truncate, entire all round; articulating with the body by an elongate cartilage in the nuchal region and a large apparatus with a deep L-shaped groove on either side of the funnel, differing only in slight detail from that already described for *Sthenoteuthis bartramii*.

Head small in proportion to the body and slightly narrower than the latter; squarish. Eyes large; openings very large and conspicuous, with a deep anterior sinus. Below the head is deeply excavated for the reception of the large and powerful funnel, the integument bordering the depression heavily ridged and angled. Funnel supported above at base of funnel groove by a pair of muscular bristles as in *Sthenoteuthis*, etc.; apex of groove with a very conspicuous foveola constructed as follows: The median seven folds straight, massive, simple, pleat-like; next two broad, membranous, curving inward at base so that they are evenly continuous posteriorly to form a horseshoe-shaped pouch; outside this about five smaller oblique folds on either side, likewise membranous, gradually diminishing in size, and forming a series of small lateral pockets which are not necessarily in exact correspondence on the two sides. The funnel has a conspicuously large terminal valve (text fig. 9).

Arms robust at the base but becoming very attenuate toward the long and slender tips; order of length 3, 2, 1, 4, the first three pairs nearly equal, the ventral pair much the shortest; all furnished with an acute membranous keel along the outer margins attaining its greatest prominence on the much flattened and compressed third arms. Along the ventral margin of the sucker bearing area of the third arms is a broad tenuous swimming membrane supported by numerous stout, transverse, conical processes (trabeculæ) having their origin just in front of the base of the sucker pedicels and apparently in close relation with them; along the dorsal margins of these arms and along both margins of the remaining arms this membrane becomes much reduced, but the trabeculæ persist and extend out past it as conical tentacle-

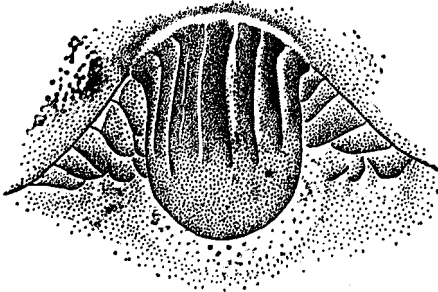


FIG. 9.—*Dosidicus gigas*, Ioveola. [72.]

ously the suckers being suddenly reduced to a size quite incommensurate with not only their former proportions but the gigantic dimensions of the entire animal as well; a reduction to a diameter of about 1 mm. is attained almost at once, and thence they become smaller and smaller until at the tip of the arm their structure is barely to be perceived by the unaided eye. At the same time they become much more crowded and their pedicels and marginal membranes also undergo reduction, but not to such an extent as the suckers themselves (pl. XLIX, fig. 4, 6). On the second arms (e. g.) the reduction begins gradually at the tenth pair of cupules, becomes suddenly accelerated at the sixteenth, and distal to this point, occupying but about one-half the total length of the arm, over 150 pairs of suckers are to be made out without a lens.

No hectocotylization known to occur.

Tentacles stout, robust, and relatively not very long; laterally compressed, outwardly keeled; inner edge flattened and equipped with a narrow marginal membrane on each side as well as short trabeculæ very suggestive of some of those already noted on the sessile arms. Club large, somewhat expanded, lanceolate; about three-sevenths as long as the entire tentacle; the outer keel reaching a high state of development toward the extremity; about fifteen pairs of large, deep suckers along the middle, with a row of much smaller basin-shaped suckers along the marginal web on either side; supports of marginal web bifurcate, the lateral suckers having their origin far out upon the web at the point of bifurcation; at its inner end each trabecula connected by a further pair of bifurcating ridges with the similar ridges from the trabeculæ just anterior and posterior of the opposite side; distally the suckers of all four rows become more nearly equal, much reduced, and much crowded, those of the ventral row being slightly the largest and those of the dorsal row the smallest. Dorsal margin of the carpal region of the club conspicuously armed with a fixing apparatus, comprising four heavy, fleshy pads, alternating with three comparatively small suckers, the horny rings of which are smooth; the median rows of suckers cease just below the most distal pad, but those of the ventral row persist to a point nearly opposite the most proximal tubercle (pl. XLIX, fig. 2). Horny rings of the large median suckers with about twenty-

like processes of a very characteristic appearance; distally the membrane is better developed and extends to the tips of the trabeculæ, even exceeding them to as great a distance again on the ventral edge of the third arms (pl. XLIX, fig. 3).

Suckers large, oblique, hood-shaped, ranking in two regularly alternating rows; pedicels short, stout, their bases much swollen (pl. XLIX, fig. 5); horny rings with about nineteen sharp conical teeth, very small at the lower, edge the upper median and two extreme lateral teeth notably the largest (text fig. 10). Above condition prevalent on the arms for only about half their length; at this point begins the region of attenuation, simultane-

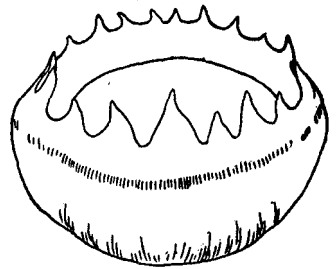


FIG. 10.—*Dosidicus gigas*, horny ring from large sucker near base of second arm. X 4. [72.]

one sharp teeth, one tooth of each quadrant larger than its neighbors (text fig. 11); horny rings of lateral suckers much deeper on the upper side and with but sixteen to seventeen teeth (text fig. 12).

Buccal membrane conspicuously seven-pointed; rugose within, but bearing no suckers.

Radula and gladius not examined.

Color in life unknown; in alcohol dark purplish above, pale below; everywhere punctate with small chromatophores not appreciably larger than those occurring in vastly smaller animals.

The chief dimensions of the only specimen available are as follows:

MEASUREMENTS OF *DOSIDICUS GIGAS*.

	mm.
Total length, including tentacles.....	1,245
Excluding tentacles.....	1,180
Length of mantle (dorsal).....	635
Width of mantle.....	162
Length of fins (extreme).....	330
Along line of attachment.....	300
Width across fins.....	515
Of head.....	160
Length of dorsal arms.....	425
Second arm.....	446
Third arm.....	450
Ventral arm.....	375
Tentacle.....	495
Tentacle club.....	215
Diameter of large sucker from second arms.....	13
From tentacle.....	11

Distribution: North Queensland, New South Wales, and Lord Howe Island, Australasia (Brazier); Chile (d'Orbigny, Gray, Martens, Steinhaus, Pfeffer); Peru (d'Orbigny). California—Monterey Bay, Santa Rosa Island (Yates), San Clemente Island (Carpenter), San Diego (Kelsey).

The single specimen examined is a finely preserved adult in the possession of the University of California (no. 72 of the author's register).

In the foregoing description I have purposely entered into considerable detail, as the species seem somewhat unusual in collections, and the above-mentioned specimen is in such excellent state as to render the possibility of misstatement comparatively remote. It should be added here, however, that the apparent rarity of the animal seems to be due rather to the difficulties attendant upon its capture and preservation than to its actual scarcity in our waters, for as a matter of fact the species would seem to be not an uncommon one. It has appeared rather frequently in local lists, usually under the cognomen of *Ommastrephes gigas*, and I have at hand a number of unpublished records of instances where creatures of undoubtedly the same form have been stranded on the beaches near Pacific Grove, California, during storms.

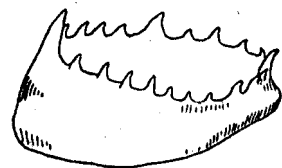


FIG. 11.—*Dosidicus gigas*, horny ring from a median sucker of the tentacle club, $\times 5$. [72.]



FIG. 12.—*Dosidicus gigas*, horny ring from a lateral sucker of the tentacle club, $\times 7$. [72.]

Once its salient characteristics are noted, *D. gigas* can not be confounded with any other species of cephalopod now known; yet until the present specimen was reported upon (Berry, 1911a, p. 304) its identification from this region can not be said to have been unquestionably established. The assumption now is, however, that in this instance the old records were correct.

In identifying the *Ommastrephes gigas* of d'Orbigny with the *Dosidicus eschrichtii* of Steenstrup, I have followed Pfeffer, whose course in the matter seems to me a very logical one, although I have not had the opportunity to examine all the statements of the various authors involved nor any further material. The recorded distribution is somewhat remarkable, but not particularly to be wondered at, considering

the open-sea habits of this powerful species, and the fact that it belongs to the widely dispersed family of the Ommastrephidae.

Genus SYMPLECTOTEUTHIS Pfeffer, 1900.

Symplectoteuthis Pfeffer, 1900, p. 178, 180.

Animal like *Ommastrephes* in general features, differing from its allies *Dosidicus* and *Sthenoteuthis* chiefly in that the cartilaginous locking apparatus at the base of the funnel is fused with that of the mantle and the swimming membrane of the third arms is much less developed than in those groups. Arms frequently so compressed that the suckers have the appearance of being in a single series.

Type, *Loligo oualaniensis*, Lesson 1830 (= *Symplectoteuthis oualaniensis* (Lesson) Pfeffer), a tropical Pacific species of wide distribution.

***Symplectoteuthis oualaniensis* (Lesson, 1830) Pfeffer.**

Loligo oualaniensis Lesson, 1830, p. 240, pl. 1, fig. 2.

♀ *Ommastrephes Tryonii* Gabb, 1862, p. 483, pl.

♀ *Ayresii* "Gabb" Carpenter, 1864, p. 613, 664 (name only).

Oualaniensis Tryon, 1879, p. 180, pl. 81, fig. 368 (after d'Orbigny).

♀ *Tryonii* Tryon, 1879, p. 180, pl. 81, fig. 372-373 (after Gabb).

♀ *Ayresii* Tryon, 1879, p. 182.

oualaniensis Hoyle, 1886, p. 33, 167: 1886a, p. 243 (39).

Symplectoteuthis oualaniensis Pfeffer, 1900, p. 180

Hoyle, 1904, p. 32, fig. F.

Not *Ommastrephes tryonii* Keep, 1904, p. 271, 351 (= *Loligo oregonensis*), nor Keep, 1910, p. 297 (same).

The claims of this species to a place within our fauna, whether identical with that described by Gabb or not, are not yet by any means fully established. Brief mention is made here chiefly for the sake of completeness, as no specimens have been examined. One thing is clear, that all authors who have used the term *Ommastrephes tryonii* subsequent to its description have not been unanimous in their allusion to the same species or even the same genus as that described by Gabb, whatever the latter may prove to be. Usually a species of *Loligo* is the squid referred to under this name in the lists. It may be said in explanation of this confusion, however, that the original diagnosis of *tryonii* is sadly inadequate in almost all essential respects. As a possible preventive of further error and for the benefit of those who may not chance to have access to the publication in which it originally appeared, I have taken the liberty to reprint it in full (Appendix, art. II).

Ommastrephes Ayresii is a manuscript name of Gabb. It was published by Carpenter without description, and has been since repeated in several local lists despite the fact that it has no standing.

S. oualaniensis is reported from the vicinity of Cocos Island by Hoyle; this is probably the nearest locality to our region from which we have the species indubitably recorded.

Family HISTIOTEUTHIDÆ Verrill, 1881.

Genus MELEAGROTEUTHIS Pfeffer, 1900.

Meleagroteuthis Pfeffer 1900, p. 170.

Body of moderate size, short and ovate, with short posterior rounded fins. Head strongly asymmetrical. Arms of moderate length, with two rows of small distant suckers having toothed horny rings. Umbrella rudimentary. Luminous organs extremely numerous, especially on the ventral surface, although a few exist dorsally as well; on the dorsal and second arms three rows, on the third pair four, on the ventral arms about eight rows.

Meleagroteuthis is extremely close to *Calliteuthis*, differing but little save in the arrangement and number of its luminous organs. On such a ground the wisdom of separating the two further than subgenerically seems very doubtful, for if minute characters of this sort be generic, one wonders what features should be taken as specific. One of the lesser characters depended upon, the complete toothing of the sessile arm suckers, is at least in part broken down by the specimens described below.

Type, *Meleagroteuthis hoylei* Pfeffer, 1900, described from deep water off the western coast of Central America. But the one species is known.

Meleagroteuthis hoylei Pfeffer, 1900. (Pl. I, fig. 1-3; pl. LI; pl. LII, fig. 5-7.)

Meleagroteuthis hoylei Pfeffer, 1900, p. 170 (very incomplete description).

(no species named) Hoyle, 1904a, p. 13, 20.

hoylei Joubin, 1905, p. 64-69 (luminous organs).

Pfeffer, 1908a, p. 292 (full description).

Hoyle, 1909, p. 272 (merely listed).

Hoyle, 1910, p. 411 (merely listed).

Animal of moderate size, its general outline, including the arms, more or less spindle-shaped. Body short, robust, bluntly conical, widest near the front, and tapering to a rounded point behind; texture firmly semigelatinous; mantle thick, its anterior margin rounded, somewhat emarginate below the funnel with very obtuse lateral angles, barely produced above to form an obscure anteriorly projecting angle in the median line. Locking apparatus well developed; nuchal cartilage a somewhat spoon-shaped plate; on either side of the base of the funnel a heavy, deeply excavated, pyriform cartilage, terminated by a broadly reflexed, membranous margin (pl. LI, fig. 5).

Fins short, broad, semi-circular, together forming a transverse ellipse; about two-fifths as long as the mantle; well lobed in front and behind; posteriorly not attached as far as the extreme tip of the body, but broadly continuous with one another above it.

Head enormous, rounded, strongly asymmetrical, deflected to the right so that its longitudinal axis shows a divergence of some 30° from

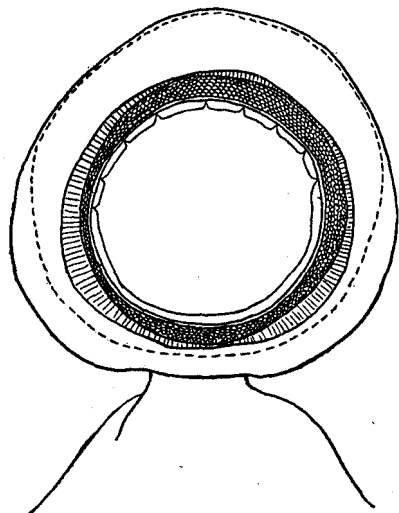


FIG. 13.—*Meleagroteuthis hoylei*, sucker from dorsal arm; camera drawing from mount in balsam. [109.]

that of the body; this state apparently brought about chiefly through the extraordinary development of the left eye, which includes nearly one-half of the total bulk of the head, the diameter of its lid opening more than twice that of the right (pl. LII, fig. 6-7); right eye well developed, but of very moderate size. (The distribution of the phosphorescent organs shows various eccentricities apparently correlated with this condition; but see below.) A small, slender, but fairly prominent papilla (the so-called "olfactory process") situated well back of each eye and posterior in direction. Funnel short, broad, prominently constricted in front and with a sharp downward flexion; within equipped with a flap-like valve and an elaborate "funnel organ," comprising a large A-shaped dorsal pad and two elongate lateral pads (pl. LI, fig. 4.)

Arms considerably longer than the mantle, in general subequal, but the dorsal and ventral arms slightly the shortest, so that the order of length may perhaps be stated as 3=2, 1, 4; connected at base by a very short umbrella, which continues along the outer edges of the ventral arms to their tips; all the arms squarish, a narrow keel-like membrane bordering the sucker-bearing area; the first three pairs with a membranous carina along their distal portions. Suckers deeply basin-shaped, obliquely placed

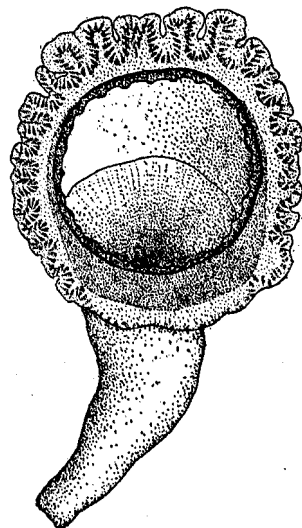


FIG. 14.—*Meleagroteuthis hoylei*, sucker from near middle of tentacle club; camera drawing from mount in balsam. [109.]

on short pedicels, and ranked along the margins of the arms so that the two rows are very widely separated (pl. LI, fig. 2); horny rings apparently smooth to the eye, but under a high power exhibiting some seven to eight very short, wide, squarely truncate teeth on their superior margin (text fig. 14, pl. LII, fig. 5).

No hectocotylation observed.

Tentacles very variable in length, elastic; outer surface rounded except along the distal portion of the club, where there is a conspicuous membranous keel; inner surface flattened. Club spatulate, its widest expansion near the base; tip strongly and obliquely recurved. Suckers rather small, flattish, crowded, very obliquely placed on short pedicels in seven to eight rows; largest near the middle of the expanded portion; apertures large, crowned above by a broad, lobed frill; horny rings armed with about thirty delicate, acute teeth of exceeding minuteness (text fig. 14). Sucker-bearing area bordered by a narrow membrane. Fixing apparatus very remarkable, comprising two series of suckers and pads extending from the club at its point of broadest expansion far down upon the stalk; first, about seven pads and as many minute suckers alternating in single file run along the extreme dorsal margin of the proximal portion of the club and the distal end of the stalk; the second set of suckers and pads are also minute and in single file, but they extend along the ventral margin of the stalk and alternate by pairs, the first two suckers being opposite the last two of the other series; in the proximal set there are eight suckers and six pads, rather closely placed distally, but becoming quite distant down the stalk (pl. LI, fig. 3).

Buccal membrane well developed, wide, seven-pointed (pl. I, fig. 3).

Gladius extremely delicate, with a slender midrib and broad lateral expansion.

Radula not examined.

Integument smooth, delicate; the outer epidermis rather loose and easily delaminated or rubbed off in preserved specimens. Everywhere punctate with small purplish chromatophores, so that the whole animal except the pale margins of the fins is of a livid purple-brown color.

Photophores exceedingly numerous, but apparently distributed with a surprisingly constant regularity. Owing to their great multitude this is somewhat obscure on the ventral surface of the mantle; dorsally more sparse; none on the ventral surfaces of the fins, but a few extend out on their bases above; a very distinct, close set row borders the anterior mantle margin below the funnel (text fig. 15). On the ventral surface of the head the organs appear ranked in about twenty-four longitudinal rows; on the dorsal surface about half as many, composed of much smaller and more widely spaced organs. These rows are continued from the head out upon the arms as follows: Upon the first and second arms, three rows; upon the third pair, four; upon the ventral arms, about eight; on none of the arms do more than two or three of these rows persist to the tips. In addition, a distinct single ring of photophores circumscribes the border of each eyelid. The asymmetrical appearance of the head in gross aspect extends in an equally striking degree to the arrangement of its phosphorescent organs; those of the right side in general more crowded and more sharply defined, although actually no more numerous. The greatest differences present themselves in the development of the circumocular rings; that of the

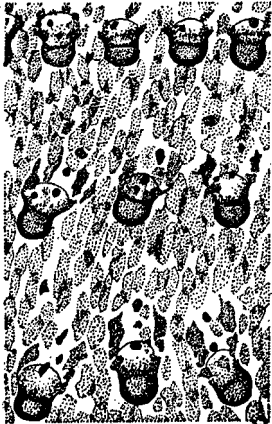


FIG. 15.—*Meleagroteuthis hoylei*, integument from anterior ventral margin of mantle showing photophores; drawn from a mount in balsam, X(?). [109.]

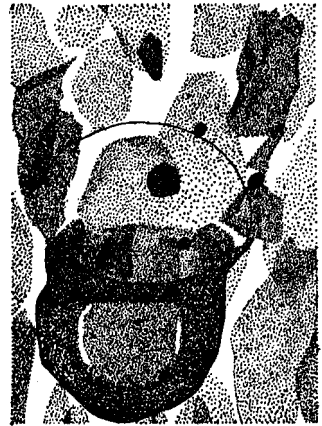


FIG. 16.—*Meleagroteuthis hoylei*, individual photophore enlarged from preparation shown in fig. 16, X(?). [109.]

right side consists of about sixteen to twenty very distinct close set organs, while on the left side they are farther from the margin of the lid, much farther from one another, and so greatly reduced that some of them (especially the more dorsal and posterior ones) are with difficulty made out at all (pl. LII, fig. 6-7). No luminous organs were observed upon the funnel.

The individual photophores appear as small, slightly elevated, ovoid tubercles of but little over a millimeter in length, and consisting of two fairly distinct divisions—a dense dark, more or less horseshoe-shaped area with a lighter core, and an anterior part of a pale or nearly white color, overlying which are usually two or three correlated chromatophores. The latter, though small, are somewhat more than ordinary in size. (Text fig. 16.)

MEASUREMENTS OF MELEAGROTEUTHIS HOYLEI.

	Albatross station 4544.	Albatross station 4538.	Albatross station 4416.
Total length, including tentacles.....	mm. 203	mm. 168	mm. 179
Excluding tentacles.....	145	141	176
Length of mantle (dorsal).....	51	48	59
Width of mantle.....	29	28	31
Across fins.....	31	28	36
Length of fin.....	21	21	72
Width of head.....	34	28	40
Longitudinal diameter of right eye opening.....	7	8	7
Longitudinal diameter of left eye opening.....	17	14	17
Length of dorsal arm.....	73	71	83
Second arm.....	74	75	88
Third arm.....	74	76	87
Ventral arm.....	70	73	78
Tentacle.....	126	94	77
Tentacle club.....	17	15	16

Type locality, Gulf of Fonseca, west coast of Central America.

Distribution: Monterey Bay, California; off Santa Barbara Island, California; Gulf of Fonseca, west coast of Central America (Pfeffer); Paternoster Islands, Dutch East Indies (Joubin).

SPECIMENS OF MELEAGROTEUTHIS HOYLEI.

No.	Locality.	Depth in fathoms.	Station.	Where deposited.	Author's register.
1	Monterey Bay, Cal.....	724-1,000	Albatross station 4544.....	U. S. Nat. Mus.....	109
1	do.....	795- 871	4538.....		110
1	Off Santa Barbara Island, Cal.....	323- 448	4416.....		108

The earliest description of this species is contained in the brief diagnosis of the genus *Meleagroteuthis* given by Pfeffer in his "Synopsis der cegopsiden Cephalopoden" of 1900 (p. 170):

"Leuchtflecke sehr dicht stehend, auf den dorsalen und dorsolateralen Armen in drei Reihen, auf den ventrolateralen in vier, und auf den ventralen in acht Reihen. Auf der Aussenseite der dorsalen und lateralen Arme und auf der dorsalen Mittellinie des Mantels je eine Reihe knorpeliger Tuberkel. Segel nur ganz schwach entwickelt."

In 1905 Professor Joubin published an account of the structure of the photophores of a supposedly identical form from the other side of the Pacific, but no further information was forthcoming until three years later, when Doctor Pfeffer issued his "Teuthologische Bemerkungen" (1908, p. 292-294) in which he gives us a more complete description of his type, but appends no figures.

The interesting discovery of somewhat larger specimens of apparently the same species by the Albatross as far north as Monterey Bay considerably extends the known range and enables me to add numerous important details to the information previously published as well as to present a fairly complete series of illustrations.

It will be noticed that my description fails to tally, however, with that of Pfeffer in quite a number of more or less weighty particulars. The umbrella in the Albatross specimens seems to be less developed, but I am inclined to think that this is to be explained by the larger size of the latter. More difficult to understand is the fact that I have been unable to identify any structures corresponding to the rows of tubercles ("Höckerreihe") described by Pfeffer with much stress as occurring on the arms and the dorsal surface of the mantle along the median line; but this, too, may turn out to be a juvenile character.

In other respects Pfeffer's account fits the Californian examples with fair accuracy, even to the extraordinary asymmetrical development of the head and its organs. The latter is certainly a most astonishing condition, the function of which, in the light of our present knowledge at least, seems utterly inexplicable, nor am I aware that any theory regarding it has ever been advanced.

Despite its known abyssal habit, it came as more or less of a surprise to find this beautiful Panamic species associated in the Albatross collection with the Arctic *Gonatus*, and indeed taken in at least one instance in the selfsame haul. It is without a doubt one of the most important and interesting additions to the Californian fauna which has lately come to notice. It is in every way distinct, a most remarkable creature, and not to be confused with any other form.

Family GONATIDÆ Hoyle, 1886.

Genus GONATUS Gray, 1849.

- Gonatus* Gray, 1849, p. 68.
Lestoteuthis Verrill, 1880, p. 251.
Chiloteuthis Verrill, 1880, p. 293.
Cheloteuthis Verrill, 1881, p. 109.
Gonatus Hoyle, 1886, p. 174.
 Hoyle, 1889, p. 117.

Animal of moderate size, loliginiform. Arms short, stout; the ventral pair with four rows of suckers, the remaining arms with two lateral rows of suckers and two median rows of hooks. No hectocotylization. Tentacles with numerous rows of suckers and a few median hooks; fixing apparatus comprising a large series of pads and suckers extending from a point low down upon the stem nearly to the middle of the terminal expansion.

