No. 1. — *Reports on the Dredging Operations off the West Coast of Central America to the Galapagos, to the West Coast of Mexico, and in the Gulf of California, in charge of* ALEXANDER AGASSIZ, *carried on by the U. S. Fish Commission Steamer "Albatross" during 1891,* LIEUT. COMMANDER Z. L. TANNER, U. S. N., *Commanding.* XXIX.

AND

Reports on the Scientific Results of the Expedition to the Tropical Pacific, in charge of ALEXANDER AGASSIZ, *on the U. S. Fish Commission Steamer "Albatross," from August, 1899, to March, 1900,* COMMANDER JEFFERSON T. MOSER, U. S. N., *Commanding.* V.

Reports on the Cephalopoda. By WILLIAM E. HOYLE.

THE collection made by the "Albatross" during 1891 came into my hands in the year 1892. In the summer of 1893 I took the specimens to Copenhagen and spent some time studying them in the Zoölogical Museum of that city. I had then the pleasure and privilege of discussing the more interesting forms with the *doyen* of students of Cephalopoda, Professor Steenstrup, and with his assistant, Dr. Posselt. Both these have since died, but the memory of their ready sympathy and helpful counsel remains and is here gratefully acknowledged. I have also received assistance from my friend Dr. Georg Pfeffer, for which I beg to tender him my sincere thanks.

Some preparations of the luminous organs of *Abraliopsis* were exhibited at the meeting of the German Zo logical Society at Göttingen in 1893, and also at the British Association in Nottingham in the same year, but after that, owing to the claims arising from the charge of a rapidly growing museum, no further progress was made for some years.

The collection consists of thirty species (including a few forms to which I have not found it possible to affix names), distributed in nineteen genera, one of which (*Froekenia*) is new. Another (*Pterygioteuthis*) was first found by the "Albatross," but its publication has been anticipated by the description of an immature example by Dr. H. Fischer in 1896. There are six species described as new. I have also proposed a new genus (*Pyroteuthis*) for the *Enoploteuthis margaritifera* of Rüppell.

In the preparation of the Plates I have utilized a number of water-color drawings made on the expedition by Mr. Agassiz and Mr. Magnus Westergren whilst the animals were still fresh and the colors of life retained. It would be well if this practice had been followed on other expeditions, as the appearance of Cephalopoda changes very markedly after preservation in alcohol. The other figures are based upon my own sketches, carefully made to scale, and in making the finished drawings I have had the assistance of Miss Mabel B. Ede, Miss E. R. Dust, and Dr. J. H. Ashworth.

In conclusion I have to express my gratitude to Mr. Agassiz for the opportunity of studying such an interesting collection.

I subsequently received a smaller collection made by the "Albatross" during a cruise among the Pacific Islands in 1899–1900, which contained thirteen species, one of which was new to science and forms the type of a new genus, *Cirrobrachium*.

LIST OF SPECIES.

FAMILY CIRROTEUTHIDAE.

Cirroteuthidae, Keferstein, '66, p. 1447.

This family was defined by its founder Keferstein ('66, p. 1447) as follows: "Körper mit rundlichen Flossen, von weicher Consistenz. Mantel rundum bis zur Trichterbasis mit dem Kopfe verwachsen. Eine knorpelige, breite innere Schale (wahrscheinlich als verwachsene Rückenknorpel anzusehen)." This definition still holds good in all essential points: there might be added to it the words, — "suckers in a single series alternating with paired cirri, radula absent;" and in view of the variety which has since been shown to exist in the form of the internal cartilage, the word "breite" might be advantageously omitted.

Here are included at present the following genera: —

Cirroteuthis. — Dorsal cartilage saddle-shaped; umbrella present, intermediate web present or absent.

Stauroteuthis. — Dorsal cartilage horseshoe-shaped with the free ends directed towards the head; umbrella present, intermediate web present.

Froekenia. — Dorsal cartilage horseshoe-shaped, the free ends directed towards the head; umbrella absent.

CIRROTEUTHIS.

Cirroteuthis Eschricht, '36, p. 627.

The species of this genus hitherto known may be discriminated by the annexed key: —

1.	Total length to breadth about 3 : 1	*plena* Verrill.
	Total length to breadth more than 4 : 1	2.
2.	Length and breadth of fin equal to length and breadth of body	*megaptera* Verrill.
	Length and breadth of fin less than length and breadth of body	3.

3.	Intermediate web absent	*pacifica* Hoyle.
	Intermediate web present	4.
4.	Internal cartilage longer than broad	*mülleri* Eschricht.
	Internal cartilage broader than long	*magna* Hoyle.

The characters of *C. umbellata* as given by Fischer ('83, p. 402) do not enable me to discriminate between his species and those described by Verrill; in fact, from the account of his two larger specimens it seems not unlikely that they ought to be referred to the genus *Opisthoteuthis* Verrill ('83, p. 113). The phrase "le corps . . . était tellement court qu'on ne distinguait, au premier abord, que le disque formé par les bras, et que l'animal rassemblait en quelque sorte à une astérie molle (Hymenaster)." A comparison of this description with the figures of *O. depressa* given by Ijima and Ikeda ('95, p. 133) is, to say the least of it, very suggestive.

Since the above was written I have seen Professor Joubin's important work (:01) on the collections made by the "Princesse Alice," in which he records the capture of examples identified with *C. umbellata*. He does not seem very certain of this identification, for he speaks of having arrived at it "par exclusion successive," and adds that "les deux ou trois caractères signalés par P. Fischer, . . . s'appliquent bien á l'échantillon de la *Princesse Alice*." It seems to me, however, that M. Joubin overlooks the important account of the general shape just alluded to. In any case a comparison of his figures and descriptions with those given below suggests very strongly that his specimens are the same as the species here called *Stauroteuthis hippocrepium* (see p. 6).

1. Cirroteuthis, sp.

Habitat. — Station 3414, off Tehuantepec, April 8, 1891; lat. 10° 14′ N.; long. 96° 28 W., 2232 fathoms; green mud; temperature, surface 82°, bottom 35.°8; one specimen, No. 7945 A. [H. 33.] [1]

But little is left of this specimen; the head and body have entirely disappeared with the exception of one gill and one eye, and the arms have lost most of their integument and of the umbrella connecting them. So far as can be seen, it agrees in many respects with *C. pacifica* from the "Challenger" Expedition (Hoyle, '86, p. 61), the only noteworthy difference being that the nodule which indicates the attachment of the web to the ventral side of the arm is rather less instead of rather more than halfway up the arm, but as the dorsal cartilage was not preserved, it is impossible to say with certainty whether it belonged to the genus *Cirroteuthis* or to *Stauroteuthis*.

2. Cirroteuthis, sp.

Habitat. — Station 3358; off Cape Mala; February 24, 1891; lat. 6° 30′ N., long. 81° 44′ W., 555 fathoms; temperature, surface 83°, bottom, 40.°2; green sand.

[1] The numbers in square brackets preceded by "H" refer to my own register of specimens examined.

On the margin of the drawing of specimen 7961 is a memorandum to the effect that the "wire came up with a large film of the violet membrane of tentacles: must have been a large specimen at least × 20 this one." No further record is to be found, and the fragments do not appear to have been preserved.

STAUROTEUTHIS.

Stauroteuthis Verrill, '**79**, p. 468; '**81**, p. 382, Plate 32, Figs. 1–5.

In the "Challenger" Report (Hoyle, '**86**, p. 61), I ventured to throw some doubt on the validity of this genus. The examination of the "Albatross" collection has, however, led me to believe that these doubts were ill founded. The genus presented many obvious resemblances to *Cirroteuthis*, and it appeared quite possible that the recorded differences were due to defects in the preservation of the specimens. The chief points of distinction seemed to be the form and position of the dorsal cartilage and the attachment of the web to the tips of the arms.

With respect to the former I have now no doubt whatever that the horizontal position of the horseshoe-shaped cartilage is normal. This was unquestionably the case in the specimen (No. 7942), which forms the type of *S. hippocrepium* below: it was seen too in the young specimen figured in the "Challenger" Report ('**86**, p. 65, Plate **13**, Figs. 5, 6). In that particular instance I regarded it as a juvenile character, for in the example, which was taken to be a more mature one of the same species, the cartilage seemed to be placed vertically. That specimen was, however, much distorted, and I now incline to the view that the horseshoe-shaped cartilage is normally horizontal, as Professor Verrill has figured it in the type of his genus.

To the genus *Stauroteuthis* I should now refer the following species which may be thus diagnosed: —

1. *S. syrtensis*: "cartilage forming a median angle, directed backward": fins triangular; umbrella reaching equally up dorsal and ventral aspects of the arm; no nodule where the free edge of the web joins the ventral aspect of the arm; intermediate web present.[1]

2. *S. meangensis*: cartilage horseshoe-shaped with angular process on the outer aspect of the curve; fins long, narrow, and pointed; umbrella extending only four-fifths up the ventral aspect of the arm and provided with a nodule where it joins the arm; intermediate web absent.

3. *S. hippocrepium*: cartilage horseshoe-shaped, smooth externally; fins paddle-shaped; umbrella extending nearly halfway up the ventral aspect of the arm, and provided with a nodule at the point of union; intermediate web absent.

[1] By "intermediate" web is meant a membrane which joins the arms to the umbrella.

3. Stauroteuthis hippocrepium, sp. n.

(Plate 1, Fig. 1; Plate 2, Fig. 1; Plate 3, Figs. 1-4.)

Habitat. — Station 3374, southwest of Malpelo Island; March 3, 1891; lat. 2° 35′ N., long. 83° 53′ W., 1823 fathoms; green ooze; temperature, surface 80°, bottom 36.°4; one specimen, No. 7942. [H. 47.]

The Body is ovoid, about half as long again as broad; the *mantle-opening*, as usual in the genus, closely surrounds the base of the *siphon*, which is comparatively small and subulate. What remains of the *fins* (Plate 3, Fig. 2) is muscular, flattened, pointed, and directed outwards and forwards; at the base of each is a gently hollowed, subtriangular surface, which during life articulated with the external surface of the anterior end of the dorsal cartilage (Plate 3, Fig. 3). There are, however, traces of a membranous expansion on the anterior edge of the fin. The *dorsal cartilage* is horseshoe-shaped (Plate 3, Fig. 1) and disposed in the horizontal plane of the body, with the concavity directed forwards: its surface is smooth, without any characteristic markings or prominences.

The Head is so macerated that no description of it is possible.

The Arms are subequal, and rather stout, soft, and tapering, rounded on the aboral aspect, wedge-shaped on the oral, the row of suckers occupying the narrow end of the wedge. All have lost their tips so the measurements given are merely approximate; their original length, however, would be from 5 to 10 mm. greater than the dimensions here given. The *umbrella* is entirely wanting, but it appears to have been attached directly to the arm, so that there was no intermediate web. It is impossible to ascertain how far the web extended on the dorsal side of the arm, but on the ventral its attachment terminated nearly halfway up the arm about the 25th sucker, as is shown by the presence in that position of a horny induration (Fig. 4) somewhat resembling that in *S. meangensis* (Hoyle, '86, Plate 11, Fig. 2). The *suckers* are upwards of 50 in number, and of the usual form, the largest being just over 1 mm. in diameter. The *cirri* are very small and begin as minute papillae only perceptible with a lens between the fourth and fifth suckers; they extend up the arms beyond the attachment of the web on the ventral aspect, but how much further it is impossible to say.

The *color*, when captured, is shown in Plate 1, Fig. 1, Plate 2, Fig. 1.

Dimensions.

		mm.
Length, total	about	80
End of body to mantle-margin		23
Breadth of body		20
Breadth of head		22
Length of fin[1]		28
Breadth of fin (at origin)		13
Diameter of largest sucker on arm		1.2

[1] The length of the fin is measured from the root outwards towards the tip.

	Right.	Left.
Length of first arm	80+	90+
Length of second arm	75+	85+
Length of third arm	70+	85+
Length of fourth arm	65+	75+

Fortunately two excellent colored drawings were made of this specimen when it was captured, which give a much better idea of its general appearance than could be obtained from the sadly mutilated creature which came into my hands. The animals of this family seem particularly difficult to preserve, whether it is that their gelatinous tissues are not easily permeated by the alcohol or what the cause may be I know not, but no single well-preserved example of this family has ever come into my hands.[1] In the present instance the body was much decomposed, especially on the dorsal aspect, where the integument and subjacent tissues had entirely disappeared, leaving the cartilage *in situ*, but with its upper surface clearly exposed to view (Plate 3, Fig. 2) in such a way as to leave no doubt as to what was its normal position. The significance of this in reference to the generic position of the species I have already dwelt upon.

I have remarked above that the figures and description of the examples called by M. Joubin (:01) *Cirroteuthis umbellata* present a very striking resemblance to the species just described. This identification does not rest on a comparison with the type, and seems to me to be at variance with an important passage in Fischer's all-too-short diagnosis. Unfortunately M. Joubin gives no account of the form or position of the internal cartilage, which would furnish important evidence for or against the view here suggested.

FROEKENIA, g. n.[2]

Allied to *Cirroteuthis*, with paired fins at the sides, but with no connecting membranes between the arms.

4. Froekenia clara, sp. n.

(Plate 2, Fig. 2; Plate 3, Fig. 5.)

Habitat. — Station 3358, off Cape Mala, February 24, 1891; lat. 6° 30′ N., long. 81° 44′ W., 555 fathoms; green sand; temperature, surface 83°, bottom 40.°2. One specimen, No. 7961. [H. 50.]

The Body is ovoid, broadest just in front of the fins, tapering slightly towards the hinder extremity. The *fins* are about equal in length to the breadth of

[1] Verrill ('96, p. 75, footnote) mentions that satisfactory results may be obtained by the use of a refrigerator.

[2] From the Danish word "Frøken," in honor of a lady to whose help I am indebted for much of the leisure utilized in preparing this Report.

the body, sub-elliptical in shape, the posterior margin almost straight, the anterior more curved. The *internal cartilage* (Plate 3, Fig. 5) lies in a horizontal plane around the hinder end of the body; it is almost semicircular, delicate and transparent, and pointed at the extremities; on the external surface near the extremity is a facet with which the base of the fin articulates; the long axis of the fin is directed somewhat forward with respect to the median axis of the cartilage.

The Head is short; the eyes prominent, standing out somewhat further than the sides of the body.

The Arms are long, slender, and sub-equal, and taper very gradually to their ends, but as these were in many instances mutilated, it is impossible to give accurate dimensions: the length was, however, about 5–6 cm. The *suckers* are small, placed in a single series, very closely set, and of firm consistency, embedded in much soft connective tissue and not in the muscular substance of the arms. Most of the suckers were lost, and it was only here and there that I could find traces of the *cirri* alternating with them: those I did find were a little longer than the diameter of the suckers, and rather stout and blunt.

The *Color*, when alive, is shown in the sketch reproduced on Plate 2, Fig. 2.

The solitary specimen on which this species is based came into my hands in a state approaching disintegration and fell to pieces under very careful handling. The characters which I was able to decipher are, however, quite sufficient to prove that it cannot be placed in any genus yet known. Fortunately a sketch, partly colored, was made of the animal immediately after its capture, which, reproduced in Plate 2, gives the form and proportions of the animal much more clearly than could be ascertained from the preserved specimen. On the margin of the drawing is a memorandum by Mr. Agassiz to the effect that the creature was "like *Cirroteuthis*, but no film" (umbrella). This statement is very important, for it proves that the absence of the umbrella is not due to defective preservation.

Family ALLOPOSIDAE.

Alloposidae, Verrill, '81, p. 365.

BOLITAENA.

Bolitaena, Steenstrup, '59, p. 183.

Although this generic name was published and very briefly characterized more than forty years ago (Steenstrup, '59, p. 183), the type was first described in the "Challenger" Report (Hoyle, '86, p. 16) from notes made in the Copenhagen Museum. It was then placed by me in the family Polypodidae (Octopodidae) along with *Eledonella* and some other forms, but on reconsidering the question in connection with the specimen to be described below I have come to the conclusion that its affinities are rather with the genus *Alloposus*. It shares with this the soft gelatinous consistency, the short rounded body, the relatively extensive umbrella, the large siphon, attached for its whole length to the inferior surface of the head, and the ligament attaching the margin of the mantle to the body in the middle line and passing just under the posterior edge of the siphon (compare Verrill, '81, Plate 39, Fig. 2). The chief distinction is that it has only a single row of suckers, but I think this is hardly sufficient to outweigh the numerous points of resemblance. The genus may perhaps be regarded as having the same relation to *Alloposus* that *Moschites* (*Eledone*) has to *Polypus* (*Octopus*).

5. Bolitaena microcotyla.

(Plate 3, Figs. 6-11; Plate 4, Fig. 1.)

Bolitaena microcotyla, Steenstrup, '59, p. 183.
" " Hoyle, '86, p. 16.

Habitat. — Station 3410, off Bindloe Island, 4 miles W., April 3, 1891; lat. 0° 19′ N., long. 90° 34′ W., 331 fathoms; black sand; temperature, surface 82°, bottom 44.°2; one specimen, No. 7955. [H. 55.]

This occurrence extends the known range of the genus, for the type species is from the Atlantic. The locality of a specimen in the Hamburg Museum, shown me by Dr. Pfeffer, is unknown.

In general appearance this young specimen resembled a spheroidal mass of jelly barely 2 cm. in diameter; on turning it about there were seen on one side several rows of suckers and on the other a deep transverse groove, whilst at opposite poles were two large eyes shining through the integument. The photographs reproduced on Plate 3 give an idea of the general appearance, whilst the semi-diagrammatic side-view (Fig. 10) shows more clearly the disposition of the parts.

