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A MONOGRHPH OF THE DIBRANCHIATE CEPHALOPODS OF THE JAPANESE AND ADJACENT WATERS.

By

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With 30 Plates and 179 Textfigures.

The present paper deals with the fauna of Dibranchiate Cephalopods occurring in the Japanese and adjacent waters and embodies the results of study carried on during about ten years past. The species described amount to one hundred and twenty-five in number, comprised in fifty-two genera which belong in turn to twenty-one families. Of this number fifty-three species, one subgenus, three genera, and two families are recognised as new to science although some of them have already been reported as such in preliminary papers of this work. Besides these, there are seven additional new forms which deviate respectively so slightly from their typical forms, that they may not be regarded as distinct species, but only as varieties.

The material on which the study is based comprises not less than 10,000 individual specimens which were chiefly derived from the following sources.

1. The collection of our University.
2. The specimens preserved in the Imperial University of Tôkyo, a greater part of which collected under the care of Professor S. Watase.
3. The collection of the U.S. Bureau of Fisheries Steamer "Albatross," made in the north-western Pacific during 1906.
4. That of the Fisheries Bureau, Imperial Department of Agriculture and Commerce, Tôkyo.
5. That of the Imperial Household Museum, Tôkyo.
6. The private collection of Mr. K. Tago.
7. That of Dr. M. Oshima from Formosa and the vicinity, of which the great majority now preserved in the Formosan Museum.
8. The collection of the Fishery Experiment Station of the Provincial Government of Hokkaido.
9. That of the Local Fishery Institutes of the Prefectures at Toyama, Okayama, Nagasaki, and Shimane.

In addition to these, many specimens have been collected by myself in order to examine anatomical details as well as to observe physiological functions of certain organs, for instance, of the external and internal reproductive organs in male as well as in female individuals.

[Jour. of the Coll. of Agr. Hokkaido Imp. Univ. Sapporo, Suppl. to Vol. XX., July 1928.]

The geographical area covered by these collections extends from the Bering and Okhotsk Seas on the north to the Bonin Islands and Formosa on the south, and further comprises Korea and Kantoshu of China.

The systematic order here used has been as far as possible retained within the ordinary form hitherto universally used, but for some part of the classification of octopods, I have inevitably made changes. Besides this, a necessary revision has been made of the diagnostic characteristics as to almost every group of graduated order, to include the newly added characters or to accommodate the alterations of characteristics. The systematic methods recently offered by Naef and Grimpe, which involve very many improvements of the classification, are also taken into consideration, but I have hesitated in the application as to the main systematic order in this work, and they seem still to have many points to be discussed and revised.

With this opportunity, I wish to tender my thanks to all those who have aided me in one way or another, in the course of the present investigation. First of all I desire to express my warmest thanks to the late Professor I. Ijima and to Professor S. Watase under whose supervision this work was carried out at its start. I am also much indebted to Professor S. Hatta as well as to Professor S. Goto, whose great sympathy enabled me to bring out this work in the printed from. My cordial gratitude is due to Dr. M. Oshima, and also to Mr. K. Tago, who kindly placed all the specimens in their possessions at my disposal. My grateful thanks are none the less due also to the Superintendents of the above named institutes, bureaus, museums, and stations, for their kindly rendering the specimens forming the present material accessible to me. To Dr. W. S. Hoyle and Mr. S. S. Berry, I am indebted for their kindness in sending literature and specimens which are not only important, but also indispensable for the present study.

Finally, I wish to express my obligations to the Superintendent and staff of the Natural History Museum (British Museum), London, for their kindly giving me the privilege of examining type specimens preserved there, by which, I believe, the present work has surely become more comprehensive.

Order **Dibranchiata** Owen, 1832.

Suborder **Octopoda** Leach, 1817.

Octopia+Argonauta, Rafinesque 1815 (fide Gray).

Octopoda, Leach 1817, pp. 137, 138.*)—d'Orb. et Fér. 1835, p. 1.—Verany 1851, p. 6.—Adams, H. & A. 1858, p. 18.—Verrill 1881c, p. 360; 1882, p. 387.—Naef 1912e, p. 195.—Berry 1914a, p. 274.

Octopia, Gray 1849, pp. 2, 3.

Octocera, de Blainville 1824 (fide Gray).

Body short, rounded behind; very rarely furnished with fins. Head and mantle always broadly continuous on the back. Retractor pallii medianus ordinarily well developed. Mouth surrounded by inner and outer lips only. Funnel-valve nearly always absent. Arms only eight in number and similar in structure. Suckers mostly sessil, uni- or biserial, without horny ring. No gladius, nor calcareous shell present, but sometimes a crescentic or U-shaped cartilaginous bar (dorsal cartilage) or two chitinous stylets may occur internally. Coelom greatly reduced, with which the gonocoel is usually connected through so-called water vascular canal.

Key to the families and subfamilies found in Japan.

(I) Fins present; arms with uniserial suckers alternating with biserial cirri (*Pinnata*).
- (a) Fins bipaired; mantle-opening wide; no retr. palli. med.....*Watasellidae.*
- (b) Fins unipaired; mantle-opening narrow, fitting closely around funnel; retr. palli med. present.....*Cirroteuthidae.*

(II) No fins; arms with uni- or biserial suckers only (*Apinna*).
- (A) Pelagic or abyssal octopods of soft, transparent and more or less jelly-like consistency.
  - (c) Mantle-opening wide; umbrella narrow; funnel organshaped; suckers distinctly uniserial throughout; right third arm hectocotylized, the modification consisting in the enlargement of suckers.....*Eledonellidea.*
  - (d) Mantle margin adherent to funnel base, so that its opening is reduced to two small ostium-like apertures on sides; umbrella broad, thick; funnel organ W-shaped; suckers uni-biserial; hectocotylus in right third arm, mainly confined to the tip.....*Amphitretidae.*
  - (e) Mantle-opening wide; umbrella broad, thick; funnel organ W-shaped; suckers uni-biserial; sexes dismorphic; hectocotylus involves the whole right third arm, originating in an internal space of head, and most probably separable at maturity.....*Alloposidae.*
- (B) Pelagic or littoral octopods of more or less firm and fleshy consistency, often attaining great dimension.
  - (f) Funnel base locks inner surface of mantle by means of cartilaginous apparata; aquiferous pores often present; sexes dimorphic; male much smaller than female; hectocotylus involving the whole third arm of either side, originating in a specialized sac, and detachable at maturity; ova small, attaining some development within a special part of female or in its external shell.....*Argonautidae.*
    - (*a*) Hectocotylus smooth on back, originating in a pedunculate sac; umbrella very narrow.
      - (i) Female with greatly expanded dorsal arms and an external shell; no aquiferous pore present on head; in male hectocotylus on the left side, with cylindrical suckers numbering below 40; animal pelagic .....*Argonautinae.*
      - (ii) Female distinctly tuberculate ventrally; with no external shell; in male, hectocotylus

*) Original description done by Leach: Pedus longitudine fere æquales, a basi ad apicem interne antiliis instructi; basi membrana coaliti. Saccus postice cum collo coalitus. Corpus ovale bursiforme, infra et utrinque frenatum; freno inferiore ad sacci marginem fere attingente; frenis lateralibus parvis.

on the right side, with oval, saucer-shaped suckers about 100 in number; ventral aquiferous pores present on head; animal rather littoral.....*Ocythoinae.*

(β) Hectocotylus on the right side, with fringe-like papillae on back, having its origin in an internal space of head; female with broad umbrella, and veliform membranes on dorsal arms; both dorsal and ventral aquiferous pores present on head.....*Tremoctopodinae.*

(g) Umbrella more or less developed; no locking apparata between funnel and mantle; arms comparatively long, with uni- or biserial suckers; no aquiferous pores present on head; sexes similar, except as to the hectocotylization which is confined to the tip of either arm of the third pair, and is never separable at maturity.....*Polypodidae.*

Division **Pinnatta** nom. nov.

Lioglossa, Lütken 1882 (fide Joubin).—Joubin 1900, p. 21.—Naef 1912e, p. 195.
Cirrata, Grimpe 1916, p. 353; 1917, p. 326; 1922, p. 38.
Cirroteuthoidea, Berry 1920, p. 155.—Naef 1921, p. 537.
Cirromorpha, Robson 1926, p. 1328.

Uni- or bipaired fins developed on the dorsal or dorso-lateral surface of mantle. Arms provided with uniserial suckers, and ordinarily also with biserial cirri alternating with the former. Radula may be rudimentary.

Subdivision **Protopinnata** nom. nov.

Eurytreta, Grimpe 1917, p. 326 (pars).
Vampyromorphae, Grimpe 1922, p. 39 (pars).
Odorstoglossa, Naef 1922, p. (pars).

Family **Watasellidae** Sasaki, 1920.

Watasellidae, Sasaki 1920, p. 168.
Vampyroteuthidae, Naef 1921, p. 537 (pars).

Mantle-opening wide, extending half round the body. Two pairs of fins present on mantle. Retractor pallii medianus not developed. Olfactory organ papilliform, situated behind each eye. Umbrella broad. A glandular filamentous organ present between first and second arms on either side. Funnel organ composed of a pair of ovate pads, situated far in advance of the centre of the dorsal funnel-wall. A distinct funnel valve present in front of the pads. Suckers globular, deeply constricted at base; uniserial, distributed on the distal half of arms. Cirri well developed, biserial, extending from base to tip of arms. Oviducts of both sides functional. Abyssal Octopoda of small size, and choroidal consistency.

Only a unique genus *Watasella* is at present known belonging to this family.

Genus **Watasella*** Sasaki, 1920.

Watasella, Sasaki 1920, p. 168.—Naef 1921, p. 537.
Type.—*Watasella nigra* Sasaki, 1920.

Watasella nigra Sasaki, 1920.

(Pl. I, figs. 1–4; Pl. VII, 1. 2; textfigs 1, 2.)

Watasella nigra, Sasaki 1920, p. 168; pl. 23, fig. 1.

The type specimen has been found in the "Albatross" collection.

Animal soft, choroidal; skin smooth, and color quite black. Mantle thick, saccular, a little longer than broad, widest anteriorly, rounded posteriorly. Mantle-opening wide, extending half round the

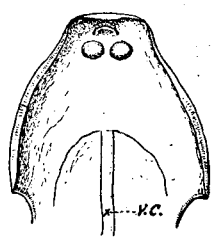
*) It is named in honour of Professor Watasé.

body, its angles situated far behind the centres of eyes. Mantle margin even, with no marked projection nor emargination, tinged with red. Dorsal surface of mantle furnished with a longitudinal-ovate area characterized by its very thin and quite transparent skin, extending from near the posterior end of body to its mid-dorsal part. Whether the existence of the area is natural or caused by ill handling cannot be determined (Pl. I, figs. 1, 2).

Fins developed in two pairs, those of each pair attached near together to the dorsal surface of mantle close to the lateral boundary line of the ovate area mentioned above, their apices turning laterad. Transverse length of fins equal to about twice their longitudinal length and about a quarter of the mantle-length.

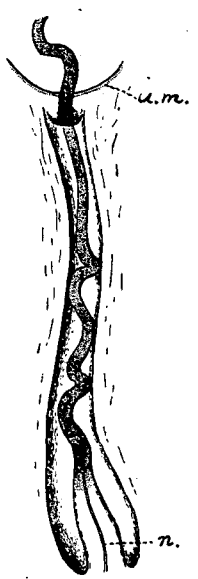
Head large, subcylindrical, as broad as body, and evenly continuous with it. Distinct tuberculus olfactorius present on either side of neck region a little before and below each angle of mantle-opening; tinged with light crimson. Eyeball of dark violet color, peeping into the exterior through a wide eye-opening, and attached to the bottom of orbit by a long peduncle. Superficial integument of eyeball, forming another pupil-like fold around a soft lens. Peduncle of eyeball surrounded at base by a ringular brownish substance of unknown function.

Funnel roughly conical, but only a short distal part projecting ventrad; out-line of the remaining part hardly distinguishable from outside. Funnel organ composed of two small transverse-ovate pads transversely arranged far in front of the centre of dorsal wall (textfig. 1). A distinct semilunar funnel-valve present in front of the pads, and as large as the latter. Free posterior end of funnel emarginated in the middle, devoid of locking apparata on sides.



Textfig. 1.
Watasella nigra. Funnel, laid open; ×ca. 7.

Arms subequal, on an average about as long as head and mantle measured together; thickened and cylindrical in the proximal half, then tapering off distad to attenuated extremities. Umbrella thick, broad, extending half up the arms; apparently no nodule present in any termination of its attachment, the margin continued on as a ridge a distance up along either side of arms. Arms provided with suckers and cirri, of which the whole nature can not be clearly made out, owing to their imperfect preservation. In the second, third, and fourth arms of the right side, of which the extremities are relatively well preserved, the suckers number over ten, sparsely set in a single series on the distal half. They are globular, but depressed at the distal end, which has a minute aperture at the centre. As a peculiar characteristic, none of the suckers are attached to the arms by broad bases as in other octopods, but they are separated from them by strong constrictions, strikingly resembling the pedunculate suckers of decapods, though no horny rings are found within them. The color of suckers is light crimson superiorly and yellowish drab inferiorly. Cirri light crimson in the distal parts, biserial, alternating with suckers, but ten or twelve more are found below first sucker; fifth or sixth pair the longest, then gradually shortening towards the extremity of the arm (Pl. I, figs. 3, 4).



Textfig. 2.
Watasella nigra. Filamentous organ in tubular pouch of umbrella; ×ca. 7.

A tubular pouch lined by a blackish integument (textfig. 2) exists between the first and second arms on either side, running through the umbrella. It opens externally at the umbrella edge, and blindly terminates between the roots of the above-mentioned arms. From the blind end of the pouch grows an opaque, salmon-pink, filamentous organ fixed to a conical colorless transparent base. The organ under microscope shows a fine structure composed of an axial part and an external integument, the former being made chiefly of longitudinal smooth muscular fibres and a thin nerve, while the latter consists of clavalate cells of various sizes. In the transparent base of the organ is visible through its integument a white nerve running towards the extremity. When I examined the specimen, the extremity of the organ in the left pouch was

protruded about 8 mm. through the opening, while in the right pouch the organ was shrunken and hidden in the deeper parts. The whole structure of the organ and its pouch thus revealed seemed as if to account for emitting light.

Beak strong, very large, measuring 2.2 mm. in length. Inner lip thick, with 17 radial grooves, colored in a rose-pink. Outer lip smoothly bordered and of the same color as the inner lip.

Viscera massive, compact; its general shape roughly ovoidal, projecting into mantle cavity; (Pl. VII. figs. 1, 2); retractor pallii medianus not developed; median pallial septum being quite rudimentary, confined to the posterior. Oviducts of both sides, developed, only short distal parts projecting into mantle-cavity. Gills somewhat elongate, each consisting of about 15 leaflets. Free part of rectum very short, with two rudimentary valves at the end.

Total length of the specimen examined, 25 mm.; ventral length of mantle 8.3 mm.; maximum breadth of mantle 8 mm.; length of arms 12 mm.

Remarks.—There are two species resembling *Watasella nigra* in question; one is *Melanoteuthis lucens* Joubin,*) and the other, *Vampyroteuthis infernalis* Chun.**) The former is known by only one specimen collected by the "Prince of Monaco" from the Sargasso Sea, and the latter, by three specimens collected by the "Michael Sars" with a vertical net all from deeper parts of the North Atlantic. They agree with the present *Watasella* in the general coloration and consistency of the body, in the brachial armatures, in the development of fins, and in some anatomical characters, which are all of important bearing in determining their phylogenetic relationship. Principal points discriminative from one another, so far as the descriptions go, are as follows.

	Watasella nigra	*Melanoteuthis lucence*	*Vampyroteuthis infernalis*
Fins:	bi-paired;	unipaired;	unipaired.
Filamentous organ in umbrella:	present;	present;	absent.
So-called luminous organ on fin-root:	absent;	present;	absent.
Eyes:	not prominent;	not prominent;	telescope-like.
Neck:	not constricted;	not constricted;	markedly constricted.
Funnel:	a little separated distally;	not separated;	extensively separated distally.

Type locality.—Off Kii Prov. (Albatross!). Depth 544 fathoms.

Type.—In U. S. Nat. Mus.

Subdivision **Metapinnata** nom. nov.

Stenotreta, Grimpe 1917, p. 326.
Cirromorphae, Grimpe 1922, p. 38.
Lioglossa, Naef 1922, p.

Family **Cirroteuthidae** Keferstein, 1866.

Pteroti, Reinhardti and Prosch 1847, p. 38 (fide Joubin).—Joubin 1900, p. 21.
Cirrhoteuthidae, Keferstein 1866, p. 1447 (fide Hoyle 1904).—Verrill 1881c, p. 382; 1882, p. 406.
Opisthoteuthidae, Verrill 1896, p. 74.
Cirroteuthidae, Hoyle 1904, p. 3.—Pfeffer 1908, pp. 15, 23.—Berry 1914a, p. 274; 1920, p. 155

*) Joubin 1912, p. 218, textfigs. 1–12.
**) Chun 1903, p. 88; Thiele, in Chun 1915, p. 534, pl.xc & xci, figs 1–5; textfigs. 67–70.

(pars)—(+*Opisthoteuthidae*), Naef 1912e, pp. 195, 196; 1921, p. 537—Thiele, in Chun 1915, p. 536.—(+*Opisthoteuthidae*), Grimpe 1916, p. 355; 1922, p. 38.—(+*Opisthoteuthidae*), Robson 1926, p. 1328.

A single pair of fins occur on mantle. Mantle-opening narrow, fitting closely around funnel. Retractor pallii medianus well developed. Tuberculus olfactorius situated on funnel-base within mantle cavity near each angle of mantle-opening.

Funnel organ ∧-shaped. Arms extensively interwebbed. Suckers uniserial throughout; generally a little prominent, cylindrical and sessil but sometimes sunk deep in the tissue of arms, or conspicuously projecting and club-shaped. Biserial cirri present on each arm alternating with suckers. Hectocotylus developed in both dorsal arms, represented by special enlargement of suckers. Oviduct single. Pelagic or abyssal octopods of moderate size and choroidal consistency.

Six genera*) may be included in this family, of which two occur in the Japanese waters.

Genus **Stauroteuthis** Verrill, 1879.

Stauroteuthis, Verrill 1879, p. 468; 1881c, p. 382; 1882, p. 406.—Hoyle 1904, p. 5.—Berry 1912a, p. 274; 1920, p. 155.—Naef. 1912e, p. 196; 1921, p. 537.

Entire body more or less campaniform, with a pair of fins near the halfway along mantle. Mantle-opening narrow, fitting closely around funnel. Umbrella generously developed, often extending the whole length of arms. Dorsal cartilage bent round into the shape of a horse-shoe, the extremities directed forwards. Suckers in a single series, alternating with biserial cirri. Oviduct single, oviducal ball enormous; vagina conspicuous, its greater part projecting into mantle cavity. Both dorsal arms hectocotylized, bearing conspicuous suckers toward the middle. In general, the entire external surface of animals is of a whitish rose-pink or a creamish red color and the internal surface of the umbrella and arms, of a chocolate or a deep purple.

The genus is closely allied to *Cirroteuthis*, the shape and position of the dorsal cartilage being regarded as the chief point of distinction.

Type.—*Stauroteuthis syrtensis* Verrill, 1879.

Stauroteuthis albatrossi Sasaki, 1920.

(Pl. VII, figs. 3–6; textfig. 3.)

Stauroteuthis albatrossi, Sasaki 1920, p. 169.

Four specimens caught by the "Albatross" in the Japanese waters have been at my disposal.

Adult, of moderate size, attaining about 200 mm. in length; very soft, choroidal, flabby, plump, campaniform, and no clear external demarkation visible betwen body, head, and arms, owing to the investment with a thick, continuous and quite choroidal coating as well as to the generous development of the umbrella. Surface quite smooth throughout, with no warts nor tubercles.

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*) A synopsis of the six genera of the Cirroteuthidae is appended here :—

1) *Cirroteuthis* Eschricht. Dorsal cartilage broad, saddle-shaped; umbrella broad; intermediate web present or absent. *C. mülleri* Eschricht (type); *C. umbellata* Fisher; *C. caudani* Joubin?; *C. grimaldii* Joubin?; *C. magna* Hoyle; *C. pacifica* Hoyle; *C. plena* (Verrill); *C. megaptera* (Verrill); *C. richardi* Joubin; *C. gilchristi* Robson; *C. mawsoni* Berry.

2) *Stauroteuthis* Verrill. Dorsal cartilage narrow, horseshoe-shaped with the free ends directed cephalad; umbrella present, intermediate web present or absent, *S. syrtensis* Verrill (type); *S. meangensis* (Hoyle); *S. hippocrepium* Hoyle; *S. albatrossi* Sasaki; *S. ebersbachii* (Grimpe).

3) *Froekenia* Hoyle. Dorsal cartilage narrow, horseshoe-shaped, the free ends directed cephalad; umbrella absent. *F. clara* Hoyle (monotypic).

4) *Opisthoteuthis* Verrill. Body exceedingly flattened from anterior posteriad. Dorsal cartilage slender and bent crescentwise; umbrella broad; arms all hectocotilized. *O. agassizii* Verrill (type); *O. depressa* Ijima & Ikeda; *O. extensa* Thiele; *O. medusoides* Thiele; *O. persephone* Berry; *O. pluto* Berry.

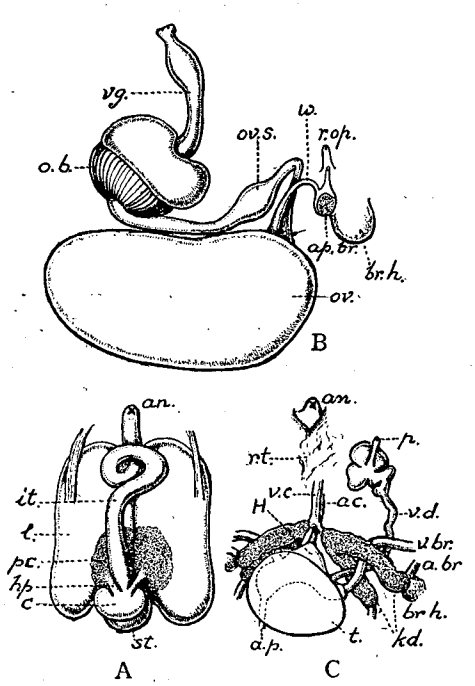
5) *Girrothauma* Chun. Eyes rudimentary; umbrella broad; suckers greatly elongated, clavelate, with rudimentary cup at the tip. *C. murrayi* Chun (monotypic).

6) *Laetmoteuthis* Berry. Umbrella broad; paired cirri of greatly reduced size; radula generously developed; dorsal cartilage present. *L. lugubris* Berry (monotypic). This genus is sometimes taken to be a form belonging to the fam. *Vampyroteuthidae*.

Body proper nicely hemispherical, its posterior end quite rounded and not flattennd as in *S. meangensis*. Mantle-opening very narrow, crescentiform, fitting closely around the tubular part of funnel. Transverse diameter of the opening, 1/7—1/6 that of body. Fins in full-sized specimens, roughly semilunar, with rounded antero-distal margin and nearly straight posterior margin; attached to the dorso-lateral surfaces of mantle a little in front of the halfway along its length, showing a faint indentation at the anterior attachment. Longitudinal length of fins equal to about two-thirds of their transverse length, this latter in turn equaling one-third or one-fourth of the head-breadth. In a young specimen 40 mm. long, the fins are relatively much larger than those of full-sized specimens. They are orbicular, nearly as broad as long, measuring about half the body-breadth, and deeply indented at the anterior attachment.

Head very broad, representing the greatest breadth of the animal. Eyes somewhat prominent, full, the diameter of each eyeball measuring one-third the head-breadth. Mammillary tuberculus olfactorius, attached to funnel-base near each angle of mantle-opening. Funnel sunk deep in mantle cavity, only a short terminal part appearing externally. Umbrella very broad, as thick as the arms are entirely embodied within it; radii about equally long, but the dorsal three are a little longer than the others, and the ventralmost is the shortest. On the two dorsal pairs of arms the umbrella extends along their dorsal aspect for about four-fifths the length, then is continued to the extremity as a narrow contractile web. Along their ventral aspect the umbrella terminates in a faint nodule-like thickening a little less forward than on the dorsal aspect, and from the nodule a contractile web, which is decidedly narrower than that of the dorsal aspect, runs distad to the extreme tip. These same characterizations appear similarly also in the two ventral pairs, but the attachments of the umbrella to these pairs as well as its continuations towards their extremities terminate more proximally than in the dorsal pairs.

Arms soft and quite elastic, seemingly about uniform and about twice as long as the head and body taken together; their proximal three-fourths or even more, quite embodied within umbrella and hardly traceable upon the general surface as special elevations or ridges either internally or externally. Suckers number 80 or more on each arm; subglobular, attached to arms with wide bases, their aperture small, bordered with a thick margin. They are in a single series and begin by a minute suckers at the base of arms, becoming remarkably larger to the sixth or seventh, then very gradually diminishing in size toward the extremity. Cirri slenderly conical, the longest measuring 4 mm. in length, arranged in two opposite series, regularly alternating with suckers, continued on to the extreme tip of arms, proximally beginning between first and second suckers.



Textfig. 3.

Stauroteuthis albatrossi. A. Portion of digestive organ; ×⅔. B. Internal genital organ of female sex; ×⅔. C. Internal genital organ and central part of circulatory system of male sex; ×⅔.

Both dorsal arms hectocotylized (Pl. VII, fig. 3). In these arms are found three very conspicuous suckers in a single series at a part just proximal to the termination of the umbrella attachment, and one or two others adjoining them on both sides also show a tendency to enlargement.

Dorsal cartilage bent round into the shape of a U, situated horizontally just beneath the mid-dorsal part of mantle so that the horns turn cephalad (Pl. VII, figs. 5a, b). The horns taper distad to sharp points and the posterior transverse part forms an obtuse angle in the middle. The section of the cartilage is not oval as in *S. hippocrepium*, but rather crescentiform approaching that of the saddle-shaped cartilage of *Cirroteuthis;* the convexity turns an-

teriad and inwards. The concave surface of the distal half of the horn, which is directed outwards, is separated from that of the remaining proximal half by a low ridge, thus adjusted to form an attachment plane for the fin which is tightly fixed there with its thick and fibrous root.

Inner surface of umbrella and arms colored in a deep purple, which sometimes still deepens into quite black, but the suckers are always of a little lighter shade and more reddish. The color of the external surface of the full-sized specimens examined, as far as the remnants of skin show, is uniformly light reddish brown. This is the same also with the young specimen, alluded to before, but a little lighter, and there are eight longitudinal rows of white spots running along the arms (Pl. VII, figs. 4a, b). The rows all continue on to the head, and the dorsal two reach behind the eyes. The color of the inner umbrella surface of this specimen is not so deep as in the full-sized specimens.

Oesophagus situated dorsal to liver, without penetrating it. Rectum long, forming a coil in its course; anal valves rudimentary (textfig. 3A). No ink-gland nor posterior salivary gland discernible. Gills massive, each composed of eight thick lobular leaflets radially arranged. Oviduct and water vascular canal both single, viz. those of the left size; oviducal ball enormous, oblique, subglobular, slightly constricted near the equater, situated just in front of ovary; vagina thick, short, its greater part projecting into mantle cavity (textfig. 3B). Ripe ovarial ova measure 10 × 7 mm. Penis small, its distal extremity situated a little posterior to anus; vas deferens weakly differenciated (textfig. 3c).

Measurements of Largest Specimen Examined.

Length, total	200 mm.
Mantle opening to posterior body-end	36 „
Mantle opening to anterior base of fin	32 „
Posterior base of fin to posterior body-end	45 „
Eye-opening to anterior base of fin	18 „
Breadth of head	75 „
Breadth of fins	20 „
Length of fins	23 „
Posterior body-end to umbrella-edge between first arms	150 „
Posterior body-end to umbrella-edge between first and second arms	140 „
Posterior body-end to umbrella-edge between second and third arms	120 „
Posterior body-end to umbrella-edge between third and fourth arms	112 „
Posterior body-end to umbrella-edge between fourth arms	105 „
Diameter of largest sucker of first arms	3 „
„ „ „ „ „ second arms	3 „
„ „ „ „ „ third arms	3 „
„ „ „ „ „ fourth arms	3 „

Locality.—Near Aleutian Is., Bering Sea (Albatross!); southern Okhotsk Sea (Albatross!); off Kinkasan (Albatross!); off Tôtômi Prov. (Albatross!).

