

XVI THE CEPHALOPODA OF THE  
INDIAN MUSEUM

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(Plates XXIII—XXIV.)

The collection described in this paper includes all the specimens of Cephalopoda (except shells of *Nautilus*) that have accumulated in the Indian Museum in the course of the last 20 years, since Mr. Goodrich published his "Report on the collection of Cephalopods in the Indian Museum" in the "*Transactions of the Linnean Society*" in 1896.

The Cephalopods in the present list have been taken in most instances by the 'Investigator' off the Indian and Burmese coasts at depths varying from 5 to 947 fathoms, and in one instance a haul was made at 2000 fathoms. Reference to the text will show that many specimens were also collected on shore, and that the area covered extends from the Persian Gulf to China and Japan, and southwards to the Andaman Islands. It will be noted that many interesting specimens owe their capture to the energy of private collectors. Over four hundred specimens are enumerated, consisting of sixteen genera and forty-three species, only one of which, a small *Sepia*, appears to have been hitherto undescribed. There are also some specimens which are too young or in too bad a state of preservation for specific identification. Over half the collection is comprised of individuals of *Loligo indica*, Pfeffer, and *Sepiella inermis* (van Hasselt), in about equal numbers. Goodrich (1896) enumerates fifteen genera and twenty-eight species, five genera and twelve species of which are absent from the present list, but the results of both collections produce a total of twenty-one genera and fifty-five species.

Of these genera *Polypus* comes first with twenty species, and it may be thought that the eighteen members of this genus noted in the present paper have been described at undue length, but anyone who has made a study of these creatures is aware of the difficulties lying in the path to correct identification and will not, I think, regret having as many details as possible, especially as it seems probable that future research may reduce the number of species ascribed to this genus. The *Sepia* family comes next with nine species. In this family so many differences occur in colour, surface and shape, from individual variation, and different modes of preservation, that in many cases specimens very unlike each other have proved to be the same species when the shell was examined. Measurements of a number of shells will be found in

the text showing that the index is longest in young shells (at which period it is natural to expect that growth would be more rapid) and becomes shorter with age.

I have to thank Mr. Robson of the British Museum, and Mr. Nichols of the Dublin Museum, for giving me every facility to examine eastern Cephalopods in their charge.

I am indebted to M. Edouard Lamy for taking much trouble to find a number of specimens in the Paris Museum, and to my colleague Mr. Farran for much help and advice. Mrs. Russell is responsible for the illustrations. The three parts of Dr. Hoyle's "Catalogue of Recent Cephalopoda"<sup>1</sup> have of course been invaluable, as they must always be to anyone working out a large collection of Cephalopoda. All the specimens except where otherwise stated have been preserved in alcohol.

### Family CIRROTEUTHIDAE.

#### *Cirroteuthis grimaldii*, Joubin.

*Cirroteuthis grimaldii*. Joubin, *Bull. L'Inst. Océan.*, No. 226, pp. 1-13, figs. 1-7 (1912).

M  $\frac{743}{1}$  'Investigator' station 233: 6-xii-1897, Andaman Sea, 13° 17' 15" N., 93° 10' 25" E., 185 fathoms—One.

M  $\frac{3274}{1}$  'Investigator' station 332: 12-iv-1904, Andaman Sea, 10° 21' N., 92° 46' 15" E., 279 fathoms—One.

M  $\frac{3283}{1}$  'Investigator' station 333: 19-iv-1904, S. W. of Ceylon, 6° 31' N., 79° 38' 45" E., 401 fathoms—One.

M  $\frac{8127}{1}$  'Investigator' station 361: 24-iii-1906, Arabian Sea, 13° 9' 27" N., 46° 45' 15" E., 540 fathoms—One.

M  $\frac{8133}{1}$  'Investigator' station 381: 28-ii-1908, off Akyab, Burma, 18° 8' N., 93° 40' E., 298 fathoms—One.

These are all in very bad condition but appear to be of the same species. The two last-named and specimen M  $\frac{743}{1}$  are in sufficiently good condition to show that their general contour bears a strong resemblance to the photographs of *C. grimaldii*, Joubin, which is characterized by its egg-shaped body, enormous eyes, and small fins set in a line with the posterior end of the body. Specimens M  $\frac{3274}{1}$  and M  $\frac{3283}{1}$  are much larger than the others and are in fragmentary condition. The dorsal cartilages of M  $\frac{3283}{1}$  and M  $\frac{743}{1}$  were examined as they were protruding from the integument, and resemble fairly well the scheme of Joubin (*l.c.*, fig. 7) designed after feeling the cartilage through the skin.

The dorsal cartilage of the other specimens, felt through the skin, seems to be of the same shape.

It is very like that of *C. meangensis*, Hoyle (1886, fig. 5) except that the outer curves of the "horse-shoe" are less angular.

The fin cartilage resembles that of *C. grimaldii*. All the specimens agree with the type in the arrangement of the single row of arm suckers. The three or four next the mouth are very minute, and are suddenly succeeded by very large ones until

<sup>1</sup> *Proc. Royal Phys. Soc. Edinburgh*, 1886, 1897 and 1909.

about the seventh or eighth sucker, after which they become much smaller and continue gradually diminishing in size until the tip is reached. The cirri commence at about the second or third sucker. Specimen M  $\frac{8127}{1}$  has enormously enlarged suckers on the ventral arms at the edge of umbrella. One of the arms is mutilated and only shows one large sucker, the other has five. Probably these enlarged suckers are connected with a hectocotylus but as the specimen is the best in the collection I have not dissected it. Specimen M  $\frac{3283}{1}$  which has lost almost all of its internal organs has three very large suckers at the edge of umbrella on four of the arms. The fragments of mantle remaining are so twisted that it is impossible to say if these are the four ventral arms.

With regard to measurements M. Joubin has already pointed out the difficulty of obtaining accurate figures from placing a compass on such soft tissues. A few approximate measurements and the number of suckers on some of the arms may be of use.

Eighty-six suckers were found on the type specimen on an arm of 214 mm. Specimen M  $\frac{3274}{1}$  possesses fifty-six suckers on the second left arm of 126 mm. less tip, seventy-two on the first right arm of 140 mm., and seventy-six on the third left of 130 mm.; specimen M  $\frac{3283}{1}$  has eighty-six suckers on the first right arm of 163 mm., seventy-one on the second left arm of 147 mm. less tip, and ninety on the fourth left of 150 mm. less tip. The proportionately larger number of suckers on the arms of the present specimens is probably due to the arm lengths being contracted from preservation in alcohol.

All the specimens have the surface inside the umbrella of a deep chocolate colour and the outer surface and fins much paler.

Specimen number	... M $\frac{743}{1}$	M $\frac{3274}{1}$	M $\frac{3283}{1}$	M $\frac{8127}{1}$	M $\frac{8133}{1}$
	mm.	mm.	mm.	mm.	mm.
End of body to dorsal edge of umbrella	...	61	...	...	61 51
Breadth of body	...	21	...	...	33 22
"  across eyes	...	22	...	...	45 25
Diameter of eye measured through skin	...	10	18	17	12 12
Fin length, insertion to tip	...	21	48	...	20 17
"  "  anterior to posterior margin	...	5	12	...	10 9
Diameter of ordinary largest sucker	...	2	5	3	3 50
"  "  enlarged sucker	...	...	...	6	5 ...

*Distribution.*—Azores, 1900 m. (*Joubin, 1912*).

### ***Cirroteuthis macrope*, Berry.**

*Cirroteuthis macrope*, Berry, *Bull. Bur. Fish.*, XXX, pp. 273-4, pl. 32, figs. 1-3 (1912).

M  $\frac{8284}{1}$  Investigator' station 109: 25-x-1890, S. of Cape Cormorin, 7° 41' N., 78° 21' E., 738 fathoms—One.

This is a damaged specimen intermediate in size between the two examples described by Berry. It is in sufficiently good condition to show clearly the wide mantle-opening, oar-like fins,

and large fused siphon with organ of two small oval pads on either side of dorsal wall near apex. The umbrella, which is very delicate and possibly mutilated, extends for about two-thirds of the length of the arms. The latter have lost almost all their suckers and only doubtful traces of cirri are present. Both eyes seem to measure about the same diameter. In the type specimens the left eye is much larger than the right. The inside of umbrella, and any patches of epidermis remaining on other parts of the body, are dark purple-brown.

Some approximate measurements are appended:—

	mm.
Total length	50
End of body to mantle-opening	15
Width of body	13
From point to insertion of fin	12
Breadth of fin at insertion	4
Width between eyes	16
Length of siphon	9

*Type*.—In U. S. National Museum.

*Type locality*.—Vicinity of San Diego, California, 2113-2259 fathoms, bottom of soft gray mud. Two specimens (*Berry*, 1912).

#### Family ARGONAUTIDAE.

#### *Argonauta böttgeri*, Maltzan.

*Argonauta böttgeri*, Maltzan, *Fourn. de Conch.*, XXIX, p. 163, pl. 9, fig. 7 (1881); Hidalgo, *Rev. Real. Acad. Cien.*, p. 9 (1905) *Argonauta boettgeri*, Dall, *Bull. Mus. Comp. Zool.*, XLIII, pp. 226, 229 (1908); *Argonauta böttgeri*, Smith, *Ann. Mag. Nat. Hist.*, XXI, p. 409, pl. 17, figs. 1-6 (1887); *Berry*, *Bull. Bur. Fish.*, XXXII, pp. 277-280, pl. 48, fig. 5, text-figures 3-7 (1914).

M  $\frac{3+1}{1}$  Investigator, Andamans, Marine Survey of India—One ♀.

This is in very soft condition and the mantle is denuded of epidermis. The dorsal surface of the head and upper arms is buff, spotted with small bluish-black chromatophores. The expanded portions of the first pair of arms are about 5 mm. in diameter. The arm suckers, except on the expanded portions, are very prominent. The web is about equal on all the arms and does not extend higher than the third sucker anywhere. The beak appears to be black when seen with the naked eye, and dark brown when viewed through a lens. The mantle-opening extends to the dorsal margin of each eye. The funnel is very long and its organ is similar to that figured by *Berry* (1914, text-fig. 5). The branches of the median pad measure 4.50 mm. in length and the lateral pads are 4 mm. in length. The end of the mantle is broken, disclosing the gonad with ova. The principal measurements are appended:—

	mm.
End of body to dorsal mantle-margin	14
" " " " eye	16
Breadth of body	7
" " head	7

	mm.
Length of funnel	8
Diameter of eye ...	4
"    " largest sucker ...	1
1st right arm to expanded portion	12
2nd "    "	18
3rd "    "	15
4th "    "	15
1st left "    " to expanded portion	12
2nd "    "	19
3rd "    "	16
4th "    "	14

*Distribution.*—Mauritius and Chagos Islands (*Smith*); Masbate, Philippines (*Smith, Hidalgo*); China Sea and Australia (*Smith*); Hawaiian Islands (*Berry*).

#### Family POLYPODIDAE.

##### *Polypus rugosus* (Bosc), d'Orbigny.

*Sepia rugosa*, Bosc, *Actes Soc. d'histoire nat. Paris*, p. 24, pl. 5, figs 1, 2 (1792); *Octopus rugosus*, d'Orbigny, *Céphalopodes acétabulifères*, p. 45, pls. 6, 23, fig. 2 (1838); Brock, *Zool. Jahrb.*, II, pp. 591-614, taf. 16, figs. 1-4, Jena (1887); Joubin, *Bull. Soc. Zool. France*, XXII, p. 99 (1897); *Octopus granulatus*, Lamarck, *Mém. Soc. d'histoire nat. Paris*, p. 20 (1799); Hoyle, 'Challenger' Rep. XVI (Cephalopoda), pp. 80-81 (1886); Goodrich, *Trans. Linn. Soc. Zool.*, VII, p. 19 (1896); Wülker, *Abh. d. II. Kl. d. k. Ak. d. Wiss.*, III Suppl.-Bd., I Abh., pp. 5, 6 (1910); *Octopus boscii* var. *pallida*, Hoyle, *l.c.*, pp. 81-83, pl. 1, pl. 3, fig. 2; *Octopus polyzenia*, Gray, *British Museum Catalogue*, p. 13 (1849); E. A. Smith, *Rep. Zool. Coll. Indo-Pacific Ocean during voyage H.M.S. 'Alert'*, p. 34, pl. 4, fig. A (1884); (?) *Octopus kagoshimensis*, Ortmann, *Zool. Jahrb.*, V, p. 644, pl. 21, fig. 2 (1888).

- M  $\frac{47.0}{1}$  Investigator, Palk St., Ceylon, Marine Survey of India—One ♀.  
M  $\frac{10.5.2}{1}$  Investigator, station 267: 9-iv-1900, W. of Ceylon, 7° 2' 30" N., 79° 36' E., 457-589 fathoms—One ♀.  
M  $\frac{82.2.1}{1}$  Persian Gulf (*Townsend*)—One ♀.  
M  $\frac{82.7.9}{1}$  Off Santapily, Madras Presidency, x-1909, trawler *Golden Crown*, Bengal Fish. Dept.—One ♂.  
M  $\frac{93.2.5}{2}$  Persian Gulf, 19-v-1914, R. I. M. S. *Palinurus*'—One ♂.

These possess a round body with ventral furrow, a narrower head, and robust arms tapering to fine points, and measuring about two and a half times the length of the ventral mantle.

The umbrella, which is about one-quarter the length of the arms, and extends on their outer margins nearly to the tip, is lowest dorsally and about equal on the other arms. It is tubercled and covered with chromatophores inside and outside between the dorsal pair, and smooth and colourless elsewhere.

The mantle opens just below the eye and about half way between eye and siphon. Siphon conical, free for half its length and extending to, or above, the level of the eyes, and less than half way to umbrella margin; funnel organ **W**-formed and composed of narrow bands. Hectocotylized arm with well-marked sperm canal and very small terminal organ. Some suckers are enlarged on the lateral arms of both male specimens. In colour, all show

the very pronounced difference commented upon by Brock between the dorsal and ventral surface, the scoop out of the umbrella between the dorsal arms being also very marked. The Santapily specimen is of a reddish-purple colour above with an immense number of tubercles and oblong ridges, and a large cirrus at the posterior dorsal edge of eye. The examples M  $\frac{4770}{1}$ , M  $\frac{1055}{1}$  and M  $\frac{9325}{2}$  resemble each other very closely in size and appearance, and are dark grey above with no oblong ridges, but with a great number of round tubercles regularly disposed, and surrounded and intersected by small dark chromatophores, arranged sometimes in masses which causes a handsome appearance like black veins all over the dorsal surface of head, mantle and arms. A trace of this marbling occurs on one side of the Santapily specimen. Ocular cirri are present on specimen M  $\frac{1055}{1}$  and faintly visible on M  $\frac{9325}{2}$  and suppressed entirely on M  $\frac{4770}{1}$ . All four specimens possess a smooth ventral surface scattered thinly with reddish or brown chromatophores on a pale ground. The young specimen M  $\frac{8221}{1}$  is obviously the same species as the three just mentioned, but is without the dark veinings, and shows two rows of large dark chromatophores on the upper arms, in addition to the small chromatophores. Ocular cirri are present, and there are close-set tubercles on the dorsal surface of head and umbrella, but the mantle is nearly smooth. Specimen M  $\frac{1055}{1}$  closely resembled two specimens in the British Museum, one of which labelled "*O. granulatus*," came from the Cape, and the other labelled "*P. polyzenia-granulatus*," came from Thursday Island, Torres Straits.

Many arms are in course of regeneration in M  $\frac{9325}{2}$ . The principal measurements of the other specimens are appended:—

Specimen number	... M $\frac{4770}{1}$	M $\frac{1055}{1}$	M $\frac{8274}{1}$	M $\frac{8221}{1}$
	mm.	mm.	mm.	mm.
End of body to mantle-margin	26	25	39	8
" " " " eye	35	30	52	10
Eye to umbrella	19	19	29	6
Breadth of body	28	28	39	8
" " head	18	18	30	7
1st right arm <sup>1</sup>	ca. 66	70	117	15
2nd " "	" 62	81	123	17
3rd " "	" 80	83	102	18
4th " "	" 81	87	159	18
1st left " "	mutilated.	mutilated.	116	15
2nd " "	... 77	80	119	16
3rd " "	... 75 less tip.	86	146	mutilated.
4th " "	... 77	72	142	17
Hectocotylus	...	...	3	...
Length of funnel	... 12	10	15	2.50
Diameter of largest sucker	... 4	3	6	ca. .75

*Distribution*.—Africa, west and south, Peru, Indo-Malayan Region, Japan, Australia.

<sup>1</sup> Arms much curled up.

**Polypus aculeatus** (d'Orbigny).

*Octopus aculeatus*, d'Orbigny, *Céphalopodes acétabulifères*, p. 53, pl. 7, figs. 1, 2 (1825); pl. 8, fig. 1, pl. 23, figs. 3, 4 (1838).

M  $\frac{8101}{1}$  Investigator, 25-viii-1911, Byikhwaaw Bay, Burma, Marine Survey of India—One ♂.

M  $\frac{82+3-2}{1}$  (?) Burma (*W. T. Blanford*) from coral reef—Five ♂.

These are characterized by a short body, narrower head, and arms about seven times the length of the mantle. The umbrella is highest laterally, attains from one-eighth to one-tenth of the length of the arms, and continues on their outer margins almost to the tip, forming wide membranous expansions. The mantle opens midway between the eye and the siphon, and on a line with the base of the eye. Siphon conical, with a narrow opening, free for about half its length, and reaching above the level of the eyes; funnel organ, in the only specimen examined, **W**-shaped, and dark red on a pale ground; hectocotylyzed arm relatively long, with a wide membranous sperm canal; terminal organ small, narrow, with crenulated edges folded over the transversely-grooved inner channel. Some suckers on the lateral arms are moderately enlarged.

One specimen has had four of its arms mutilated near the base, a sharply-projecting point indicating the commencement of a new limb in each case. Very large cirri occur on the head and near the eyes in all the specimens, and are dispersed also on the dorsal surface of the mantle and umbrella and on the proximal parts of the arms. Some cirri measure as much as 2 mm. in length. In two of the specimens the surface between the large cirri is almost smooth, in others it is very rugose. All have the ventral surface smooth. Colour dull lilac, heavily marked on the dorsal surface with minute purple-black chromatophores. The specimen M  $\frac{82+3}{1}$  was compared with the type in the Paris Museum and appeared to resemble it very closely.

The latter was carefully set up in such a manner that a good comparison could be made. The Indian Museum specimens are, perhaps, a little more purple than the type but nevertheless the colouring and sculpture are very like.

The umbrella in the type is very short and much continued up the arms, and the tip of the hectocotylyzed arm is very minute. Enlarged suckers are present on the second and third arms, the largest being just above the umbrella.

The principal measurements of three specimens are appended:—

Specimen number	...	M $\frac{8101}{1}$	M $\frac{82+3}{1}$	M $\frac{82+1}{1}$
		mm.	mm.	mm.
End of body to mantle-margin		11	17	22
" " " " eye...	...	18	31	32
Eye to umbrella	...	12	22	24
Breadth of body	...	14	21	24
" " head	...	10	15	20

Specimen number	... M $\frac{8101}{1}$	M $\frac{82+8}{1}$	M $\frac{8244}{1}$
	mm.	mm.	mm.
1st right arm ...	57	110 <sup>1</sup>	157
2nd ,, ,, ...	80 less tip.	141	184
3rd ,, ,, ...	80	127	156
4th ,, ,, ...	mutilated.	137	172
1st left ,, ...	63	130	156
2nd ,, ,, ...	98	147	210
3rd ,, ,, ...	62 less tip.	168	223
4th ,, ,, ...	82	163	182
Hectocotylus ...	1'25	2'50	2'25
Length of funnel ...	6	12	15
Diameter of largest sucker ...	1'50	4	5

*Distribution.*—Indo-Malayan and Insular Pacific Regions.

*Type.*—In Paris Museum, a male from Manila.

### Polypus macropus (Risso).

*Octopus macropus*, Risso, *Hist. nat. Europ. méditerr.*, p. 3, pl. iv (1826); Hoyle, *Challenger' Rep.* XVI (Cephalopoda), p. 95 (1886); Ortmann, *Zool. Jahrb.*, III, p. 643, pl. 21 (1888); Jatta, *I Cefalopodi viventi nel Golfo di Napoli*, p. 117, pls. 6, 23, 24 (1896); Joubin, *Bull. Soc. Zool. France*, XXI, p. 99 (1897); *Octopus cuvieri*, d'Orbigny-Férussac, *Céphalopodes acétabulifères*, p. 18, pls. 1, 4, 24, 27 (1838); Appellöf, *K. Svensk. Vetensk. Akad. Handl.*, XXI, p. 6, pl. i (1886); *Polypus macropus*, Hoyle, *Bull. Mus. Comp. Zool.*, XLIII, p. 195 (1904); (?) Hoyle, *Trans. Linn. Soc. Zool.*, XXXI, pp. 36-37 (1907); Wülker, *Abh. d. II. Kl. d. k. Ak. d. Wiss.*, III Suppl.-Bd., 1 Abh., p. 6 (1910); Berry, *Proc. Acad. Nat. Sci. Phil.*, pp. 389-90 (1912a).

M  $\frac{603}{1}$  Indian Seas (*Dr. Armstrong*)—One ♂.