The Body and *Head* have no line of demarcation between them, but form a rounded mass; the *mantle-opening* is very extensive, reaching far beyond the eyes; it presents a somewhat W-shaped appearance, owing to the arrangement of its attachments; the free border of the mantle is united to the ventral aspect of the body by a ligament in the middle line, which passes just under the hinder margin of the funnel, whilst this latter has on either side a ligament binding it down to the apex of the gill (Plate 3, Fig. 11). The *siphon* is very broad at the base and tapers rapidly down to a long tube, which terminates at a considerable distance in front of the eyes. The *funnel organ* is very prominent and indeed can be seen shining through the translucent wall of the siphon. It consists of an elongated white pad in the shape of a W, the central point being attached to the dorsal middle line of the siphon, whilst the extremities of the lateral limbs nearly meet in the ventral median line. On either side of the base of the siphon is a deep hollow, covered by a flap of skin passing backward from the side of the head so as to form a valve. This hollow space is traversed by a band of tissue containing the ganglion stellatum and the nerves connected with it. Behind the eye and just within the angle of the aperture of the mantle-cavity is a minute papilla, which is presumably the *olfactory organ*. The *rectum* terminates at the base of the funnel in the middle line and emerges from the body wall through the ligamentous attachment of the mantle, which is forked to give it passage (Plate 3, Fig. 11). The anal appendages are spatulate. The *radula* has seven rows of teeth and does not show the arrangement stated by Steenstrup to be characteristic of the genus. According to him each row of the radula differs from those immediately preceding and following it, but in such a way that the pattern repeats itself every five rows. It is quite possible that this character may appear as the animal becomes more mature. The drawing on Plate 4, Fig. 1, will give a better idea of the form and proportions of the teeth than any verbal description.

Dimensions.

	cm.
Length, total	1.8
End of body to mantle-margin	0.7
End of body to eye	1.0
Breadth of body	1.5
Diameter of largest sucker	0.1

	Right.	Left.
Length of first arm	2.0	2.0
Length of second arm	1.6	1.6
Length of third arm	1.1	1.1
Length of fourth arm	1.1	1.1
Suckers on first arm [1]	18	18
Suckers on second arm [1]	17	19
Suckers on third arm [1]	14	12
Suckers on fourth arm [1]	13	12

On opening the *mantle-cavity*, this is seen to be very short from before backwards, but very extensive laterally. The mantle is only bound down to the body wall in the median line for a short distance anteriorly (Plate 3, Fig. 11): behind this it is free, so that there is a communication between the two sides. The gills lie one on either side, quite near the posterior margin of the sac ; each consists of half a dozen lamellae, crescentic in form, with the concavity directed forwards, and subdivided into numerous tufts. Just at the apex of the gill is attached the ligament which binds down the lateral part of the siphon, and proceeding outwards from this is a broad fold of skin passing backwards from the head and forming a valve, when the mantle contracts over it. This fold of skin is large and loose, and the cavity, which is arched over by it during expiration, must contain a considerable quantity of water, to which must also

[1] These numbers are exclusive of minute evanescent suckers at the tips of the arms.

be added the amount lodged in the lateral extensions of the mantle-cavity, which reach completely round the body, meeting behind the visceral sac. In those cephalopods in which the body is elongated antero-posteriorly there is a large space in the mantle-cavity, behind the gills; this may be fairly assumed to serve the purpose of holding a reserve supply of water which will gradually pass over the gills during expiration. In the present instance, owing to the short, rotund character of the body, space is found for a similar reserve store of water at the outer side of the gills. To the outer side of each gill this cavity is traversed by a ligament which contains the pallial nerve, the ganglion stellatum, and the nerves proceeding from it. The specimen being small as well as unique I was able to make but few observations on its internal anatomy. The heart is fusiform, and lies transversely: the ink-sack is small and pyriform; the renal appendages of the veins large and floccular in appearance, and there is the usual curved caecum at the bottom of the visceral sac. I was not able to ascertain the sex of the specimen.

I have recently had an opportunity of comparing this specimen with one belonging to the same genus in the Hamburg Museum, which closely resembles Steenstrup's type. I find the two specimens agree in the following points:

1. The form and arrangement of the suckers and the umbrella.
2. The mantle-cavity extending all round the visceral sac.
3. The presence of a ligament containing the stellate ganglion.
4. The wide aperture of the mantle-cavity.
5. The long siphon with intermediate ligaments.

The principal differences are that in the present individual the arms are proportionally larger and the umbrella does not extend so near to their ends, and that the siphon is proportionally somewhat longer.

Notwithstanding the difference in the radula, above alluded to, I am inclined to believe the specimen under discussion to be a young example of *Bolitaena microcotyla*.

Family ARGONAUTIDÆ.

Argonautidae Cantraine, '40, p. 20.

ARGONAUTA.

Argonauta Linné, '58, p. 708.

6. Argonauta hians.

Argonauta hians Solander, '86, p. 44.
Argonauta gondola Adams & Reeve, '48, p. 3, Plate 2, Figs. 2 i, 2 k, 2 l.

Habitat. — Station 3425, off Las Tres Marias; April 18, 1891; lat. 21° 19′ N., long. 106° 24′ W., 680 fathoms; green mud and sand; temperature, surface 76°, bottom 39°; one specimen, No. 8138. [H. 60.]

This small broken specimen agrees exactly, as far as can be made out, with the figures of Adams and Reeve referred to above, and is of about the same size. The specific name *gondola* has been regarded by Von Martens (**'67**) and other authorities as a synonym of *hians*, and this view I have adopted.

7. Argonauta argo.

Argonauta argo Linné, **'58**, p. 708.

Habitat. — Station 3371, off Cocos Island; March 1, 1891; lat. 5° 26′ 20″ N., long. 86° 55′ W.; temperature, surface 82°; two shells, immature; No. 8172. [H. 57, 58.]

Station 2627 Hyd., off Cape San Francisco; March 25, 1891; lat. 0° 36′ N., long. 82° 45′ W.; temperature, surface 81°; one shell, immature; No. 8139. [H. 59.]

The three specimens all belong to what Dr. von Martens (**'67**, p. 104) calls the *forma aurita*, figured by Férussac and d'Orbigny (**'35**, Argonautes, Plate **2**, Figs. 4, 5).

8. Argonauta, sp.

(Plate 10, Fig. 12.)

Habitat. — 50 miles south of Guaymas, surface; one specimen ♀. [H. 56.]

Station 236, off Arhno, Marshall Islands; January 28, 1900; lat. 6° 34′ N., long. 170° 59′ E., surface, electric light; temperature, surface, 81°; one specimen ♀ [H. 127], one ♂ [H. 145].

These specimens are too young to admit of their being referred to any particular species. The shell of the example from Guaymas (Plate **10**, Fig. 12) is interesting as showing the form at this period of development: it is extremely delicate, and hence has been a little chipped at the edge. The dorsal arms show the usual expansion, greatly shrunken and contracted by the action of the spirit.

Family TREMOCTOPODIDÆ.

Tremoctopodidae Tryon, **'79**, p. 130.
Philonexidae (*pars*) d'Orbigny, **'45**, pp. 159, 199.

TREMOCTOPUS.

Tremoctopus delle Chiaje, **'29**, Plates 70, 71.

9. Tremoctopus quoyanus.

Octopus (*Philonexis*) *quoyanus* d'Orbigny, **'35**, p. 17, Plate 2, Figs. 6–8.
Philonexis quoyanus Férussac and d'Orbigny, **'35**, p. 96, Poulpes, Plate 16, Figs. 6–8, Plate 23, Fig. 5.
Tremoctopus quoyanus Hoyle, **'86**, p. 70, Plate 13, Fig. 7.

Habitat. — Tropical Pacific; September 1, 1899; lat. 18° 19′ N., long. 134° 57′ W.; surface, 8 p. m.; temperature, surface 76°; two specimens ♀. [H. 151, 152.]

I refer these specimens to the above species with a little hesitation, because although the general appearance and relative lengths of the arms agree fairly well, there is a very definite pattern of conspicuous chromatophores on the back of the head in both specimens, which does not appear either in d'Orbigny's description or figures. There are two large round chromatophores over each eye (compare Figure *A*), the anterior a little nearer the middle line than the posterior. Almost in the centre of these four is a smaller one, whilst two others nearer the middle line peep out from under the mantle-margin behind. On the arms are first three or four chromatophores in a single series, and then a double series almost up to the extremity.

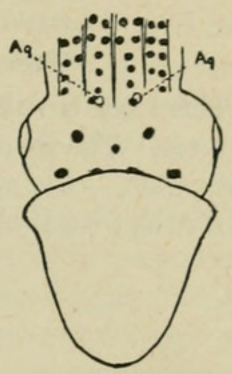

Fig. *A*. *Tremoctopus quoyanus?* Dorsal view. × 2½. *Aq.*, Aquiferous pores.

10. Tremoctopus scalenus,[1] sp. n.

(Plate 4, Figs. 6–9.)

Habitat. — Station 3388, off Cape Mala; March 9, 1891; lat. 7° 6′ N., long. 79° 48′ W.; temperature, surface 73°; one specimen ♀, No. 7963. [H. 51.]

The Body is roughly ovoid in form, but so mutilated posteriorly that it is difficult to make out its original shape correctly. The posterior extremity appears, however, to have been bluntly pointed as shown in the restored outline (Plate 4, Fig. 7).

The Head is small, the sides being occupied entirely by the prominent eyes. The integument is so damaged that the aquiferous pores can no longer be made out.

The Arms are very slender and of unequal length, the second pair enormously exceeding the others. The *Suckers* (Figs. 8, 9) are small, prominent, widely separate and alternating. There is no trace of hectocotylization.

Dimensions.

	mm.
Length, total	120
End of body to mantle-margin	15
End of body to eye	17
Breadth of body	9
Breadth of head	6.5
Diameter of largest sucker	0.75

[1] In allusion to the marked inequality in the length of the arms.

	Right.	Left.
Length of first arm	40	36
Length of second arm	100	90
Length of third arm	50	24
Length of fourth arm	25	26

This form is sufficiently distinguished by the elongation of the second pair of arms. The disparity in length between the two arms of the third pair is noticeable, — the more so since that of the right side has a truncated extremity, as if it had been originally still longer.

Family POLYPODIDAE, n. n.

Octopodidae Auctorum.

POLYPUS.

Polypus Schneider, :84, p. 116.
Octopus Lamarck, :99, p. 18.
Polypus Hoyle, :01.

I have elsewhere (: 01) shown that in accordance with the rules of zoölogical nomenclature now generally adopted, Schneider's name must take precedence of that proposed by Lamarck. It is no light matter to change a name that has been in daily use for just over a century, but I am so fully convinced that the only way of securing anything like uniformity in nomenclature is the rigid adherence to rules, that it seems to me best to make the change and trust to its gradual adoption. I notice that this view has been accepted by no less an authority than Mr. Edgar A. Smith, of the British Museum (: 02).

11. Polypus occidentalis.

Octopus vulgaris var. *americanus* d'Orbigny, '53, p. 14, Plate 1, Fig. 1.
Octopus occidentalis Hoyle, '86, p. 77.

Habitat. — Charles Island, Galapagos Islands, April 1, 1891; one specimen ♀, No. 7943. [H. 39.]

On my last visit to Copenhagen I had the satisfaction of comparing this specimen with Steenstrup's type, in company with my friend the late Dr. H. J. Posselt, whose untimely death in July, 1896, cut short a career of unusual promise.

12. Polypus oculifer, sp. n.

(Plate 4, Figs. 3, 4.)

Habitat. — Charles Island, Galapagos Islands, March 31, 1891; one specimen ♀, No. 7948. [H. 40.]

The Body is oblong, rounded behind, very little longer than broad ; with a slight depression in the ventral median line. The *mantle-opening* extends less than halfway round the body, terminating some distance below and behind the eye. The *siphon* is small and bluntly terminated, and would reach only about one-third of the distance from the mantle-margin to the edge of the umbrella.

The Head is short, and, owing to the prominence of the *eyes*, considerably wider than the body.

The Arms are sub-equal in length, the dorsal being somewhat shorter than the others : on the average they are three times as long as the body (measured to the eye). The *umbrella* is well developed between each pair of arms, though between the dorsal arms its radius is only 12 mm., whilst between the ventral it is 18 mm. (measured from the mouth). The *suckers* are of average size, closely set and rather prominent : the three proximal ones form a single series. On the third left arm the eleventh sucker is absent: a similar loss seems to have affected the second right arm, but to be in process of repair, for a small sucker is growing in the space between the ninth and eleventh, which was probably formerly occupied by a much larger one. No hectocotylus is present.

The Surface is rough: the back is covered with granulations which become smaller on the sides and gradually vanish in the centre of the lower surface. These are also found on the external surface of the umbrella and on the proximal moiety of the arms. Very minute granulations occur also on the internal surface of the umbrella and the adjacent portions of the sides of the arms. There are no cirri and no papillae which are much larger than the others.

The Color (in spirit) is a dull violet, shading into ochre below. On the sides lighter patches are indistinctly seen separated from each other by darker veins. In front of and below each eye between the bases of the lateral arms is an eye-like spot, distant about 7 mm. from the eye and 8 to 11 mm. from the umbrella margin (Plate 4, Fig. 4). It has a pale whitish centre, surrounded by a dark ring ; this in its turn is bounded by a broader area of the paler color of the skin, enclosed by a narrow dark line.

Dimensions.

		mm.
Length, total	about	52
End of body to mantle-margin		11
End of body to eye		15
Breadth of body		13
Breadth of head		14
Eye to edge of umbrella		13
Diameter of largest sucker		2.3

	Right.	Left.
Length of first arm	44[1]	35
Length of second arm	50	55
Length of third arm	50	52
Length of fourth arm	40	50

[1] The lengths of the arms are measured from the mouth.

From the five species of *Polypus*, which have hitherto been described as having an ocellar spot in front of the eye, the present form is easily distinguished as follows: —

1. From *P. pulcher* (Brock) ('**87**, p. 607) by the rough surface of the body, combined with the absence of any specially prominent cirri.

2. From *P. areolatus* (De Haan) (Fér. & D'Orb. '**35**, p. 65) by the dorsal (not the fourth arms being the shortest), by the smaller development of the arms, and by the centre of the eye-spot being light instead of dark.

3. From *P. ocellatus* (Appellöf) ('**86**, p. 8) by the relative shortness of the ventral arms, by the absence of a cirrus over the eye, by the ocellus being situated nearer to the eye than to the umbrella margin, and by its having a white centre.

4. From *P. membranaceus* (Quoy & Gaimard) ('**32**, p. 89) by the absence of the lateral web on the body.

5. From *P. bimaculatus* (Verrill, '**83**A, p. 121) by the rough granular surface, with a distinct cirrus over each eye, and by the ocellar spot being of a purplish black all over without any paler centre or ring.

13. Polypus pusillus.

(Plate 4, Fig. 5; Plate 5, Fig. 1.)

Octopus pusillus Gould, '**52**, p. 478, Fig. 591.
Octopus pusillus Tryon, '**79**, p. 112, Plate 31, Figs. 32, 33.
Octopus pusillus Ortmann, '**88**, p. 644, Plate 21, Fig. 1.

Station 3356, off Mariato Point; February 23, 1891; lat. 7° 9′ 30″ N., long. 81° 8′ 30″ W., 546 fathoms; soft blue mud; temperature, surface 83°, bottom 40.°1; one specimen ♀, No. 7952. [H. 98.]

Station 3358, off Cape Mala; February 24, 1891; lat. 6° 30′ N., long. 81° 44′ W., 535 fathoms; green sand; temperature, surface 83°, bottom 40.°2; one specimen ♀, No. 7954. [H. 54.]

Station 3363, east of Cocos Island; February 26, 1891; lat. 5° 43′ N., long. 85° 50′ W., 978 fathoms; white globigerina ooze; temperature, surface 83°, bottom 37.°5; one specimen ♂, No. 7949. [H. 38.]

Station 3417, off Acapulco; April 11, 1891; lat. 16° 32′ N., long. 99° 48′ W., 493 fathoms; green mud; temperature, surface 82°, bottom 40.°6; one specimen ♀, No. 7950. [H. 37.]

Station 3418, off Acapulco; April 11, 1891; lat. 16° 33′ N., long. 99° 52′ 30″ W., 660 fathoms; brown sand, black sp.; temperature, surface 82°, bottom 39°; one specimen ♀, No. 7953. [H. 43.]

It is not without hesitation that I refer all these specimens to the above species. Gould's description leaves something to be desired in the matter of fulness and precision, but the most conspicuous character (the large globular eyes) is shared by them; they also agree in the size of the umbrella and in the smooth surface. The arms are given by Gould as being in order of length, 1, 2, 3, 4; but it would appear from his figure that there is no great disparity between them and that they might with propriety be termed sub-equal. It may further be remarked, in this connection, that in Gould's specimen the arms were contorted by the contraction of the mantle, under which circumstances accurate measurements are very difficult. In all these from the "Albatross" Expedition the arms are sub-equal; in some one is a trifle longer, in others another. In the male specimen (No. 7949), in which the total length is 8.5 cm. and that of the longest arms 6.5 cm., the hectocotylized arm is only 4.5 cm. long and the modified extremity only 4 mm. This is of the usual form; the centre of the spoon-shaped portion forms a rounded elevation without any transverse ribs (Plate 4, Fig. 5). The specimen numbered 7950 differs from the last (7949) in the paler dull-gray color, but this is possibly due to some difference in the mode of preservation. The body is distended and wrinkled, and much of the epidermis is stripped from the arms. The proximal four suckers are in two rows, not in one, but I am not at all sure of the value of this character.

The radula presents a noteworthy character in the way in which the lateral denticles of the median tooth occupy successively higher positions as we pass backwards in the radula. There is thus produced a serial repetition which is completed in about five teeth (Plate 5, Fig. 1).

Specimen No. 7954 is small (about 4.5 cm. in total length), but it seems to me also to belong to this species. It is a good deal more contracted and harder in consistency, and more ruddy in hue. The only difference on account of which I should be inclined to separate it is the existence of a very small pale wart above each eye, but it is so small and the skin is a good deal wrinkled round about, so that it appears to me too insignificant a character to outweigh the numerous points of resemblance.

14. Polypus tonganus ?

Octopus tonganus Hoyle, '86, p. 83, Plate 8, Figs. 1, 2.

Habitat. — Pacific Ocean, between Columbia and Mexico; no more precise locality. Two specimens. No. 8040. [H. 34, 35.]

The larger, a very flaccid and mutilated specimen, presents no characters by which it can be distinguished from the species discovered by the "Challenger" at Tongatabu. The identification is a little uncertain because the "Challenger" specimens were in a state of extreme contraction and the surface considerably injured by mutual pressure.

One specimen is about 20 cm. in total length, the other about 6 cm.

15. Polypus januarii.

(Plate 5, Fig. 2.)

Octopus januarii Hoyle, '86, p. 97, Plate 7, Figs. 1-4.