Bathymetrical distribution.—266 fms., 440, fms., 426 fms., and 918 fms., all attributable to the "Albatross" collection.

Type-locality.—Off Kinkasan, Rikuzen Prov.

Type.—In U. S. Nat. Mus.

Genus **Opisthoteuthis** Verrill, 1883.

Opisthoteuthis, Verrill 1883, p. 113; 1896, p. 74.—Hoyle 1904b, p. 4.—Berry 1920, p. 155.—Naef 1921, p. 537.—Robson 1926, p. 1328.

Entire body exceedingly flattened from anterior posteriad; this flattening conjointly with the great development and thickening of the umbrella gives it the appearance of a plano-convex or convex-concave disc. Unipaired fins attached just posterior to the eye-prominences. Mantle-opening narrow, fitting

closely around the distal part of funnel. Suckers in a single series, regulary alternating with biserial cirri, both extending from base to extremity on each arm. Dorsal cartilage bent crescentwise but the extremities turning outward; cross section in the middle region, dumbbell-shaped, weakly constricted in the middle. Arms in male all hectocotylized at maturity; several suckers at the middle part being so much enlarged that they are rendered zigzag in their arrangement by close contact. Left oviduct developed only.

Type.—Opisthoteuthis agassizii Verrill, 1883.

Opisthoteuthis depressa Ijima & Ikeda, 1895.

(Pl. VII, figs. 7–9; textfig. 4.)

Opisthoteuthis depressa, Ijima & Ikeda 1895, pp. 1–15, pl. xxxiii.—Meyer 1906, pp. 758–760.—Meyer 1906a, pp. 183–269, pls. xi-xvi.—Doflein 1906, p. 260, fig.—Marchand 1907, p. 381.—Dollo 1912, pp. 131, etc., pl. iii, fig. 5.—Berry 1912b, p. 284.—Sasaki 1920, p. 170.

Animal soft, flabby, choroidal, exceedingly flattened from posterior to anterior, the general shape being that of a plano-convex or convex-concave disc, but rarely it may be shallowly campaniform, approaching that of *Stauroteuthis*. In the largest specimen examined by me, which was quite flattened, the greatest diameter from tip to tip of arms measured a little over 200 mm.

Aboral surface with three special rounded prominences, one of which represents the body proper, while the remaining two, the eye-bulbs. With exception of the eye-prominenses, the head is a little lower, smaller and narrower than the body; the latter nowhere overhangs the mantle-opening. Eyes large, separated from each other by a wide, concave space. Eye-opening small, generally semilunar, provided with a thin upper, and a thick lower lid. Distance between both eye-openings slightly over twice the diameter of an eye-prominence.

Fins very small, thick, soft, gradually narrowing to blunt free apices; breadth (transverse) about one and a half times or even twice the length. They are attached to the aboral surface close to the posterior borders of the eye-prominences; the line of attachment being nearly longitudinal and the free apices turning outwards. The distance between their bases is about the same as between the eye-openings.

Mantle-opening reduced into a small crescentiform aperture, fitting closely around the tubular part of funnel, situated nearer to free umbrella-edge than to the centre of aboral surface. Funnel sunk deep in mantle cavity, only a short extremity projecting beyond its opening.

Arms subequal, the formula of length being about $3>4>2>1$; all extensively interwebbed, their projecting distal part being only $^1/_{10}$—$^1/_8$ the entire length. In flattened specimens the arms show a regular curvature on the same plane, the concavities turning forwards, with a slight tendency to coil symmetrically on both sides of the median line. Consequent upon this the extremities of arms turn forwards with the same tendency of coiling as in the concavities; thus the extremities of the dorsal arms tend to approach each other whilst those of the ventral arms diverge in opposite directions. The horizontal curvature of the arms, seems to have some connection with the attachments of umbrella to the arms. In each arm on the dorsal aspect, viz. the anterior aspect, the attachment extends nearly to the extremity, while on the ventral aspect it terminates far proximally. This difference of attachment renders the drawing forward of the extremities of arms, and consequently forms the said curvature.

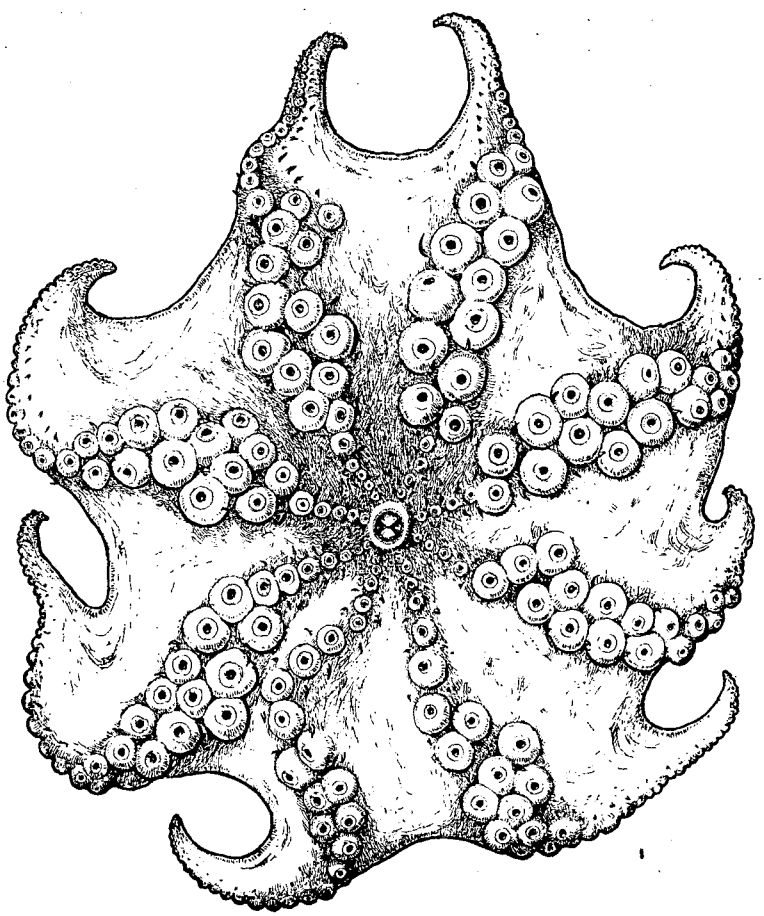
Suckers in female, very small, strictly uniserial throughout, deeply immersed; when extracted, subglobular, swollen at base, truncate distally, and shallowly constricted near the distal truncate margin; uniform in size for the greater part of arms, diminishing in size at the extremity as well as at base, and several at the extremity are as minute as impossible to view with the naked eye. In full-grown females they number a little over 50 in each arm, and the largest measures about 2 mm. in diameter.

Cirri small, slenderly conical; in female, strictly biserial, regularly alternating with the suckers. They commence proximally between the first and second suckers as a minute prominence, then rather

rapidly increasing in length, and run to the extreme tip on each arm, becoming again minute. The distance between the cirri of each pair is broadest halfway along the arms, diminishing distally and also proximally.

All arms in male hectocotylized at maturity (textfig. 4). A number of suckers in each arm conspicuously enlarged, this enlargement being specially marked in the suckers from fifth to twentieth, which in full-grown specimens attain over 7 mm. in diameter. Owing to the enlargement, these suckers are considerably raised above the general surface of arms and can not form a straight row as in the female, but take a alternate biserial arrangement. At the same time the cirri on both sides of these suckers are arranged in three or four irregular rows.

Dorsal cartilage nearly straight in young, but in adult, curved roughly crescentwise, with five weak bendings, which are situated so as to divide the cartilage into six subequal parts (Pl. VII, figs. 8, 9). The cartilage is somewhat flattend from anterior posteriad, gently narrowed at the middle portion, and expanded at the part a distance from each extremity, which is attenuated and directed outwards. The narrowed middle part is shallowly furrowed lengthwise on both surfaces so that its cross section is panduriform. In the expanded distal part, the anterior surface is nearly flat, the posterior surface slightly concave, the upper edge sharp, and the lower edge blunt, the whole effect being that of a forged knife blade. The entire length of cartilage measures 15mm. in a specimen of 75 mm. maximum diameter, and 35 mm. in a specimen of about 200 mm. maximum diameter.



Textfig. 4.
Opisthoteuthis depressa. Inner aspect of umbrella and arms of male sex; ×⅔.

Color of the aboral surface in formalin, deep drab; the oral surface, dark reddish violet, but lips, cirri, the margins of suckers and the under surfaces of fins, are all of much lighter hue. The aboral surface decorated with eight radiate rows of round pink patches running along arms (Pl. VII, fig. 7). Of the eight rows, the anterior four consisting of eight or nine patches each, begin behind the eye-prominences and run into the four dorsal arms, crossing the anterior parts of the said prominences. The remaining four rows consisting of eight or nine each, begin on the lateral aspects of the body-prominence behind the fins, and continue their course to the four ventral arms. Besides the above mentioned patches, there are found three more on the same surface: one on the upper surface of the funnel, the remaining two, on the umbrella outside the bases of the fins.

Measurements of Male and Female Examined.

Sex	♂	♀
Distance between eye-openings	45 mm.	45 mm.
Distance between fin-bases	38 „	35 „
Length of fins	18 „	15 „
Breadth of fins	12 „	10 „
Breadth of mantle-opening	10 „	10 „
Eye to fin-base	18 „	16 „
Eye to mantle-margin	58 „	55 „
Length of first arms	125 „	100 „
„ „ second arms	130 „	104 „
„ „ third arms	135 „	110 „
„ „ fourth arms	132 „	110 „
Diameter of largest sucker of first arms	10 „	2 „
„ „ „ „ „ second arms	9 „	2 „
„ „ „ „ „ third arms	9 „	2 „
„ „ „ „ „ fourth arms	9 „	2 „

Remarks.—In figure 9 of Plate VII, I give illustrations of the dorsal cartilage of Ijima and Ikeda's original specimen, as it was not fully described.*) The dorsal cartilage of full-grown individuals which I have examined differs from Meyer's illustrated description**) by having five faint angular bendings and sharply pointed extremities. Meyer's illustration of the cartilage also differs from the above-mentioned cartilage of the original specimen in having blunter extremities.

Locality.—Misaki, Sagami Prov. (Ijima & Ikeda); Fuku-ura, Sagami Bay (Doflein; Meyer); Sagami Sea (Albatross!); off Kii Prov. (Albatross!); off Satsuma Prov. (Albatross!); near Kusakakijima (Albatross!).

Bathymetrical distribution.—250 fms. (Ijima & Ikeda); 150m. (Doflein); 70–440 fms. (Albatross!).

Division **Apinna** nom. nov.

Trachyglossa, Lütken 1882 (fide Joubin).—Joubin 1900, p. 26.—Naef 1912e, p. 196.

Incirrata, Grimpe 1916, p. 353; 1921, p. 298; 1922, p. 23.

Polypodoidea, Naef 1921, p. 537.

No fin developed. Arms provided with uni- or biserial suckers only, and devoid of cirri. Radula always well developed.

Family **Eledonellidae** Sasaki, 1920.

Eledonellidae, Sasaki 1920, p. 170.—Grimpe 1922, p. 39.—Robson 1926, p. 1329.

Bolitaenidae, Chun 1911, p. 20.—Naef 1912e, p. 196; 1921, p. 537 (pars).—Berry 1914a. p. 289; 1920, p. 156 (pars)—Thiele, in Chun 1915, p. 490.—Degner 1925, p. 78.

Mantle saccular, devoid of fins, its anterior opening very wide. No aquiferous pores present. Tuberculus olfactorius situated behind each eye. Funnel organ ∧-shaped. Arms relatively short; third pair by far the longest and thickest. Suckers uniserial throughout. Umbrella present but generally rather narrow and thin. Right third arm in male, hectocotylized; a pair of, or even all its suckers attaining a conspicuous size. Radular teeth 7-serial, polycuspid but the marginal are unicuspid. Pelagic or abyssal octopods, of choroidal consistency.

To this family are referable three genera, viz. *Eledonella* Verrill, *Chunella* Sasaki and *Vitreledonella* Joubin; of these the former two are found in Japanese waters and are briefly diagnosed as follows:—§)

*) I wish to express my sincere thanks to Professor Ijima and Mr. Ikeda for generously placing at my disposal their specimen referred to.

**) Meyer 1906a (l. c.), pp. 16, 17, Pl. xi. fig. 5.

§) Naef (1922) classifies this division into two subdivisions, i.e. *Ctenoglossa* and *Heteroglossa*. The formes group involves the families *Eledonellidae* (Naef's *Bolitaenidae*) and *Amphitretidae* whilst the family Argonautidae and Polypodidae belong to the Heteroglossa. This view is followed by Grimpe (1922) and also by Robson (1926).

1. Umbrella more or less well developed; hectocotylization affecting only some distal suckers of right third arm ..... *Eledonella.*

2. Umbrella rather ill developed, hectocotylization affecting all the suckers of right third arm... ..... *Chunella.*

Genus **Eledonella** Verrill, 1884.

Eledonella, Verrill 1884, p. 144.—Hoyle 1886b, p. 106 (pars).—Chun 1911, p. 16.—Berry 1912a, p. 276; 1920, p. 156.—Naef 1921, p. 537.
Japetella, Hoyle 1885a, p. 231; 1886b, p. 108.
Bolitaenella, Grimpe 1922, p. 39.

Entire body soft, choroidal; mantle saccular, with wide anterior opening. No fin nor horizontal ridge present on sides of body. No constriction between head and body. Eyes somewhat small. Optic nerve slender; ganglion pedunculi distant from G. opticum. Funnel organ /\-shaped. Arms more or less slender, third pair by far the longest. Umbrella present but thin. Suckers uniserial. Right third arm in male hectocotylized, some distal suckers being of conspicuous size.

Type.—Eledonella pygmæa Verrill, 1884.

Eledonella ijimai sp. nov.

(Pl. VII, figs. 10–15)

Animal soft choroidal, semitransparent even in preserved state, covered over by a somewhat flabby coat; surface smooth but creased. Body much longer than broad, but as long as deep, seeming as if mechanically compressed laterally (Pl. VII, figs. 10–12). Longitudinal keel-like ridge developed along the mid-ventral line of mantle as pointed out by Hoyle in *Japetella prismatica* (1886). Mantle opening very wide, extending more than half round the body, its angles situated behind eyes. Mantle margin protruding a little in the middle.

Head as broad as body; depth equal to breadth; slightly concave dorsally, highly convex ventrally. Eyes rather small, more or less projecting dorsally and laterad; their opening small, round. Funnel entirely covered over by loose ventral integument of head, so that its superficial contour is not traceable externally. Distal opening of funnel transversely elongated, situated a little behind the ventral interbrachial space. Funnel organ nicely /\-shaped, tightly adherent throughout to the dorsal wall of funnel near its distal opening. No funnel-valve developed.

Arms rather unequal; third pair as long as body, and decidedly longer than the remaining pairs which are in turn of about uniform length (Pl. VII, fig. 13). All nearly cylindrical in the proximal half, then tapering gradually towards the extremities. Umbella well developed except between fourth arms where it is quite rudimentary. Between the first arms as well as between the first and second arms on each side, the umbrella extends a little more than half up their length while between the second and third arms as well as between the third and fourth arms it terminates below the halfway.

Suckers somewhat prominent, with round aperture each, numbering about 15 in each arm; straightly uniserial, but taking a slightly zigzag course at the base of first and second arms; sparsely set until the middle of arms, whence they become closer in arrangement towards the extremity. Suckers small at the base of arms, increasing in size to the fifth or sixth which is situated about the middle of arms; thence they rather rapidly diminish in size distad, and four or five at the extremity are so minute that they are hardly visible to the naked eye.

Ground color in formalin, of a light drab; chromatophores reddish brown, somewhat sparsely distributed, but closely crowded on both surfaces of umbrella and arms. Visceral sac covered with large blackish chromatophores.

Retractor palli medianus very thin. Gill very small, only 3 mm. long, consisting of ten leaflets each (Pl. VII, fig. 14). Length of optic nerve two or three times the brain breadth. Distance from bain to ganglion pedunculi three or four times greater than between g. pedunculi and g. opticum. (Pl. VII, fig. 15).

Length, total: 55 mm.

Remarks.—The specimen, on which the species is based, is a young female. It was found together with *Branchiocerianthus imperator* at Misaki, January, 1th, 1899. As compared with Chun's illustrations on *E. pygmæa**) the ganglion opticum of *E. ijimai* is considerably small and the distance from it to the ganglion pedunculi, very short. *E. ijimai* is distinguished from both *E. prismatica* and *E. heathi* by having a funnel organ of different shape and no umbrella between the ventral arms. Moreover, the skin is much thicker and looser than in these two species.

It is named in honour of the late Professor Ijima.

Type locality.—Misaki, Sagami Prov. (!).

Type.—In Tôkyo Imp. Univ.

Genus **Chunella** Sasaki, 1920.

Japetella, Hoyle 1885a p. 232 (pars).

Eledonella, Hoyle 1886b, p. 106.

Bolitaena, Chun 1911, p. 17 (pars);—Thiele, in Chun 1915, p. 491 (pars).—Berry 1920, p. 156.—Naef 1921, pp. 537, 541.

Chunella, Sasaki 1920, p. 170.

Entire body soft, choroidal; mantle saccular, widely opened before, with no fin nor horizontal ridge on sides. Head and body not marked off from each other by constriction. Tuberculus olfactorius present on head, posterior to each eye. Eyes comparatively large. Optic nerve short; ganglion pedunculi close to g. opticum. Umbrella rather badly developed. Funnel organ, /\-shaped. Arms very short in comparison with body; conical, thick. Suckers strictly uniserial throughout. Right third arm in male, hectocotylized, its suckers all considerably enlarged.

Type.—Japetella diaphana Hoyle, 1885.

Chunella diaphana (Hoyle, 1885).

(Pl. VIII, figs. 1–4.)

Japetella diaphana; Hoyle 1885a, p. 232.—Hoyle 1885c, p. 108.

Eledonella diaphana, Hoyle 1886b, p. 107. pl. ix, figs. 3–6.—Joubin 1900, p. 37, pl. ii, figs. 5–7.—Hoyle 1904, p. 22, pl. v, fig. 11.

Bolitæna diaphana, Chun 1911, pp. 15–20; figs. 7. 8.—Thiele, in Chun 1915, p. 493, pls. lxxxii–lxxxiv, textfigs. 60, 61.

Bolitæna (*Eledonella*), Chun 1903, p. 87; 2 figs.

Chunella diaphana, Sasaki 1920, p. 171.

A young male specimen caught by the "Albatross" off Kii Prov., which is without hesitation referred to this species, has been placed at my disposal.

Animal soft, choroidal, semitransparent even in preserved state. Skin flabby, smooth. Body roughly ellipsoidal, twice as long as broad, widest in the middle, rounded behind, highly arched above, somewhat flattened below (Pl. VIII, fig. 1). Mantle-opening wide, extending half round the body, its angles situated behind eyes. Mantle margin gently arcuate in the middle, projecting beneath head, and covering the greater part of funnel.

Head relatively small, a little narrower than body. Eye exactly lateral, faintly projecting, furnished with a minute opening. Umbrella but little developed, on an average extending about a quarter up the arms. Funnel roughly conical, but its proximal two-thirds is incorporated with head; the extremity reaching two-thirds of the distance from posterior free edge to umbrella edge. Funnel organ composed of a thick/\-shaped pad on the dorsal wall; distal extremity free and valvate (Pl. VIII, fig. 4).

*) Chun 1911 (l.c.), p. 18.

Arms short, conical without contractile web on sides, unequal; third pair being the thickest and longest, about half as long as mantle, and first pair the shortest (Pl. VIII, fig. 3). Suckers large, prominent, nearly urceolate but sometimes cylindrical; their opening bordered with a thick margin around, which is often folded so as to form a triangular or quadrangular contour. Suckers number 12 or 13 on each arm, arranged in a straight row; the second or third being the largest, thence they gradually diminish in size towards the extremity.

Chromatophores sparsely distributed on the external surface in all parts. Visceral sac thickly covered with many large chromatophores.

Gill composed of 15 leaflets. Anal valve conspicuous. Inkbag small, fusiform, and free from liver (Pl. VIII, fig. 2). Retractor palli medianus a little developed. Optic nerve short; ganglion pedunculi situated close to g. opticum.

Measurements of Specimen Examined.

Length, total	ca.	42	mm.
Length of body	„	28	„
Breadth of body	„	15	„
Eye to posterior end of body	„	24	„
Breadth of head	„	12	„
Length of first arms	„	8	„
„ „ second arms	„	9	„
„ „ third arms	„	14	„
„ „ fourth arms	„	10	„
Diameter of largest sucker of first arms	„	8	„
„ „ „ „ „ second arms	„	8	„
„ „ „ „ „ third arms	„	1	„
„ „ „ „ „ fourth arms	„	8	„
Diameter of eye-ball	„	5	„

Locality.—North of Papua (Hoyle); east of Galapagos I. (Hoyle); south-east of Acapulco (Hoyle); Marshall Archipelago (Hoyle); between Madère and the coast of Maroc (Joubin); south to Sierra Leone (Chun); north-east of St. Thomas I. (Chun); Indian South-equatorial Current (Chun); Sumatra (Chun); south-west of Ceylon (Chun); east of Seychelles Is. (Chun); Guinea Gulf (Chun); off Kii Prov. Japan (Albatross!).

Bathymetrical distribution.—1100 fms? (Hoyle); 1067 fms. (Hoyle); 664 fms. (Hoyle); 1897 fms. (Hoyle); 1200–4000 m. (Chun); 720 fms. (Albatross!).

Family **Amphitretidae** Hoyle, 1886.

Amphitretidae, Hoyle 1886b, p. 67.—Berry 1912b, p. 397; 1920, p. 156.—Naef 1912e, p. 196 (pars); 1921, p. 537.—Thiele, in Chun 1915, p. 531.—Grimpe 1922, p. 40.—Robson 1926, p. 1329.

Pelagic octopod of graceful and choroidal consistency; campaniform on account of the great development of the umbrella, and the continuous investment of the head, funnel, umbrella and body proper by a thick choroidal coating. Mantle fused with funnel base in the middle, so that its opening is reduced into two small ostium-like branchial apertures on sides. Funnel organ W-shaped. Eyes situated near together above head; their balls pyriform, immersed below the surface. Suckers uniserial proximally, and biserial distally. Mantle cavity incompletely bisected by median septum. Posterior end of liver conoidal, projecting posteriad and ventrad. Oviducts of both sides developed, somewhat resembling those of *Polypus* in structure. Right third arm hectocotylized, chiefly its terminal part affected by the modification; appearing by no means either to be separable or to develope in a specialized sac. Penis retort-shaped, situated on visceral sac on the left side. Radula almost as in the Elledinellidae.

The family has been represented by a single genus *Amphitretus*.

Genus **Amphitretus** Hoyle, 1885.

Amphitretus, Hoyle 1885, p. 271; 1885a, p. 235; 1886a, p. 67.—Thiele, in Chun 1915, p. 531.—Berry 1920, p. 156.—Naef, 1921, p. 537.
Type.—Amphitretus pelagicus Hoyle, 1885.

Amphitretus pelagicus Hoyle, 1885.

(Pl. III, figs. 1, 2; Pl. VIII, fig. 5.)

Amphitretus pelagicus, Hoyle 1885, p. 271, fig. 106; 1885a, p. 235; 1885c, p. 113, woodcut; 1886b, pp. 4, 67, etc., pl. 9, figs. 7–9.—Ijima & Ikeda 1902, pp. 85–101, textfigs. 1–3, pl. 2.—Berry 1912b, p. 397.—Thiele, in Chun 1915, p. 532.—Sasaki 1917, p. 361.
Amphitretus, Chun 1903, p. 577, 1 fig.

Animal campaniform, covered over by a smooth, soft, choroidal, colorless, semitransparent coating, so that the head, funnel, umbrella, arms, and body proper all exhibit no external demarkation nor constrictions, although the deeper muscular parts of these organs are discernible through their superficial coating. A small ovate depression present on either side of body, surrounded by somewhat crowded chromatophores and a few concentric muscular fibres. Within the depression is found a free edge of muscular tunic of mantle, which encloses inside a pocket-like mantle-opening. This opening leads posteriorly into a compressed passage, the outer wall of which is formed by the mantle, while the inner, by a posteriorly directed, valvular fold, i.e. the lateral wall of collar-like funnel-base (Pl. III, figs. 1, 2).

Deeper tunic of funnel, vaguely discernible through the superficial coating; thick, roughly conical, extending a quarter up the entire length of ventral arms. The deepest muscular stratum of the tunic, clearly visible through all the upper layers by its opaque contour, lining the internal passage of funnel; this has uniform diameter throughout except its distal part which is swollen a little. External opening of funnel, bordered with a somewhat prominent velum. Funnel organ conspicuous, composed of a thick-delineated W-shaped cushion, lying near the extremity of funnel; all lobes, of the uniform length.

Eyes conspicuous on account of their brilliant coloring even in preserved condition, and characteristic in both shape and position. Eyeballs long, pyriform, each consisting of a swollen spheroidal base, and a conoidal distal part which terminates in a rounded lens; situated near together above head, long-axises turning dorsad and laterad. They are sunk deep below the surface, and not protrud beyond it as figured by Chun (1903, p. 577) and by Hoyle (1886a, Pl. IX, fig. 7). For each eye a narrow opening is formed in the continuous choroidal coating, marked by a few fibres encircling them.

Umbrella very thick, choroidal, transparent, traversed by numerous separated fibres running mostly sideways. In a specimen examined by me, the radii of umbrella were about equal, extending two-thirds up the arms while in Ijima and Ikeda's specimen the dorsal radius is said to be decidedly the shortest of all. Umbrella margin continued distally as narrow contractile webs along both sides of arms, without terminating in nodule-like thickenings as found in *Cirroteuthis*.

Mascular parts of arms, which are traceable through the choroidal coating, are thick and of uniform breadth in the proximal half but slightly constricted at base; from the middle they taper off distad. Suckers number 32–35 in each arm, of which about 12 are present in a straight row on the interwebbed part of arms; the remaining suckers are set in two alternate series on the protruding extremity. They increase in size very gradually to the eighth, and from this to the twelfth attain maximum, whence they become smaller very rapidly towards the extremity. The intervals between suckers are wide in the proximal parts and diminish at the extremity.

Right third arm hectocotylized, slightly shorter than the left third. Distal one-fifth of the arm, attenuated, and of somewhat firm consistency, its flattened oval surface provided with two series of minute rounded protuberances along the margins. The base of the distal portion is swollen, and

forms, on the oral side, a peculiar angular shaped ridge, of which the angle is pointed distad and the two ends project on the sides of the arm. The ridge is traversed by a well defined, narrow, and deep groove of a similar shape and disposition, provided with a small rounded protuberance in the middle behind the groove. Directly proximal to the above-mentioned ridge and unilaterally on the ventral side of the arm, there exists an indentation, which is proximally bounded by a firm prominence of the arm on the side referred to. Suckers occur on the arm in a series from the base to the angular shaped ridge. They are smaller, more numerous and more closely set than in other arms. Numbering 27 in all, the fourth and the fifth suckers are the largest.

Branchial leaflets number 20 in each gill. Posterior end of liver, conoidal, projecting caudad and ventrad between the two lamellæ of the median mantle connective. Penis shaped like a retort, the elongated part being directed cephalad (Pl. VII, fig. 5). Oviducts of both sides developed; oviduct *s.s.* and vagina both, of a moderate length, connected together by a roundish ovidual ball. Vagina thicker than oviduct *s.s.*, terminating at a point far posterior to anus.

Total length of the male specimen examined, 135 mm. For other measurements, refer to: Sasaki 1917 l.c., pp. 363, 364.

Remarks.—One male and female specimens have been placed at my disposal; both were already examined, the former by myself (1917) and the latter by Ijima and Ikeda (1902). They differ equally from the description made by Hoyle (1885, 1886) as well as from that by Thiele (1915), in having a continous gelatinous coating over the whole body, so that no superficial demarkation is discernible between the head and body, nor the eyes project outside as illustrated by these writers. The differences are possibly not specific but may be due to the different ways of preservation of the specimens.