M  $\frac{8220}{1}$  Persian Gulf (*R. Hugh Butler*)—One ♂.

M  $\frac{10303}{2}$  Singgora, Talé Sap, Gulf of Siam, i-ii-1916 (*N. Annandale*)—One ♀

Specimen M  $\frac{603}{1}$  agrees closely with a male example from Naples Bay, purchased by the Dublin Museum from the Zoological Station at Naples. The loose skin, which forms many thick rolls on the nuchal region is a remarkable feature, and both specimens have a closely noded surface with minute chromatophores, and a long funnel indented laterally at the apex so as to produce a lip on the dorsal and ventral walls. The example M  $\frac{603}{1}$  has a ventral median groove of which there is no trace in the Naples specimen. The main characters of M  $\frac{603}{1}$  are, briefly, arms about seven times the length of the mantle; the first pair the thickest and longest, and the only arms with enlarged suckers; umbrella about one-fifth of the arms and continued on their outer margins, highest dorsally; mantle-opening 6 mm. behind the eye and on a level with its lower edge; siphon long, two-thirds of it above the level of the eye, and reaching to within 3 mm. of the edge of umbrella; sperm canal striated faintly in proximal part, smooth elsewhere; terminal organ of hectocotylized arm very small<sup>2</sup>, and narrower than the part of arm immediately preceding it; surface more or less

<sup>1</sup> In course of regeneration.

<sup>2</sup> In the Naples specimen, the terminal organ measures 6.50 mm. on an arm of 140 mm.

closely granulated all over, including inside of arms and umbrella; colour buff with minute dark chromatophores on dorsal surface of mantle and head. Specimen M  $\frac{8220}{1}$  is a dried-up sand-coated specimen, but closely resembles a female from Yokohama in the British Museum which was got by the 'Challenger' Expedition. It differs a good deal from specimen M  $\frac{603}{1}$ , but like it, has the first pair of arms the longest and thickest. Enlarged suckers are present on the four upper arms. The sperm canal is not striated. The hectocotylus is mutilated, but was probably very small and narrower than the part of arm immediately preceding it. The funnel is indented at the apex but does not extend so far as in specimen M  $\frac{603}{1}$ . The umbrella is about one-seventh the length of the arms and is much higher dorsally than ventrally. It does not seem to extend up the arms, which are, however, much shrivelled and each possesses a remarkable dark line on the dorsal surface. A distinct trace of this line occurs in the Yokohama specimen, but it is absent in specimen M  $\frac{603}{1}$ .

The principal measurements are appended:—

Specimen number ...	...	...	M $\frac{603}{1}$ mm.	M $\frac{8220}{1}$ mm.
End of body to mantle-margin ...	...	...	19	32
" " " " eye ...	...	...	28	43
Eye to umbrella ...	...	...	27	27
Breadth of body ...	...	...	26	23
" " " head ...	...	...	21	20
1st right arm ...	...	...	137	mutilated.
2nd " " ...	...	...	133	170
3rd " " ...	...	...	62	83
4th " " ...	...	...	90	137
1st left " " ...	...	...	145	196
2nd " " ...	...	...	128	146 less tip.
3rd " " ...	...	...	105	153
4th " " ...	...	...	87	148
Hectocotylus ...	...	...	3	mutilated.
Length of funnel ...	...	...	17	15
Diameter of largest sucker ...	...	...	3	5

The female from the Gulf of Siam, which was received too late to incorporate full particulars, has the mantle 44 mm. long.

*Distribution.*—Mediterranean, Azores, Canary Islands, Red Sea, Indo-Malayan Region, Japan, Pacific Ocean.

### **Polypus areolatus (de Haan).**

*Octopus areolatus*, de Haan MS., 1835 (*fide* d'Orbigny); d'Orbigny and Férussac, *Céphalopodes acétabulifères*, p. 65 (1838), p. 186 (1845); Hoyle, *Challenger' Rep.* XVI (Cephalopoda), pp. 86-88, pl. 3, figs. 6, 7 (1886); Brock, *Zool. Jahrb.*, II, pp. 610-611 (1887); Ortmann, *Zool. Jahrb.*, III, p. 662 (1888); Joubin, *Revue Suisse Zool.*, II, p. 28 (1894); *Notes Leyden Mus.*, XX, p. 22 (1898); *Octopus ocellatus*, Gray, *Cat. Moll. B.M.* part 1, p. 15 (1849); Appellöf, *K. Svensk. Vetensk. Akad. Handl.*, XXI, p. 8, pl. i, figs. 1, 3 (1886); *Octopus brocki*, Ortmann, *Zool. Jahrb.*, V, p. 645 (1888); *Polypus areolatus*, Hoyle, *Bull. Mus. Comp. Zool.*, XLIII, p. 16 (1904); Wülker, *Abh. d. II. Kl. d. k. Ak. d. Wiss.* III Supple.-Bd., I Abh., p. 6 (1910); Berry *Proc. Acad. Nat. Sci. Phil.*, pp. 393-396, text-fig. 1 (1912a).

M <sup>8272</sup> Investigator station 328: 7-iii-1904, Gulf of Martaban, 14° 46' N., 95° 52' E., 61 fathoms—One ♂.

Brock objects to Hoyle's view that the *O. ocellatus* of Appellöf is the same species as *O. areolatus*, and states that the umbrella in Appellöf's species is weakly developed and that the ocellus is placed close to its edge. A glance at Appellöf's fig. 2 of pl. 1 shows, however, that he placed the ocellus at fully 8 mm. from the edge of the umbrella, and in his description he states that the umbrella is "well developed" (Väl utvecklade) and describes the situation of the ocellus as being "between the base of the second and third arm pair." Appellöf's description and illustration of the terminal organ of the hectocotylized arm, and the widely developed membranous sperm canal with its transverse grooves, closely agrees with the form of hectocotylus in the present specimen, which is, however, characterized by a somewhat shorter body than that of the example figured by Appellöf. It has the mantle widest posteriorly and with a conspicuous ventral furrow. Arms two and a half to three times the length of the body and with prominent suckers, some of which are enlarged on the lateral arms. Umbrella extending to about one-third of the length of the arms, thin, smooth and membranous, except between the dorsal pair, where it is much shorter, thick and tubercled. Umbrella continued on outer margin of arms for more than two-thirds of their length. Ocelli placed midway between eye and edge of umbrella, each consisting of a dark core surrounded by a white ring, and succeeded by a dark outer ring. Mantle opening placed a little below and behind eye, and on a line with ocellus, visible from above. Funnel free for half its length and reaching considerably above level of eye. Funnel organ more like the typical printer's **W** than Berry's illustration (1912a, fig. 1). Dorsal surface of head and mantle closely set with round tubercles; traces of cirri on dorsal edge of eye. The space between each tubercle is covered with minute dark chromatophores which are thinly scattered on the ventral surface, causing the colour to appear grey above and buff beneath. Hoyle (1886, p. 87) remarks that "on the outer surface of each of the four ventral arms are two rows of dark elongated spots." All the arms of the present specimen are thus adorned.

The principal measurements are appended:—

	mm.
End of body to mantle-margin	20
" " " " eye	25
Eye to umbrella	11
Breadth of body	19
" " head	13
1st right arm	44
2nd " "	49
3rd " "	45
4th " "	61
1st left " "	39
2nd " "	52
3rd " "	58
4th " "	56
Hectocotylus	6

	mm.
Length of funnel ... ..	8
Diameter of largest sucker ... ..	2
"    " eye opening ... ..	2
Ocellus ... ..	5

*Distribution.*—Japan (*Wülker, Ortmann, Appellöf, Berry*); Hong Kong and south of Papua (*Hoyle*).

### **Polypus cyanea** (Gray).

*Octopus cyanea*, Gray, *Brit. Mus. Cat.*, p. 15 (1849); Brazier, *Aus. Mus. Cat. Sydney*, p. 7 (1892).

M <sup>253</sup><sub>1</sub> Akyab, Burma (*J. H. Burkill*)—One ♀

This has an elongate body, widest at centre, and quite smooth except for a few very minute tubercles on dorsal mantle and arms. Eyes not prominent and without cirri. Mantle-opening placed just behind eye but much below it. Apex of siphon about on level with eyes and reaching nearly half way to umbrella. Siphon free for almost half its length and appearing to be without a funnel organ. Arms about four and a half times the length of the body and head, and six times the length of the body alone, very robust and long in proportion to size of body; semi-equal, the second and third being the longest, and the fourth a little longer than the first. Suckers very prominent and not very close; in two alternate rows except at the base where a few are placed singly. About the eleventh sucker from the base is very large and has eighteen to twenty radial grooves. The umbrella attains one-third to one-quarter the length of the arms, and is highest laterally, and considerably higher dorsally than ventrally. Colour pale lilac, produced by a sprinkling of minute black or purple dots on a buff ground; ventral surface paler with brownish and purple-red dots. A male specimen in the British Museum, labelled "*Octopus cyanea*, Gray, Moreton Bay, between tide marks, Queensland Museum," very closely resembles this in general appearance, as well as in the absence of ocular cirri, the almost smooth body, the position of the mantle-opening, the shape of the siphon, the order and length of arms and the prominence of the suckers. The colouring of the Australian specimen is a little darker and the chromatophores on the arms are sometimes arranged in circles which is not the case with specimen M <sup>253</sup><sub>1</sub>. It may be useful to add that the hectocotylized arm of the Australian specimen has a minute terminal organ measuring only 2 mm. on an arm of 340 mm. The sperm canal is unusually broad and its clear buff colour is sharply defined from the mottled oral and dorsal surface. Some suckers at the margin of the umbrella are much enlarged on the second and third arms. The principal measurements of specimen M <sup>253</sup><sub>1</sub> are appended:—

	mm.
End of body to mantle-margin ... ..	108
"    "    "    " eye ... ..	125
Eye to umbrella ... ..	100

				mm.
Breadth of body (flattened)	...	...	...	78
Breadth of head	...	...	...	46
1st right arm	...	...	...	342
2nd " "	...	...	...	455
3rd " "	...	...	...	427
4th " "	...	...	...	422
Umbrella between dorsal arms	...	...	...	98
" " ventral "	...	...	...	73
" " 1st and 2nd left arms	...	...	...	128
Diameter of largest sucker	...	...	...	10
" " eye-opening	...	...	...	7
Length of funnel	...	...	...	32
Breadth of funnel at apex	...	...	...	15

*Distribution.*—New South Wales, Queensland, Solomon Islands (Brazier, 1892).

### **Polypus defilippi (Verany).**

*Octopus defilippi*, Verany, *Céphalopodes de la Méditerranée*, p. 30, pl. xi, figs. d. f. (1851); Hoyle, 'Challenger' Rep., XVI (Cephalopoda), p. 8 (1886); Jatta, *I Cefalopodi viventi nel Golfo di Napoli*, pp. 221-224, pl. 4, fig. 2; pl. 24, figs. 4-13; pl. 25, fig. 1 (1896); *Octopus De Filippi*, Targioni-Tozzetti, *Commentario sui Cefalopodi mediterranei del R. Museo di Firenze*, p. 20 (1869); Tiberi, *Bull. Soc. Mal. Ital.*, V, p. 2 (1880); Carus, *Prodromus Faunae Mediterraneae, etc.*, II, Cephalopoda, p. 460 (1890); *Octopus Defilippi*, Tryon, *Manual of Conchology*, I, Cephalopoda, p. 3 (1879); *Octopus de-filippi*, Bergmann, *Sitz.-Ber. Ges. Nat. Freunde Berlin*, pp. 104-109, 3 figs. [Receptaculum seminis] (1903).

M  $\frac{8154}{1}$  Investigator's station 503: 25-1-1913, Mergui Archipelago, shore collecting, Marine Survey of India—One ♂.

Except that it is a little smaller, this specimen exactly resembles the illustration of Jatta (*l.c.*, tav. 4, fig. 2) having the same long narrow body, prominent eyes, and pale greenish-yellow colouring with delicate slightly-defined dark reticulations. The fourth arms are much the longest and thickest, being six or seven times the length of the mantle, while the dorsal pair is only about three times of this length. None of the suckers is specially enlarged. Umbrella attaining about one-eighth of the length of the arms, widest ventrally, and extending prominently on the upper part of arms forming large crests. The mantle opens a little below and at the ventral edge of eye. Funnel small and extending about half way to the margin of umbrella. Two ocular cirri are present over each eye and a few tubercles are scattered on the dorsal surface of the head and mantle. Ventral surface smooth except for a faintly-indicated median groove. The striated sperm canal and small terminal organ of the hectocotylized arm agree with Jatta's description. A Bay of Naples specimen, purchased from the Zoological Station of Naples by the Dublin Museum, has the typical round body represented by Verany, and by Jatta on pl. 24, figs. 10, 12. Jatta mentions that this is due to the mantle of specimens in alcohol becoming contracted, and, therefore, swollen in the middle, restricted at each end, and furnished with a median ventral groove. He describes the surface as being perfectly smooth

except for two ocular cirri. The Dublin Museum specimen is however, much tubercled, even on the ventral surface, where there is also a strong median groove, and in the centre of the posterior end of the mantle there is a slight projection surrounded by a ring of tubercles.<sup>1</sup> The specimen is of a pale purple-gray tint, but agrees with the example M  $\frac{81.5}{1}$  in having the first four suckers placed singly on all the arms, and also in the width of the mantle-opening, the size of the funnel, and its distance from the umbrella-margin, as also in the size of umbrella and the conspicuous development of the white transparent portion of it between the ventral arms. Tryon remarks that this species is certainly very near *P. aranea*, d'Orb., and I thought at first that the example M  $\frac{81.5}{1}$  would probably prove to be it, particularly as *P. defilippi* had not been observed outside the Mediterranean. On comparing M  $\frac{81.5}{1}$ , however, with the type of d'Orbigny in the Paris Museum, I found that the umbrella in *P. aranea* is lower ventrally than dorsally and does not appear to be continued on the arms, which are much slighter in proportion to the size of the body than in *P. defilippi*; the body also is quite round, but that, as in *P. defilippi*, may be due to contraction. *P. aranea* has a very smooth surface and a pale body with very minute round red-brown chromatophores. In the specimen M  $\frac{81.5}{1}$  the chromatophores are minute, oblong and almost black. The principal measurements are appended:—

	mm.			
End of body to mantle-margin	...	...	...	23
"    "    "    "    eye	...	...	...	32
Eye to umbrella	...	...	...	14
Breadth of body	...	...	...	15
"    "    head	...	...	...	11
1st right arm	...	...	...	82
2nd " "	...	...	...	135
3rd " "	...	...	...	46
4th " "	...	...	...	157 <sup>2</sup>
1st left "	...	...	...	80
2nd " "	...	...	...	115
3rd " "	...	...	...	107
4th " "	...	...	...	138 <sup>2</sup>
Hectocotylus	...	...	...	1.50
Diameter of largest sucker	...	...	...	3

*Distribution.*—Mediterranean.

### **Polypus hongkongensis** (Hoyle).

(?) *Octopus punctatus*, Gabb, *Proc. Calif. Acad. Nat. Sci.*, II, p. 170 (1862); Dall, *Ibid.*, III, p. 243, fig. 27 (1866); Verrill, *Blake' Suppl.*, p. 117, pls. 4, 5, fig. 2 (1883); *Octopus hongkongensis*, Hoyle, *Diagnoses I*, p. 224; *Prelim. Rep.*, I, p. 99 (1885); *Octopus punctatus*, Hoyle, '*Challenger' Rep.*, XVI (Cephalopoda), p. 100, pl. 5 (1886); Ortmann, *Zool. Jahrb.*, III, p. 662 (1888); Joubin, *Mém. Soc. Zool. France*, X, p. 110, pl. 9 (1897); *Bull. Soc. Zool. France*.

<sup>1</sup> This would appear to be an abnormality common to several species. It is noted by Hoyle (1886, p. 93) for *Polypus pictus* (Brock), and is figured by Joubin (1903, pl. 1, figs. 7 and 8) for *P. fontianus*, d'Orb.

<sup>2</sup> Less tip.

XXII, p. 98 (1897); *Polypus punctatus*, Wülker, *Abh. d. II. Kl. d. k. Ak. d. Wiss.* III Supple.-Bd., I Abh., p. 7 (1910); *Polypus hongkongensis*, Berry, *Bull. Bur. Fish.*, XXX, pp. 280-4, pls. 35, fig. 3; 36, fig. 1; 39, figs. 3-4; 40, fig. 1 (1912); *Proc. Acad. Nat. Sci. Phil.*, p. 391 (1912).

M  $\frac{8112}{1}$  Investigator' station 237: 13-iv-1898, Andaman Sea, 13° 17' N., 93° 7' E., 90 fathoms—One ♂

M  $\frac{8147}{1}$  'Investigator' station 465: 22-iv-1912, S. of Ceylon, 5° 56' N., 81° 22' E., 109-132 fathoms—One ♀

Specimen M  $\frac{8112}{1}$  agrees exactly with the 'Challenger' example in the British Museum in shape of body and general appearance, distribution of web, brown coloured chromatophores, round tubercles and large cirri under eyes.

The funnel organ was apparently **W**-shaped but the lateral pads have become very indistinct

Specimen M  $\frac{8147}{1}$  is darker, being of a reddish-brown mottled with black on the upper surface. The web is highest laterally but the ventral arms and web are longer than the dorsal. The entire surface, including inside of web, is tubercled, and there are also oblong wart-like folds on the dorsal surface of the body and arms. Funnel organ **W**-shaped.

The principal dimensions are appended:—

Specimen number ...	...	...	M $\frac{8112}{1}$ mm.	M $\frac{8147}{1}$ mm.
End of body to mantle-margin	...	...	14	54
" " " " eye	...	...	16	63
Breadth of body	...	...	12	51
" " head	...	...	9	32
Eye to umbrella	...	...	15	51
1st right arm	...	...	70	140
2nd " "	...	...	62 less tip.	170
3rd " "	...	...	38	190
4th " "	...	...	mutilated.	170
1st left " "	...	...	70	150
2nd " "	...	...	60 less tip.	172
3rd " "	...	...	79	187
4th " "	...	...	67	133 less tip.
Diameter of largest sucker	...	...	1	6
Hectocotylus	...	...	3 less tip.	...

*Distribution.*—Indo-Malayan Region, Japan, Alaska, British Columbia, California.

*Type.*—A male in the British Museum.

*Type locality.*—Off Ino Sima Island, Japan, 345 fathoms.

### **Polypus levis**, Hoyle.

*Octopus levis*, Hoyle, *Diagnoses* I, p. 229; *Prelim. Rep.*, I, p. 104 (1885); 'Challenger' *Rep.*, XVI (Cephalopoda), pp. 98-99, pl. 2, figs. 1-4, pl. 3, fig. 1 (1886).

M  $\frac{4768}{1}$  Investigator,' Indian seas, Marine Survey of India—One ♀.

Compared with the large type male this has the same shaped head and body, and wide web not attaining much development on

the arms. The large type specimen shows no colour but a smaller example exhibits the same peculiar large chocolate coloured chromatophores distinguishing  $M \frac{47.68}{1}$ , which is further characterized by a hard dried-up body with ventral furrow, narrow mantle opening, and siphon extending one-third of the distance to margin of web between ventral arms and having its apex above the line of the eyes. Surface smooth, colour slate-blue<sup>1</sup> above with large chromatophores at sides, paler beneath and freckled with minute dots and paler large chromatophores. Funnel organ **W**-shaped.

Principal measurements :—

	mm.
End of body to eye ... ..	30
Eye to umbrella ... ..	21
Breadth of body ... ..	20
"  "  head ... ..	17
End of body to ventral mantle ... ..	24
1st right arm ... ..	59
2nd " " ... ..	60
3rd " " ... ..	57
4th " " ... ..	56
1st left " " ... ..	60
2nd " " ... ..	62
3rd " " ... ..	56
4th " " ... ..	57
Diameter of largest sucker ... ..	2

*Distribution.*— $52^{\circ} 59' 30''$  S.,  $73^{\circ} 33' 30''$  W., 75 fathoms.

*Type.*—In British Museum, two males (one immature) and two immature females.

### **Polypus januarii** (Steenstrup).

*Octopus januarii*, "Steenstrup, MS., Hoyle, *Diagnoses* I, p. 229; *Prelim. Rep.*, p. 105 (1885); '*Challenger*' *Rep.*, XVI (Cephalopoda), pp. 97-98, pl. 7, figs. 1-4 (1886); *Octopus januarii*, Goodrich, *Trans. Linn. Soc. Zool.*, 2, VII, part 1, p. 19 (1896); *Polypus januarii*, Hoyle, *Bull. Mus. Comp. Zool.*, XLIII, p. 18, pl. 5, fig. 2 (1904a); Berry, *Proc. Acad. Nat. Sci. Phil.*, p. 392 (1912).

$M \frac{51.5}{0}$  Investigator' station 222 : 21-xii-1896, Andaman Sea,  $13^{\circ} 27' N.$ ,  $93^{\circ} 14' 30'' E.$ , 405 fathoms—One ♀.

$M \frac{81.11}{1}$  Investigator' station 332 : 12-iv-1904,  $10^{\circ} 21' N.$ ,  $92^{\circ} 46' 15'' E.$ , 279 fathoms—One ♀.

$M \frac{13.41}{1}$  Investigator' station 297 : 13-iv-1902, Gulf of Oman,  $25^{\circ} 11' 30'' N.$ ,  $57^{\circ} 15' E.$ , 689-700 fathoms—One ♂.