Habitat. — Station 3371, off Cocos Island; March 1, 1891; lat. 5° 26′ 20″ N., long. 86° 55′ W., 770 fathoms; globigerina ooze; temperature, surface 82°, bottom 39°; one specimen ♂, No. 7944. [H. 41.]

The body of this example was in a very rotten and disintegrated condition, and among the débris at the bottom of the bottle I found several spermatophores. A portion of the radula is figured in Plate 5, Fig. 2.

16. Polypus macropus? juv.

Octopus macropus Risso, '26, p. 3.
Octopus Cuvierii Férussac and d'Orbigny, '35, Poulpes, Plate 4.
Octopus macropus Jatta, '96, p. 217.

Habitat. — Arhno Atoll, Marshall Islands; January 24-26, 1900; lat. about 7° N., long. about 171° 30′ E.; surface of the lagoon, electric light; one young specimen ♀. [H. 111.]

This small specimen, not quite 10 cm. in total length, is most likely the young of the widely distributed *Polypus macropus* (Risso), or possibly of an undescribed species nearly allied to it.

17. Polypus, sp. juv.

(Plate 5, Figs. 3-9.)

Habitat. — Station 3353, off Cape Mala; February 23, 1891; lat. 7° 6′ N., long. 80° 34′ W., 695 fathoms; green mud; temperature, surface 73°, bottom 39°; 22 specimens, immature; No. 7941. [H. 73-94.]

In the present instance a small shoal of young specimens would seem to have been captured in the trawl. They are quite immature, as may be seen from the fact that in some the yolk sac persists in the midst of the arms. I am not aware that specimens as large as these have been found leading a free existence with the yolk sac still unabsorbed. I have seen advanced embryos of *Sepia* and *Loligo* when artificially liberated swim freely and actively about, though I do not know how long they can survive.

The disposition of the suckers on the arms of these specimens is curious and interesting, for they are sometimes in one row, sometimes in two. In the majority of cases the proximal and the distal suckers are in a single row (Fig. 7), whilst a greater or smaller number in the middle of the arm are arranged biserially (Fig. 6). There are, however, several cases in which the whole of the suckers are in a single series, and these occur in specimens where other arms have the arrangement described above. The disposition is often very irregular, especially where the uniserial arrangement is changing to the biserial (Fig. 5). The question might arise whether these examples belong to the genus *Moschites* (*Eledone*), the uniserial being normal and the biserial due to contraction, or whether they are a species of *Polypus* (*Octopus*) in which the uniserial arrangement is gradually becoming biserial. I have no hesitation in adopting the latter view, because the animals are undoubtedly young, as shown by the presence of the yolk sac, and because, as I have elsewhere remarked, ('86, p. 76) the suckers in the genus *Polypus* are not, strictly speaking, in two rows, but in one zigzag row. I am not aware whether this point has been established by an examination of embryos, but the present series of young examples seems to indicate that the suckers are first formed in a single series which press each other sideways so as to form two rows as they become more crowded.

It is quite impossible to decide as to the species to which these specimens belong. From the size to which they have attained before losing the yolk sac it is likely that they are the young of some large species, perhaps one hitherto undescribed. I give below a description, to facilitate the clearing up of this point at some future date.

The Body (Figs. 3, 4) is ovoid, distinctly longer than broad, and the ventral groove is well marked. The *mantle-opening* is narrow, extending only about one-fifth round the body, and ending directly below the centre of the eye. The *siphon* is tapering and extends from one-third to halfway to the umbrella margin, according to its state of contraction.

The Head is short and narrow, distinctly narrower than the body, and the eyes are round, black, and prominent.

The Arms are sub-equal and conical, tapering to blunt extremities. They are about equal in length to the head and body together; round in section except for the projection of the suckers. The *umbrella* extends about one-third up the arms. The *suckers* are small and closely set, and the arrangement varies between a biserial and a uniserial disposition as above described.

The Surface of the dorsal half of the body, head and arms, is finely granular, the inferior half smooth.

The Mantle is attached to the middle line ventrally by a broad ligament, 4 mm. wide, close to its free border. The edge of the mantle is turned over and thickened internally just within the free border so as to form a kind of ridge, which fits into a corresponding hollow in the base of the siphon (Fig. 8); this arrangement no doubt serves to insure the complete closure of the mouth of the mantle when water is being ejected through the funnel.

The Radula was extracted from one of the specimens and is figured on Plate 5, Fig. 9. In the bending of the outermost teeth and the recurving of the parts of the inner laterals it seems to present signs of incomplete development. The *centrals* have a broad median cusp, tapering to an acute point, and on either side are rudiments of a small lateral cusp. The *first* and *second laterals* are triangular and pointed: the *third* laterals very long and slender and bluntly pointed. The irregular bending shown in the drawing is not, I think, a natural condition.

Dimensions of Figured Specimen.

		mm.
Length, total		37
End of body to eye		12
Breadth of body		14
Eye to edge of umbrella, dorsally		10
Mantle-margin umbrella, ventrally		6
Diameter of largest sucker		0.6

	Right.	Left.
Length of first arm [1]	25	25
Length of second arm	23	23
Length of third arm (about)	22	22
Length of fourth arm	20	20

18. Polypus, sp.

Habitat. — Papiete, Tahiti; on the reefs; November 14, 1899; one young specimen. [H. 146.]

A young Octopus, 11 mm. in total length, with a short bursiform body and sub-equal arms, up which the umbrella extends for a distance of about 1 mm. The body and umbrella are liberally besprinkled with minute brown chromatophores; there is a single row of large pale red chromatophores along the outer aspect of each arm and there is a single similar one above each eye.

19. Polypus, sp.

Habitat. — Arhno Atoll, Marshall Islands; January 24–27, 1900; surface lagoon, electric light; three young specimens. [H. 112, 113, 121.]

These specimens are not specifically determinable; their most prominent characteristics are that the arms are sub-equal, the laterals being slightly larger than the dorsal or ventral. Each arm has on its outer surface a double row of chromatophores, which are small and black on the proximal third, then larger and more reddish in tint. There is also a patch of pale reddish chromatophores between the eyes and on the anterior part of the dorsal surface. The total length is 20 mm., and the arms about 10 mm., measured from a point just in front of the eye.

20. Polypus, sp.

Habitat. — Makatea Island, Paumotu Archipelago; October 6, 1899; shore; one young specimen. [H. 125.]

Makemo Island, Paumotu Archipelago; October 19 or 20, 1899; lagoon; one young specimen. [H. 124.]

This small Octopus, measuring about 3 cm. in total length, has no very striking characteristics, and in view of the inadequacy of our knowledge of

[1] Measured from a point opposite the centre of the eye.

the forms from these islands it seems useless to attempt to affix a specific name to it. The specimen from Makemo Island is a little larger, but has become dried and shrivelled so that its determination is even more uncertain.

MOSCHITES.

Moschites Schneider, :84, p. 118.
Eledone Leach, '17, p. 137.
Moschites Hoyle, :01.

21. Moschites rotunda.

Eledone rotunda Hoyle, '86, p. 104, Plate 8, Figs. 4–6.

Habitat. — Station 3398, off Cape San Francisco; March 23, 1891; lat. 1° 7′ N., long. 80° 21′ W., 1573 fathoms; green ooze; temperature, surface 84°, bottom 36°; one specimen ♀, No. 7951. [H. 44.]

With some little hesitation I regard this little species as the young of a species discovered by H. M. S. "Challenger" in the Pacific and Southern Oceans. The only points of difference are: (1) there is a shallow depression in the middle line below, (2) the mantle-opening terminates immediately below the eye, (3) the umbrella is proportionally better developed, and (4) the eyes are comparatively larger. Some of these are known to be characteristics of youth, and I do not think that they justify me in creating a new species for what is undoubtedly a young specimen.

22. Moschites verrucosa.

Eledone verrucosa Verrill, '81A, p. 105, Plates 5, 6.
Eledone verrucosa Hoyle, '86, p. 104.

Habitat. — Station 3393, off Cape Mala; March 10, 1891; lat. 7° 15′ N., long. 79° 36′ W., 1020 fathoms; green mud; temperature, surface 74°, bottom 36.°8; three specimens ♀, two badly macerated, No. 7940. [H. 95–97.]

The only one of these specimens which was in reasonably good condition agrees very well with Verrill's description. The eyes are rather more swollen than in his figure, and the tubercles covering them are uniform in size. Verrill states that in his female they were smaller than in the male, and as the present example is only one-third the size of his, this may probably be due to incomplete development.

ELEDONELLA.

Eledonella Verrill, '84, p. 144, Plate 32, Fig. 2.

23. Eledonella diaphana.

(Plate 5, Fig. 11.)

Japetella diaphana Hoyle, '85 A, p. 232.
Eledonella diaphana Hoyle, '86, p. 107, Plate 9, Figs. 3–6.

Habitat. — Station 3366, east of Galapagos Islands; February 27, 1891; lat. 5° 30′ N., long. 86° 45′ W., 1067 fathoms; yellow globigerina ooze; temperature, surface 84°, bottom 37.°0; one specimen ♀, No. 7946. [H. 99.]

Station 3415, S. E. of Acapulco; April 10, 1891; lat. 14° 46′ N., long. 98° 40′ W., 1879 fathoms; brown mud, globigerina ooze; temperature, surface 83°, bottom 36.°0; one specimen ♀, No. 7960 A. [H. 101.]

Station 3420, off Acapulco; April 12, 1891; lat. 16° 46′ N., long. 100° 8′ 20″ W., 664 fathoms; dark green mud; temperature, surface, 82°, bottom 39.°6; one specimen, No. 7947. [H. 100.]

Station 220, about 12 miles southwest of west point of Kwajalong Island, Marshall Archipelago; January 16, 1900; lat. 8° 38′ N., long. 167° 37′ E.; temperature, surface 82°, bottom 35°, 1897 fathoms, globigerina mud; one young specimen. [H. 129.]

These specimens differ only in insignificant characters from the type in the "Challenger" collection. The arms are proportionally a little shorter, but the general appearance, the form and disposition of the chromatophores, and the shape of the suckers are identical. There is no valve in the funnel, and as this character was recorded as doubtful in the case of the "Challenger" specimen I have re-examined this latter with care, and feel now convinced that the appearance of a valve is due to the tip of the funnel organ (the pad alluded to in the "Challenger" Report, p. 107), having become separated from the wall of the funnel.

The specimens were all immature, so that no sex indications were found in the viscera, but I conclude they are females because Verrill's example of *E. pygmaea*, which was no larger than the smallest of them, already showed the enlarged suckers on the third pair of arms which are believed to be characteristic of males.

One of the specimens (No. 7960) shows the funnel organ very well (Plate 5, Fig. 11). It consists mainly of two pads broader behind than in front, where they are prolonged into a kind of stalk and nearly meet, but are separated by the tip of a much smaller pad lying in the middle line and directed backwards. This median portion springs gradually from the dorsal wall of the funnel without any clear line of demarcation.

The young specimen [H. 129] shows a noticeable resemblance in general appearance to the *Octopus venustus* of Rang ('**37**, p. 66, Plate 93). This authority, however, figures the suckers in two rows, though he adds that they are "assez peu apparentes." The resemblance is in any case sufficiently strong to raise the interesting question whether the small pelagic forms described as *Octopus brevipes* Férussac and d'Orbigny ('**35**, p. 22), *O. capensis* and *O. dubius* Eydoux and Souleyet ('**52**) may not be allied to *Eledonella*.

JAPETELLA.

Japetella Hoyle, '**85** A, p. 231; '**86**, p. 109.

24. Japetella prismatica.

(Plate 5, Figs. 10, 12.)

Japetella prismatica Hoyle, '**85** A, p. 231; '**86**, p. 109, Plate 9, Figs. 1, 2.

Habitat. — Station 3414, off Tehuantepec; April 8, 1891; lat. 10° 14′ N. long. 96° 28′ W., 2232 fathoms; green mud; temperature, surface 82°, bottom 35.°8; one specimen ♂, No. 7945 B. [H. 36.]

I have compared this specimen with the type in the British Museum (Natural History) and have satisfied myself that both belong to the same species: there are, however, one or two points which call for special notice.

In the "Challenger" Report it is stated (p. 108) that there is a valve in the siphon, but I have ascertained by comparison of this example with the type that I was misled (as in the case of *Eledonella diaphana*) by the tip of the funnel-organ having become detached, producing a deceptive appearance of a valve. The form of the funnel-organ in the "Challenger" specimen is shown in Plate **5**, Fig. 12.

The other point relates to the median septum in the branchial cavity. In the "Challenger" specimen such a septum appeared to be absent, but in the present example there is a narrow delicate ridge running along the median ventral line of the interior of the mantle, which may be the remains of such a septum, though I can find no trace of its attachment to the visceral sac. Led by this discovery, I have re-examined the "Challenger" type and find there also traces of a similar ridge on the inner surface of the mantle. It seems, therefore, quite within the bounds of possibility that specimens in a better state of preservation might show a complete septum, in which case there would be no further cause for separating the genera *Eledonella* and *Japetella*. Although I think it very probable that in the future these two genera will be united, I think it advisable pending further evidence to retain them as distinct. The suckers on the third pair of arms of the "Albatross" specimen are much enlarged (Plate **5**, Fig. 10), exactly as figured by Verrill ('**84**, Plate **32**, Fig. 2) in the case of *Eledonella pygmaea*. This is almost certainly a form of hectocotylization and is an additional point of similarity between these two genera.

Family SEPIOLIDAE.

EUPRYMNA.

Euprymna Steenstrup, '**87**, p. 66 (20).

25. Euprymna stenodactyla.

Sepiola stenodactyla Grant, '**33**, p. 42.
Sepiola stenodactyla Grant, '**33** A, p. 77, Plate 11, Figs. 1, 2.
Euprymna sthenodactyla Steenstrup, '**87**, p. 66 (20); '**87** A, p. 89 (43).
Inioteuthis stenodactyla Brazier, '**92**, p. 9.
Sepiola stenodactyla Joubin, : **02**, p. 92.

Habitat. — South Pacific Ocean, near Rangiroa; September 24, 1899; about lat. 15° S., long. 148° W.; surface tow net, 8 P. M., one specimen. [H. 126.]

Funafuti Island; December 24, 1899; shore, taken with the seine; one specimen. [H. 128.]

Gilbert Islands about one mile off Tarawa Island; January 2, 1900; surface, electric light; one specimen. [H. 137.]

Marshall Islands, Arhuo Atoll; January 24–26, 1900; surface of lagoon, electric light; seven specimens. [H. 114–120.]

Same locality; January 27, 1900; two specimens. [H. 122, 123.]

The Body is thick and rounded; the fins are round, nearly circular, and rather more than half the body in length; there is a notch at the anterior but not at the posterior origin from the mantle; a broad ligament unites the *mantle* with the head in the nuchal region; the articulation between the mantle and the *siphon* consists of an elongated ridge and groove as usual in the family; the siphon is conical and reaches just to the gap between the ventral arms.

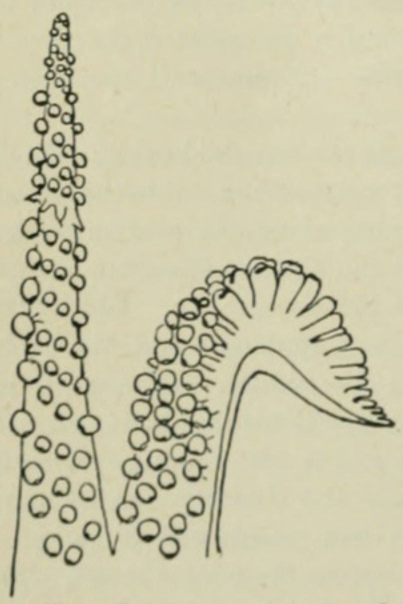

Fig. *B*. *Euprymna stenodactyla*. ♂. Dorsal arms. × 2½.

The Head is very broad and the *eyes* very large and prominent.

The Arms are in order of length 3, 2, 1 = 4; rather thick, rounded, and tapering, with no trace of keel, or protective membrane; the *suckers* are, speaking generally, in four rows, though the arrangement is here and there a little irregular; those at the root and tip are in two rows, and there appear to be one or two sets of three between; they are spheroidal, oblique, and of the type usual in *Sepiola*. In the male the suckers are somewhat differently disposed; in the *first right arm* (Fig. *B*) the two outer rows of suckers are a little larger than the inner, and those of the ventral row are again a little larger than those of the dorsal in the middle of the arm; the *first left arm* is a very little shorter than its fellow and decidedly thicker; the suckers are first in two and afterwards in four rows, and extend about halfway up the arm, where they are succeeded by a number of stout papillae in two or three rows (Fig. *C*); these thicken towards the tip, and do not bear suckers, but each has in its rounded top a slit, much resembling a mouth, closed by two lips, one thicker than the other; they diminish rapidly towards the tip of the arm. The modified papillae about halfway up figured by Appellöf ('86, Plate 2, Fig. 16), in *Inioteuthis morsei* were not seen, though there were two stalks from which suckers had fallen in this position. In the *second* arms the suckers of the outer rows are a little larger than those of the inner. In the *third* pair not only are the two outer rows enlarged, but four or five in the ventral row are much larger than the rest (Fig. *D*). In the *fourth* pair the outer rows are again somewhat larger than the inner, and there are two or three suckers of the dorsal series and four or five in the ventral much enlarged, though not to so great an extent as in the third pair. The *web* between the third and fourth arms extends up about one-fourth of their length; it is very small between the other pairs of arms and absent between the ventral pair.

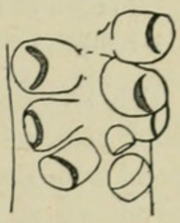

Fig. *C*. *Euprymna stenodactyla.* Modified suckers of left dorsal arm. × 8.

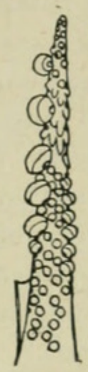

Fig. *D*. *Euprymna stenodactyla.* Third right arm. × 2½.

The Tentacles are about as long as the arms; there is a groove in the inner aspect of their *stem*, the dorsal margin of which is elevated into a kind of web or deep keel towards the *club*, which bends round in a hook; it is slightly expanded and of a velvety appearance, owing to the numerous small suckers.