This curious group is known to include but a single aberrant species, but the latter is so unique in its remarkable assemblage of characters that its treatment in a genus by itself is clearly justifiable.

Type, *Onychoteuthis? amæna* Møller, 1842 (= *Sepia loligo* Fabricius, 1780 = *Gonatus fabricii* (Lichtenstein) Steenstrup), a circumpolar species of quite wide distribution.

***Gonatus fabricii* (Lichtenstein, 1818) Steenstrup, 1880.** (Pl. LII, fig. 1-4; pl. LIII; pl. LIV, fig. 1-4; pl. LV.)

- Sepia loligo* Fabricius, 1780, p. 358.
Onychoteuthis Fabricii Lichtenstein, 1818, p. 13 (vide Hoyle).
 Lichtenstein, 1818a, p. 223.
Onychoteuthis Fabricii Møller, 1842, p. 76.
Onychoteuthis? amæna Møller, 1842, p. 76.
Onychoteuthis Kamtschatica Middendorff, 1849, p. 515, pl. XII, fig. 1-6.
Gonatus amæna Gray, 1849, p. 68.
 H. and A. Adams, 1858, 1, p. 36, pl. IV, fig. 2.
amænus Sars, 1878, p. 336, pl. XXXI.
amæna Tryon, 1879, p. 168, pl. 73, fig. 290 (after Adams).
Enoplateuthis Kamtschatica Tryon, 1879, p. 174, pl. 77, fig. 333-335 (after Middendorff).
Lestoteuthis Kamtschatica Verrill, 1880, p. 251.
Gonatus amænus Verrill, 1880a, p. 362 (merely listed).
 Verrill, 1881, p. 291, pl. XLV, fig. 1-2.
Chiloteuthis rapax Verrill, 1881, p. 293, pl. XLIX, fig. 1.
Gonatus Fabricii Steenstrup, 1881, p. 9, pl. 1.
Cheloteuthis rapax Verrill, 1881a, p. 110, pl. III, fig. 1-1f.

- Gonatus Fabricii* Verrill, 1881b, p. 297.
Lestoteuthis Fabricii Verrill, 1881, p. 387-393, pl. XLV, fig. 1-2; pl. XLIX, fig. 1; pl. LV, fig. 1.
Lestoteuthis Kamischatica Verrill, 1882a, p. 280 (76).
Cheloteuthis rapax Verrill, 1882a, p. 286 (76), pl. XV, fig. 3-3f, 4.
Gonatus Fabricii Verrill, 1882a, p. 289 (79), pl. XV, fig. 1-1c, 2-2d.
Lestoteuthis Fabricii Verrill, 1882a, p. 416 (206), pl. XLV, fig. 1-1d.
Gonatus Fabricii Steenstrup, 1882, p. 143.
Lestoteuthis Fabricii Verrill, 1882, p. 316 (merely listed).
Gonatus amoenus Dall, 1884, p. 341 (merely listed).
Lestoteuthis fabricii Dall, 1886, p. 209 (merely listed).
Gonatus fabricii Hoyle, 1886, p. 41, 174.
 Hoyle, 1886a, p. 252 (48), (no description).
 Jatta, 1889, p. 66
 Hoyle, 1889, p. 117-135, pl. XIII-XIV (anatomy).
Gonatus fabricii Lönnberg, 1891, p. 38.
 Fabricii Appellöf, 1893, p. 9 (fide Pfeffer).
 Joubin, 1894, p. 5 (merely listed).
 fabricii Vanhöffen, 1897, p. 193 (fide Pfeffer).
 Fabricii Hoyle, 1897, p. 372 (10), (merely listed).
 antarcticus Lönnberg, 1898, p. 51, pl. IV, fig. 4-5.
 fabricii Posselt, 1898, p. 279 (fide Pfeffer).
 Fabricii Lönnberg, 1899, p. 792 (merely listed).
 Not *Gonatus amoenus* Lucas, 1899, p. 61, pl. XII (= *Sthenoteuthis bartramii*).
 Dall, 1899, p. 544 (merely listed).
Lestoteuthis fabricii Dall, 1899, p. 544 (merely listed).
Gonatus fabricii Pfeffer, 1900, p. 163.
 Friele and Grieg, 1901, p. 124 (fide Pfeffer).
 Fabricii Massy, 1907, p. 381.
 fabricii Pfeffer, 1908, p. 71, fig. 80-84.
 Fabricii Massy, 1909, p. 27.
 fabricii Hoyle, 1909, p. 267 (merely listed).
 antarcticus Hoyle, 1909, p. 267 (merely listed).

I. (Pl. LII, fig. 3, 4; pl. LV, fig. 2.) A number of immature squids clearly referable to this much-abused species were obtained by the Albatross off the California coast. They agree in the following characteristics:

Body small, fragile and delicate, in general loliginiform, pointed behind. Fins short, very broad, continuous posteriorly where they form a distinct point; widest in advance of the middle, outer angles rounded. Mantle margin truncate above, not produced in the median line; laterally angled below and broadly but not deeply emarginate beneath the funnel.

Head short, broad; with extremely large, swollen, conspicuous eyes.

Sessile arms of moderate length, their armature comprising both suckers and hooks ranked in four rows; ventral pair bearing four rows of suckers only, all the others with two median rows of hooks and two lateral rows of small, broad pediceled suckers, a condition unique among known cephalopods. Umbrella wanting.

Detailed structure of tentacles subject to considerable variation, but always rather short, robust, obscurely carinated along the outer margin, and with a broad, prominent web along the outer edge of the distal portion of the club. Club flattened, broadly expanded; armed at the tip with four rows of small crowded suckers; at the expanded portion the four-rowed condition becomes obscure, the rows separating and passing down either margin, leaving the center of the club bare save for an extremely large elongate hook, supplemented just distally by a much smaller moderate-sized one; near the median line below occur usually a single series of about five more or less distinct hooks or hook-like suckers of small size, the two distal of which are apt to have more the appearance of true suckers than the others; nearly opposite the latter the inner suckers of the dorsal margin of the club exhibit a tendency to pass over toward the center, in one specimen terminating in a single row of three small suckers near the base of the third hook; the most marginal row, however, persists, undergoing remarkable transformation to become the fixing apparatus comprising both pads and suckers in regular alternation; the first eight pads and six suckers of this series the largest, pushing their way well inward, the suckers further characterized

by a series of elevated transverse fleshy pads extending outwardly from the base of the pedicels; the latter complication ceases at the proximal end of the club, but the pads and suckers continue in alternation, although much reduced, down the stalk of the tentacle for over half its length; the suckers of the ventral row also are peculiarly differentiated, and perhaps worthy of note (though not to be distinguished in all specimens) would seem two rows of five to eight extremely minute acetabula which sometimes parallel the much larger suckers of the marginal row just below the large median hook; proximal to these the suckers become more uniform and continue down the stalk much as on the opposite side, but more irregularly and without the interspersal of pads. Hardly any two published figures agree in their representation of the finer details of the tentacular arms, so that the numerous small discrepancies exhibited by the Albatross specimens from these as well as from one another can hardly be regarded as significant until more is known regarding their development and function. (Pl. LII, fig. 3, 4.)

No hectocotylyzation observed and sexes not known to be otherwise outwardly differentiated.

Gladius not examined, but for completeness a description of that of the Atlantic form as given by Hoyle (1889, p. 119) is appended:

"*The Gladius* is narrow and linear anteriorly, but broader and lanceolate in the hinder two-thirds, whilst it ends posteriorly in a hollow cup or cone, which has several diaphragms within it, and is not covered outside and behind by a solid chitinous spine, as is the case with most, perhaps all, *Onychoteuthids*; at all events no species hitherto known has such a hollow cone."

Radula not examined; it is stated to include but five rows of teeth.

Color in spirits very pale, the chromatophores exceedingly obscure.

II. (Pl. LII, fig. 1, 2; pl. LIII; pl. LIV, fig. 1-4; pl. LV, fig. 1, 3-7.) At first sight very different from the foregoing appear two vastly larger examples from the region of Puget Sound which, while somewhat dubiously referring them to the same species, I describe in corresponding detail in the succeeding paragraphs.

Animal of moderate size, robust, powerful in appearance. Body loliginiform, subcylindrical, somewhat compressed dorso-ventrally; slightly inflated between the anterior margin and the fins; thence tapering rapidly at first, then more gradually, to an acute attenuate point between the fins. Fins large, over half as long as the mantle, broad, rhomboid; obtusely angular in advance of the middle, anterior lobes projecting well forward; posterior margins continuous around the tip of the body, forming an obtuse point. Anterior mantle margin evenly truncate above, projecting only very slightly in the median line; broadly emarginate below, with well-marked though somewhat rounded lateral angles. Mantle connectives the customary three in number, comprising a median elongate cartilage in the nuchal region, and on either side of the funnel a wedge-shaped lateral one, having a bifurcate groove and corresponding to a flattened ridge of similar shape on the inner surface of the mantle coincident with the lateral angles of its margin (pl. LV, fig. 5-6).

Head rather large, rounded above, flattened beneath. Eyes large; the lid openings large, with a prominent slit-like sinus in front. Funnel broadly conical, rounded at the tip, supported above by a pair of very wide thin bridles; opening wide, valved; funnel groove broad, rounded in outline, rather shallow; funnel organ conspicuous, comprising a median lobate Λ -shaped pad and two ovate lateral ones (pl. LIV, fig. 4).

Sessile arms stout, of moderate length; slightly unequal, the dorsal and ventral pairs the shortest; extremities attenuate. True umbrella wanting save between the second and third arms, where it is very rudimentary; outer edges of third and fourth arms angled and keeled, and insignificant indications of a similar membrane persistent on the second arms as well. Armature of ventral arms comprising four rows of small suckers, their horny rings furnished with a few very slender acute teeth on the upper margin; remaining arms agreeing in the possession of an entirely different arrangement; here two marginal rows of small suckers persist as on the ventral arms, but the two median rows are transformed into stout hooks of a somewhat larger size than the suckers (pl. LV, fig. 1, 3-4).

Tentacles stout and rather short; the club broadly expanded and armed with a great multitude of small basin-shaped suckers arrayed in numerous indistinct rows; horny rings with about twenty low acute teeth (pl. LIV, fig. 2); suckers largest near the middle of the club, but becoming extremely

minute distally, along the margins, and at the base of the club, whence they extend well down upon the stalk, gradually diminishing all the while (pl. LII, fig. 1-2). No hooks present in whatever form, but the curious fixing apparatus so characteristic of *Gonatus* is evident as a series of small, rounded, whitish, bead-like tubercles or pads extending along the dorsal margin of the sucker bearing area from its proximal end upon the stalk well past the point of widest expansion of the club, and occurring in regular alternation with the minute suckers of the outermost row (pl. LV, fig. 7).

Buccal membrane well developed; eight pointed, there being two lappets between both the dorsal and the ventral arms, but none between the second and third pairs; copiously wrinkled within.

Color in spirits (formalin and alcohol) everywhere a pale muddy white.

The measurements of one of the best of the Albatross specimens, as well as the two large ones just described, are given in the annexed table.

MEASUREMENTS OF GONATUS FABRICII.

Locality.....	Albatross station, 4512.	Puget Sound, Wash.	Victoria, B. C.
Author's register no.....	98	88	90
	<i>mm.</i>	<i>mm.</i>	<i>mm.</i>
Total length, including tentacles.....	67	295	305
Excluding tentacles.....	61	275	250
Length of mantle (dorsal).....	35	153	133
Width of mantle.....	10	45	37
Across fins.....	28	100	100
Length of fin.....	17	80	72
Width of head.....	10	42	41
Length of dorsal arm.....	16	85	83
Second arm.....	20	90	87
Third arm.....	20	95	91
Ventral arm.....	16	80	84
Tentacle (total).....	30	124	149
Sucker bearing area of tentacle.....	21?	62	76

Distribution: Davies Strait, off coast of Greenland (Fabricius, Møller, etc.); Iceland; Faroe Islands; Jan Mayen; Porsangerfjord, Norway (Sars); coast of Finmark (Sars); off the coast of Ireland (Massy); Nice and Toulon, France (Joubin); south of Cape of Good Hope (Steenstrup); off Seal Island, Nova Scotia (Verrill); south of Newport, Rhode Island (Verrill).

Punta Arenas, Patagonia (Lönnberg, *G. antarcticus*); Japan (Steenstrup); Kuril Islands (Middendorff); Bering Island (Dall).

British Columbia—Vancouver Island (?). Washington, Puget Sound (?). California, Monterey Bay (Albatross) and off San Nicolas Island (Albatross). Lower California, off Los Coronados Islands (Albatross).

In all, the following 11 specimens have been examined, the greater part of them obtained by the Albatross.

SPECIMENS OF GONATUS FABRICII.

No.	Locality.	Depth in fathoms.	Collector.	Where deposited.	Author's register no.
1	Near Victoria, B. C.....	Salmon traps.	J. B. Babcock, 1907.....	Stanford Univ. Coll. ...	90.
1	Puget Sound, Wash.....		Shrimp fishermen, 1909.....	do.....	88.
3	Monterey Bay, Cal.....	724-1,000	Albatross station 4544.....	do.....	100 juv.
1	do.....	755- 958	4530.....		97 juv.
1	do.....	750- 766	4517.....		96 juv.
1	do.....	309- 469	4512.....		98 juv.
1	do.....	32- 309	4468.....		95 juv.
1	Off San Nicolas Island, Cal.....	581- 594	4424.....		99 juv.
1	Off North Coronado Island, Lower California.	257- 408	4379.....		89 juv.

From the foregoing descriptions it will at once be seen that the two large specimens from the Puget Sound region differ strikingly in several very important particulars from *Gonatus fabricii* as represented by the Albatross collection or as understood and described (or misdescribed) by the array of authors cited at length in the synonymy. The most notable divergence appears in the extraordinary structure of the tentacles, which I am utterly unable to bring into correlation with that of the smaller animals. This difference, if it shall later prove to be not ontogenetic and more than superficial, will certainly warrant their recognition as a very remarkable new species, even if the other characters noted (e. g., the shape of the fins, etc.) fail. However, the Albatross specimens, while coinciding with very fair exactness with the diagnoses and figures of Steenstrup, Verrill, and Hoyle, have nevertheless an obvious appearance of immaturity, and exhibit variation of such a nature as to indicate that development to the adult stage might well be productive of still greater changes.

All these considerations lead me to believe that it would be unsafe to risk further confusion of the already appalling synonymy by the addition of another name, and that it will be better to await the discovery of specimens intermediate in size. Examination of such material should quickly prove or disprove the possibility that the Puget Sound animals are but adults which have lost the hooks and definite arrangement of the suckers so characteristic of the young. One important item of evidence weighing against this hypothesis should not, however, be overlooked. The tentacles of the large specimens described by Verrill (1881, p. 391, pl. LV, fig. 1) and Pfeffer (1908, p. 72) agree with those of the Albatross specimens and are totally different from those of the two in the Stanford collection. The entire question is a momentous one which I do not feel competent to decide without a more complete series than is now at hand, especially in the absence of any Atlantic material for comparison.

The smaller specimens, at any rate, seem without doubt to be true *Gonatus fabricii* and greatly extend the already wide range of the species in the Pacific.

In the hope of performing some small service to the next worker who endeavors to elucidate the puzzling history of this interesting species, I have given as extended a list of references as the literature at my command will allow.

Family ONYCHOTEUTHIDÆ Gray, 1847.

Genus ONYCHOTEUTHIS Lichtenstein, 1818.

- Onychoteuthis* Lichtenstein, 1818, p. 1591.
Lichtenstein, 1818a, p. 223.
Pfeffer, 1900, p. 156, 158.

Body of moderate size, cylindrical, tapering, with broad sagittate fins. Head moderate. Arms stout; suckers in two rows showing no modification into hooks. Tentacles stout and rather long; the club armed with two rows of hooks on the central part; fixing apparatus a very definite, compact, rounded group of small suckers and pads on the carpal region. No hectocotylization. Gladius showing through the mantle as a well-defined dark streak. (For a further discussion of the genus see Pfeffer, 1900, p. 158, and Hoyle, 1904, p. 18.)

The occurrence of photophores within the mantle cavity has been reported by Doctor Hoyle.

Type, *Onychoteuthis bergii* Lichtenstein, 1818 (= *Onychoteuthis banksii* (Leach, 1817) Féruccac), a tropical species of wide dissemination.

Two alleged species of *Onychoteuthis* have been reported to occur off the Pacific coast of the United States, but the exact status of neither can be taken as yet to be established. There is another well-recognized species, however—the *O. banksii* of Leach—the distribution of which is so cosmopolitan that we need not be surprised to find specimens within our limits.

Onychoteuthis lobipennis Dall, 1872.

- Onychoteuthis* ? *lobipennis* Dall, 1872, p. 96.
Onychoteuthis lobipennis Verrill, 1880, p. 252 (mere note).
Verrill, 1882a, p. 281 (71), (mere note).
Hoyle, 1886, p. 39 (merely listed).
Hoyle, 1886a, p. 250 (46), (merely listed).

Onychoteuthis ? lobipennis, n. s.

Body short and inflated, somewhat cup shaped. Ventral posterior portion rounded and produced, giving the animal a decidedly pot-bellied appearance. Anterior portion slightly constricted or concave behind the edge, which is oblique, roundly excavated in front, and produced into a sharp point in the median line behind. Back slightly keeled. Fins rounded ovate on each side, not continuous around the posterior extremity, which is produced into a conical point. Nuchal collar prominent, keeled in the median line behind and on each side of the funnel; margin interrupted by the funnel, otherwise entire. Head rather swollen. Eyes large, blue in life, with a black inner ring. Color yellowish white, with brown ocellated spots on the back and sides, and brown specks on the arms and head. Sessile arms subequal, tentacular arms somewhat longer. Length of pairs: i, .8; ii, .9; iii, 1.3; iv, .9; v, .8 in. Length of back, along dorsal keel, .7; do., on ventral surface, .5; max. diam., .43; width of back, .46; width of fins, .66 transversely; .23 longitudinally. Length of head and collar on the dorsal line, .4; total length, 2.2 in. Diameter of eye, .2 in. Cupules in two rows. Two hooks in the median line of the extremities of each of the tentacular arms between the cupules. Mouth surrounded by a six-keeled frill of integument.

Habitat, caught in the towing net off San Francisco, Cal., in lat. 37° 22' and long. 140° 10', one specimen, Dall, July 17, 1865. Coll. reg. No. 302.

This pretty little species is doubtfully referred to the genus *Onychoteuthis*. It is well characterized by its pot-bellied appearance and narrow rounded fins. The posterior part of the funnel is very globose."—(Dall, in American Journal of Conchology, vol. VII, p. 96-97, 1872.)

No further information has been forthcoming in regard to this species since the appearance of the original description as above quoted. It seems likely that the specimen in hand was immature, and it has been suggested that if adult it might be found to possess affinities with *Lestoteuthis kamschatica* (*Gonatus fabricii* (Lichtenstein)), although this appears to me somewhat doubtful.

Onychoteuthis fusiformis Gabb, 1862.

Onychoteuthis fusiformis Gabb, 1862, p. 171.

? Carpenter, 1864, p. 613, 632, 633, 664 (listed from San Clemente Island).

Hoyle, 1886, p. 39 (merely listed).

Hoyle, 1886a, p. 250 (46), (merely listed).

? Taylor, 1895, p. 98 (merely listed).

Keep, 1904, p. 351 (merely listed).

This species is here included because it has been reported from San Clemente Island, California, on the authority of Cooper, by Carpenter, and from Oak Bay, British Columbia, by Taylor, but in each case the determination seems at best a very doubtful one.

The paper by Gabb containing the original description is reprinted in the appendix of the present report. Gabb's specimen is said to have been taken off Cape Horn.

Genus **MOROTEUTHIS** Verrill, 1881

Moroteuthis Verrill, 1881, p. 298.

Verrill, 1881, p. 393.

Pfeffer, 1900, p. 156.

Besides the peculiarities of the gladius as hereinafter mentioned, this genus has for lesser characters the enormous size of its single species; the presence of about 36 hooks in two rows on the tentacle club; and the very numerous pads and suckers of the fixing apparatus. Otherwise the characters are very much as in *Onychoteuthis* or *Ancistroteuthis*, to each of which *Moroteuthis* has at various times been referred.

Type, *Ommastrephes robustus* "Dall" Verrill 1876 (= *Moroteuthis robusta* (Dall) Verrill), a species of southwestern Alaska.

Moroteuthis robusta (Dall) Verrill, 1876.

- Onychoteuthis Bergi* ? Dall, 1873, p. 484 (measurements, but no description).
Ommastrephes robustus "Dall MSS." Verrill, 1876, p. 236 (measurements and scanty diagnosis).
 Tryon, 1879, p. 183 (after Verrill).
Onychoteuthis robusta Verrill, 1880, p. 195, 246, pl. XXXIII-XXXIV (full description).
Lestoteuthis robusta Verrill, 1880, p. 251-252 (mere note).
Ancistroteuthis robusta Steenstrup, 1880, p. 17.
Moroteuthis robusta Verrill, 1881, p. 393; Verrill, 1881b, p. 298, note.
 Verrill, 1882a, p. 231 (21), 275 (65), 281 (71), 419 (209), pl. XIII-XIV.
Ancistroteuthis robusta Steenstrup, 1882, p. 150.
 Hoyle, 1886, p. 40 (no description).
 Hoyle, 1886a, p. 251 (47), (no description).
 Thompson, 1900, p. 992 (description of tentacles and other details).
Moroteuthis robusta Pfeffer, 1900, p. 161.
 Pfeffer, 1908, p. 68, fig. 78-79 (after Verrill).
 Pfeffer, 1908a, p. 294.
 Hoyle, 1909, p. 268 (no description).

As the only opportunity the writer has had to examine the giant squid of Alaska extended merely to a few fragments of one of Dall's specimens in the Yale University Museum, the liberty is taken to append herewith an abridgment of the excellent description given by Thompson (1900, p. 992-998). For further and more detailed information reference may be had to this careful paper and to the several articles by Verrill cited in the synonymy.

"The general shape of the body is almost evenly conical, very slightly attenuated between the fins, which latter extend over just about one-half the length of the mantle. The head is rather small and narrow, the eyes not prominent. The broadest part of the fins is about 27 inches from the apex, which they reach, and toward which their trapezoidal outline is sharply narrowed.

* * * The funnel possesses a large internal valve. * * *

The upper mandible is very sharply hooked; the lower has no tooth on its cutting edge. The radula has the usual seven rows of teeth.

The buccal membrane or "circumoral web" is well developed, expanding to a radius of about four inches. * * *

The suckers are in two rows, and commence on the dorsal arm about 2 inches, and in the others about 3 inches from the base. In the two rows the suckers are obliquely opposite. * * * There are on the ventral arm about fifty distinct pairs, beyond which for about 2 inches at the distal end of the arm the paired arrangement is not clearly maintained. * * *

Of the left tentacle only about seven inches is preserved. * * * Of the other tentacle about twenty-three inches is preserved in connection with the body. It is a broad, flattened strap, about an inch and a half in breadth. The distal end of the tentacle, including the tentacular club (which has hitherto remained unknown) is, very fortunately, preserved; it has all the appearance of having been directly continuous with the attached portion, and measures nearly 24 inches in length, the terminal club occupying the last eight inches. The club is laterally compressed, and has on each side a web or frill. * * *

The arrangement of the connective organ is as follows:—The first inch and a half or inch and a quarter of the club is occupied by a group of intermixed suckers and pads, in which we can discern an arrangement of six oblique rows containing 3, 4, 4, 4, 3, 3 elements, respectively; of these the first or external one has two pads and a sucker between, the last has two suckers and a pad between; the rest consist alternately of suckers and pads exclusively. * * * Beyond this portion of the connective organ commences a double row of hooks, of which there are about eighteen pairs. In our specimen many of these are missing. Of those that are left the largest belongs to the ninth pair, and beyond it they become much smaller. The lowermost hooks are about three-eighths of an inch long and nearly of equal breadth in their flattened bases. The largest, toward the middle of the club, are about five-eighths of an inch long, and with bases about five-sixteenths of an inch broad. The extreme tip of the club bears a group of thirteen small suckers within a square of about a quarter of an inch. * * * "

The gladius is remarkable in that it terminates posteriorly "in a conical, hollow, many ribbed, oblique cone, which is inserted into the oblique, anterior end of a long, round, tapering, acute, *solid*, cartilaginous terminal cone, composed of concentric layers, and corresponding to the solid cone of *Belemnites* in position and relation to the true pen." (Verrill.)

Type locality, Unalaska, Alaska, W. H. Dall, 1872.