$M \frac{33.48}{1}$  Investigator' station 343 : 19-x-1904, Gulf of Oman,  $23^{\circ} 46' 15'' N.$ ,  $58^{\circ} 31' 50'' E.$ , 609 fathoms—One ♀.

These are all characterized by a round body of very soft consistency, enormous eyes, and arms of from three and a half to five times the length of the ventral mantle. The arms are not so long in proportion to the body as in Hoyle's description, but this is a character depending much on preservation. The first and second pairs seem to be always longer than the others, and slightly thicker

<sup>1</sup> This tint seems like a deposit over a reddish-brown colour.

than the ventral pair. The suckers are small, prominent and far apart; none are enlarged in the male. The umbrella attains to one-third or one-fourth of the arms, is lowest ventrally and about equal elsewhere. It is continued on the outer margins of the arms, but not remarkably so except in the largest specimen. The mantle-opening is placed just below the eye. The funnel is much fused to the head and reaches to about one-third of the distance to the umbrella margin. Two specimens were examined with regard to the funnel organ. One is in too bad condition; but the other, M  $\frac{8111}{1}$ , possesses an oval, somewhat shield-like median pad, and two oblong lateral pads of about half the width of the median one. It is possible that these may have been joined to the median pad at the posterior end. The tip of the hectocotylized arm resembles that figured by Hoyle (1886, pl. 7, fig 2) except that, as in the examples recorded by Goodrich, the ridges are more marked. All the examples are quite smooth and pinkish in colour. The chromatophores are very minute, and of various tints from yellow-brown to purple-red. The principal measurements are appended:—

Specimen number	...	M $\frac{515}{1}$	M $\frac{8111}{1}$	M $\frac{1341}{1}$	M $\frac{3348}{1}$
		mm.	mm.	mm.	mm.
End of body to mantle-margin	...	24	25	37	42
"    "    "    "    eye	...	29	31	54	60
Eye to umbrella	...	...	37	40	70
Breadth of body	...	24	21	30	40
"    "    head	...	18	20	18 <sup>1</sup>	26 <sup>1</sup>
1st right arm	...	118 <sup>2</sup>	96	140	182
2nd " "	...	115 <sup>2</sup>	90	136	201
3rd " "	...	112	mutilated.	65	201
4th " "	...	115	"	117	192
1st left "	...	135	93	mutilated.	185
2nd " "	...	130	85 <sup>2</sup>	124	168
3rd " "	...	122	84	114	172
4th " "	...	76 <sup>3</sup>	75	122	180
Hectocotylus	...	...	...	13	...
Diameter of largest sucker	...	1.50	2	1.50	3

*Distribution.*—Off Barra Grande, Brazil (type locality); Rio de Janeiro, Brazil, and North Pacific, east of Japan (Hoyle); Bay of Bengal and Andaman Sea (Goodrich); Off the Cocos Islands (Hoyle).

### *Polypus tonganus*, Hoyle.

*Octopus tonganus*, Hoyle, *Diagnoses* I, p. 225 (1885); *Prelim. Rep.*, p. 100 (1885); '*Challenger*' *Rep.*, XVI (Cephalopoda), pp. 83-84, pl. 8, figs. 1, 2 (1886); Hedley, *Mem. Austr. Mus. Sydney*, III, pp. 520, 550 (1899); *Polypus tonganus*, Hoyle, *Bull. Mus. Comp. Zool.*, XLIII, no. 1, p. 17 (1904); *Fauna and Geogr. Maldive Laccadive Archip.*, II, suppl. 1, p. 978 (1905).

M  $\frac{796}{1}$  Investigator station 242: 2-x-1898, Arabian Sea, 17° 27' N., 71° 41' E., 56-58 fathoms—One ♂

<sup>1</sup> In bad condition.

<sup>2</sup> Less tip.

<sup>3</sup> In course of regeneration.

This resembles the type male in the British Museum very closely but is a little lighter in colour on the lower surface.

The hectocotylus is exactly like that of the type. It will be remembered that the latter has four enlarged suckers on each lateral arm; the present specimen does not show these probably because the arms are in course of regeneration. The first and third pairs are the most slender at the base and the second and fourth the strongest and thickest.

The web is very short, highest laterally and lowest ventrally. The funnel organ appears to be **W**-shaped but is not in good condition. A few very small tubercles are present on the head and dorsal mantle. Colour buff densely covered above with very minute dark brown chromatophores, paler beneath. The dark dorsal surface of arms presents a strong contrast to the flesh-coloured ventral surface.

The principal measurements are appended:—

	mm.
End of body to mantle-margin ... ..	31
" " " " eye ... ..	38
Eye to umbrella ... ..	16
Breadth of body ... ..	22
1st right arm <sup>1</sup> ... ..	92
2nd " " ... ..	148
3rd " " ... ..	73
4th " " ... ..	200
1st left " ... ..	86
2nd " " ... ..	145
3rd " " ... ..	69
4th " " ... ..	72
Hectocotylus ... ..	ca. 1
Diameter of largest sucker ... ..	3

*Distribution.*—Pacific Insular Region; Indian Ocean.

*Type.*—In British Museum, one male, two females.

### **Polypus bandensis** (Hoyle).

*Octopus bandensis*, Hoyle, *Diagnoses* I, p. 227; *Prelim. Rep.*, I, p. 109 (1885); *Challenger' Rep.*, XVI (Cephalopoda), p. 96, pl. 7, figs. 2 and 10 (1886); Appellöf, *Abh. d. Senckenb. naturf. Ges.*, XXIV, p. 566 (1898).

M <sup>109</sup><sub>1</sub> Investigator' station 152; 12-xii-1893, 11½ miles S. 83° W. of Colombo I.t., 26½ fathoms—One ♀

The extreme length of the third arms is the most important character of this species.

The present example has a roundish body separated from the head by a constriction, and the head is wider than the body owing to the large prominent eyes. The third arms are about six times the length of the mantle and nearly twice as long as any of the other arms. Umbrella very short and membranous, about equal all round, continued on the outer surface of the arms, and forming

<sup>1</sup> A study of the base of the arms shows that the short ones are evidently in course of regeneration.

large webs on the third pair. Siphon pointed, and reaching halfway between the mantle and margin of umbrella. Prominent tubercles surround the eyes and a few are scattered on the dorsal surface of the mantle. The ventral mantle has a median furrow, and eight little pits arranged in a row of four pairs at 1 mm. from the posterior end. As indications of similar pits appear elsewhere, I believe them to be surface indentations due to accidental pressure sustained in transit<sup>1</sup>.

Colour buff with reddish-brown chromatophores, usually thinly distributed, but forming definite patches below each eye on the constriction between head and body, and also on each side of the mantle at about half way between the first patch and the end of the body. The arms show dark patches on their outer surface arranged either in pairs or in single bars.

The principal measurements are appended:—

	mm.
End of body to mantle-margin	6
" " " " eye	7
Eye to umbrella	6.50
Breadth of body	5.50
" " head	6.50
1st right arm	26
2nd " "	27
3rd " "	46 less tip.
4th " "	34
1st left " "	39
2nd " "	36
3rd " "	59
4th " "	35
Diameter of largest sucker	ca. 50

*Distribution.*—Banda, Ternate.

*Type.*—In British Museum, one young specimen.

### *Polypus globosus* (Appellöf).

*Octopus globosus*, Appellöf, *K. Svensk. Vetensk. Akad. Handl.*, XXI, pp. 7, 8, pl. 1, figs. 4, 5 (1886); Ortmann, *Zool. Jahrb.*, III, p. 662 (1888); *Octopus rugosus* (pars), Ortmann, *Zool. Jahrb.*, V, p. 669 (1891); *Octopus globosus*, Goodrich, *Trans. Linn. Soc.*, VII, p. 19, pl. 5, fig. 81 (1896); Joubin, *Bull. Soc. Zool. France*, XXII, p. 98 (1897); Appellöf, *Abh. d. Senckenb. naturf. Ges.*, XXIV, pp. 565, 566 (1898); *Polypus globosus*, Hoyle, *Proc. Roy. Phys. Soc. Edinburgh*, XVII, p. 259 (no description) (1909); Berry, *Proc. Acad. Nat. Sci. Phil.*, p. 388 (1912a).

M  $\frac{38.2}{1}$  Bombay—One ♂.

M  $\frac{527.8}{1}$  Off Gopalpore, 25-28 fms., Sept., 1909, trawler 'Golden Crown', Bengal Fish. Dept.—One ♂.

M  $\frac{54.50}{1}$  Bandra, near Bombay (F. W. Caunter)—One ♂.

The globular body, small mantle-opening, ventral furrow, order of arms, and the colouring and sculpture of these three little specimens closely agrees with the description of the type. The umbrella, which is about one quarter the length of the arms,

<sup>1</sup> All the specimens were wrapped in muslin and closely packed in soldered in boxes, and a few specimens had metal labels.

and about equal all round, is so membranous as to be almost transparent, while that of the type is described as "quite thick", but the much smaller size of the present examples may account for the difference. It is continued up the arms, as in Appellöf's (1886, p. 8) description, "in the form of two keels on their outer sides." The terminal organ of the hectocotylized arm resembles Goodrich's illustration, and appears to have no striae in the concave part; the sperm canal, on the contrary, is transversely striate throughout. In the two largest specimens the arms are bent back over the head, and one or two suckers are markedly enlarged on the lateral arms. In the specimen M  $\frac{827.8}{1}$  the arms are only partially bent over the head, the terminal organ of the hectocotylized arm is very short, and looks as if it was only in process of formation, and no suckers appear to be enlarged on the lateral arms; two rows of large dark chromatophores are present on all the arms, and on the dorsal mantle a few large, almost black, chromatophores are interspersed with small brown ones, while on the ventral mantle the large dark spots only are present, being placed about 1 mm. apart. The specimen M  $\frac{545.0}{1}$  was found in a hole in a rock at low tide.

The principal measurements are appended:—

Specimen number ...	M $\frac{382}{1}$	M $\frac{545.0}{1}$	M $\frac{827.8}{1}$
	mm.	mm.	mm.
End of body to mantle-margin	12	13	6
" " " " eye	17	15	9
Breadth of body ...	14	14	7
" " head ...	12	12	8
1st right arm ...	64	43	19 less tip.
2nd " " ...	72	50	24
3rd " " ...	59	44	20
4th " " ...	69	48	22
1st left " " ...	60	44	20
2nd " " ...	71	53	22 less tip.
3rd " " ...	68	51	22
4th " " ...	62	44	22
Hectocotylus ...	4	ca. 3	ca. .25
Length of funnel ...	5	ca. 5	2.50
Diameter of largest sucker ...	3	2	1

*Distribution.*—Japan (*Appellöf, Joubin*); Straits of Malacca, Kabusa Islands, Nicobar Islands, Bombay, Ceylon (*Goodrich*).

*Type.*—In Zoological Museum, Upsala University, two females.

### **Polypus fusiformis (Brock).**

*Octopus fusiformis*, Brock, *Zool. Jahrb.*, V, p. 601, pl. 16, figs. 1 and 2 (1887); *Octopus pisiformis*, Hoyle, *Proc. Royal Phys. Soc. Edinburgh*, p. 5 (merely listed) (1897).

M  $\frac{232.3}{1}$  Palk Straits, south of India—Two ♀

These are characterized by a very long narrow body with extremely narrow neck and prominent eyes; mantle-opening so wide that it is visible from above; arms of about five times the length of the body and tapering to very fine points; umbrella

extending about one-fifth of the length of the arms, and with indications showing that it was continued on their outer margins; funnel long, conical, and adherent for two-thirds of its length; funnel organ in bad condition in both specimens; surface smooth, except for a few small tubercles, chiefly on the dorsal surface of the mantle, head and umbrella; no cirri; colour brownish above, paler below; dorsal surface with very many minute dark chromatophores, which are fewer, and of a reddish-brown colour, ventrally. These seem to agree with Brock's description very closely, except that he describes the umbrella in his specimen to be highest ventrally, and prolonged in a well developed swimming membrane to the points of the arms. In the largest of the present specimens the umbrella is slightly highest dorsally, and in the other example it is about equally developed all round. Brock remarks that this species "is excellently characterized by the long spindle-shaped body, which is completely like a *Loligo* without fins", and that no species already described resembles it.

An example of *Cistopus indicus*, Gray, in the British Museum, bears, however, a strong superficial resemblance in colour and form, but possesses arms seven or eight times the length of the body, and an umbrella about one-eighth of the arms. As, however, a careful examination fails to reveal any trace of pouches between the arms in the present specimens, I have no doubt that they belong to the form described by Brock. Steenstrup is very doubtful whether d'Orbigny's two figures of *Cistopus indicus* represent the same species. "He is disposed to regard the type of Rapp's species as having been a true *Octopus* and for the form with pouches between the arms he has adopted the name *Cistopus bursarius*" (Hoyle 1886a., p. 19). It seems, therefore, possible that Brock's form may be identical with the type of Rapp's species.

The principal measurements of the present examples are appended:—

Specimen number ...	...	...	M 8232	M 8233
			mm.	mm.
End of body to mantle-margin	...	...	43	43
" " " " eye	...	...	67	60
Eye to umbrella at left side	...	...	50	36
" " " " right "	...	...	35	36
Breadth of body	...	...	24	21
" " head	...	...	22	16
" " neck	...	...	15	9
1st right arm	...	...	200	155
2nd " "	...	...	185	143
3rd " "	...	...	128	156
4th " "	...	...	135	143
1st left arm	...	...	162	151
2nd " "	...	...	167	160
3rd " "	...	...	135	137
4th " "	...	...	125	110
Length of funnel	...	...	22	16
Diameter of largest sucker	...	...	6	3

*Distribution.*—Amboina, a male presented by the natives.

***Polypus microphthalmus* (Goodrich).**

*Octopus microphthalmus*, Goodrich, *Trans. Linn. Soc.*, VII, p. 20, pl. 5, figs. 83, 84 (1896).

<sup>10072-8</sup><sub>1</sub> Karnaphuli River, Chittagong, Dec., 1914 (*A. C. Chowdhury*)  
— Two ♀

These have a long narrow body with a yet narrower head, wide mantle-opening placed a little below and in line with the eye,<sup>1</sup> visible from above; eyes small; siphon with broad apex extending above the eyes and half-way to umbrella margin; free for half its length; no trace of funnel organ in either, although the specimens are in very good condition; arms not very tapering at the tips, and about two and a half times the length of the body. Web lowest ventrally, and highest in both at the right side, extending to about one-third of the length of the arms but not continued up them. Suckers small and much elevated, very like Goodrich's illustration (pl. 5, fig. 83). Surface quite smooth everywhere. Colour white, speckled with minute, dark-grey or purple-black, round chromatophores, which are most numerous on the dorsal surface of head and mantle where they form occasionally elongate grey smears. Larger chromatophores, measuring about 50  $\mu$ m., are also present on the mantle and form two rows up each arm, each spot being placed about 3 mm. apart. These rows are very ornamental, and are especially distinct on the umbrella region. The inner surface of web and oral aspect of arms is sparsely sprinkled with small dots. There is a tendency, especially in the smaller specimen, to form pockets in the umbrella. These are not to be compared to the aquiferous pouches of *Cistopus indicus*, Gray, as they are merely tranverse or oblique folds of the web extending from one arm to the next at about the middle of umbrella. They are not confined to any particular pair of arms but are most developed between the laterals, where the umbrella is widest, and are scarcely indicated between the ventral pair.

This delicately-pretty species seems to differ from the other more or less pale and smooth-skinned Polyps of this region chiefly by its small eyes, wide mantle-opening, and short arms possessing very prominent suckers and with web not continued up them. *Polypus elegans* (Brock), *P. fusiformis* (Brock) and *P. pricei* (Berry), are perhaps the nearest to it.

*P. elegans* has, however, very prominent eyes, a pointed funnel, much longer arms, and chromatophores which "almost vanish in alcohol." *P. fusiformis* has a narrower body and head, and longer arms and web, and *P. pricei* is of much more delicate consistency with huge eyes and a longer web.

The principal dimensions are given below: —

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<sup>1</sup> One specimen has the mantle-opening at one side placed as in the type, *e.g.*, at "rather more than halfway from the siphon to the eye."

Specimen number	...	...	M $\frac{1077}{1}$ mm.	M $\frac{1078}{1}$ mm.
End of body to mantle-margin	...	...	26	31
Breadth of body	...	...	20	22
" " head	...	...	15	14
Eye to umbrella	...	...	20	23
Length of funnel	...	...	11	13
1st right arm	...	...	65	67
2nd " "	...	...	64	75
3rd " "	...	...	83	81
4th " "	...	...	82	76
Diameter of largest sucker	...	...	1.75	1.75

*Distribution.*—Port Blair, Andaman Islands.

*Type.*—In Indian Museum, Calcutta, a female.

### **Polypus herdmani, Hoyle.**

*Polypus herdmani*, Hoyle, *Rep. Pearl Oyster Fish. Gulf of Manaar*, p. 187, pl. 1 (1904); Hoyle, *Proc. Zool. Soc. London*, p. 454 (1907).

M  $\frac{8235}{1}$  Pearl Banks, Ceylon (*T. Southwell*)—One ♀

This has a round body with a median ventral groove; mantle-opening placed a short distance below and behind the eyes, and extending a little less than half round the body; arms stout and nearly four times the length of the mantle; suckers apparently ceasing at a short distance from the tip of each arm; umbrella extending about one-fourth of the length of the arms, continuing moderately on their outer margins, lowest dorsally and highest between the two ventral pairs; siphon small, not passing the level of the eye, and reaching nearly half way to the edge of umbrella; ocellar spots (each consisting of a dark oval patch surrounded by a narrow lighter coloured ring) placed about half way between the eye and the edge of umbrella; numerous elongated warts and tubercles placed chiefly round eyes and on dorsal surface of head and umbrella; inside of umbrella wrinkled but not tubercled. Colour greyish-brown, produced by minute brown chromatophores on a buff ground; ventral surface paler and browner. It will be seen from the above notes that this specimen seems to differ from the description of the type only in having a somewhat smaller mantle-opening, and that the ocellar spots are placed a little nearer the umbrella. The latter difference may be accounted for by contraction, many nuchal wrinkles being present.

The principal measurements are appended:—

	...	...	...	mm.
End of body to mantle-margin	...	...	...	8
" " " " eye	...	...	...	12
Eye to umbrella	...	...	...	8.50
Breadth of body	...	...	...	8
" " head	...	...	...	9
1st right arm	...	...	...	25 <sup>1</sup>
2nd " "	...	...	...	.. mutilated.
3rd " "	...	...	...	31

<sup>1</sup> All the arms are much curled up, so that measurements can only be regarded as approximate.

				mm.
4th right arm	...	...	...	28
1st left arm	...	...	...	26
2nd " "	...	...	...	28
3rd " "	...	...	...	32
4th " "	...	...	...	mutilated.
Length of funnel	...	...	...	3.50
Diameter of largest sucker	...	...	...	1
" " eye-opening	...	...	...	1
Ocellus	...	...	...	2

*Distribution.*—Ceylon (type locality); Zanzibar (Hoyle).

### **Polypus arborescens, Hoyle.**

*Polypus arborescens*, Hoyle, *Rep. Pearl Oyster Fish. Gulf of Manaar*, p. 189, pl. 2, figs. 8, 9, 12; pl. 3 (1904); *Fauna and Geogr. Maldive Laccadive Archip.*, II, suppl. 1, p. 979 (1905); *Proc. Zool. Soc. London*, p. 454 (1907).

M <sup>234</sup> Pearl Banks, Ceylon (*T. Southwell*)—One ♂.

This possesses a round body with a constriction at the neck, and a mantle-opening placed about halfway between the eye, and an unusually broad siphon; the latter has a blunt apex, and reaches nearly halfway to the margin of umbrella. The arms are about three times the length of the mantle, and are bent back over the body revealing that the first four suckers on each arm are placed singly, and that all have the eighth, ninth and tenth suckers enlarged. Umbrella lowest dorsally, extending about one-third of the length of the arms, and continued on their outer margins. Terminal organ of hectocotylyzed arm very small. Colour of body grey with dark lines; arms reddish with light coloured patches, each of which is the seat of a cirrus. Cirri very numerous even on the ventral surface, many being much branched and measuring 2 mm. in length.

The principal measurements are appended :—

				mm.
End of body to mantle-margin	...	...	...	6
" " " " eye	...	...	...	8
Breadth of body	...	...	...	5
" " head	...	...	...	7
1st right arm	...	...	...	18
2nd " "	...	...	...	20
3rd " "	...	...	...	19
4th " "	...	...	...	22
1st left arm	...	...	...	mutilated.
2nd " "	...	...	...	19
3rd " "	...	...	...	21
4th " "	...	...	...	21
Hectocotylus	...	...	...	50

*Distribution.*—Indian Ocean; Zanzibar.

### **Polypus hoylei, Berry.**

*Polypus hoylei* Berry, *Proc. U. S. Nat. Mus.*, XXXVII, pp. 407-8, text-fig. 1 (1909); *Bull. Bur. Fish. U. S. A.*, XXXII, pp. 296-298, text-fig. 15, pl. 48, figs. 2-4, pl. 55, fig. 1 (1914).