The Color is yellowish gray, with very conspicuous chromatophores, especially large on the back of the head and the arms. In the latter there is a row of transversely elongated oval chromatophores up the outer surface, as figured by Grant, and a small round one on the pedicle of each sucker of the two outer rows. There is also a row of transversely placed oval ones on the outer side of the tentacular stem.

Dimensions of H. 114.

	mm.
Length, total	33
End of body to mantle-margin	11.5
Breadth of body	12
Breadth of head	12
Breadth of nuchal ligament	8
Centre of eye to edge of umbrella, between second and third arms	8
Length of fin	7
Breadth across both fins	21

	Right.	Left.
Length of first arm	11	10
Length of second arm	16	16
Length of third arm	17	17
Length of fourth arm	11	11
Length of tentacle	13	13

The following discrepancies between the above account and that given by Grant seem worth mentioning. The arms are a little larger than would correspond with the measurements given in Grant's text, but in the figure the arms are shown as larger than stated in the text. The tentacle is much longer in Grant's figure and description than in the "Albatross" specimens, but this organ varies so much in this respect both during life and after death according to preservation that a difference in this respect can hardly invalidate an identification based on so many resemblances. The head is sunk back into the mantle-cavity and hence the waist-like constriction behind the eyes, shown in Grant's figure, does not appear; this again is merely a matter of contraction of the tissues.

The nomenclature of this interesting form demands, perhaps, a few words of explanation. The generic name *Euprymna* was first proposed by Steenstrup in the Latin summary appended to his paper on the "Mediterranean Species of *Sepiola*" ('**87**). Speaking of the short-finned forms ("species brevipinnes") he says that they approach the typical species of the genus *Inioteuthis* Verrill, "dum ab atypicis speciebus ejusdem generis (*In. Morsei*, *sthenodactyla*, *bursa*, cet. propter connexionem *latam* capitis cum pallio et tentaculorum *miram* formationem ad genus novum, *Euprymnam* mihi dictum, referendis) valde recedunt."

In a subsequent paper ('**87** A, p. 88 [42]) he recurs to the same subject as follows: "The other Japanese Sepiolid, *In. Morsei* Verr., only provisionally referred by Professor Verrill to the genus *Inioteuthis*, only known to him in the shape of a single female example, is the most northeasterly form yet discovered of a series of very plump, thick-set Sepiolas, which seem to occur in all zones of the Indian Ocean and South Sea, and of which the most southwesterly representative yet known to me is the *Sepiola sthenodactyla* from Mauritius, described and depicted more than fifty years ago (1833) by Prof. Robert Grant in the Trans. Zoöl. Society, Vol. 1. All the individuals of this thick-set group of Sepiolas are characterized by a very broad ligament between the mantle and head, as has been mentioned by Verrill in the case of *In. Morsei*, Verr., and as is recorded for this species or one closely allied to it by W. Hoyle (Challenger Expd. Cephalop., Plate XLV., Fig. 1) and by Appellöf (*Op. cit.*, ['**86**] Plate II.), and as is equally strongly emphasized both in text and figure by Robert Grant in the case of *Sepiola sthenodactyla* (Plate **11**, Fig. 1), they are especially remarkable for the stout, swollen tentacular clubs, which have a velvety appearance on account of the hair-like thinness of the stalks of the suckers, and the (almost or quite) rudimentary condition of the suckers themselves as figured by Hoyle in the case of *In. bursa*, Pfeff., Plate XIV., Figs. 4–8.

They are all also very remarkable for the shape of the ink-sac, which is broader and with larger auricular processes than even in *Sep. Rondeletii* Leach, or *Sep. atlantica* d'Orbigny. On the whole they constitute, in my opinion, a special and well-marked generic type, which on account of the habit of body mentioned above I have called *Euprymna*, and of whose natural character I am the more convinced, inasmuch as I find in all the males of the group the sexual arm modified in the way represented by Mr. Appellöf (*loc. cit.*) in *In. Morsei*."

Later on it is stated that *Euprymna* is the Latinized feminine of the adjective *εὔπρυμνος,-ον* and has reference to short, stout body (stern, *πρύμνη*).

Dr. Ortmann ('**88**, p. 647) was presumably not acquainted with this paper of Professor Steenstrup when in 1888 he published his memoir on the Japanese Cephalopoda; it had indeed only appeared in the previous year. Dr. Ortmann points out a number of characters in which *Inioteuthis japonica* differs from *I. morsei*, and concludes by pointing out the necessity of creating a new genus for the latter, unless *I. japonica* is united with *Sepiola*, in which case the name *Inioteuthis* might be retained for *I. morsei* and its allies. Against this it may be pointed out that *I. japonica* was expressly made by Verrill the type of his genus, and as the name *Euprymna* had been proposed and defined by Steenstrup, it seems proper to accept it, whatever may be the fate of *Inioteuthis* as against *Sepiola*.

It is worthy of notice that Professor Steenstrup consistently spells the specific name of this species "*sthenodactyla*," not "*stenodactyla*." In a note appended to No. 7 of his "Notæ Teuthologicæ" ('**87** A, p. 74 [120]), he explains this by the statement that "Grant says expressly that he called the species thus on account of the stoutness and strength of the arms, and that, therefore, it must be in consequence of a typographical error that '*stenodactyla*,' meaning thin or small-armed, has crept into the text and plate." If this were all, it would no doubt be desirable to correct the faulty spelling and write the word as Steenstrup suggests, but the matter is not quite so simple. On turning to Grant's memoir ('**33** A, p. 85) we find these words: "The arms are proportionally much thicker and shorter than in *Sep. vulgaris*. . . . From this contracted form of the cephalic arms, by which it differs so much from the European species, I have termed it *Sep. stenodactyla*," and in the earlier note ('**33**), where the first mention of the species occurs, the name is said to be suggested by "the comparative shortness of its members." *στενός* would, of course, be a correct translation for "contracted," but the contraction referred to seems to have been in the matter of length and not breadth, and it is, to say the least of it, doubtful whether *στενός* can be used in that sense. For myself I have little doubt that Grant meant to write *stenodactyla*, when he would have done better to use *sthenodactyla*, but I do not see that anything is gained by making such a "conjectural emendation."

INCERTAE SEDIS.

CIRROBRACHIUM, gen. n.

In the absence of a complete specimen, the only diagnostic character which can be assigned to this new genus is the presence of a row of filaments along the outer or ventral side of each arm, except those of the fourth pair.

26. Cirrobrachium filiferum, sp. n.

Habitat. — Station 17; equatorial Pacific Ocean, north of the Marquesas Islands; September 10, 1899; lat. 0° 50′ N., long. 137° 54′ W.; trawl, 2463 fathoms; temperature, surface, 79°; one fragmentary specimen. [H. 130.]

The specimen upon which this new species, the type of a new genus, is based consists unfortunately only of the head and arms, which have suffered denudation of the integument here and there. The suckers are, however, almost all intact, as also the characteristic filaments which spring from beside them. A description as complete as I have been able to prepare of the specimen is given below.

The Head, so far as can be seen, was flattened on the dorsal side, and slightly excavated for the funnel below. The *eyes* are large and prominent, and occupy the whole of the lateral surface of the head. The *eyelids* have disappeared, but there can be little doubt that they were of the type common to the Oegopsida. A few patches of the integument remain, which are thickly covered with bright pink chromatophores.

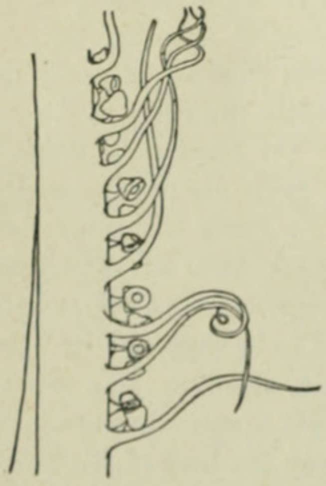

FIG. E. *Cirrobranchium filiferum.* Portion of third right arm. × 5.

The Arms are slender, rounded, and tapering, and bear, besides the suckers, a series of long slender filaments which form the characteristic peculiarity of the genus. The first pair are about 15 mm. in length, measuring from the front edge of the eye. The suckers are in two rows, small and stalked, and do not show any trace of a modification into hooks. Immediately to the proximal side of each sucker is a dull pink chromatophore. Close to the base of each sucker of the ventral row arises one of the filaments above mentioned. Those springing from the proximal suckers are about twice the diameter of the arm in length; they gradually increase to the middle of the arm, where their length is three or four times the thickness of the arm; they then diminish towards the tip, where they finally disappear. The arms of the second pair are about one-fourth longer than the first. The arrangement of the suckers and filaments is the same, but the filaments are considerably longer. The arms of the third pair are the largest of all, and were probably twice as long as the first pair; but as they have both been broken off it is impossible to say exactly what was their original length. The filaments in this case are much longer, and in the centre their length is fully four times the diameter of the arm. On the outer aspect of the proximal half of these arms is a distinct keel. The arms of the fourth pair are about as long as the first. They have two rows of suckers, but none of the filaments just described; only a small lappet arising opposite each sucker of the inner series. On the outer aspect of each of these arms is a broad membrane, which stretches outside the root of the tentacle across to the root of the third arm and passes nearly to its tip, becoming gradually narrower as it proceeds. Here and there between the filaments may be seen the remains of a very delicate membrane which seems to have united them, but it is impossible to say how far along the arm this membrane may have extended, or how far it may have reached up the filaments. The only structure with which I am acquainted comparable to this is the series of lappets connected by a membrane, which has been above described in the case of *Abraliopsis* (see pp. 37, 38, *postea*), or the membrane supported by ribs seen in some forms of *Ommastrephes*.

The *suckers* are helmet-shaped, mounted on short tapering peduncles, and with smooth, horny rings.

It is impossible to form any correct idea of the family to which this interesting form should be referred.

Family LOLIGINIDAE.

Loligidae d'Orb., *in*: Férussac and d'Orbigny, '**35**, p. 297.
Loliginei Steenstrup, '**61**, p. 69 (1).
Loliginei Steenstrup, '**81**, p. 28.

LOLIGO.

Loligo Schneider, '**84**, p. 110.
Loligo Lamarck, '**99**, p. 10 (*pars*).

27. Loligo diomedeae, sp. n.

(Plate 5, Fig. 13; Plate 6, Figs. 1-7.)

Habitat. — Station 3422, off Acapulco; April 12, 1891; lat. 16° 47′ 30″ N., long. 99° 59′ 30″ W., 141 fathoms; green mud; temperature, surface, 83°, bottom 53.°5; one specimen ♀, No. 7958. [H. 46.]

The Body is comparatively long, and cylindrical for more than half its length, tapering rather rapidly to the posterior extremity. The *fin* is decidedly short for a *Loligo*, broader than long, slightly notched at its anterior points of attachment to the body and with rounded lateral boundaries. The *mantle-margin* has a blunt nuchal prominence and is slightly excavated ventrally.

The Head presents no character calling for a special remark.

The Arms are unequal, the order of length being 4, 3, 2, 1; the first are slender and have a very distinct dorsal keel; the second have a well-marked ventro-lateral angle; the third are broad and flattened and with a distinct web externally; the fourth are nearly as stout as the second, and have the sides, especially that turned towards the tentacle, excavated into a groove. The *suckers* (Plate 6, Figs. 1, 2) are of the usual form and arrangement; the *horny ring* has about 20 blunt teeth, of which about 12 are in the proximal and 8 in the distal moiety. The *buccal membrane* has seven points, which bear one or two very minute suckers (Plate 6, Fig. 7); between the ventral points is a papilla for the reception of spermatophores.

The Tentacle is small and slender; the club is of the usual type and about one-third the length of the tentacle; in the centre are eight or ten large suckers (Plate 6, Fig. 3), about double the lateral ones in diameter; there are about half-a-dozen proximal suckers and a larger number in four rows distally gradually diminishing in size towards the tip. The *horny ring* in the six or eight largest suckers has five blunt square-cut teeth on its distal margin, and in the lateral and terminal suckers about eight acute teeth separated by intervals broader than themselves on the distal semi-circumference (Plate 6, Fig. 5). The *Gladius* has not been extracted.

Dimensions.

	mm.
Length, total	135
End of body to mantle-margin	85
Breadth of body	18
Breadth of head	15
Eye to edge of umbrella	7
Length of fin	27
Breadth of fin	35
Diameter of largest sucker on sessile arm	1
Diameter of largest sucker on tentacle	1.7

	Right.	Left.
Length of first arm	15	14
Length of second arm	18	19
Length of third arm	25	22
Length of fourth arm	25	24
Length of tentacle	47	47

This species differs from *L. japonica* (Hoyle, '86, p. 157) in the comparatively small length of the fin and in the fact that the teeth in the large tentacular suckers have rather more space between them. It also resembles *L. gahi* in many particulars, but the teeth of the large tentacular suckers are blunt and square instead of with sharp angles of about 60°.

SEPIOTEUTHIS.

Sepioteuthis Blainville, **'24**.

28. Sepioteuthis lunulata.

Sepioteuthis lunulata Quoy & Gaimard, **'32**, p. 74, Plate 3, Figs. 8–13.
Sepioteuthis lunulata Férussac & d'Orbigny, **'35**, p. 300, Sepioteuthes, Plate 3, Fig. 1, Plate 6, Figs. 1–8 [1839].

Habitat. — Jaluit, Marshall Islands; January 13, 1900; shore; six specimens, 3 ♂, 3 ♀. [H. 104–109.]

These specimens present resemblances both to *S. lunulata* and *S. mauritiana*. The former of these presents in the figures given by Quoy & Gaimard a series of dark circular spots on each fin, and in three of the specimens taken by the "Albatross" similar spots, though not so regular either in form or distribution, are found. On the other three they cannot be made out. The six specimens, nevertheless, seem to me all referable to one species, and I can only conclude that this must vary a good deal in the matter of coloration, as indeed is expressly stated by Quoy & Gaimard; for in the case of *S. guineensis*, which is regarded, and no doubt rightly, by d'Orbigny, as being the same species, the spots were not noticed until after it had been preserved.

Turning to other characters, the horny rings of the suckers in the arms and tentacles resemble very clearly the figures given by d'Orbigny of *S. lunulata*, though the teeth are rather fewer than in that species and much less numerous than in *S. mauritiana*. On the other hand as regards the fin, the breadth is 17 per cent of the length in *S. lunulata*, 15 per cent in *S. mauritiana*, and 12.5 per cent in the "Albatross" examples.

To sum up, then, in the suckers the present form resembles *S. lunulata*, in the fin it is more like *S. mauritiana*, whilst in the coloration half the specimens show a very distinct likeness to *S. lunulata*, whilst the others might be *S. mauritiana*. On the whole I have thought it best to refer these examples with some doubt to *S. lunulata*. It is, however, possible that *S. lunulata* and *S. mauritiana* may be only varieties of one widely distributed species.

The tip of the tentacle shows the little spoon-shaped group of suckers to which attention was first called by Goodrich (**'96**, p. 6).

FAMILY OMMASTREPHIDAE.

Ommastrephini Steenstrup, **'61**, p. 1.
Ommastrephidae Gill, **'71**, p. 1.

OMMASTREPHES.

29. Ommastrephes sp.?

Habitat. — Station 14, north of the Marquesas Islands; September 7, 1899; lat. 6° 41′ N., long. 137° W., 150 fathoms to surface; temperature, surface, 82°; three specimens. [H. 133, 141, 142.]

These specimens, though the mantle-length is only some 5 mm., show distinctly the characteristic form of the articulation with the base of the siphon.

SYMPLECTOTEUTHIS.

Symplectoteuthis Pfeffer, **:00**, pp. 178, 180.

This genus has recently been created by Dr. Pfeffer for the reception of the species named below, on account of the fusion of the mantle with the base of the funnel on either side.

30. Symplectoteuthis oualaniensis.

Loligo oualaniensis Lesson, **'29**, p. 240, Plate 1, Fig. 1.
Ommastrephes oualaniensis d'Orb., *in:* Férussac and d'Orbigny, **'35**, p. 351, Calmars, Plates 3, 21; Ommastrephes, Plate 1, Figs. 14, 15.
Ommatostrephes oualaniensis Steenstrup, **'80**, pp. 76, 84.
Ommastrephes oualaniensis Hoyle, **'86**, p. 162.
Symplectoteuthis oualaniensis Pfeffer, **:00**, p. 180.

Habitat. — Station 3363, east of Cocos Island (surface tow-net); February 26, 1891; lat. 5° 43′ N., long. 85° 50′ W., 978 fathoms; white globigerina ooze; temperature, surface 83°, bottom 37.°5; one specimen. [H. 53.]

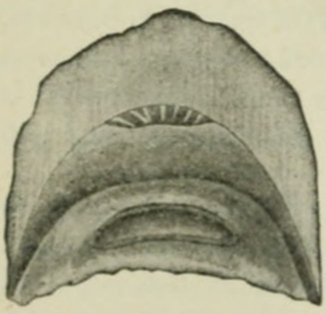

FIG. *F*. Funnel groove of *Symplectoteuthis oualaniensis.*

The funnel groove (see Figure *F*) somewhat resembles that figured by Steenstrup (**'80**, p. 81) for *Todarodes sagittatus* and *Ommastrephes pacificus* (**'80**, p. 79, Figs. 4, 5) except that the area occupied by the cutaneous folds is very much narrower. In this respect it differs from the original drawing by Lesson (**'29**, Plate **1**, Fig. 2) of his *L. oualaniensis*, where the funnel groove is shown as though it were striated all over.

RHYNCHOTEUTHIS.

31. Rhynchoteuthis chuni, sp. n.

Rhynchoteuthis Chun (**:03**).

Habitat. — Station 14; Pacific Ocean, north of the Marquesas Islands; September 7, 1899; lat. 6° 41′ N., long. 137° W.; temperature, surface, 82°; taken at the surface; one young specimen. [H. 134.]

Professor Chun's re-discovery of the curious immature form described by Souleyet (**'52**, p. 17, Plate 1, Figs. 15–21) is of extreme interest, and although the specimen which has come into my hands differs somewhat from those previously figured, it agrees in the *Ommastrephes*-like form of the connection between the mantle and siphon and the fusion of the tentacles. The main difference is that the tentacles are small and short and are united only for a short distance just above the mouth (see Figure *G*), whilst in the others these organs are much elongated, are thicker than the arms, and constitute a stout, flexible proboscis, which has suggested the generic name.