Locality.—Off the Kermadec Islands (Hoyle); Agulhascurrent (Chun). Okinose Bank, near Misaki (Ijima & Ikede); Tateyama, Awa Prov. (Sasaki).

Bathymetrical distribution.—520 fms. (Hoyle); 572 m. (Ijima & Ikeda); 1800 m. (Chun).

Family **Alloposidae** Verrill, 1881.

Alloposidae, Verrill 1881c, p. 365; 1882, p. 390.—Hoyle 1904, p. 8; 1904b, pp. 2, 4.—Berry 1914a, p. 286; 1920, p. 156.

Argonautidae, Naef 1912e, pp. 197, 198 (pars); 1921, p. 537 (pars).—Grimpe 1922, p. 4. (pars).

Sexes a little dimorphic, the male much smaller than the female. Entire body campaniform, devoid of fins; mantle-opening wide, no aquiferous pores present on head. Funnel organ W-shaped. Radula markedly developed, composed of seven series of strong teeth, the median of which are distinctly tricuspid. Arms extensively interwebbed by a thick umbrella; suckers in one or two series. Hectocotylization affects the whole of the right third arms, which has its origin in a specialized space situated in head in front of the right eye, and when mature is most probably detachable. Pelagic octopods of soft and jelly-like consistency.

This family comprises two genera, viz. *Bolitaena* Steenstrup, and *Alloposus* Verrill. To the former is referred only *B. microcotylea* Steenstrup i.e. the type species of the genus. Judging from the reproduction of Steenstrup's M.S. of that species by Hoyle (1886, p. 16), the genus *Bolitaena* is very closely related to the genus *Alloposus*, so that I am strongly inclined to consider them identical.

Genus **Alloposus** Verrill, 1880.

Haliphron? Steenstrup 1861, p. 333 (fide Hoyle).

Alloposus, Verrill 1880c, p. 393; 1881c, p. 365; 1882, p. 390.—Hoyle 1886b, p. 72; 1904b, p. 5.—Naef 1912e, p. 198; 1921, p. 537.—Berry 1914a, p. 286; 1920, p. 156.

? Bolitaena, Steenstrup M.S. in Hoyle 1886a, p. 16.

Bolitaena, Hoyle 1904, p. 8 (pars).

Alloposina, Grimpe 1922, p. 41.

Naef*) seems to regard *Octopus alberti* Joubin as nothing but a species of *Alloposus*. However, Joubin's original description and illustrations of this species**) have no resembrance at any rate to *Alloposus*, the only point of similarity consists in its soft graceful consistency and the great development of the umbrella.

Type.—*Alloposus mollis* Verrill, 1880.

Alloposus pacificus Ijima, 1902.

(Pl. VIII, figs. 6-8; textfig. 5.)

Alloposus pacificus, Ijima in Ijima & Ikada 1902, p. 87, note.—Berry 1912b, p. 397.

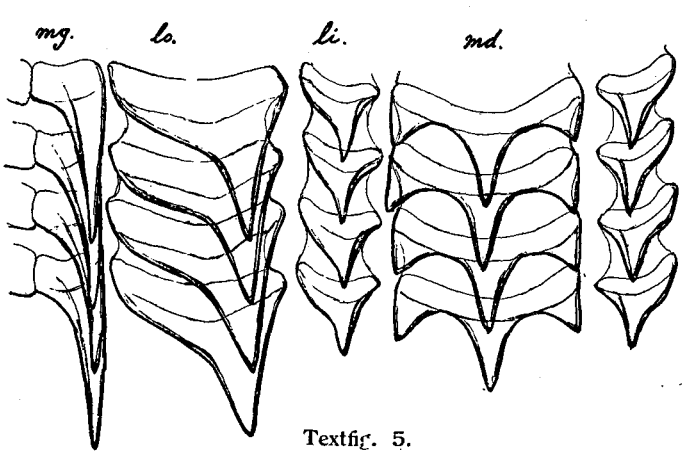
Of this interesting species four specimens from Japan have come under my observation, measuring up to 450 mm. in length.

Animal roughly campaniform, slightly flattened dorso-ventrally, soft, flabby and of quite choroidal consistency; external surface entirely smooth, sparsely and uniformly covered with large violet-brown chromatophores.

Body hemispherical, short, as long as wide, widest anteriorly, rounded posteriorly (Pl. VIII, fig. 6). Mantle-opening very broad, extending about half round the body, its angles situated a little more dorsally than eye-openings. Mantle margin arcuate in the middle, protruding forward below head.

Head very large as contrasted with body, nearly cylindrical, not marked off by constriction either from arm-base or from body proper; more or less flattened below and arched above. Eyes somewhat ventrally situated, quite slightly protruding. Funnel extending nearly the half way to umbrella edge; only a short terminal part separated from head; the remaining part quite incorporated with head, showing no outline externally. Umbrella well developed, very thick and soft; radii subequal, that between dorsal arms the longest, extending $\frac{2}{3}$-$\frac{3}{4}$ up the arms.

Arms subequal, the formula of length being $1>2>3>4$, and longest pair comprising a little more than half the entire length of the animal; incorporated with umbrella except the distal $\frac{1}{4}$—$\frac{1}{2}$, which is conical and attenuated at the extremity. Suckers comparatively large, prominent, cylindrical, truncated distally; their rim thick, of much firmer consistency than in other parts (Pl. VIII, fig. 7). On each arm, the first five or six suckers are in a single straight row which gradually undergoes a change into a biserial condition as the suckers approach the umbrella edge; and on the distal uninterwebbed part of arms, the arrangement is somewhat distinctly biserial. The suckers at the uniserial part are large and sparsely set, but upon reaching the biserial part they become very minute and thickly crowded together. In the largest specimen examined, there were found on each arm about 30 large suckers and about 50 minute ones.



Textfig. 5.

Alloposus pelagicus. Part of radula; ×19.

Tuberculus olfactorius transverse-ellipsoidal, situated behind each eye at the angle of mantle opening (Pl. VIII, fig. 8). Anal valves conspicuous. Each gill composed of about 20 leaflets.

Radula well developed, composed of seven series of peculiar greenish teeth, which are unicuspid except the median, this being distinctly tricuspid. Median and outer lateral teeth very large, a little wider than twice the breadth of remaining teeth (textfig. 5).

*) Naef 1912e (l.c.), p. 198.

**) Joubin 1895a (l.c.), pp. 18-20, pl. I, figs. 3, 4.

The male specimen examined by me, being greatly mutilated, the hectocotylization was incapable of examination.

Measurements of Female Examined.

Length, total	120 mm.	
Length of body	30 „	
Maximum breadth of body	40 „	
	Left	Right
Length of first arms	95 mm.	95 mm.
„ „ second arms	85 „	86 „
„ „ third arms	70 „	70 „
„ „ fourth arms	60 „	60 „
Radius of umbrella between first arms	55 mm.	
„ „ „ „ and second arms	47 „	
„ „ „ „ second and third arms	40 „	
„ „ „ „ third and fourth arms	ca. 40 „	
„ „ „ „ fourth arms	ca. 40 „	

Remarks.—This species differs from *A. mollis* at least in the arms which are subequal even at maturity.

The species was first made known to the scientific world by the late professor Ijima with a brief footnote. Through his courtesy, I have been enabled to examine the type specimen preserved in the Science College, Tôkyo, to identify the specimens in my own hand with it. The label annexed to it tells that it was caught by Mr. K. Aoki at Misaki, Sagami Prov., from a depth between 150 and 200 fathoms, June 18, 1902.

Locality.—Misaki, Sagami Prov. (Ijima); Sagami Bay (!); Awa Prov. (!).

Family **Argonautidae** (Cantraine, 1841).

Argonautides, Cantraine 1841, p. 20.

Argonautidae, Adams H. et A. 1858, vol. 1, p. 23.—Tryon 1879, p. 101.—Joubin 1900, p. 26.—Naef 1912e, pp. 197, 198 (pars); 1921, p. 537 (pars).—Berry 1914a, p. 277—Chun 1915, p. 476.

Philonexidae, Gray 1849, pp. 3, 24.—Troschel 1857, p. 42 (pars).—d'Orb. 1855, p. 199,—Adams H. & A. 1858, p. 21.—Verrill, 1882, p. 388.

Ocythidae (*Argonautidae?*), Gray 1839, pp. 3, 28.

Tremoctopidae, Tryon 1879, p. 101.

Argonautidae + *Philonexidae*, Carus 1890, pp. 457, 458.

Argonautoidea, Berry 1920, p. 155 (pars).

Pelagic octopods of somewhat firm and fleshy consistency and of small to moderate size. No fin present. Suckers biserial throughout. Funnel base articulates with the inner surface of mantle by two sets of cartilaginous locking apparata. Sexes dimorphic. Males much smaller than females. One of third arms hectocotylized, developing in a specialized sac into a highly modified and detachable copulatory organ which exists separately for a certain length of time in the mantle cavity of the female. Oviducts of both sides developed; ova very small, attaining some development within a specialized part of body or external shell.

Subfamily **Argonautinae** Berry, 1914.

Argonautinae, Berry 1914b, p. 277.—Naef 1921, p. 537 (pars).

Argonautidae, Berry 1920, p. 156.

Locking apparatus of funnel, oval, cartilaginous, button-like in shape, with a deep depression at the centre. Funnel organ composed of a Λ-shaped dorsal, and two elongated ventral pads. Dorsal arms in female, provided with very broad, glandular membranes which serve to secrete and hold in

their embrace a delicate, involute, calcareous shell; the function of the latter is to form a nest, as well as to be a partial retreat for the animal itself. Oviducts very long, greatly winding, terminating in globular muscular swellings, which are a little prominent and situated near together at the centre of the visceral sac. Water vascular canals rudimentary. Left third arm of the female, hectocotylized, developing in a pedunculate sac outstanding near the mouth; provided with about 50 cylindrical suckers and a smooth but carinated aboral surface.

Genus **Argonauta** Linné, 1758.

Argonauta, Linné 1758. p. 708.—Fér. et d'Orb. 1835, pp. 106–157.—Cantraine 1841, p. 20.—d'Orbigny 1855, p. 210.—Verany 1851, p. 47.—Adams H. et A. 1858, p. 24.—Tryon 1879, p. 123.—Verrill 1882, p. 182.—Hoyle 1886b, p. 4.—Carus J. V. 1890, p. 457 (fide Jatta).—Naef 1912e, p. 198; 1921, p. 537.—Berry 1914a, p. 277; 1920, p. 156.

Ocythœ, Gray 1849, pp. 30–34 (pars).

Type.—Argonauta argo Linné, 1758.

Key to the species of *Argonauta* found in Japan.

I. Ventral arms in female, distinctly longer than lateral arms. Shell greatly flattened laterally; 50 or more tubercles visible laterally in full-sized shell, which measures more than 100 mm. in length; every rib termitates in a tubercle on keel ..... *A. argo.*

II. Ventral arms in female, distinctly shorter than lateral arms. Shell less flattened; length less than 85 mm.; laterally-visible tubercles number at most 20; every second rib terminates in a tubercle on keel.

A. Centre of whorl not depressed; surface polished; ribs and tubercles rather low, the former numbering less than 35 in shell 50–60 mm. long ..... *A. hians.*

B. Centre of whorl depressed; surface finely granulose; ribs and tubercles both prominent, the former ordinarily numbering over 40 in shell 50–60 mm. long ..... *A. böttgeri.*

Argonauta hians Solander, 1786.

Japanese name: Funedako.

(Pl. III, figs. 3-6; Pl. VIII, figs. 9, 10; textfig. 6.)

Argonauta hians, Solander 1786, p. 44.—Dillwyn 1817, p. 334.—Fér. et d'Orb. 1838, p. 174, pl. v.—Gray 1849, p. 33.—Tryon 1879, p. 136, pl. xlvi, figs. 100–102.—Ortmann 1888, p. 641.—Ikeda 1891, p. 26.—Hoyle 1904, p. 11.—Berry 1912b, p. 385.—Chun 1915, p. 476, pl. lxxiv, figs, 1, 2, 4–6,—Sherborn 1902, p. 458.

Argonauta gondola, Dillwyn 1817, p. 335.—Lischke 1869, p. 29.—Dunker 1882, p. I.

Ocythoe cranchii, Gray 1849, p. 33.—Dall 1908, p. 229.

Thirty female specimens from various localities have been brought to me for examination. They are referred with no hesitation to the species above entitled, and have the mantle-length ranging from 12 mm. to 56 mm. and the shell-length from 21 mm. to 87 mm.

Body roughly conical, widest in front, flattened laterally; depth taken dorso-ventrally less than the length; posterior part with a sharp upward torsion, at least in animals preserved in situ within the shell. Ventral surface of mantle provided with a distinct transverse sulcus at a short distance from the mantle margin, coinciding with a similar sulcus on its inner surface. Mantle margin even, thickened, constricted off by the above-mentioned two sulci from the remaining parts of mantle. Mantle-opening very wide, extending well above and a little behind the eyes.

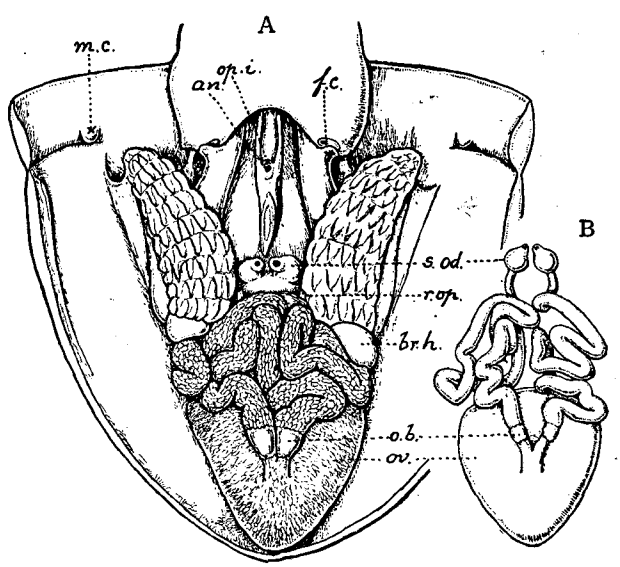
Head small, and indistinctly delimited because so deeply embedded within the mantle. Eye large, protruding; a distinct constriction at the base separating it from the general level of head. Funnel, of robust proportions, but thin-walled, and extremely long, reaching nearly one-third up the ventral arms. Funnel organ conspicuous, comprising a large Λ-shaped pad on the dorsal wall and two

somewhat shorter elongate-ovate pads on the ventral wall just below the dorsal pad. Locking-apparatus of funnel, well developed, small, ovate, cartilaginous, with a pit-like depression at the centre. Mantle-apparatus corresponding to the preceding, of a rounded nodule with the extremity directed posteriad.

Arms flattened from aboral to oral side, sharply separated from head at base by a deep sulcus; unequal, the formula of length being distinctly $1>2>3>4$; second arm one and a half times or even twice the body-length. Dorsal arm the thickest and longest, furnished with a conspicuous, wing-like, dorsal web which is quite folded and contracted in preserved specimens. Lateral arms broad at base, tapering distad at first rather rapidly but gradually afterwards so as to form fine attenuated extremities. Ventral arm decidedly the shortest, its extremity not so fine as in lateral arm. Umbrella very narrow; longest radius between dorsal arms, about twice those between other arms.

Suckers large, prominent, expanded distally, somewhat unequal in size, strictly biserial throughout; in full-grown specimens, numbering a little over 60 pairs on first arm, about 50 pairs on second arm, about 45 pairs on third arm, and about 25 pairs on fourth arm. In the first arm, the first four or five pairs become gradually larger distad, then followed by five or six pairs which rapidly diminish in size toward the extremity; along the terminal part are found about 20 pairs of uniform minute suckers. In the remaining arms the second or third pair is the largest, and the succeeding six or seven pairs rapidly diminish in size distally; the uniform minute suckers on the terminal part number about 10–15 pairs; but these are absent in the ventral arm.

Branchial leaflets number about 20 in each gill. Female internal genital organs as shown in textfig 6.



Textfig. 6.

Argonauta hians. A. Mantle of mature female, laid open; ×4/3. B. Internal genital organs of immature female; the oviduct is laid loose so that its whole course is easily traceable; ×4/3.

Shell about two-thirds as broad as long. Aperture wide, $^2/_3$–$^5/_6$ as great in transverse diameter as in longitudinal diameter. Auricles of greatly variable development indifferent to age, sometimes quite obsolete, its apical angle being about 120°, but more often markedly prominent, bent outward and projecting in a quite sharp apical angle (Pl. III, figs. 3–5). Ribs on sides distinct, short and long arranged alternately; every second terminating in a tubercle on keel. Keel wide, each edge decorated with a sparse series of roundish or quardrangular tubercles, of which 15 or 18 appear in full-sized shells when viewed laterally (Pl. III, fig. 6). Surface polished but may be sparsely covered with fine granules. Color light sepia, the depth being greatly variable in different specimens. Axial part of whorl, and first part of shell-periphery both, of a much deeper shade in the same color than the remaining parts, but the median line of the keel always remains white.

The principal measurements of the largest shell examined are appended:—

Length of shell	87 mm.
Depth of shell	53 „
Longitudinal diameter of shell aperture	57 „
Transverse „ „ „ „	36 „
Greatest width of shell keel	20 „
Distance between apices of shell auricles...	45 „

No male specimen has come under the observation of the author. But, three among the females alluded to above had each a detached hectocotylus in the mantle cavity, lying between a gill and the liver capsule, one of the three specimens carrying it on right side, while the remaining two on left side (Pl. VIII, fig. 9). The three hectocotylus from these three different animals all have the same appearance and are of about equal size (Pl. VIII, fig. 10). The sucker-bearing part is about 15 mm. long, flattened dorso-ventrally, and gradually tapering to a blunt extremity, from which a slender tubular appendage grows out. The opposite extremity is thick and abruptly terminates. On the back a broad web is found contracted, so that the whole hectocotylus curves round almost into the shape of a horse-shoe. The suckers are 45–50 in number, cylindrical, flattened laterally, slightly expanded at the distal end, and arranged in two distinct rows on the extreme margins. The space enclosed by these two rows of suckers is very wide and a little convex. The protective membranes are as broad as the suckers are high. The apical tubular appendage is a little longer than the sucker-bearing part, gradually and evenly tapering to a filiform extremity. On the proximal part is found a thin triangular wing-like membrane attached to each side.

Locality.—Enoshima, Sagami (Ortmann); Sagami (Hirase); Loo-Choo Is. (Lischke); Misaki, Sagami Prov. (!); Kagoshima, Satsuma Prov. (!); Yenshû Nada (Albatross!); Aomori Bay(!). China (Gray); off Las Tres Marias (Hoyle); Southequatorial Current (Chun); coast of Africa (Gray), etc.

Argonauta böttgeri Maltzan, 1881.

(Pl. III, fig. 7; Pl. VIII, fig. 11.)

Argonauta böttgeri, Maltzan 1881, p. 163, pl. vi, fig. 7.—Smith Edg. A. 1887, p. 409, pl. xvii, figs. 1–6.—Dall 1908, pp. 226, 229.—Berry 1914a, pp. 277–280; pl. xlviii, fig. 5, textfigs. 3–7.—Massy 1916b, p. 143, textfigs. 1, 2.

Argonauta owenii, Ikeda 1891, p. 27.—? Dunker 1882, p. 1.

? Argonauta hians navicula, Berry 1912b, p. 385.

Fifteen specimens from Misaki and two specimens from east of Osumi Prov. are referred to the present species. Their mantle-length ranges from 10 mm. to 33 mm. and the shell-length, from 17 mm. to 58 mm.

The species is closely related to *A. hians* Solander, especially in the soft parts. The differences between them is only that the arms are a little longer and the suckers somewhat larger than in *A. hians*, as shown in the following table (The measurement are given in millimeter).

	A. böttgeri				*A. hians*		
No. of specimen	i	ii	iii	iv	i	ii	iii
Shell length	58	56	50	39	59	59	47
Length of second arms	Left 110 Right 110	L. — R. 80	L. 63 R. 60	L. 55 R. 50	L. 75 R. 85	L. 63 R. 64	L. — R. 53
,, ,, third arms	70 65	55 60	44 45	45 —	55 65	43 45	— 40
,, ,, fourth arms	55 65	45 45	31 33	33 —	40 45	34 32	30 30
Diameter of largest sucker of first arms	4.5	4	4	2.6	3.0	3.2	2.7
,, ,, ,, ,, ,, second arms	3.	2.7	3	2.2	2.5	2.5	2.3
,, ,, ,, ,, ,, third arms	2.8	2.6	2 5	2.2	2.3	2.5	2.3
,, ,, ,, ,, ,, fourth arms	3.5	3.2	2.9	2.2	2.5	2.5	2.3

The shell is distinguished from that of *A. hians* in many respects as diagnosed in the following:—

Shell-length under 60 mm. Ribs on sides, prominent, well-defined; numbering 45 or more in full-sized specimens, quite variable in length, often united proximally in twoes or threes; every second terminating in a tubercle, but the alternation occurs less regularly than in *A. hians*, often two together ending in a tubercle. Aperature roughly elliptical, broadest in the middle or a little more dorsally; longitudinal diameter about one and a half times the transverse-diameter. Auricles invariably in-

conspicuous; apices very blunt, turning straight forward. Centres of whorl more or less depressed. Keel broad; its width at the ventral margin of aperature, equaling a half of the shell-width. Tubercles on edges, very prominent, often twice as long as those of *A. hians* in the shell of equal size; conical or flattened laterally. In full-sized specimens 18 or 19 tubercles are made out when viewed laterally. Surface always finely granulose; the granulation especially marked around the centres of whorl. Color deep ochre; more deeply shaded in the first part of whorl than in the remaining parts (Pl. III, fig. 7).

The principal measurements of the largest shell examined are as follws:—

Length of shell	58 mm.
Depth of shell	39 „
Longitudinal diameter of aperture	37 „
Transverse diameter of aperature	25 „
Width of keel at ventral margin of aperture	14 „
Distance between the apices of auricles	23 „

Remarks.—Dunker lists *Argonauta owveni* Ad. & Rev. in the Japanese fauna, but the occurrance of this species in Japan is at least quite doubtful as far as I have ascertained, and that species of Dunker's seems to be a synonym with either *A. böttgeri* or *A. hians.*

Locality:—Misaki (!); east of Ôsumi Prov. (Albatross!). Mauritius (Smith); Chagos Islands (Smith); China Sea (Smith); Australia (Smith); Masbate, Philippines (Smith & Hidalgo); Hawaiian Islands (Berry); New Zealand (Massy).

Argonauta argo Linné, 1758.

Japanese name: Aoigai.

(Pl. III, figs. 8–12; textfig. 7.)

Argonauta argo, Linné 1758. p. 708.—Gmelin in Linné 1790, p. 3367.—Fér. et d' Orb. 1838, p. 158. Alg. pl. i, ibis, iter, i^{4to}, i^{5to}; pls. ii, vi.—Cantraine 1841, p. 20.—Gray 1849, p. 31.—Verany 1851, p. 48, pls. xvii, xviii.—Lischke, 1869, p. 29.—Tryon 1879, p. 138; pl. xlvii, figs. 111–115; pl. xlviii, figs. 116–119; pl. xlix, figs. 120–123.—Verrill 1882, p. 392.—Dunker 1882, p. 1.—Hoyle 1886b, p. 69.—Ortmann 1888, p. 641.—Ikeda 1890, p. 26—Joubin 1894d, p. 212.—Joubin 1895a, p. 9.—Jatta 1896, p. 191, pl. viii, fig. 3; pl. xviii, figs. 15–29.—Heinrich 1904, p. 14, figs.—Hoyle 1904, p. 12.—Hirasé 1907, p. 3.—Berry 1912b, p. 385.—Berry 1916, p. 48.—Naef 1923, pp. 763–788—Degner 1925, p. 81.

Ocythoe tuberculatus, Gray 1849, p. 30 (pars).

Thirty-two specimens from various localities of Japan have been placed at my disposal, being referred with a great deal of hesitation to the species above entitled. Among them the largest specimen has 82 mm. mantle-length, and 145 mm. shell-length.

Body more flattened laterally than in *A. hians* and also than in *A. böttgeri;* depth taken dorso-ventrally, distinctly less than the length; posterior end sharply curving upwards at least in animals preserved in situ within shell. Mantle-margin thickened as in *A. hians* into a broad transverse band marked off posteriorly by a transverse groove; but the groove is a little deeper, and the part of the mantle just behind it more highly projects than in that species. Dorsal surface of body strongly arched anteriorly. Mantle-opening very wide, extending well above and behind eyes.

Head small, somewhat concave above, sunk deep in mantle cavity. Eyes large, subspherical, protruding sideways, more or less constricted at base. Funnel large, thinly walled, extending far beyond the ventral interbrachial space. Adductors infundibuli lateral in position, fastened to the bases of ventral arms. Funnel organ composed of a thick-delineated $\wedge$-shaped dorsal pad and two elongate-elliptical ventral pads; The dorsal pad situated in the middle of dorsal funnel wall; the ventral pad a little shorter than the former, and situated just opposit to it on ventral funnel wall. Locking

apparata between funnel base and mantle, shaped as in *A. hians*. Umbrella rather rudimentary, best developed between dorsal arms, where it extends to the fourth pair of suckers.

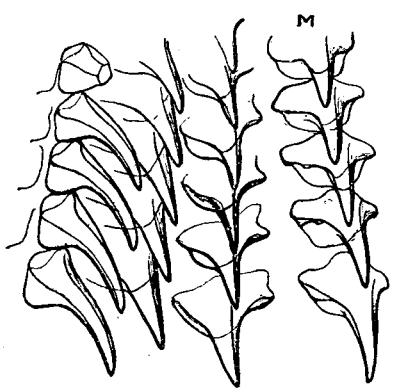
Arms unequal, the formula of length being $1>4>2>3$. Dorsal arm the thickest, triangular on section at the proximal part, provided with a wide, conspicuous, wing-like membrane along the aboral surface. Ventral arm decidedly longer and thicker than lateral arms, flattened laterally, provided with a high aboral keel which is broadest at the base, narrowing towards the extremity. Lateral arms flattened, with rounded aboral surfaces. Except the dorsal pair, the arms taper very gradually to attenuated extremities.

Suckers highly prominent, nearly cylindrical but expanded a little at the distal end, biserial, standing on the margins of arms; of small and uniform size, and of sparse arrangement as compared with those of *A. hians*. In an individual of 65 mm. mantle-length, which I have subjected to an examination, they number 150 pairs on the dorsal arm, a little over 100 pairs on each of the lateral arms and a little below 90 pairs on the ventral arm.

External surface quite smooth in all parts, bespinkled with chromatophores, shining here and there in silver or green.

Branchial leaflets number about 28 in each gill.

Radula composed of seven series of teeth; pentagonal in section; marginal teeth a little longer than remaining teeth, which are of about uniform length. Central teeth slender but exceedingly expanded at base, and provided with one or two faint, low, broad cuspi on either side. Inner lateral teeth shaped as in the central, but a little oblique, curving less in the outer edge than in the inner. Outer lateral teeth roughly triangular in contour, oblique, their point turning inwards; inner side nearly straight, while the outer is concave (textfig. 7).



Textfig. 7.
Argonauta argo. Part of radula; × 47.

Full-sized shell, 140–145 mm. in length, and about 90 mm. in depth, markedly flattened laterally; periphery very narrow, sharply marked off from sides by two series of sharp-edged, squarish tubercles, which number 60 or more when viewed laterally. Ribs on sides, distinct, numerous, three or four kinds of varied length arranged in regular order; each terminating in a tubercle on periphery. Aperture of a high isosceles triangle, becoming still higher as the shell grows larger, and the height in full-sized shells, being greater than twice the base-line. Auricles in immature shells, invariably conspicuously developed, bent outwards, terminating in acute apices; at maturity, becoming obscure, their apices much blunter, and the outward-warp much less conspicuous. Surface polished, white, but drab ones may rarely occur. First part of shell-margin ordinarily shaded in black, except the median zone of periphery, which always remains white (Pl. III, figs. 8–12).