- M  $\frac{8123}{1}$  Investigator station 379 : 8-x-1905, Persian Gulf,  $28^{\circ} 59' N.$ ,  $50^{\circ} 3' E.$ , 25 fathoms—One ♂.
- M  $\frac{8125-6}{1}$  Investigator station 360 : 20-xii-1905, Arabian Sea,  $13^{\circ} 36' N.$ ,  $47^{\circ} 32' E.$ , 130 fathoms—Two ♂.
- M  $\frac{8144}{1}$  'Investigator' station 464 : 22-iv-1912, S. of Ceylon,  $6^{\circ} 2' 30'' N.$ ,  $81^{\circ} 29' E.$ , 52-68 fathoms—One ♀

These agree very closely with Berry's full description and excellent figures. All are characterized by a soft body ; very large eyes with small openings, stout arms of about two and a half times the length of the mantle : a semitransparent umbrella extending about equally (slightly less between ventral pair) on all the arms for from one-third to nearly one half of their length, and continued along their outer margins in membranous expansions ; a very small mantle-opening ; and funnel organ of two V-shaped pads.

The tip of the hectocotylized arm is stout and broad, and the usual transverse grooves are very obscure in two examples, and absent in the third.

The male specimens show no special enlargement of the suckers. The ventral mantle is divided by an incipient groove in one specimen only.

In three examples the funnel is free for the anterior third, or less, of its length, in the other it is totally fused to the head. The latter specimen is from comparatively shallow water, but the fused funnel, when opened, disclosed the same peculiar type of organ and the specimen did not appear to differ from the rest in any other character. Two examples exhibit clearly two cirri near each eye, one being placed above and the other below its dorsal edge. The sculpture and colouring are very striking ; each of the numerous tubercles is surrounded by a dotted circle of minute reddish-brown chromatophores, producing a somewhat star-like, or white-spotted pattern. The tubercles are sometimes continued on the ventral surface, and a few may be observed on the inner dorsal surface of the umbrella. In two specimens the dorsal chromatophores are so dense as to present a purple-red tone, and the lower surface appear much paler by contrast.

Three of Berry's specimens were taken at 257-460 fathoms, and the remaining one off the Hawaiian Islands, depth unknown. The present examples show that the species does not restrict its range to deep water.

The principal measurements are appended :—

Specimen number	...	M $\frac{8123}{1}$	M $\frac{8125}{1}$	M $\frac{8126}{1}$	M $\frac{8144}{1}$
		mm.	mm.	mm.	mm.
End of body to mantle-margin	...	31	32	25	30
" " " " eye	...	40	49	38	48
Eye to umbrella	...	30	42	22	31
Breadth of body	...	28	30	26	38
" " head	...	29	29	22	29
1st right arm	...	65	... <sup>1</sup>	67	96
2nd " "	...	75	... <sup>1</sup>	70	92
3rd " "	...	47	60	45	... <sup>1</sup>

<sup>1</sup> In course of regeneration.

Specimen number	...	M $\frac{8123}{1}$	M $\frac{8125}{1}$	M $\frac{8126}{1}$	M $\frac{8144}{1}$
		mm.	mm.	mm.	mm.
1st left arm	...	... <sup>1</sup>	82	69	91
2nd " "	...	80	... <sup>1</sup>	65	100
3rd " "	...	... <sup>1</sup>	... <sup>1</sup>	... <sup>1</sup>	93
4th " "	...	... <sup>1</sup>	85	... <sup>1</sup>	93
Hectocotylus	...	6	7	5	...
Diameter of largest sucker	...	2	2	1.50	2

*Distribution.*—In the archibenthal region of the Hawaiian Islands.

*Type.*—In U. S. National Museum, an adult male.

### *Polypus pricei*, Berry.

(Pl. XXIII, figs. 7-8).

*Polypus pricei*, Berry, *Proc. Acad. Nat. Sci. Phil.*, pp. 73-5 (1913);  
*Polypus* juv., Berry, *University of California Publications in Zool.*,  
 VIII, p. 303, 304 (1911).

M  $\frac{8129-31}{1}$  Investigator station 366: 10-iv-1906, Arabian Sea, 24° 45' N., 63° 50' 15" E., 544 fathoms—Three ♂.

This species possesses the delicate and fragile appearance of a pelagic organism, and is so transparent that the venous system can be distinctly traced, without a lens, all about the head and up each arm. The body is soft and elongate, and the head is occupied by large prominent eyes. The arms are two and a half times the length of the body, and have small but very prominent suckers placed rather far apart; none are specially enlarged. The hyaline umbrella attains more than one-third of the length of the arms, continues a little on their outer margins, and is slightly less between the ventral pair. Berry describes the umbrella as extending about equally between all the arms for "perhaps a twelfth of their length." His specimens were, however, all taken from the stomach of a salmon and it seems reasonable to suppose that the fragile membrane constituting the umbrella might easily suffer injury under such conditions. The mantle opens just below the eye. The funnel has an unusually broad apex, and the funnel organ is so peculiar that two specimens were examined, and both were found to agree exactly. The median organ consists of two very small, oblong, widely-spaced pads, placed rather near the anterior margin of the funnel, and single lateral pads of similar shape and size are also present. In the smallest specimen the median pads measure about 1.50 mm. in length, and the space between them is about 3 mm. Owing to the condition of Berry's specimens, he was unable to give a drawing of the funnel organs which is therefore given here (pl. xxiii, fig. 8). The hectocotylus (not observed in the type) is also figured (pl. xxiii, fig. 7). The terminal organ is small, and the usual transverse furrows are faintly marked in the largest specimen, and almost invisible in the others;

<sup>1</sup> In course of regeneration.

the sperm canal is moderately defined. All the examples have a perfectly smooth surface and are pale buff in colour with minute yellow-brown chromatophores, interspersed with a few larger ones. "The two alternating longitudinal rows of large light-coloured chromatophores" described by Berry as decorating the outer surface of each arm are very conspicuous in the present specimens in parts where the outer skin has been rubbed off.

Some measurements of the largest and smallest examples are appended:—

Specimen number	...	...	M $\frac{8120}{1}$ mm.	M $\frac{8131}{1}$ mm.
End of body to mantle-margin	...	...	26	20
" " " " eye	...	...	34	27
Eye to umbrella	...	...	28	13
Breadth of body	...	...	20	13
" " head	...	...	14	10
1st right arm	...	...	70	54
2nd " "	...	...	64	53
3rd " "	...	...	41	30
4th " "	...	...	71	47
1st left " "	...	...	70	48 less tip.
2nd " "	...	...	72	49
3rd " "	...	...	70	mutilated.
4th " "	...	...	68	47
Hectocotylus	...	...	2.50	1.75
Length of funnel	...	...	14	12
Diameter of largest sucker	...	...	1	.75
Diameter of eye	...	...	7	5

*Distribution.*—Off Point Pinos, Monterey Bay, California; four specimens from the stomach of a salmon (*Onchorhynchus tshawytscha*). Santa Catalina Island, California.

*Type.*—In the Stanford University Collections, four female specimens.

### Polypus sp.

M  $\frac{8285}{1}$ . Locality lost—One ♀

This would appear to have been preserved in alcohol for a long period, all trace of chromatophores having faded, leaving the specimen of a uniform dull pale-green colour. Body ovoid, firm, much wrinkled, but appearing to possess many tubercles on the dorsal surface and to be smooth below. A narrow fold of skin, more developed laterally than posteriorly, divides the dorsal from the ventral region. Hoyle (1886, p. 89) says with regard to a similar character in *P. australis*: "It is doubtful what value " is to be attached to the raised ridge mentioned above; it is to " be seen in other species under certain conditions, possibly due " either to different modes of preservation or to varying states " of contraction; nevertheless, in the majority of forms it is never " observed, and I am therefore inclined to attribute to it a " certain systematic importance."

This example does not, however, agree with any of the species hitherto described as possessing a carinated membrane. The head is a little narrower than the body and there is a large

conical cirrus on the posterior dorsal edge of each eye, with a smaller cirrus at the anterior dorsal edge. No nuchal constriction; eyes not prominent. Arms about twice the length of the body, thick and muscular, tapering to fine points. Umbrella highest laterally, extending nearly one-third of the length of the arms, measuring 80 mm. between the dorsal and 70 mm. between the ventral pair; continued on outer margins of arms. Mantle-opening placed nearly at the ventral edge of eye and but little below it. Siphon conical, about half of its length projecting above level of eyes; funnel organ **W**-shaped, the median pads being very wide and touching one another throughout most of their length; the lines forming the commencement and end of the "**W**" meet in a point and all the other angles are rounded.

In the short arms, ocular cirri, and the deep scoop out occurring on the umbrella margin between dorsal arms, this resembles *P. rugosus*. It differs, however, in the long narrow body and the broad funnel organ to the specimens referred to *P. rugosus* in the present paper. Compared with an example of *P. vulgaris* from Plymouth<sup>1</sup>, this has a longer and narrower body, a wider mantle-opening, larger suckers, a higher umbrella dorsally, and a blunter apex to the siphon; the latter also reaches higher above the eye than in *P. vulgaris*. The ventral mantle in the Plymouth specimen measures 85 mm. in length and 84 mm. in breadth, and the distance from the end of the body to the eye is 100 mm.

The principal measurements of the specimen M <sup>8285</sup><sub>1</sub> are as follows:—

	mm.
End of body to mantle-margin	128
"    "    "    "    " eye	146
Eye to umbrella	88
Breadth of body	89
"    "    "    "    " head	67
1st right arm	... mutilated.
2nd " "	287
3rd " "	270
4th " "	278
1st left " "	... mutilated.
2nd " "	"
3rd " "	"
4th " "	277
Diameter of largest sucker	16
"    "    "    "    " eye-opening	9
Length of funnel	55
Breadth of funnel at apex	15

### Polypus sp.

M <sup>8242</sup><sub>1</sub> Kilakarai, Ramnad District, Gulf of Manaar, South India, from coral reefs, Feb. 1913 (*S. W. Kemp*)—One ♀

This is too small to determine with certainty. It is characterized by an oblong body; very prominent eyes, each having a

<sup>1</sup> Kindly forwarded by the Marine Biological Laboratory, Plymouth, May 1914.

large four-lobed cirrus at the centre of its dorsal edge; arms about three times the length of the mantle; umbrella about a quarter the length of the arms, a little higher laterally, about equal elsewhere, not continued on outer margins of arms; mantle-opening placed just behind, and on a level with, the posterior end of the eye; siphon reaching about half way to the edge of umbrella. Colour above greyish, produced by minute red-brown chromatophores closely sprinkled on a buff ground; paler below, with fewer and larger chromatophores. On the outer surface of each arm there is a row of four to six large dark chromatophores which cease at about the edge of the umbrella, or, more rarely, a little above it. Numerous small pointed tubercles are scattered over the dorsal surface. The ventral mantle is smooth except for a median groove. Compared with the descriptions of Hoyle, Wülker and Berry of young specimens of this genus, the present example seems to be nearest to *Polypus* H. (Hoyle, 1904, p. 197) and *Polypus* M. (Hoyle, 1907, p. 455).

The principal measurements are appended:—

	mm.
End of body to mantle-margin ... ..	5
" " " " eye ... ..	6
Eye to umbrella ... ..	4
Breadth of body ... ..	4
" " head ... ..	5
1st right arm ... ..	19
2nd " " ... ..	mutilated.
3rd " " ... ..	17
4th " " ... ..	18
1st left " ... ..	17
2nd " " ... ..	20
3rd " " ... ..	17
4th " " ... ..	14

### *Polypus* sp.

M  $\frac{9006}{2}$  Investigator station 557: 1-xi-1913, Port Maria, Elphinstone I., 12° 23' 15" N., 98° 2' 00" E., shore collecting—One ♀

This young example does not seem to agree with the characters of any of the described species, and the comparison is rendered more difficult by the mutilation of the ventral arms which are represented only by stumps with the first two suckers, and as a consequence of this much of the umbrella is also absent. The principal characters are: elongate body; prominent eyes; arms two and a half times the length of the mantle, with large suckers, the first four being placed singly; umbrella (where present) about one-fifth the length of the arms, continued conspicuously on the outer margins of the arms almost to the extremity; mantle-opening at ventral edge of eye; siphon somewhat pointed and reaching above arm roots, siphonal organ probably **W**-shaped but is not in good condition; dorsal surface, and inside of umbrella between dorsal arms, much wrinkled and with many small tubercles, the latter becoming less numerous on the mantle which has a smooth ventral surface without a median groove, only a few elongate

wrinkles being present. Ocular cirri not apparent. Colour buff with numerous minute dark chromatophores which are equally small, but much fewer, ventrally. This approaches *P. rugosus* more than any other species in the collection, but the eye, in the examples which have been referred in the present list to that species is lower in regard to the position of the siphon than it is in M  $\frac{2006}{2}$ , and this would seem to be a character less dependent on modes of preservation than such differences as the elongate shape of the body and the absence of ocular cirri.

The principal measurements are appended:—

	mm.
End of body to mantle-margin . . . . .	19
"  "  "  "  "  eye . . . . .	25
Eye to umbrella . . . . .	10
Breadth of body . . . . .	12
"  "  head . . . . .	12
1st right arm . . . . .	39
2nd  "  " . . . . .	46
3rd  "  " . . . . .	47
4th  "  " . . . . .	mutilated.
1st left arm . . . . .	38
2nd  "  " . . . . .	45
3rd  "  " . . . . .	50
4th  "  " . . . . .	mutilated.
Length of funnel . . . . .	6
Diameter of largest sucker . . . . .	2

### *Eledonella diaphana* (Hoyle).

*Fapetella diaphana*, Hoyle, *Diagnoses*, I, p. 232; *Prelim. Rep.*, I, p. 108 (1885); *Eledonella diaphana*, Hoyle, '*Challenger*' *Rep.*, XVI (Cephalopoda), pp. 187-8, pl. 9, figs. 3-6 (1886); *Bull. Mus. Comp. Zool.*, XLIII, No. 1, p. 22, pl. 5, fig. 11 (1904); Joubin, *Res. Camp. Sci. Monaco*, XVII, pp. 37-39, pl. 2, figs. 5-7 (1901); *C. R. Acad. Paris*, XXXVI, p. 101 (1903).

M  $\frac{1211}{1}$  Investigator station 273 : 27-xii-1900, Laccadive Sea, 12° 47' N., 73° 44' 45" E., 823-870 fathoms—One.

M  $\frac{1451}{1}$  'Investigator' station 315 : 12-iv-1903, S. of Andaman Islands, 10° 6' N., 92° 29' E., 705 fathoms—One.

Specimen M  $\frac{1211}{1}$  agrees closely with Hoyle's description of the type and it is interesting to note that some of the suckers have a circular opening and others the quadrangular or triangular form which Hoyle thought was probably due to shrinking. The siphon extends two-thirds of the distance to the umbrella margin and its organ is a  $\blacktriangle$ -shaped pad. The third arms are nearly as long as the mantle. Colour pale with red-brown spots.

Specimen M  $\frac{1451}{1}$  differs a little from the type but agrees very closely with the illustrations and measurements of an almost similar sized specimen referred by Joubin (1901) to this species. The arms and siphon are shorter and the umbrella higher than in the type. The latter is highest between the dorsal arms, extending to two-thirds of their length, and attains about half the length of the other arms. The mantle extends 6 mm. below and 7 mm. at either side of the visceral sac. About eighteen suckers are

present on the longest arm. Neither specimen shows any trace of a hectocotylus.

The principal measurements are appended:—

Specimen number	...	...	M $\frac{1211}{1}$ mm.	M $\frac{1451}{1}$ mm.
End of body to dorsal mantle-margin	...	...	33	23
" " " " eye	...	...	39	27
Eye to umbrella	...	...	7	6
Breadth of body	...	...	22	20
" " head	...	...	12	12
Length of eye	...	...	7	6
" " siphon	...	...	10	5
1st right arm	...	...	mutilated.	ca. 7
2nd " "	...	...	19 <sup>l</sup>	ca. 11
3rd " "	...	...	29 <sup>l</sup>	mutilated.
4th " "	...	...	22	9
1st left "	...	...	20	9
2nd " "	...	...	22	mutilated.
3rd " "	...	...	31 <sup>l</sup>	14
4th " "	...	...	21	10

*Distribution.*—North of Papua (Hoyle, 1886); Between Madeira and Morocco (Joubin, 1901); Tropical Pacific (Hoyle, 1904); Off Cape Verde (Joubin, 1903):

### Elledonella sp.

M  $\frac{8110}{1}$  Arabian Sea, 947 fathoms—One.

M  $\frac{8137}{1}$  'Investigator' station 393: 21-x-1911, Bay of Bengal, 7° 21' 6" N., 85° 7' 15" E., net at 400 fathoms, soundings 2000 fathoms—One.

M  $\frac{8141}{1}$  'Investigator' station 462a: 20-iv-1912, Bay of Bengal, 9° 8' N., 87° 25' E., 475 fathoms—One.

Specimen M  $\frac{8110}{1}$  consists of fragments of a very large example. The siphon, which has a  $\Lambda$ -shaped organ, measures 15 mm. in length and 6 mm. at the apex which is flattened. None of the arms shows any sign of a hectocotylus, and as they are all detached from the body their order cannot be ascertained. The shortest measures 100 mm. in length and possesses thirteen suckers arranged singly, but unequal gaps and fibres of muscle show that many suckers are missing. The six largest are placed on the distal half and measure nearly 5 mm. in diameter by 5 mm. in height; the most distal sucker measures 1.25 mm. in diameter and the final 8 mm. of arm is devoid of suckers. All are shaped as described by Hoyle for *E. diaphana* and have a quadrangular opening caused by four rounded lips folded towards each other as in Berry's figure of a single sucker of *E. heathi*, Berry (1912, pl. 33, fig. 3). The longest arm measures 171 mm. and has eleven suckers, the largest measuring 7 mm. in diameter at the base. The other arms measure 166 mm., 167 mm., 135 mm., 130 mm., 125 mm., and 110 mm. in length. The mantle is denuded of epidermis, but the arms are pale buff with brown spots, and such of the animal as is present possesses the delicate hyaline consis-

<sup>l</sup> Less tip.

tency of the specimens referred to *E. diaphana*. Specimen M  $\frac{8137}{1}$  is very young having a mantle-length of only 5 mm., the pallial opening is very wide and the eyes large: the siphon extends half way to the umbrella margin. The arms are all mutilated. The umbrella reaches to about the third sucker on the dorsal arms and is much shorter ventrally. Colour pale with a few reddish-brown chromatophores. This and the following have been preserved in formalin. Specimen M  $\frac{8141}{1}$  has a mantle of 8 mm. The third arms are the longest, and the siphon extends two-thirds of the distance to the umbrella margin. Colour as in specimen M  $\frac{8137}{1}$ . Probably these specimens are referable to *E. diaphana*.

### Family SEPIOLIDAE.

#### *Inioteuthis japonica*, Verrill.

*Inioteuthis japonica*, Verrill, *Rep. U. S. Fish. Comm.*, p. 417, footnote (1881); Joubin, *Bull. Soc. Zool. France*, XXII, p. 101 (1897); Berry, *Proc. Acad. Nat. Sci. Phil.*, pp. 405-8, pl. 5, fig. 5 (1912a).

M  $\frac{10073-6}{2}$  Port Blair, Andaman Islands (S. W. Kemp)—Two ♀ one young.

The two smallest of these specimens have a mantle-length of 5 and 9 mm.

The largest female, compared with a male of *I. maculosa*, Goodrich, of similar mantle-length, shows that *I. japonica* has the nuchal commissure narrower than the length of the fin at insertion, while in *I. maculosa* these measurements are about equal.

The latter has a uniformly narrower body, shorter, rounder fins, and larger siphon than *I. japonica*. The bell-shaped mantle of the latter is very marked in the large female, when viewed ventrally.

In *I. maculosa* the chromatophores form large, dark-brown spots and blotches all over the body and arms, except the siphon and lower surface of fins.

In *I. japonica* they form very minute bluish-red dots which become larger on the head, and the ventral surface of the fins and siphon is freckled with orange dots. A note on the label states that the specimens were bright yellow when alive. These three specimens of *I. japonica* are all a little contracted, and seem to have a thicker skin and harder body than *I. maculosa*, but these differences may be due to varying modes of preservation.

The valve in the siphon is much longer in the example examined than in that of *I. maculosa*.

The measurements of this large female are appended :—

Specimen number	...	...	...	M $\frac{10073}{2}$
				mm.
End of body to mantle-margin	...	...	...	13
Breadth of body	...	...	...	12
"    "    head	...	...	...	10
Nuchal commissure	...	...	...	5
Fin length at insertion	...	...	...	6

Specimen number	...	...	...	M $\frac{10075}{2}$
				mm.
1st right arm	...	...	...	8
2nd " "	...	...	...	8
3rd " "	...	...	...	9
4th " "	...	...	...	8
Tentacle	...	...	...	18
Club	...	...	...	4

*Distribution.*—Japan.

*Type.*—Cat. No. 9, 639 (part) Yale University Museum, a male.

### *Iniotheuthis maculosa*, Goodrich.

*Iniotheuthis maculosa*, Goodrich, *Trans. Linn. Soc.*, VII, pp. 2-3, pl. 1, figs. 1-3 (1896).

M  $\frac{8211}{1}$  Puri Beach, Orissa Coast (*R. E. Lloyd*)—One ♂.