As this form is clearly specifically different from those figured by Professor Chun, I have ventured to name it in his honor.

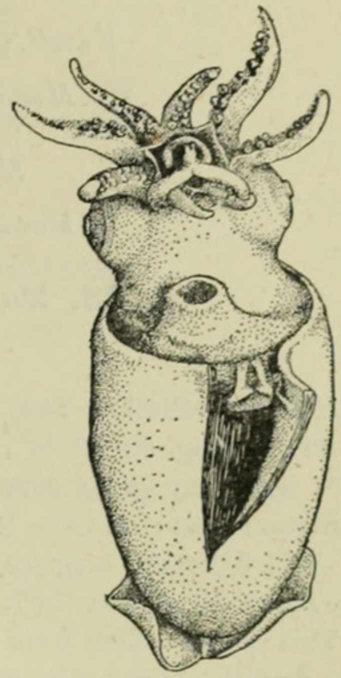

FIG. *G*. *Rhynchoteuthis*, sp. Showing the fused tentacles and the siphonal cartilage; drawn by A. D. Darbishire.

FAMILY BATHYTEUTHIDAE.

Bathyteuthidae Pfeffer, :00, pp. 152, 171.

BATHYTEUTHIS.

Bathyteuthis Hoyle, '85, p. 272.
Benthoteuthis Verrill, '85, p. 401.

32. Bathyteuthis abyssicola.

(Plate 1, Fig. 2.)

Bathyteuthis abyssicola Hoyle, '85, p. 272, Fig. 108; '86, p. 168.

Habitat. — Station 3358; off Cape Mala; February 24, 1891; lat. 6° 30′ N., long. 81° 44′ W., 555 fathoms; temperature, surface, 83°, bottom 40.°2; green sand; one specimen, No. 7967. [H. 52.]

Station 3388: off Cape Mala; March 9, 1891; lat. 7° 6′ N., long. 79° 48′ W.; 1168 fathoms; temperature, surface, 73°, bottom 36° 2′; green globigerina ooze; one young specimen. [H. 533.]

A colored drawing (Plate 1, Fig. 2) was made when the animal was fresh, and is interesting as showing that the deep red color common to many deep-sea Cephalopods fades only very slightly under the influence of alcohol, the specimen being now almost as dark in hue as the drawing. The mantle in this specimen was 23 mm. long, but it is not so prominent in the nuchal region as shown in the drawing. The head and arms also are figured a little too large.

Family MASTIGOTEUTHIDAE.

Mastigoteuthidae Verrill, '81 A, p. 100.

MASTIGOTEUTHIS.

Mastigoteuthis Verrill, '81 A, p. 100.

33. Mastigoteuthis dentata, sp. n.

(Plate 6, Figs. 8-11.)

Habitat. — Station 3400; E. of Galapagos Islands; March 27, 1891; lat. 0° 36′ S., long. 86° 46′ W., 1322 fathoms; temperature, surface 81°, bottom 36°; light gray globigerina ooze; one specimen ♀, No. 7956. [H. 102.]

Station 3394; off Cape Mala; March 10, 1891; lat. 7° 21′ N., long. 79° 35′ W., 511 fathoms; temperature, surface 73°, bottom 41.°8; dark green mud; one specimen ♂, No. 7957. [H. 45.]

This species differs from *Mastigoteuthis agassizi* (Verrill, '81 A, p. 100) in the fact that the horny rings in the suckers of the arms are furnished with teeth (Plate 6, Fig. 8), whereas in that species they are smooth.

It differs from *M. levimana* Lönnberg ('97, p. 605) in the fact that the ventral arms are thicker and not thinner than the others and have the suckers normally disposed. It agrees with this, however, in the denticulation of the horny ring of the suckers. Lönnberg is mistaken when he says that the horny rings on the arms of the "Challenger" specimen had pointed teeth. The "Challenger" specimen was only a fragment of a tentacle and therefore gave no information regarding the suckers of the arms.

The two sexes show an interesting difference in the form and proportions of the body and fin, the latter being two-thirds the length of the mantle in the male and only about two-fifths in the female; the body too is more conical in the former, more cylindrical in the latter. The absolute dimensions of the male are much smaller, but there is no evidence to show whether the specimens are full grown. One of Verrill's male specimens attained a length of 232 mm., which is intermediate in size between the two examples here described.

The general arrangement of the organs seen on opening the mantle-cavity is shown in Plate 6, Figs. 10, 11.

Dimensions.

	7957♂	7956♀
	mm.	mm.
Length, total (without tentacles)	180	290
End of body to mantle-margin	72	140
End of body to eye	81	155
Breadth of body	17	30
Breadth of head	17 ?	25 ?
Length of fin	48	60
Breadth of fin	52	75

	♂ Right.	♂ Left.	♀ Right.	♀ Left.
Length of first arm	37	38	53	53
Length of second arm . . .	44	47	57	70
Length of third arm	45	42	70	67
Length of fourth arm . . .	87	78	130	125

Family ONYCHOTEUTHIDAE.

Onychoteuthidae Gray, **'47**, p. 206.

ONYCHOTEUTHIS.

Onychoteuthis Lichtenstein, **'18**, p. 1591.

34. Onychoteuthis banksi.

Loligo banksii Leach, **'17**, p. 141.
Onychoteuthis banksii d'Orb. and Fér., **'35**, p. 332, Onychot., Plates **1–5**, **9**, and **12** [1839].
Onychoteuthis banksi Pfeffer, **:00**, p. 159.

Habitat. — Tropical Pacific Ocean; September 6, 1899; lat. about 8° N., long. about 137° W.; surface at night; one specimen. [H. 110.]

TELEOTEUTHIS.

Onykia Lesueur, **'21**, p. 98.
Teleoteuthis Verrill, **'82**, p. 70.

35. Teleoteuthis caribaea.

Onykia caribaea Lesueur, **'21**, p. 98, Plate **9**, Figs. 1, 2 *a–e*.
Teleoteuthis caribaea Verrill, **'82**, p. 70.
Teleoteuthis caribaea Pfeffer, **:00**, p. 157.

Habitat. — Station 1, 320 miles from Point Conception; August 26, 1899; lat. 31° 10′ N., long. 125° W.; surface; temperature, surface, 63°; three specimens. [H. 148, 149, 150.]

Station 14, north of the Marquesas Islands; September 7, 1899; lat. 6° 41′ N., long. 137° W.; surface; temperature, surface 82°; two specimens. [H. 131, 132.]

Dr. Pfeffer has confirmed the identification of these specimens, which are all very young, the largest measuring only 10 mm. in length of mantle.

36. Onychoteuthid, gen. et sp.?

Habitat. — Station 18, about 75 miles north of the Marquesas Islands; September 13, 1899; lat. 6° 25′ S., long. 138° 59′ W.; 400 fathoms to surface; temperature, surface, 80°; one specimen. [H. 136.]

Station 27, off Anna Maria Bay, Marquesas Islands; September 15, 1899; lat. 9° 01′ S., 140° 04′ W.; 320 fathoms to surface; temperature, surface, 79°; one specimen. [H. 138.]

These two small specimens are probably both to be referred to the same species, though the one first mentioned is much shrivelled. They are almost certainly the young of one or other of the numerous hook-squids.

Family ENOPLOTEUTHIDAE.

Enoploteuthidae Pfeffer, :00, pp. 153, 163.

ABRALIOPSIS.

Abraliopsis Joubin, '96, pp. 32.

37. Abraliopsis hoylei.

(Plate 1, Fig. 3; Plate 8.)

Enoploteuthis hoylei Pfeffer, '84, p. 17.
Abraliopsis hoylei Joubin, '96, p. 33.

Habitat. — Station 3375, off Cape San Francisco, March 4, 1891; lat. 2° 34′ N., long. 82° 29′ W., 1201 fathoms; gray globigerina ooze; temperature, surface 77°, bottom 36.°6, one specimen ♂, No. 7959 A. [H. 65.]

Station 3382, off Mariato Point, March 7, 1891; lat. 6° 21′ N., long. 80° 41′ W., 1793 fathoms; green mud; temperature, surface 75°, bottom 35.°8; one specimen ♀, No. 7964. [H. 66.]

Station 3414, off Tehuantepec ("surface to 300 fathoms"), April 8, 1891; lat. 10° 14′ N., long. 96° 28′ W., 2232 fathoms; green mud; temperature, surface 82°, bottom 35.°8, one specimen ♀. [H. 67.]

Station 3415, S. E. of Acapulco, April 10, 1891; lat. 14° 46′ N., long. 98° 40′ W., 1879 fathoms; brown mud, globigerina ooze; temperature, surface 83°, bottom 36°; one specimen ♂, No. 7960 B. [H. 68.]

The female specimen from Station 3414 is very well preserved, and I have no doubt about its being correctly referred to this species, for my friend Dr. Pfeffer and I compared it together with the type specimen in the Hamburg Museum. The only difference of any moment is that the tentacular club is provided with three instead of four large hooks. The dark spots on either side of the cartilage in the nuchal region are perceptible, though faint, a character which in this species differs from *A. pfefferi* Joubin.

A colored figure of this individual from a sketch made on board whilst the animal was alive will be found on Plate **1**, Fig. 3.

The characters of the arms have not been very minutely described either by Joubin or Pfeffer. The order of the arms in the present specimen is 4, 2, 3, 1, on the left side, whereas on the right side 4 is much shorter, and the order is 2, 3, 1, 4. The first (Plate **8**, Fig. 3) arm has a keel for about the distal two-thirds of its length, which attains its greatest breadth just beyond the middle of the arm, being there rather broader than the thickness of the arm. Along the ventral margin of the sucker-bearing face is a series of lappets, one opposite to each hook, whose maximum length is about equal to the diameter of the arm in its middle: these become gradually shorter toward both the distal and proximal ends of the arm. They are united by a delicate web, which extends almost to their extremities. Along the edge of the proximal moiety of each lappet, just where the web joins it, is a row of minute conical papillae (Fig. 7). The hooks are about fifteen in number, and at the end of the arm is a patch of minute suckers arranged in two rows (Fig. 8). The second arm is in all essential respects similar to the first.

The third arm (Plate **8**, Fig. 2) is much stouter than any of the others, and has a very broad keel, expanding into a swimming membrane throughout the whole of its length. The lappets on the ventral margin of the sucker-bearing face are longer, stouter, and blunter than in the first arm and are united by a web in the same way. On the ventral surface of the arm close to the attachment of the keel are several patches of two to five luminous organs, a group of three being found quite close to the tip.

The fourth arm (Plate **8**, Figs. 4, 5) presents considerable differences from the others. It is distinctly longer and the hooks are smaller, and there are no suckers at the extremity. On the dorsal margin of the hook-bearing face is a low irregular elevation, which looks like a vestigial protective membrane: it extends from a point opposite the proximal hook to about two-thirds up the arm. On the ventral margin a narrow membrane extends along the middle third. On the dorso-external aspect of the arm is a membrane which springs from the root of the third arm, passes outside the tentacle, and is attached along the fourth arm almost to its extremity, becoming gradually narrower as it proceeds. The breadth at the base is about equal to the diameter of the arm. At the extremity are the three black, bead-like knobs, characteristic of the genus, the structure of which has been described by Joubin ('**96**).

Two other specimens I take to be males of the same species. The general arrangement of the arms is the same. The specimens are not so well preserved, and the delicate web between the lappets along the margins of the arms has been in a great part destroyed. At the base of each arm just proximally to the suckers is a larger or smaller number of small papillae, which look at first sight almost like the stalks from which suckers have fallen. There is, however, no indication of any solution of continuity in the surface, and in no single instance did I find any of them bearing a sucker. On the first arm there are only three or four of these, very low down close to the buccal membrane; on the second they are slightly more numerous, on the third there are seven or eight, which form a triangular patch with the apex directed towards the root of the arm; on the fourth right arm there are about a dozen similarly disposed.

The fourth left arm (Plate 8, Fig. 5) further shows a remarkable form of hectocotylization. This is produced chiefly by a development of the lappets and web along the ventral margin of the sucker-bearing surface. The web becomes rapidly broader from the proximal end, until at a point about one-third along the arm its breadth is three times the diameter of the arm: hence it becomes gradually narrower, running off into the arm just before the tip. The lappets are correspondingly lengthened and form a series of parallel ribs strengthening the membrane. Along their margins (Plate 8, Fig. 6) may be seen a series of minute papillae like those described on the other arms. On the dorsal margin of the sucker-bearing face is a row of lappets, also provided with rows of papillae, but I was not able to find any trace of a web uniting them. However, as the web is in all cases very delicate, it is quite possible that it may exist. At the root of the arm is the triangular group of papillae alluded to above.

The Radula, which has not been hitherto described, is figured on Plate 8, Fig. 9. It consists of the usual seven longitudinal series: the *centrals* are extremely simple, an acute point arising from a plain rounded base; the points diverge from the middle line, sometimes to the right, sometimes to the left, only about one in six being quite symmetrical. The *first laterals* have a strong pointed tip mounted towards the median aspect of a simple base, the points being directed somewhat inwards; the *second laterals* are stout, curved, and pointed; the *third laterals* are much larger, comparatively more slender and blunter than the second, and are bent to about the quadrant of a circle.

38. Abraliopsis, sp.?

(Plate 2, Fig. 3.)

Habitat. — Station 2619 Hyd., Gulf of Panama; March 11, 1891; lat. 7° 31′ N., long. 78° 42′ 30″ W., surface to 300 fathoms; temperature, surface 68°; one specimen; immature. [H. 64.]

Station, 14, north of the Marquesas Islands; September 7, 1899; lat. 6° 41′ N., long. 137° W.; 150 fathoms to surface; temperature, surface, 82°; one specimen. [H. 143.]

My friend Dr. Pfeffer, who examined the former of the above-mentioned young specimens, considers it to belong to the *Abraliopsis* group, partly because of the length of the tentacles, and partly because at the extremity of the left ventral arm (the right being imperfect) is to be seen a slight knob-like swelling, which might be a stage in the development of the curious pigmented organ, found in this position in the genus *Abraliopsis*. At this stage of growth there is no trace of hooks : they are represented only by suckers. The colored drawing here reproduced was made on the voyage immediately after the capture of the specimen.

The specimen [H. 143] captured on the later cruise shows rudimentary phosphorescent organs, when examined under a lens just as the alcohol has evaporated from the surface. One ventral arm has a little brown patch near the tip.

PTERYGIOTEUTHIS.

Pterygioteuthis H. Fischer, '96, p. 205.
Pterygioteuthis Pfeffer, : 00, pp. 165, 166.

39. Pterygioteuthis giardi.

(Plates 7 and 9.)

Pterygioteuthis giardi H. Fischer, '96, p. 205, Plate 9.

Habitat. — Station 3375, off Cape San Francisco, March 4, 1891 ; lat. 2° 34′ N., long. 82° 29′ W., 1201 fathoms ; gray globigerina ooze ; temperature, surface 77°, bottom 36.°6, one specimen, No. 7959 B. [H. 69.]

Station 3406, Galapagos Is., between James and Indefatigable Is., April 3, 1891 ; lat. 0° 16′ S., long. 90° 21′ 30″ W., 551 fathoms ; rock ; temperature, surface 81°, bottom 41.°3, one specimen, No. 7965. [H. 70.]

Station 3436, south of Guaymas, April 22, 1891 ; lat. 27° 34′ N., long. 110° 53′ 40″ W., 905 fathoms; br. m. bk. sp.; temperature, surface 72°, bottom 37.°2, one specimen, No. 7968. [H. 71.]

Station 3437, about 50 miles south of Guaymas, April 23, 1891 ; lat. — N., long. — W., 628 fathoms ; br. m. bk. sp. ; temperature, surface 70°, bottom 40°, one specimen, No. 7966. [H. 72.]

As the type specimen figured by Fischer was a very young one, it seems worth while to give a full description of a more mature form.

The Body (Plate 7, Fig. 6) is conical ; about three times as long as broad. The *fins* are each broadly elliptical, attached to the body for only about one-half their length : the breadth across the two expanded fins is about two-thirds the length of the body. The *siphon* is short and bluntly conical with double supporting bands ; the *valve* is small, but distinct ; the *funnel-organ* consists of a roughly triangular pad, with the sides somewhat excavated ; lying on the dorsal wall of the funnel on either side of it are two oval pads, with the anterior extremities directed obliquely inwards.

The Head is large and rounded, distinctly wider than the body : the *eyes* are globular, occupying the whole of each side of the head : the *ocular aperture* is contracted and shows no sign of an emargination. There is only a shallow *depression* for the siphon. Below and behind each eye is the *olfactory organ* in the shape of a minute papilla. Around the inferior circumference of the eye, beneath the integument, are four or five eye-like bodies, which are presumably *phosphorescent organs:* the largest of these is situated just in front of and below the ocular opening; it forms the antero-lateral prominence in the outline of the head and is readily seen through the semi-transparent skin: it is oval in form, the length being nearly equal to the diameter of the lens; the others are difficult to see until the skin has been removed. Surrounding the mouth is an extensive *buccal membrane*, of a purplish color, which is attached to the inner surface of all the arms, except the ventral pair, to a height of about 3 mm. from their bases.

The Arms are sub-equal and about two-fifths the length of the body. The *first* arm (Plate 7, Fig. 1) is provided on the inner aspect proximally with about eight pairs of moderately large suckers, then four pairs of gradually diminishing hooks, and beyond these a double series of small suckers, gradually diminishing and reaching to the tip of the arm. The form of the hooks is shown in Figs. 8 and 9. On the dorsal margin the middle third of the arm is occupied by a narrow membrane: on the ventral margin is a web nearly half the breadth of the arm, which is cut by a series of notches into lappets large in the middle third of the arm and gradually diminishing towards the apex. On the external aspect of the arm is a narrow web for about its third quarter.

The *second* arm (Fig. 2) is of almost the same length as the first: it is armed with about five pairs of suckers and then three pairs of hooks, beyond which is a single small sucker; there is no web on the dorsal margin, but on the ventral is a broad web which has a wavy margin in the proximal half, becoming somewhat more deeply notched towards the apex: on the external aspect is a narrow web for about the distal third.

The *third* arm (Fig. 3) is of the same length as the second: it is provided with three pairs of suckers and then six or seven hooks about the middle of its length, the distal portion being unarmed: on the dorsal margin is a very narrow web for the proximal two-thirds and on the ventral a broad web, wavy at first and then scalloped: there is a broad web for more than the distal half on the outer aspect.