Distribution: The individual described by Thompson as well as the three original specimens found by Dall in 1872, was cast up on the beach at Unalaska, Alaska, and it does not appear to have been reported elsewhere.

This is the largest species of cephalopod, perhaps of any invertebrate, known to inhabit the Pacific coast of North America, and is stated to attain a total length of over 14 feet (Dall's largest specimen minus part of the tentacles measured 427 cm.) or a mantle length of over $7\frac{1}{2}$ feet.

As may be seen by a glance at the synonymy, its true generic position has been a matter of more or less debate, but the consensus of opinion seems now to be clearly that its claims to a genus by itself are entirely justified. Its nearest relative among described forms appears to be the *Moroteuthis* (or *Moroteuthopsis*) *ingens* (Smith) from the Magellan region.

Family CRANCHIIDÆ Gray, 1849 (em).

Subfamily GALITEUTHINÆ NEW NAME.

CRANCHIONYCHIAE Joubin, 1898.

As stated by Joubin, this group has the facies of an interesting connecting link between the Onychoteuthidæ on the one hand and the highly aberrant Cranchiidæ on the other. Whether this represents its actual relationships, however, or is rather to be regarded as an instance of converging development (parallel adaptation) does not yet appear.

Genus GALITEUTHIS Joubin, 1898.

Galiteuthis Joubin, 1898, p. 280.

Taonidium Chun, 1906, p. 86 (pars).

Body of moderate size, elongate, attenuate, with long, narrowly separated, lanceolate fins; mantle delicate, membranous, immovably adherent to the head in the nuchal region and at a point on either side of the funnel. Arms short; suckers unmodified, in two rows. Tentacles long; club bearing two rows of hooks along the middle succeeded distally by minute suckers, and with a well-developed fixing apparatus on the carpal region supplemented by a further series of suckers and pads extending down the stalk.

Type, *Galiteuthis armata* Joubin, 1898, described from a specimen taken in the Mediterranean at Nice, France.

Galiteuthis phyllura Berry, 1911. (Pl. XLVI, fig. 1-3; pl. LIV, fig. 5-6; pl. LVI.)

Galiteuthis phyllura Berry, 1911, p. 592.

Animal of moderate size, exceedingly delicate and translucent. Mantle membranous, smooth, thin, elongate; tapering gradually to the beginning of the fins, whence it continues between them to their tips as a slender, attenuate, spit-like process containing little but the gladius; anterior mantle margin thin, entire, closely and broadly adherent to the body in the nuchal region and undergoing a similar firm fusion with the base of the funnel on either side below, so that the water finds ingress to the mantle cavity by three openings; of these the two lateral are very broad and full, but the mantle margin is drawn more tightly across the funnel so that the ventral opening is considerably smaller. Fins remarkably developed, lanceolate, as broad as the body at its widest point, but leaf-like, thin, and excessively long and slender; nearly half as long as the body, attached for their entire length, and barely separated in the median line by the delicate integument covering the gladius.

Head (except the eyes) small, rather elongate above and below. Funnel large, with a strong ventral flexion; membranous, thin, much wrinkled in the preserved specimens; true valve lacking, its place taken by a thickened fold or pseudo-valve on the dorsal wall just in advance of the median pad of the funnel organ. Funnel organ highly complicated, comprising three distinct components, as follows: A large, rounded ovate, flattened pad on each ventro-lateral wall; between them a large, conspicuous, median, liver-shaped pad, its convex outline directed forward; from its center rises a long papilla, robust at the base, but tapering and terminated by the anal aperture; lateral lobes of this pad broad and rounded, each of these also giving rise near its center to a rather large, soft, bluntish papilla, which appears to terminate blindly in a rounded, finger-like extremity. The general arrangement of the entire apparatus is represented in the annexed diagram (text fig. 17), as well as in figures 5-6 of plate L.IV. Eyes relatively enormous, globular, sessile, nearly approaching in the median line below; openings small.

Sessile arms moderately short, about one-fourth as long as the body, unequal, their order 4, 3, 2, 1; rather slender and delicate, each bordered by a broad, extremely delicate, hyaline membrane strengthened by numerous fairly slender, transverse trabeculae having their origin near the base of the suckers (pl. XLVI, fig. 1). Suckers small, subspherical, obliquely placed on very short pedicels in two regularly alternating rows of about 20 to 25 each; horny rings well developed, but delicate and smooth (text fig. 18).

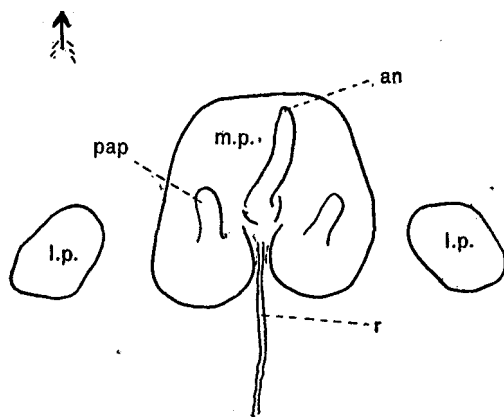


FIG. 17.—*Galiteuthis phyllura*, diagram to illustrate the relations of the component parts of the funnel organ; *an*, anal opening; *r*, rectum; *l. p.*, lateral pads; *m. p.*, median pad; *pap*, papilla.

Tentacles long, somewhat stouter at the base than the sessile arms and about twice as long; inner surface flattened and with a median groove, on either side of which appears a row of minute flattened suckers (about 18 in all), regularly but distantly alternating with as many small, more or less obscure, circular pads (pl. XLVI, fig. 3). Distally the pads and suckers move closer together and their ranks exhibit a tendency to separate in alternation to form four rows, the entire apparatus terminating on the carpal portion of the club in a compact group of about eight suckers and the same number of pads, still minute although much larger than those of the stalk. Club slightly expanded, furnished with a thin marginal membrane; expanded portion armed with two alternating rows of large delicate hooks, 12 in all, succeeded at the extremity of the club by a group of very minute suckers. Hooks of very characteristic appearance; sheaths hood-like; bases broadly expanded; a single isolated sucker of exceeding minuteness occurring near the proximal end of the dorsal row (pl. XLVI, fig. 2).

Buccal membrane well developed, suckerless.

Gladius not removed, but in large part easily apparent through the dorsal integument; fragile; excessively slender and attenuate.

Radula not examined.

Color in alcohol a soiled white, the chromatophores appearing as indistinct brownish spots thickly scattered over the dorsal surface of the head and on the tentacles (notably on the inner surface of the club); much less numerous but more distinct on the ventral portion of the head and the dorsal surfaces of the fins; on the mantle only a few large ones sparsely distributed.

The chief dimensions of the single specimen seen are as follows:

MEASUREMENTS OF GALITEUTHIS PHYLLURA.

	mm.
Total length including tentacles.....	^a 350
Length of mantle (dorsal).....	^a 230
Fins.....	114
Width of mantle.....	^a 35
Across fins.....	35
Of head.....	35
Length of dorsal arm.....	33
Second arm.....	41
Third arm.....	47
Ventral arm.....	57
Tentacle.....	100
Tentacle club.....	16

Type, cat. no. 214325, U. S. National Museum (no. 113 of author's register).

Type locality, Albatross station 4529, off Point Pinos, Monterey Bay, California, from a depth of 780 to 799 fathoms, hard mud and sand bottom; one specimen.

Distribution, Monterey Bay, California.

The relationships of the present form are entirely with the only other described member of the genus, the *G. armata* of Joubin, from the Mediterranean. The two descriptions, however, fail to parallel in a number of minor details, especially in the accounts of the structure of the tentacles, where Joubin's figures differ very strikingly in their representation of the hooks and fixing apparatus. Furthermore, in neither his figures nor description am I able to find any allusion to the remarkable apparatus on the stalk. The latter seems altogether too evident to have been overlooked by him unless it was either absent on the Mediterranean specimen, or entirely obscured through poor preservation.

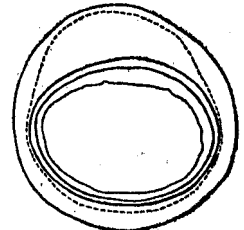


FIG. 18.—*Galiteuthis phyllura*, horny ring from sucker of sessile arm; camera drawing from mount in balsam. [113.]

Nevertheless it was with no little doubt and some misgiving that I eventually proposed a new specific name for the reception of the specimen in hand. This was done on account of my firm belief that in cases of habitats of little known species so far removed from one another, where the only alternatives seem to be (1) the description of a slightly differentiated form as new, or (2) uniting them and leaving to future generations to work out such differences as may exist, the exigencies of modern science are best served by the adoption of the former course. This seems on the whole a rule less apt to create confusion than the other, for more complete knowledge regarding these animals is as likely to reveal further differences heretofore unnoted, as to establish their identity. In the same connection it should be remembered how very few of the molluscan species of our west coast, so many of which were once supposed to be inseparable from Mediterranean forms, have actually proved to be so; and it does not appear that the distribution of recent cephalopods has been brought about under such different conditions as to constitute an exception to the rule. *G. armata* is stated by Joubin to be pelagic, and there is no telling at just what point our specimen became entangled in the Albatross dredge, so that this may be true. If so, a possible reason at once appears for such an exception as that mentioned above, and indicates that further evidence may reduce *G. phyllura* to the position of an absolute synonym of the older species.

In any case *G. phyllura* constitutes a very remarkable addition to the fauna of the North Pacific, and one which can not fail to be recognized when it is recaptured. Those possessing the opportunity to observe the offshore hauls of the coast fishermen, or who tramp the beach after the winter storms, should endeavor to maintain a watch for further evidence of the presence of this curious creature in our seas.

^a Measurements inaccurate due to extreme contraction of mantle.

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^a I have followed Hoyle in giving 1834 as the date of Owen's contribution to this work. Most authors give it as one year later, and this is the date on the copy examined by me.

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LIST OF THE ALBATROSS STATIONS AT WHICH CEPHALOPODS WERE TAKEN, WITH THE SPECIES COLLECTED AT EACH.

Station 4194, Gulf of Georgia, British Columbia; June 20, 1903; 111-170 fathoms; temperature at surface 63° F., at bottom 43.8°; soft green mud. *Polyopus leioderma*.

Station 4205, Admiralty Inlet, vicinity of Port Townsend, Washington; June 29, 1903; 26-15 fathoms; temperature at surface 57° F., at bottom 50.8°; rock and shells. *Polyopus hongkongensis*.

Station 4209, Admiralty Inlet, vicinity of Port Townsend, Washington; June 30, 1903; 25-24 fathoms; temperature at surface 53°, at bottom 50.3°; rocky, coarse sand, and shells. *Polyopus hongkongensis*.

Station 4218, Admiralty Inlet, vicinity of Port Townsend, Washington; July 1, 1903; 16 fathoms; temperature at surface 54°, at bottom 51.8°; soft green mud. *Rossia pacifica*.

Station 4220, Admiralty Inlet, vicinity of Port Townsend, Washington; July 1, 1903; 16-31 fathoms; temperature at surface 54°, at bottom 50.8°; green mud, sand, and broken shells. *Polyopus hongkongensis*, *Rossia pacifica*.

Station 4222, Admiralty Inlet, vicinity of Port Townsend, Washington; July 1, 1903; 39 fathoms; temperature at surface 54°, at bottom 50.8°; gray sand and broken shells. *Polyopus hongkongensis*, *Rossia pacifica*.

Station 4223, Boca de Quadra, southeast Alaska; July 6, 1903; 48-57 fathoms; temperature at surface 59°, at bottom 44.6°; soft green mud. *Rossia pacifica*.

Station 4226, vicinity of Naha Bay, Behm Canal, southeast Alaska; July 7, 1903; 31-62 fathoms; temperature at surface 61°, at bottom 44.8°; rocky. *Rossia pacifica*.

Station 4227, vicinity of Naha Bay, Behm Canal, southeast Alaska; July 7, 1903; 62-65 fathoms; temperature at surface 61°, at bottom 43.8°; dark green mud and fine sand. *Rossia pacifica*.

Station 4228, vicinity of Naha Bay, Behm Canal, southeast Alaska; July 7, 1903; 41-134 fathoms; temperature at surface 63°, at bottom 47.8°; gravel and sponge. *Polyopus gilbertianus*.

Station 4233, vicinity of Yes Bay, Behm Canal, southeast Alaska; July 8, 1903; 39-45 fathoms; temperature at surface 61°, at bottom 44.7°; soft gray mud and rock. *Rossia pacifica*.

Station 4234, vicinity of Yes Bay, Behm Canal, southeast Alaska; July 8, 1903; 45 fathoms; temperature at surface 61°, at bottom 43.7°; gray mud, rocky. *Rossia pacifica*.

Station 4242, Kasaan Bay, Prince of Wales Island, southeast Alaska; July 11, 1903; 9-24 fathoms; temperature at surface 58°, at bottom 58.9°; fine gravel, broken shells, rocky. *Rossia pacifica*.

Station 4243, Kasaan Bay, Prince of Wales Island, southeast Alaska; July 11, 1903; 42-47 fathoms; temperature at surface 57°, at bottom 49.1°; green mud. *Rossia pacifica*.

Station 4253, Stephens Passage, Alaska; July 14, 1903; 188-136 fathoms; temperature at surface 52°, at bottom 40.9°; rock and broken shells. *Polyopus gilbertianus*.

Station 4286, Chignik Bay, Alaska; August 10, 1903; 57-63 fathoms; temperature at surface 55°, at bottom 47.2°; green mud and rock. *Rossia pacifica*.

Station 4293, Shelikof Strait, Alaska; August 15, 1903; 112-106 fathoms; temperature at surface 57°; blue mud and fine sand. *Polyopus leioderma*.

Station 4310, vicinity of San Diego, California; March 3, 1904; 71-75 fathoms; temperature at surface 61°, at bottom 49.7°; fine gray sand, green mud. *Rossia pacifica diegensis*.

Station 4312, vicinity of San Diego, California; March 4, 1904; 135-95 fathoms; temperature at surface 60°; fine gray sand, rock. *Polyopus californicus*.

Station 4323, vicinity of San Diego, California; March 7, 1904; 227-193 fathoms; temperature at surface 63°, at bottom 45.8°; soft green mud. *Polyopus californicus*.

Station 4324, vicinity of San Diego, California; March 7, 1904; 10 fathoms; temperature at surface 64-60°; gray sand. *Loligo opalescens*.

Station 4325, vicinity of San Diego, California; March 8, 1904; 191-292 fathoms; temperature at surface 62°, at bottom 46-43°; green mud and fine sand. *Stauroteuthis* (?) sp., juv., *Polyopus californicus*.

Station 4339, vicinity of San Diego, California; March 10, 1904; 241-369 fathoms; temperature at surface 59°, at bottom 41.5°; green mud. *Polyopus californicus*.

Station 4349, vicinity of San Diego, California; March 12, 1904; 75-134 fathoms; temperature at surface 58-59°, at bottom 50°; green mud and fine sand. *Polyopus hongkongensis*.

Station 4356, vicinity of San Diego, California; March 15, 1904; 120-131 fathoms; temperature at surface 57-58°, at bottom 48.2°; green mud. *Rossia pacifica diegensis*.

Station 4357, vicinity of San Diego, California; March 15, 1904; 134-155 fathoms; temperature at surface 58-59°, at bottom 46.8°; green mud. *Rossia pacifica diegensis*.

Station 4358, vicinity of San Diego, California; March 15, 1904; 167-191 fathoms; temperature at surface 59-60°, at bottom 45.4°; green mud. *Polyopus californicus*, *Rossia pacifica diegensis*.

Station 4364, vicinity of San Diego, California; March 16, 1904; 101-129 fathoms; temperature at surface 59°, at bottom 48°; gray sand, rock, green mud. *Polyopus hongkongensis*, *Rossia pacifica diegensis*.

Station 4365, vicinity of San Diego, California; March 16, 1904; 130-158 fathoms; temperature at surface 59°, at bottom 47°; green mud. *Polyopus californicus*, *Rossia pacifica diegensis*.

Station 4366, vicinity of San Diego, California; March 16, 1904; 176-181 fathoms; temperature at surface 59°, at bottom 46°; green mud. *Polyopus californicus*.

Station 4369, vicinity of San Diego, California; March 16, 1904; 260-284 fathoms; temperature at surface 60-59°, at bottom 43°; green mud, gray sand, rock. *Polyopus californicus*.

Station 4377, vicinity of San Diego, California; March 17, 1904; 127-299 fathoms; temperature at surface 60°; green mud and sand. *Rossia pacifica diegensis*.

Station 4379, vicinity of San Diego, California; March 18, 1904; 257-408 fathoms; temperature at surface 59°, at bottom 41.1°; green mud, brown specks, and rock. *Gonatus fabricii*.

Station 4393, vicinity of San Diego, California; March 30, 1904; 2113-2259 fathoms; temperature at surface 58-59°; soft gray mud. *Cirroteuthis macrope*.

Station 4396, vicinity of San Diego, California; March 31, 1904; 2228 fathoms; temperature at surface 59°, at bottom 35°; red mud. *Eledonella heathi*.

Station 4413, off Bird Rock, Santa Catalina Island, California; April 11, 1904; 152-162 fathoms; temperature at surface 62°; dark gray sand. *Polyopus californicus*.

Station 4416, off Santa Barbara Island, California; April 12, 1904; 448-323 fathoms; temperature at surface 59°; dark green mud and rock. *Meleagroteuthis hoylei*.

Station 4420, off San Nicolas Island, California; April 12, 1904; 594-581 fathoms; temperature at surface 58-59°; fine gray sand. *Polyopus hongkongensis*.

Station 4424, off San Nicolas Island, California; April 13, 1904; 594-581 fathoms; temperature at surface 59-60°; fine gray sand. *Gonatus fabricii*.

Station 4446, Monterey Bay, California; May 11, 1904; 59-52 fathoms; temperature at surface 58°, at bottom 47.2-47.7°; green mud. *Rossia pacifica*, *Loligo opalescens*.

Station 4447, Monterey Bay, California; May 11, 1904; 52-42 fathoms; temperature at surface 59-58°, at bottom, 47.5-47.9°; green mud. *Loligo opalescens*.

Station 4449, Monterey Bay, California; May 11, 1904; 29-22 fathoms; temperature at surface 57°, at bottom 49°; green mud and gray sand. *Loligo opalescens*.

Station 4452, Monterey Bay, California; May 11, 1904; 49-50 fathoms; temperature at surface 54°, at bottom 47.8-48.5°; green mud and fine sand. *Rossia pacifica*.

Station 4453, Monterey Bay, California; May 11, 1904; 49-51 fathoms; temperature at surface 54°, at bottom 48.5-49°; dark green mud. *Polyopus hongkongensis*, *Rossia pacifica*.

- Station 4455, Monterey Bay, California; May 12, 1904; 62-56 fathoms; temperature at surface 54°, at bottom 48°; green mud. *Rossia pacifica*.
- Station 4457, Monterey Bay, California; May 12, 1904; 46-40 fathoms; temperature at surface 53-54°; dark green mud. *Polyopus hongkongensis*, *Rossia pacifica*.
- Station 4464, Monterey Bay, California; May 13, 1904; 51-36 fathoms; temperature at surface 53°, at bottom 49.5°; soft dark gray mud. *Polyopus hongkongensis*.
- Station 4468, Monterey Bay, California; May 13, 1904; 51-309 fathoms; temperature at surface 54°, at bottom 44.5°; fine sand. *Gonatus fabricii*.
- Station 4473, Monterey Bay, California; May 14, 1904; 59-65 fathoms; temperature at surface 55°; gray sand and mud. *Rossia pacifica*.
- Station 4475, Monterey Bay, California; May 16, 1904; 142-58 fathoms; temperature at surface 54-55°; soft green mud. *Rossia pacifica*.
- Station 4480, Monterey Bay, California; May 16, 1904; 76-53 fathoms; temperature at surface 54°; dark green mud and sand. *Rossia pacifica*.
- Station 4482, Monterey Bay, California; May 17, 1904; 43-44 fathoms; temperature at surface 53°; soft green mud. *Polyopus hongkongensis*.
- Station 4489, Monterey Bay, California; May 18, 1904; 20-18 fathoms; temperature at surface 55°; dark gray sand. *Polyopus hongkongensis*.
- Station 4492, Monterey Bay, California; May 18, 1904; 26-27 fathoms; temperature at surface 54°; soft green mud, rock. *Polyopus hongkongensis*, *Rossia pacifica*.
- Station 4512, Monterey Bay, California; May 23, 1904; 530-309 fathoms; temperature at surface 55°, at bottom 45°; hard green mud. *Gonatus fabricii*.
- Station 4517, Monterey Bay, California; May 24, 1904; 766-750 fathoms; temperature at surface 56°; green mud and sand. *Gonatus fabricii*.
- Station 4526, Monterey Bay, California; May 26, 1904; 204-239 fathoms; temperature at surface 57°; soft gray mud. *Polyopus leioderma*.
- Station 4529, Monterey Bay, California; May 27, 1904; 780-799 fathoms; temperature at surface 58°; hard mud and sand. *Galiteuthis phyllura*.
- Station 4530, Monterey Bay, California; May 27, 1904; 958-755 fathoms; temperature at surface 58°; soft gray mud. *Gonatus fabricii*.
- Station 4536, Monterey Bay, California; May 31, 1904; 1006-1041 fathoms; temperature at surface 58°, at bottom 38.5°; hard sand and mud. *Polyopus californicus* (?) juv.
- Station 4538, Monterey Bay, California; May 31, 1904; 871-795 fathoms; temperature at surface 59°; hard gray sand. *Meleagroteuthis hoylei*.
- Station 4544, Monterey Bay, California; June 2, 1904; 724-1000 fathoms; temperature at surface 58°; gray sand and mud. *Meleagroteuthis hoylei*, *Gonatus fabricii*.
- Station 4550, Monterey Bay, California; June 7, 1904; 50-57 fathoms; temperature at surface 57-58°; green mud and rock. *Polyopus* (sp.) juv.

APPENDIX.

For the benefit of students without immediate access to large zoological libraries, it has been thought serviceable to offer accurate reprints of several of the earlier and more inaccessible papers having a direct bearing on the teuthology of the west American region and containing the original descriptions of several of our species.

[From Proceedings of the California Academy of Natural Sciences, vol. II, 1862, p. 170-172.]

DESCRIPTION OF TWO SPECIES OF CEPHALOPODES IN THE MUSEUM OF THE CALIFORNIA ACADEMY OF NATURAL SCIENCES.

By W. M. GABB.

Octopus punctatus.—Body ovate, rounded at the extremity. Head moderately large, without any well-marked neck; compressed above, about one-fifth as long as the body, abruptly truncated in advance of the eyes, so that the constriction below the arms is barely more than half as wide as the greatest diameter of the head. Eyes of medium size; not prominent; color destroyed by alcohol. Abdominal aperture wide, the ends being directly behind the eyes; lip simple and acute. Siphon broad at the base, rapidly narrowing and extending a little beyond the origin of the arms. Arms subquadrate in section, the largest about four times the length of the body; proportionate length beginning with the dorsal side, 2, 1, 4, 3, varying very little in length, and being of about the same thickness. Cupules moderate, about half the diameter of the arms, largest just beyond the termination of the umbrella; short, robust, tapering almost imperceptibly, and slightly constricted just below the top. Umbrella small, not extending between the arms for one-fourth of their length, but continued as a very narrow membrane, for about one-half of their length along the side farthest from the dorsal side. Mouth very small, surrounded by small lips. Surface smooth, flesh-colored, and profusely marked by very minute reddish-brown, or chocolate-colored points. These points are so closely placed on the dorsal surface of the body and arms as to produce a nearly uniform, dirty-brown appearance; on the inside of the arms, the inner surface of the umbrella, and the whole ventral surface they are sparsely scattered. Length of body and head to origin of the arms, 3.5 inches. Circumference of body, at its broadest part, 4.3 inches. Length of body to the opening in the abdomen, 2.5 inches. Breadth of head, 1.1 inches. Length of the longest arm, from the mouth, 10.8 inches. Length of shortest, 9.25 inches. Circumference of one arm, 2 inches. Diameter of largest cupule, .3 in. Length of siphon, .7 in. Diameter at base .7 in. Diameter at apex (flattened), .3 in.

Locality.—Common in the neighborhood of San Francisco. Also found on the coast of Lower California, having been brought from Scammon's Lagoon, in abundance, by Capt. C. M. Scammon. The specimen from which the species is described is comparatively small. Dr. W. O. Ayres told me that he had seen them several feet in length, and spoke of one in which the arms were seven feet long.

It appears to approach most nearly to *O. megalocyathus*, Couthouy (Gould, Mollusca of Wilkes' Expedition, p. 471), but differs in the absence of the lateral membrane, the size of the mouth, the size of the cupules and the general coloration. There may be other differences, but I have not had an opportunity of examining the figures of Couthouy's species.