M  $\frac{8994}{2}$  Investigator' station 556; off Burma Coast, Marine Survey of India—One ♀

The hectocotylus in the male specimen closely resembles Joubin's (1897, p. 101) description of the modified arm in *I japonica*, VII., *e.g.*, "Une membrane demi-circulaire, en forme de C, entoure un tubercule median."

Such of the tentacular rings as are in a favourable position for examination show ten or eleven blunt teeth which seem to extend round the entire ring. What appear to be papillae are also present in the guise of small, pointed between-teeth.

Some of the differences between this species and the last mentioned have been already pointed out.

The principal measurements are appended:—

Specimen number	...	...	M $\frac{8211}{1}$	M $\frac{8994}{1}$
			mm.	mm.
End of body to mantle-margin	...	...	13	8
Breadth of body	...	...	10	7
" " head	...	...	9	6
Nuchal commissure	...	...	3.50	3
Length of fin at insertion	...	...	3.50	2.50
Breadth across fins	...	...	15	10
1st right arm	...	...	12	5
2nd " "	...	...	13	7
3rd " "	...	...	15	7
4th " "	...	...	12	ca. 6
Tentacle	...	...	20	12
Club	...	...	7	3

*Distribution.*—Andamans; Persian Gulf.

*Type.*—In Indian Museum, Calcutta, two females.

### *Euprymna morsei* (Verrill), Steenstrup.

*Iniotheuthis morsei*, Verrill, *Rep. U. S. Fish Comm.*, p. 417, footnote (1881); Joubin, *Bull. Soc. Zool. France*, XXII, p. 102 (1897); ? *Sepiola bursa*, Pfeffer, *Abh. Naturw. Ver. Hamburg*, VII, p. 6, fig. 6 (1884); *Euprymna morsei*, Steenstrup, *Overs. K. D. Vidensk. Selsk. Forh.*, p. 66 (1887); Hoyle, *Bull. Mus. Comp. Zool.*, XLIII, p. 26 (1904); Wülker, *Abh. d. II. Kl. d. k. Ak. Wiss.*, III Suppl.-Bd., 1 Abh., pp. 9

etc., pl. 1, fig. 9; pl. 3, figs. 23, 24; pl. 4, fig. 40 (1910); Berry, *Proc. Acad. Nat. Sci. Phil.*, pp. 408-14, pl. 6, fig. 1 (1912a).

- M  $\frac{8099}{1}$  Nyanbyini Bay, Burma: 28-viii-1911, 5 fathoms—One ♀  
 M  $\frac{8169}{1}$  Andamans—One ♂. 1899.  
 M  $\frac{8224}{1}$  Persian Gulf (*Townsend*)—One ♀  
 M  $\frac{8469}{6}$  Hongkong (*R. Hungerford*)—One ♂.

Berry states that the umbrella is "lacking or at best rudimentary between the dorsal arms." In the present specimens a delicate web extends to the third or fifth sucker between these arms. The hectocotylus in both males agrees with Berry's description. In specimen M  $\frac{8169}{1}$  enlarged suckers appear on the third and fourth right arms, and in specimen M  $\frac{8469}{6}$  on the third right and fourth left. Many suckers are missing from the other arms of both specimens. The enlarged suckers occur on the two ventral rows as noted by Berry. The principal measurements are appended:—

Specimen number	M $\frac{8099}{1}$	M $\frac{8169}{1}$	M $\frac{8224}{1}$	M $\frac{8469}{1}$
	mm.	mm.	mm.	mm.
End of body to web between dorsal arms	24	24	22	28
" " " " mantle-margin	16	18	15	14
Breadth of body	15	12	12	11.50
" " nuchal commissure	8	7	8	6
" " head	12	11	11	9
" " fins	24	22	22	21
1st right arm	mutilated.	15	mutilated.	14
2nd " "	17	19	"	15
3rd " "	15	17	"	16
4th " "	14	16	"	14
1st left " "	12	12	"	11
2nd " "	16	17	"	mutilated.
3rd " "	14	16	"	16
4th " "	13	15	"	12
Tentacle	15	14	"	27
Club	6	ca. 5	"	5

*Distribution.*—Japan, Philippines (*Joubin*), Formosa, Hong Kong, Andamans, Gulf of Manaar, Maldivé Archipelago.

*Type.*—Cat. No. 9,638, Yale University Museum, a female.

#### Family SEPIOLIDAE.

- M  $\frac{8134}{1}$  Investigator' station 383: 23-xi-1908, off Burma, 17° 18' N., 94° 8' E., 517 fathoms—One ♀

This is in such bad condition that it is not possible to say if a nuchal commissure was present or if the species was provided with a pen.

The mantle is bell-shaped, and the lacerated fins appear to have been attached at about the middle portion. The funnel is long and its organ consists of two elongate somewhat pyriform pads, the narrowest part in each being placed anteriorly. Each pad is 10 mm. by 4 mm. in breadth. Eyes very large. First pair of arms the shortest, the others semi-equal. The suckers are missing but their bases show that they were placed in two rows.

The club suckers are very minute and possess a smooth ring; they are placed in about eight rows at the centre of the club. The epidermis is wanting in many parts but the colour seems to have been buff covered very densely with purple or black chromatophores, which are present on both sides of the fins also. Such of the surface as is entire seems to be smooth.

The principal measurements are given below:—

	mm.
End of body to ventral mantle-margin	35
Breadth of body	ca. 22
Length of fin	21
Breadth "	16
Diameter of eye	8
" eye-opening	5
1st right arm	30
2nd " "	34
3rd " "	37
4th " "	33
1st left "	29
2nd " "	31
3rd " "	33
4th " "	32
Tentacle	59
Club	15

### Family LOLIGINIDAE.

#### *Loligo indica*, Pfeffer.

(Pl. XXIII, fig. 9; pl. XXIV, fig. 11.)

*Loligo indica*, Pfeffer, *Abh. Naturw. Ver. Hamburg*, VIII, p. 4, figs. 3, 3a (1884); Hoyle, 'Challenger' *Rep.*, XVI (Cephalopoda), pp. 156-7, pl. 26, figs. 1-10 (1886); Goodrich, *Trans. Linn. Soc.*, VII, p. 7, pl. 2, figs. 20-28 (1896).

	mm.
M $\frac{3.07}{1}$ Cochin ( <i>F. Day</i> ): 26-vi-1877—One ♀ Mantle-length	95
M $\frac{6.24}{1}$ Penang, Malay Peninsula ( <i>Dr. Stoliczka</i> )	
—One ♂	73
M $\frac{6.25}{1}$ Akyab, Burma ( <i>W. Dodgson</i> )—One ♂	82
M $\frac{5.44.9}{1}$ Puri, Orissa Coast ( <i>S. W. Kemp</i> )—	
One ♀	22
M $\frac{5.4.56.8}{1}$ Off Puri Coast, 1908, trawler 'Golden Crown', Bengal Fish. Dept. —Three ♂	83-187
M $\frac{8.08.8.0.0}{1}$ Cochin ( <i>F. Day</i> ): 26-vi-1877—Two ♂	65-77
One ♀	69
M $\frac{8.0.0.1}{1}$ Akyab, Burma ( <i>W. Dodgson</i> )—One ♀	74
M $\frac{8.0.0.2.7}{1}$ Madras, purchased —Three ♂	68-94
Three ♀	45-83
M $\frac{8.1.4.8.5.0}{1}$ Investigator station 481: 25-26-xii -1912, Mergui Harbour, 7 fathoms—Two ♂	53-71
One ♀	58
M $\frac{8.1.5.6}{1}$ Investigator station 522: 2-iii-1913, Mergui Archipelago, 12° 35' 15" N., 98° 16' E., 5 fathoms —One ♀	44
A $\frac{8.1.6.5.8}{1}$ Andamans ( <i>J. Wood Mason</i> )—Two ♂	72-77
Two ♀	72-80

Less tip.

	mm.
M $\frac{8174-91}{1}$ Puri Beach (?)—Eighteen young	Mantle-length 12-26
M $\frac{8192-8200}{1}$ Puri, Orissa Coast ( <i>N. A. and R. E. L.</i> )	—Five ♂ .. 32-49
	Four ♀ .. 47-98
M $\frac{8206-10}{1}$ Puri Beach ( <i>F. H. Gravely</i> )—	
	Three ♂ .. 36-77
	Two ♀ .. 64-75
M $\frac{8218-14}{1}$ Puri Beach ( <i>C. Paiva</i> ), 23-iii-1908	
	—One ♂ .. 92
	One ♀ .. 110
M $\frac{8215}{1}$ Puri Beach, Orissa Coast ( <i>J. Caunter</i> )	
31-i-1909	—One ♂ .. 43
M $\frac{8216-18}{1}$ Varkulay, Travancore ( <i>N. Annandale</i> ): 10-xi-1900	
	—One ♂ .. 220
	Two ♀ .. 93-114
M $\frac{8219}{1}$ Karachi ( <i>W. D. Cumming</i> )—One ♂	.. 75
M $\frac{8226}{1}$ Gangaram, Vizagapatam District, Madras Coast ( <i>Moti Ram</i> )	—One ♀ .. 91
	? Small specimen in bad condition.
M $\frac{8252}{1}$ Akyab, Burma ( <i>I. H. Burkill</i> )—One ♀	.. 72
M $\frac{8274-6}{1}$ Off Gopalpore, trawler <i>Golden Crown</i> , Bengal Fish. Dept., 23-27-ix-1909—	
	Three ♀ .. 78
	.. 120
	.. 34
M $\frac{8280-1}{1}$ Off Eastern Channel, m. of R. Hughli, trawler <i>Golden Crown</i> , xi-1909, Bengal Fish. Dept.	—Two ♂ .. 97-148
M $\frac{8295-9003}{2}$ Investigator ' station 565 and 567 : 13-21-xi-1913, 11° 54' 00" N., 98° 19' 00" E., 6-7 fathoms	
	—Five ♂ .. 25-85
	Two ♀ .. 33-42
	(?) Three young .. 10-12
M $\frac{9007-12}{2}$ Investigator station 575: 20-xii-1912, Off entrance to Mergui Harbour, S. Burma, 7-fathoms	(?) Six young .. 8-0
M $\frac{9317-19}{2}$ Investigator station 590: 8-9-i-1913, Mergui Archipelago. 13° 5' 15" N., 97° 53' E., about 30 fathoms	
	—One ♂ .. 17
	Two ♀ .. 72-80
M $\frac{9030-9097}{2}$ Investigator ' station 569: 29-30-xi-1913, 11° 52' 10" N., 98° 18' 40" E., 5 fathoms	
	—Thirty-six ♂ .. 16-81
	Thirty-two ♀ .. 10-102
M $\frac{9374}{2}$ Off Gopalpore, 30-38 fathoms, Bay of Bengal, trawler ' <i>Golden Crown</i> ' Bengal Fish. Dept., Dec., 1909	—One ♀ .. 110

These twenty-five records of seventy males and sixty-two females show that the present species occurs all round the coast of India from Karachi to the mouth of the River Hughli, and also off the Burmese coast and Andaman Islands. The length and breadth of the fins with regard to the length of the mantle exhibits a certain amount of individual variation, but, except in the case of several small females in the haul M  $\frac{9030-9097}{2}$ , which showed much wider fins than males of the same size, there seems to be no

marked difference as regards this between the sexes. The small specimens M  $\frac{817\frac{1}{2}-91}{1}$  possess a fin measuring one-third of the length of the mantle and resemble the useful illustration of Hoyle (*l. c.*, p. 156, text-fig.). Sixteen males from various hauls, with mantle-length of 21-97 mm., possess a fin measuring about half the length of the mantle, and the same proportion is shown by eleven females with mantle of 16-120 mm. In three females with mantle of 63-75 mm. the fin does not attain quite half the length of the mantle, and in two others with mantle of 30-42 mm. the fin measures two-thirds of the mantle. The largest sized specimens of both sexes possess a fin measuring more than half and less than one-third of the mantle.

The rings of the arm suckers in the young specimens M  $\frac{817\frac{1}{2}-91}{1}$  show five to eight teeth, and some large tentacle rings possess sixteen to nineteen teeth round the ring; suckers occur on the buccal membrane but there is no trace of a hectocotylus.

Large males, frequently, but not always, have the largest rings of the lateral arms larger than the largest rings of the club. In females these rings are almost always either slightly or much smaller than the largest rings of the club, and as a consequence of this they have fewer teeth on the lateral arm rings than the male owing to the smaller size of the ring. Thus a male with mantle of 75 mm. possesses ten or eleven teeth on the lateral rings, and not more than six on the dorsal and ventral arms, and a female with mantle of 72 mm. does not possess more than six teeth on the largest arm suckers. The number of teeth on the largest tentacle rings does not appear to increase after a certain mantle-length has been attained. Thus a male and female with mantle-length of 77 mm. possess seventeen to twenty teeth on the largest rings, and the same number is shown by two females with mantle of 120-134 mm.

The number of suckers on the different angles of the buccal membrane varies from one or two to three, four or six. Five to nine blunt teeth are present on the ring, part of which is always smooth. In large females a tubercle is placed at the base between the ventral angles. In the small specimens M  $\frac{9030-9097}{2}$  the nidamental glands are barely perceptible in females with a mantle-length of 10-15 mm. The smallest sexually distinct males have a mantle of 16 mm. Young specimens of both sexes have much fewer chromatophores, but examples with a mantle-length up to about 37 mm. seem always to show two very conspicuous clusters of dark chromatophores on the dorsal surface of the head, giving each little creature a superficial appearance of having two eyes on the back of its head as well as the real laterally-placed eyes.

As regards anatomy the specimens M  $\frac{8213-14}{1}$  were examined and nothing was discovered that is not usual in the genus. The female specimen had the ovary tightly packed with eggs—the bilobed nidamental gland measured  $24 \times 11$  mm. The radula

(pl. xxiv, fig. 11) closely resembles that of *L. pealii*, Verrill (1882, pl. xxviii, figs. 6-8). The frontal lamina of the upper mandible (pl. xxiii, fig. 9) curves more upwards than in that species and the posterior end of the palatine lamina has a median indentation. The lower mandible (pl. xxiii, fig. 9) has the notch near the rostrum less marked than in *L. pealii* and the lower edge of the gular lamina is indented.

*Distribution.*—Indo-Malayan Region.

*Type.*—In Hamburg Museum.

### *Loligo spectrum*, Pfeffer.

*Loligo spectrum*, Pfeffer, *Abh. Naturw. Ver. Hamburg*, VIII, pp. 5-6, figs. 5, 5a (1884).

M <sup>8292</sup> Arakan coast, trawler *Golden Crown* Bengal Fish. Dept.,  
—One ♂.

The long, slender body readily distinguishes this species from *L. indica*. Order of arms 3, 4, 2, 1. Rings of arm suckers usually with eight teeth (sometimes seven or nine) on the distal margin, and the rest of ring smooth. At the base and distal portion of each arm the teeth are short, broad and blunt, elsewhere they are rather narrow, pointed and slightly curved. Distal rings often have only four to six teeth, and a sucker at the base of the fourth right arm has eleven teeth. Sixteen rows of suckers occur on the proximal part of the hectocotylized arm, the two pairs immediately preceding the papillae being placed on long stalks. Pfeffer describes the tentacular rings as possessing forty teeth. Thirty-one is the largest number I could find on any tentacular ring, but this specimen is considerably smaller than the type which has a mantle-length of 284 mm. A marginal sucker, intermediate in size between the large and the distal club suckers, possesses eight pointed teeth separated by the width of the base of a tooth, and covering the distal half of the ring. Suckers are present on the buccal membrane which is seven-angled.

The principal measurements are appended:—

		mm.
End of body to dorsal mantle-margin	...	155
Length of fin	...	100
Breadth of fins	...	62
1st right arm	...	28
2nd " "	...	30
3rd " "	...	mutilated.
4th " "	...	45
1st left " "	...	33
2nd " "	...	38
3rd " "	...	45
4th " "	...	42
Length of tentacle	...	103
" " club	...	33
Diameter of largest tentacular ring	...	2.50
" " " arm "	...	2

*Distribution.*—Marquesas.

*Type.*—In Hamburg Museum, three males.

**Loligo sp.**

	mm.
M $\frac{626}{1}$ and M $\frac{825}{1}$ Madras, purchased, 30-iv-1877 —Two ♂	Mantle-length 120-135
M $\frac{829-7}{1}$ Pamban, Ramnad District, Gulf of Manaar, from weeds, 0-2 fathoms, 24-iii-1913 (S. W. Kemp) —Two	" 4
M $\frac{8238}{1}$ Kilakarai, Ramnad District, South India, from weeds, 0-2 fathoms, 16-ii-1913 (S. W. Kemp) —One	" 7
M $\frac{9323}{2}$ Investigator station 565: 13-xi- 1913, 11° 57' 30" N., 98° 19' 00" E., 7 fathoms —One	" 8

Specimens M  $\frac{626}{1}$  and M  $\frac{825}{1}$  resemble *L. indica* in their shape and colour, and in the size and arrangement of the suckers on club, arms and buccal membrane; as, however, the horny rings of all the suckers are missing it is not possible to determine the species with certainty.

**Loliolus investigatoris, Goodrich.**

*Loliolus investigatoris*, Goodrich, *Trans. Linn. Soc.*, VII, pp. 8-9, pl. 2, figs. 29-37 (1896).

	mm.
M $\frac{823}{1}$ Penang ( <i>Dr. Stoliczka</i> ) —One ♀	Mantle-length 43
M $\frac{729}{1}$ Sandheads, River Hughli ( <i>G. Lord</i> )— One ♀	" 53
M $\frac{5447-8}{1}$ Puri, Orissa Coast <sup>1</sup> ( <i>S. W. Kemp</i> )— Two ♂	" 35-39
M $\frac{8098}{1}$ Investigator Mouth of Tavoy River, 28-viii-1911 —One ♂	" 25
M $\frac{8102}{1}$ E. S. E. of S. Moscos I., Marine Sur- vey of India —One ♂	" 26
M $\frac{8151}{1}$ Investigator station 481: 25-26-xi- 1912, Mergui Harbour, 7 fathoms— One ♀	" 30
M $\frac{8157-61}{1}$ Mouth of River Hughli ( <i>Capt. R.</i> <i>Munro</i> ) —Four ♂	" 31-88
	One ♂ " 34
M $\frac{8173}{1}$ Puri Beach, 1-2-ii-1900 ( <i>N. Annandale</i> ) —One ♂	" 34
M $\frac{8201}{1}$ Puri, Orissa Coast, 18-19-i-1908 ( <i>N. A.</i> and <i>R. E. L.</i> ) —One ♀	" 26
M $\frac{8254}{1}$ 10 miles N. E. of Devi river, Orissa Coast —One ♀	" 31
M $\frac{8263}{1}$ Shrimp-trawler off Frazerunge, Sunderbunds —One ♂	" 35
M $\frac{9324}{2}$ Investigator' station 402: 15-16-xi- 1911, Mergui Archipelago, 13° 2' N., 98° 25' E., 5 fathoms —One mutilated	" 27
M $\frac{10079-83}{2}$ Karnaphuli River, Chittagong ( <i>A. C.</i> <i>Chowdhury</i> ) December, 1914 —Two ♂	" 32-37
	Three ♀ " 2-42
M $\frac{10073-74}{2}$ Near Mud Point, River Hughli, D. net used as townet, S. L. <i>Kitty</i> ( <i>T. Southwell</i> ) 13-ii-1915 —One ♂	" 28
	One ♀ " 37

A marked sexual difference is apparent in the specimens M  $\frac{8157-61}{1}$ . The male with a mantle-length of 31 mm. has much

<sup>1</sup> Found in a hole near a rock at low tide.

longer lateral arms with much larger suckers than the female with a mantle-length of 34 mm.

*Distribution.*—Indo-Malayan Region.

*Type.*—In Indian Museum, Calcutta.

#### Family SEPIIDAE.

##### *Sepia aculeata*, Van Hasselt MS., in d'Orbigny.

*Sepia aculeata*, Van Hasselt MS., in d'Orbigny and Férussac, *Hist. Nat. Céph. acét.*, p. 287, pls. 5, 25 (1834); Steenstrup, *Vidensk. Selsk. Skr.* 5th R., Bd. 10. VII (1875); Tryon, *Man. Conch.*, (1) 1, p. 169, pl. 90, fig. 415; pl. 91, figs. 416, 417 (after d'Orbigny) (1879); Goodrich, *Trans. Linn. Soc.*, VII, p. 3 (1896); Joubin, *Notes Leyden Mus.*, XX, p. 25 (1898); Wülker, *Abh. d. II. Kl. K. Ak. d. Wiss.*, III Suppl.-Bd., 1 Abh., p. 11 (1910); Berry, *Proc. Acad. Nat. Sci. Phil.*, p. 418 (1912a); *Acanthosepion Hasselti*, de Rochebrune, *Bull. Soc. Phil. Paris*, (7), VIII, p. 101 (1884).

M  $\frac{619}{1}$  Akyab, Burma (*W. Dodgson*)—One ♀

M  $\frac{728}{1}$  Sandheads, River Hughli (*F. Milner*)—One ♂.

M  $\frac{8155}{1}$  Investigator' station 519: 1-iii-1913, Mergui Archipelago, Elphinstone I., Port Maria, shore collecting—One ♀.

M  $\frac{8228}{1}$  Palk Straits, South of India—One ♀

M  $\frac{8251}{1}$  Akyab, Burma (*J. H. Burkill*)—One ♂.