The *fourth* arm (Fig. 4) tapers more abruptly, especially in the proximal portion, than the others; the dorsal aspect is hollowed, where it lies against the tentacle, and the dorso-external angle is produced into a thin web which joins the root of the third arm: it passes outside the tentacle and expands distally into a web, comparatively broad in the middle third of the arm and becoming evanescent towards the tip. It possesses neither hooks nor suckers.

The *tentacle* is about as long as the body. It is at first slender; then follows a swollen portion, after which it is slender again, and afterwards becomes rhomboidal in section, that angle of the rhomb which is directed outwards being rounded off, whilst the other three are pronounced. From this point it tapers gradually to the tip, there being no expanded club. The sucker-bearing face occupies only a few millimetres of the extreme tip of the infero-internal face. There are two moderate-sized suckers proximally with smooth rings succeeded by two pairs of smaller suckers, and then by a large number of gradually diminishing suckers in four series. Besides the two large proximal suckers are two rounded pads, situated in hollows, so placed that they occupy two angles of a rhombus, the suckers occupying the other two. With the suckers they undoubtedly constitute a fixing apparatus, as suggested by Fischer.

The *Surface* is smooth throughout.

The *Color*, in the spirit specimen, is a pinkish yellow, rather darker above; the buccal membrane a dull yellowish purple, paler within than without.

The *Radula* (Plate 7, Fig. 7) is remarkable for the complexity of the *central* tooth, which consists of a triangular cusp, springing from a rather irregular base; on either side of the base, near its posterior end, there is a prominence, which sometimes forms a separate denticle, united by a distinct articulation with the body of the tooth; this is seen on the left-hand side of the portion drawn. The *first laterals* are stout and simple, an acute point springing gradually from a somewhat rectangular base. The *second* and *third laterals* are very much alike, sickle-shaped, bent almost to a quadrant, and rather blunter than the others: the outer series are comparatively more slender than the inner.

Dimensions.

	mm.
Length, total (excluding tentacle)	33
End of body to mantle-margin	19
Breadth of body	6
Length of fin	9
Breadth of fin	13
Length of first arm	8
Length of second arm	7
Length of third arm	7
Length of fourth arm	9
Length of tentacle	18

On opening the mantle-cavity there are seen just behind the base of the funnel two acorn-shaped bodies, one on either side of the middle line, the rectum passing forwards between them. Farther back in the middle line is a spheroidal body, very much like an eye in general appearance; still farther back in the middle line is a fourth, and at the root of each gill is another larger one; these are phosphorescent organs, and an account of their structure will be found in the Appendix (p. 51).

Professor Pfeffer has included in the genus *Pterygioteuthis* Rüppell's species hitherto known as *Enoploteuthis margaritifera*. This view I adopted in a communication (:02) dealing with the luminous organs of the latter species, but further consideration has led me to the conclusion that the differences between them are too great to allow of such a course. They agree in form and general appearance, in the size and deep color of the buccal membrane, in the tips of the arms being devoid of either hooks or suckers, and very strikingly in the position and structure of the luminous organs. On the other hand *Pterygoteuthis giardi* differs from *Pt. margaritifera* in the following characters:

1. The ventral arm has neither hooks nor suckers.
2. The tentacular club has two fixing cushions and corresponding suckers and no hooks whatever.
3. The subocular luminous organs are not so numerous, and the anterior abdominal organ is single and not a group of three.

These differences, especially those relating to the armature of the tentacular club, seem to me of generic value, and I see no alternative but the creation of a new genus with *Enoploteuthis margaritifera* as its type. For it I propose the name *Pyroteuthis* in allusion to its luminous organs. It is sufficiently diagnosed by the presence of intra-pallial luminous organs combined with a tentacular club armed with both hooks and suckers.

Family HISTIOTEUTHIDAE.

Histioteuthidae Verrill, '81, p. 431.
Histioteuthidae Pfeffer, :00, p. 168.

CALLITEUTHIS.

Calliteuthis Verrill, '80, p. 393.

40. Calliteuthis reversa.

Calliteuthis reversa Verrill, '80, p. 393.

Habitat. — Station 3385; off Cape Mala; March 8, 1891; lat. 7° 32′ 36″ N., long. 79° 16′ W., 286 fathoms; temperature, surface 72°, bottom 45.°9, green mud; one specimen, No. 7962. [H. 48.]

This specimen about 35 mm. long appears to be the young of the above species. It is not in very good condition, and the surface has suffered abrasion here and there. This makes it impossible to give the exact distribution of the luminous organs. There appear to be, however, on the first arm a single row on the outer margin, on the third arm a single row along the ventral margin, and on the fourth arm three rows proximally and two rows distally. Pfeffer (:00, pp. 169, 170) makes use of the distribution of these organs as a generic character, and it therefore becomes of importance to ascertain whether it varies with age, and if so to what extent.

The division into two parts of the cartilaginous ridge fitting into the base of the siphon, which was mentioned in the "Challenger" specimen, does not appear in this young example.

Family CRANCHIIDAE.

Cranchiadae Gray, **'49**, pp. 36, 37.
Cranchiaeformes Steenstrup, **'61**, p. 69 (1).

CRANCHIA.

Cranchia Leach, **'17**, p. 137.

41. Cranchia scabra.

(Plate 10, Fig. 11.)

Cranchia scabra Leach, **'17**, p. 140.
Octopus (*Philonexis*) *eylais* d'Orbigny, **'35**, p. 20, Plate 1, Figs. 8–14.
Cranchia scabra Owen, **'38**, p. 105, Plate 21, Figs. 1–5.
Philonexis eylais d'Orb., *in:* Férussac & d'Orbigny, **'35**, p. 102, Poulpes, Plate 17, Figs. 4, 5.
Cranchia scabra Steenstrup, **'61**, p. 72 (4).

Habitat. — "Station 74. Surface." [H. 103.]

Station 6; North Pacific Ocean, 960 miles from Guadalupe Island; August 31, 1899; lat. 20° 26′ N., long. 133° 28′ W.; 150 fathoms to surface; temperature, surface 75°; one specimen. [H. 144.]

The specimens here recorded cannot, I think, be referred to any other species than *C. scabra;* the correspondence in the form of the body and fins and the tubercles on the mantle is so close. At the same time there are certain differences in the form of the arms and arrangement of the suckers, which I think it desirable to place on record, and I have therefore given a figure of the oral aspect of the head with the arms of the example from Station 74 (Plate **10**, Fig. 11).

It will be seen that the "Albatross" specimen differs from Owen's description and figures in the following points: —

1. There is no connecting membrane ("intervening web" of Owen) between the arms.
2. There are no processes connecting the oral lip with the arms.
3. The suckers are in a double series with an intervening space between them.
4. There is a double row of suckers on the stem of the tentacle not mentioned by Owen.

It must, however, be observed that the "Albatross" specimen measures only 11 mm. (just over 5 lines) from the posterior end of the body to the root of the tentacle, whilst in Owen's the corresponding dimension was fully twice as much (11 lines). Most of the characters above mentioned are such as may be fairly ascribed to incomplete development. Certainly this is the case with the first three, and with regard to the fourth there is nothing impossible (or even improbable) in suckers being developed which subsequently disappear. This appears to be the case even with the arms in *Verania*. For these reasons I do not think it needful to create a new species for the reception of the present example.

TAONIUS.

Taonius Steenstrup, '61, p. 83 (15).

42. Taonius, sp.

(Plate 1, Figs. 4, 5; Plate 6, Figs. 12, 13.)

Habitat. — Station 3414; off Tehuantepec; "surface to 100 fathoms." April 8, 1891; lat. 10° 14′ N., long. 96° 28′ W., 2232 fathoms; temperature, surface 82°, bottom 35°.8; green mud; one specimen; immature. [H. 49.]

This young specimen probably measured about 25 mm. in length (excluding the tentacle) in its uncontracted condition. It is somewhat difficult to form an opinion as to the species to which it should be referred. The shape of the fin and of the terminal portion of the pen is shown in Plate 6, Fig. 13, but it is too immature to give any definite indications.

The stalk of the tentacle (Plate 6, Fig. 12) has a flattened surface extending halfway from the club towards the oral extremity, with four rows of very minute long-stalked suckers. In the adult *T. hyperboreus* (Hoyle, '86, Plate 33, Figs. 6, 7) there are suckers and fixing pads somewhat similarly disposed. A comparison suggests the query — Are the fixing pads the stumps of suckers which have fallen off? In *T. suhmi* there are two rows of small papillae reaching down the stem of the tentacle for a distance about equal to the length of the club, but there does not seem to be any definite arrangement of suckers and fixing pads. The whole question of the development of these organs would repay investigation if adequate material were forthcoming.

A drawing showing the appearance of the animal when alive is reproduced on Plate 1, Figs. 4, 5.

43. Decapod, fam., gen., et sp.?

Habitat. — Station 14; north of the Marquesas Islands; September 7, 1899; lat. 6° 41′ N., long. 137° W.; 150 fathoms to surface; temperature, surface 82°; one young specimen. [H. 140.]

A curious little creature with very short mantle, the dorsal margin forming a prominent point in the middle line; the tentacles comparatively very thick. I do not know to what group it is to be referred.

LIST OF STATIONS, WITH THE SPECIES OBTAINED AT EACH.

Cruise of 1891.

Station 3353, off Cape Mala; February 23, 1891; lat. 7° 6′ 15″ N., long. 80° 34′ W., 695 fathoms; temperature, surface 73°, bottom 39°; green mud.

Polypus, sp., No. 7941.

Station 3356, off Mariato Point; February 23, 1891; lat. 7° 9′ 30″ N., long. 81° 8′ 30″ W., 546 fathoms; temperature, surface 83°, bottom 40.°1; soft blue mud.

Polypus pusillus, No. 7952.

Station 3358, off Cape Mala; February 24, 1891; lat. 6° 30′ N., long. 81° 44′ W., 555 fathoms; temperature, surface 83°, bottom 40.°2; green sand.

Cirroteuthis, sp.
Froekenia clara, No. 7961.
Polypus pusillus, No. 7954.
Bathyteuthis abyssicola, No. 7967.

Station 3363, E. of Cocos Island; February 26, 1891; lat. 5° 43′ N., long. 85° 50′ W., 978 fathoms; temperature, surface 83°, bottom 37.°5; white globigerina ooze.

Polypus pusillus, No. 7949.
Symplectoteuthis oualaniensis. [H. 53.]

Station 3366, E. of Galapagos Islands; February 27, 1891; lat. 5° 30′ N., long. 86° 45′ W., 1067 fathoms; temperature, surface 84°, bottom 37°; yellow globigerina ooze.

Eledonella diaphana, No. 7946.

Station 3371, off Cocos Island; March 1, 1891; lat. 5° 26′ 20″ N., long. 86° 55′ W., 770 fathoms; temperature, surface 82°, bottom 39°; globigerina ooze.

Argonauta argo, No. 8172.
Polypus januarii, No. 7944.

Station 3374, S. W. of Malpelo Island; March 3, 1891; lat. 2° 35′ N., long. 83° 53′ W., 1823 fathoms; temperature, surface 80°, bottom 36.°4; green ooze.

Stauroteuthis hippocrepium, No. 7942.

Station 3375, off Cape San Francisco; March 4, 1891; lat. 2° 34′ N., long. 82° 29′ W., 1201 fathoms; temperature, surface 77°, bottom 36.°6; gray globigerina ooze.

Abraliopsis hoylei, No. 7959 A.
Pterygioteuthis giardi, No. 7959 B.

Station 3382, off Mariato Point; March 7, 1891; lat. 6° 21′ N., long. 80° 41′ W., 1793 fathoms; temperature, surface 75°, bottom 35.°8; green mud.

Abraliopsis hoylei, No. 7964.

Station 3385, off Cape Mala; March 8, 1891; lat. 7° 32′ 36″ N., long. 79° 16′ W., 286 fathoms; temperature, surface 72°, bottom 45.°9; green mud.

Calliteuthis reversa, No. 7962.

Station 3388, off Cape Mala; March 9, 1891; lat. 7° 6′ N., long. 79° 48′ W., 1168 fathoms; temperature, surface 73°, bottom 36.°2; green globigerina ooze.

Tremoctopus scalenus, No. 7963.
Bathyteuthis abyssicola. [H. 533.]

Station 3393, off Cape Mala; March 10, 1891; lat. 7° 15′ N., long. 79° 36′ W., 1020 fathoms; temperature, surface 74°, bottom 36.°8; green mud.

Moschites verrucosa, No. 7940.

Station 3394, off Cape Mala; March 10, 1891; lat. 7° 21′ N., long. 79° 35′ W., 511 fathoms; temperature, surface 73°, bottom 41.°8; dark green mud.

Mastigoteuthis dentata, No. 7957.

Station 2619, Hyd., Gulf of Panama, "surface to 300 fathoms;" March 11, 1891; lat. 7° 31′ N., long. 78° 42′ 30″ W., 1100 fathoms; temperature, surface 68°, bottom 36.°5; green globigerina ooze.

Abraliopsis, sp. [H. 64.]

Station 3398, off Cape San Francisco; March 23, 1891; lat. 1° 7′ N., long. 80° 21′ W., 1573 fathoms; temperature, surface 84°, bottom 36°; green ooze.

Moschites rotunda, No. 7951.

Station 2627, Hyd., off Cape San Francisco; March 25, 1891; lat. 0° 36′ N., long. 82° 45′ W., 1832 fathoms; temperature, surface 81°, bottom 36°; gray globigerina ooze.

Argonauta argo, No. 8139.

Station 3400, E. of Galapagos Islands; March 27, 1891; lat. 0° 36′ S., long. 86° 46′ W., 1322 fathoms; temperature, surface 81°, bottom 36°; light gray globigerina ooze.

Mastigoteuthis dentata, No. 7956.

Charles Island, Galapagos Islands; March 31, April 1, 1891.

Polypus oculifer, No. 7948.
Polypus occidentalis, No. 7943.

Station 3406, between James and Indefatigable Islands, Galapagos Islands; April 3, 1891; lat. 0° 16′ S., long. 90° 21′ 30″ W., 551 fathoms; temperature, surface 81°, bottom 41.°3; rock.

Pterygioteuthis giardi, No. 7965.

Station 3410, off Bindloe Island, 4 miles W.; April 3, 1891; lat. 0° 19′ N., long. 90° 34′ W., 331 fathoms; temperature, surface 82°, bottom 44.°2; black sand.

Bolitaena microcotyla, No. 7955.

Station 3414, off Tehuantepec; April 8, 1891; lat. 10° 14′ N., long. 96° 28′ W., 2232 fathoms; temperature, surface 82°, bottom 35.°8; green mud.

Cirroteuthis, sp., No. 7945 A.
Abraliopsis hoylei. [H. 67.]
Taonius, sp. [H. 49.]
Japetella prismatica, No. 7945 B.

Station 3415, S. E. of Acapulco; April 10, 1891; lat. 14° 46′ N., long. 98° 40′ W., 1819 fathoms; temperature, surface 83°, bottom 36°; brown mud, globigerina ooze.

Eledonella diaphana, No. 7960 A.
Abraliopsis hoylei, No. 7960 B.

Station 3417, off Acapulco; April 11, 1891; lat. 16° 32′ N., long. 99° 48′ W., 493 fathoms; temperature, surface 82°, bottom 40.°6; green mud.

Polypus pusillus, No. 7950.

Station 3418, off Acapulco; April 11, 1891; lat. 16° 33′ N., long. 99° 52′ 30″ W., 660 fathoms; temperature, surface 82°, bottom 39°; brown sand, black sp.

Polypus pusillus, No. 7953.

Station 3420, off Acapulco; April 12, 1891; lat. 16° 46′ N., long. 100° 8′ 20″ W., 664 fathoms; temperature, surface 82°, bottom 39°.6; dark green mud.

Eledonella diaphana, No. 7947.

Station 3422, off Acapulco; April 12, 1891; lat. 16° 47′ 30″ N., long. 99° 59′ 30″ W., 141 fathoms; temperature, surface 83°, bottom 53.°5; green mud.

Loligo diomedeae, No. 7958.

Station 3425, off Las Tres Marias; April 18, 1891; lat. 21° 19′ N., long. 106° 24′ W., 680 fathoms; temperature, surface 76°, bottom 39°; green mud and sand.

Argonauta hians, No. 8138.

Station 3436, S. of Guaymas; April 22, 1891; lat. 7° 34′ N., long. 110° 53′ 40″ W., 905 fathoms; temperature, surface 72°, bottom 37.°2; brown mud, black sp.

Pterygioteuthis giardi, No. 7968.

Station 3437, about 50 miles S. of Guaymas; April 23, 1891; 628 fathoms; temperature, surface 70°, bottom 40°; brown mud, black sp.

Pterygioteuthis giardi, No. 7966.

"50 miles south of Guaymas."

Argonauta, sp. [H. 56.]

"Pacific Ocean between Columbia and Mexico."

Polypus tonganus, No. 8040.

"Station 74, surface."

Cranchia scabra. [H. 103.]

Cruise of 1899–1900.

Station 1, North Pacific Ocean, 320 miles from Point Conception; August 26, 1899; lat. 31° 10′ N., long. 125° W.; temperature, surface 63°; taken at the surface.

Teleoteuthis caribaea, 3 juv. [H. 148–150.]

Station 6, August 31, 1899; lat. 20° 26′ N., long. 133° 28′ W.; temperature, surface 75°; 150 fathoms to surface.

Cranchia scabra, 1. [H. 144.]

Tropical Pacific; September 1, 1899; lat. 18° 19′ N., long. 134° 57′ W.; temperature, surface 76°; taken at the surface, 8 p. m.

Tremoctopus quoyanus, 2 ♀. [H. 151, 152.]

Equatorial Pacific Ocean, north of the Marquesas Islands; September 6, 1899; lat. about 8° N.; long. about 137° W.; surface at night.

Onychoteuthis banksi, 1. [H. 110.]

Station 14, Pacific Ocean, north of the Marquesas Islands; September 7, 1899; lat. 6° 41′ N., long. 137° W.; temperature, surface 82°; taken at the surface.