Onychoteuthis fusiformis.—Body slender, fusiform, prolonged and sharply acuminate posteriorly, truncated sinuously above, having a slight projection in the median dorsal region, and being equally

emarginate on the ventral side. Head small, narrower than the body, subquadrate; eyes moderate and prominent, lachrymal sinus large. Sessile arms, not half so long as the body, nearly of the same size; formula of relative size, counting from the dorsal side, 1, 2, 4, 3, the second and last, being almost exactly of the same length, the dorsal the smallest. The dorsal arms are connected at their base by a minute membrane, which does not run up their sides; the second and third arms, and the tentacles have this membrane on one side, running to the extreme tips; the ventral and the adjoining arms are united by a larger membrane, but like the dorsal, the ventral arms are unprovided with it beyond the base, and are not united to each other; the tips are laterally compressed. The cupules on the sessile arms are strongly constricted at their base, and are pedunculated; they are arranged in a double series, without being either in pairs, nor yet alternating. They commence a short distance from the base of the arms, and are continued to the extreme tips, becoming smaller and scattered as they approach the end. Tentacles, nearly two-thirds the length of the body, exclusive of the head, the club forming about one-third of the whole; the club is little if at all widened; tentacle naked to the base of the club, where the "sucker" is placed, consisting of a small, irregularly rounded disc, bearing eight or nine sessile cupules. Beyond, as far as the extreme tip, are large and small, strongly hooked claws, arranged in an irregular line, and each one pierced near the base, and above grooved for half its length on the concave side. Mouth small, surrounded by a thin, simple lip, and outside of that, by a seven-lobed fold of skin, two lobes of which are placed opposite the base of the ventral arms—one opposite the space between the dorsals, and the other four opposite the laterals. Mandibles black. Siphon small, hardly projecting beyond the mantle. Fins dorsal, triangular, terminal, half as long as the body, outer angle rounded. Internal plate long, very slender, widest in the middle, tapering both ways, median ridge as high as the lateral plate, conical portion at the base, minute, laterally compressed, tip curved.

Color, light yellowish-brown, on the under surface and inside of the arms; back purplish-brown, nearly black on the median line and the posterior portion of the head, caused as in the preceding species, by the peculiar arrangement of dark spots. On the back of the fins these spots are of two sizes—large ones surrounded by an uncolored space, and small ones of a lighter color, interspersed.

Length of horny plate, 3.2 inches; width, .15 inch; length of terminal cone, .15 inch; circumference of body, 2 inches; length of fin, 1.6 inches; breadth of fins, 2.1 inches; length of longest sessile arm, 1.5 inches; length of shortest, .9 inch; length of tentacle, 2.1 inches.

Said to have been caught off Cape Horn.

[From Proceedings Academy Natural Science, Philadelphia, vol. XIV, 1862, p. 483.]

DESCRIPTION OF A NEW SPECIES OF CEPHALOPOD FROM THE COAST OF CALIFORNIA.

By W. M. GABB.

Ommastrephes Tryonii.—Body large, subcylindrical for about two-thirds of its length, posterior third tapering, acute at the extremity. Fins between one-third and one-fourth the length of the body, nearly twice as broad as long, rhomboidal; angles rounded. Anterior of the body truncated at a right angle to the length and with a slight angle on the dorsal median line. Siphon short, broad, head small, not wider than the body, flattened above (and at the sides?). Eyes small. Sessile arms robust, short, compressed: comparative length, 4, 2, 1, 3, the dorsal being the shortest, although they are all of nearly equal length. The second and third pair are so compressed that the cups appear to be arranged in a single line. The lower half or two-thirds of the outer side of the dorsal and the whole of the same portion of the other arms are fringed with a narrow membrane. The inner side of the third pair is also fringed on each side of the cupules.

The cupules are all small, but the bordering rows of teeth are well marked. Tentacular arms compressed, very little longer than the longest pair of sessile arms. Cupules arranged on the distal two-fifths, largest in the middle, becoming very small towards each end. Mouth small, the surrounding membrane without cupules, with a bifurcating process between the dorsal pair of arms and one extending to each of the other sessile arms. Surface flesh colored, covered with small dots, sparsely placed on

the lower side and pinkish; on the back these dots are nearly black and placed close together so as to produce a mottled appearance. Between the back and sides there is a well-marked lighter band extending from the edge of the fins to the anterior end of the body.

Shell narrow, pointed in front, and tapering backwards regularly, except the last half inch which is dilated into the usual slipper-like process.

Length of body, 5.5 in.; circumference, 3 in.; length of fin, 1.8 in.; width of fin, 3.4 in.; length of head, .8 in.; breadth (about), .9 in.; length of longest sessile arm, 2.1 in.; length of shortest, 1.5 in.; length of tentacular arm, 2.5 in.; length of siphon (about), .5 in.

Locality.—Coast of California?

The specimen was presented to me by Dr. W. O. Ayers, of San Francisco, and was found in a lot of salt, most probably from near Point Conception. The colors are well-preserved, but the specimen is so soft after relaxation that the exact form of the head can not be determined.

It resembles *O. sagittata*, d'Orb., in both external form and the shape of the shell. It differs from that species, however, in the much shorter tentacular arms and the broader fin. The shell, which is pointed in nearly the same manner anteriorly, tapers regularly, while in d'Orbigny's species it is suddenly constricted.

[From Zoe, vol. III, 1892, p. 51-52.]

NOTE ON A CALIFORNIAN LOLIGO.

By HENRY HEMPHILL.

In the July (1891) number of the *Nautilus*, in an article under the heading "Edible Shell Notes," Mr. R. E. C. Stearns mentions a "Ten-armed Cephalopod" which he had seen offered as an article of food in the San Francisco markets. Recently, while passing through the San Francisco and Oakland markets, I found a form of a loligo lying on the stalls of the fish dealers, which they offered at 25 cents per pound, and which I think is the "Ten-armed cephalopod" referred to by Mr. Stearns. Doctor Cooper informs me that he had observed a shoal of loligo at Monterey, some years ago, but having no net he was unable to secure a specimen. These that we find here in the markets now are said, by the fish dealers, to be taken in nets outside the Heads by the Chinese fishermen.

The body and arms of my largest specimen measures about 10 inches, the two longest arms being about three inches longer. The arms are not webbed, but each of the eight short ones have two rows of suckers their entire length, while the two other arms have a small patch of small suckers toward their tips. It took nine individuals of those I purchased from the fish dealer to weigh a pound, so we may say they weigh about two ounces each. In cleaning for cooking they will lose about half their weight, and each one will then furnish about one ounce of flesh.

In preparing them for cooking, after having removed the outer skin, pen, head, arms and entrails, they should be carefully washed, and fried in plenty of hot butter or fat, and seasoned to the taste.

Those which I had prepared and cooked were a little tough, though quite palatable, being nicely flavored, but they never will take the place of the delicious oysters and clams that have inspired poets to sing their praises.

In the form of its body and the coloring, as well as in the form of the pen, it closely resembles *Loligo Gahi* D'Orbigny, but as I have no other material with which to compare it, and no description of that form, I can not say definitely whether it is that species or not. This form makes an interesting addition to our west coast Cephalopods, and if upon further study I should conclude it to be new I propose to call it *Loligo Stearnsii*.

The following is a list of all the Cephalopods known to our coast, from San Diego to Alaska:

- Argonauta argo L.
- Octopus punctatus Gabb.
- Ammostrephes ayresii Gabb.
- Ammostrephes giganteus Gabb.
- Onychoteuthis fusiformis Gabb.

EXPLANATION OF PLATES.

Except where otherwise stated in the context, all the drawings in the following plates were prepared by Miss Lora Woodhead, of Stanford University. The photographs, except that reproduced on plate XLVIII, are by Mr. J. H. Paine.

Numbers in brackets refer to specimen number in author's register.

PLATE XXXII.

Fig. 1. *Cirroteuthis macrope*, ventral view of entire animal (type specimen); $\times 1\frac{1}{4}$; arms and web partially restored. [120.]

Fig. 2. *Cirroteuthis macrope*, odontophore of young individual; greatly enlarged camera drawing from mount in balsam. [120.]

Fig. 3. *Cirroteuthis macrope*, view of interior of funnel of type specimen showing the funnel organ, $\times 1\frac{1}{2}$. [120.]

Fig. 4. *Eledonella heathi*, inner aspect of right third arm of type, enlarged to about 2 diameters. [118.]

PLATE XXXIII.

Fig. 1. *Stauroteuthis* (?) sp., ventral view of young animal, $\times 2$. [119.] Drawn by R. L. Hudson.

Fig. 2. *Eledonella heathi*, ventral view of type specimen, $\times 1\frac{1}{5}$. [118.] Drawn by R. L. Hudson.

Fig. 3. *Eledonella heathi*, sixth sucker of right third arm of type, dorsal aspect; much enlarged. [118.]

Fig. 4. *Eledonella heathi*, interior of funnel showing the funnel organ. [118.]

PLATE XXXIV.

Fig. 1. *Polypus bimaculatus*, dorsal view of a young specimen from San Diego, California, rugose stage, $\times 2\frac{1}{2}$. [124.]

Fig. 2. *Polypus bimaculatus*, dorsal view of a slightly larger individual with relatively smooth surface from La Jolla, California, slightly enlarged. [104.]

PLATE XXXV.

Fig. 1. *Polypus leioderma*, lateral view of type specimen, a female from Shelikof Strait, Alaska, natural size. [127.]

Fig. 2. *Polypus bimaculatus*, hectocotylyzed portion of right third arm of a male specimen from La Jolla, California; inner aspect, $\times 10$. [104.]

Fig. 3. *Polypus hongkongensis*, detail of surface papillation on medio-dorsal region of body of a very rugose specimen, $\times 4$. [142.]

Fig. 4. *Polypus gilbertianus*, detail of surface papillation on medio-dorsal region of body, same scale as fig. 3. [139.]

Fig. 5. *Polypus gilbertianus*, hectocotylyzed portion of right third arm of a male specimen (type) from Behm Canal, Alaska; inner aspect, $\times 5$. [139.]

Fig. 6. *Polypus californicus*, detail of surface papillation of type specimen in medio-dorsal region of head, $\times 4$. [131.]

Fig. 7. *Polypus californicus*, detail of surface papillation of same specimen in medio-dorsal region of body, same scale as fig. 6. [131.]

PLATE XXXVI.

Fig. 1. *Polypus hongkongensis*, lateral view of a male specimen from Uyak Bay, Alaska (type of *P. apollyon*), $\times \frac{2}{3}$. [142.] Photograph by J. H. Paine.

Fig. 2. *Polypus gilbertianus*, dorsal view of a male specimen (type) from Behm Canal, Alaska, $\times \frac{1}{2}$. [129.] Photograph by J. H. Paine.

PLATE XXXVII.

Polyopus gilbertianus, drawing of specimen shown in fig. 2 of preceding plate, $\times\frac{2}{3}$. [129.]

PLATE XXXVIII.

Fig. 1. *Polyopus californicus*, ventral aspect of large male from off San Diego, California, $\times\frac{1}{2}$. [132.] Photograph by J. H. Paine.

Fig. 2. *Polyopus californicus*, dorsal aspect of type specimen (male), $\times\frac{2}{3}$. [131.] Photograph by J. H. Paine.

PLATE XXXIX.

Fig. 1. *Polyopus californicus*, hectocotylyzed portion of right third arm of specimen shown in pl. VII, fig. 1, $\times 1\frac{3}{4}$. [132.]

Fig. 2. *Polyopus californicus*, inner aspect of portion of left ventral arm of same specimen just below the margin of the umbrella, $\times 1\frac{3}{4}$. [132.]

Fig. 3. *Polyopus hongkongensis*, inner aspect of portion of right dorsal arm of young male near the umbrella margin, showing sucker enlargement, $\times 3\frac{1}{2}$. [134.]

Fig. 4. *Polyopus hongkongensis*, hectocotylyzed portion of right third arm of a male specimen from Uyak Bay, Alaska, $\times 6$. [142.]

Fig. 5. *Polyopus bimaculatus*, beak of a ♂ individual from the vicinity of San Diego, California, much enlarged. [103.]

PLATE XL.

Fig. 1. *Polyopus hongkongensis*, ventral aspect of a young male from Pacific Grove, California, $\times 2$. [164.] Photograph by J. H. Paine.

Fig. 2. *Polyopus californicus*, lateral view of an immature specimen from off Santa Catalina Island, California, $\times 1\frac{1}{4}$. [130.] Photograph by J. H. Paine.

Fig. 3. *Polyopus californicus*, dorsal view of a still smaller specimen from off San Diego, California, $\times 1\frac{1}{2}$. [128.] Photograph by J. H. Paine.

Fig. 4. *Polyopus leioderma*, dorsal view of a female (type), $\times 1\frac{1}{2}$. [137.] Photograph by J. H. Paine.

Fig. 5. *Polyopus leioderma*, ventral view of very young specimen from Monterey Bay, California, $\times 1\frac{1}{2}$. [138.] Photograph by J. H. Paine.

PLATE XLI.

All figures on this plate are from photographs by J. H. Paine, and are approximately natural size.

Fig. 1. *Rossia pacifica*, dorsal view of a male from Behm Canal, Alaska. [21.]

Fig. 2. *Rossia pacifica*, dorsal view of a female from Behm Canal, Alaska. [21.]

Fig. 3. *Rossia pacifica*, dorsal view of another female from the same lot. [21.]

Fig. 4. *Rossia pacifica*, ventral view of specimen shown in fig. 3. [21.]

Fig. 5. *Rossia pacifica*, dorsal view of a large female from Chignik Bay, Alaska. [26.]

Fig. 6. *Rossia pacifica*, dorsal view of a male from Monterey Bay, California. [24.]

PLATE XLII.

All figures on this plate are from photographs by J. H. Paine, and are approximately natural size.

Fig. 1. *Rossia pacifica*, ventral view of specimen shown in figure 6 of preceding plate. [24.]

Fig. 2. *Rossia pacifica diegensis*, dorsal view of a female from off San Diego, California. [19.]

Fig. 3. *Rossia pacifica diegensis*, ventral view of same specimen. [19.]

Fig. 4. *Rossia pacifica diegensis*, dorsal view of another female from the same lot. [19.]

Fig. 5. *Rossia pacifica diegensis*, dorsal aspect of a very young specimen from the same lot. [19.]

Fig. 6. *Rossia pacifica diegensis*, dorsal view of a variant male from off San Diego, California. [20.]

PLATE XLIII.

Fig. 1. *Rossia pacifica diegensis*, inner aspect of left third arm of male from off San Diego, California, $\times 2\frac{1}{2}$. [20.]

Fig. 2. *Rossia pacifica*, inner aspect of arms of entire right side of a male from Behm Canal, Alaska, $\times 2$. [21.]

Fig. 3. *Rossia pacifica*, outer lateral view of left dorsal arm of same specimen, $\times 2$. [21.]

Fig. 4. *Rossia pacifica*, right tentacle club of same specimen, $\times 4$. [21.]

Fig. 5. *Loligo opalescens*, ventral view of an embryo of 3.5 mm., $\times 20$. [163.] *br*, gill; *c*, chromatophores; *e*, eye; *g*, gonad; *i*, ink-sac; *l*, lens; *y*, yolk-sac.

Fig. 6. *Loligo opalescens*, buccal membrane of type, $\times 3$. [101.]

Fig. 7. *Loligo opalescens*, distal portion of left ventral arm of an adult male from Monterey Bay, California, showing hectocotylization, $\times 2\frac{1}{2}$. [59.] Drawn by H. V. Poor.

Fig. 8. *Loligo opalescens*, part camera drawing of sucker from third arm of male oral aspect. [101.] From a mount in balsam.

PLATE XLIV.

Fig. 1. *Rossia pacifica*, ventral view of an adult male from Admiralty Inlet, Alaska, $\times 2$. [5.] Drawn by R. L. Hudson.

Fig. 2. *Loligo opalescens*, ventral view of young animal from Monterey Bay, California, $\times 1\frac{1}{2}$. [62.] Drawn by R. L. Hudson.

Fig. 3. *Loligo opalescens*, locking cartilage from left side of funnel of a male from Monterey Bay, California, $\times 2\frac{1}{4}$. [69.]

Fig. 4. *Loligo opalescens*, nuchal locking cartilage of same individual, $\times 2\frac{1}{4}$. [69.]

Fig. 5. *Rossia pacifica*, interior of funnel of a female from Monterey Bay, California, laid open from below to show the funnel organ, $\times 2\frac{1}{2}$. [7.] The posterior outlines of the median organ are not shown.

PLATE XLV.

Fig. 1. *Loligo opalescens*, dorsal view of type specimen (male) from Puget Sound, natural size. [101.]

Fig. 2. *Loligo opalescens*, ventral view of same, natural size. [101.]

PLATE XLVI.

Fig. 1. *Galiteuthis phyllura*, right third arm of type, inner aspect, $\times 3$. [113.]

Fig. 2. *Galiteuthis phyllura*, right tentacle club of type, inner aspect, $\times 5\frac{1}{2}$. [113.]

Fig. 3. *Galiteuthis phyllura*, inner aspect of left tentacle of type near the base showing fixing pads and suckers, $\times 6$. [113.]

Fig. 4. *Loligo opalescens*, inner aspect of median portion of right third arm of type, showing suckers and marginal web, much enlarged, $\times 5$. [101.]

Fig. 5. *Loligo opalescens*, right third arm of type, inner aspect, $\times 2$. [101.]

PLATE XLVII.

Fig. 1. *Sthenoteuthis bartramii*, oblique lateral view of right third arm of specimen from Bering Sea, $\times 1\frac{1}{2}$. [114.]

Fig. 2. *Sthenoteuthis bartramii*, nuchal locking cartilage of same specimen, $\times 2\frac{1}{2}$. [114.]

Fig. 3. *Sthenoteuthis bartramii*, locking cartilage of right side of funnel, $\times 2\frac{1}{2}$. [114.]

Fig. 4. *Sthenoteuthis bartramii*, ventral view of same specimen, reduced nearly $\frac{1}{2}$. [114.] Drawn by R. L. Hudson.

PLATE XLVIII.

Dosidicus gigas, photograph of ventral aspect of specimen from Monterey Bay, California, $\times\frac{1}{6}$. [72.]

PLATE XLIX.

- Fig. 2. *Dosidicus gigas*, inner aspect of carpal portion of right tentacle, natural size. [72.]
 Fig. 3. *Dosidicus gigas*, inner aspect of portion of left third arm near the base of the wide web, greatly enlarged. [72.]
 Fig. 4. *Dosidicus gigas*, inner aspect of portion of right third arm near the extremity, greatly enlarged. [72.]
 Fig. 5. *Dosidicus gigas*, lateral view of sixth ventral sucker from basal portion of right second arm, greatly enlarged. [72.]
 Fig. 6. *Dosidicus gigas*, lateral view of small sucker from extreme distal portion of second arm, greatly enlarged. [72.]

PLATE L.

- Fig. 1. *Meleagroteuthis hoylei*, dorsal view of specimen from off Santa Barbara Island, California, nearly natural size. [108.] Drawn by R. L. Hudson.
 Fig. 2. *Meleagroteuthis hoylei*, ventral view of same specimen, same scale as preceding. [108.] Drawn by R. L. Hudson.
 (This and the preceding drawing err in representing a condition of complete bilateral symmetry. A further sketch by Miss Woodhead has been added as giving a better idea of the true proportions; pl. LI, fig. 1.)
 Fig. 3. *Meleagroteuthis hoylei*, buccal region of same specimen, same scale as preceding. [108.] Drawn by R. L. Hudson.
 Fig. 4. *Sthenoteuthis bartramii*, sucker from right third arm, $\times 5$. [114.]
 Fig. 5. *Sthenoteuthis bartramii*, carpal region of left tentacle of specimen from Bering Sea, $\times 2$. [114.]

PLATE LI.

- Fig. 1. *Meleagroteuthis hoylei*, dorsal view of specimen from Monterey Bay, California, $\times\frac{2}{3}$. [110.]
 Fig. 2. *Meleagroteuthis hoylei*, right third arm of specimen shown in fig. 1-3 of preceding plate, inner aspect, $\times 1\frac{1}{3}$. [108.]
 Fig. 3. *Meleagroteuthis hoylei*, distal portion of right tentacle of same specimen, inner aspect, showing fixing apparatus, $\times 2$. [108.]
 Fig. 4. *Meleagroteuthis hoylei*, funnel of specimen from Monterey Bay, California, laid open ventrally to expose the funnel organ, $\times 2$. [109.]
 Fig. 5. *Meleagroteuthis hoylei*, funnel region of same specimen with mantle laid open ventrally to expose the locking apparatus, $\times 1\frac{1}{2}$. [109.]

PLATE LII.

- Fig. 1. *Gonatus fabricii* (?), inner aspect of right tentacle club of specimen shown on pl. LIII, fig. 1, $\times 1\frac{1}{2}$. [88.]
 Fig. 2. *Gonatus fabricii* (?), outer aspect of same, drawn to same scale. [88.]
 Fig. 3. *Gonatus fabricii*, distal portion of left tentacle of young specimen from Monterey Bay, California, $\times 7$. [98.]
 Fig. 4. *Gonatus fabricii*, basal portion of right tentacle club of another individual from Monterey Bay, California, $\times 10$. [100.]
 Fig. 5. *Meleagroteuthis hoylei*, oral aspect of sucker from third arm of specimen from Monterey Bay, California, $\times 40$. [109.] Drawn from mount in balsam.
 Fig. 6. *Meleagroteuthis hoylei*, left eye with surrounding integument from same specimen, $\times 2$. [109.]
 Fig. 7. *Meleagroteuthis hoylei*, right eye of same individual, same scale as fig. 6. [109.]

PLATE LIII.

Fig. 1. *Gonatus fabricii* (?), ventral view of adult specimen from Puget Sound, $\times\frac{1}{2}$. [88.] Photograph by J. H. Paine.

Fig. 2. *Gonatus fabricii* (?), ventral view of specimen taken near Victoria, B. C.; mantle laid open along medio-ventral line to expose interior of mantle cavity, $\times\frac{1}{2}$. [90.] Photograph by J. H. Paine.

PLATE LIV.

Fig. 1. *Gonatus fabricii* (?), dorsal aspect of specimen shown in fig. 1 of preceding plate, $\times\frac{2}{3}$. [88.]

Fig. 2. *Gonatus fabricii* (?), oral aspect of sucker from median portion of tentacle club of same specimen, $\times 40$. [88.] Drawn from a mount in balsam.

Fig. 3. *Gonatus fabricii* (?), oral aspect of sucker from third arm, $\times 25$. [88.] Drawn from a mount in balsam.

Fig. 4. *Gonatus fabricii* (?), interior of funnel viewed from below, showing funnel organ, slightly enlarged. [90.]

Fig. 5. *Galiteuthis phyllura*, funnel laid open along medio-ventral line to expose the funnel organ, $\times 2$. [112.]

Fig. 6. *Galiteuthis phyllura*, right lateral pad of the funnel organ shown in isolation, same scale as fig. 5. [112.]

PLATE LV.

Fig. 1. *Gonatus fabricii* (?), basal portion of right third arm of specimen shown in pl. LIII, fig. 1, $\times 3$. [88.]

Fig. 2. *Gonatus fabricii*, ventral view of young specimen from Monterey Bay, California, $\times 3$. [98.] Drawn by R. L. Hudson.

Fig. 3. *Gonatus fabricii* (?), hook from near tip of third arm shown in fig. 1, greatly enlarged. [88.] Drawn by reflected light from mount in balsam.

Fig. 4. *Gonatus fabricii* (?), hook from near middle of same arm, $\times 4$. [88.]

Fig. 5. *Gonatus fabricii* (?), locking cartilage from left side of funnel of specimen taken near Victoria, B. C., $\times 1\frac{1}{2}$. [90.]