No male specimen has come under my observation, except a detached hectocotylus which was found in the mantle cavity of a female. The hectocotylus appears on the whole to resemble that of *A. hians*. It is about 32 mm. long and bent round into the shape of a horse-shoe, due to the contraction of a wide contractile membrane on its back. The suckers on it number 65, and are set quite marginally in two distinct series. The protective membranes are about as broad as the sucker height and come in close contact with the outer surfaces of the suckers.

Measurements of Specimen Examined.

Ventral length of mantle	63 mm.
Width of mantle at mantle-margin	40 „
Depth of mantle	55 „
Breadth of head	35 „

	Left	Right
Length of first arms	300 mm.	300 mm.
„ „ second arms	190 „	180 „
„ „ third arms	140 „	135 „
„ „ fourth arms	230 „	230 „
Radius of umbrella between first arms	24 „	
„ „ „ „ first and second arms	16 „	
„ „ „ „ second and third arms	14 „	
„ „ „ „ third and fourth arms	20 „	
„ „ „ „ fourth arms	16 „	
Diameter of largest sucker of first arms	5 „	
„ „ „ „ „ second arms	4. 5 „	
„ „ „ „ „ third arms	4 „	
„ „ „ „ „ fourth arms	4. 6 „	
Length of shell	140 „	
Maximum breadth of shell aperture	90 „	
Length of shell aparture	45 „	
Maximum breadth of shell carina	7. 5 „	
Distance between tips of shell auricles	47 „	

Remarks.—The Japanese specimens, upon which the above description is based, differ from Jatta's description of the Mediterranean form in some respects; (1) The outer lateral teeth of the radula are not so long as illustrated by him, but only slightly longer, or even shorter than either the internal lateral or the median teeth. (2) The median teeth have on either side, one or two faint cuspi which are not given in Jatta's illustration. (3) The funnel organ consists of much thicker pads, of which the ventral ones are a little longer than shown in the Mediterranean form.

Locality.—Enoshima, Sagami (Ortmann); Tôkyo (Dunker); Tango (Hirasé); Loo-Choo Is. (Lischke); Misaki, (!); Ôshima, Ôsumi Prov. (!); Etchû Prov. (!); Aomori Bay (!); Yuwanai, Hokkaido (!) Gulf of California (Tryon); off Cape San Francisco (Hoyle); off Cocos I. (Hoyle); Madeira (Suhm, M.S.); Fayal (Joubin); Mediterranean (d' Orbigny; Cantraine; Verany; Jatta, etc.); east coast of U. S. A. (Lockwood; Verrill); Cape of Good Hope (d' Orbigny; Tryon; Hoyle); 37°54'N18°02'0 (Degner).

Subfamily **Ocythoinae** Berry, 1912.

Ocythoidae (*Argonautidae?*), Gray 1849, p. 28 (pars).—Berry 1920, p. 155.
Philonexidae, d' Orb. 1855, p. 159 (pars).—Verrill 1882, p. 388 (pars).
Ocythoinae, Berry 1912b, p. 385.

A pair of aquiferous pores present on the ventral surface of head, but none on the dorsal surface. Funnel organ conspicuous, composed of a large, ∧-shaped, dorsal pad and a pair of elongated, ventral pads; both smooth. Locking apparatus of funnel, composed of a strong recurved cartilaginous protuberance with deep pit in front of the base. Arms slender; contractile webs rudimentary. Suckers highly prominent, set in two series along the extreme edges of arms. Umbrella rudimentray. Sexes dimorphic.

Female sex large, up to 500 mm. long. Belly ornamented with stiff tubercles connected by radiating ridges. Renal and genital openings both not projecting but ostium-like. Oviducts and water vascular canals of both sides developed. Vagina filiform, very long tortuous. Oviducts *s.s.* very short and twice or thrice as thick as vagina. Water vascular canal serving to pass the eggs to renal sac, in which they attain development. Male sex small, at most 100 mm. in length. The entire right third arm, hectocotylized, detachable at maturity, developing in a pedunculate outstanding sac; with about 100, flat, oval, saucer-like shaped suckers in two well-defined series.

Only one genus *Ocythoe* is known to belong to this subfamily.

Genus **Ocythoe** Rafinesque, 1814.

Ocythoe, Rafinesque 1814, p. 29.—Gray 1849, p. 30 (pars).—Steenstrup 1880a, p. 104.—Hoyle 1886a, p. 5.—Steenstrup 1887a, pp. 61–67.—Jatta 1896, p. 197.—Naef 1912e, p. 198; 1921, p. 537.—Berry 1920, p. 155.

Philonexis, Fér. et d' Orb. 1835, p. 83 (pars).—d' Orb. 1855, pp. 158, 202 (pars).—Adam, H. et A. 1858, I, p. 52.

Parasira, Steenstrup 1861, p .69.—Keferstein 1866, p. 1449.—Tryon 1879, p. 132.—Verrill 1882, p. 388.—Fischer P. 1887, p. 334.

Type.—Ocythoe tuberculata Rafinesque, 1814 (monotypic).

Ocythoe tuberculata Rafinesque, 1814.

(Pl III, figs. 13, 14; Pl. VIII, figs. 12–16; textfig. 8.)

Ocythoe tuberculata, Rafinesque 1814, p. 29.—Gray 1849, p. 30 (pars).—? Tryon 1879, p. 132.—Steenstrup 1880a, p. 104.—Hoyle 1886b. p. 5.—Steenstrup 1887a, pp. 61–67.—Jatta 1896, p. 198, pl. vi, fig. 3; pl. vii, fig. 8; pl. xix, figs. 1–12; textfigs. 14, 52.—Joubin 1900, p. 26.—Marchand 1906, pp. 753, 755, 758, fig. 3.—Wülker 1910, p. 4; fig. 7.—Berry 1912b, p. 385; 1916a, pp. 1–4; 1 pl.—Naef 1923, p. 749.—Degner 1925, p. 81.

Philonexis tuberculatus, d' Orb. et Fér. 1835, p. 87, Pouples pl. vibis, viter et pl. xxiii, figs. 6–9.—d' Orb. 1855, p. 206.—Adams, H. and A. 1858, pp. 19, 22.

Octopus catenulatus, Verany 1851, p. 37, pl. xiii.

Octopus carenae, Verany 1851, p. 34. pl. xiv, figs. 2, 3.—Adams, H. et A. 1858, pp. 19, 22.

Parasira carenae, Tryon 1879, p. 132, pl. xlv, fig. 99.

Parasira catenulata, Tryon 1879, p. 132, pl. xlv, figs. 95–98.—Verrill 1882, p. 389, pl. xl, figs. 2, 2a.—Ikeda 1891, p. 25.

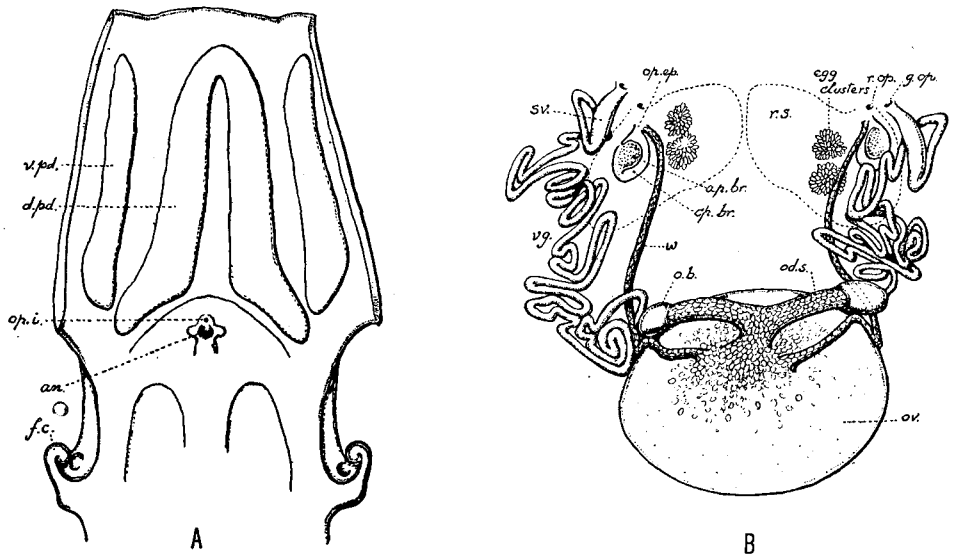
Tremoctopus catenulatus + *Tremoctopus carenae*, Brock 1880, p. 198.

Tremoctopus döderleini, Ortmann 1888, p. 642, pl. xx.

Of this striking species five female and two male specimens from Japan have been placed at my disposal for examination. The females range from 24 cm. to 52 cm. in length, while the males both attain only about 10 cm. long. These males are excellently preserved, one collected at Misaki, Sagami Prov., and the other purchased at a fish market of Tôkyo; the former specimen had the hectocotylus still contained in the pedunculate sac, while the same organ of the latter specimen was already developed and stretched out of the sac.

Female:—Body robust, very large as contrasted with head and arms; roughly ovoidal, broadest one-third of the way back, arched above, more or less flattened beneath; ventral surface and periphery ornamented with stiff, pointed, uniform tubercles. The tubercles sparsely scattered at regular intervals and connected by distinct radiating ridges woven together into a characteristic network.

Head small, decidedly narrower than body, sunk deep in mantle-cavity. Two aquiferous pores present on the ventral surface on both sides of funnel but none on the dorsal surface. Eyes a little prominent. Funnel large, conical, extending beyond the ventral interbrachial space. Funnel organ composed of a thick, ∧-shaped dorsal pad and two elongated, roughly triangular ventral pads; all so large as to cover the greater part of their respective walls (textfig. 8A). Locking apparatus of funnel-base conspicuous, composed of a hard, strong, cartilaginous protuberance bent forward, the apex of which is a little expanded, and directed upward. Opposite to the apex a deep pit is found in front of the base of the protuberance. Mantle apparatus corresponding to the funnel apparatus, composed of deep, conspicuous pit facing rightly posteriad, its anterior margin thickened and protruding into mantle-cavity. Umbrella quite rudimentary.



Textfig. 8.

Ocythoe tuberculata. A. Funnel laid open; ×½. B. Internal genital organ of mature female; the water vascular canals are filled with eggs, and the renal sacs have eggs clusters fixed on their inner walls; ×½.

Arms unequal, the formula of length being 4=1>2>3; the longest exceeding the conjoined head and body in length. All tapering evenly to attenuated extremities, furnished with a narrow web on the dorsal side. Suckers highly prominent, cylindrical, but expanded distally; sparsely set in a double alternate series except first three or four which are nearly uniserial; their number in full-grown individuals, about 100 on each arm. The suckers increase in size to the sixth or seventh pair and then decrease very gradually toward the extremity.

Color of preserved specimens purplish brown above, much paler beneath; sides of head and body as well as the median line of aboral arm-surface all, of greenish hue with metalic rustre.

Branchial leaflets number about 35 in each gill.

Oviducts of both sides well developed. Oviducts *s.s.* very short, united proximally so as to reveal the shape of a Y. Vaginae very long, greatly tortuous, and ½—⅓ as thick as oviducts *s.s.*; terminal part swollen, thin-walled, provided with a much wider internal passage than in the remaining parts (textfig. 8B).

Measurements of the female specimens examined are appended:—

No. of specimen	i	ii	iii	iv	v
Length, total	470 mm.	345 mm.	250 mm.	370 mm.	520 mm.
Mantle length (Ventral)	115 ,,	80 ,,	70 ,,	95 ,,	160 ,,
Mantle breadth	102 ,,	75 ,,	70 ,,	80 ,,	140 ,,
Head breadth...	70 ,,	55 ,,	45 ,,	53 ,,	80 ,,
Breadth of nuchal ligament	53 ,,	40 ,,	37 ,,	45 ,,	75 ,,
Length of first arms	Left Right 280mm. —	Left Right 220mm. 340mm.	Left Right 150mm. 160mm.	Left Right 260mm. 260mm.	Left Right 345mm. 345mm.
,, ,, second arms	235 ,, 210 ,,	170 ,, 180 ,,	— 125 ,,	195 ,, 240 ,,	270 260
,, ,, third arms	200 ,, 195 ,,	150 ,, 150 ,,	— 110 ,,	175 ,, 190 ,,	240 230
,, ,, fourth arms...	290 ,, 290 ,,	140 ,, —	165 ,, 160 ,,	250 ,, 260 ,,	340 340
Largest sucker of first arms (diameter)	6.3 mm.	—	4.5 mm.	5.2 mm.	8.0 mm.
,, ,, ,, second arms (do.)	4.0 ,,	—	4.0 ,,	3.2 ,,	6.0 ,,
,, ,, ,, third arms (do.) ...	3.5 ,,	—	3.8 ,,	4.0 ,,	5.0 ,,
,, ,, ,, fourth arms (do.)	5.5 ,,	—	4.5 ,,	4.5 ,,	5.5 ,,

Male:—Body roughly conical, broadest anteriorly, more or less pointed posteriorly. Tubercles on belly, faint; retiform ridges still fainter. Head decidedly broader than body, a little flattened dorso-ventrally; ventral surface provided with a pair of minute aquiferous pores in a similar position as in the female. Eyes prominent owing to the location of full, large eyeballs, and furnished with a small round opening at the centre. Funnel nicely conical, with a wide base which shows no distinct external demarkation, being covered over continuously by the integument of head (Pl. III, figs. 13, 14; Pl. VIII, fig. 13).

Arms slender, greatly unequal, the formula of length being $1 \fallingdotseq 4 > 3 \fallingdotseq 2$; first pair longer than twice the length of the third or second, and about three times as long as body. Suckers shaped and arranged as in the female; decidedly smaller and more closely set on lateral arms than on dorsal and ventral arms; numbering less than 40 on each of lateral arms and more than 50 on dorsal arm and also on the ventral.

Whole right third arm hectocotylized; when immature, coiled, folded, and resting tightly upon itself, enclosed within a saccular envelope. The envelope ovoidal, but somewhat flattened laterally, attached by a peduncle to the usual position of the arm, and furnished with a small round orifice on the oral aspect near the peduncle. The peduncle cylindrical, provided with two suckers arranged longitudinally. Hectocotylus when stretched, flattened dorso-ventrally, broader than any of remaining arms, tapering gradually to a blunt extremity; armed with about 100 suckers thickly set in two well-defined series. Suckers of an ovate saucer-like shape, with a minute aperture eccentric towards the inner margin. To the outer aspect of the extremity of the hectocotylus is attached a small ellipsoidal sac, in which is contained a long filamentous organ winded tightly upon itself into a ball. At maturity the hectocotylus stretches out of the succular envelope, and its proximal part becomes thicker, while its envelope disappears. The filamentous appendage in the terminal sac also stretches out and remaines fixed to the extremity of the hectocotylus (Pl. VIII, figs. 14–16).

Measurements of Males Examined.

No. of specimen	i	ii
Length, total	960.0 mm.	100 mm.
Ventral length of body	21.5 ,,	18 ,,
Maximum breadth of body	13.5 ,,	13 ,,
Depth of head	12.0 ,,	12 ,,
Breadth of head	17.0 ,,	17 ,,
Centres of eyes to posterior body-end	27.0 ,,	27 ,,
Length of first arms	Left 64 mm. Right 55 mm.	Left 75 mm. Right 75 mm.
,, ,, second arms	26 ,, 29 ,,	32 ,, —
,, ,, third arms	27 ,, —	30 ,, 100 ,,
,, ,, fourth arms	67 ,, 60 ,,	80 ,, 75 ,,
Diameter of largest sucker of first arms	2.0 mm.	2.0 mm.
,, ,, ,, ,, ,, second arms	1.4 ,,	1.3 ,,
,, ,, ,, ,, ,, third arms	1.4 ,,	1.3 ,,
,, ,, ,, ,, ,, fourth arms	2.2 ,,	2.1 ,,

Remarks.—The male specimens examined agree well with Jatta's description; the only discrepancy from it is to bear two suckers on the peduncle of the hectocotylus emvelope. Ortmann's *Tremoctopus döderlein* is probably identical with the present species as already pointed out by Wülker.

Locality.—Tôkyo Bay (Ortmann); Sagami Prov. (Wülker); Awa Prov. (?); Misaki (?); Tôkyo market (?); Hakodaté, Hokkaido (?). Santa Catalina, California (Berry); New Zealand (Massy); Massachusetts (Verrill); Mediterranean (d'Orb.; Gray; Tryon; Verany; Jatta; Joubin); 40°53′N13°43′0 (Degner).

Subfamily **Tremoctopodinae** Berry, 1912.

Philonexidae, Gray 1849, p. 24 (pars).—Adams H. et A. 1858, p. 21.—Verrill 1882, p. 388 (pars).—Carus 1890, p. 458.—Chun 1915, p. 478.

Tremoctopidae, Tryon 1879, p. 130 (pars).

Tremoctopodidae, Brock 1882, p. 589.—Fisher P. 1882a, p. 334 (pars).—Hoyle 1904, p. 12.—Berry 1920, p. 156.

Tremoctopodinae, Berry 1912b, p. 386; 1914a, p. 281.—Naef 1921, p. 537 (pars).

Sexes dimorphic. Female sex fairly large, without external shell. Arms greatly unequal in length and also in shape; two dorsal pairs of arms connected at base by a broad umbrella which extends along the both sides of the dorsal arm towards the extremity as a broad veliform membrane. Two ventral pairs of arms interwebbed only at base. Vaginae comparatively short; subterminal parts greatly swollen, ovoidal, succular, functioning as uteri; water vascular canal rudimentary. Two aquiferous pores on the dorsum of head and another two on the ventrum near the roots of ventral arms. Tuberculus olfactorius, situated inside of each angle of mantle opening. Funnel organ composed of a thick-deliniated W-shaped cushion which is markedly folded into a series of longitudinal glandular lamellae. Funnel base articulates with mantle by means of folds of its posterior edge turned inside out, which are thick stiff and cartilaginous in the adult, though thin, membranous and fibrous in the young.

Male sex much smaller than the female; umbrella narrow; hectocotylus involving the whole right third arm, separable at maturity, its outer surface ornamented with fringe-like papillae. The arm attains its development in a specialized sac occupying the region which would ordinarily be the base of the arm and which is situated between the base of the funnel and the eye.

A unique genus *Tremoctopus* is referred to this subfamily.

Genus **Tremoctopus** Chiaje, 1829.

Tremoctopus, Chiaje 1829; 1841, p. 5.—Gray 1849, p. 27.—Steenstrup 1860, p. 332.—Keferstein 1866, p. 1449.—Woodward 1871, p. 164.—Tryon 1879, p. 130.—Brock 1880, pp. 210, 214, etc. (pars).—Brock 1882, p. 589.—Hoyle 1886b, pp. 6,70.—Carus 1890, p. 458.—Joubin 1893, p. 5.—Pelseneer 1894, p. 207.—Jatta 1896, p. 203.—Naef 1912e, p. 199; 1921, p. 537.—Berry 1914a, p. 281; 1920, p. 156.

Philonexis, d'Orb. in Fér. et d'Orb. 1839, p. 83 (pars).—d'Orb. 1855, pp. 159, 200 (pars).—Gray 1849, p. 24 (pars).

Octopus (*Tremoctopus*), Verany 1851, p. 41.

Type.—*Tremoctopus violaceus* Chiaje, 1829 (Monotypic).

Tremoctopus violaceus Chiaje, 1829.

(Pl. VIII, figs. 17–19; textfigs. 9,10.)

Tremoctopus violaceus, Chiaje 1829, I, pls. lxx, lxxi, et 1841, I, p. 6; V. p. 66 Gray 1849, p. 27.—Tryon 1879, p. 131, pl. xliii, figs. 86–90; pl. xliv, figs. 93, 94.—Brock 1880, pp. 214, 232, etc.—Brock 1882, p. 583.—Hoyle 1886b, p. 6.—Fischer P. 1882a, p. 335.—Carus 1890, p. 458.—Jatta 1896, p. 204, pl. 6, fig. 2; pl. 20, figs. 1–18.—Wülker 1910, p. 5.—Naef 1912e, p. 199, 4 figs.; 1923, p. 735.—Berry 1912b, p. 386; 1914a, p. 281, textfigs. 8–10; pl. xlix, figs. 3, 4.—Massy 1916b, p. 144, textfigs. 3, 4.—Degner 1925, p. 80.

Tremoctopus(=*Philonexix*)*violaceus*, steenstrup 1860, p. 332.

Philonexis velifer, Fér. & d'Orb. 1835, p. 91, Poulpes pls. xviii–xx; pl. xxiii, figs. 24.

Philonexis quoyanus, d'Orb. & Fér. 1835, p. 96, Poulpes pl. xvi, figs. 6–8; pl. xxiii.

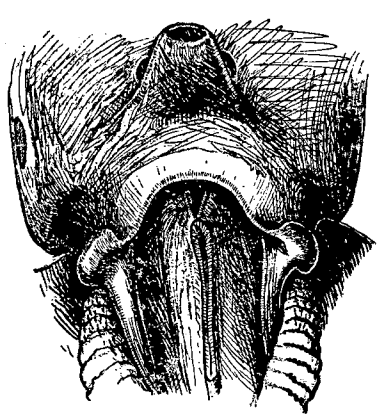
Philonexis atlanticus, d'Orb. & Fér. 1835, p. 98, Poulpes pl. vi, figs. 4–5a.

Philonexis microstomus, d'Orb. & Fér. 1835, p. 100, Poulpes pl. x, figs. 5a–g.
Philonexis hyalinus, d'Orb. & Fér. 1835, p. 104, Poulpes pl. xvi, figs. 1–3.
Tremoctopus quoyanus, Gray 1849, p. 27.—Steenstrup 1861, p. 332.—Tryon 1879, p. 131, pl. xliv, figs. 91, 92.—Hoyle 1886b, pp. 70, 71; pl. xiii, fig. 7; 1904, p. 12, 1 textfig.; 1912, p. 276.
Octopus (*Tremoctopus*) *violaceus*, Verany 1851, p. 41, pl. xiv, fig. 1; pls. xv, xvi.
Octopus Koellikeri, Verany 1851, p. 33, pl. xi, figs. a, b, c.
Tremoctopus atlanticus, Tryon 1879, p. 130, pl. xlii, figs. 76, 77.—Hoyle 1886b, p. 71.
Tremoctopus microstomus, Tryon 1879, p. 130, pl. xlii, fig. 78.
Tremoctopus dubius, Tryon 1879, p. 131, pl. xliii, figs. 80, 81.
Tremoctopus gracilis, Tryon 1879, p. 131, pl. xliii, figs. 82, 83.—? Hoyle 1886b, p. 71, pl. xiii, figs. 8, 9.
Tremoctopus hyalinus, Tryon 1879, p. 131, pl. xliii, figs. 84, 85.—Chun 1915, p. 478, pl. lxxvii, figs. 1, 4–6.
Tremoctopus microstoma, Joubin 1893, p. 218, figs. 2–9.

Four female specimens from Japan have been placed at my disposal. They are without hesitation referred to this species, and upon them the following description is based.

Body roughly conical, broadest anteriorly, bluntly terminating posteriorly, ordinarily longer than broad, but sometimes the breadth and length may be about the same; cross section roundish. Mantle opening wide, extending more than half round the body; angles situated just above and behing eyeballs; margin even, without emargination (Pl. VIII, fig. 1).

Head large, wider than body; cross section squarish or hexagonal; sides flattened. A pair of oval acquiferous pores present on the ventral surface of head near the roots of ventral arms, and another pair on the dorsal surface in its central region. Eyes large and full. Funnel broad, thin-walled, not extending to ventral umbrella edge; the projecting distal part, short; posterior collar-like portion connected on either side with head by several longitudinal ligaments, of which the uppermost is the strongest. Funnel organ composed of a very thick, W-shaped pad which is deeply and finely plicated, forming 100 or even more longitudinal glandular lamellae. Locking apparata between funnel and mantle, representing the simplest structure among the three known genera in the Argonautidae: funnel apparatus plate-like, formed of the latero-posterior edge of funnel-base turned inside out, the extreme edge being directed dorsad (textfig. 9). The funnel apparatus in young, soft, fibrous, and rather membranous, but at maturity it becomes stiff, hard, thick and quite cartilaginous (Pl. VIII, fig. 19). The mantle apparatus. composed of a deep transverse, pocket-like groove facing posteriad; in front of the groove the mantle is thickened.

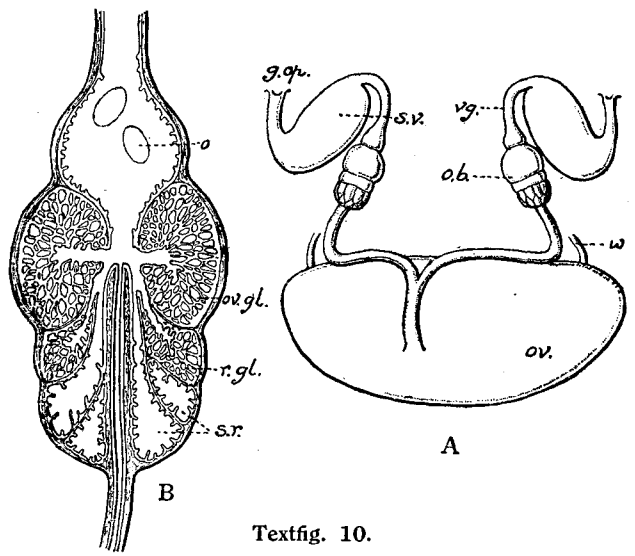


Textfig. 9.
Tremoctopus violaceus. Funnel region of mature female; × 1/2.

Arms exceedingly unequal, the formula of length being 1>2>4>3. First arm long, when perfectly preserved, provided distally a delicate, flattened, tape-like appendage. Second arm shorter, and stouter than first arm and without tape-like apical appendage. Third arm the shortest but yet a little longer than body, and equal to fourth arm in structure, regularly tapering towards the extremity. First and second arms rounded in the aboral side, without keel; remaining arms provided with a distinct keel along the proximal half. Umbrella very broad, though thin and delicate; of exceedingly unequel development in the different interbrachial spaces; the formula of radius-length being 1–2>1–1>2–3>3–4>4–4. Umbrella in first and second arms, continued along either side towards the extremity as a delicate membrane. The membrane in first arm, veliform, quite extensive, bordering both sides of the arm; in second arm, developed only on the dorsal side, extending to the extremity and continually narrowing towards it.

Suckers cylindrical, slightly expanded at the distal end, set at wide intervals. Proximal three or four suckers on first and second arms and similar two or three on third and fourth arms, uniserial; in either pair of arms followed distally by another three or four suckers arranged in two alternate rows, whence a distinct biserial arrangement of suckers sets out, continuing towards the extremity. But on the extremity of the first arm the suckers are strictly uniserial. In all arms especially in the second, the distance between the two suckers in each transverse row is very short at first but soon becomes greater and it attains maximum along the central part of the arm.

Surface rather soft to the touch, invested with a loose skin which is evenly beset with faint minute uniform warts. Color brownish violet; the dorsal surface of head and body as well as both surfaces of umbrella, of much deeper shade in the color than remaining parts.



Textfig. 10.

Tremoctopus violaceus. A. Internal genital organs of mature female; ×⅔. B. Longitudinal section of oviducal ball; ×4.

Oviducts of both sides well developed. Vaginae short, not projecting into mantle cavity; external opening, situated far posterior to anus; considerably expanded near the middle into an ellipsoidal, thin-walled sac, within which numerous fertilized eggs may be fixed (Pl. VIII, fig. 18; textfig. 10A). The proximal portion of vaginae also a little expanded, its internal epithelium finely creased transversely. Oviducal balls ellipsoidal, each provided at the subequetorial region with twofaint transverse constrictions which mark the external boundaries of the three internal organs, viz. distal gland, proximal gland, and seminal receptacle (textfig. 10B). These organs are similarly composed of radial components of the same number, and group themselves into 21 radial sets in the similar manner as in the Polypodidae. Ova small, ovoidal, measuring 1 × 1.5 mm.

Measurements of the Specimens Examined.