Teleoteuthis caribaea, 2 juv. [H. 131, 132.]
Ommastrephes, sp., 1 juv. [H. 133.]
Rhynchoteuthis chuni, 1 juv. [H. 134.]
Embryo, indeterminate. [H. 147.]

Station 14; 150 fathoms to surface.

Ommastrephes, sp., 2 juv. [H. 141, 142.]
Abraliopsis, sp., 1 juv. [H. 143.]
Embryo, indeterminate, 2. [H. 139, 140.]

September 7, 1899; surface, 8 p. m.

Embryo, sp. indet. [H. 135.]

Station 17, equatorial Pacific Ocean, north of the Marquesas Islands: September 10, 1899; lat. 0° 50′ N., long. 137° 54′ W.; depth, 2463 fathoms; temperature, surface 79°; light yellowish-gray globigerina ooze; trawl.

Cirrobrachium filiferum. [H. 130.]

Station 18, 175 miles north of the Marquesas Islands; September 13, 1899; lat. 6° 25′ S., long. 138° 59′ W.; temperature, surface 80°; 400 fathoms to surface.

Onychoteuthid, gen. et sp. indet. [H. 136.]

Off Rangiroa Island; September 24, 1899; lat. about 150° N., long. 148° W.; 8 p. m., surface tow net.

Euprymna stenodactyla, 1 juv. [H. 126.]

Station 27, 6 miles S. 20° E. of Anna Maria Bay; September 15, 1899; lat. 9° 1′ S., 140° 4′ W.; temperature, surface 79°; 320 fathoms to surface.

Onychoteuthid, indet., 1 juv. [H. 138.]

Makatea Island, Paumotu Archipelago; October 6, 1899; shore.

Polypus, sp. juv. [H. 125.]

Makemo Island, Paumotu Archipelago, October 20, 1899. Lagoon of Makemo, October 19, 1899.[1]

Polypus, sp. [H. 124.]

Papiete, Tahiti; on the reefs, November 14, 1899.

Polypus, sp. [H. 146.]

Funafuti Island; December 24, 1899; shore; taken by the seine.

Euprymna stenodactyla, 1 ♀. [H. 128.]

Gilbert Islands, about 1 mile off Tarawa Island; January 2, 1900; surface, electric light.

Euprymna stenodactyla, 1 juv. [H. 137.]

Jaluit; January 13, 1900; shore.

Sepioteuthis lunulata, ♂ ♀. [H. 104–109.]

Station 220, southwest of Kwajalong Island, Marshall Islands; January 16, 1900; lat. 8° 38′ N.; long. 167° 37′ E.; temperature, surface 82°; 150 fathoms to surface.

Eledonella diaphana, juv. [H. 129.]

[1] There were two labels with different dates in this bottle.

Arhno Atoll, Marshall Islands; January 24–26, 1900; lat. about 7° N.; long. about 171° 30′ E.; surface of the lagoon, electric light.

Polypus macropus, juv. [H. 111.]
Polypus, sp. juv. [H. 112, 113.]
Euprymna stenodactyla, 2 ♂ [H. 114, 116], 1 ♀ [H. 115]; 4 juv. [H. 117–120.]

Arhno Atoll, January 27, 1900; surface of the lagoon, electric light.

Polypus, sp. juv. [H. 121.]
Euprymna stenodactyla, 1 ♀ [H. 122], 1 juv. [H. 123.]

Station 236; southwest of Arhno Atoll, Marshall Islands; January 28, 1900; lat. 6° 34′ N., 170° 59′ E.; temperature, surface 81°; surface, electric light.

Argonauta, sp. 1 ♀ [H. 127], 1 ♂ [H. 145].

APPENDIX.

THE LUMINOUS ORGANS OF CERTAIN CEPHALOPODA.

(A) Pterygioteuthis giardi.

(Plate 9.)

THE luminous organs in this species closely resemble, as might be expected, those of the nearly allied species, *Pyroteuthis margaritifera*. Of these a short notice has recently appeared (Hoyle, :02), and what follows will, of necessity, be to some extent a recapitulation of that paper. The specimens which came into my hands had not been preserved with any special view to histological examination, and some of them had suffered a good deal of injury, so that the account here given can only be regarded as of a preliminary character.

The most striking peculiarity in regard to the luminous organs in the genus *Pterygioteuthis* is that they are situated on the eyeball or within the mantle-cavity, in either case below the integument, so that they are only functional by reason of its transparence during life. After immersion in alcohol the tissues become opaque, and though sometimes one or two of the larger ocular organs may be dimly seen through the skin, it is only after dissection that they are clearly visible, or, in the case of the intrapallial organs, visible at all.

As in the Mediterranean species, the luminous organs may be divided, according to their situation, into four sets: —

I. Ocular.
II. Siphonal (Plate 9, Fig. 1, *S.*, *S.*)
III. Branchial (Fig. 1, *B.*, *B.*)
IV. Abdominal (Fig. 1, A^1, A^2).

I. THE OCULAR ORGANS are disposed in the equatorial region of the ventral aspect of the eyeball, and resemble a series of warts projecting from it. Owing to the damaged condition of the eyes in most of the "Albatross" specimens, I have been unable to determine their number and position with certainty, but there appear to be five, situated at approximately regular intervals on the lower half of the equator of the eyeball. Each organ is roughly spheroidal, with the outer surface somewhat flattened and the deeper more convex. The diameter and the depth are subequal, being about 0.45 mm. in the larger and a little more than half as much in the smaller.

As regards microscopic structure, the state of preservation leaves so much to be desired that it seems hardly worth while to go into very minute details. The following is an account of the facts I have been able to elucidate by a study of serial sections.

Each organ consists of the following parts: —

1. The Capsule.
2. The Posterior Cup.
3. The Inner Cup.
4. The Central Mass.
5. The Anterior Cap.

1. *The Capsule* (Plate 9, Fig. 2, *c*) is about 0.04 mm. thick, and consists of rather loose connective tissue with small irregularly-shaped nuclei scattered in it here and there. The inner half of the thickness of this layer is deeply pigmented, the tissue being permeated by a mass of granular reddish-brown particles. The color and density of this layer agree with that to be noticed subsequently in other organs of this species, and it is in marked contrast with the very opaque black pigment seen in *Abraliopsis*. It is specially noteworthy that no similar layer was observed in the case of *Pyroteuthis margaritifera*.

2. *The Posterior Cup* (Fig. 2, *p. c.*) is built up of a large number of flattened oval or almost circular scales arranged in concentric layers, and leaving a hollow in the middle which contains the knob of the central mass. In section these scales, being thicker in the middle than at the edges, have an irregularly fusiform outline, and their concentric arrangement is very conspicuous. They stain very deeply with all the reagents yet tried (haematoxylin, carmine, and osmic acid). In some parts of the sections, notably in the more superficial layers, they appear to be homogeneous, but in other parts they present a frayed-out appearance, and are then seen to be made up of a number of interlacing fibrils with a less dense substance between them (Fig. 3). They vary much in dimensions; the largest, situated in the outer layers, measure 0.08 mm. in diameter by 0.03 in thickness, whilst those near the centre measure rather less than half these dimensions. The smallest of all are near the rim of the cup; they are sub-circular rather than fusiform in outline, and the diameter in many cases is only about 0.015 mm.

The scales are not in contact with each other, but are separated by interspaces of about 0.01 mm. in thickness, but varying much in different places. A delicate connective tissue, which stains only very feebly with the reagents above mentioned, fills up these interspaces. Here and there a radially directed passage is seen perforating several of the layers of scales, and in its centre may be seen a fibril which can often be traced to the central mass, and is presumably a nerve (Fig. 2, *n*). I have not, however, been able to trace these nerves to their source in the outer layers of the organ.

The actual form of the periphery of these scales is very difficult to determine, because the sections cut them at such varying angles. Tangential sections naturally give the best idea of it, but even here it is impossible to be certain that in any particular case the whole outline is shown. Two scales from the same series of sections are shown in Fig. 4, *A* and *B*.

Comparison of a number of such sections leads, however, to the belief that they are, speaking generally, oblong in form with rounded angles. Here and there a deep notch is seen in the margin of a scale, which gives passage to the nerve as mentioned above (Fig. 4, *B*, *n*).

The fibrillar structure is not shown in these tangential sections, but there are indications of the presence of lacunae which may, perhaps, be the inter-spaces between them. There are great variations in the constitution of the scales in the different sections, which I can only attribute to the state of preservation.

As compared with *P. margaritifera*, the scales are less regular in arrangement and not so homogeneous in structure.

3. *The Inner Cup* (Fig. 2, *i. c.*) might perhaps be more correctly termed a funnel, for where the bottom would be is a space through which passes the central mass to be described below, and not only is the diameter of the cup much larger at the top, but the thickness, too, increases very greatly towards what may be termed the rim, whilst at the bottom it tapers away to a thin edge. The internal diameter of the cup at the mouth is 0.2 mm. and at the bottom 0.09 mm., the depth 0.12 mm., and the thickness of the rim about 0.08 mm. It is composed of a mass of rather coarse fibres, which pass from the deeper portion to the more superficial, in layers parallel with the inner surface of the cup. Here and there an opening is left through the wall of the cup, apparently for the passage of a nerve. The fibres are much coarser and more closely packed, and stain much more deeply than those of *P. margaritifera*, in which species, too, there are no nerve channels to be seen, — a fact which is probably to be explained by the difference in size and arrangement of the central mass in the two species.

4. *The Central Mass* may be considered as divisible into two portions: (A) a spheroidal knob, and (B) a cone occupying the axis of the organ, and bearing on its apex the knob just mentioned.

(A) The *spheroidal knob* (*s. k.*) occupies the centre of the posterior cup, and constitutes, in fact, a nucleus around which the concentric layers of scales are arranged. It is about 0.1 mm. in diameter.

(B) The *axial cone* (*a. co.*) is situated in the centre of the inner cup. It projects through the bottom of the cup to join the spheroidal knob just described, and its length being greater than the depth of the cup, it projects some distance above it. Its sloping sides bulge outward somewhat, and its upper surface is convex. Its measurements are, basal diameter, 0.23 mm., apical, 0.09 mm., total length, including the spheroidal knob, 0.29 mm.

The bulk of this central mass is composed of large rounded parenchymatous cells, closely packed together. They may attain a diameter of as much as 0.02 mm., though many are much less. They consist of almost structureless protoplasm, which stains but slightly, and the cell-boundaries are indistinct.

The nuclei are large and spheroidal, measuring, in some cases, as much as 0.008 mm. in diameter. The nuclei in the more superficial parts of the organ are much larger than those situated more deeply.

In the centre of the thicker part of the cone are a number of scale-like bodies, placed at right angles to its axis (*c. s.*). There are from ten to twelve of these scales, measuring on an average 0.08 mm. in diameter, and 0.012 mm. in thickness. In structure they resemble, on the whole, those forming the posterior cup. They stain in the same way and to the same depth, but they are, on the whole, somewhat thinner in proportion to their diameter, and the fibres composing them are more obvious.

The form of this central mass constitutes the most important difference between the present species and *P. margaritifera*, for in the latter it is much shorter, the conical part only extending halfway along the sides of the inner cup, and being hollowed to receive the deeper portion of a structure I have called in that species the "internal cone."

5. *The Anterior Cap* (*a. c.*) covers the whole surface of the organ above the central mass. It has the form of a meniscus, the deeper surface, which rests upon the central mass, the inner cup, and the edge of the posterior cup, being deeply concave, whilst the upper surface is very convex. The greater part of it is composed of delicate wavy fibres interlacing with each other, and disposed in general parallel with the surface of the organ. Over the central mass the fibres are closer and more nearly parallel than over the lateral portions of the organ, where the texture is much more open, leaving rounded interspaces between them. A few nuclei were seen in these lateral parts, but none in the centre.

In the superficial layers of this anterior cap are a number of scales disposed parallel to the surface. They very closely resemble the scales of the outer layers of the posterior cup, but are somewhat larger in diameter and not quite so thick. They stain very deeply, and the more superficial ones are almost homogeneous in composition. There are a few of these scales in the deeper layers, but these are much smaller and show a tendency to break up into fibres something like the scales in the middle of the central mass.

II. The Siphonal Organs (Fig. 1, *S. S.*) are paired and lie just within the hinder margin of the funnel, and are seen peeping out from beneath it when the mantle-cavity is opened. Each organ is bluntly pyriform in shape, or more accurately, perhaps, has the form of an acorn in its cup (Fig. 5). The smaller end is directed backwards, and at the inner side of the broad end is a kind of stalk by which it is attached to the ventral wall of the body. The free distal end is slightly pigmented, while the broad end is paler and the tip is a paler patch of a semi-transparent yellowish horn color. The length of the organ is about 0.9 mm. and the greatest diameter 0.8 mm.

In minute structure the siphonal organs closely resemble the ocular organs in their main features (Fig. 6). It will be sufficient therefore to enumerate their constituent parts and to mention the points in which they present differences. On the whole, they are more like the organs of *P. margaritifera*.

1. *The Posterior Cup* presents an outer coating of brown pigment (*c.*) which, however, is neither so thick nor so dense as that of the ocular organ. The scales composing the cup (*p. c.*) are thicker and more closely packed, and the connective tissue lying between them is more delicate. Most of the sections of this organ which I examined had been stained with carmine, and this fact may account for an apparent difference in the composition of the scales. They present a granular appearance, but do not show traces of a network like that described above. The form of the scales, judging by an examination of tangential sections, seems to be much less regular than in those above mentioned. They give off processes which branch, and in some cases almost appear as though they joined one scale with another, though I hardly think that such is the case. A somewhat oblique section, through the cup and the central knob, is shown in Fig. 8, and exhibits very clearly the concentric arrangement of the scales round the central knob.

2. *The Inner Cone* (*i. c.*) presents very little difference from that of the ocular organs except that the fibres composing it are more delicate. In some of the sections, they show a tendency to curve round the outside edge of the central mass, but this appearance I imagine is due to the sections not being cut exactly through the centre. In some places I detected a nerve passing through the inner cone in the same way as in the ocular organ.

3. *The Central Mass* (*c. m.*) is in general form intermediate between that of the ocular organs just described and that of *P. margaritifera*. It resembles the latter in the fact that it has no scales in its centre, and that it does not show distinct cell outlines, whilst in the fact that it extends as far as the rim of the inner cone it presents a likeness to *P. giardi*. It is made up of finely granular substance which stains only very faintly. The nuclei are very few and far between in the central knob, but are much more abundant towards the base of the conical portion, where many of them seem to be elongated in the direction parallel to the base of the cone.

4. *The Anterior Cap* (*a.c.*, *a.c.'*) is made up of two layers of about equal thickness, but whereas in the ocular organs the deeper layer is composed of delicate fibrils and the more superficial of large scales, in this instance the scales are in the deeper part, whilst the fibrous portion is above. The scales differ from those of the posterior cup inasmuch as they show a marked tendency to become resolved into fibres (Fig. 7). One or two of the larger ones, however, show no fibres, but simply a granular structure similar to those of the posterior cup, but more pronounced. The superficial layer is almost homogeneous, but there can be seen in it delicate striations which run for the most part parallel with the surface. They are more clearly marked and less wavy in the deeper layers. The nuclei are fairly abundant and are fusiform in shape, with their long axes parallel to the direction of the fibres.

5. *The Collar* (*co.*) is the structure whose presence most clearly distinguishes the siphonal from the ocular organs. It surrounds the organ parallel with its equator just opposite to the deeper layer of the anterior cap. It is covered by the connective tissue capsule of the organ and in minute structure

consists of a number of delicate fibres arranged in bundles, passing outwards and forwards, parallel to each other. Its breadth is about 0.24 mm. and its thickness 0.12 mm.

III. THE BRANCHIAL ORGANS are paired and situated one near the root of each gill (Plate 9, Fig. 1, *B*, *B*) a little further back, and also a little deeper in the mantle-cavity than the actual attachment of the gill itself. They are of a flattened ovoid form with the longer axis directed rather forwards and inwards. The anterior and more superficial portion has a pale yellowish and rather lustrous appearance, behind which is a crescentic band, which looks as though it were due to subcutaneous pigment. The greatest length is about 0.75 mm. and the breadth somewhat less.

The structure of these branchial organs (Fig. 9) is much simpler than that of either of the sets just described. The following parts may be distinguished proceeding from the surface downwards: —

1. Over the surface is a thin layer (*s. l. c.*) of connective tissue varying from 0.005 to 0.015 mm. in thickness.

2. Beneath this is a delicate membrane (*s. m.*) which stains deeply and in which rounded nuclei can be made out here and there. It has an almost uniform thickness of about 0.006 mm.

3. The *central mass* (*c. m.*) constitutes by far the greatest part of the whole organ. It consists of a parenchymatous tissue of cells (Fig. 11), the largest of which are about 0.04 mm. in length, the smallest being less than half as much. The cell boundaries are very distinctly marked, and the protoplasm stains but slightly with haematoxylin. The nuclei are spheroidal and stain very deeply, so deeply that in most cases the nucleolus cannot be seen. The nuclei are more numerous and the cell boundaries less distinct in the layer which immediately underlies the delicate membrane just described.

Here and there may be seen amongst the cells a sort of lacuna in which is a granular mass with one or two nuclei. Sometimes this mass fills the lacuna, in others it seems to have shrunk away, in which case threads of protoplasm may be seen stretching out from it across the intervening space.

Towards the posterior edge the structure of the central mass undergoes a change (Fig. 10) ; instead of a parenchyma of rather elongated cells it assumes the appearance in its more superficial part of a fibro-cellular mass with nuclei scattered irregularly in it (*s. c.*). In its deeper portion is an ovoid mass of material similar to that composing the greater part of the central mass, but not so clearly marked off into cells (*el.*). There is a kind of spiral striation obscurely indicated, as though the structure had in some way been formed round a centre.

4. A rather thick layer of very close compact tissue lies below the central mass (*c. t. c.*). It stains very deeply, and hence its minute structure is very difficult to decipher, but it apparently consists of a granular substance in which no definite elements can be made out. In the anterior half this layer forms the boundary of the organ.