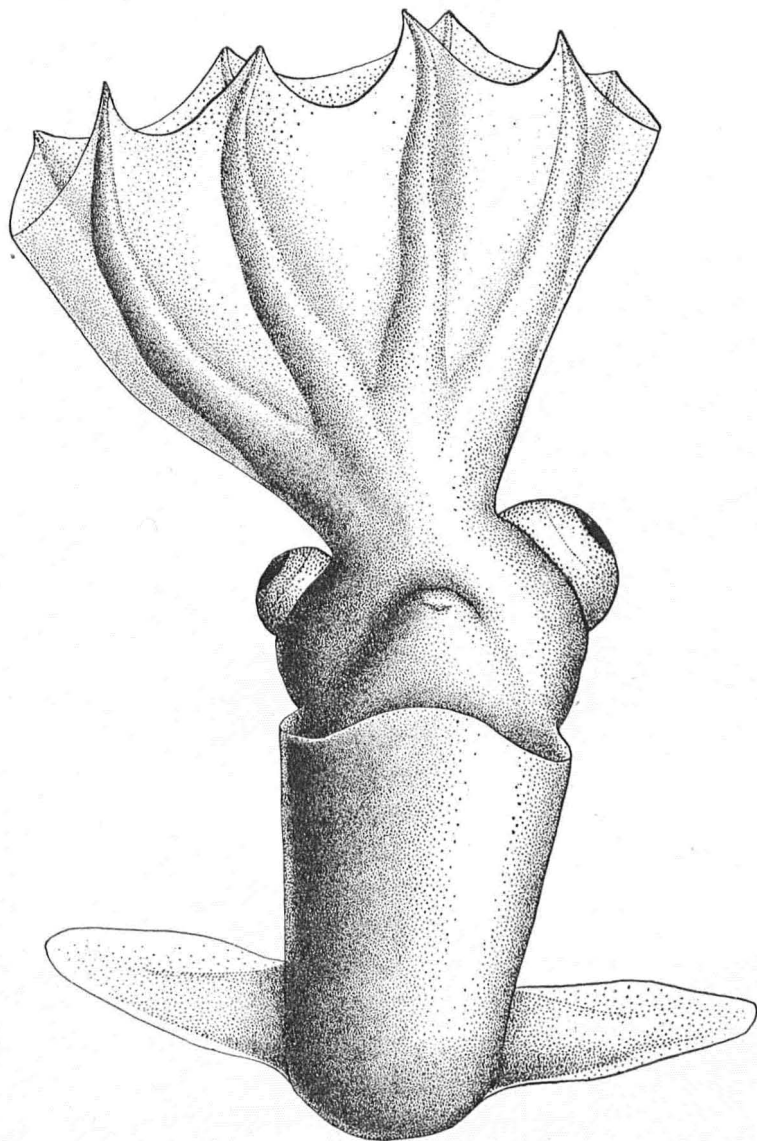
Fig. 6. *Gonatus fabricii* (?), ridge on inner surface of mantle of same specimen corresponding to cartilage shown in fig. 5, same scale. [90.]

Fig. 7. *Gonatus fabricii* (?), recurved dorsal margin of right tentacle club, showing distal portion of fixing apparatus, $\times 4$. [88.]

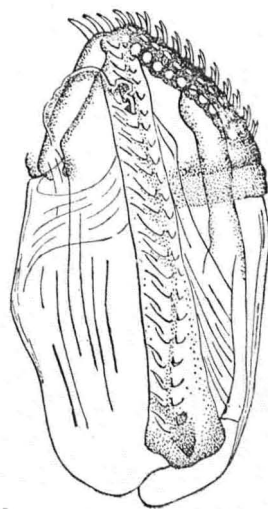
PLATE LVI.

Fig. 1. *Galiteuthis phyllura*, dorsal view of entire animal (type), nearly natural size. [113.]

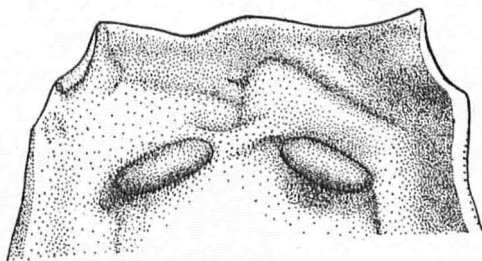
Fig. 2. *Galiteuthis phyllura*, ventral view of same, same scale. [113.] Drawn by R. L. Hudson.



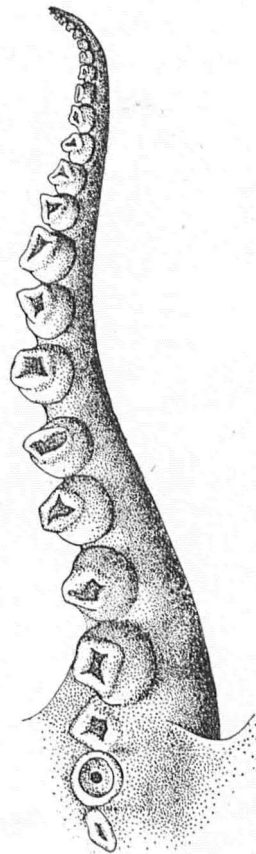
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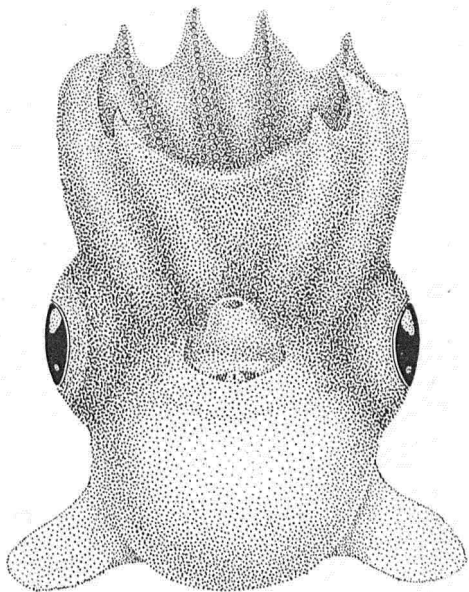
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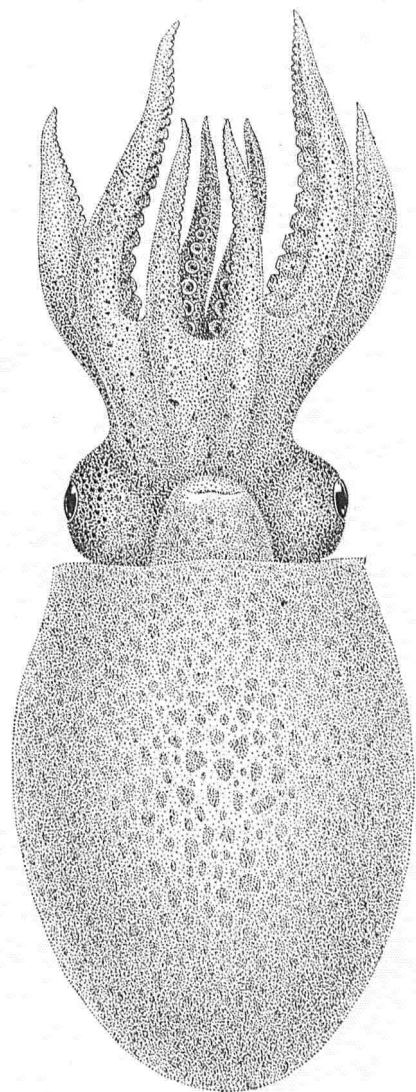
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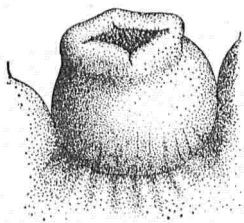
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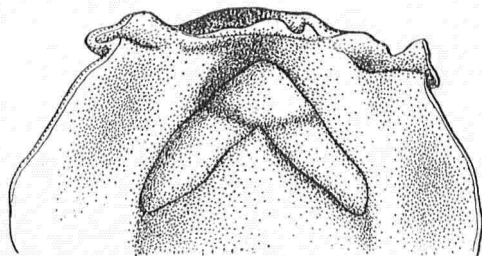
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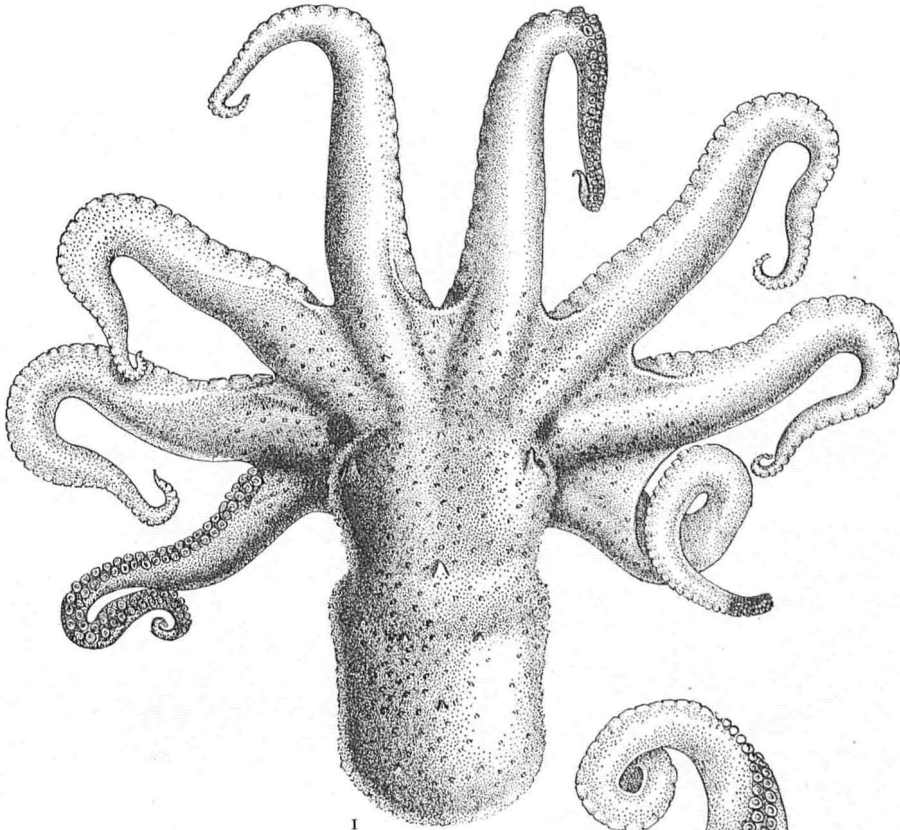
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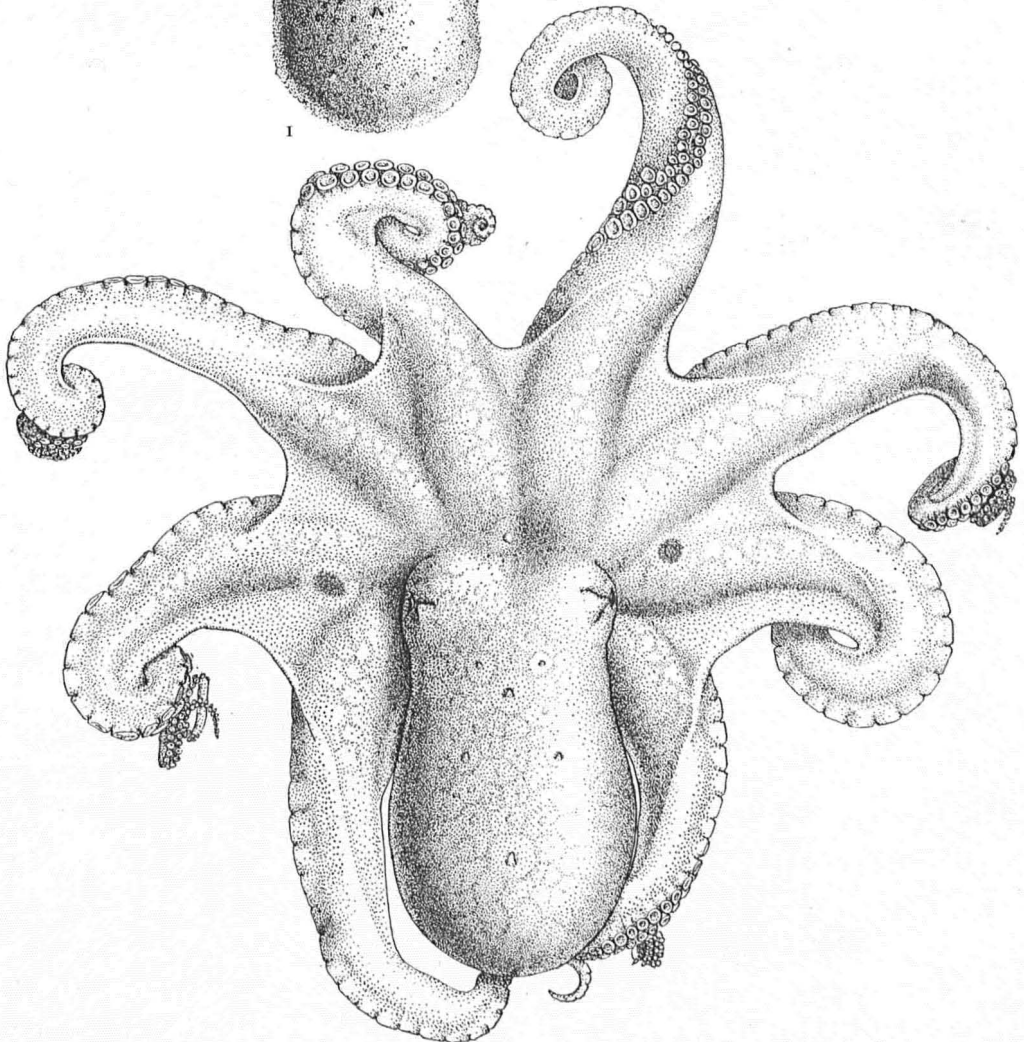
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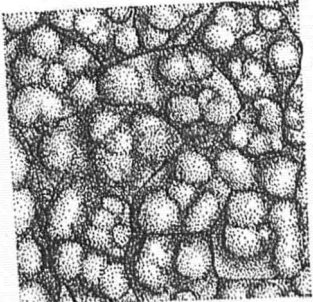
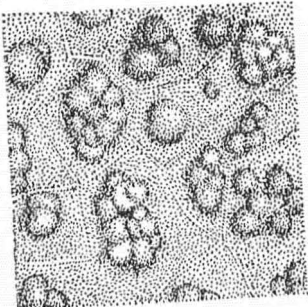
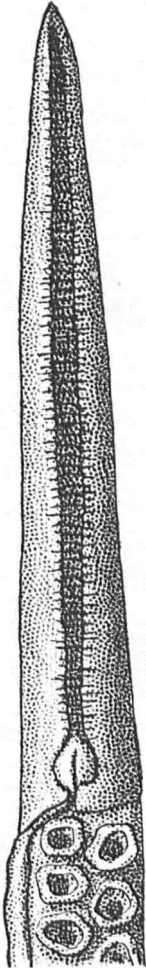
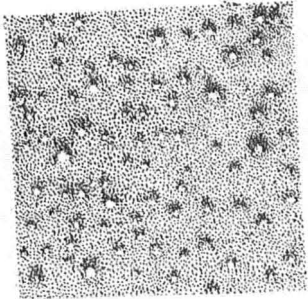
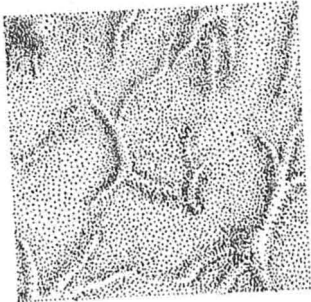
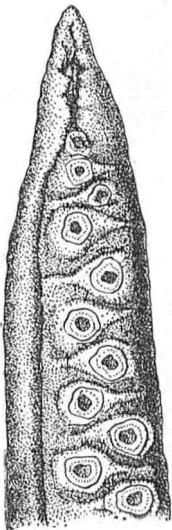
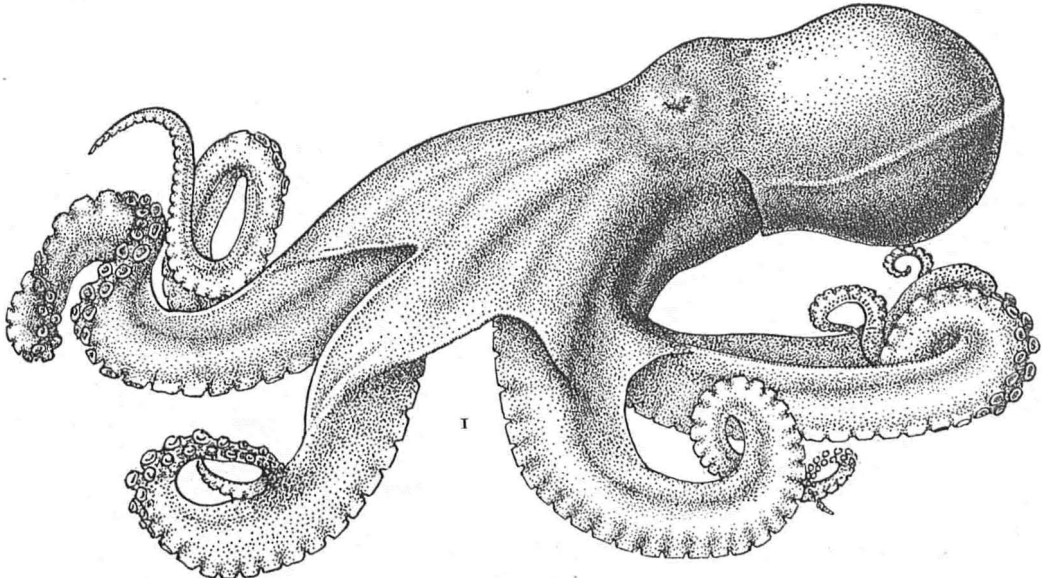
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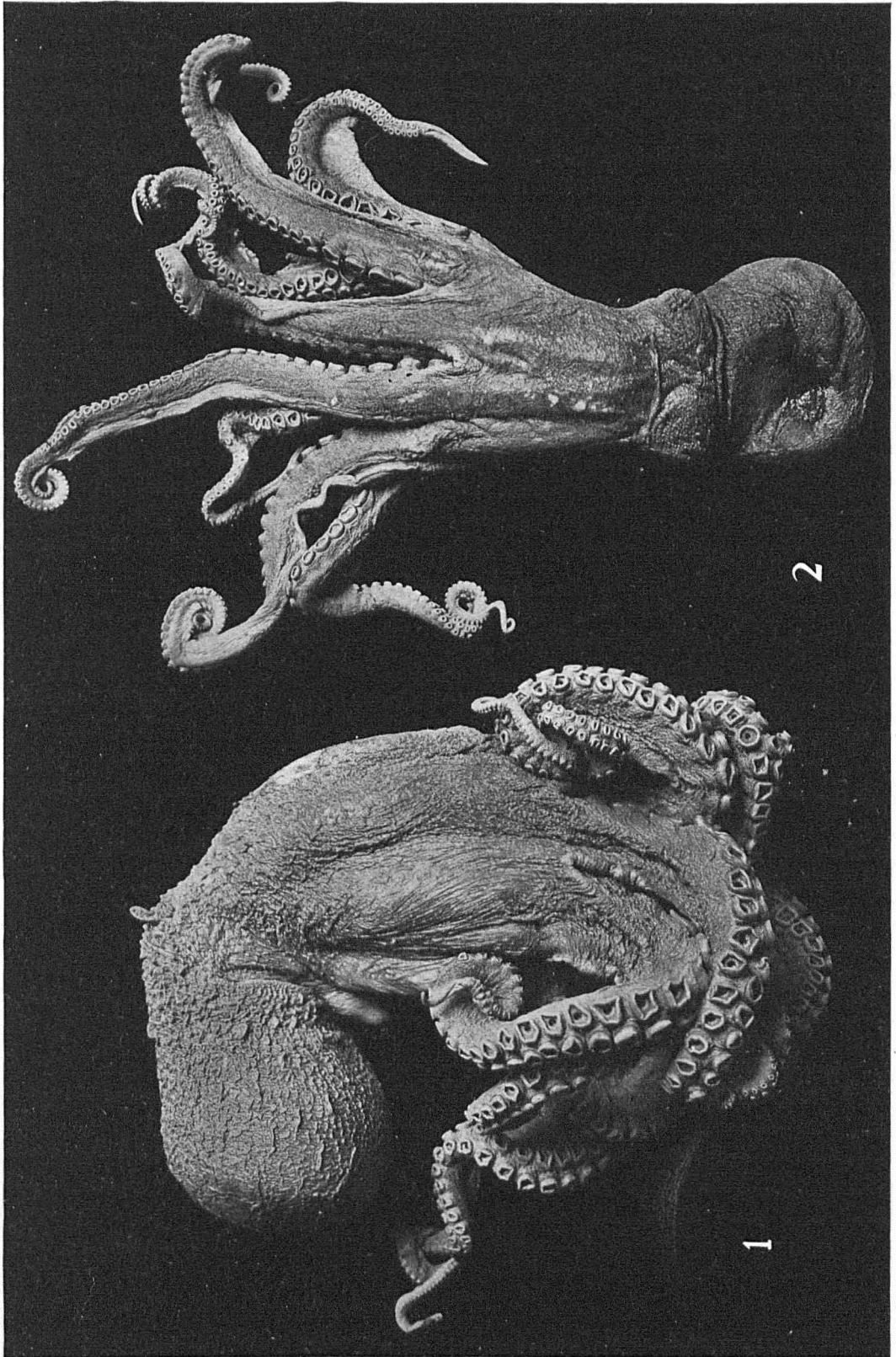


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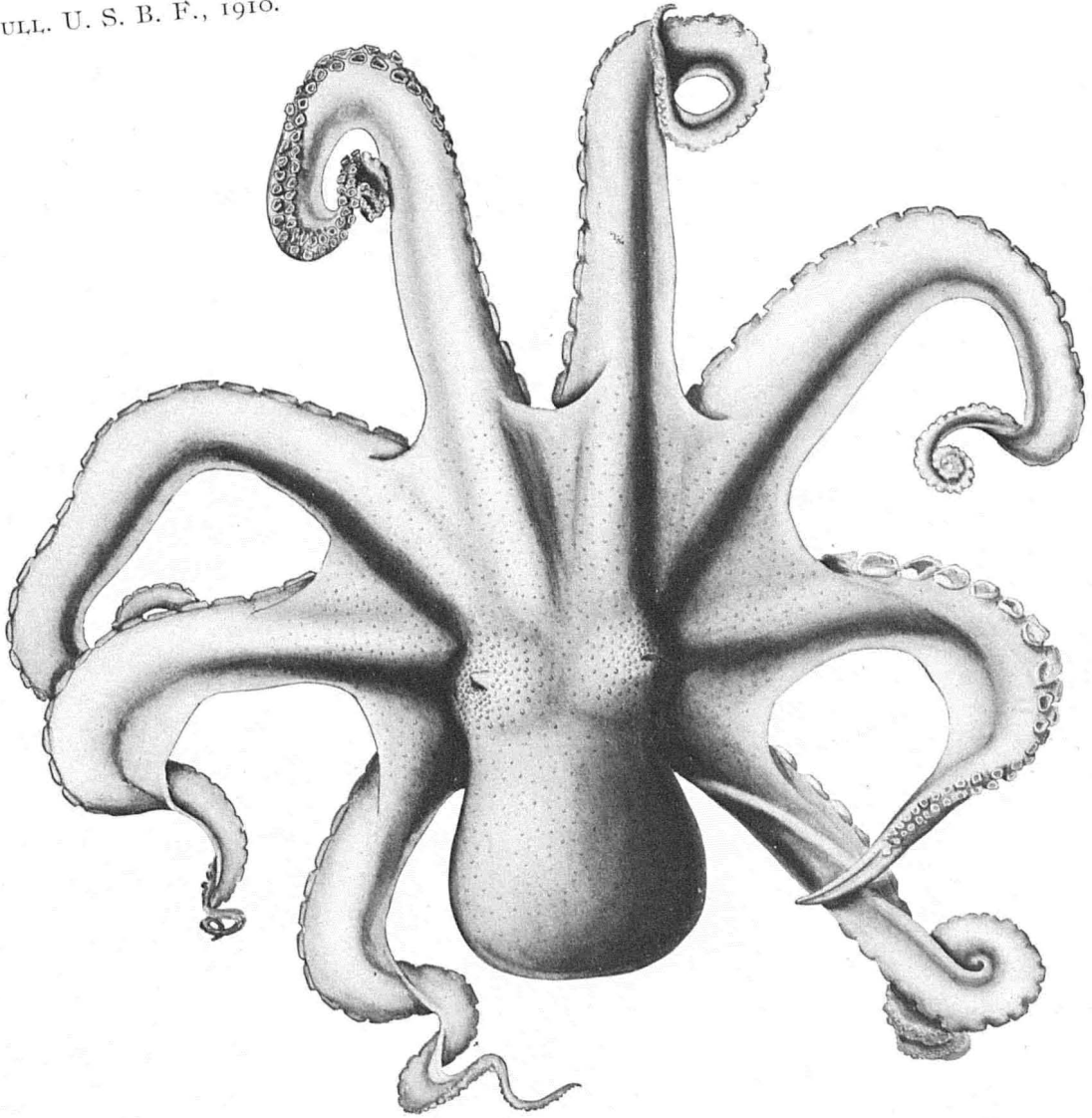
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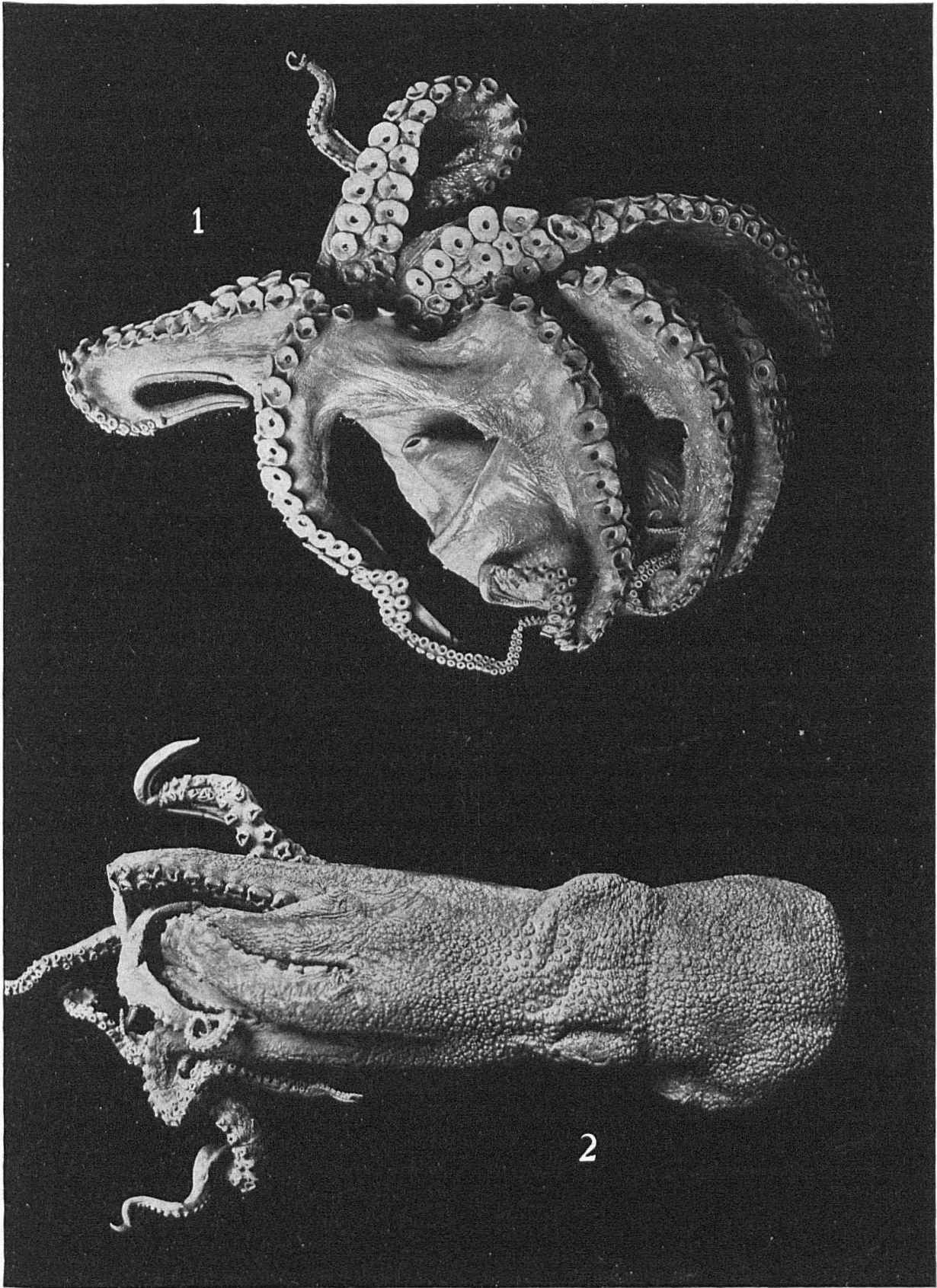