M  $\frac{8282}{1}$  Bay of Bengal, trawler *Golden Crown* Bengal Fish. Dept., —One ♀

M  $\frac{8267-8}{1}$  Bay of Bengal, trawler *Golden Crown* Bengal Fish. Dept., —One ♂, one ♀.

M  $\frac{8269}{1}$  Balasore Bay, Orissa Coast, viii-1908, trawler *Golden Crown* Bengal Fish. Dept.,—One ♀

M  $\frac{9022}{2}$  Investigator' station 557: off Burma Coast, Marine Survey of India—One ♂.

These all agree in the presence of suckers on the buccal membrane and in having the tentacle suckers all of small size and semi-equal, and armed with acute teeth all round the ring, the largest being on the distal half of the circumference. Very prominent papillae are also apparent in the best-preserved specimens. Specimen M  $\frac{8269}{1}$  possesses what appear to be clubs in process of repair at the end of each tentacle stem. They are much narrower than the stems and end acutely, and possess a very rudimentary fin only visible with a lens; minute pointed papillae, which would seem to be the base of suckers (as occasionally fibres of muscle project from them), are present on either side of a median line.

The arm suckers are arranged in four rows and their rings are usually armed with many teeth on the distal half of the ring. They vary greatly in number and appearance; often two are welded together or they may be somewhat widely spaced; eighteen to thirty are present on many rings but those placed on the proximal or distal portions are usually (but by no means invariably) smooth. An idea of the variation in dentition is afforded by specimen M  $\frac{8262}{1}$ . Fifty-six teeth surround a sucker ring on the middle of the first right arm, the distal teeth being the longest; a sucker on the distal half of the third left arm shows a ring with about forty teeth; twenty-one teeth are present on a sucker ring on the distal half of the fourth right arm, and are placed on the distal margin, the rest of the ring being smooth. All the proximal rings examined in this

specimen are smooth. Some suckers from the buccal membrane show smooth rings, others have notches or short blunt teeth.

The hectocotylus is placed on the proximal half of the left ventral arm. The first three or four rows of suckers are normal, and are followed by about six pairs of very minute suckers on the ventral margin, about four pairs being placed on an excavation on the corresponding part of the dorsal margin of the arm. In the smallest male, M  $\frac{8251}{1}$ , this excavation is slight, but a deep round cavity is formed on the older specimens. The spermatic pad is broad and very papillate. Colour, slate above and buff-pink below; the chromatophores are all small and usually dark; a few look like white spots but are pale blue when examined with a lens; although very dense on the dorsal mantle they form no bands or other definite markings. The fins, which have fewer chromatophores on their ventral surface, are usually broad and thick but are sometimes closely adherent to the mantle. The surface is generally smooth but often about six crescent-shaped wrinkles occur at the base of the fins along either side of the dorsal mantle. The cuttle bones of seven specimens examined all show a callosity on the inner cone, and their form agrees closely with the illustration of d'Orbigny (pl. 25, fig. 4), and also closely resembles that of the shell of *S. indica*, d'Orb., which Joubin (*l.c.*, pp. 21-28) thinks is very likely identical with the present species. Hoyle has pointed out that *S. indica* is called *S. blainvillei* in d'Orbigny's illustration (pl. 21, figs. 1, 3, 4). The specimens M  $\frac{8155}{1}$  and M  $\frac{8228}{1}$ , with mantle-lengths of 44-59 mm., have both much smaller spermatic pads, and in the shell the callosity of the inner cone is only partly developed. The smallest has thinner fins than the others; probably this may be attributed to its youth. Measurements of some of the specimens are appended:—

Specimen number	...	M $\frac{728}{1}$	M $\frac{8267}{1}$	M $\frac{8268}{1}$	M $\frac{8269}{1}$
		mm.	mm.	mm.	mm.
Dorsal mantle-length	...	105	109	125	170
Ventral mantle-breadth	...	54	60	70	ca. 62
Fin maximum	...	11	11	7	18
Breadth of head	...	37	41	44	60
1st right arm	...	43	mutilated.	50	61
2nd " "	...	43	50	45	55
3rd " "	...	49	60	49	59
4th " "	...	48	65	57	60
Tentacle	...	110	191	...	128
Club	...	25	33	...	...

#### Sepiostaire:—

Specimen number	M $\frac{8155}{1}$	M $\frac{8228}{1}$	M $\frac{8251}{1}$	M $\frac{8262}{1}$	M $\frac{8267}{1}$	M $\frac{8269}{1}$	M $\frac{9004}{2}$
	mm.	mm.	mm.	mm.	mm.	mm.	mm.
Total length	42	58	80	110	110	173	112
Breadth	17	23	25	35	35	60	36
Length of spine	ca. 3				4		
Index <sup>1</sup>	40	40	25	ca. 27	22	23	18

*Distribution.*—Japan, Java, Indian Ocean.

<sup>1</sup> The index is the relation of the last loculus plus the total length of the shell when divided into one hundred parts. See Hoyle, 'Challenger' Rep., XVI (Cephalopoda) p. 123.

***Sepia singaporensis*, Pfeffer.**

*Sepia singaporensis*, Pfeffer, *Abh. Naturw. Ver. Hamburg*, VIII, pp. 10-11, figs. 13, 13a (1884); Hoyle, *Proc. Roy. Phys. Soc. Edinburgh*, p. 27 (1886); Goodrich, *Trans. Linn. Soc.*, VII, p. 3 (1896).

M  $\frac{8136}{1}$  Investigator' station 387: 16-xi-1909, off C. Negrais, Burma, 15° 25' N., 93° 45' E., 40-49 fathoms—One ♂.

This has lost the tentacles but in all other respects seems to agree closely with Pfeffer's description. Fourteen to thirty-three teeth were counted on different arm sucker rings.

On the fourth left arm about six rows of suckers on the proximal half are appreciably smaller than those immediately preceding and following them, the two dorsal suckers in each row being the smallest; the surface of this modified portion appears to be slightly excavated.

Hoyle (1886, p. 128) thinks that it is quite possible that this species may be identical with *S. plangon*, Gray. The shell of specimen M  $\frac{8136}{1}$  measures 63 mm. by 18 mm., and has an index of 31. The end of the spine is broken but the portion remaining does not show the keel on the ventral edge present in the shell of *S. plangon*.

The principal measurements are appended:—

	mm.
Dorsal mantle-length	62
Breadth of body	29
" " head	22
Fin maximum	ca. 4
1st right arm	25
2nd " "	mutilated.
3rd " "	28
4th " "	31
1st left " "	26
2nd " "	mutilated.
3rd " "	24
4th " "	25

*Distribution*.—Singapore (Pfeffer and Goodrich).

*Type*.—In Hamburg Museum.

***Sepia esculenta*, Hoyle.**

*Sepia esculenta*, Hoyle, *Diagnoses*, II, p. 188; *Prelim. Rep.*, II, p. 291 (1885); '*Challenger*' *Rep.*, XVI (Cephalopoda), pp. 129-31, pl. 17, figs. 1-5; pl. 18, figs. 1-6 (1886); Appellöf, *K. Svensk. Vetensk. Akad. Handl.*, XXI, p. 28, pl. 3, figs. 1-6, 24 (1886); Ortmann, *Zool. Jahrb.*, III, pp. 649-665 (1888); Pilsbry, *Nautilus.*, VII, p. 144 (1894); Joubin, *Bull. Soc. Zool. France*, XXII, pp. 102-103 (1897); Hedley, *Proc. Linn. Soc. N. S. W.*, XXXI, p. 463 (1906); Berry, *Proc. Acad. Nat. Sci. Phil.*, pp. 418-19 (1912a).

M  $\frac{8286}{1}$  Moji, Japan, 1-vii-1913 (*F. D. Cooper*)—One ♀

Owing to its large size this specimen was not taken to be compared with the type. A vivid recollection of its appearance, and a subsequent glance at the type male in the British Museum has, however, quite satisfied me that it is rightly referred here.

It agrees with Appellöf's description as regards the presence of notches, in some cases amounting to teeth, on the rings of the arm suckers.

The median tentacular suckers are a little larger than those at the margin (as observed by Joubin), and there are two larger than the rest at the tip of the club. Thirty to forty teeth are present on some of the tentacular rings.

The crescent-shaped folds, or wrinkles on the dorsal skin, which frequently occur along the origin of the fin in this genus, are well-marked. The shell agrees closely with Hoyle's description except that the last loculus is shorter. The horny brown mass noticed by Joubin between the spine and inner cone is distinct. Berry has remarked that this species is very nearly allied to *S. aculeata*, van Hasselt, in spite of the absence of suckers on the buccal membrane and that the shell is without the callosity of the inner cone. Besides these two important differences, it may be noted that the parallel lines of the striated area of the shell are always more or less evenly rounded in *S. aculeata* and never form the acute angle present in *S. esculenta*, and the fins, buccal membrane and sperm pad are all much thicker and narrower in *S. aculeata*. A number of sperms are adhering to the sperm pad in the present specimen.

The principal measurements are appended :—

	mm.
Dorsal mantle-length ... ..	108
Breadth of body ... ..	75
"  "  head ... ..	58
Fin maximum ... ..	20
1st right arm ... ..	72
2nd " " ... ..	77
3rd " " ... ..	90
4th " " ... ..	100

**Sepiostaire :—**

Length ... ..	156
Breadth ... ..	57.50
Spine (end broken) ... ..	5
Index ... ..	13

*Distribution*.—Japan ; Queensland.

*Type*.—In British Museum, a male and female.

***Sepia elliptica*, Hoyle.**

*Sepia elliptica*, Hoyle, *Diagnoses*, II, p. 189; *Prelim. Rep.*, II, p. 293 (1885); 'Challenger' *Rep.*, XVI (Cephalopoda), pp. 131-3, pl. 19, figs. 14-24 (1886); Wülker, *Abh. d. II. Kl. d. k. Ak. d. Wiss.*, III Supl.-Bd., I Abh., pp. 11-12 (1910).

M <sup>5108</sup><sub>1</sub> Investigator station 90 : 17-21-ii-1890, 8 miles E. S. E. of Kalingapatam Lt., Ganjam Coast, 28-30 fathoms—One ♀

M <sup>5283</sup><sub>1</sub> 'Investigator' station 366 : 10-iv-1906, Arabian Sea, 24° 45' N., 63° 50' 15" E., 544 fathoms—One ♂.

These two specimens differ a good deal outwardly, the small female being of a greenish tint and the male of a beautiful purple-

brown mottled with buff. The shells of both are, however, alike, and that of the male was compared with the shell of a type male in the British Museum and found to be exactly similar. This shell measures about 58 mm. in length by 25 mm. in breadth, and has an index of about 30; the spine is broken. Both specimens exhibit irregular teeth or notches on the distal surface of some of the arm rings, while other rings are quite smooth. M  $\frac{8108}{1}$  possesses from 8-10 teeth, and M  $\frac{8283}{1}$  11-18. The hectocotylized arm of the latter specimen has five normal rows of suckers proximally, followed by seven rows of modified suckers.

The principal measurements are appended:—

Specimen number	...	...	M $\frac{8108}{1}$	M $\frac{8283}{1}$
			mm.	mm.
End of body to dorsal mantle-margin	...	...	27	63
Breadth of body	...	...	18.50	33
"    "    head	...	...	13	25
Fin maximum	...	...	3	11
1st right arm	...	...	10	mutilated.
2nd " "	...	...	9	"
3rd " "	...	...	8	22
4th " "	...	...	10	mutilated.
Tentacle	...	...	35	missing.
Club	...	...	4	

*Distribution.*—Misaki, Sagami (*Wülker*); Arafura Sea, south of Papua, 28-49 fathoms (type locality).

*Type.*—In British Museum, two males, six females.

### *Sepia singalensis*, Goodrich.

*Sepia singalensis*, Goodrich, *Trans. Linn. Soc.*, VII, pp. 3-5, pl. 1, figs. 4-8 (1896); Hoyle, *Rep. Pearl Oyster Fish. Gulf of Manaar*, p. 198 (1904).

M  $\frac{4771}{1}$  Investigator ' Indian Seas, Marine Survey of India—One ♂.

M  $\frac{8265-6}{1}$  Arakan Coast, 3-i-1909, trawler *Golden Crown*, Bengal Fish. Dept.—Two ♂.

M  $\frac{8277}{1}$  Off Gopalpore, Ganjam Coast, 25-28 fathoms, 23-ix-1909, trawler *Golden Crown*, Bengal Fish. Dept.—One ♂.

M  $\frac{8282}{1}$  Investigator ' station 366 : 10-iv-1906, 24° 45' N., 63° 50' 15" E. 544 fathoms—One ♂.

M  $\frac{9373}{2}$  Port Blair, Andamans (*G. H. Rooley*)—One ♂ (dorsal-mantle 155 mm.).

These are "conspicuously striped with broad dark bands on the upper surface of the mantle, head and arms" as described by Goodrich. The form of the hectocotylus and the arrangement of the teeth on the arm and tentacular sucker rings agrees with the type except for an interesting deviation as regards the large tentacular rings of specimen M  $\frac{8265}{1}$ . Goodrich has pointed out that the largest tentacular rings in this species are smooth and the others are denticulate, and that this is one of the characters separating it from the nearly allied species *S. rouxii*, d'Orb., which has all the tentacular rings denticulate. Specimen M  $\frac{8265}{1}$ , which is the smallest of the above, has the largest tentacular suckers of 2 mm. in diameter with denticulate rings like the small suckers.

The specimen next in size (M  $\frac{8266}{1}$ ) has the two largest tentacular suckers, of 3 mm. in diameter, with smooth rings and the remaining suckers of the club denticulate. All the other specimens show a number of large smooth rings on each club; specimen M  $\frac{8277}{1}$  for instance possesses ten smooth rings (some much larger than the others) on one club. As far as can be judged from the present material of a few male specimens, it would appear that the number of smooth rings on the club depends on the age of the specimen, and that in youth all the tentacular suckers are denticulate. The shell of specimen M  $\frac{8265}{1}$  was examined and measures about 107 mm. by 37 mm., and has an index of 28. The wide flattened inner cone with an oval prominence in the centre is very like Goodrich's figure. The chitinous margins measure in some parts as much as 8 mm.

The spine (broken in the type) measures 4 mm. and curves slightly backwards. Hoyle (1905, p. 981) has referred a *Sepia* to *S. rouxii*, d'Orb. with some hesitation, adding that it possessed teeth on the rings of the large tentacular suckers, but that in certain respects it seemed to be intermediate between *S. rouxii* and *S. singalensis*.

Some measurements of the specimens are appended:—

Specimen number	...	M $\frac{4771}{1}$	M $\frac{8265}{1}$	M $\frac{8266}{1}$	M $\frac{8277}{1}$	M $\frac{8282}{1}$
	...	mm.	mm.	mm.	mm.	mm.
End of body to dorsal mantle-margin	...	180	111	125	173	151
Breadth of mantle	...	76	53	55	70	68
"    "    fin	...	25	15	17	ca. 20	19
1st right arm	...	mutilated.	44	50	68	52
2nd    "    "	...	69 <sup>1</sup>	46	47	83	55
3rd    "    "	...	59	48	45	90	65
4th    "    "	...	69	58	57	96	73
Tentacle	...	41	113	106	148	51
Club	...	33	27	26	36	30

*Distribution*.—Ceylon and Gulf of Manaar (*Goodrich* and *Hoyle*); Suez, Zanzibar (*Hoyle*).

### *Sepia arabica*, sp. n.

(Plate xxiii, figs. 1-5; pl. xxiv, fig. 10.)

M  $\frac{8113}{1}$  Investigator' station 246: 15-x-1898, Laccadive Sea, 11° 14' 30" N., 74° 57' 15" E., 68-148 fathoms—One ♀

M  $\frac{8122}{1}$  'Investigator' station 292: 2-xi-1901, Persian Gulf, 26° 20' N. 53° 54' E., 53 fathoms—One ♀

Body broad in proportion to length, fins narrow, dorsal mantle-margin not much produced in centre. Head broad and flattened. Eyes large. Buccal membrane without suckers. Sperm pad not developed, perhaps owing to youth. Funnel with broad apex not reaching to fork between ventral arms. Umbrella well developed between the dorsal arms, lower laterally, and absent between the ventral pair. Fourth arms the longest, the rest

<sup>1</sup> Less tip.

subequal, and about one-third the length of the body. Suckers usually arranged in a slanting series of four in a row, except the proximal two rows which generally consist of two and three suckers each. The rings are usually smooth, but a few irregular notches are present on the rings of some distal suckers in specimen M  $\frac{8113}{1}$ . Tentacles not extending below mantle. Club small with moderate fin. Tentacular suckers subequal and placed about five in a row. The rings possess a few minute widely-spaced teeth, some blunt, others pointed. Six were observed on one ring. Surface smooth except for a few tubercles on the dorsal mantle, and oblong folds or wrinkles along the origin of the fin.

Specimen M  $\frac{8113}{1}$  has also two curious ear-shaped folds on the head behind each eye, but these appear to be accidental. Colour pinkish-buff sprinkled with reddish-brown or grey-blue chromatophores which are less numerous ventrally. The shell appears to be unusually narrow in proportion to the width of the body, but this seems to be due in part to the chitinous margin having unfortunately decayed away in both specimens, the inner cone being also absent. Enough of the shell remains, however, to show the most important character of this species, *viz.*, the form followed by the lines composing the striated area.

The parallel lines are at first almost transverse, gradually a median indentation which rapidly deepens makes its appearance, so that the posterior margin of the last loculus is bounded by two V-shaped lines apparently quite unlike that of any *Sepia* hitherto described. Both shells are alike in this respect. The smooth, polished dorsal surface of the shell is only interrupted by a moderate median ridge and the divisions between the loculi. The ventral surface is slightly elevated and marked by a narrow, shallow, median groove. Judging the length of the shell from the impression of the mantle cavity the index in specimen M  $\frac{8113}{1}$  would appear to be about 55 and that of M  $\frac{8122}{1}$  about 40.

Some measurements are appended :—

Specimen number	...	...	M $\frac{8113}{1}$ mm.	M $\frac{8122}{1}$ mm.
Dorsal mantle-length	...	...	29	28
Breadth of body	...	...	16	16
"    "    head	...	...	11	13
Fin maximum	...	...	2	3
1st right arm	...	...	10	mutilated.
2nd " "	...	...	9	8
3rd " "	...	...	10	9
4th " "	...	...	12	11
1st left " "	...	...	9	8
2nd " "	...	...	7	mutilated.
3rd " "	...	...	8	9
4th " "	...	...	12	11
Tentacle	...	...	38	31
Club	...	...	3	ca. 5

### *Sepia (Doratosepion) andreanoides*, Hoyle.

*Sepia andreanoides*, Hoyle, *Diagnoses*, II, p. 193; *Prelim. Rep.*, II, p. 297 (1885); '*Challenger*' *Rep.*, XVI (Cephalopoda), pp. 139, etc., pl. 21,

figs. 11-19; pl. 22, fig. 11 (1886); Ortmann, *Zool. Jahrb.*, III, pp. 653, 665 (1888); Wülker, *Abh. d. II. Kl. d. k. Ak. d. Wiss.*, III Suppl.-Bd., I Abh., pp. 19, 22, 24 (1910); Berry, *Proc. Acad. Nat. Sci. Phil.*, p. 423 (merely listed) (1912a).

- M  $\frac{797}{1}$  Investigator station 246 : 15-x-1898, Laccadive Sea,  $11^{\circ} 14' 30''$  N.,  $74^{\circ} 57' 15''$  E., 68-148 fathoms—One ♂.  
 M  $\frac{8124}{1}$  Investigator' station 360 : 20-xii-1905,  $13^{\circ} 36'$  N.,  $47^{\circ} 32'$  E. 130 fathoms—One ♀  
 M  $\frac{8146}{1}$  Investigator' station 464 : 22-iv-1912, S. of Ceylon,  $6^{\circ} 2' 30''$  N.,  $81^{\circ} 29'$  E., 52-68 fathoms—One ♀

These all have smooth rings to the arm suckers, and teeth on the distal border of the tentacular suckers. Specimens M  $\frac{8124}{1}$  and  $\frac{8146}{1}$  have dorsal mantle-lengths of only 20-21 mm., and possess three to five teeth on the tentacular rings.

Specimen M  $\frac{797}{1}$  is much larger and has eight to seventeen teeth on the tentacular rings, and about twelve of the club suckers are as large as those of the arms. The hectocotylus and shell agree with the description of the type.

The principal measurements of this specimen are appended :—

				mm.
Dorsal mantle-length	...	...	...	48
Breadth of body	...	...	...	19
"    "    head	...	...	...	15
Fin maximum	...	...	...	ca. 6
1st right arm	...	...	...	20
2nd " "	...	...	...	19
3rd " "	...	...	...	19
4th " "	...	...	...	17
Tentacle	...	...	...	51
Club	...	...	...	6
Sepiostaire :—				
Length	...	...	...	47
Breadth	...	...	...	9.50
Index	...	...	...	32

*Distribution.*—Bay of Tokio (Ortmann); Yokohama market (Hoyle).

*Type.*—In British Museum, one male, two females.