No. of specimen	i	ii	iii	iv
Length, total	ca. 470 mm.	ca. 440 mm.	300 mm.	100 mm.
Length of body	120 ,,	90 ,,	76 ,,	24 ,,
Maximum breadth of body	185 ,,	90 ,,	41 ,,	20 ,,
,, ,, ,, head	90 ,,	90 ,,	46 ,,	22 ,,
Length of first arms	Left —mm. Right —mm.	Left —mm. Right —mm.	Left —mm. Right 30c(+)mm.	Left 90mm. Right 87mm.
,, ,, second arms...	320 ,, — ,,	330 ,, 330 ,,	200 ,, 200 ,,	63 ,, 63 ,,
,, ,, third arms	135 ,, 135 ,,	200 ,, 190 ,,	110 ,, 87 ,,	35 ,, 35 ,,
,, ,, fourth arms	145 ,, 145 ,,	200 ,, 200 ,,	— ,, 98 ,,	42 ,, 42 ,,
Radius of umbrella between first arms	120 mm.	— mm.	50 mm.	24 mm.
,, ,, ,, ,, first and second arms	200 ,,	140 ,,	100 ,,	35 ,,
,, ,, ,, ,, second and third arms	80 ,,	65 ,,	35 ,,	10 ,,
,, ,, ,, ,, third and fourth arms	50 ,,	50 ,,	30 ,,	7 ,,
,, ,, ,, ,, fourth arms	40 ,,	70 ,,	20 ,,	7 ,,
Diameter of largest sucker of first arms ...	6 ,,	5.3 ,,	3.5 ,,	1.6 ,,
,, ,, ,, ,, ,, second arms ...	6 ,,	5 ,,	3 ,,	1.4 ,,
,, ,, ,, ,, ,, third arms ...	5.5 ,,	4.5 ,,	3 ,,	1.3 ,,
,, ,, ,, ,, ,, fourth arms ...	5.5 ,,	4.4 ,,	3 ,,	1.2 ,,

Locality.—Coast of Bôshû (Wülker); Misaki (!); Tango Prov. (!); Hizen Prov. (!). Between Papua & Java (Hoyle); tropical Pacific (Hoyle); epuatorial Atlantic (Hoyle); North Atlantic (Hoyle); Atlantic (Fér. & d'Orb.); Mediterranean (Fér. & d'Orb.; Jatta).

Family **Polypodidae** Hoyle, 1904.

Octopidae, d'Orb. in Fér. et d'Orb. 1839, p. 3 (pars).—d'Orb. 1845, pp. 159, 164 (pars).—Gray 1849, p. 4 (pars).—Tryon 1879, p. 109 (pars).

Octopodidae, Adams H. & A. 1858, p. 18 (pars).—Verrill 1882, p. 393.—Carus 1890, p. 459.—Hoyle 1886b, p. 74.—Chun 1915, p. 479.—Grimpe 1922, p. 40.—Robson 1926, p. 1329.

Polypodidea, Hoyle 1904b, pp. 2, 5; 1909, p. 258 (pars).—Berry 1912a, p. 276; 1914a, p. 289 (pars).—Naef 1912e. p. 197.

Small to gigantic octopods, of more or less fleshy consistency. Body rounded and compact, sometimes a membranous or fleshy horizontal ridge present around the periphery, but no fin developed. Skin variously colored, frequently warty. Cirri very often developed above eyes. Head more or less distinct, destitute of aquiferous pores. Olfactory pit present in each corner of mantle opening. Funnel organ W-shaped or double V-shaped. No locking apparatus present between funnel-base and mantle. Arms of various length, but ordinarily long, with attenuated extremities; basal parts connected by means of an extensive umbrella. Suckers uniserial or biserial. Right or left third arm hectocotylized, its extremity transformed into a conical or spoon-shaped or spadicose, undetachable, copulatory organ. Retractor pallii medianus invariably well developed. Oviducts of both sides developed, invariably functioning as such.

Subfamily **Polypodinae** (Grimpe, 1921). *Octopodinae*, Grimpe 1921, p. ; 1922, p. 40.

Key to the genera found in Japan.

1. Right third arm hectocotylized.....*Polypus.*
2. Left third arm hectocotylized.....*Scaeurgus.*

Genus **Polypus** Schneider, 1784.

Polypus, Schneider 1784, p. 116 (fide Hoyle).—Hoyle 1901a, pp. 1–5; 1904b, pp. 5, 6.—Berry 1912a, p. 278; 1914a, p. 289.—Chun 1915, p. 485.

Octopus, Lam. 1799, p. 18 (fide Hoyle).—d'Orbigny, in d'Orb. et Fér. 1838, p. 17—Gray 1849, p. 4 (pars).—Verany 1851, p. 16 (pars).—Adams, H. & A. 1858, p. 19.—Tryon 1879, p. 109 (pars).—Verrill 1882, p. 395.—Hoyle 1886b, p. 74.—Carus T. V. 1890, p. 459 (fide Jatta).—Norman 1890, p. 465.—Jatta 1896, pp. 53, 211.

Suckers mostly biserial. Right third arm hectocotylized. No strong constriction present between first and second parts of spermatophoric gland. Nor cartilaginous stylets present internally.

Type.—*Octopus vulgaris* Lamarck, 1799.

Key to the species of *Polypus* found in Japan.*)

(I) Surface smooth or rough, often granulose; arms rather uniform, or at least not very unequal; terminal organ of hectocotylised arm slender or rudimentary.

(A) Surface more or less granulose, firm to the touch, often an oceller patch present in front of each eye, rarely distinct stripes on body and arms; hectocotylus rudimentary, shorter than 1/10 the entire length of the arm in which it is developed.

(a) Neither ocellar patch nor distinct stripes present.

(*α*) Arms nearly equal in length.

(1) Adult about 60 cm. long; gill with 17–20 leaflets; penis small elongated, its posterior end swollen into a round diverticle; spermatophores about 25 mm. long; vagina extending nearly to anus .....*P. vulgaris.*

(2) Adult less than 15 cm. long; gill with 9 or 10 leaflets; penis small, retort-shaped; spermatophores 12 mm. long; oviduct terminating far behind anus.....*P. parvus.*

(3) Adult about 28 cm. long; gill with 16–18 leaflets; penis conspicuous, bent into U-shape; spermatophores about 160 mm. long, oviduct terminating far behind anus..... ..... *P. granulatus.*

(4) Adult about 35 cm. long; gill composed of 15 or 16 leaflets; penis long, but bent into V-shape; spermatophores about 40 mm. long; oviduct extending to anus..... ..... *P. oliveri.*

(5) Adult about 30 cm. long; surface smooth except for very fine warts; gill composed of about 18 leaflets; penis slenderly pirriform or retort-shaped; spermatophores about 60 mm. long; oviducts far shorter than to anus; Hectocotylized arm about 2/3 as long as the corresponding arm of the opposite side, terminal 1/10 transformed, about 36 pairs of suckers on normal part..... *P. oshimae*, n. sp.

(β) Arms unequal in length, the dorsal pair being the longest. Adult a little over than 60 cm. in length; surface with pimple-like warts of various sizes; gill consisting of about 24 leaflets; penis elongate but with recurved posterior end; spermatophores about 75 mm. long; oviducts far shorter than to anus; hectocotylized arm about $\frac{2}{3}$ as long as the arm of the opposite side; terminal $^1/_{27}$ transformed, about 44 pairs of suckers on normal part..... ..... *P. luteus*, n. sp.

(b) Ocellar patch present in front of eye.

(α) Adult about 100 cm. long; ink-duct greatly swollen, ocellar patch, rather indistinct..... ..... *P. marmoratus.*

(β) Adult less than 30 cm. in length; ink-duct thin as usual; ocellar patch very distinct.

(i) Ocellar ring greenish to yellowish, nearer to eye than to umbrella edge, penis rather small, flask-shaped.

(1) Brick-colored elliptical or dumbbell-shaped patch present between eyes; elliptical or cardiform patch of similar tint, above mantle..... *P. fang-siao, var. typicus.*

(2) Brick-colored crescentiform patch present between eyes; Y- or V-shaped patch of similar tint, above mantle..... *P. fang-siao* n. var. *etchuanus.*

(ii) Ocellar ring violet to bluish, nearer to umbrella edge than to eye; no brick-colored patch between eyes, nor any above mantle; penis conspicuous, V-shaped... *P. ovulum.*

(c) Body and arms distinctly striped, the latter with many ringular patches ..... *P. fasciatus.*

(B) Surface quite smooth and very soft to the touch, color uniformly buff to maroon; animal of more or less choroidal consistency, and abyssal habit.

(a) No cirri above eyes; arms more or less unequal, ink-bag absent.

(1) Arms rather unequal, 4- to 5-times as long as body; the latter without horizontal peripheral ridge..... *P. januarii.*

(2) Arms rather equal, 3- to 4-times as long as body, the latter provided with distinct horizontal peripheral ridge..... *P. hokkaidensis.*

(b) A few cirri above each eye; arms rather unequal, 3-times as long as body; ink-bag present... ..... *P. ochotensis.*

(C) Surface smooth, consistency firm.

(a) Color uniformly reddish brown, not marbled; suckers near umbrella margin, markedly enlarged; arms shorter than 4 and a half times the body-length.

(1) Adult about 15 cm. long; arms about 4-times as long as body, hectocotylized arm with 57 pairs of suckers, its terminal organ slender..... *P. tsugarensis.*

(2) Adult longer than 50 cm.; arms about 4 and a half times as long as body; hectocotylus slender ..... *P. abruptus.*

(b) Color brownish pink, marbled with deeper shade; arms 5-times as long as body; suckers subequal ..... *P. fujitai* n. sp.

(D) Surface more or less warty, varying from quite soft to firm to the touch; penis mostly fusiform or cylindrical.

(a) Consistency somewhat choroidal, surface pimpled; two cirri present above each eye; arms

rather unequal ..... *P. madokai.*

(b) Consistency rather firm; penis always fusiform or cylindrical; arms nearly equal.

(α) Funnel organ W-shaped; hectocotylus more or less attenuated.

(1) Gigantic octopus, growing over 2 m. in length; head markedly narrower than body; hectocotylus about 1/5 as long as the arm in which it is developed; spermatophore about 1 m. long ..... *P. döfleini.*

(2) Adult about 1 m. long; head slightly narrower than body, with an attenuated cirrus above each eye; hetocotylized arm with about 20 pairs of suckers, its terminal organ 1/20 the entire length ..... *P. tenuicirrus.* n. sp.

(3) Adult 30 cm. long; head a little narrower than body, with short cirri above eyes; hectocotylized arm as long as, or even longer than, the corresponding arm of the opposite side, with 49–60 pairs of suckers, its terminal organ being about 1/10 the entire length..... *P. longispadiceus.*

(4) Adult about 30 cm. long; head slightly narrower than body, without cirri above eyes; hectocotylized arm decidedly shorter than the corresponding arm of the opposite side, with 49–52 pairs of suckers ..... *P. yendoi.*

(5) Octopus of small size; head slightly narrower than body, with a low warted cirrus above each eye; freely projecting part of vagina shorter than renal papilla... *P. spinosus.*

(β) Funnel organ double V-shaped; hectocotylus robust, nicely conical; adult about 1 m. long ..... *P. conispadiceus.*

(II) Surface smooth or wrinkled, often more or less warty; arms very long, markedly unequal; hectocotylus spoon-shaped, or short and stout.

(A) Contractile web well developed on arms; funnel organ W-shaped.

(1) Adult over 70 cm. long; surface rather rough, arms 5-times as long as body; penis elongated ..... *P. hattai* n. sp.

(2) Adult about 45 cm. long; surface smooth; arms 6-times as long as body; penis 6-shaped... ..... *P. alatus.*

(B) Contractile webs of arms rather rudimentary; funnel organ double V-shaped.

(1) Adult 70 cm. long; V-shaped pads of funnel organ usually set close to each other; hectocotylized arm 1/2—1/3 as long as the corresponding arm of the opposite side, with 20–30 pairs of suckers, the terminal organ being nicely spoon-shaped and 1/4—1/8 the entire length; penis retort-shaped ..... *P. variabilis* n. sp.

(2) Adult about 35 cm. long, V-shaped pads of funnel organ set apart from each other; hectocotylized arm apparently 4/5 as long as the corresponding arm of the opposite side, with 55 pairs of suckers, the terminal organ being very short; penis elongated..... ..... *P. variabilis* n. sp. *pardalis* n. var.

(3) Adult about 20 cm. long; funnel organ as in *P. variabilis* var. *pardalis*, hectocotylization as in *P. variabilis;* penis roughly triangular in outline..... *P. variabilis* n. sp. *minor.*

(C) Contractile webs of arms rudimentary; funnel organ W-shaped.

(1) Adult about 24 cm. long; surface sparsely pustulated; hectocotylized arm about 2/3 as long as the corresponding arm of the opposite side, with about 38 pairs of suckers, its terminal organ about 1/15 as long as the entire length; penis elongated..... *P. globosus.*

(2) Adult about 17 cm. long; surface finely wrinkled; funnel organ W-shaped, but its median lobe greatly elongated, extending to distal funnel extremity ..... *P. tenuipulvinus.*

(III) Surface conspicuously granulose, but no cirri above eyes, arms of moderate length, or even very short, subequal; hectocotylus as far as known, conspicuous.

(1) Warts rossette-shaped or stelliform; arms slender, attenuated at their extremities, with broad contractile webs ..... *P. validus.*

(2) Warts coarse, rounded; arms robust, very short, without contractile webs ..... *P. salebrosus.*

Polypus vulgaris (Lamarck, 1799).

Japanese name: Madako; Tako.

(Pl. IV, fig 1; Pl. IX, figs. 1–3; Pl. XXIX, fig. 1; textfigs. 11, 12.)

Octopus vulgaris, Lam. 1799, p. 18 (fide Jatta).—Fér. et d'Orb. 1835, p. 26, Poulpes pls. ii, iii, iiibis; pl. viii, figs. 2, 3; pls. xi–xv; pl. xxix, fig. 6.—Gray 1849, p. 6.—Verany 1851, p. 16, pl. viii.—d'Orb. 1855, p. 168.—Hoyle 1886b, p. 7.—Appellöf 1886, p. 7, pl. xiii.—Ortmann 1888, p. 642.—Carus 1890, p. 459.—Racovitza 1894, p. 23, 5 textfigs.—Jatta 1896, p. 212, pl. iv, fig. 1; pl. vii, fig. 9; pl. viii, fig. 6; pl. xxii, figs. 2–10; pl. xxiii, figs. 1–4.—Goodrich 1896, p 19.—Marchand 1906, p. 757.—Degner 1925, p. 98.—Grimpe 1925, p. 13, fig. 5.—Robson 1925a, p. 100, figs. 1–3.

Octopus sinensis, d'Orb. in Fér. et d'Orb. 1835, p. 68, Poulpes pl. 9 (pars).

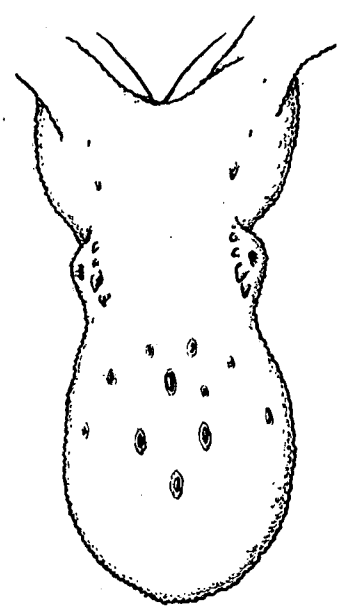
Octopus octopodia, Tryon 1879, p. 113, pl. xxiii, figs. 3, 4; pl. xxiv, figs. 5, 6, 7.—Ikeda 1890, p. 480.

Octopus cephea, Smith Edg. A. 1900, p. 407, pl. xviii.

Polypus vulgaris, Hoyle 1907, p. 35.—Pfeffer 1908a, p. 20, figs. 11–13.—Massy 1909, p. 6.—Wülker 1910, p. 5.—Berry 1912b, p. 386.

Fifty five specimens at my disposal, which have been collected in Japan at various localities as listed later, are properly referable to the present species, and they make a row of 63 cm. in length.

Surface character greatly variable, probably due to different methods of preservation, but in good specimens invariably warty. The warts conical or rounded, of unequal size, much more conspicuous on the dorsal surface of head and body than on the remaining parts. The warts when slacken are flattened off into indistinct yellowish spots lying at the centres of meshes of a chromatic network. Even in the latter case, several distinct, prominent special tubercles are found regularly distributed on the dorsal surface of the body and head as well as on the arm-bases. Four of such tubercles on the mid-dorsal part of the body are especially prominent and situated so as to mark the four points of a rhombus (textfig. 11). Around the eyes are found several cirri, of which about four are above each eye and larger than the others. Of these four cirri the one existing above and slightly behind the pupil is still longer than the remaining three, roughly conical and warty.



Textfig. 11.

Polypus vulgaris. Dorsal view of body; × ⅓.

Body ovate in contour, slightly longer than broad, rounded behind; broadest about half-way along the length or slightly more posteriorly. Periphery not keeled but furnished on each side, with several streak-like tubercles in a longitudinal series. Belly flattened but often furrowed along the median line. Mantle-opening of moderate breadth, extending fully half round the body.

Head of moderate size, narrower than body, flattened above; neck more or less constricted. Eyes somewhat prominent. Funnel conical, extending a little less than half way to umbrella edge; its proximal part marked off rom head by grooves. Funnel organ conspicuous being broader than long and about half as long as the distance from anus to distal funnel extremity, situated much nearer to the latter than to the former; W-shaped, consisting of broad fillet, of which the all divisions are of equal length. Umbrella rather narrow, usually extending for only ⅕—⅙ the length of arms, and its shortest radius existing between dorsal arms, as well as between ventral arms.

Arms subequal, dorsal and ventral pairs a little longer than the others, measuring about thrice

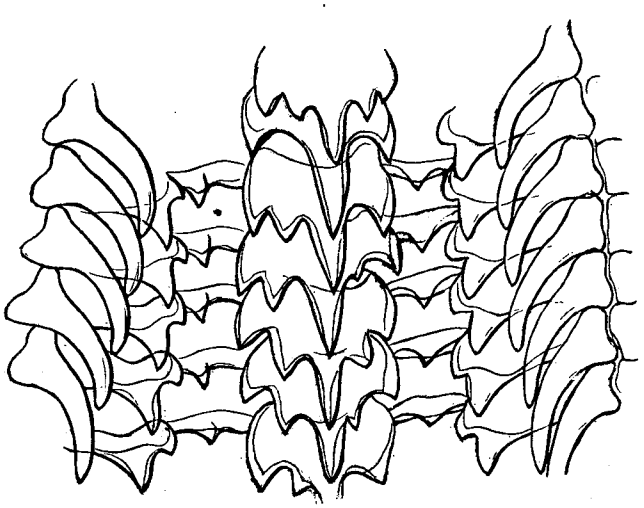
the length of head and body taken together; squarish in section, furnished with a narrow continuation of the umbrella along the ventral side. Suckers expanded at the distal end, sometimes slightly shrivelled at margin, closely set in a double well-defined series except at the base of arms where they are in a single zigzag series. Suckers of lateral arms, on the whole, a little larger than those of the remaining arms, and 2–4 pairs opposite to umbrella-edge often conspicuously enlarged.

Right third arm weakly hectocotylized, slightly shorter than the corresponding arm of the opposite side. Terminal organ very small even in adult, measuring less than $^1/_{50}$ the entire length of the arm; conical, more or less acutely pointed; oral surface flattened, without forming any distinct copulatory groove but furnished with 6–10 faint transverse streaks. Suckers on the normal part number 67–78 pairs (Pl. IX, flg. 1).

Color of dorsal surface of preserved specimens, deep dull-buff; shading off to pale violet-brown or pale straw on the ventral surface.

Branchial leaflets number 17–20 in each gill.

Penis in adult, slender, its posterior end bent inward, forming a more or less marked diverticle. Needham's sac when full of spermatophores, much swollen, bent into an L-shape, with blunt extremities, its duct connected with the diverticle. Spermiduct very thin, finely tortuous. Accessory spermatophoric gland forming a coil separate from that of spermatophoric gland (Pl. IX, fig. 2).



Textfig. 12.

Polypus vulgaris. Radula of a specimen from Etchu Prov.; ×33.

Spermatophores minute, measuring only about 25 mm. in length, their aboral end about 0.8 mm. thick, then narrowing very gradually and continually to the middle, thence they are continued on in uniform diameter to the oval end. Pellucid part 15 mm. long, internally provided with a discharging tube forming about 15–23 uniform coils. Coils of sperm cord 65–75 in number, extending quite to the aboral end of etui (Pl. IX, fig. 3).

Vagina slender, gently curved, terminating a short distance posterior to the level of anus. Oviducal ball composed of about 17 radial sets of internal organs.

Radula as shown in textfigure 12.

Measurements of Largest Male and Female Examined.

No. of specimen	i		ii	
Sex	♂		♀	
Length, total	500 mm.		630 mm.	
Ventral length of mantle	80 ,,		95 ,,	
Eye to posterior end of body	110 ,,		123 ,,	
Maximum breadth of body	60 ,,		95 ,,	
Breadth of head	37 ,,		55 ,,	
Eye to umbrella edge between lateral arms	100 ,,		130 ,,	
Length of first arms	Left 300 mm.	Right 300 mm.	Left 430 mm.	Right 430 mm.
,, ,, second arms	360 ,,	360 ,,	490 ,,	480 ,,
,, ,, third arms	360 ,,	315 ,,	490 ,,	—
,, ,, fourth arms	350 ,,	350 ,,	380 ,,	380 ,,

No. of specimen	i	ii
Sex	♂	♀
Length of hectocotylized part	5 mm.	—
Radius of umbrella between first arms	58 ,,	50 mm.
,, ,, ,, ,, first and second arms ...	77 ,,	80 ,,
,, ,, ,, ,, second and third arms ...	70 ,,	80 ,,
,, ,, ,, ,, third and fourth arms ...	70 ,,	75 ,,
,, ,, ,, ,, fourth arms...	55 ,,	—
Diameter of largest sucker of first arm	9 ,,	12 ,,
,, ,, ,, ,, ,, second arms	12 ,,	15 ,,
,, ,, ,, ,, ,, third arms	13 ,,	15 ,,
,, ,, ,, ,, ,, fourth arms	8 ,,	12 ,,

Remarks.—The species is the commonest octopus in Middle and South Japan. In seas of sandy bottom fishermen capture it for the market from summer to autumn by simply sinking earthen jars over night, and then drawning them up in the morning when some of them are found to be filled with these interesting creatures.

Octopus sinensis d'Orbigny which I synonymize with the present species, has long been taken as a doubtful species by most naturalists. Judging from d'Orbigny's description it is quite obvious that the species is based on an octopus mentioned under the name of "Tako" (章魚) in the "Wakansansaizue" a well known Japanese classical encyclopedic book, but his illustrated plate annexed (Poulpes Pl. IX) has been reproduced from a quite different source i.e. from the "Uodzukushi," a popular picture-book,*) although he cites the titles of these books nowhere. The original description of the octopus given in the "Wakansansaizue" is referable to *Polypus vulgaris* so that *O. sinensis* naturally may be taken thus as I offer. Moreover, a note in regard to d'Orbigny's plate alluded to, which has often been suspected is advisable to be given here. d'Orbigny reproduces the drawings of two quite different octopi confounded from their original in the "Uodzukushi" as illustrations of his species. The lower figure in the said plate is rightly taken from a picture of an octopus named "Tako" in that book. But the upper figure in the same plate is wrongly reproduced from a quite different octopus painted as "Iidako" (飯鮹), which should be referred to *Polypus fangsiao* d'Orbigny as mentioned later.

Smith describes a monstrous specimen of an octopus with branching arms obtained from Japan (1900, 1. c.). So far as his graphic description goes the specimen seems to belong to *P. vulgaris*, although he identifies it with *P. cephea* (Gray). Such a monstrosity as his specimen shows is rather rare in cephalopods, yet I have met with such twice, both occurring in *P. vulgaris*, and once being so remarkable in furcation of the arms as written by Smith. This specimen, which is still preserved in an excellent state in the Science College, Tôkyo, was denoted by Admiral Imai who collected it off Kannonzaki, Sagami Sea, Aug. 1885. A note of the specimen was already made by Mr. Ikeda (1902, 1. c. p. 481). Here is inserted its photographic illustration, to which the reader is kindly referred (Pl. IV, fig. 1).

Locality.—Sakai Harbour, Echizen Prov. (Ikeda); Tôkyo market (Ikeda); Tôkyo Bay (Ortmann); off Kannonzaki, Sagami Sea (Ikeda); Misaki (Ikeda; Wülker; Berry); Kominato, Awa Prov. (Ikeda); Enoura, Suruga Prov. (Ikeda); Wakanoura (Berry); Tomonotsu, Bingo Prov. (Ikeda); Tsuruga, Tango Prov. (Berry); Nagasaki (Appellöf); Fusan, Korea (Berry); Mutsu Prov. (!); Etchu Prov. (!); Rikuzen Prov. (!); Echizen Prov. (!); Miyazu, Tango Prov. (!); Osaka market (!); Kôbe (!); Akashi (!); Awajishima (!); Tokushima (!); Okayama (!); Hiroshima (!); near Nagasaki (!); Ôsumi

*) The "Uodzukushi" (うをづくし) was published by Ryusui Kakuma, 1762, who was a calligraphist at that time and also was good at painting as well as at composing poems. All pictures given in that book were painted by himself from life.

Prov. (!); Kagoshima (!); Sakurajima (!); Taihoku, Formosa (!); Dublin Bay (Massy); Cape Verde Is. (Hoyle); Yarmouth (Gray); Nice (Verany); Genes (Verany); Napoli (Verany; Jatta); Port Blair (Goodrich); Andamans (Goodrich); Great Cocos Is. (Goodrich); Bombay (Goodrich); Malacca Strait (Goodrich); Maskat, Arabia (Goodrich); Taormina Bay (Degner); North Sea (Grimpe).

Polypus parvus Sasaki, 1917.

Japanese name: Mamedako.

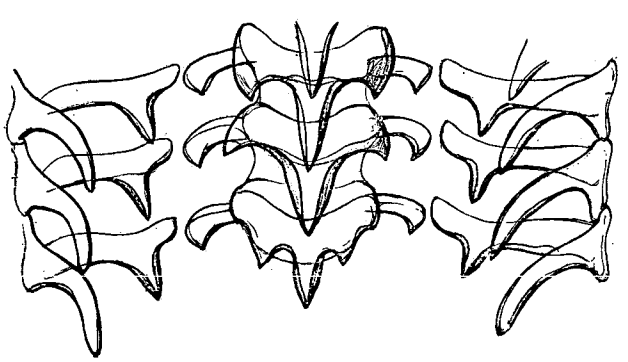
(Pl. III, figs. 15–17; Pl. IX, figs. 4–10; textfigs. 13, 14.)

Polypus parvus, Sasaki 1917, p. 365; 1920, p. 171.

Animal very small, the whole length measuring less than 150 mm. even in adult; rather firm to the touch; skin loose, often finely wrinkled especially at nape. Dorsal surface of the head and body evenly covered with uniform warts with ill defined bases. No special tubercles perceptible either above body or above head; also none on the periphery of body. But a few above each eye marked, though not cirrus-like. Body more or less elongated, expanded backward, arched above, flat below where is often found a narrow, but rather deep, longitudinal groove in the middle; posterior end rounded but sometimes more or less acuminate (Pl. III, fig. 5). Mantle-opening of moderate width, extending fully half round the body.

Head rather small, decidedly narrower than body, concave above, marked off from body by a neck-like constriction. Eyes somewhat prominent. Umbrella narrow, on an average extending for about one-fifth the length of arms, of uniform breadth, but a little narrower between dorsal arms as well as between ventral arms. Funnel organ a little broader than long, about one-third as long as the distance from anus to distal funnel-extremity, situated distally beyond the centre of the dorsal funnel-wall; W-shaped, the fillet being very narrow, its angles of bending all rounded and the outer divisions half as long as the inner.

Arms subequal, the formula of length variable, but oridinarily second pair the longest, and first pair the shortest. All squarish in section in the proximal parts, tapering gradually and uniformly towards extremities. Length of arms on an average a little shorter than twice the length of head and body taken together. Suckers expanded distally, with non-shriveled margins; thickly arranged in two clearly defined series except at the base and extremity of arms. At the base the first three suckers form a single series, and the succeeding four or five are in two alternate series. The suckers on the extremity also in two alternate series (Pl. III, fig. 16).



Textfig. 13.

Polypus parvus. Radula; × 80.