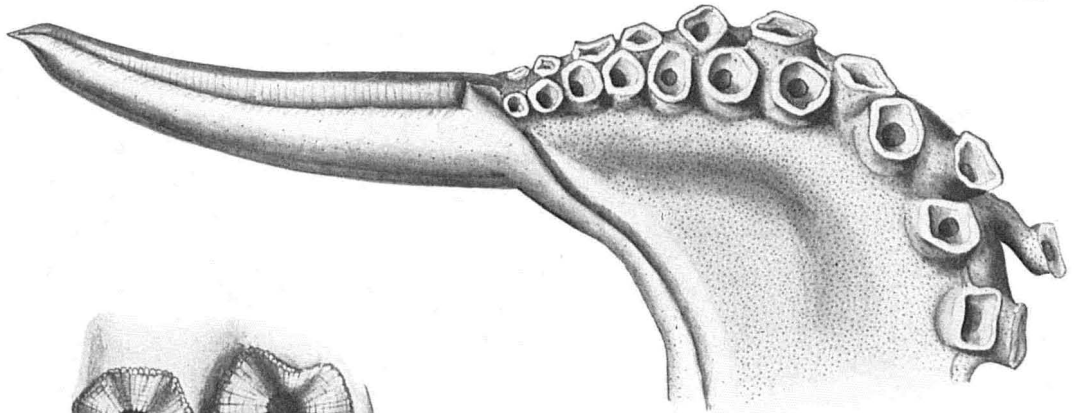


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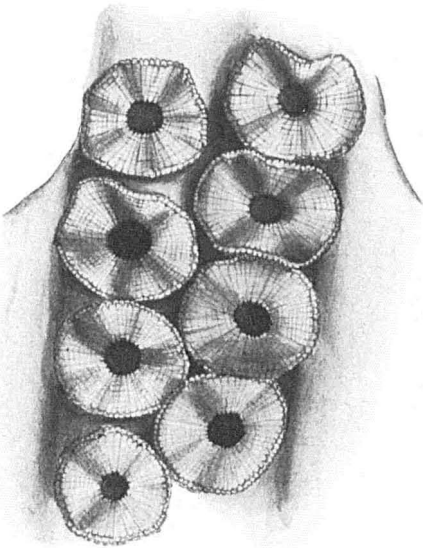
PLATE XXXVII.



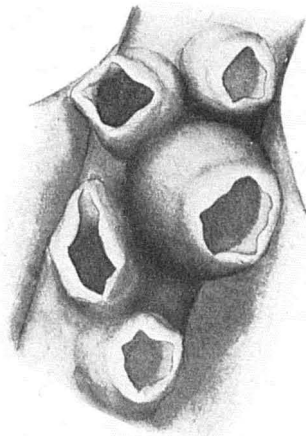




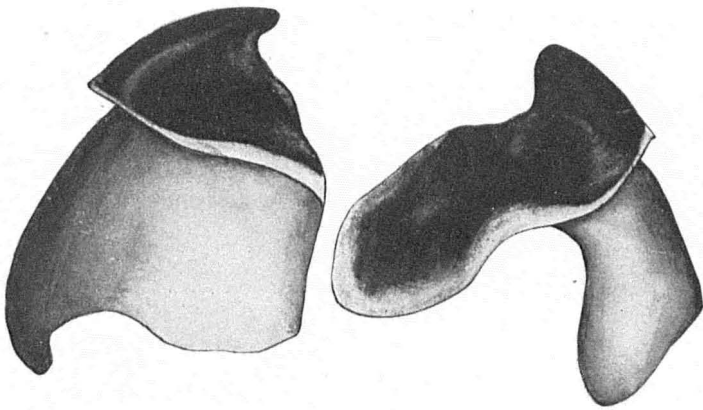
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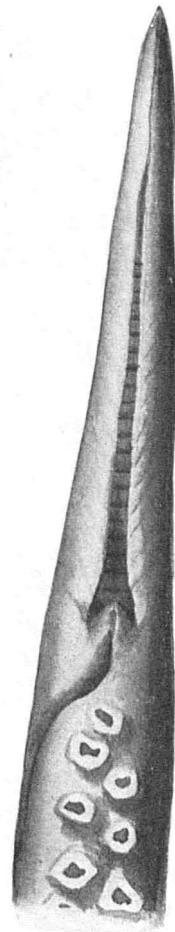
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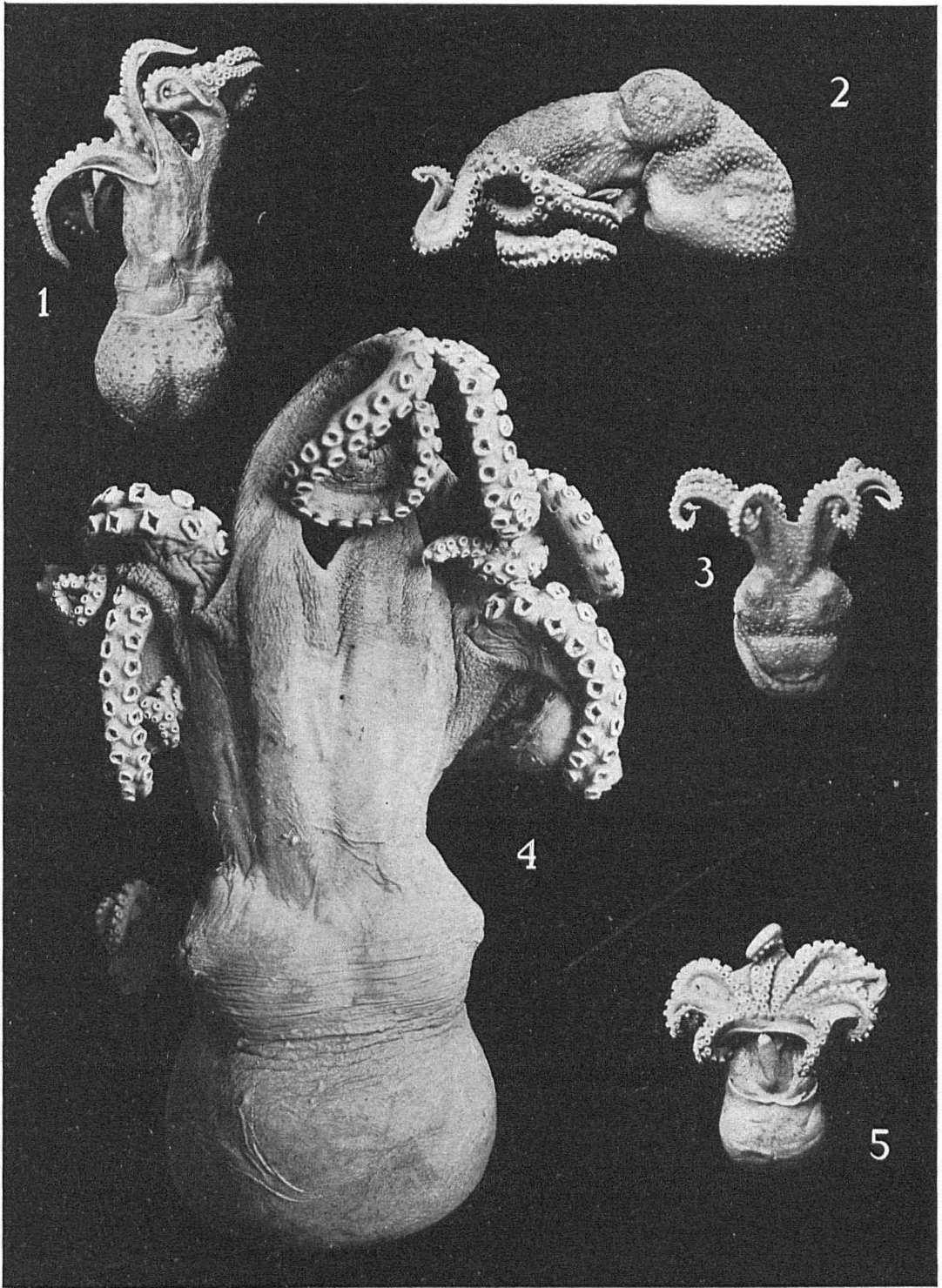
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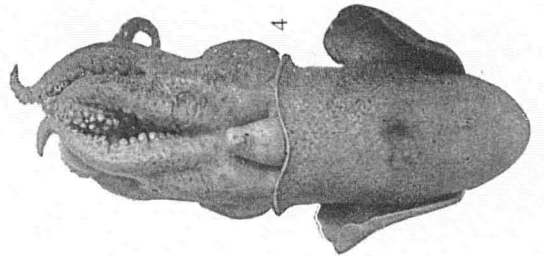
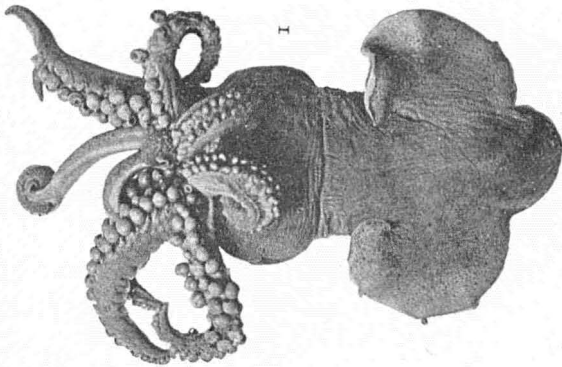
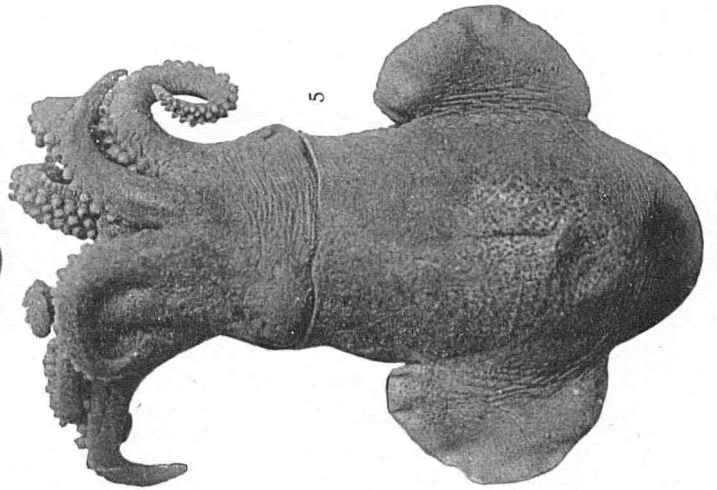
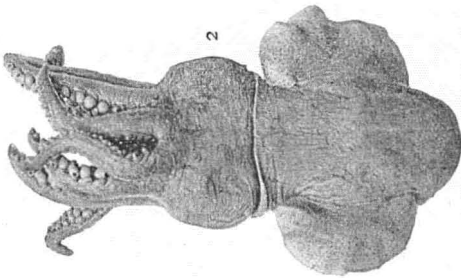
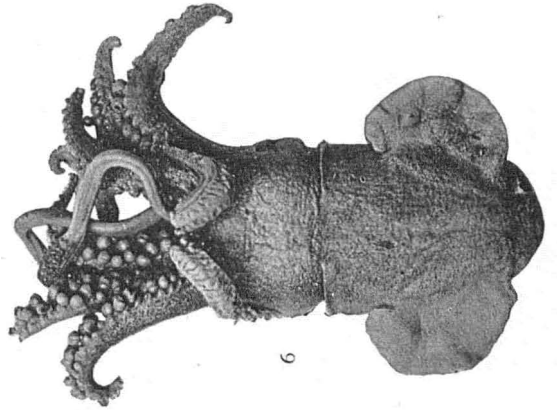
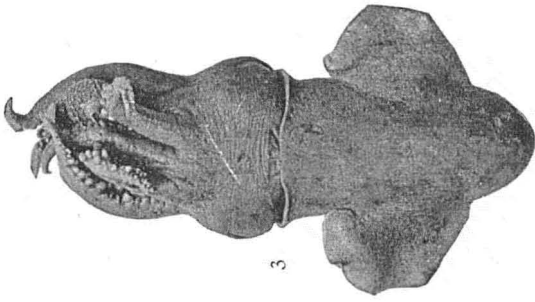


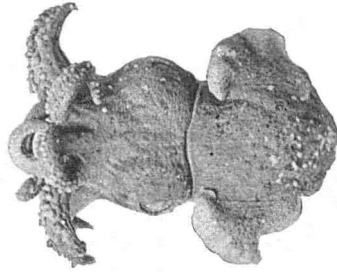
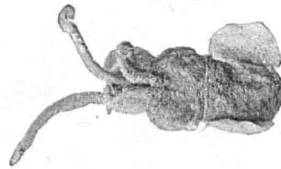
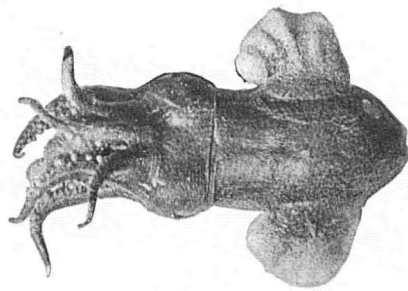
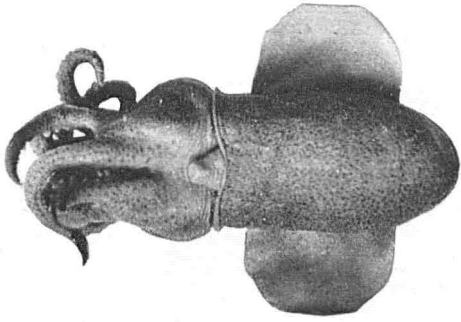
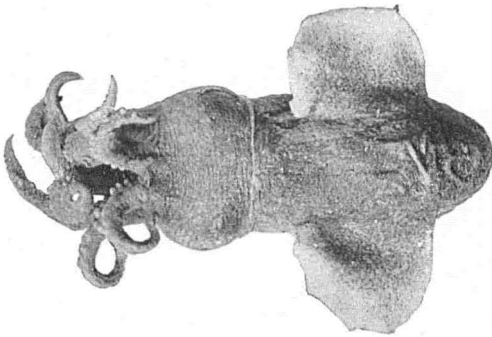
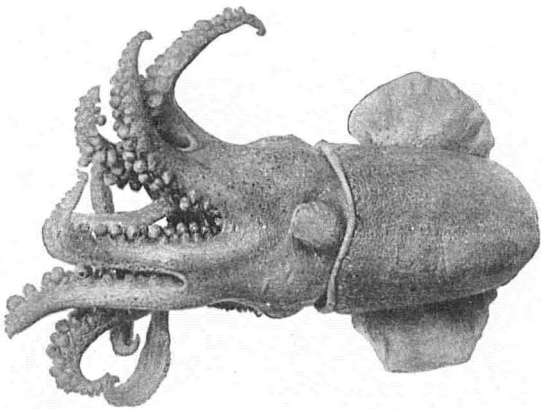
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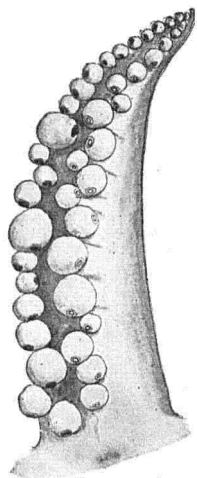


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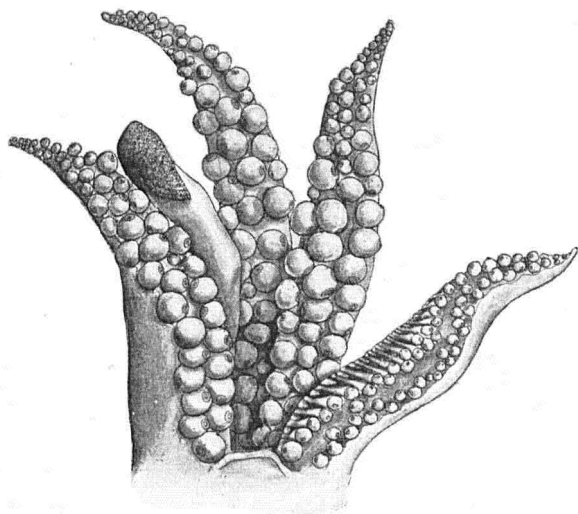