### *Sepia (Doratosepion) kobiensis*, Hoyle.

*Sepia kobiensis*, Hoyle, *Diagnoses*, II, p. 195; *Prelim. Rep.*, II, p. 300 (1885); *Challenger' Rep.*, XVI (Cephalopoda), p. 142, pl. 18, figs. 7-14 (1886); Appellöf, *K. Svensk. Vetensk. Akad. Handl.*, XXI, p. 20, pl. 3, fig. 7 (1886); Ortmann, *Zool. Jahrb.*, III, pp. 654, 665 (1888); Wülker, *Abh. d. II. Kl. d. k. Ak. d. Wiss.* III Suppl.-Bd., I Abh., pp. 16, 20, 24 (1910); Berry, *Proc. Acad. Nat. Sci. Phil.*, p. 423 (1912a).

- M  $\frac{8114-19}{1}$  Investigator station 246 : 15-x-1898, Laccadive Sea,  $11^{\circ} 14' 30''$  N.,  $74^{\circ} 57' 15''$  E., 68-148 fathoms—Four ♀, two young.  
 M  $\frac{8120-21}{1}$  Investigator station 292 : 2-xi-1901, Persian Gulf,  $26^{\circ} 20'$  N.,  $53^{\circ} 54'$  E., 53 fathoms—One ♀ one ♂  
 M  $\frac{8135}{1}$  Investigator' station 383 : 22-ii-1909, off C. Negrais, Burma,  $16^{\circ} 0'$  N.,  $93^{\circ} 37'$  E., 40 fathoms—One ♂.  
 M  $\frac{8145}{1}$  Investigator' station 464 : 22-iv-1912, S. of Ceylon,  $6^{\circ} 2' 30''$  N.,  $81^{\circ} 29'$  E., 52-68 fathoms—One ♀

The outline of the striated area of the shell seems a little different in these specimens to the description of the type and to the illustration of Appellöf (1886, pl. 3, fig. 7a). The present examples have no median indentation in the curved line which more resembles that of the shell of *S. esculenta*, Hoyle. The line is, however, somewhat irregular, especially in the earlier stages, and in all other respects there is no deviation from the description of the type.

The smallest female examined has a mantle-length of 22 mm. and nidamental glands measuring 1.25 mm. in length. Measurements of three of the largest specimens are appended, also measurements of four shells:—

Specimen number	M $\frac{8120}{1}$ ♂	M $\frac{8121}{1}$ ♀	M $\frac{8114}{1}$ ♀
	mm.	mm.	mm.
Dorsal mantle-length ...	55	40	37
Breadth of body ...	22	19	17
"  "  head ...	16	16	14
1st right arm ...	16	13	14
2nd "  " ...	15	12	11
3rd "  " ...	12	11	10
4th "  " ...	15	14	12
Tentacle ...	missing.	41	34
Club ...	...	ca. 6	5

**Sepiostaire:—**

Specimen number	M $\frac{8121}{1}$ ♀	M $\frac{8125}{1}$ ♂	M $\frac{8115}{1}$ ♀	M $\frac{8116}{1}$ ♀
	mm.	mm.	mm.	mm.
Length ...	39	26	35	27
Breadth ...	10	6	8.50	8
Spine ...	ca. 2	1		1.75
Index ...	30	32	30	32

*Distribution.*—Japan; Indo-Malayan Region; Pacific Region.

*Type.*—In British Museum, one female.

***Sepia* sp.**

M  $\frac{8222:3}{1}$  Persian Gulf (*Townsend*)—Two young.

These have a broad body, and dorsal mantle-length of about 10 mm. The arm suckers are placed four in a row and have eight or nine teeth. The proximal tentacular suckers are placed two or three in a row. Suckers in the central part of the club have ten teeth and are twice the size of those at the outer edge. The ventral mantle-margin shows a marked indentation below the siphon. Colour greyish-brown above, lighter beneath.

**Genus *Sepiella*, Gray.**

***Sepiella inermis* (van Hasselt, MS.), Steenstrup.**

(Plate xxiii, fig. 6; pl. xxiv, figs. 1-9.)

*Sepia inermis*, d'Orbigny, *Cephalopodes acetabuliferes*, p. 226, pl. 6, bis; pl. 20, figs. 1-9 (1839); Steenstrup, *K. d. Vid Selsk. Skr.* (5) VII, p. 478, pl. 2, fig. 3 (1875); *Sepia sinensis*, d'Orbigny, *op. cit.*, p. 289, pl. 9, figs. 1, 2 (*fide* Gray) (1839); *Sepia microcheirus*, Gray,

*British Museum Catalogue*, p. 107 (1849); *Sepiella inermis*, Steenstrup, *Vid. Meddel. Nat. Foren. Kjöbenhavn*, pp. 347-356, figs. 1-8 (1880); Goodrich, *Trans. Linn. Soc.*, VII, p. 5 (1896); Joubin, *Bull. Soc. Zool. France*, XXII, p. 103 (1897); Joubin, *Notes Leyden Mus.*, XX, p. 25 (1898); Hoyle, *Fauna and Geogr. Maldive-Laccadive Archip.*, II, suppl., p. 982, fig. 152 (1905); *Sepiella curta*, Pfeffer, *Abh. Naturw. Ver. Hamburg*, VIII, p. 13, fig. 16 (1884); *Sepiella ocellata*, Pfeffer, *op. cit.*, p. 13, fig. 17 (1884).

		mm.
M $\frac{210}{1}$	Sandheads, River Hughli ( <i>J. Barnett</i> ) —One ♀ dorsal mantle-length	61
M $\frac{611}{1}$	Galle, Ceylon ( <i>Dr. Anderson</i> )—One ♂	68
M $\frac{614}{1}$	Indian Seas ( <i>Dr. Armstrong</i> , 1875) —One ♀	58
M $\frac{615}{1}$	Loc. ? Asiatic Soc. Bengal —One ♂	55
M $\frac{616}{1}$	Penang ( <i>Dr. Stoliczka</i> ). —One ♂	45
M $\frac{727}{1}$	Sandheads, River Hughli ( <i>Milner</i> ) —One ♀	68
M $\frac{3273}{1}$	Investigator' station 332 : 12-iv-1904, Andaman Sea, 10° 21' N., 92° 46' 15" E., 279 fathoms. —One ♂	59
M $\frac{3647-9}{1}$	Mutlah River, surface —One ♂, Two ♀	26-60
M $\frac{4772-4}{1}$	Indian Seas, Marine Survey of India —One ♂ two ♀	47-64
M $\frac{5459-61}{1}$	Off Puri, Orissa Coast, trawler 'Golden Crown', Bengal Fish. Dept. —One ♂. two ♀	46-7
M $\frac{8087}{1}$	Sandheads, River Hughli, 20-iv-1870 ( <i>G. Lord</i> ) —One ♂	323
M $\frac{8100}{1}$	Hainze Basin, Burma, Marine Survey of India —One ♀	50
M $\frac{8106}{1}$	'Investigator' station 70 : 9-i-1890, Off Chilka L., Orissa Coast, 11 fathoms —One ♀	28
M $\frac{8107}{1}$	Investigator station 83 : 28-i-1890, 9 miles S. W. of Bawanapadu Beacon, Ganjam Coast, 13 fathoms —One ♂	45
M $\frac{8142-3}{1}$	'Investigator' station 463a : 21-iv-1912, Bay of Bengal, 7° 37' N., 84° 19' E., 400 fathoms —Two ♂	39-53
M $\frac{8152-3}{1}$	'Investigator' station 481 : 25-26-xii-1912, Mergui Harbour, 7 fathoms—One ♂, One ♀	36-47
M $\frac{8162}{1}$	Mouth of River Hughli ( <i>Capt. T. Munro</i> ) —One ♀	77
M $\frac{8170}{1}$	Puri Beach ( <i>N. Annandale</i> ), 20-22-iii-1906 —One ♂	66
M $\frac{8171-2}{1}$	Puri Beach, Orissa Coast ( <i>N. Annandale</i> ), 1-2-ii-1909 —Two ♀	79-84
M $\frac{8202-05}{1}$	Puri Beach, Orissa Coast, 18-19-1-1908 ( <i>Capt. R. E. Lloyd</i> ) —One ♂, Three ♀	53-71
M $\frac{8211}{1}$	(a, b, c, d) Puri Beach, Orissa Coast ( <i>F. H. Gravely</i> ) —Three ♂, One ♀	25-79
M $\frac{8212}{1}$	Puri Beach, Orissa Coast ( <i>C. Paiva</i> ) —One ♀	70
M $\frac{8219}{1}$	Persian Gulf ( <i>R. Hugh Butler</i> ) —One ♂	46
M $\frac{8229-31}{1}$	Palk Straits, S. of India—Two, ♂, One ♀	36-52

	mm.
M $\frac{82.50}{1}$ Akyab, Burma ( <i>I. H. Burkill</i> ) —One ♀ dorsal mantle-length	40
M $\frac{82.55.8}{1}$ 10 m. N. E. of Devi River, Orissa Coast, 8 fathoms, 24-xii-1888—Three ♂ One ♀ .. ..	21-31
M $\frac{82.59.6.1}{1}$ Puri Beach, Bengal Fish. Dept. —One ♂, Two ♀ .. ..	57-73
M $\frac{827.0.7.1}{1}$ Balasore Bay, Orissa Coast, trawler <i>Golden Crown</i> ', Bengal Fish. Dept. —Two ♀ .. ..	62-63
M $\frac{827.2.3}{1}$ Balasore Bay, Orissa Coast, trawler <i>Golden Crown</i> ', Bengal Fish. Dept. —Two ♀ .. ..	62-65
M $\frac{9013.2.9}{2}$ Investigator ' station 565 and 567 : 13-20-xi-1913, 11° 57' 30" N., 98° 19' 00" E., 6-7 fathoms —Fourteen ♂, .. .. Three ♀ .. ..	26-37 40-47
M $\frac{9028.9.1.5.9}{2}$ Investigator station 569 : 29- 30-xi-1913, 11° 52' 10" N., 98° 18' 4" E., 5 fathoms —Forty-three ♂, .. .. Nineteen ♀ .. ..	20-40 15-40

These eighty-one males and fifty-one females taken either by shore collecting, or at a few fathoms to four hundred fathoms' depth, chiefly come from the Bay of Bengal region, and southwards to the Andamans and Ceylon. The Persian Gulf and Malay Peninsula are also represented.

All agree in having an oblong body, the breadth of which is two-thirds of the mantle-length, except in the case of large females (mantle 63-79 mm.), when the breadth is a little more than half the length.

The fins usually begin at a short distance from the mantle-margin and are generally formed anteriorly like a roll, and become wider posteriorly. The deep water specimens, and many collected on shore or at a few fathoms, have very wide fins throughout their entire length.

Head very broad. Umbrella highest laterally, and absent between the ventral arms. Arms short and keeled, the fourth pair strongly, the first and second very slightly. All with strong protective membranes and suckers in four rows. The suckers have meridional grooves and distal notches. In male specimens the rings of the arm suckers possess eight to fourteen long, pointed, closely-placed teeth on the distal margin, the rest of the ring being smooth. The number of teeth is largest in suckers from the centre of an arm, although the proximal suckers may equal them in size. A specimen with mantle-length of 36 mm. possesses eight teeth on the proximal and distal suckers and ten on those from the centre of an arm.

The female specimens have arm suckers with smooth rings; occasionally the horny ring shows indications of ten to eleven long, pointed teeth on the distal portion but the margin is un-split. In some cases it is notched but not deeply enough to form teeth. Wülker (*op. cit.*, p. 20) refers two females to *Sepiella*

*curta*, Pfeffer, and describes them as having arm rings quite wanting in teeth and yet not completely smooth. He expresses doubt as to whether the species should not be united with *S. inermis*, as the only difference rests on whether the arm rings are smooth or dentate. The type specimens of *S. curta* are two in number, and one is described as having a hectocotylized arm. The other is presumably a female, and if the description of the arm rings was taken from it, and not from the male, it would naturally seem to be a different species to *S. inermis*, which is figured by d'Orbigny as possessing sharp teeth on the upper edge of the ring. The exceptional advantage I have enjoyed in having such a large collection of both sexes of various sizes to examine has convinced me that both *S. curta* and *S. ocellata*, Pfeffer are the same species as *S. inermis*, and although *S. ornata* (Rang) has only been recorded from the west African region, I think it may eventually prove to be also this species, in which case Rang's name would have the priority. The hectocotylus has been figured by Hoyle (1905, fig. 152). It affects the proximal part of the fourth left arm, extending over more than half its length in small specimens, and less than half the length in larger examples. The modified suckers are very minute and in four rows, each row having a pair of suckers placed close together at either side of the arm, those on the ventral border being larger and placed closer together. Transverse folds on the modified portion of the arm are very distinct in well preserved specimens. The tentacle stems are flattened on the inner surface. The club is very long and possesses a moderate fin and slight protective membrane, and a width at the centre of about twice that of the stem.

The very numerous and minute club suckers are distributed in no particular order. Two much larger than the rest are placed at the tip of the club. The rings of the tentacular suckers possess blunt teeth on the distal margin, the remainder of the ring being smooth. The teeth are very little wider at the base than at the top and are generally separated by about the width of their base. The number varies according to the size of the specimen, and individual variation plays a part. Thus a male with mantle-length of 33 mm. possesses three to four teeth, and a female specimen with mantle-length of 30 mm. possesses three to six teeth. A male with mantle of 48 mm. possesses nine to eleven teeth, and a female of 52 mm. mantle-length has five to seven. Females with mantle-length of 61-79 mm. show nine to thirteen teeth. If one of the minute club suckers is placed on its side the papillae cause the ring to appear to be dentate all round.

Two females from Puri Beach (M  $\frac{8171.2}{1}$ ) showed either no teeth, or a very feeble development of them on the rings of the only tentacle present, but in general appearance, funnel organ and shell, they agreed perfectly with other specimen of *S. inermis*. Buccal membrane seven-angled and minus suckers. A large spermatic pad is developed in the female. Funnel organ: a  $\blacktriangle$ -shaped median pad and pear-shaped lateral pads, widest posteri-

only. Sculpture: a few papillae are usually present on the dorsal surface of the mantle, and sometimes extend to the head, but never to the fins or ventral surface. Colour in alcohol, buff with a variety of bluish-slate and purple-pink markings. The innumerable chromatophores are very small and dark on the dorsal surface and are usually reddish ventrally. Very few chromatophores occur on the ventral surface of the fins. The row of dark ornamental spots or ocelli along the base of the fin shown in the illustration of d'Orbigny (pl. 20) is present only in males of a certain size. Among the specimens M  $\frac{9013 \cdot 29}{2}$ , eight males with mantle-length of 26-35 mm. show no ocelli, which are, however, distinctly marked on four males with mantle-length of 32-37 mm. As regards the specimens M  $\frac{9098 \cdot 9159}{2}$ , thirty-one males with mantles of 33-40 mm. show the ocelli and the remaining twelve males, which are without them, have a mantle-length of only 20-32 mm. The ocelli are always largest at the posterior end of the mantle, and in very small males appear first at this end. They are usually pear-shaped with the pointed end innermost, and may be 7 mm. by 2 mm. in large specimens. Anteriorly they become rounder. A male with mantle-length of 36 mm. shows five ocelli on each side, one with mantle-length of 46 mm. has seven on each side, and one with mantle of 53 mm. has nine on each side. The Penang specimen (M  $\frac{616}{1}$ ) shows a deviation from this rule by exhibiting eleven strongly-marked ocelli on either side of a mantle of 43 mm. in length. The ocelli, which show no iridescence, are situated in the skin beneath the outside layer, and do not penetrate to the muscular layer. If a portion of epidermis is examined with a high power, the ocelli appear as opaque, white, oblong masses, and are thus in sharp distinction to the round dark chromatophores none of which approach them in size. In light coloured specimens the ocelli are pinkish<sup>1</sup>, and small dark chromatophores are sprinkled over their surface as elsewhere. In the female the ocelli are always absent, and they are also wanting in a few males large enough to possess them (M  $\frac{614}{1}$ , M  $\frac{4772}{1}$  and M  $\frac{8219}{1}$ ), but these latter are either faded or in bad condition as regards the epidermis. Many of the specimens in the collection possess no date of capture, but there is evidence to show that examples with ocelli were taken in the months of January (1890 and 1908, in both hauls ocelli barely visible); March (1900, very distinct); April (1870, faint, 1904 and 1912, very distinct); November (1913, very distinct); and December (1912, well-marked).<sup>2</sup> A male *S. ornata* in the Paris Museum exhibits ocelli along the sides closely resembling those of male *S. inermis*. A female *S. ornata* in the same collection has unfortunately become suffused with black so that it is not possible to see if the ocelli are absent.

Eight males (M  $\frac{9013 \cdot 29}{2}$ ) with mantle-length of 30-37 mm. and six males and one female (M  $\frac{9098 \cdot 9159}{2}$ ) also small, exhibit a beauti-

<sup>1</sup> It is often necessary to hold a specimen up to the light, or allow it to become dry, in order to discover the ocelli.

<sup>2</sup> A specimen taken in December, 1888 shows no ocelli.

ful iridescent patch on the dorsal surface at the posterior end of the body. The pore, situated at the ventral posterior end of the body in the present genus, leads into a gland the function of which has never been made clear. This gland is covered by a muscular coat under and amongst which lies (in the present specimens) a thin iridescent layer which does not extend to the many-furrowed inner wall, and only traces of iridescence were observed outside the lower surface of the gland. Besides the above-mentioned female, two others (M<sup>9013</sup><sub>2</sub><sup>29</sup>), showing no external iridescence, displayed, when the skin was removed, flashes of golden-green and pink. In one of these females the gland was pale purple and the pore had a purple tinge, but on being opened no trace of purple fluid could be seen. Wülker, *op. cit.* p. 32, has remarked on the existence of a purple gland in this part of the body in *Sepiella*, discovered by Appellöf. He alludes also to the striking coloured appearance figured by d'Orbigny and Férussac for *S. ornata* (Rang) at the dorsal posterior end of the body, and suggests that if a living example could be examined a luminous organ might be found in this situation. The adornment figured by d'Orbigny is, however, probably similar to the iridescent patch described above, which would seem, moreover, to be evanescent in alcohol, no specimens exhibiting it excepting those which had been preserved for less than a year when examined. Steenstrup has remarked with regard to the shell in *Sepia* that the proportion which the last loculus bears to the area of the shell varies according to the season of the year. Jatta says with regard to this "while the sepium increases in volume" and therefore augments the number of lamelli, the striated area "becomes larger while the smooth area diminishes: as a consequence of which in the same species there may be found" according to the stage of growth of the bone, and the greater "or less activity in the formation of lamelli, and, therefore, perhaps also according to the seasons, the two areas now equal" and now one prevailing above another." The shells of sixteen males and twenty females from the present collection were examined. The limited amount of evidence thus available seems to show that the limbs of the inner cone become accentuated with age and are then widest in the female, and, also, that individual variation exists as to their thickness and height. It will be observed in the specimens figured (pl. xxiv, figs. 1-8) that the striated area comprises more than half of the length of the shell in youthful specimens, and that the shell of a very young female is not broader in proportion to its length than that of a male. The shells of older specimens usually have the last loculus occupying about two-thirds of the length of the shell. The curvature of the parallel lines formed by the margin of the striated area varies occasionally, as is seen in the shell of the largest male figured, the other specimens exhibiting what appears to be the usual form. The dorsal surface is coarsely granulated and the shell beneath it is striated longitudinally. This can be seen in young specimens

in which the granulation is not much developed, and in most other examples at the commencement of the chitinous margin of the last loculus. An examination of the arrangement of the various internal organs showed, that, as Wülker (*op. cit.*, p. 31) has already pointed out, this genus and *Sepia* resemble each other almost exactly as regards the anatomy.

The radula and mandibles are shown on pl. xxiii, fig. 6 and pl. xxiv fig. 9.

The principal measurements of a male and female are appended.

Specimen number	...	...	M $\frac{8230}{1}$ ♂	M $\frac{8272}{1}$ ♀
			mm.	mm.
End of body to dorsal mantle-margin			43	62
Breadth of body	...	...	29	42
"  "  head	...	...	20	26
1st right arm	...	...	15	20
2nd " "	...	...	16	21
3rd " "	...	...	21	25
4th " "	...	...	23	32
Tentacle	...	...	56	76
Club	...	...	13	ca. 18
Fin maximum	...	...	6	6
"  minimum	...	...	2	3

*Distribution.*—Indo-Malayan Region; Timor, Japan (*Joubin*).

### **Sepiella** sp.

M  $\frac{8240}{1}$  Kilakarai, Ramnad District, South India, 0-2 fathoms, ii-1913 (*S. W. Kemp*)—One.

The above is too young to determine with certainty as it has a mantle-length of only 13 mm. Wülker regards *Sepia* specimens with mantle of 27-40 mm. as too young to determine specifically. If, however, a number of specimens of large and small size occur together it seems possible to assign them specifically at a much earlier age.

### Family SEPIIDAE.

M  $\frac{8104.5}{1}$  'Investigator' station 80: 17-i-1890, 4 miles S.E. of Sonapur Beacon, Ganjam Coast, 24 fathoms—Two immature.

These have a mantle-length of 6 mm. The fins commence at 2 mm. from the mantle-margin and are most developed posteriorly. Fourth arms the largest and with keels; suckers of arms in two rows. Tentacles missing except for a retracted one which can be observed coiled round beneath the skin on the ventral surface. Colour buff, closely freckled with small purple-brown chromatophores, which are thickest on the median dorsal surface of the mantle and head.