Right third arm in male feebly hectocotylized, nearly equal in length to the corresponding arm of the opposite side. Terminal organ very small, comprising only $^1/_{20}$ the entire length of the arm; conoid with quite blunt extremity, its oral surface quite smooth save for a shallow, broad canalis copulatorius (Pl. IX, fig. 4). Relatively ample spermatophoric groove terminates in a minute, conical calamus. Suckers on the normal part number 37—43 pairs.

Penis very short, roughly retort-like shaped, provided with a well-marked diverticle posteriorly. Needham's sac when filled with spermatophores, thickly swollen and bent into the shape of an L, its duct opening into penis

at the neck of its diverticle. Accessory spermatophoric gland circinate, the coil separated from that of spermatophoric gland. Spermiduct short, and thick (Pl. IX, figs, 6; 9a, b). Spermatophores minute, only about 12 mm. long; of which 5 mm. are composed of the opaque part; sperm cord coils itself about 65 times; internal discharging sheath forming a special ovoidal expansion near the oral end (Pl. IX, fig. 10).

Vagina short, thick, nearly straight, or a bit crooked, terminating far posteriorly to anus (Pl. IX, figs. 5, 8).

Caecum of stomach globular, but a little involute. Ink-bag small, spindleshaped; its greater part embedded in liver. Inkduct runs straight to anus, without a slack, its whole course being traceable on the surface of liver (Pl. IX, fig. 7).

Gill exhibits a convenient, diagnostic character by its being compact, massive and composed of only nine or ten, thick leaflets.

Radula as shown in textfigure 13, specially characterized by the flattened, broad-based, unicuspid, outer-lateral teeth, their cuspus being triangular and sharp.

Measurements of some Specimens Examined.

No. of specimen	i	ii	iii	iv	v
Sex	♀	♀	♀	♂	♂
Length, total	145mm.	100mm.	100mm.	115mm.	115mm.
Ventral length of mantle	25 ,,	17 ,,	13 ,,	17 ,,	19 ,,
Eye to posterior body-end	36 ,,	22 ,,	20 ,,	25 ,,	28 ,,
Maximum breadth of body	22 ,,	18 ,,	15 ,,	16 ,,	18 ,,
Breadth of head	18.5 ,,	14 ,,	12 ,,	20 ,,	14 ,,
Length of first arms	Left Right —mm. 90mm.	L. R. 77mm. —mm.	L. R. 65mm. 55mm.	L. R. 14mm. 75mm.	L. R. 74mm. 74mm.
,, ,, second arms	105 ,, 100 ,,	— —	72 ,, 65 ,,	— 83 ,,	— 80 ,,
,, ,, third arms	— —	90 ,, 85 ,,	65 ,, 65 ,,	77 ,, 75 ,,	66 ,, 76 ,,
,, ,, fourth arms	95 ,, 100 ,,	83 ,, 83 ,,	55 ,, 53 ,,	85 ,, 83 ,,	— 80 ,,
Radius of umbrella between first arms	15 mm.	11 mm.	10 mm.	13 mm.	11 mm.
,, ,, ,, ,, first and second arms	17 ,,	11 ,,	11 ,,	14 ,,	13 ,,
,, ,, ,, ,, second and third arms	18 ,,	12 ,,	12 ,,	15 ,,	13 ,,
,, ,, ,, ,, third and fourth arms	17 ,,	12 ,,	12 ,,	15 ,,	13 ,,
,, ,, ,, ,, fourth arms	16 ,,	10 ,,	10 ,,	14 ,,	12 ,,
Diameter of largest sucker of first arms	5 ,,	3 ,,	3 ,,	4 ,,	4 ,,
,, ,, ,, ,, ,, second arms	5.8 ,,	3.5 ,,	3.5 ,,	4.7 ,,	4.5 ,,
,, ,, ,, ,, ,, third arms	5.7 ,,	3.5 ,,	3.5 ,,	4.1 ,,	4.6 ,,
,, ,, ,, ,, ,, fourth arms	5.2 ,,	3 ,,	3 ,,	4 ,,	4.2 ,,

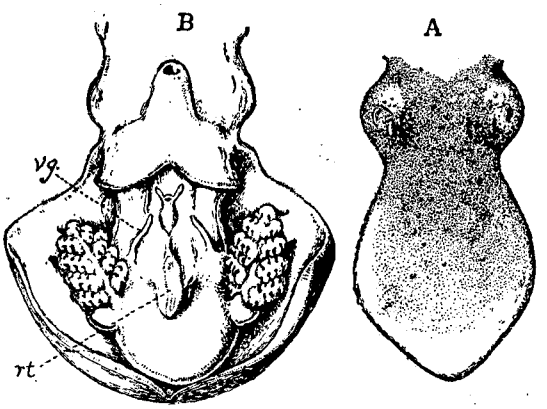
Remarks.—This species approaches *P. vulgaris* in the general shape of the head, body, arms and suckers, as well as in the hectocotylus, but diverges from it principally in the gills, spermatophores, and surface ornamentations. Moreover, the present species becomes by no means so large as in that species.

A female 45 mm. long, which was captured together with its own nest at Misaki, differs from all the others examined, in having more distinct cirrus above each eye, 13 leaflets in each gill, and slender vaginae extending to within a few mm. of the anus (textfig. 14). The nest is built of a broken molluscan shell, beset with barnacles, bryozoans, and other various marine creatures. The eggs in it are ovoidal in shape, and measure 1.8 mm. in length and 0.9 mm. in maximum breadth. They form separate clusters composed of 50 or more eggs each (Pl. III, fig. 17).

Locality.—Satsuma Prov. (Sasaki); Akune, Satsuma Prov. (Albatross!); Tôkyo market (!); Misaki, Sagami Prov. (!); Shimizuminato (Albatross!).

Type locality.—Satsuma Prov.

Type.—In Hokkaido Imp. Univ.



Textfig. 14.

Polypus parvus. A. Dorsal view of head and body; ×ca. 4. B. Mantle, laid open to show pallial organs; ×4.

Polypus granulatus (Lamarck, 1799).

Japanese name: Sunadako.

(Pl. III, fig. 18.; Pl. IX, figs. 11–13; Pl. XXIX, figs. 2, 3.)

Octopus granulatus, Lam. 1799, p. 20.—Hoyle 1886b, p. 80.—Goodrich 1896, p. 19.

Polypus granulatus, Hoyle 1904a, p. 195.—Hoyle 1907, p. 36.—Wülker 1910, p. 5.—Berry 1912b, p. 388.—Massy 1925, p. 223.

Sepia rugosa, Bosc. 1792, p. 24, pl. v, figs. 1, 2 (fide d'Orb.).

Octopus rugosus, Fér. et d'Orb. 1838, p. 45, Poulpes, pl. vi; pl. xxiii, fig. 2.—Gray 1849, p. 8.—Tryon 1879, p. 116; pl. xxv, fig. 9.—Brock 1887, p. 605.—Ortmann 1891, p. 669.—Joubin 1897b, p. 99 (pars).

Octopus granulatus var. *rugosus*, Joubin 1898b, p. 22.

Octopus Kagoshimaensis, Ortmann 1888, p, 644, pl. xxi, fig. 2.

Five specimens from Boshu, eight from Tôkyo market, six from Kagoshima, one from Suruga Prov. all are without hesitation referred to the present species. They range 88 mm.—295 mm. in length, the sexually mature ones measuring over 220 mm. The following description is based upon these Japanese specimens.

External surface in good specimens invariably quite warty as much as in a shagreen. Warts thickly set, each composed of several minute papillae; uniform in size, but much finer on belly than on back, and one or two above each eye conspicuous, developed into cirri. No special tubercles perceptible above either head or body. Generally also none perceptible on the periphery of body.

Body ovate or elliptical in contour, decidedly longer than wide, broadest near the middle, rounded behind, no marked longitudinal groove present on belly. Mantle-opening broad, extending more than half round the body.

Head narrower than body, marked off by constrictions both anteriorly and posteriorly, its dorsal surface flattened or even a little concave. Eyes a little prominent. Umbrella of moderate breadth, extending about one-fifth up the arms except between dorsal pair where its radius is only one-third that in other interbrachial spaces. Umbrella margin continued distad along the ventral aspect of arms as a narrow ridge. Funnel organ conspicuous, of a nicely but thickly deliniated W-shape, situated in the middle of dorsal funnel-wall, its length about half that of the wall (Pl. IX, fig 11).

Arms nearly equal, but lateral pairs slightly longer than remaining pairs, and about thrice as long

as the body length, or even a little longer. Suckers closely set, biserial except first three or four, which are uniserial. Suckers uniform but slightly varying with the arms on which they are set, and on each arm those of the base are small, the sexth to eighth are the largest, then they greadually diminish in size towards the extremity.

Right third arm hectocotylized, a quarter shorter than the corresponding arm of the opposite side. Terminal organ slenderly conical, comprising about $^1/_{20}$ the entire length of the arm, provided with a faint copulatory groove and a minute, but distinct, conical calamus. Spermatophoric groove well-defined, fairly broad. Suckers on the normal part number 40–44 pairs.

Branchial leaflets number 16–18 in each gill.

Penis conspicuous, very long but bent into the shape of an U, of which the right ramus is shorter than the left and forms a large, elongated, clearly marked, roughly 6-shaped diverticle at the anterior end (Pl. IX, fig. 11). Proximal part of the diverticle connected with Needham's sac by a distinct duct. Needham's sac very long, its distal part bent into L-shape while the remaining part curves round so as to from a large complete circle. Terminal part of accessory spermatophoric gland folded and resting tightly upon itself, forming an S-shaped curve, which is separated from the coil of spermatophoric gland (Pl. IX, fig. 12). Spermatophores 160 mm. long, their aboral end 1.5 mm. thick; coils of sperm cord umber 50–55.

Measurements of Largest Male Examined.

Length, total	295 mm.	
Ventral length of mantle	65 „	
Eye to posterior body-end	86 „	
Maximum breadth of body	38 „	
	Left	Right
Length of first arms	185 mm.	180 mm.
„ „ second arms	194 „	200 „
„ „ third arms	210 „	150 „
„ „ fourth arms	190 „	195 „
„ „ hectocotylized extremity	9 mm.	
Radius of umbrella between first arms	12 „	
„ „ „ „ first and second arms	40 „	
„ „ „ „ second and third arms	40 „	
„ „ „ „ third and fourth arms	45 „	
„ „ „ „ fourth arms	45 „	
Diameter of largest sucker of first arms	6 „	
„ „ „ „ „ second arms	7 „	
„ „ „ „ „ third arms	7 „	
„ „ „ „ „ fourth arms	6 „	

Remarks.—A male example from Kagoshima, which is referred with great hesitation to this species, differs from all the others alluded to in the beginning of this description. It measures only 160 mm. in length, yet is already sexually maturate, the spermatophores is only 110 mm. long, the penis bent round into δ-shape, and all organs of the vas deferens differs in structure from those of the other specimens (Pl III, fig. 18; Pl IX, fig. 13).

Joubin is of opinion that *P. boscii* (Les.) and also *P. boscii* var. *pollida* Hoyle are synonymous with the species now in question. But as far as I have ascertained the present species does not seem at any rate to grow so large as that species, and I am greatly inclined to consider them as different species.

Locality.—Rikuzen (Wülker); Misaki (Wülker); Nagasaki (Joubin); Kagoshima (Ortmann); Bôshû (!); Tôkyo market (!); Suruga Prov. (!); Taihoku, Formosa (!); Valparaiso, Chile? (Gray); Bahama (Joubin); Port Blair (Goodrich); Andamans (Goodrich); Great Cocos I. (Goodrich); Bombay (Goodrich); Malacca Strait (Goodrich); Maskat (Goodrich); West Ceylon (Hoyle); South end of Cheval Paar (Hoyle); Manaar Gulf (Hoyle); Palk Bay (Hoyle); Indian Ocean (Massy), Natal (Massy); Bird I. (Massy); Suakin Harbour (Hoyle); Vineyard Sound, Mass. (Tryon); Amboina (Brok); Batavia (Brock); Cape Verde Is. (Hoyle).

Polypus oliveri Berry, 1914.

Japanese name: Anadako (Ogasawarajima).

(Pl. IV., fig. 2; Pl. IX., figs. 14–18; textfigs. 15, 16.)

Polypus oliveri, Berry 1914, p. 136.—Oliver 1915, pp. 560, 564 (fide Berry).—Berry 1916, p. 49, pl. vi, fig. 2.

One male and three female specimens from Ogasawarajima in hand are referred to this species, but their identity with it is by no means so satisfactory as might be wished. They are all sexually mature, ranging in length from 29 cm. to 36 cm.

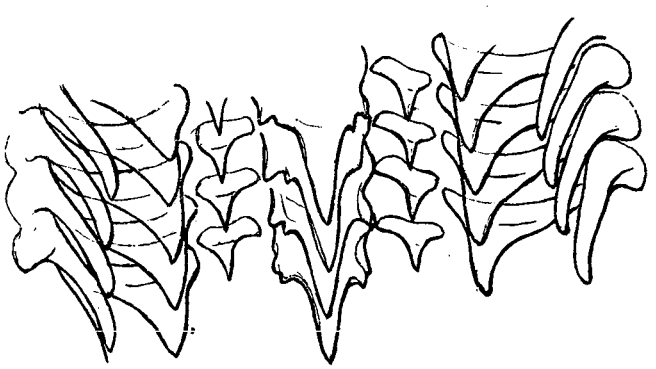
Surface of preserved specimens very firm to the touch, quite rough and warty (Pl. IV, fig. 2). Warts ill defined at base, of various sizes but roughly classified into two kinds: (1) minute, exceedingly numerous and widely distributed, occurring even on the ventral surface of head and body; (2) much larger and fewer than the preceding, conical or rounded, beset with several minute papillae, found only on the dorsal surface of every part, their thickest distribution being around head. No other special tubercles nor cirri found above head, and also none above body, but each eye-opening surrounded by a circlet of five or six low and indistinct tubercles.

Body small, compact, globular, broadest in the middle or even a little more posteriorly, arched above, flat below; sometimes a faint longitudinal groove found in the middle of belly. Mantle opening moderately wide, extending fully half round the body.

Head small, far narrower than body, marked off from it by a distinct neck constriction; dorsal surface flat or even a little concave. Eyes somewhat protrude sideways and a little upwards. Funnel conical, small, more slender than in any of octopi found in Japan. Funnel organ small, W-shaped, the fillet narrow, its outer divisions considerably shorter than the inner; posteriorly situated, the anterior end marking the midway between anus and distal funnel extremity (Pl. IX, fig. 14). Umbrella narrow, uniformly developed all around, but broadest by little between lateral arms, where it extends to the fifth pair of suckers. Margin of umbrella continued distad as a low ridge along either side of arms.

Arms very stout, equal, but lateral pairs a little longer than the others, on an average six times as long as body, or even longer. All proximally squarish in section but roundish distally. Roots of arms taken together markedly thicker than body.

Suckers prominent, expanded distally, numbering about 200 on each arm, closely set in two well-defined series except first two or three which are in two alternate series. Suckers small at the base of arms, rapidly increasing in size to eighth pair which is situated a short distance beyond the umbrella edge; thence they gradually diminish in size towards the extremity. Suckers of lateral arms, subject to an individual variation, and two or three often markedly enlarged.



Textfig. 15.

Polypus oliveri. Radula; ×60.

Right third arm hectocotylized, a little shorter than the left third. Terminal organ very small, comprizing only $^1/_{40}$ the entire length of the arm, conical, bluntly pointed; its oral surface flattened save for a faint copulatory groove.

Color dark slate above, shading off to buff underneath.

Radula as shown in textfigure 15.

Caecum of stomach turbinated, consisting of two and a half whorls. Anal valves filiform and minute. Inkbag small, its greater part imbedded in liver (Pl. IX, fig. 15).

Gill short, compact, composed of 15 or 16, very thick leaflets.

Fully formed ovary much broader than long. Vagina slender, extending to the level of anus, sharply curving into the shape of an S in the vicinity of oviducal ball which is hidden among visceral organs (Pl. IX, figs. 14–16). Ripe ovarial eggs 2 mm. in longest diameter.

Penis slender, sharply bent into the shape of a V, the inner lobe being about half as long as the outer, no diverticle developed (Pl. IX, figs. 17, 18). Needham's sac when fully formed, much swollen, bent into L-shape, its duct connected with the corner of the bend of penis. Accessory gland circinate, forming a separate coil from that of spermatophoric gland. Spermiduct rather short in course.

Spermatophores 40–42 mm. in length; spermatic part 17 mm. in length, composed of 55–58 coils of sperm cord (see textfig. 16).

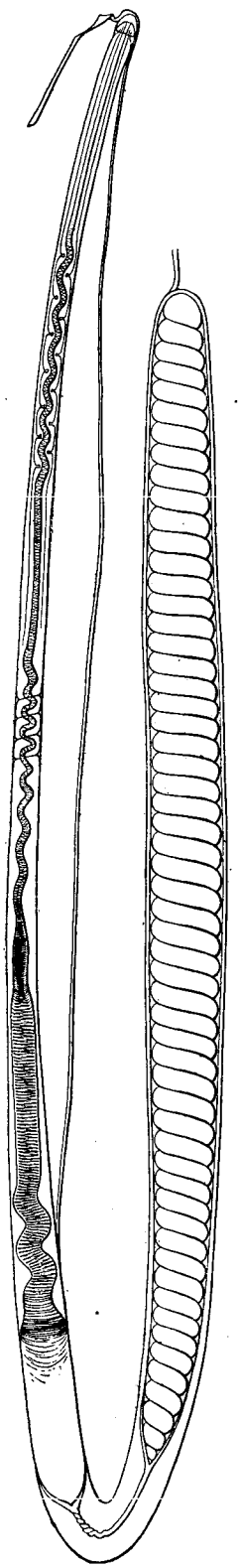
Measurements of the Specimens Examined.

No. of specimen	i	ii	iii	iv
Sex	♀	♀	♀	♂
Length, total	360mm.	350mm.	330mm.	290mm.
Ventral length of mantle	40 ,,	40 ,,	40 ,,	31 ,,
Maximum breadth of body	40 ,,	48 ,,	40 ,,	31 ,,
Eye to posterior body-end	60 ,,	60 ,,	52 ,,	62 ,,
Breadth of head	25 ,,	35 ,,	26 ,,	26 ,,
Length of first arms	Left 250mm. Right 250mm.	Left — Right —	Left 230mm. Right —	Left 205mm. Right 220mm.
,, ,, second arms	290 ,, —	280mm. 290mm.	260 ,, 240mm.	230 ,, 210 ,,
,, ,, third arms	285 ,, —	280 ,, 275 ,,	214 ,, 240 ,,	230 ,, 190 ,,
,, ,, fourth arms	255 ,, —	250 ,, 240 ,,	210 ,, 210 ,,	205 ,, 205 ,,
Radius of umbrella between first arms	23mm.	45mm.	20mm.	23mm.
,, ,, ,, ,, first and second arms	33mm. 23mm.	45mm. 45mm.	23mm. 23mm.	23mm. 25mm.
,, ,, ,, ,, second and third arms	40 ,, 30 ,,	45 ,, 45 ,,	25 ,, 25 ,,	23 ,, 23 ,,
,, ,, ,, ,, third and fourth arms	33 ,, 30 ,,	40 ,, 42 ,,	22 ,, 22 ,,	23 ,, 23 ,,
,, ,, ,, ,, fourth arms	23mm.	40mm.	20mm.	23mm.
Diameter of largest sucker of first arms	7.5 ,,	8 ,,	6.5 ,,	7 ,,
,, ,, ,, ,, ,, second arms	8.5 ,,	10 ,,	9 ,,	9 ,,
,, ,, ,, ,, ,, third arms	10 ,,	12 ,,	8.5 ,,	7 ,,
,, ,, ,, ,, ,, fourth arms	8 ,,	9 ,,	7 ,,	7 ,,

Remarks.—This species is said to be common in Ogasawarajima, and of littoral habit, living the whole year in crevices or holes in the reefs. The natives are fond of it and also use it as superior bait.

The specimens referred to deviate from Berry's description of the species in having longer arms, and in that the largest suckers are situated more distally.

Locality.—Kermadec Is. (Berry); Ogasawarajima (?).



Textfig. 16.
Polypus oliveri.
Spermatophore; × 10.

Polypus oshimai sp. nov.

Formosan dialect: Chucoo (石舊).

(Pl. XXVIII, figs. 1—5; Pl. XXX, fig. 12.)

Small octopus, rather fleshy and firm in consistency. Surface smooth except on the back where very fine warts are found in places. The warts are, however, very frequently flattened off, merely revealing themselves as paler dots. No tubercular streak nor horizontal ridge on the periphery of body. Body ovoidal, ¾—⅔ as broad as long, quite rounded posteriorly. Mantle-opening wide, extending a little more than half round the body. Eyes small, not prominent, with no cirrus around.

Funnel slender, extending within a short distance of the ventral umbrella margin. Funnel organ W-shaped, the outer arms are much shorter than the middle part; a little longer than one-third the distance from anus to anterior funnel extremity, situated at equal distance from both of these points.

Arms subequal, the formula of length being usually $1=2>3>4$; the longest pair five or six times the body length. All slender, uniformly and gradually tapering towards extremities, rounded-quadrangular in section, devoid of any conspicuous contractile webs at least on the distal half. Umbrella of moderate breadth, extending ¼—⅕ up the arms and then continuing on for some distance as a narrow fold.

Suckers small, cylindrical or a little expanded distally, with a thick, non-shrivelled margin; biserial but forming a zigzag row on the distal one-third of the arms and also at their base. They become larger to the fourth or fifth pair, from which to the eleventh or twelfth pair are represented by the largest suckers; thence they become very gradually and evenly smaller distad. Their number in the largest specimen examined counted about 200 on the first arm as well on the second, about 190 on the third, and about 180 on the fourth.

Right third arm hectocotylized, as long as or a little shorter than two-thirds the length of left third arm. Terminal organ conoid, tapering very gradually at first but rapidly afterwards; its breadth about one-third the length which is in turn about one-tenth the entire length of the arm; oral surface flattened and with a comparatively shallow but well-defined longitudinal furrow. Spermatophoric groove of moderate breadth, terminating in a conical calamus. Suckers on the normal part count 35–37 pairs.

Penis when fully formed, a little flattened dorso-ventrally, nearly retort-shaped, enlarged and rounded in the posterior half, and tapered in the remaining parts, connecting with Needham's sac just before the enlarged part. Needham's sac curves into the shape of an *S*. Coiling of spermatophoric gland independent from that of its accessory gland. Spermiduct of moderate thickness, short, forming only several bendings. Spermatophore about 55 mm. in length.

Vaginae curve a little, terminating far behind the anus. Ovarial eggs longer than 6 mm.

Branchial filaments of a gill, 16–19 (usually 17) in number. Liver about one-third as broad as long, rounded anteriorly, bifurcate posteriorly.

Ink-bag elongate-ovate, its duct separate from liver. Caecum of stomach relatively large, resembling the concha of a snail, coiling one turn and a half.

Dorsal surface of preserved specimens, purplish grey in colour more or less marbled with deeper shades of the same tint, ventral surface uniformly light farn or buff.

Measurements of Specimens Examined.

Sex	♀	♀	♂	♂	♂	♂
Length, total	320mm.	290mm.	245mm.	241mm.	210mm.	203mm.
Eye to posterior end of body	60 ,,	50 ,,	44 ,,	48 ,,	45 ,,	43 ,,
Ventral length of body	45 ,,	38 ,,	30 ,,	30 ,,	30 ,,	35 ,,
Breadth of body	35 ,,	30 ,,	25 ,,	25 ,,	20 ,,	23 ,,
Breadth of head	23 ,,	20 ,,	18 ,,	16 ,,	15 ,,	17 ,,
Breadth of neck	18 ,,	16 ,,	16 ,,	15 ,,	14 ,,	16 ,,
Eye to dorsal umbrella margin	57 ,,	46 ,,	45 ,,	35 ,,	44 ,,	37 ,,
Length of first arms	Left Right mm. mm. 230 254	L. R. mm. mm. 220 215	L. R. mm. mm. 198 185	L. R. mm. mm. 188 188	L. R. mm. mm. 162 140	L. R. mm. mm. 145 —
,, ,, second arms	mm. mm. 205 250	mm. mm. 175 236	mm. mm. 190 185	mm. mm. 190 185	mm. mm. 142 147	mm. mm. 155 155
,, ,, third arms	mm. mm. 205 240	mm. mm. 182 206	mm. mm. 167 100	mm. mm. 176 102	mm. mm. 145 84	mm. mm. 145 95
,, ,, fourth arms	mm. mm. 210 220	mm. mm. 175 170	mm. mm. 167 167	mm. mm. 158 158	— —	mm. mm. 145 145
Diameter of umbrella between first arms	60mm.	40mm.	39mm.	30mm.	26mm.	30mm.
Diameter of umbrella between first and second arms	50 ,,	38 ,,	36 ,,	30 ,,	26 ,,	28 ,,
Diameter of umbrella between second and third arms	47 ,,	34 ,,	35 ,,	35 ,,	23 ,,	28 ,,
Diameter of umbrella between third and fourth arms	47 ,,	30 ,,	35 ,,	35 ,,	23 ,,	28 ,,
Diameter of umbrella between fourth arms	47 ,,	26 ,,	35 ,,	28 ,,	23 ,,	28 ,,
Lenth of penis	—	—	9 ,,	17 ,,	8 ,,	8 ,,
Length of hectocotylized parts	—	—	9 ,,	10 ,,	4 ,,	5 ,,

Remarks.—The species shows many similarities with *P. glogosus* (Appellöf), from which it differs, however, in the surface ornamentation and in the shape of the penis. Moreover, *P. globosus* is of less slender built and has a relatively larger head and more unequal arms than *P. oshimai.*

The above tabulated specimens were obtained by Dr. M. Oshima in a fish market of Tainan, Formosa, in whose honour the specific name of the species is adopted.

Type locality.—Formosa.

Type.—In Hokkaido Imp. Univ.

Polypus luteus sp. nov.

Formosan dialect: Towpow (泥婆) or Ancgion (紅鱆).

(Pl. XXVII, figs. 6—9; Pl. XXIX, figs. 4, 5; textfig. 160.)

One male and female individuals which were fully sexually mature, were obtained at the Pescadores Islands by Dr. M. Oshima on July 3, 1920.

Surface firm to the touch, often finely wrinkled and thickly covered with pimple-like warts of various sizes, of which some above the eyes are enlarged into cirri; but these are by no means so marked as found in some octopi. On the ventral surface the warts may often be flattened off; then the surface appears as if smooth by nature. Color of preserved specimens reddish brown throughout

but much lighter below than above, and on the back there are frequently developed darker ill-defined irregularly marmorate blotches.

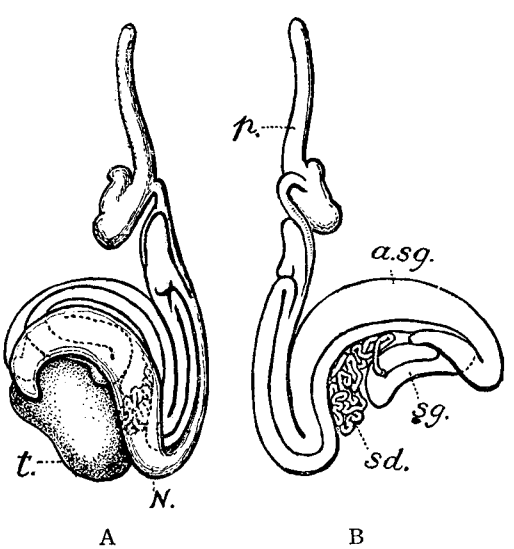
Body oval, a little longer than wide; with no horizontal ridge on the periphery. A very indistinct groove marks the sagittal line of the belly. Mantle opening of moderate breadth, extending fully half round the body.

Head narrow, only a little wider than body. Neck very weakly constricted. Eyes but little at any rate prominent.

Funnel of moderate size, rather well separate; its tubular part comprising about a half of the entire length, much shorter than to the ventral umbrella edge. Funnel organ W-shaped, its middle part longer than the outer rami; situated much nearer to funnel extremity than to anus. In the male specimen examined, the funnel organ was a little longer, and in the female, shorter, than half the length of the funnel measured distally from the anus.