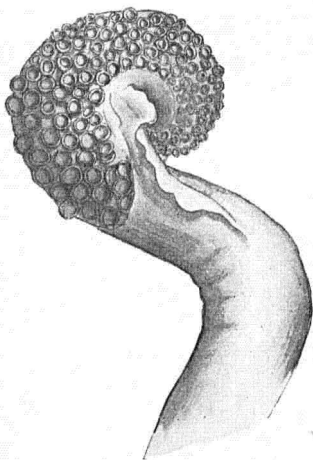




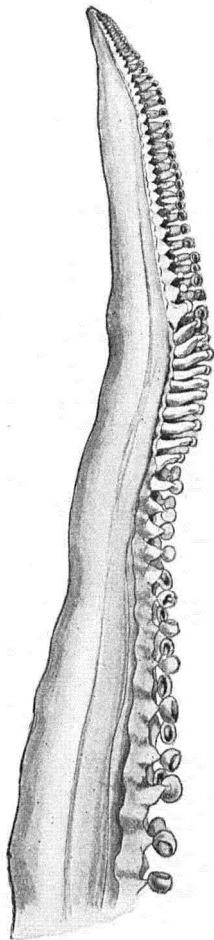
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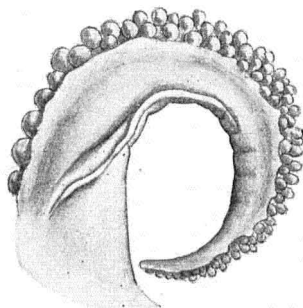
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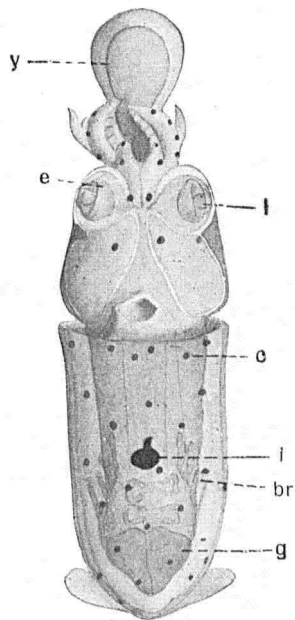
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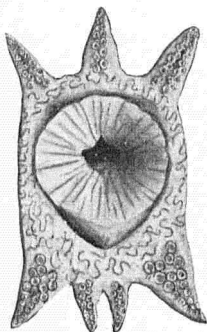
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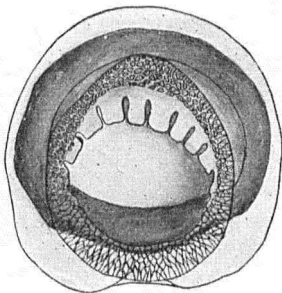
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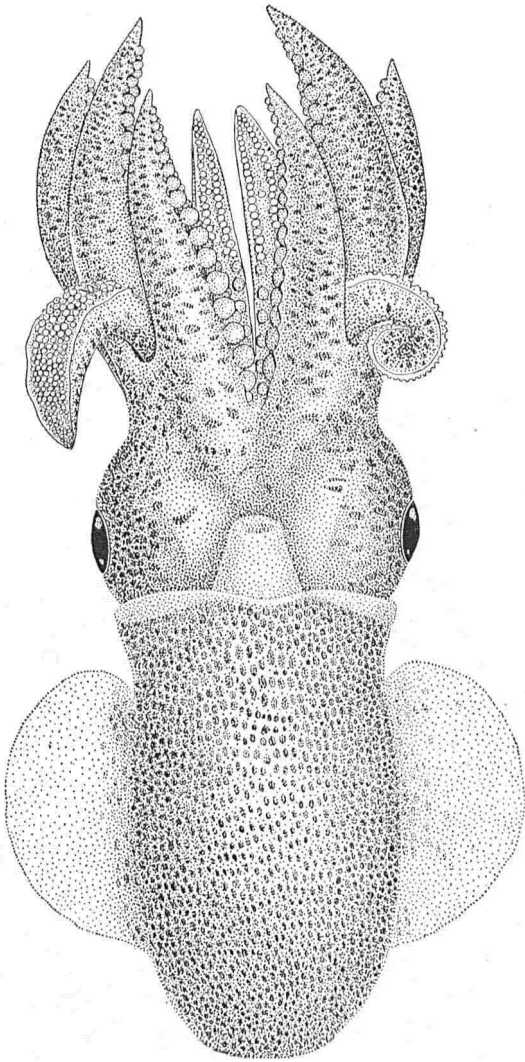
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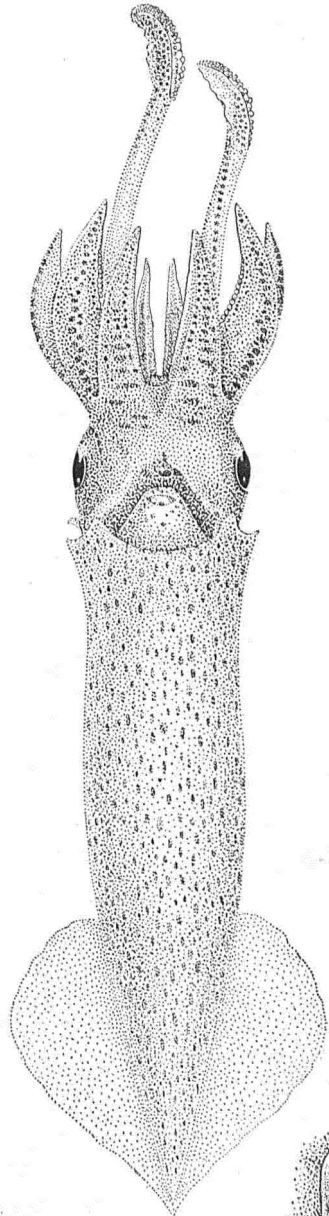
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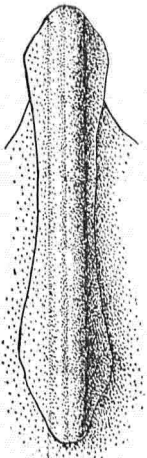
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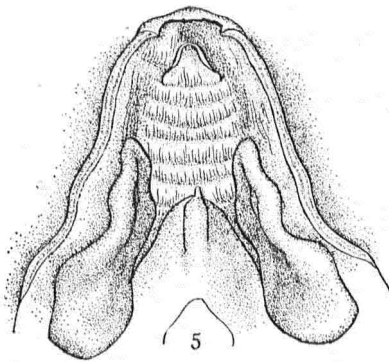
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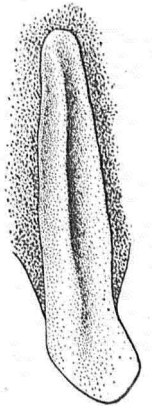
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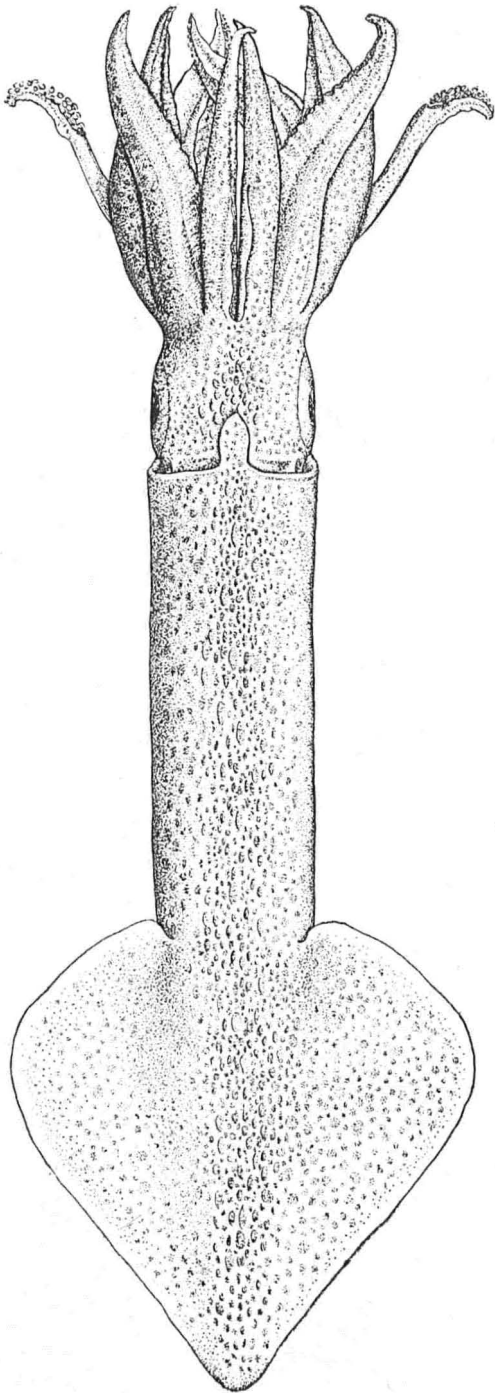
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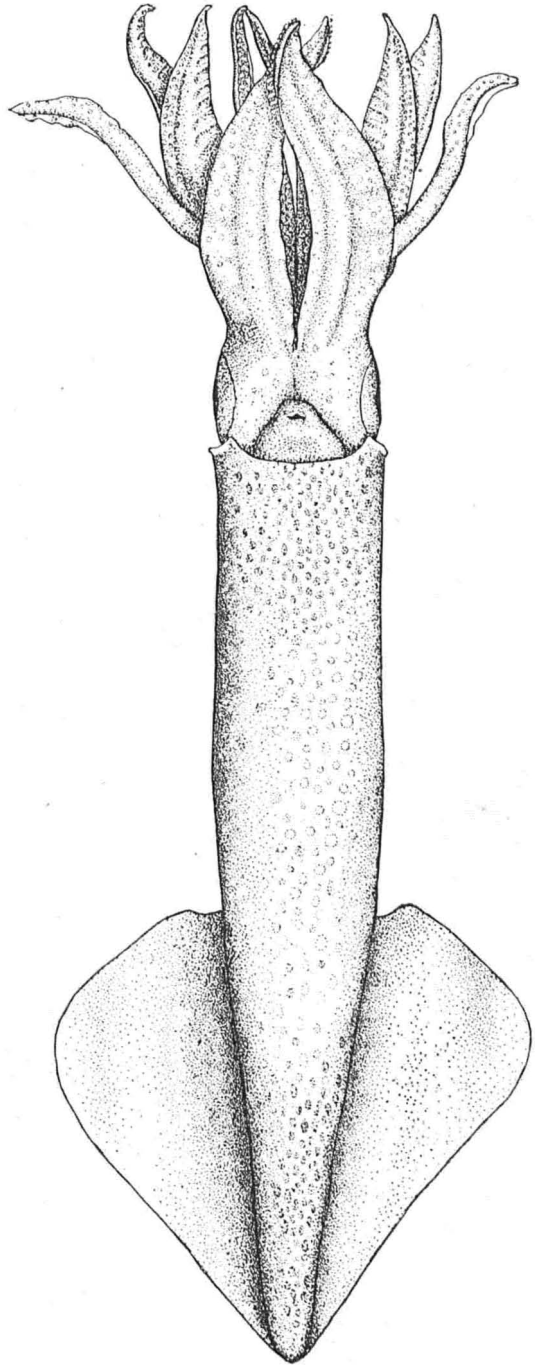
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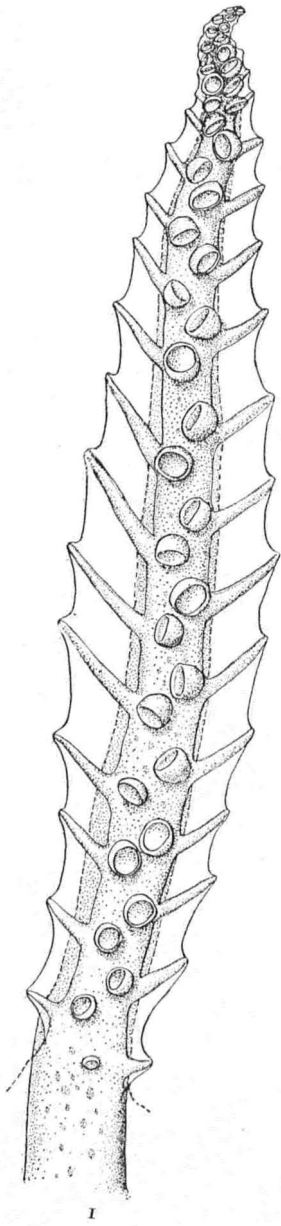
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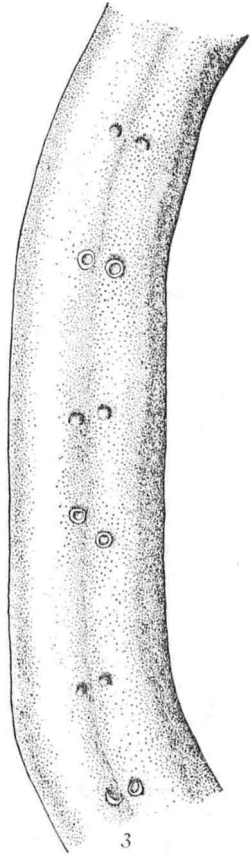
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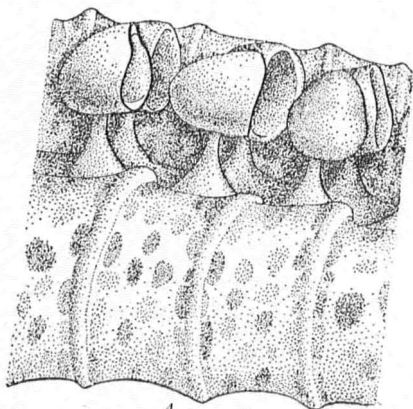
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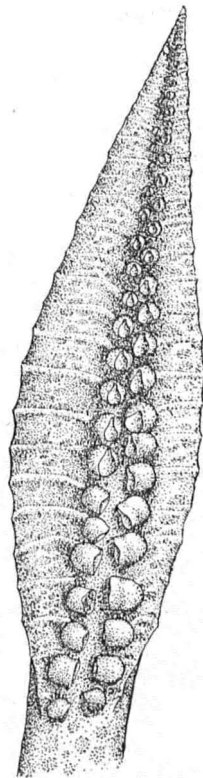
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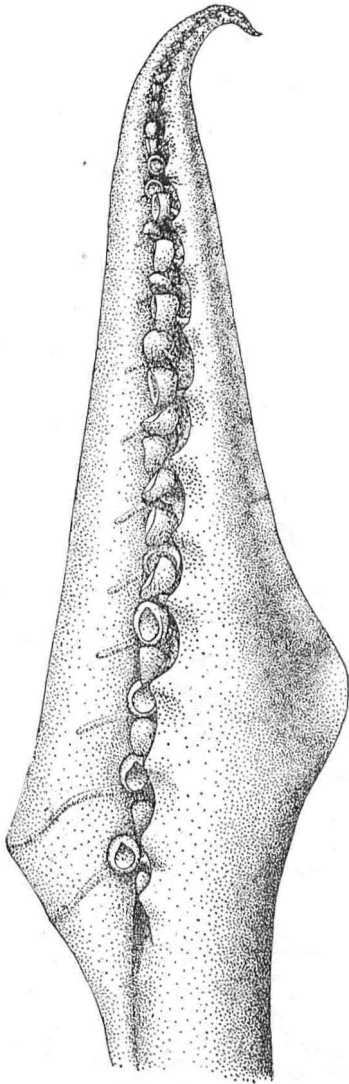
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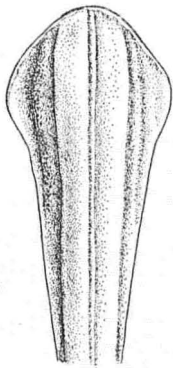
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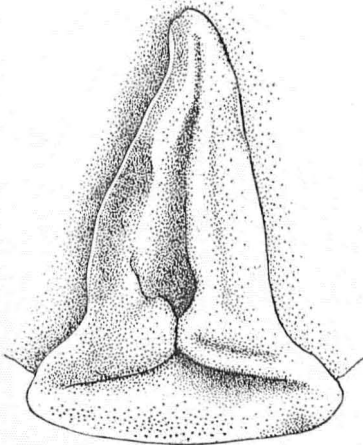
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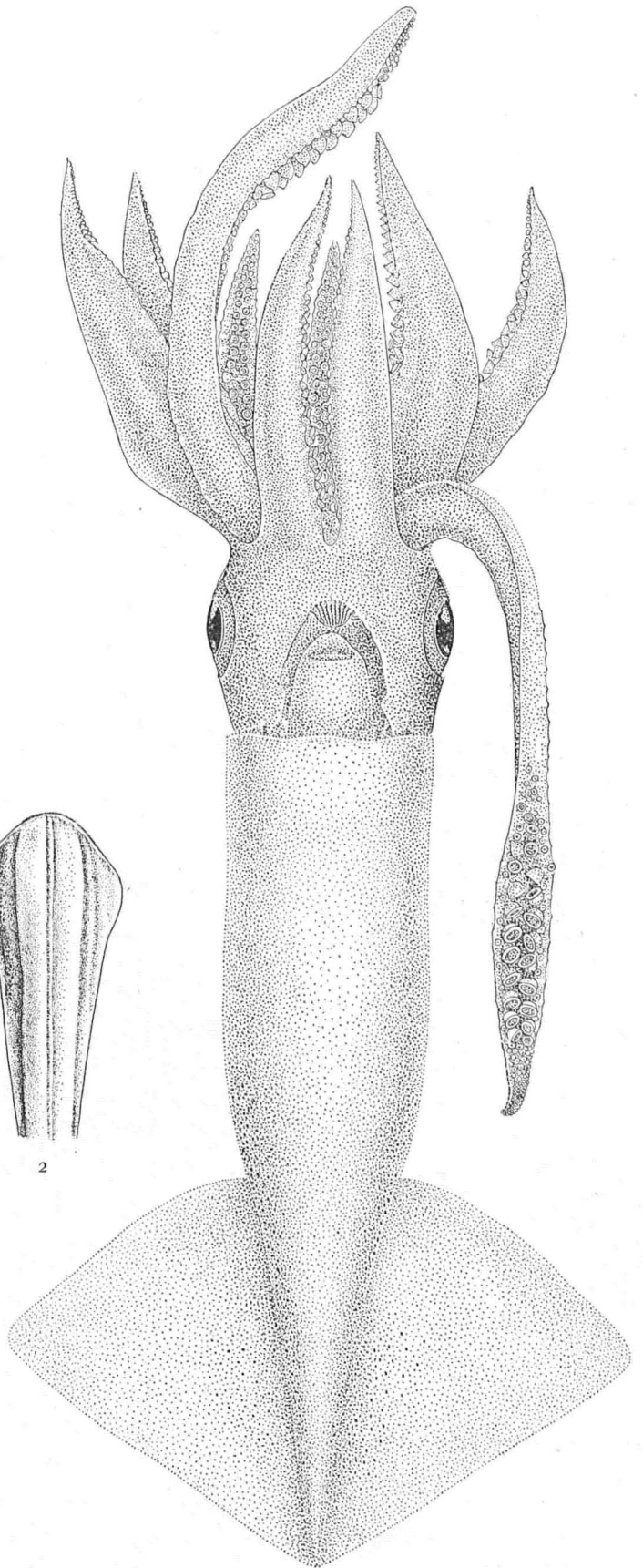
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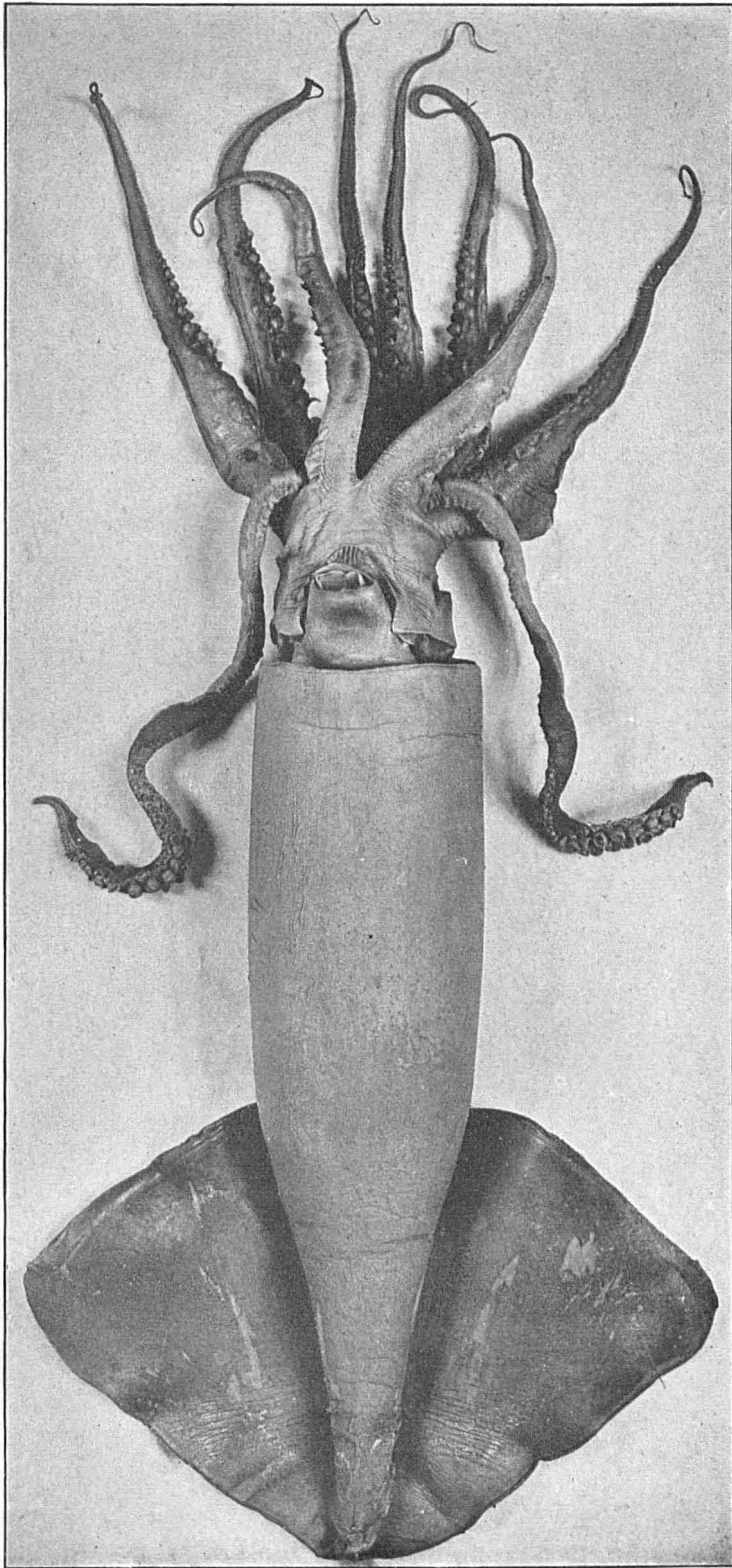
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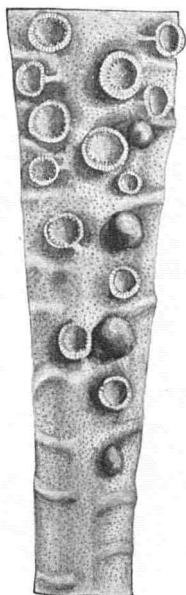


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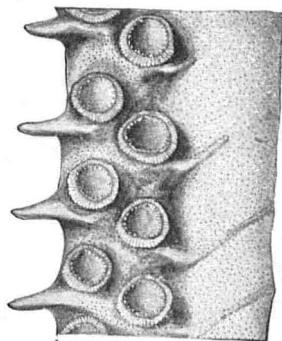


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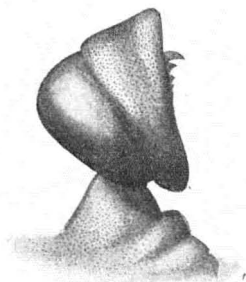




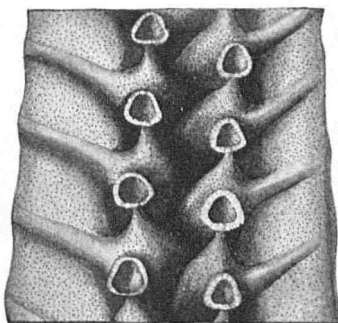
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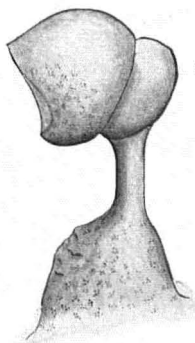
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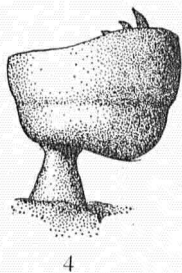
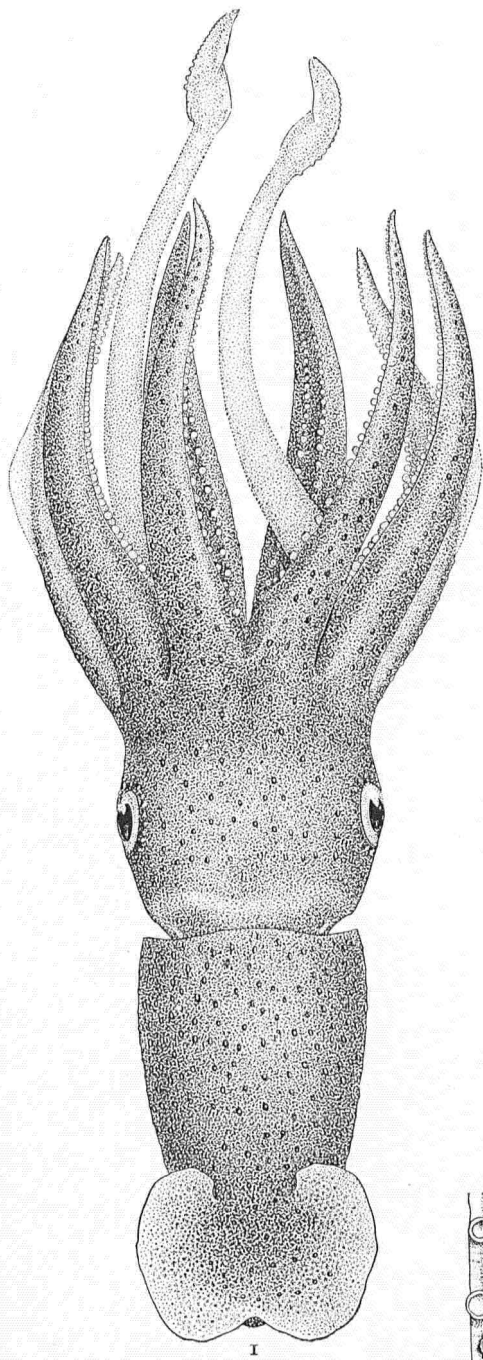
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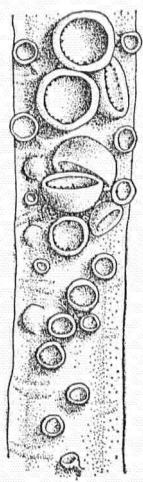
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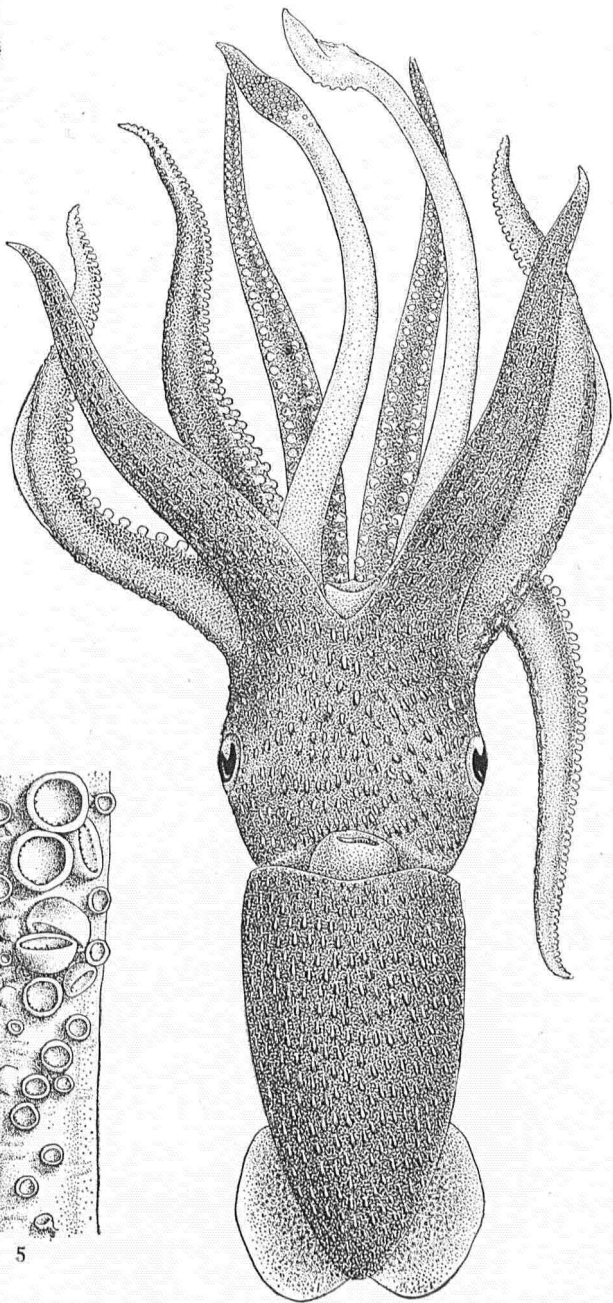
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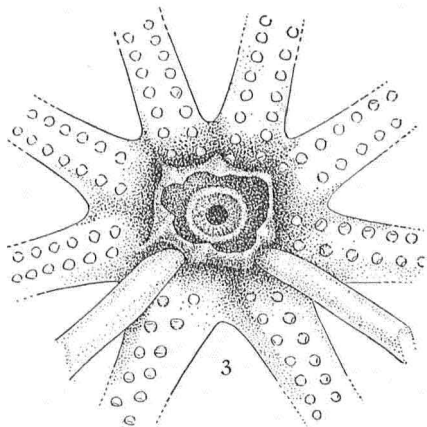
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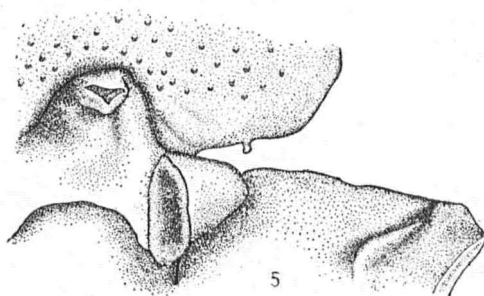
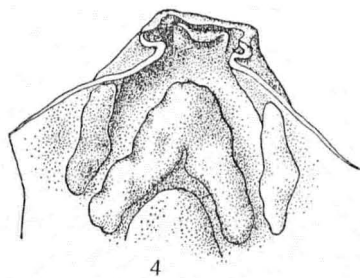
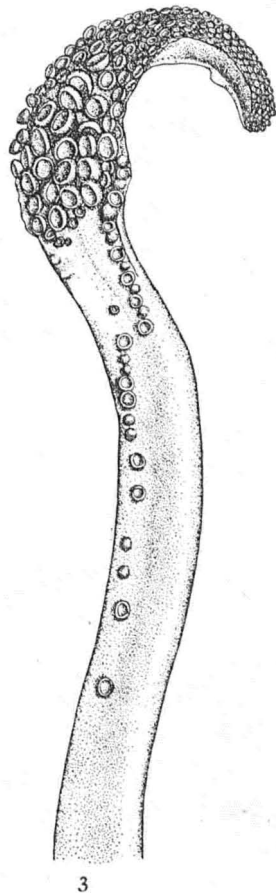
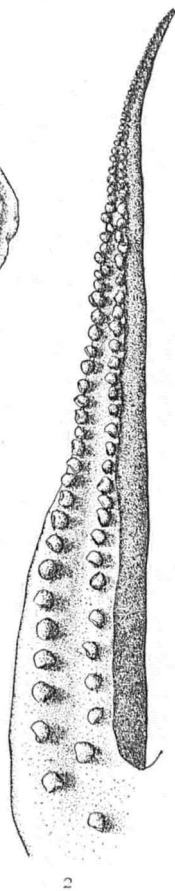
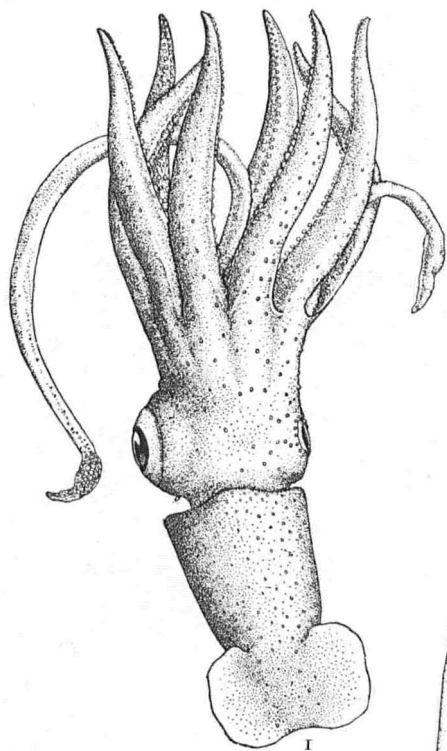
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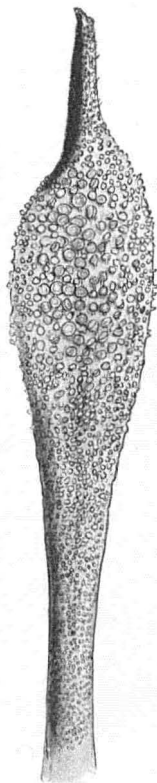