### Family SEPIOTEUTHIDAE.

#### **Sepioteuthis arctipinnis**, Gould.

*Sepioteuthis arctipinnis*, Gould, *U. S. Exploring Exp.*, XII, p. 479, fig. 93 (1852); Wülker, *Abh. Senckenb. Nat. Gesell.*, XXXIV, pp. 452-

475, 482 (1913); Berry, *Bull. Sur. Fish.*, XXXII, pp. 308-9, figs. 20-22 (1914).

M  $\frac{513-4}{1}$  Investigator N. Andaman Island, littoral, Marine Survey of India—One ♂, one ♀.

M  $\frac{8103}{1}$  Investigator, E.S.E. of S. Moscos Island, Marine Survey of India—One ♀

M  $\frac{8163-4}{1}$  Andamans (F. Wood-Mason)—One ♂, one ♀

The above all agree in the shape of the pen and in having the greatest width of the fin at the posterior third of the body. The pen has a hollow midrib with broad marginal thickenings, and is covered by a transparent and very delicate horny plate with a broadly rounded anterior margin. The median mantle-margin in order to correspond with the shape of the pen is, therefore, very obtuse and evenly rounded. The funnel organ was examined in specimens M  $\frac{8164}{1}$  and M  $\frac{8103}{1}$ . It is  $\Lambda$ -shaped, with smaller, oblong, lateral pads. Order of arms 3, 4, 2, 1; protective membranes to all, especially developed on third pair; suckers in two rows. Specimens M  $\frac{8163-4}{1}$  are in good condition, and their largest arm suckers have rings armed with nineteen or twenty teeth all round the ring, five or six on the distal margin being larger than the rest. The space between each tooth is about the width of the base of two teeth and this space is equal to the length of a tooth. The teeth are incurved and resemble short, broad claws. A distal sucker shows twenty teeth, eight of which are larger than the rest. The tentacle suckers are in four rows, those of the middle third of the club being much larger than the rest. The suckers of the inner rows here are larger than the marginal ones. The rings of the tentacular suckers also have teeth on the entire circumference, five, or sometimes more, claw-like teeth larger than the rest being placed on the distal margin.

The space between each of these is about equal to the width of three teeth and corresponds with the length of each. The proximal suckers show less space between the teeth. Both specimens have a spoon-shaped expansion with small flat suckers at the tip of the club. The hectocotylized arm of specimen M  $\frac{8163}{1}$  has twenty rows of ordinary suckers followed by a few small suckers on long pedicels; these are succeeded by papillae surmounted by extremely minute suckers which persist either as complete suckers, or in rudimentary form, to the tip of the arm. The ventral papillae are smaller than those of the dorsal margin. Buccal membrane seven-angled and with suckers with toothed rings. As many as five suckers may be present on an angle. Colour pinkish-buff with large brownish-red chromatophores or small, almost black, ones.

Ventral fin surface without chromatophores. Specimens M  $\frac{513-4}{1}$  are in bad condition and much contracted. Their characters seem to agree with the foregoing except that their colour is much darker, *viz.*, ground colour gray, with very dark blotches covering much of the ventral as well as the dorsal surface. The ink sac is ruptured in one of the specimens which may account for the dark ground colour.

Specimen M  $\frac{8103}{1}$  seems to have a somewhat wider and rounder head, and arms shorter in proportion to the length of the mantle than the other specimens, but these differences may be accounted for by its being at a younger stage of growth or by varying modes of preservation. The tentacle stems are evidently partly withdrawn. The arm rings of this little specimen are armed with fourteen to twenty-four teeth surrounding the entire ring, about five on the distal margin being stouter and longer than the rest. A large median tentacular sucker shows eleven long teeth on the distal portion and the rest of the ring possesses much smaller teeth. Conical papillae are present and those near the ring sometimes look like small between teeth. The teeth are longer in proportion to the size of the ring than in the older specimens.

Colour pinkish-brown with many dark blotches and spots, head so densely mottled as to be almost black.

No chromatophores on ventral surface of fins.

The principal measurements in mm. are appended:—

Specimen number...	M $\frac{513}{1}$ ♂	M $\frac{514}{1}$ ♀	M $\frac{8103}{1}$ ♀	M $\frac{8163}{1}$ ♂	M $\frac{8164}{1}$ ♀
End of body to dorsal mantle-margin	60	52	34	95	129
Breadth of mantle	28	22	12	34	43
" " head...	16	20	11.50	27	35
Greatest width of fins	39	32	22	58	85
1st right arm	15	ca. 13	ca. 8	28 <sup>1</sup>	45
2nd " "	22	ca. 22	10	38 <sup>1</sup>	54
3rd " "	24	ca. 24	17	51	67
4th " "	24	ca. 23	13	49	69
Tentacle	ca. 63	57	23	98	133
Club	23	22	13	37	58
Diameter of largest sucker of sessile arm	75		50	1.50	ca. 1.75
Diameter of largest sucker of tentacle.	1		.75	2	2

*Distribution.*—Island of Maui (type locality); Honolulu, Oahu, Bertrand Island, North Coast of Papua? (*Wülker*).

## Family ENOPLOTEUTHIDAE

### *Abralia andamanica*, Goodrich.

*Abralia andamanica*, Goodrich, *Trans. Linn. Soc.*, VII, p. 9, pl. 2, figs. 38-45 (1896); *Asteroteuthis andamanica*, Pfeffer, *Plankton Exp.*, (Oegopsida) p. 137 (1912).

M  $\frac{539}{1}$  Investigator' station 224: 23-ii-1897, 14° 54' 30" N., 96° 13' E., 55 fathoms—One ♀.

M  $\frac{9329:1}{2}$  Investigator' station 590: Mergui Archipelago, Marine Survey of India—One ♀ and one (?) ♂.

Specimen M  $\frac{539}{1}$  is not in very good condition and it is difficult to discover more than about three rows of transverse luminous

<sup>1</sup> Less tip.

organs on the ventral surface of the mantle. A few organs are visible on the siphon and they form nine rows on the ventral surface of the head. Three rows are present on the ventral arms and a single organ is visible on the third left arm. About thirty surround one eye, those on the ventral surface being most conspicuous. The first right arm possesses eleven hooks and twelve suckers, and the fourth has sixteen hooks and the same number of suckers. The rings of the arm suckers have twelve to fourteen blunt and rather long teeth, separated by about the width of their base on the distal edge of the ring. Goodrich (1896, pl. 2, fig. 42) represents the ring as being toothed all round. Pfeffer (*l.c.*, p. 137) has, however, suggested that Goodrich may have mistaken some papillae for teeth as it is frequently very difficult to distinguish them unless the horny ring is isolated from the sucker. This specimen has more tentacular hooks and suckers than the type, but the fact that these vary on the different clubs shows that no hard and fast rules can be laid down as regards this. One tentacle has a connective apparatus of five suckers and six papillae, and along the ventral margin of the club are three much-curved hooks and the sockets of two others, the central hook being the largest. Nine large suckers occur near the hooks, each having a horny ring with about thirty teeth (separated by about the width of their base) on its circumference. The distal part of the club has fifteen or sixteen rows of very small suckers placed four in a row and becoming very minute towards the tip, their rings being armed with many teeth. The other tentacle has a connective apparatus of four suckers and eight papillae, and the club shows five hooks and the socket of a sixth, as well as eight large suckers, and fifteen or sixteen rows of minute suckers on the distal portion.

Specimen M  $\frac{9320}{2}$  has five hooks on the only club present. The ventral surface of the mantle shows many luminous organs on the median line, and elsewhere, but they are not arranged in any definite order, and a few trespass a little on the dorsal surface. Besides the three rows on the ventral arms, a single row ornaments each of the third arms. The eight-angled buccal membrane is pale and dotted with red chromatophores. The funnei organ closely resembles that of *A. trigonura*, Berry (1914, p. 329, text-fig. 33), and consists of a median **Λ**-shaped dorsal pad and broad ovate ventro-lateral pads, a small valve being also present. The luminous organs on the funnel fail, however, to show the triangular arrangement described by Berry. The small specimen M  $\frac{9321}{1}$  seems to be a male, but it is not in very good condition, and there is no trace of a hectocotylus. Four hooks are present on one club and five on the other. Luminous organs are visible on the third as well as on the fourth arms, and are very distinct round each eye-opening, but the eyes, as is the case with the other specimens, are injured.

The principal dimensions in mm. are given below.

Specimen number	...	M $\frac{539}{1}$	M $\frac{9320}{2}$	M $\frac{9321}{2}$
End of body to dorsal mantle-margin...		40	35	24
Mantle-margin fork between dorsal arms		12	13	9
Breadth of mantle	...	12	10	10
"    across fins	...	30	25	15
Length of fin	...	22	20	11
1st right arm	...	20	20	14
2nd " "	...	25	21	18
3rd " "	...	22	20	17
4th " "	...	22	22	14
Tentacle	...	45	35	33
Club	...	10	9	5

*Distribution.*—Andaman Sea, 188-320 fathoms.

*Type.*—In Indian Museum, Calcutta, three specimens, male and female.

### Family BATHYTEUTHIDAE.

#### *Bathyteuthis abyssicola*, Hoyle.

*Bathyteuthis abyssicola*, Hoyle. *Narr. Chall. Exp.*, I, p. 272, fig. 108 (1885); 'Challenger' *Rep.*, XVI (Cephalopoda), pp. 168-169, pl. 29, figs. 1-7 (1886); Pfeffer, *Synopsis Oegopsid. Ceph.*, pp. 172-3 (1900); Hoyle, *Bull. Mus. Comp. Zool.*, XLIII, no. 1, p. 33, pl. 1, fig. 2 (1904); *Trans. Royal Soc. Edin.*, XLVIII, part II, no. 14, pp. 282-283 (1912); *Benthoteuthis megalops*, Verrill, *Trans. Connect. Acad., Third Catalogue* (Cephalopoda), p. 401, pl. 44, fig. 1 (1885); Chun, *Valdivia Exp.*, (Oegopsida) p. 185, pls. 24-27 (1910); Pfeffer, *Plankton Exp.*, (Oegopsida) pp. 325-331, pl. 40, figs. 12-16 (1912).

M  $\frac{8138}{1}$  'Investigator' station 393 : 21-x-1911, Bay of Bengal, 7° 21' 6" N., 85° 7' 15" E., 2000 fathoms—One.

M  $\frac{8139}{1}$  'Investigator' station 462a : 20-iv-1912, Bay of Bengal, 9° 8' N., 87° 25' E., 475 fathoms—One.

In specimen M  $\frac{8139}{1}$  the suckers of the ventral arms are in two rows throughout, and on the other arms they are proximally in two rows and distally in three or four irregular rows. The rings of the arm suckers have five to six teeth.

The tentacles are very long which is perhaps due to the specimen having been preserved in formalin. The suckers of the club begin proximally by a single sucker, followed by three in a row, and gradually increasing to about six in a row. A few rings of the club suckers appear to have about four blunt rather widely separated teeth on the distal margin and the rest of the ring smooth. Their position on the ring, and their blunt ends, seems to point to their being teeth and not papillae. Other rings seemed to be smooth. Hoyle describes the tentacular rings to be smooth, and Verrill does not mention their condition which would seem to imply that he had not observed any teeth.

The horny rings of both tentacular and arm suckers are very dark. The luminous organs of the arms are about .50 mm. in length. The chromatophores are darkest on the dorsal surface of the head. Specimen M  $\frac{8138}{1}$ , from the great depth of 2000 fathoms, is very young, and the mantle is much crumpled and denuded of its epidermis. The luminous organs at the base of the arms are clearly perceptible. The arm suckers are in two rows, and their largest rings show four to five teeth. The ten-

tacles are only represented by portions of stems. The arms are about 2 mm. in length, and the distance from the dorsal mantle-margin to the fork between the dorsal pair is 2 mm. The breadth of the head across the eyes is about 2.50 mm. The specimen has been preserved in formalin.

The following are the principal measurements of specimen M  $\frac{8139}{1}$  :—

	mm.
End of body to dorsal mantle-margin ... ..	12
Breadth of mantle ... ..	4
"    "    head across eyes ... ..	6
1st right arm ... ..	3.50
2nd "    "    ... ..	4
3rd "    "    ... ..	4
4th "    "    ... ..	5
Length of tentacle ... ..	22
"    "    club ... ..	2.50

*Distribution.*—North Atlantic (Verrill, 1885); Indian Ocean (Chun); between Marion Island and the Crozets (Hoyle, 1886); North Pacific (Hoyle, 1904); Antarctic (Hoyle, 1912).

*Vertical Range.*—437-1600 fathoms (Pfeffer, 1912).

#### Family HISTIOTEUTHIDAE.

##### *Stigmatoteuthis japonica*, Pfeffer.

*Stigmatoteuthis japonica*, Pfeffer, *Plankton Exp.*, (Oegopsida) pp. 284-5 (1912); *Calliteuthis reversa*, Hoyle, *Challenger' Rep.*, XVI (Cephalopoda), pp. 183-4, pl. 33, figs. 12-15 (1886).

M  $\frac{8132}{1}$  'Investigator' station 374: 2-iv-1907, Andaman Sea, 11° 37' N., 95° 57' E., 28 fathoms—One.

The first three pairs of arms have a row of luminous organs on the ventral margin of their dorsal surface. Of these there are eight on the first arm, eleven to twelve on the second, and nine on the third. On the latter pair a short, strong keel attaining 3 mm. in width, is developed on the central third of the arm along the line of the luminous organs. The fourth arms possess three rows of luminous organs for more than half their length, two of which persist towards the tip where a single row containing four terminates the series. About twenty-nine organs are present on one of these arms. Seventeen luminous organs surround the right eye-opening. The left eye has only six organs. The mantle-margin has a well-defined row of organs all round its circumference, except on the median dorsal surface, where a space of 11 mm. is ornamented by a solitary organ in the exact median line. On the ventral mantle there are about sixteen transverse rows of organs, and about six similar rows occur on the ventral surface of the head; eight organs form a low arch above the siphon. Very few luminous organs are present on the dorsal surface of the head and mantle. The arms have slight protective membranes and their suckers are furnished with smooth rings, except at the distal portion of each arm, where the rings have five to eight

blunt rather closely-set teeth on the distal margin, the rest of the ring being smooth. The tentacle stem is flattened and its inner surface is marked with a groove. At 16 mm. from the base of the club the connective apparatus, consisting of eight suckers and four papillae, commences. These suckers have a papillary area and smooth ring. Six or seven suckers are placed in a row on the proximal two-thirds of the club, about ten being larger than the rest; the distal third has very small suckers, the last six rows containing only two apiece. Protective membranes are moderately developed, and there is a slight dorsal keel. The rings of the large tentacular suckers have twenty-two to twenty-five pointed teeth all round their circumference. Smaller suckers may have as many as thirty-six teeth. None of the suckers has accessory chitinous formations.

Colour reddish-purple, fins paler and their ventral surface sprinkled with chromatophores on the part next the mantle. Pfeffer (*l.c.*, p. 249) has shown that the genus *Calliteuthis* is defined by having smooth rings to arm and tentacle suckers, and that the latter are furnished with accessory chitinous formations which are wanting in the genus *Stigmatoteuthis* which has denticulate rings to arm and tentacle suckers.

The principal measurements are as follows:—

				mm.
End of body to dorsal mantle-margin	...	...	...	56
Breadth of mantle	...	...	...	23
Breadth across fins	...	...	...	37
"    of fin	...	...	...	29
1st right arm	...	...	...	52
2nd " "	...	...	...	62
3rd " "	...	...	...	56
4th " "	...	...	...	52 <sup>1</sup>
Tentacle	...	...	...	125
Club	...	...	...	19

*Distribution.*—Japan, 345 fathoms (*Hoyle*). One specimen.

#### Family CHIROTEUTHIDAE.

##### *Chiroteuthis (Chirothauma) imperator*, Chun.

*Chiroteuthis (Chirothauma) imperator*, Chun, *Valdivia Exp.*, (Oegopsida) p. 241, pls. 38, 39, 40, 41, 42, 43, 44 (1910); Pfeffer, *Plankton Exp.*, (Oegopsida) p. 581 (1912).

- M  $\frac{1250}{1}$  'Investigator' station 281: 20-iii-1901, Bay of Bengal, 11° 15' 15" N., 8° 7' E., 300 fathoms.—One ♀
- M  $\frac{1380}{1}$  'Investigator' station 297: 13-iv-1902, Gulf of Oman, 25° 11' 30" N., 57° 15' E., 700-689 fathoms.—One.
- M  $\frac{8128}{1}$  'Investigator' station 366: 10-iv-1906, Arabian Sea, 24° 45' N., 63° 50' 15" E., 544 fathoms.—One ♀ and arms of another specimen.

The specimen M  $\frac{1250}{1}$  resembles in colour Chun's illustration (pl. 38, figs. 1 and 2). The ventral luminous organs measure about

<sup>1</sup> Less tip.

3 mm. in length and 2.50 mm. in breadth. The nidamental glands measure nearly 1.50 mm. in length. The olfactory papillae measure about 2 mm. in length and are situated at about 3 mm. below the posterior end of the eyes. The ventral arms have the margins mutilated in many parts so that only a few luminous organs are present, *viz.*, 9 on one arm and 3 on the other. The tentacles have lost their clubs.

The example M  $\frac{1380}{1}$  is much damaged but in spite of its mutilated condition it has been easy to identify it with certainty from Chun's magnificent illustrations. One of the tentacles possesses a club, and the stalks of its suckers are furnished with the wing-like membrane described by Chun (p. 247), and in other details the club suckers and those of the arms resemble completely Chun's description and figures. About fifty luminous organs are present on the fourth right arm and forty-six on the fourth left arm. Nothing resembling a hectocotylus appears on any of the arms. The eyes have the three longitudinal rows of luminous organs which Chun describes as "sparkling like a chain of jewels." Twenty-two are present on one eye. The fins, siphon, and much of the ventral region have been torn away.

The dorsal mantle-margin has the attachment exactly as in Chun's illustration (pl. 39, fig. 1).

The tentacles are furnished at the base with membranes which are widest at the dorsal side.

The dorsal mantle region is much darker in tone than the illustration of Chun (pl. 38, figs. 1 and 2), who, however, mentions (*l.c.*, p. 251) "auch hebt sich bei einzelnen Exemplaren die Rückenregion im Bereiche des Gladius durch etwas intensivere Pigmentierung ab."

The specimen M  $\frac{8128}{1}$  is also in very bad condition, and is accompanied by the arms of another large specimen M  $\frac{8128a}{1}$  and a loose tentacle which presumably belongs to one of them. The club of the latter measures 140 mm. Approximate measurements of the different specimens are given below:—

Specimen number	...	...	M $\frac{1250}{1}$ mm.	M $\frac{1380}{1}$ mm.	M $\frac{8128}{1}$ mm.	M $\frac{8128a}{1}$ mm.
Dorsal mantle-margin to commencement of fins	...	...	26	...	74	...
Breadth of body at mantle-margin	...	...	15	...	45	...
"  of head	...	...	11	45	<i>ca.</i> 28	...
"  of fins	...	...	30	...	82	...
1st right arm	...	...	25	214	83	101
2nd " "	...	...	38	mutilated.	112	122
3rd " "	...	...	45	203	128	140
4th " "	...	...	92	337	200	202
Length of tentacle	...	...	106 <sup>†</sup>	1098	mutilated.	mutilated.
"  " club	...	...	...	167	...	...

*Distribution.*—0° 15' N., 98° 8' E., trawl 614 m. ('*Valdivia* ' *Exp.*) Sagami Bay, Japan, from the collection of Haberer and Doflein (*Chun*, 1910).

<sup>†</sup> Mutilated.

## Family CRANCHIIDAE.

**Teuthowenia (Hensenioteuthis) joubini**, Pfeffer.

*Teuthowenia (Hensenioteuthis) joubini*, Pfeffer, *Plankton Exp.*, (Oegopsida) pp. 747-8, pl. 48, figs. 12-16 (1912).

M 8139 'Investigator' station 462a: 20-iv-1912, Bay of Bengal, 9° 8' N., 87° 25' E., 475 fathoms—One.

This is considerably larger than the type, and unfortunately resembles it in having the tentacles represented only by mutilated stems. There is a slight groove on the inner surface of the stem, and at about 3 mm. from the mouth there seemed to be two minute suckers, which, however, may have been only abrasions on the stem surface. A very delicate membrane unites the first and second pairs of arms extending to about the first sucker, but is very slight between the second and third pair and absent between the ventral arms. This membrane had probably been torn away from the type. Only the rings on the distal half of the third arms could be examined without injuring the specimen. The suckers in this region have four or five short, widely-spaced teeth on the distal margin, the rest of the ring being smooth. Colour dull white sprinkled on both sides of the mantle with small dark chromatophores, arranged in about twenty-eight irregular transverse rows. When not contracted the chromatophores are reddish-brown and oblong. They are dark and narrow and placed transversely on the dorsal surface of the arms and are sometimes scattered amongst the suckers. They are present on the siphon but absent from the fins. The extraordinary eyes make this a species easy to identify.

The following are the principal measurements:—

	mm.
End of body to dorsal mantle-margin	... 14
Breadth of mantle	... 9
"    head and eyes	... 5
Length of fin	... 1
Breadth of fins	... 4
1st right arm	... ca. 2
3rd " "	... 4
Mutilated tentacle stems	... 10

*Distribution.*—31° 7' N., 43° 6' W, 0-400 m., Sargasso Sea, type specimen (Pfeffer, 1912).

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