Umbrella of moderate breadth, the formula of its radii being II III=I II>III IV>I I>IV IV, where the longest extends 1/6—1/5 up the arm to the eighth or ninth pair of suckers. Along the ventral side of the arms it continues beyond the radius to the extremity as a narrow contractile web.

Arms unequal, the formula of length being 1>2>3>4, and the longest is 5 or 6 times, and the shortest, 3 or 4 times, the length of body. They taper evenly to the fine extremities; their extreme bases taken together measure the breadth of the body. They have each about 100 pairs of suckers, of which about 25 pairs are on the proximal one-third. The suckers are biserial but the proximal 3 and the distal 25 form a zigzag row. They are markedly unequal in size, and vary with the arm on which they are situated. Larger suckers on the first arm are the eleventh and twelfth pairs; on the second, from the eleventh to the thirteenth; on the third, from the ninth to thirteenth; and on the fourth arm, from the eighth to the thirteenth.



Textfig. 160.

Polypus luteus n. sp. Vas deferens with compartments in their respective situ; nat. size. A. Ventral view (the testis is shown in situ); B. dorsal view (the testis is taken away).

Right third arm hectocotylized, about two-thirds as long as the left third. Terminal organ conical, very short, only about 1/27 of the entire length of the arm; copulatory groove rather shallow, but very well marked laterally by folds; at its base there is found a distinct conical calamus with a distinct groove which is continued proximally into a well-defined spermatophoric canal about 3 mm. wide. The suckers on the normal part count 44 pairs.

Penis elongate but its posterior end is recurved and a little swollen, forming a small diverticle which is connected at its exit with Needham's sac by means of a short duct. Blind end of the accessory spermatophoric gland merely turns back and is folded upon itself, not coiled as in some octopi. Spermiduct rather thick and of short course as shown in Textfig. 160. In the male specimen examined three full-formed spermatophores were found in Needham's sac. They were about 75 mm. long, tapering gradually and evenly towards the oral end, their diameter being 1.5 mm. at the aboral part and about 0.8 mm. at the oral; sperm cord coiling 25–30 turns.

The female specimen examined had a roundish ovary containing countless minute slender ripen ova 0.8–1.0 mm. by 0.25 mm. The oviducts proper were very short and unequal in length, that of the right side measuring 10 mm. while that of the left was only 4 mm. in length; their thickness were

equally about 2 mm. The vaginae were very slender, being about 65 mm. in length and about 1.5 mm. in diameter, and extended very little beyond the anterior end of the gills.

Liver forms posteriorly two conspicuous lobes, between which there is situated a muscular stomach with a relatively large turbinate caecum. Ink bag large, its duct thick and very long. Branchial leaflets number 24 in each gill.

Measurements of Specimens Examined.

Sex	♂	♀
Length, total	600 mm.	685 mm.
Eye to posterior end of body	110 ,,	125 ,,
Ventral length of body	83 ,,	105 ,,
Breadth of body	62 ,,	58 ,,
Breadth of head	38 ,,	40 ,,
Length of first arms	Left — mm. Right 450 mm.	Left 500 mm. Right 420 mm.
,, ,, second arms	360 ,, 420 ,,	420 ,, 405 ,,
,, ,, third arms	350 ,, 215 ,,	330 ,, 335 ,,
,, ,, fourth arms	— ,, 290 ,,	330 ,, 320 ,,
Badius of umbrella between first arms	60 mm.	65 mm.
,, ,, ,, ,, first and second arms	75 mm. 80 mm.	70 mm. 70 mm.
,, ,, ,, ,, second and third arms	75 ,, 75 ,,	70 ,, 70 ,,
,, ,, ,, ,, third and fourth arms	65 ,, 55 ,,	60 ,, 70 ,,
,, ,, ,, ,, fourth arms	50 mm.	50 mm.
Length of hectocotylus	8 ,,	—

Remarks.—The species relates superficially with *P. macropus* Risso but differs from it in having, 1) a relatively larger head, 2) shorter arms, 3) smaller number of suckers in each arm, 4) a wider umbrella, and 5) broader contractile webs of the arms. Moreover, these species seem to disagree with each other in the surface patterns: in both specimens examined there was made out no lighter blotch as found in *P. macropus*.

Type locality.—Pescadores Is.

Type.—In Hokkaido Imp. Univ.

Polypus marmoratus (Hoyle, 1885).

(Pl. I, fig. 10; Pl. V., fig. 4; Pl. IX., figs. 19–24; textfig. 17.)

Octopus marmoratus, Hoyle 1885a. p. 227.—Hoyle 1885c, p. 102.—Hoyle 1886b, p. 85, pl. vi. —Brock 1887, pp. 610, 611.—Ortmann 1891, p. 671.—Joubin 1894a, p. 35.

Polypus marmoratus, Hoyle 1905a, p. 978.—Berry 1909, p. 418.—Wülker 1913, p. 457.—Berry 1914a, p. 291; pl. xlv; pl. xlviii, fig 6; textfig. 13.

I have referred to this species one immature female from Formosa, and four males and so many females from the Bonin islands, which are all sexually mature and range from 80 cm. to 117 cm. in length.

Texture fleshy, rather firm. Surface rarely smooth, frequently finely warty, more often quite uneven and irregularly wrinkled; but in every case, there are found some large, low, longitudinally streak-like tubercles regularly scattered on the frontal region of head and also on the back of body (Pl. V, fig 4). Besides, circum-orbital protuberances invariably developed, of which the three above

each eye are especially marked; the middle of these three is the largest, existing a little posterior to the pupil (Pl. IX, fig. 19).

Body as long as, or slightly longer than, broad; rounded behind, somewhat flattened below, where is found a shallow median groove. Mantle-opening moderately wide, extending across entire neck-breadth.

Head small, decidedly narrower than body, marked off by a distinct neck constriction. Eyes somewhat prominent. Eunnel small, conical. Funnel organ conspicuous, decidedly longer than broad; W-shaped, all divisions of the fillet being of equal length, about half as long as the distance from anus to anterior funnel extremity, and situated at equal distance from either of these points.

Arms subequal, 8–10 times as long as body, thick at base, their combined root being a little broader than body; evenly tapering to thin attenuated extremities. Umbrella comparatively well developed, broadest between lateral arms, narrowest between dorsal arms; extending to 8th–10th pair of suckers, then continued on within a stort distance of the extremity as a contractile membrane, which is much broader on the ventral side than on the dorsal side, of arms. Owing to the contraction of this membrane, arms are apt to be heavily recurved and coiled in preserved specimens.

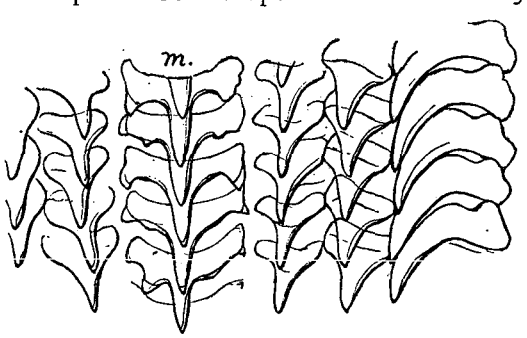
Suckers number about 150 pairs on each arm; biserial, except basal four or five which are uniserial; mostly closely set. Suckers on the whole, large, though a few at base small; ninth or tenth, which are opposite to the umbrella edge, the largest, then becoming gradually smaller towards the extremity; the lorgest suckers in male often show a special enlargement.

Right third arm in male feebly hectocotylized, about seven-tenths as long as the left third. Terminal organ conical, bluntly pointed, comprising only about $^1/_{100}$ the length of the arm, provided with a rather rudimentary calamus at base; oral surface flattened, except for a faint copulatory groove which is smooth or may be provided with several indistinct transverse streaks. Suckers on the normal part of the arm number 111–118 pairs (Pl. IX, fig. 20).

Renal gland separated into 8–10 massive lobes on each side. Branchial leaflets number 21–23 in each gill. Anal valves relatively broad, nearly orbicular (Pl. IX, fig. 21). Caecum of stomach turbinated, composed of two or three whorls. Ink-bag large. Ink-duct well characterized by its greatly expanding and being bent round in its course in a circle, which extends forwards beneath the brain (Pl. IX, fig. 22).

Fully grown penis about 25 mm. long, slender quite gradually narrowing forwards, stretched straight except its posterior end which is bent, and forms a small, clearly marked diverticle. Needham's sac bent in the middle into L- or V-shape, becoming very thick at maturity, its duct connected with penis at the vicinity of the exit of the diverticle. Accessory spermatophoric gland circinate, its coil separated from that of spermatophoric gland (Pl. IX, fig. 23).

Spermatophores about 45 mm. long, their opaque part about 16 mm. long, and about equally thick except the aboral end which is slightly swollen. Pellucid part hairly, far thinner than the former part. Coils of sperm-cord number 115–120.



Textfig. 17.

Polypus marmoratus. Radula; ×53.

Ovary reniform, with its long axis transversely lying to the right side in viscera. Right oviduct *s.s.* much shorter than the left. Vaginae slender, a little crooked, extending to the vicinity of anus (Pl. IX, fig. 24).

Ground color in formalin, dull drab or stone gray, but sometimes may be much yellowish. Dorsal and lateral surfaces in all parts marbled with deeply chromatic anastomosing veins which in contracted specimens are crowded together almost into a uniform dark slate shade. A large roundish or ovate oculation present a little way in front of, and below each eye, with a very dark centre surrounded by a broad ring of lighter tint. Aboral surface of arms decorated with 3–7 series of roughly elliptical yellowish spots, each bearing a low tubercle at

the centre; on each lateral surface there is with a series of brown blotches just outside the suckers and in rough alternation with the latter (Pl. I, fig. 10).

Radula as shown in textfig. 17.

Measurements of Female and Male Specimens from Ogasawarajima.

Sex	♀		♂	
Length, total	1170 mm.		860 mm.	
Ventral length of mantle	120 ,,		77 ,,	
Breadth of body	90 ,,		70 ,,	
Breadth of head	70 ,,		50 ,,	
Eye to posterior end of body	155 ,,		100 ,,	
Length of first arms	Left 870 mm.	Right 900 mm.	Left 650 mm.	Right 640 mm.
,, ,, second arms	960 ,,	970 ,,	670 ,,	700 ,,
,, ,, third arms	960 ,,	970 ,,	670 ,,	450 ,,
,, ,, fourth arms	900 ,,	860 ,,	720 ,,	720 ,,
Radius of umbrella between first arms	120 mm.		40 mm.	
,, ,, ,, ,, first and second arms	130 mm.	140 mm.	70 mm.	70 mm.
,, ,, ,, ,, second and third arms	135 ,,	150 ,,	90 ,,	90 ,,
,, ,, ,, ,, third and fourth arms	135 ,,	150 ,,	70 ,,	70 ,,
,, ,, ,, ,, fourth arms	140 mm.		70 mm.	

The Ogasawarajima specimens alluded to disagree with Berry's description of the Hawaiian specimens in the funnel organ, and also in the arms. Moreover, in that description no statement is given as to the yellowish spots on the aboral surface of arms. They are not mentioned also in any of other reports as far as I am aware.

Remarks.—In Ogasawarajima this species is said to be abundant and an important cuttlefish for the natives as food and also as bait, especially in the mackerel fishery.

Locality.—Central Pacific (Hoyle; Berry); Hawaiian Is. (Hoyle; Berry); Rotuma (Hoyle); Rimitara (Wülker); Salomon Is. (Wülker); Amboina (Joubin); Stewart Is. (Wülker); Indian Oc. (Ortmann); Ceylon (Ortmann); Ogasawarajima (!); Taihoku, Formosa (!).

Polypus fang-siao*) (d'Orbigny 1838) var. **typicus** mihi.

Japanese name: Ii-dako.

(Pl. X., figs. 1–3; textfigs. 18, 19.)

"Iidako" (望潮魚 or 飯鮹), Terajima 1713, pt. 51.—Katsuma 1762, p. 12, fig. 1.

Octopus fang-siao, d'Orb., in d'Orb. et Fér. 1835–48, p. 71 (from Terajima).—Gray 1849, p. 18. —Tryon 1879, p. 126.

Octopus arcolatus, ? de Haan MS. in Fér. et d'Orb. 1838, p. 65.—? Gray 1849, p. 18—? Ortmann 1888, p. 65. —Joubin 1894a, p. 28—? Joubin 1898b, p. 22.

Octopus sinensis (pars), d'Orb. in Fèr et d'Orb. 1838, Pouple pl. ix, upper fig. (from Katsuma). —Gray 1849, p. 19.

Octopus ocellatus, Gray 1849, p. 15.—Joubin 1898b, p. 22.

*) The specific name "fang-siao" seems to have been given by d'Orbigny from the Chinese vocabulary of "飯鮹", pronounced "Iidako" by Japanese till the present time.

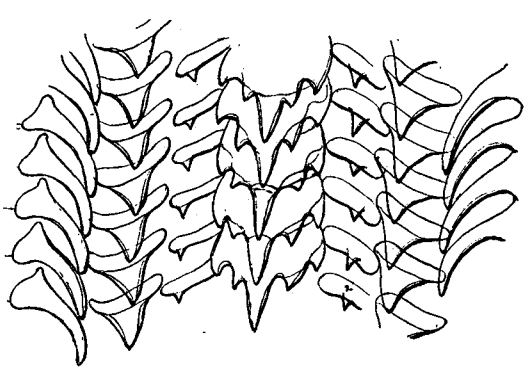
Octopus membranaceus, Tryon 1879, p. 128, pl. xxxviii, fig. 57 (pars).
Octopus brocki, Ortmann 1888, p. 645, pl. xxi, fig. 4; pl. xxii, fig. 1 (pars).
Polypus areolatus, Wülker 1910, p. 6 (pars).—Berry 1912b, p. 393 (pars).
Polypus fangsiao, Sasaki 1920, p. 172.

I refer to this species countless specimens from various localities of Japan as listed later. They range up to 220 mm. long, sexually mature individuals measuring over 180 mm. in length.

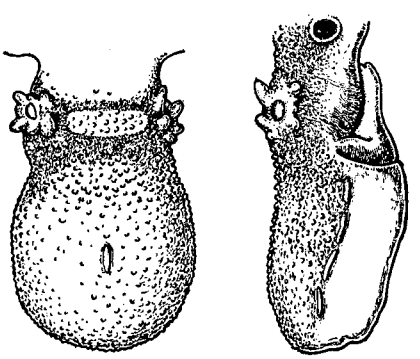
Surface character variable, due to the different method of preservation. Dorsal surface of all parts in contracted specimens, quite shagreen-like, thickly and uniformly beset with minute conical or rounded warts with obscurely marked bases. The warts in extended specimens, flattened off into brownish spots so as to render the whole external surface smooth and polished. In every case, however, five or sixth circum-orbital cirri are invariably made out, of which the two above the eye are oridnarily of equal size but decidedly larger than the others (Pl. X. fig. 1).

Body longitudinal-ovate in contour, broadest in the middle or even a little more anteriorly; posterior end rounded but sometimes may be more or less acuminated; back gently arched; belly usually flattened, but often a shallow, broad longitudinal groove is formed in the middle. Periphery not keeled but very often four or five streak-like tubercles perceptible in a longitudinal series on either side. Mantle opening of moderate breadth, extending fully half round the body.

Head small, its breadth ordinarily less than two-thirds that of body, marked off from it by a distinct constriction; dorsal surface more or less concave. Eyes somewhat prominent, projecting upwards and outwarts. Umbrella of moderate breadth, extending about a quarter up the arms except between dorsal arms, where its radius is about $\frac{2}{3}$—$\frac{1}{2}$ that in any of the remaining interbrachial spaces. The margin of umbrella on the ventral aspect of arms is continued on to the vicinity of their extremity as a narrow contractile web. Funnel organ large, excellently W-shaped, situated in the middle of dorsal funnel wall, its length about half that of the latter, and all the divisions of the fillet, of equal length.



Textfig. 18.
Polypus fangsiao var. *typicus*. Radula; ×40.



Textfig. 19.
Polypus fangsiao var. *typicus*. Dorsal and lateral views of immature individual; ×ca. 4.

Arms of moderate size, uniform, but first pair the shortest by little; proximally squarish in section, gradually and evenly tapering towards the extremities. Suckers prominently elevated, expanded at the distal margin which is not shrivelled; biserial except first four or five which are uniserial. They are on the whole larger on lateral arms than on the others, and one or two opposite to umbrella edge often considerably enlarged.

Right third arm weakly hectocotylized, slightly shorter than the left third. Terminal organ shorter than $\frac{1}{18}$ the entire length of the arm; slenderly conoidal, its oral surface quite shallowly furrowed lengthwise. Spermatophoric groove relatively broad, terminating in a rudimentary calamus. Suckers on the normal part number 60–70 pairs.

Radula as shown in textfigure 18.

Gill composed of 14–17 leaflets.

Penis comparatively large, shaped like a retort, of which the swollen part is represented by the well-defined globular diverticle at the posterior. Neck-like part of the diverticle connected with Needham's sac by a conjunctive duct.

General shape of fully formed vas deferens in situ, compact, massive, roughly globular, its posterior and lateral parts composed of greatly extended Needham's sac curved almost into the shape of an S. Accesory spermatophoric gland circinate, its coil separated from that of spermatophoric gland. Spermiduct very thin, and long, but finely and stroughly tortuous.

Spermatophores 33–36 mm. long, their opaque part 14–16 mm. consisting of 57–60 coils of sperm cord which extends to the aboral end of the etui, attached to it by means of a massive and rounded substance. Etui a little narrowed at the junction of opaque part to pellucid part. The latter part a little greater than half the former in diameter, and provided with 20–30, regular, uniform coils of internal discharging tube (Pl. X, fig. 2).

Ovary longitudinal-ovoidal (Pl. X. fig. 3). Vagina sharply bent into the shape of an S near oviducal ball, extending to a part a little posterior to the level of anus. Oviducal ball always hidden among visceral organs, composed of 22–27 radial sets of internal organs. Oviducal gland equal in size to receptacular gland which exposes its posterior half in the oviducal ball superficially. Seminal receptacle connected with receptacular gland. Mucous epithelium of oviducal gland folded while that of the receptacular gland is nearly smooth. Ripe ovarial eggs very large, measuring about 10 mm. in length.

Color of the dorsal surface of alcoholic specimens, dark dull buff, shading off to light ochre on the ventral surface. On the dorsal surface in every part, darker chromatophores group themselves into a network, each mesh of which surrounds one of the warts found there. Between the roots of the second and third arms on either side is found a distinct ocellar shining ring of yellowish or greenish hue about a quarter nearer to the eye than to the umbrella edge. The ring in full-grown individuals measures about 7 mm. across, bordered by a blackish zone outside, and internally encloses a darker centre. Above the head, there is found a large transverse-elliptical or dumbbell-shaped, brick-colored patch between the eyes; on the back of the body, there is a large, fusiform or cardiform one of similar tint present much nearer to the posterior end than to the head. Moreover, in well-preserved specimens the back of the body is decorated with 12 to 15 regularly scattered small spots of the same color as in the preceding patches; also decorated is the back with four or six, blackish, longitudinal stripes continued on to the head, and arranged so as to divide the whole surface of the back into five subequal areas.

Remarks.—Some specific characters mentioned, viz. the shining oculations in front of the eyes, the dumbbell-shaped patch between them, the circum-orbital cirri, and the streak-like tubercles along the periphery of the body, are well exhibited even in such quite young specimens that are merely 6 or 7 mm. long (textfig. 19). The hectocotylus, however, becomes visible for the first time when the octopus has grown about 35 mm. in length.

The present species was made known to science by d'Orbigny, based upon a statement of an octopus given under the name of "Iidako" (飯鮹) in the "Wakansansaizue" alluded to before. After that, nobody seems to have especially noticed it. but Gray and Tryon have listed it in their own works, and Appellöf have referred it to *P. ocellatus* Gray. The original statement in the "Wakansansaizue" is written in the Chinese language which d'Orbigny translates into the French language in his work verbatim. Although his translation is not without mistake and the description is by no means so complete as might be wished, yet it is possible to discriminate the species from its illies.

Polypus areolatus is reproduced as a new species by d'Orbigny from a manuscript of de Haan's (l. c.), but in such a very incomplete description that it is utterly impossible to discriminate this species from any of *Polypus* known at present. Hoyle have discerned the species by means of a specimen caught by the "Challenger," referring it to specimens in the Copenhagen Museum, which are men-

Measurements of some Specimens Examined.

No. of specimen	i	ii	iii	iv	v	vi	vii	viii	ix
Sex	♂	♂	♂	♂	♂	♂	♀	♀	♀
Length, total	200 mm.	175 mm.	145 mm.	140 mm.	125 mm.	96 mm.	210 mm.	186 mm.	140 mm.
Ventral length of mantle	42 ,,	36 ,,	31 ,,	29 ,,	23.5 ,,	21 ,,	36 ,,	41 ,,	27 ,,
Eye to posterior end of body	52 ,,	45 ,,	39 ,,	34 ,,	30 ,,	26 ,,	42 ,,	50 ,,	37 ,,
Breadth of body	32 ,,	26 ,,	25 ,,	24 ,,	20 ,,	16 ,,	27 ,,	32 ,,	24 ,,
Breadth of head	20 ,,	18 ,,	14 ,,	14 ,,	12 ,,	12 ,,	17 ,,	20 ,,	15 ,,
Length of first arms	L. mm. 118 R. mm. 118	L. mm. 95 R. mm. 107	L. mm. 75 R. mm. 72	L. mm. 53 R. mm. 53	L. mm. 65 R. mm. 65	L. mm. 52 R. mm. 52	L. mm. — R. mm. 148	L. mm. 98 R. mm. 98	L. mm. 70 R. mm. 75
,, ,, second arms	mm. 132 mm. 128	mm. 105 mm. —	mm. 82 mm. 82	mm. 80 mm. 87	mm. 78 mm. —	mm. 60 mm. 60	mm. 142 mm. 140	mm. 110 mm. 105	mm. 80 mm. —
,, ,, third arms	mm. 137 mm. 110	mm. 110 mm. —	mm. 87 mm. 86	mm. 85 mm. 82	mm. 78 mm. 75	mm. 60 mm. 60	mm. — mm. 150	mm. 116 mm. 116	mm. 85 mm. 84
,, ,, fourth arms	mm. 132 mm. 138	mm. 110 mm. —	mm. 86 mm. 86	mm. 60 mm. 80	mm. 78 mm. 78	mm. 58 mm. 60	mm. 150 mm. 150	mm. 116 mm. 116	mm. 88 mm. 84
Diameter of largest sucker of first arms	4.8 mm.	3.5 mm.	3 mm.	3 mm.	2.8 mm.	2.1 mm.	3 mm.	4 mm.	2.5 mm.
,, ,, ,, ,, ,, second arms	7.2 ,,	5.6 ,,	3.5 ,,	5.5 ,,	4.5 ,,	3 ,,	5.2 ,,	5 ,,	3.5 ,,
,, ,, ,, ,, ,, third arms	7.2 ,,	6.2 ,,	3.5 ,,	5.8 ,,	4.5 ,,	2.8 ,,	5.2 ,,	5 ,,	4 ,,
,, ,, ,, ,, ,, fourth arms	5.5 ,,	3.5 ,,	2.8 ,,	3.5 ,,	3 ,,	2.1 ,,	3.5 ,,	4.5 ,,	2.7 ,,
Radius of umbrella between first arms	15 ,,	20 ,,	13 ,,	14 ,,	14 ,,	7 ,,	20 ,,	20 ,,	15 ,,
,, ,, ,, ,, first and second arms	28 ,,	27 ,,	26 ,,	21 ,,	17 ,,	14 ,,	23 ,,	29 ,,	19 ,,
,, ,, ,, ,, second and third arms.	30 ,,	27 ,,	18 ,,	23 ,,	19 ,,	14 ,,	24 ,,	30 ,,	19 ,,
,, ,, ,, ,, third and fourth arms	30 ,,	30 ,,	18 ,,	23 ,,	19 ,,	11 ,,	30 ,,	32 ,,	21 ,,
,, ,, ,, ,, fourth arms	30 ,,	30 ,,	18 ,,	23 ,,	19 ,,	7 ,,	30 ,,	32 ,,	21 ,,
Length of hectocotylized extremity	5 ,,	—	5 ,,	5	5	1	—	—	—

tioned as having been identified by Steenstrup with those labelled *Octopus areolatus* de Haan in the same museum,—the latter is presumed by Hoyle to be the type specimens in which deHaan's manuscript has originated. It is, however, quite doubtful to me, if the "Challenger" specimen is really conspecific with those of the Copenhagen Museum. As far as his description goes, the "Challenger" specimen is referable to *Polypus ovulum* Sasaki, while those of the Copenhagen Museum probablly belong to *P. fangsiao* d'Orb.

As mentioned before, d'Orbigny's plate of *Polypus sinensis* alluded to, gives two figures of octopi reproduced from the "Uotsukushi" and the upper figure of the two must be referred to the species now standing in question. It is very interesting to note that its original coloured sketch of the said figure given in that Japanese book shows two principal characteristics of the species, i.e. the ocellar spot in front of, and a little below, each eye, and the dumbbell-shaped brickcolored patch*) on the head between eyes.

In catching this octopus fishermen fix molluscan shell to a rope and throw them into the sea down to the bottom. Then the octopi crowl in the shells, and the fishermen have simply to pick them up by drawing the sunken rope. The Molluscan shell used in this fishery is ordinarily that of *Turbo cornutus* Gmelin, but in Uzen Prov. the shell of *Haliotis gigantea* Chemn. also is used.

Locality.—Sapporo market (!); Muroran (!); Ôshima Prov. Hokkaido (!); Hakodate (!); Aomori Bay (!); off Niigata (Albatross!); near Kinkazan (!); Tôkyo market (!); Ômori, Tôkyo (!); Sagami Prov. (!); Wakasa Prov. (!); Aichi Prefecture (!); Tomo, Bingo Prov. (!); Beppu, Bungo Prov. (!); Nagasaki (!); Fukuoka (!). ? Aomori, Mutzu Prov. (Berry); ? Tsuruga, Echizen Prov. (Berry); ? Sagami Prov. (Wülker); Tôkyo Bay (Ortmann); ? Tôkyo Bay (Wülker); ? Tôkyo (Berry); ? Wakanoura, Kii Prov. (Berry); Kagoshima (Ortmann); ? Coast of Japan (de Haan); China (Gray); Amboina (Joubin).

Polypus fangsiao d'Orb. var. **etchuanus** nov. var.

(Pl. III, figs. 19, 20; Pl. X, figs. 4–10.)

? *Octopus brocki*, Ortmann 1888, p. 645, pl. xxi, fig. 4; pl. xii, fig. 1 (pars).

This variety is separated with a great deal of hesitation from the typical variety. The following characters are the chief points of its distinction.

External surface quite shagreen-like, beset with coarse, prominent, rounded warts with clearly marked bases. Body as broad as long, attaining over 5 cm. in length. Circum-orbital cirri rather uniform. Umbrella narrower between ventral arms and also between dorsal arms than in the remaining interbrachial spaces. One or two suckers opposite to umbrella edge on each arm characteristically larger than the remaining ones. Hectocotylus on right third arm, comparatively large, comprising 1/10–1/12 the entire length of the arm; copulatory groove well developed. Suckers on the normal part of the arm number 89–90. Oculation between the bases of lateral arms situated at the point one-third the distance from eye to umbrella edge. Brick-colored patch on head between eyes not dumbbell-shaped nor elliptical but crescentiform, with a straight edge anteriorly and a concave edge posteriorly. Another on the back of body elongate, Y- or V-shaped. Other smaller ones and black longitudinal stripes on the back both invariably indistinct. Ovary much broader than long (Pl. X, figs. 6, 7). Ripe ovarial eggs about 13 mm. long. Penis retort-shaped, mature one 18 mm. long (Pl. X, figs. 4, 8, 9). Spermatophores 36–44 mm. long; sperm cord extending to the aboral end of etui, terminating there in a deeply pigmented body, its coils numbering 84–125. Etui quite regularly and uniformly narrowing towards the oral end.

Full-grown individuals about 30 cm. long, viz. about one-third longer than those of the typical variety.

For the funnel organ, internal genital organs, digestive system, and all other respects of the visceral organs, the reader is referred to Pl. X., figs. 4–10.

*) Appellöf (1886, l. c.) mistakenly defines the dumbbell-shaped patch on the head shown in the upper figure of d'Orbigny's Poulpe plate as a strong cirri on an eye.