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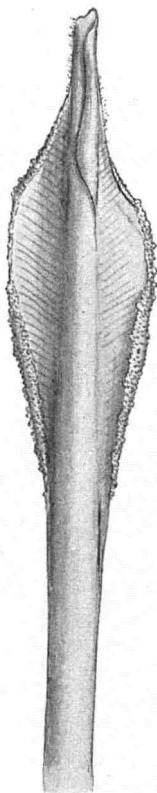


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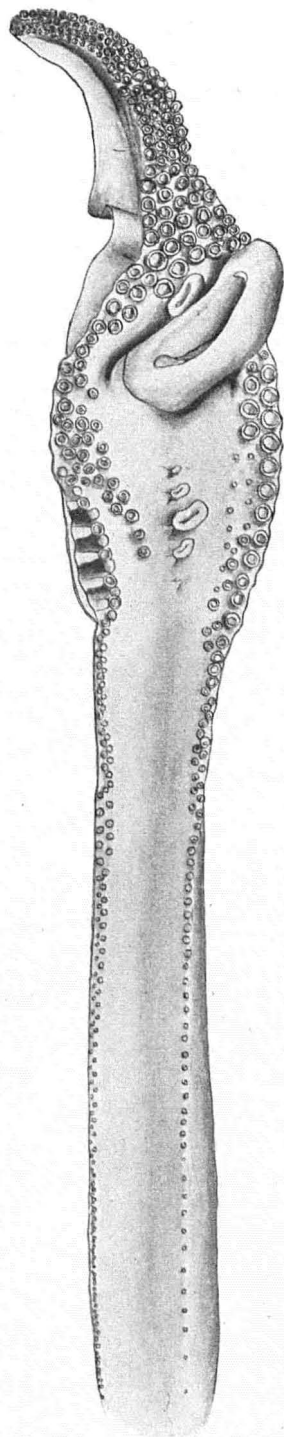




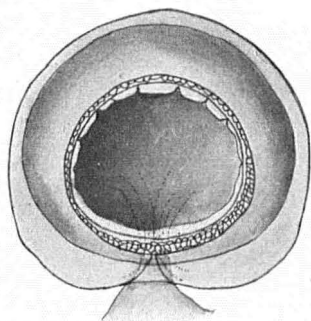
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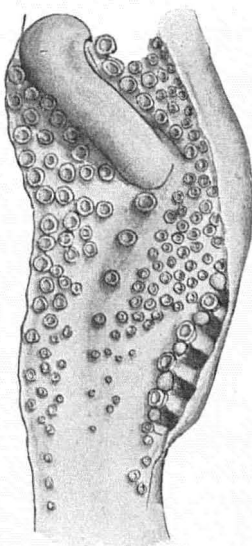
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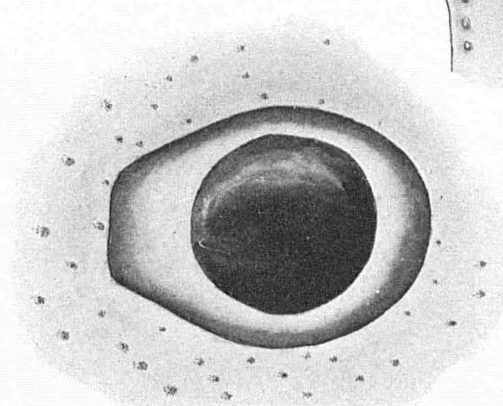
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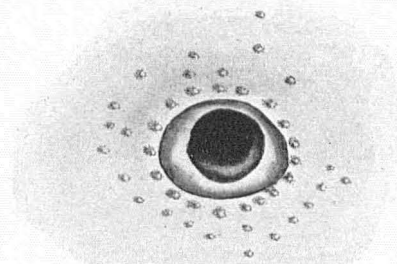
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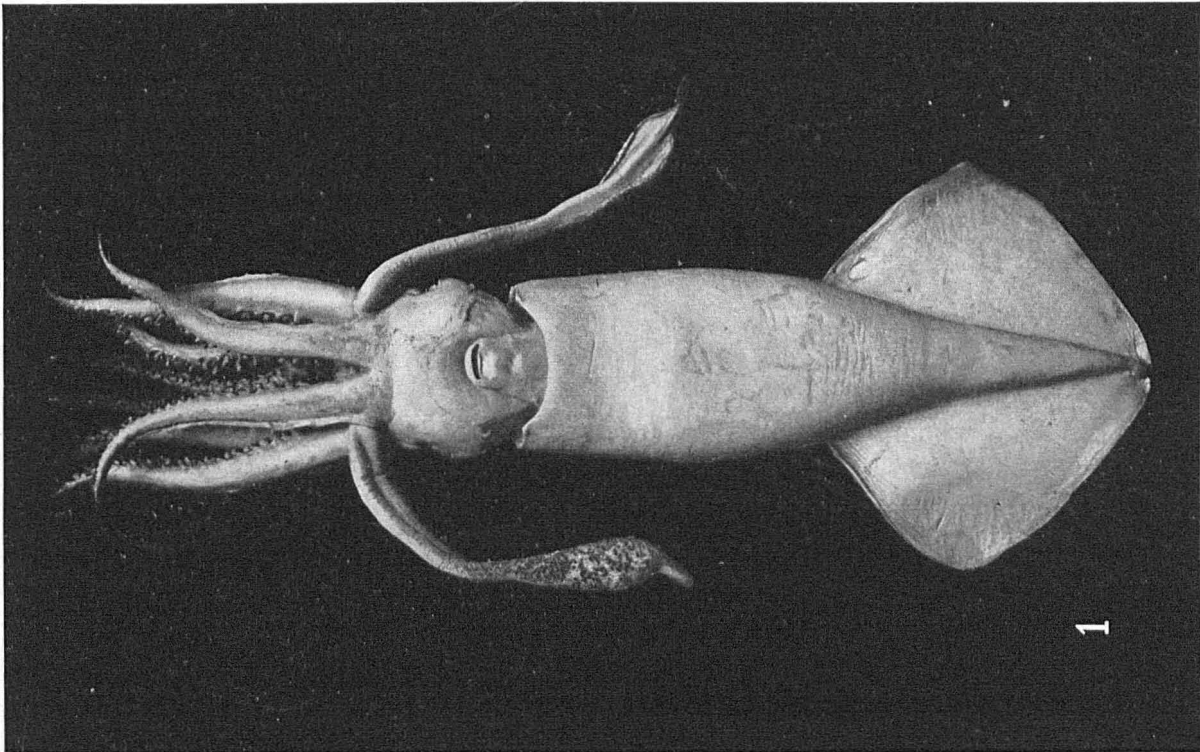
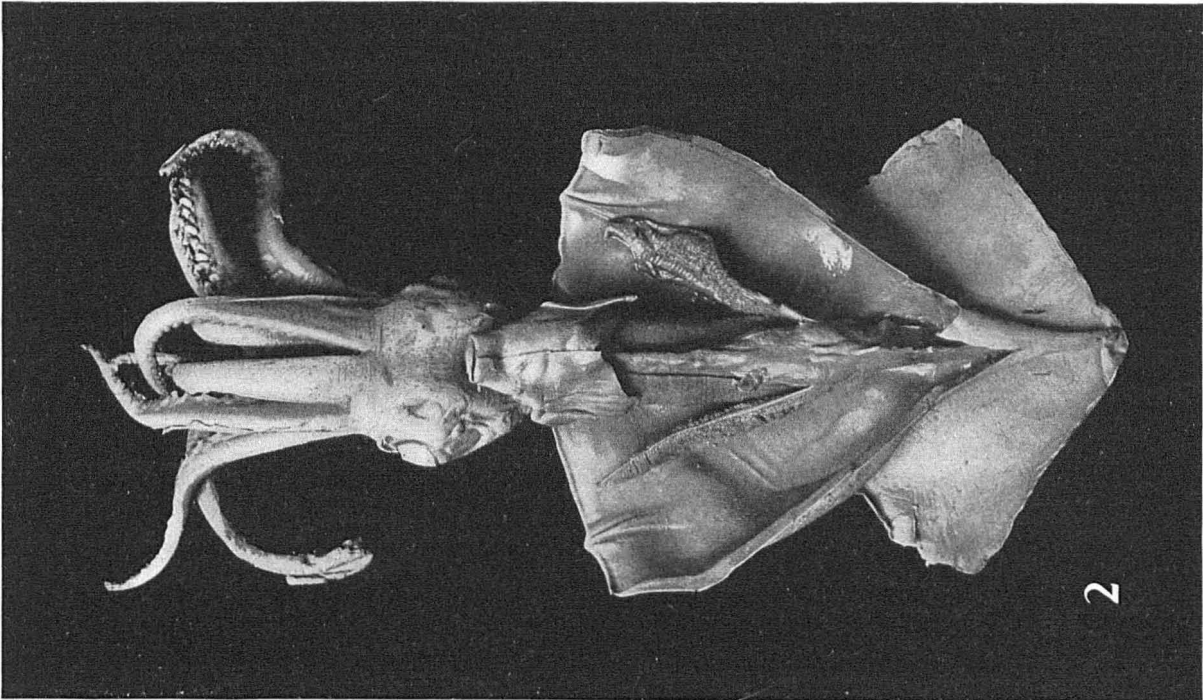
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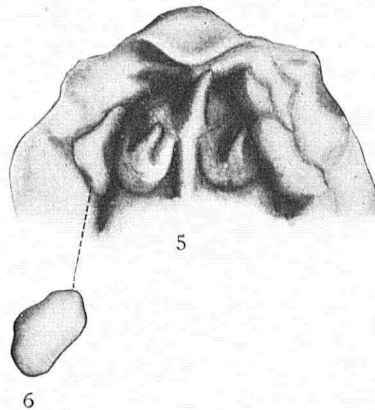
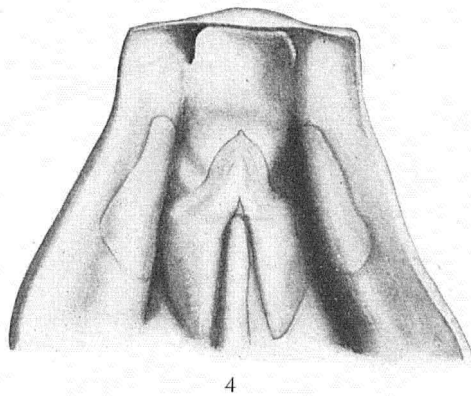
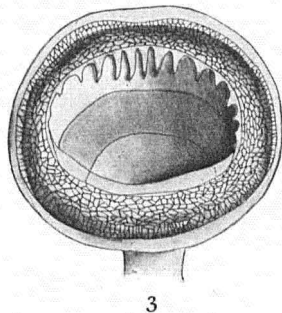
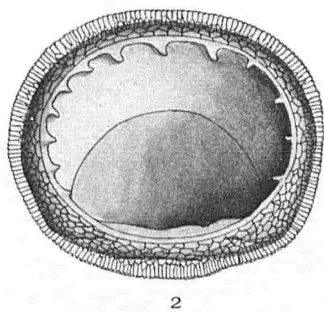
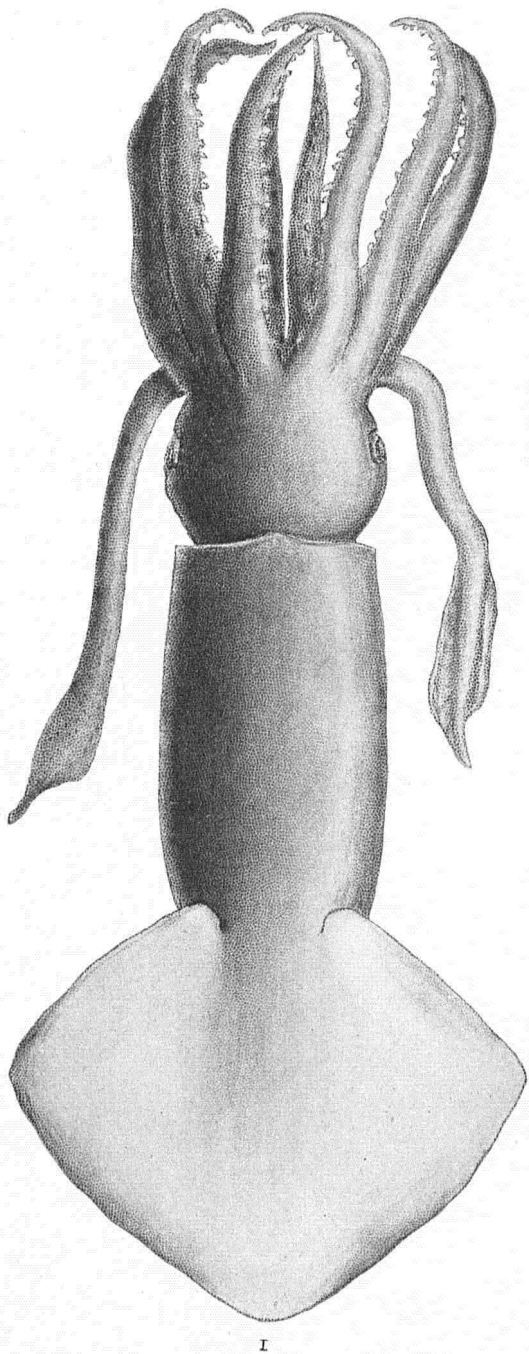


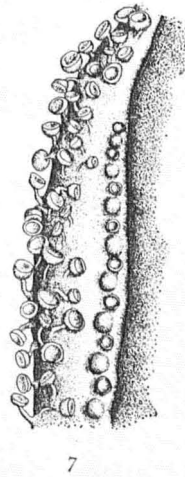
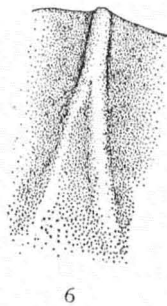
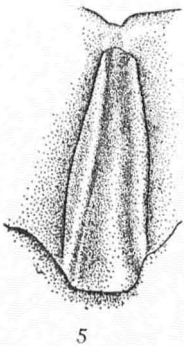
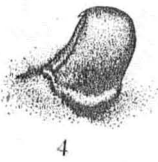
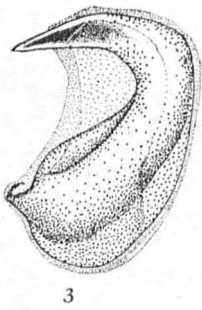
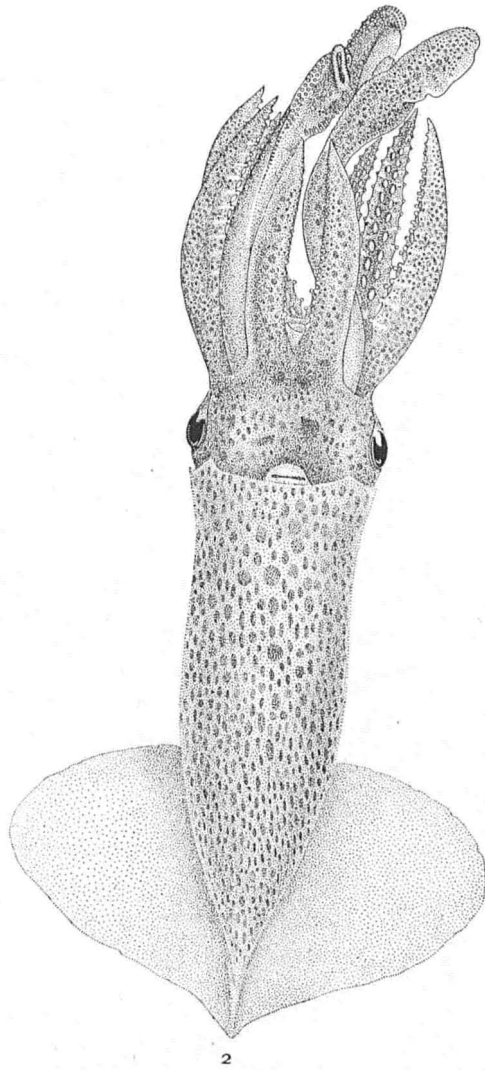
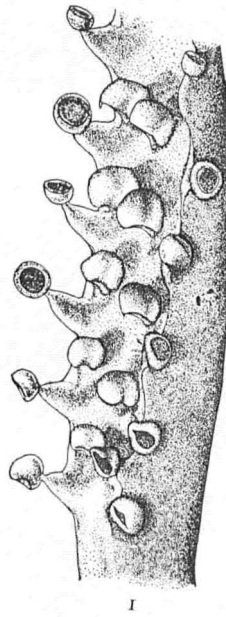
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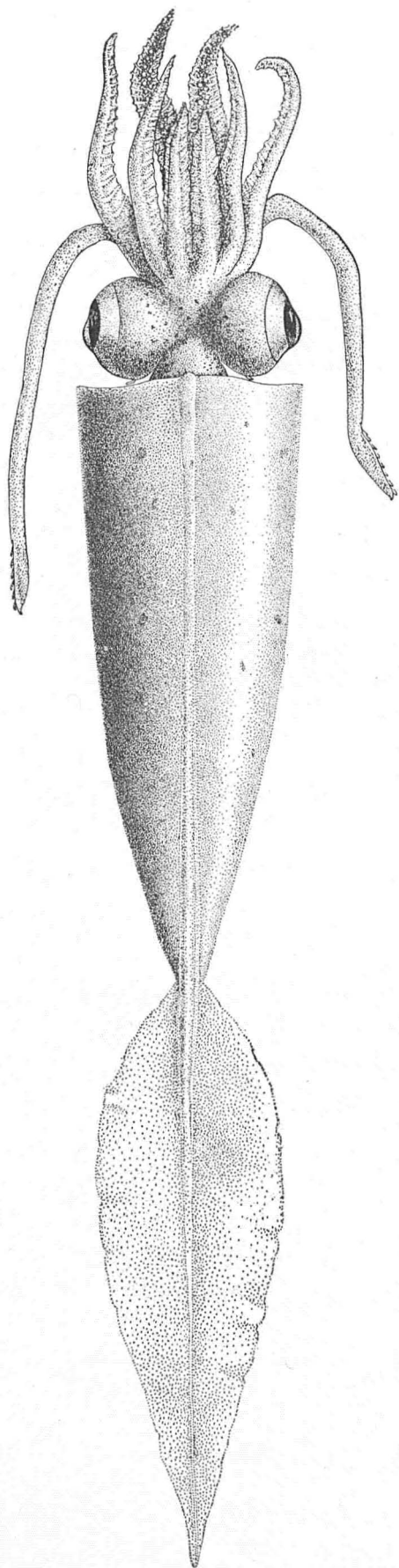


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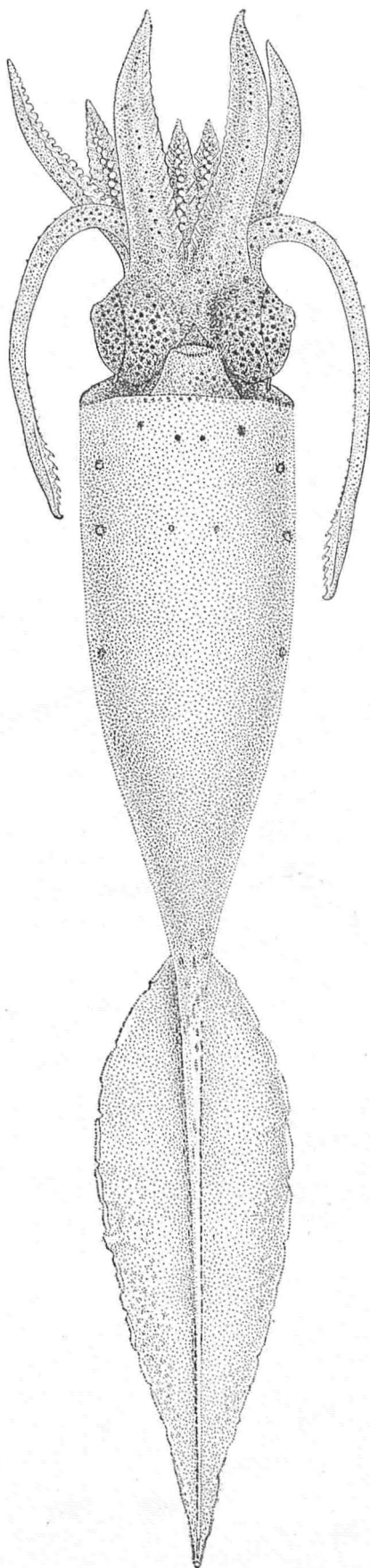








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