5. A thin layer of pigmented cells covers the posterior half of the organ on

its deeper surface. It consists of a single layer of cells each with a definite rounded nucleus, *ep*. The pigment is of the reddish-brown character, which has already been described in speaking of the siphonal and ocular organs and appears to be contained in the inner portion of the cells (*p. l.*)

IV. THE ABDOMINAL ORGANS (Plate 9, Fig. 1, A^1, A^2,) are two in number. The anterior (A^1) occupies the position of the three organs in *P. margaritifera* (Hoyle, :02, Fig. 1, *A 1, 2, 3*), though it is proportionately not quite so far in front of the branchial organs as it is in that species. The posterior one (Fig. 1, A^2) corresponds in position with that marked *A 4* in the figure of *P. margaritifera* just cited.

The anterior organ is slightly elliptical in a superficial view with the longer axis transversely; its axes measure 0.6 and 0.4 mm. respectively. The organ is nearly hemispherical (or more accurately hemi-ellipsoidal) embedded in the tissues, with its flat surface outwards and on the same level as the abdominal wall. On the anterior aspect a kind of thread or stalk runs from it, embedded in the tissues. One organ which I removed was cut into sections longitudinally, that is, by planes parallel to the sagittal plane of the body (Fig. 12); an examination of these showed it to be composed of the following structures: —

1. The Capsule.
2. The Pigment Layer.
3. The Cup.
4. The Inner Cone.
5. The Central Mass.
6. The Cover.
7. The Superficial Connective Tissue.

1. *The Capsule* of connective tissue (*c.*) covers the whole of the hemispherical surface of the organ; it is very thin (about 0.08 mm. thick) and almost structureless, though delicate fibres can be traced here and there, and a few nuclei are scattered in it.

2. *The Pigment Layer* (*p.*) immediately within the connective tissue just mentioned is thickest just opposite to the stalk and made up of reddish-brown granules like the similar layers in the other organs.

3. *The Cup* (*p. c.*) is made up of scales, so far as can be made out closely resembling those already described in other organs. The only sections I have of this organ are so deeply stained with braziline that it is impossible to make out any structure in them. This coat is on average 0.1 mm. thick.

4. *The Inner Cone* (*i. c.*) can be made out distinctly only on that side of the organ turned towards the stalk. It consists as in other cases of thin wavy fibres very deeply stained. It is much thinner and less conspicuous in this instance than in the others.

5. *The Central Mass* (*c. m.*) is much less regular in shape than in those cases already described, but shows traces of a constriction indicating a division into a deeper portion and a more superficial corresponding respectively to the spheroidal and conical portions of other cases. The minute structure is very badly

preserved; there are only very scanty traces of cell outlines and these principally in the superficial division. The nuclei are distinct and rounded or oval and much more numerous in the superficial part.

6. *The Cover* (*co.*) consists of a layer of scales which differ from any of those hitherto mentioned in form as well as in arrangement. They are greatly elongated and fusiform in outline, with one end blunter than the other. By this blunter extremity they are attached to the surface of the central mass and pass upwards from it in a more or less curved direction. Those which are furthest away from the stalk pass at an angle 45° to the surface. The next ones become successively more and more vertical and then begin to slope over to the other side. Those which cover the greater part of the central mass are inclined at an angle of about 30° to its surface, whilst at the stalk end they run almost directly into it. The thinner ends are drawn out into long delicate fibrils which curve round and become continuous with a limiting membrane forming the boundary of this layer.

7. *The Superficial Connective Tissue* (*s. c.*) is a layer about 0.016 mm. in thickness. It may be divided into three parts, the deeper and the more superficial being structureless, whilst the middle one is granular and has nuclei scattered at intervals along it. I have not been able to make out satisfactorily any nervous supply to the central mass in this instance, but it is quite possible that this may exist between the scales and the posterior cup as in other cases, for many of the sections were much broken. The Posterior Organ I have not examined in section.

Regarding the functions and homologies of the different parts of these organs, there is but little that can be said. The central mass I take to be the source of light, and it agrees in position though not in structure with the cells to which Joubin ('93, '94, '95) has ascribed a similar function in *Histioteuthis* and *Histiopsis*.

What I have termed the posterior cup appears to be closely similar to the corresponding part of the organ described by Joubin, and I think there can be little doubt that he is correct in regarding it as a reflector, though it is not exactly clear to me that one would naturally expect a body so constituted to discharge such a function. If this be admitted there would then be no reason for doubting that the superficial portions are a refracting apparatus.

(B.) Abraliopsis hoylei.

(Plate 10, Figs. 1-10.)

The luminous organs of this species are exceedingly numerous and are distributed pretty freely over the ventral surface and to some extent over the sides of the mantle, head, and third and fourth pairs of arms. Their arrangement is almost exactly bilaterally symmetrical with insignificant variations here and there. Considered more in detail, the disposition on the various organs is as follows: —

I. INTEGUMENTARY ORGANS.

A. *The Mantle* (Plate 10, Fig. 1) : — The hinder part of the inferior surface is covered by a patch of organs (p), whilst in front of this they are placed in more or less regular linear series of which the following may be distinguished :

1. A double row (m^1) placed not very far from the median ventral line on either side and leaving a narrow free space between them.

2. A single irregular series (m^2) a little distance to the outer side of each of these.

3. A fairly regular single series which commences on either side at the prominent angle of the mantle-margin and passes backwards, converging towards the median line in its course (m^3).

All these six lines pass posteriorly into the patch of organs above mentioned.

4. Still further to each side is a wavy series of small organs more irregular and more widely spaced, extending nearly to the posterior extremity of the body, whilst dorsally to these again and situated on each side of the mantle, is a row of about half a dozen.

5. Along the margin of the mantle is a single series extending rather more than halfway round (m^4).

On the dorsal surface I detected only two or three minute organs, in a linear series parallel and near to the dorsal median line.

B. *The Siphon* (s) : — On the ventral face of the siphon are two groups, one on each side, leaving a clear space in the middle between them. Each group is roughly triangular in arrangement and consists of six to ten organs.

C. *The Head* : — The inferior surface of the head presents a brilliant array of these little organs. Most conspicuous perhaps is a longitudinal series occupying the median ventral line (h^1). Anteriorly this series bifurcates to pass up the fourth arm, and posteriorly it also bifurcates just in front of the tip of the funnel and the two limbs pass backwards and outwards along the margin of the funnel-groove. Parallel with this median series are two others, one on each side (h^2), which start from the line of organs along the edge of the funnel-groove, and pass forwards to the outer edge of the fourth arm on each side. Parallel with this line is a short row of three or four organs, between the funnel and the eye (h^3), and in the same line with it in front of the eye is a group of four to eight (h^4). A semicircle of organs is found round the ventral margin of each eye aperture.

D. *The Arms* : — Only the third and fourth pairs of arms are provided with these organs. On the *fourth* pair there is a single linear series on either margin of the ventral face. The line on the inner margin is the continuation of the bifurcated median line on the lower surface of the head (h^1) mentioned above. It extends about halfway up the arm and then ceases. That in the outer margin is a continuation of the series parallel with the median line (h^2) ; after passing forward a short distance it becomes discontinuous and is resolved into little linear groups of four to seven organs, separated by interspaces about equal in length to the groups.

On the *third* pair (Plate 8, Fig. 2) there are little linear groups of two to six organs on the ventral surface along the line where the web or swimming membrane is attached to the arm.

There are no organs on the fin.

General Appearance.

Under a lens the luminous organs of the mantle, arms, etc., present the appearance of small spots which are sometimes raised into papillae by the contraction of the intervening integument (Plate 10, Fig. 3). They have a shining appearance and consist of a central white speck surrounded by a black ring. Under a low power of the microscope, the black ring is not quite even, but has a wavy external margin and in some cases is clearly seen to be made up of from five to seven separate pieces; this is still more clearly seen to be the case when sections are examined.

The white central portion presents a somewhat different appearance in different organs. In the largest ones it has a yellowish tinge and is more prominent and looks harder than in others. In the organs of smaller size it is paler and flatter, being of a dull pearly white color. In the smallest of all it is quite flat, and in these, too, the pigment ring is much less developed.

The diameter of one of the largest is about 0.2 mm., the central pearl-like spot being about 0.1 mm. in diameter. They vary considerably in size, the smallest being about half as big as the largest. They lie in spaces between the chromatophores.

Minute Structure.

The preparation of complete series of sections of these organs was found to be quite impossible, owing to the hardness of the posterior part of the interior. The cutting went on quite satisfactorily until about halfway through, when the whole of the remainder of the inside was torn out by the razor, generally spoiling the adjacent tissues on one side and damaging all the remaining sections of that particular organ. In what follows the account of the posterior part has been compiled from a few very indifferent fragments.

The organ lies embedded in the fibrous connective tissues under the epidermis and is below the level of the chromatophores with which it does not seem to come into any relation. There is a slight depression in the subcutaneous muscle underneath each organ. There is a series of large sinuses surrounding the posterior portion of the organ (Figs. 4 to 8, *s.*). The inner wall of these is formed by a thin layer of connective tissue surrounding the pigment cup, whilst the outer is formed by the sub-cutaneous connective tissue.

The shape is in general spheroidal, the axial diameter, perpendicular to the surface of the integument, being rather longer than the transverse diameter.

In general, too, the deeper half is a little more pointed than the more superficial, so that the form of the organ approaches that of a peg-top (Fig. 4).

Each organ consists of the following parts : —

1. The Lens.
2. The Pigment Cup.
3. The Inner Cup.
4. The Posterior Hemisphere.
5. The Internal Cone.

1. The *Lens* (Plate **10**, Figs. 4, 5, *l*) consists of a pale structureless material which is not acted upon by staining fluids. It is divided up by faint irregular lines of demarcation and occasional cleavage gaps into more or less rounded masses, in the interstices between which nuclei are found here and there.

Viewed in a section taken along the axis (Fig. 4) the lens is seen to be separated by an equatorial groove into an inner and outer portion. These differ somewhat in their structure. In the deeper portion, the pieces of which the lens is built up are rounder and more irregular, their depth being not infrequently equal to their transverse diameter. In the more superficial portion, these pieces are more flattened and taper to their edges on either side, and are fitted into each other something like flattened epithelial cells near the surface of the epidermis. The nuclei are modified in accordance with the tissue in which they are found, being rounded or sub-polygonal in the deeper portion and flattened in the superficial. The groove above mentioned receives the inturned edge of the pigment cup.

2. The *Pigment Cup* (Figs. 4, 6, 7, 8, *p. c.*) is in the shape of a goblet without a stem and with the edge somewhat inverted. It is built up of a number of separate pigment masses which are seen in section to be hollow sacs with a thick lining of black pigment, a structure which suggests the view that they are possibly modified chromatophores. Their boundaries are not always visible, and hence it is impossible to determine their exact number, the more so as the sections of the posterior part of the organ are never entire. In a horizontal section taken just below the lens (Fig. 6) there are usually six of these which make up a more or less complete ring, and in such cases the boundaries of the individual sacs are pretty easy to determine. This ring appears to correspond to the inturned edge of the pigment cup. In the deeper portions the hollow cavities of the pigment masses are not so easily seen, nor are the boundaries so distinct. The aperture of the cup, as above stated, is occupied by the lens. In its bottom is situated the posterior hemisphere, whilst the remainder is lined by connective tissue with numerous large nuclei (Figs. 4, 7, 8, *c. t*)

3. *The Inner Cup* (Figs. 4, 7, *i. c.*) lies inside the pigment cup just described. It might perhaps be more correctly described as a funnel, for a conical perforation runs right through its middle, diminishing in diameter as it descends. The substance of which it is composed stains only very faintly. In an axial

section (Fig. 4) it is marked by striations which run, roughly speaking, parallel to its outer boundary and seem to indicate that it is built up of irregular rods packed closely side by side. A fair number of more or less complete axial sections of this structure have been obtained, but I have only been able to discover one or two fragmentary transverse sections. These show the cut ends of the rods packed together with a kind of radiating arrangement from the central aperture towards the circumference (Fig. 7). Between these rods, nuclei occur very sparingly and elongated in a direction parallel with the rods themselves.

4. *The Posterior Hemisphere* (Figs. 4, 8, *p. h.*) occupies the deepest portion of the interior of the organ just within the pigment cup. It has, roughly speaking, the form of a hemispherical bowl with the rim turned inwards. Its thickness is about equal to one-third of its diameter and is such that only a very small spheroidal space is left in the middle of it and is occupied by the end of the internal cone. The thickness is made up of a series of concentric layers which in the sections appear to be slightly separated one from the other, especially near their edges, but this may be an effect produced by the process of cutting. This substance takes up the stain only faintly, and appears to be somewhat denser in consistency than the inner cup. No nuclei have been noticed anywhere in its substance.

5. *The Internal Cone* (Figs. 4, 6, 7, *i. co.*) is situated with its base against the deeper surface of the lens, whilst its spheroidal apex occupies the internal cavity of the posterior hemisphere just described. It is deeply subulate and is bounded by the internal surface of the inner cup. Under a high power it is seen to be composed of finely granular protoplasm, which is not much affected by the staining fluid. No definite cell boundaries can be seen, but it contains a considerable number of nuclei. Those near the base of the cone are small and ovoid in shape, whilst the deeper ones are elongated in the direction at right angles to the axis. Some of them are so long as to occupy a considerable portion of the diameter of the cone. A section parallel with the surface of the integument (Fig. 6) just beneath the lens shows that these elongated nuclei have their long axes curved to correspond with a circle drawn round the centre of the cone. They are situated in the deeper layers, whilst the round and ovate nuclei occupy the circumference.

I have not been able to trace the nerve supply to these organs.

II. SUB-OCULAR ORGANS.

Beneath each eyeball, covered in the living condition by the integument, is a row of five organs, placed at equal distances from each other along the equator of the ball (Plate 10, Fig. 2). They are visible in the living animal (Plate 1, Fig. 3) evidently by reason of the transparency of the integument.

They are slightly elevated papillae of a clear yellowish-brown color. The three central ones are the smallest and are about 0.18 mm. in diameter, whilst the two extreme ones measure 0.35 mm. in diameter. The organs are embedded in the connective tissue capsule which lies over the sclerotic coat o the eye.

MINUTE STRUCTURE (Figs. 9, 10).

In the deepest portion of the larger organs is a lenticular mass of tissue about 0.13 mm. in diameter and 0.07 mm. in thickness (*l.*). It is made up of irregularly shaped masses which are to all appearance structureless, of a pale yellowish-gray color and not affected by the haematoxylin with which the preparation has been stained. Beneath this mass is a thin layer of connective tissue (*c.*) with sparsely scattered nuclei in it, whilst above and around it is a thicker layer of connective tissue (c^1) with very numerous, deeply stained nuclei of variable shape, mostly, however, with their longer axes parallel to the surface of the organ.

The greater part of the organ is made up of a series of delicate fibrils (*f.*). These arise from a thin structureless layer lying upon the connective tissue coat of the lenticular mass just described. They are of extreme tenuity and radiate outwards in all directions from horizontal to vertical, producing in the section the appearance of a fan. The fibrils are, however, none of them exactly straight, but curved in such a way that in the deeper half of their course they are concave towards the axis of the organ and subsequently convex, becoming generally concave again where they merge into the clear zone to be described below. The structureless mass from which they arise does not take up the staining fluid, but the greater part of the fibrils has become very deeply colored. The terminal fifth of each fibril remains unstained and appears to be thinner than the remainder, so that a narrow clear zone appears in the section to bound the surface of the organ (*z.*).

On that side of the organ which may be called the inner, as it is turned towards the remaining organs of the same eye, the connective tissue (*i.c.*) encroaches to some extent over its surface in the form of a thin layer gradually becoming thinner and ceasing at a distance of about 0.01 mm. from the edge. This overlapping portion of the connective tissue contains a few nuclei.

On the other side of the organ it becomes flattened out and extends as a horizontal prolongation for a distance nearly equal to the diameter of the lenticular portion. This part consists of delicate fibrils (*h.f.*) very like those described above, but interspersed between them are strands of the yellowish-gray material described above as forming the small lenticular body in the deepest portion of the organ. Ovoid nuclei are scattered here and there among them. The arrangement of the fibrils here is very much less regular than in the central fan-like portion.

The smaller organs (Fig. 10) present a certain resemblance in structure to the large ones above described. In the deepest portion is a lenticular mass (*l.*) of unstained tissue very closely resembling that above described. It is, however, broader and flatter not only in relation to the size of the organ, but also absolutely, measuring 0.2 mm. in diameter and about 0.05 mm. in thickness. It rests upon a mass of connective tissue (*c.*) much thicker than that forming the base of the larger organs, being in fact thicker than the lenticular mass itself. Above it is a similar layer of connective tissue (c^1.) with thickly distributed nuclei very similar to that described above. The radiating fibrils (*f.*) in this case seem to spring directly from the connective tissue itself without any intervening structureless mass. They are thicker, shorter, and more closely packed than in the larger organs, and as they do not thin out towards their extremities there is no clear zone produced on the outer surface.

These smaller organs, too, appear to be much more brittle than the larger ones, for only in very few cases have I found their sections at all complete.

The only organs which at all approach the pallial organs just described are to be found in the somewhat closely allied species *Abralia oweni*, which has been the subject of a memoir by Professor Joubin ('95). In common with the form under consideration they are of a spheroidal shape and are surrounded in their deeper half by sacs of pigment which may be modified chromatophores. The network of vessels described and figured by Joubin (p. 11 [222], Fig. 6) appears to be replaced by the lacunae above mentioned. Here, however, the resemblance ceases ; it is only with difficulty that the internal structures can be regarded as in any way homologous with each other.

Judging by composition alone, it might be said that the crystalline style (*tige cristalline*) of Joubin is represented by the funnel-like apparatus of *Abraliopsis*, but even here differences obtain, for whilst the style occupies the very centre of the organ, the funnel is hollow and in its middle is found a cellular plug. Furthermore, the style is described as consisting of concentric layers and quite devoid of nuclei, whereas the funnel is made up of rodlike elements, arranged around a centre, it is true, and nuclei, though in small numbers, are present.

There is nothing, apparently, in the organs of *Abralia* corresponding either to the lens-like body, to the central cone, or to the hard posterior cup in *Abraliopsis*, whilst on the other hand the latter shows nothing like the hood (*calotte*) or the network (*reseau*) observed in the former.

In the face of discrepancies such as these in the case of forms which do not seem to be far apart systematically, the elucidation of the functions of the different parts on anatomical or histological grounds seems wellnigh hopeless.

I am not acquainted with any organs at all resembling those found on the eyes of *Abraliopsis hoylei*.

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