Measurements of Some of the Specimens Examined.

No. of specimen	i	ii	iii	iv	v	vi	vii	viii
Sex	♂	♂	♂	♂	♂	♀	♀	♀
Length, total	300 mm.	275 mm.	275 mm.	255 mm.	290 mm.	255 mm.	215 mm.	220 mm.
Ventral length of mantle	53 ,,	56 ,,	50 ,,	48 ,,	32 ,,	44 ,,	38 ,,	36 ,,
Eye to posterior end of body	60 ,,	70 ,,	65 ,,	58 ,,	43 ,,	55 ,,	50 ,,	50 ,,
Breadth of body	52 ,,	47 ,,	45 ,,	42 ,,	32 ,,	43 ,,	40 ,,	40 ,,
Breadth of head	30 ,,	26 ,,	26 ,,	26 ,,	31 ,,	25 ,,	24 ,,	24 ,,
Length of first arms	L. mm. 195 R. mm. —	L. mm. 160 R. mm. 160	L. mm. 175 R. mm. 175	L. mm. 155 R. mm. 160	L. mm. 135 R. mm. 135	L. mm. 140 R. mm. 140	L. mm. — R. mm. 130	L. mm. 135 R. mm. 125
,, ,, second arms	mm. 210 mm. 215	mm. 180 mm. 165	mm. 195 mm. 190	177 —	mm. — mm. —	mm. 170 mm. —	mm. 150 mm. 150	mm. 145 mm. 140
,, ,, third arms	mm. 210 mm. 185	mm. 185 mm. 170	mm. 205 mm. 180	175 155	mm. 145 mm. 130	mm. 175 mm. —	mm. 150 mm. 150	mm. 160 mm. —
,, ,, fourth arms	mm. 220 mm. 210	mm. 190 mm. 195	mm. 200 mm. 205	— 180	mm. 120 mm. 133	mm. 172 mm. 173	mm. — mm. 145	mm. — mm. 155
Diameter of largest sucker of first arms	10 mm.	8 mm.	9 mm.	8 mm.	6 mm.	6.1 mm.	6 mm.	6 mm.
,, ,, ,, ,, ,, second arms	18 ,,	13 ,,	12 ,,	13 ,,	8 ,,	10 ,,	8 ,,	8 ,,
,, ,, ,, ,, ,, third arms	18 ,,	14 ,,	15 ,,	13 ,,	8 ,,	10 ,,	9 ,,	10 ,,
,, ,, ,, ,, ,, fourth arms	10 ,,	9 ,,	9 ,,	8 mm.	6 ,,	8 ,,	6 ,,	6 ,,
Radius of umbrella between first arms	40 ,,	25 ,,	30 ,,	26 ,,	15 ,,	21 ,,	25 ,,	20 ,,
,, ,, ,, ,, first and second arms	45 ,,	40 ,,	42 ,,	40 ,,	25 ,,	28 ,,	30 ,,	25 ,,
,, ,, ,, ,, second and third arms	50 ,,	45 ,,	50 ,,	45 ,,	25 ,,	34 ,,	30 ,,	30 ,,
,, ,, ,, ,, third and fourth arms	50 ,,	45 ,,	50 ,,	38 ,,	23 ,,	34 ,,	30 ,,	30 ,,
,, ,, ,, ,, fourth arms	40 ,,	33 ,,	32 ,,	25 ,,	15 ,,	29 ,,	25 ,,	20 ,,
Length of hectocotylized extremity	18 ,,	15 ,,	15 ,,	13 ,,	12 ,,			

Remarks.—The above description is based on eight male and six female specimens collected by myself at Etchu Prov. One male from Nagasaki and another from Okayama are also referred to this variety but with great doubt, as these show some relationship to the typical variety. Yet still, the said Nagasaki specimen shows characteristics of the variety *etchuanus* in having conspicuous warts on the surface and a peculiarly enlarged sucker opposite to the umbrella edge on each arm (Pl. III, figs. 19, 20).

Locality.—Namerikawa, Etchu Prov. (!); Nagasaki (!); Okayama Prefecture (!).

Type locality.—Etchu Prov.

Type.—In Hokkaido Imp. Univ.

Polypus ovulum Sasaki, 1917.

(Pl. X, figs. 11–15; textfigs. 20, 21.)

Octopus areolatus, Hoyle 1886b, p. 86, pl. iii, figs. 6, 7.—Brock 1887, pp. 611, 612.—Ortmann 1888, p. 662.

Octopus ocellatus, Appellöf 1886, p. 8, pl. i, figs. 1–3.—Brock 1887, pp. 611, 612.—Ortmann 1888, p. 662.

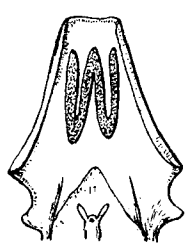
Polypus ocellatus, Hoyle 1904, p. 16.

Polypus areolatns, Hoyle 1904, p. 16.—Berry 1912b, p. 393 (pars).

Polypus ovulum, Sasaki 1917, p. 364.

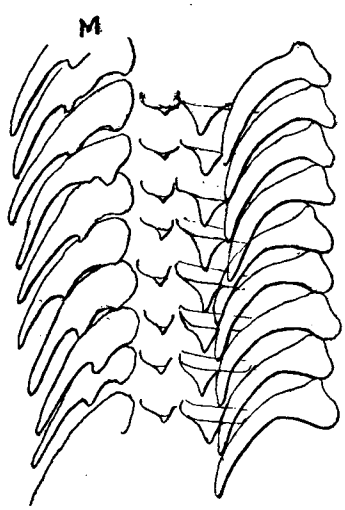
This species based on two males from Nagasaki, and five females and nine males from Tôkyo market.

Adult small, nearly 150 mm. in total length and 40 mm. in mantle length. Dorsal surface of head, body and arms, more or less shagreen-like, being thickly covered with uniform warts which are often here and there more closely set so as to form longitudinal ridges. Two supraorbital cirri clearly made out, of which the anterior is always much the smaller (Pl. X, fig. 11).



Textfig. 21.

Polypus ovulum. Funnel, laid open; a little enlarged.



Textfig. 22.

Polypus ovulum. Portion of radula; the median teeth viewed from side; ×80.

Body compact, ovoidal, decidedly longer than broad, broadest in the middle, as deep as broad, its posterior end rounded but sometimes more or less acuminate. Periphery provided with neither keel nor special tubercles. Mantle opening wide, extending nearly two-thirds round the body, its angles situated behind and slightly below the eyes.

Head comparatively wide though narrower than body, a little concave above, faintly marked off both anteriorly and posteriorly. Eyes slightly prominent. Umbrella of moderate breadth, extending ⅕—¼ up the arms except between dorsal pair where its radius is about half as long as in the remaining interbrachial spaces. Funnel organ large, deeply W-shaped, situated in the middle of dorsalf unnel wall; all divisions of the fillet equally narrow and long, and half as long as the dorsal wall or even a little longer (textfig. 20, 21).

Arms rather unequal, the formula of length variable, but more often 4>3> 2>1. All slender,

tapering to attenuated extremities, provided on the ventral side with a narrow web connected proximally with umbrella. Suckers always, prominently elevated, their margin expanded and not shrivelled; biserial except proximal five or six on each arm which are uniserial. Several suckers of lateral arms near umbrella edge on each arm, much larger than the remainder but not showing in any rate special enlargement as in *P. fangsiao.*

Right third arm weakly hectocotylized even at maturity, a little shorter than the left third; its terminal organ comprising 1/15 of the entire length, provided with a shallow copulatory groove. Spermatophoric groove of moderate breadth, terminating in a minute, low, bluntly pointed, conical calamus. Suckers on normal part number 59–70 pairs.

Radula as shown in textfigure 21, closely resembling that of *P. fangsiao*, but the median teeth are a little longer and narrower.

Gill composed of 15–17 leaflets.

General shape of vas deferens in situ, hemispherical, and cup-like, covering over antero-lateral parts of testis; Needham's sac long, encircling the vas deferens and testis meridionally; spermiduct moderately long, greatly tortuous (Pl. X, figs. 12, 13). Penis conspicuous, slender but bent round posteriorly so as to reveal the shape of a slender 6, of which the inner extremity forms a swollen, elliptical and well-marked diverticle, and which is connected with Needham's sac by a rather long conjunctive duct.

Spermatophores 49–61 mm. long. Opaque part 23–27 mm. long, containing 230–270 coils of sperm cord; the latter does not extend to the extreme aboral end of the etui. Etui of about uniform breadth throughout, but a little swollen at the aboral end, a little tapered at the oral end, and sometimes forming a slight fusiform expansion near the middle of the pellucid part, marked off by two feeble constrictions. Moreover, the plainly pellucid part is on the whole slightly narrowed, while the spring-bearing part is a little swollen, its greatest diameter of decidedly exceeding that of opaque part and representing the thickest part of the etui (Pl. X, fig. 14).

Mature ovary as long as broad (Pl. X, fig. 15). Vagina thin, bent into Z-shape near the middle of its course. Oviducal ball hidden among visceral organs, lying on the dorsal side of ovary; its radial sets of internal organs number 16; oviducal gland a little larger than receptacular gland, of which the posterior half is exposed superficially on the ball. Gland epitheliums of the two above-mentioned glands both fairly and equally folded; seminal receptacle opening into receptacular gland. Ovarial eggs very small, attaining at most 3 mm. long even when ripe.

Color of preserved specimens deep drab dorsally, shading off to much paler tint ventrad. On the dorsal surface deeply pigmented chromatophores group themselves into a network, each mesh of which encircles one of the warts found there. Often a few broad, darker, brocken stripes appear on the dorsal surface of head and body. No brick-colored patches appear above either the head or the body. A distinct, dark ocellar patch with a shining cobaltic or violet ring invariably present in front of and below each eye, the ring small compared with that of *P. fangsiao*, measuring at most 4 mm. in diameter. The patch situated more anteriorly than in the said species, lying nearer to the umbrella margin than to the eye. In young individuals, large, dark special chromatophores are found in one or two series along the aboral surface of the third and fourth arms.

Measurements.

No. of specimen	i	ii	iii	iv	v	vi	vii	viii
Sex	♂	♂	♂	♂	♂	♀	♀	♀
Length, total	135 mm.	135 mm.	120 mm.	120 mm.	80 mm.	150 mm.	115 mm.	95 mm.
Ventral length of mantle	34 ,,	30 ,,	31 ,,	25 ,,	18 ,,	40 ,,	30 ,,	25 ,,
Eye to posterior end of body	42 ,,	37 ,,	38 ,,	30 ,,	24 ,,	45 ,,	39 ,,	30 ,,
Breadth of body	21 ,,	23 ,,	28 ,,	21 ,,	14 ,,	28 ,,	20 ,,	19 ,,
Breadth of head	15 ,,	14 ,,	14 ,,	16 ,,	10 ,,	21 ,,	17 ,,	14 ,,
Length of first arms	L. R. mm. mm. 60 60	L. R. mm. mm. 62 62	L. R. mm. mm. — —	L. R. mm. mm. 60 60	L. R. mm. mm. 37 37	L. R. mm. mm. 73 73	L. R. mm. mm. 60 60	L. R. mm. mm. — 42
,, ,, second arms	mm. mm. 79 78	mm. mm. 78 80	mm. mm. — —	mm. mm. 70 65	mm. mm. 42 40	mm. mm. — —	mm. mm. 65 60	mm. mm. 48 50
,, ,, third arms	mm. mm. 78 63	mm. mm. 85 68	mm. mm. — —	mm. mm. 75 52	mm. mm. — 38	mm. mm. — —	mm. mm. 85 —	mm. mm. 55 55
,, ,, fourth arms	mm. mm. 82 80	mm. mm. 100 102	mm. mm. 70 68	mm. mm. 80 80	mm. mm. — 52	mm. mm. — —	mm. mm. — 85	mm. mm. — 60
Diameter of largest sucker of first arms	2.5 mm.	2 mm.	2.5 mm.	2.2 mm.	1 mm.	2.5 mm.	2 mm.	—
,, ,, ,, ,, ,, second arms	3 ,,	2.8 ,,	3.5 ,,	3 ,,	1.8 ,,	3 ,,	2.5 ,,	—
,, ,, ,, ,, ,, third arms	3 ,,	2.8 ,,	3.5 ,,	3 ,,	1.8 ,,	3 ,,	2.5 ,,	—
,, ,, ,, ,, ,, fourth arms	3 ,,	2.8 ,,	3.2 ,,	2.5 ,,	1.1 ,,	3 ,,	2.5 ,,	—
Radius of umbrella between first arms	6 ,,	8 ,,	6 ,,	6 ,,	4 ,,	—	—	—
,, ,, ,, ,, first and second arms	18 ,,	20 ,,	15 ,,	16 ,,	9 ,,	—	—	—
,, ,, ,, ,, second and third arms	22 ,,	22 ,,	16 ,,	18 ,,	13 ,,	—	—	—
,, ,, ,, ,, third and fourth arms	22 ,,	21 ,,	16 ,,	18 ,,	13 ,,	—	—	—
,, ,, ,, ,, fourth arms	20 ,,	16 ,,	15 ,,	15 ,,	11 ,,	—	—	—
Length of hectocotylized part	4 ,,	4 ,,	4 ,,	3 ,,	1.2 ,,	—	—	—

Remarks.—This species is very closely related to *Polypus fang-siao* var. *typicus* mihi and *P. fang-siao* var. *etchuanus* nov. From these, however, it is easily distinguished as the following table shows.

	Polypus fang-siao (d'Orb.) var. *typicus* mihi	*Polypus fang-siao* var. *etchuanus*	*Polypus ovulum* Sasaki
Total length in adult:	ca. 22 cm.;	ca. 30 cm.;	ca, 15 cm.
Shape of body:	ovoidal;	globular;	ovoidal.
Tubercles on each side of body:	4 or 5 in number, streaklike;	do.;	absent.
Circum-orbital cirri:	5 or 6, of which the dorsal 2 are the largest;	5 or 6, rather uniform;	only 2, found above eye.
Preorbital ocellar ring:	7 mm. in diameter, greenish or yellowish;	8 mm., greenish or yellowish;	4 mm.; purplish to violet.
Position of the same ring:	¼ nearer to eye than to umbrella edge;	⅓ nearer to eye than to umbrella edge;	nearer to umbrella edge than to eye.
Brick-colored interobital patch:	elliptical or dumbbell-shaped;	crescentiform;	absent.
Brick-colored dorsal patch of body:	elliptical or cordate;	Y- or V-shaped;	absent.
Dorsal radius of umbrella;	about ½ shorter than other radii;	do.;	about ⅓ shorter.
Mature ovary:	longitudinal-ovoidal;	decidedly broader than long;	spheroidal.
Ripe ovarial eggs:	ca. 10 mm. long;	ca. 13 mm. long;	ca. 2 mm. long.
Internal organs of oviducal ball:	arranged in 22–27 radial sets;	in 24–27 radial sets	in 16 radial sets.
Penis:	flask-shaped;	do.;	V-shaped, with diverticle at the anterior end of inner ramus.
Length of spermatophores:	33–36 mm.;	36–44 mm.;	49–61 mm.
Length of opaque part of spermatophore:	14–16 mm.;	12–16 mm.;	23–27 mm.
Number of coils of sperm cord:	57–60;	84–125;	230–270.

Type locality.—Tôkyo market.
Type.—In Tôkyo Imp. Univ.

Polypus fasciatus (Hoyle, 1886).

Japanese name: Hyô-dako.

(Pl. XI, Figs. 1–3)

Octopus pictus var. *faciata*, Hoyle 1886b, p. 94, pl. viii, fig. 3.—Goodrich 1896, p. 19, pl. V, fig. 82.
Polypus pictus var. *faciata*, Wülker 1910, p. 6.
Polypus pictus faciatus, Berry 1912b, p. 393.

One male from Tôkyo market and two females from Misaki in hand are referred with but little hesitation to the present species.

Animal of small size even in adult, fleshy and firm. External surface almost smooth except for some circum-orbital cirri, of which the one above the eye is the largest. Body much longer than

broad; its contour roughly pentagonal, forming an obtuse and rounded angle on either side and an acute one at the posterior end (Pl. XI, fig. 16). Mantle opening of moderate breadth, extending half round the body.

Head small, much narrower than body, marked off both before and behind; dorsal surface concave, owing to the location of prominent eye on either side.

Arms subequal, the formula of length being about $4>3>2>1$; longest pair a little longer than twice the body-length. All slender, uniformly and gradually tapering towards extremities, rounded quadrangular in section, devoid of contractile webs on sides. Umbrella badly developed, on an average extending $\frac{1}{4}$—$\frac{1}{5}$ up the arms; longest radius existing between second and third arms as well as between the third and fourth, while the shortest is between the fourth arms.

Suckers cylindrical, comparatively short, their aperture bordered with a thick non-shrivelled margin. Suckers number about 20 pairs on each arm, first three or four arranged in a single nearly straight series, the succeeding seven or eight in a double alternate series, while the remainder form a well-defined biserial arrangement. Near the middle of arms both the suckers in each pair are intervened by a wide space, but they gradually approach each other as they come towards the extremity. In respect to their size there is no difference between the different arms, but on each arm they become rapidly larger until the eighth or nineth, and then they become gradually smaller towards the extremity.

Right third arm feebly hectocolylized, slightly shorter than the corresponding arm of the opposite side (Pl XI, fig. 2). Terminal organ only one-seventeenth of the entire length of the arm, tapering to a sharp point; its oral surface flat and smooth, the copulatory groove being quite rudimentary. Spermatophoric groove shallow, terminating in a rudimentary calamus. Suckers on the normal part number 24 pairs.

Penis stretched straight, a little swollen posteriorly. Vaginae thick, terminating far behind the anus, their distance from the latter being about half the gill-length.

Branchial leaflets number only about 13 in each gill.

The ground color of alcoholic specimens is grayish. On the dorsal surface of the body are found two longitudinal stripes which are of much darker shade than the general ground color. These stripes divide transversely the dorsal surface into three about equal areas and are provided along their median line with a clear shining streak of greenish or skyblue hue. The streak in each stripe is not continuous but cut into four or five parts of quite unequal length. On each lateral surface of the body also are found four oblique stripes of the nature as those of the dorsal surface, but the streaks of these stripes are composed each of one continuous line.

Arms provided on the outer surface, with about nine, cross, black stripes which have a distinct skyblue shining ring in the middle. On each lateral surface, there is found a longitudinal series of distinct streaks alternately long and short, the longer invariably existing in the cross stripes. Moreover, some number of faint dark blotches are rather regularly on the head and on the outer surface of the umbrella, each bearing a bluish shining ring in the middle. All the bluish shining streaks and rings mentioned above seem to become darker when the animal has been long preserved in alcohol.

Juvenile form.—A young specimen which measures 40 mm. in length presents some note-worthy points of difference from the adult. The surface is by no means smooth but wrinkled, and closely warty, and the tubercles around the eyes are a little more conspicuous than in the adult. Besides, there are found on the dorsal surface of the body four longitudinal streak-like tubercles in a series along the median line, and some of much shorter, rounded tubercles scattered symmetrically on both sides of the same line. The dark stripes are much deeper in the color, clearer and broader than in mature specimens, and those on the body and head are almost continuous with one another (Pl. XI, fig. 3).

Measurements of Specimens Examined.

No. of specimen	i	ii	iii
Sex	♀	♂	juv.
Length, total	120 mm.	95 mm.	40 mm.
Ventral length of body	32 ,,	26 ,,	13 ,,
Breadth of mantle	25 ,,	19 ,,	11 ,,
Breadth of head	18 ,,	16 ,,	10 ,,
Eye to lateral mantle-margin	—	14 ,,	7 ,,
Length of first arms	Left 65mm. Right 66mm.	Left —mm. Right 54mm.	Left 21mm. Right 21mm.
,, ,, second arms	68 ,, —	54 ,, 55 ,,	22 ,, 22 ,,
,, ,, third arms	69 ,, 72 ,,	57 ,, 53 ,,	24 ,, 24 ,,
,, ,, fourth arms	75 ,, 75 ,,	— 60 ,,	24 ,, 24 ,,
Diameter of largest sucker of first arms	2.2 mm.	1.6 mm.	—
,, ,, ,, ,, ,, second arms	2.2 ,,	1.8 ,,	—
,, ,, ,, ,, ,, third arms	2 ,,	1.8 ,,	—
,, ,, ,, ,, ,, fourth arms	2.2 ,,	1.8 ,,	—
Radius of umbrella between first arms	11 ,,	10 ,,	—
,, ,, ,, ,, first and second arms	12 ,,	10 ,,	—
,, ,, ,, ,, second and third arms	14 ,,	13 ,,	—
,, ,, ,, ,, third and fourth arms	17 ,,	13 ,,	—
,, ,, ,, ,, fourth arms	13 ,,	9 ,,	—
Length of hectocotylized part	—	3 ,,	—

Remarks.—Hoyle mentioned the species for the first time under the name *Octopus pictus* Brock var. *fasciata*. His statement is by no means so complete as might have been wished, yet the illustration accompanied with it well reveals the characteristic patterns on the head, body, and arms. Through this illustration I am able to refer with but little hesitation the specimens at my disposal to his variety. The only difference in these specimens is to bear in mind the circumorbital cirri which are not given in that illustration. Judging from his statement the principal point of distinction, by which he was obliged to separate the variety from Brock's *Polypus pictus*, seems also to be those characteristic patterns. As far as the specimens in hand reveal, besides this characteristic, the elongated pentagonal profile of the body, long arms, different formula of their length and circum-orbital cirri described before all are also constant discrepancies from Brock's original description*), although some of these discrepancies, which were also occurred in Hoyle's case, were taken by him to be nothing of so great importance but attributed to varying states of contraction. Moreover, the hectocotylization considerably differs from that species. These discrepancies have convinced me to be separable the variety as a distinct species.

Wülker points out (l.c.) that a specimen of the present species from Misaki differs from Hoyle's

*) Brock 1882, l.c., pp. 603, 604, pl. xxxvii, fig. 3.

description in the said patterns. That difference in Wülker's case, I surmise, would be nothing but what is due to the different stages of growth as also occurred in the specimens examined by myself.

Locality.—Port Jackson, Australia (Hoyle, Goodrich); Misaki (Wülker); Sagami Bay (!); Tôkyo market (!).

Polypus januarii (Steenstrup, 1885).

(Pl. IV, fig. 3; Pl. XI, fig. 4; textfigs. 22, 23.)

Octopus januarii, Steenstrup MS. in Mus. Havn (fide Hoyle).—Hoyle 1885a, p. 229.—Hoyle 1885c, p. 105.—Hoyle 1886b, p. 97, pl. vii, figs. 1–4.—Goodrich 1896, p. 19.

Polypus januarii, Hoyle 1904, p. 18, pl. v, fig. 2.—Berry 1912b, p. 392.—Sasaki 1920, p. 172.

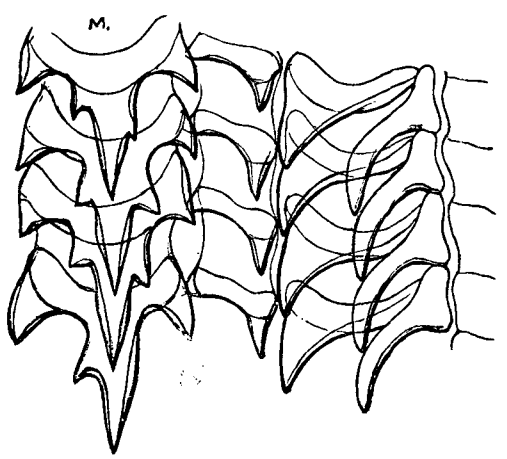
Three female specimens caught by the "Albatross" have been placed at my disposal for examination.

Animal very soft, easily multilated. Skin very thin, loose, easily flayed. Surface perfectly smooth all over. Body subglobular, about as broad as long, somewhat flattened dorso-ventrally; posterior end rounded; ventral surface nearly flat but a faint longitudinal sulcus being repeated occurrence in the middle; periphery devoid of horizontal ridge on either side. Mantle opening very narrow, extending much less than half round the body.

Head large, as broad as, or even broader than, body, due to the location of enormous eye-balls. Neck constriction rather weak. Umbrella equally wide all round except that it is a little narrower between the ventral arms. In other interbrachial space it extends ¼—⅕ up the arms.

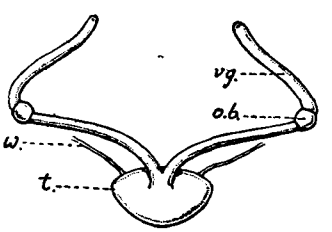
Funnel conical, its distal, freely projecting part very short. Funnel organ, rather conspicuous, W-shaped but roughly roundish in contour, as long as broad, situated, nearer to anterior funnel extremity than to anus; consisting of very thick fillet of uniform breadth, of which the two inner divisions are slightly longer than the outer and set side by side (Pl. XI, fig. 4).

Arms slender, unequal, the formula of length $1>2>3\fallingdotseq4$; the longest measuring about five to six times the body-length. All squarish in section throughout the length, furnished with a narrow web on either side of the aboral surface. Suckers comparatively small, their diameter about one-third the arm-breadth; aperture bordered with a soft shrivelled margin. First four suckers on each arm, small and arranged in a single zigzag series; the succeeding eight in a double alternate series, gradually increasing in size distad. Remaining suckers distinctly biserial, becoming quite gradually smaller towards the extremity. None of suckers on lateral arms, specially enlarged, notwithstanding the sex.



Textfig. 23.

Polypus januarii. Portion of radula; × ca. 50.



Textfig. 24.

Polypus januarii. Internal genital organ of immature female; × 4/3.

Branchial leaflets number 19 or 20 in each gill.

Radula composed of seven series of teeth as usual.

Inner lateral teeth by far the shortest and smallest, broadened at base, bearing a minute blunt cuspus on the inner end of the base and a triangular, sharply pointed one on the outer end. Outer lateral teeth wide, triangular, ½—⅔ as long as median teeth. Marginal teeth slender, crescentic, a little

longer than outer lateral teeth. Cuspi on sides of median teeth variable, sometimes quite blunt and small but more often long and sharp (textfig. 23).

Ink-bag absent. Anal valves quite rudimentary.

Vaginae in immature specimens a bit crooked or even straight, terminating far behind the anus (Pl. XI, fig. 4; textfig. 24).

The color of preserved specimens is variable, sometimes purplish pink throughout but more often of much darker shade, deepening into black on the aboral surface of arms. Suckers usually deep chestnut brown.

Measurements of Specimens Examined.

No. of specimen	i	ii	iii
Length, total	—	320 mm.	245 mm.
Ventral length of mantle	55 mm.	50 ,,	39 ,,
Eye to posterior end of body	—	67 ,,	52 ,,
Breadth of body	—	48 ,,	41 ,,
Breadth of head	—	47 ,,	45 ,,
Eye to umbrella margin between lateral arms	—	65 ,,	60 ,,
Length of first arms	Left 300mm. Right 300mm.	Left 250mm. Right 250mm.	Left 175mm. Right 160mm.
,, ,, second arms	300 ,, 328 ,,	240 ,, 230 ,,	155 ,, 140 ,,
,, ,, third arms	260 ,, 275 ,,	215 ,, 210 ,,	154 ,, 150 ,,
,, ,, fourth arms	265 ,, 265 ,,	205 ,, 205 ,,	145 ,, —
Diameter of largest sucker of first arms	—	4 mm.	3.5 mm.
,, ,, ,, ,, ,, second arms	—	4 ,,	3 ,,
,, ,, ,, ,, ,, third arms	—	4 ,,	3 ,,
,, ,, ,, ,, ,, fourth arms	—	4 ,,	2.8 ,,
Radius of umbrella between first arms	73 mm.	55 ,,	40 ,,
,, ,, ,, ,, first and second arms	78 mm. 78 mm.	55 mm. 55 mm.	34 mm. 34 mm.
,, ,, ,, ,, second and third arms	76 ,, 73 ,,	62 ,, 60 ,,	30 ,, 47 ,,
,, ,, ,, ,, third and fourth arms	80 ,, 75 ,,	55 ,, 50 ,,	32 ,, 32 ,,
,, ,, ,, ,, fourth arms	70 mm.	45 mm.	23 mm.

Remarks.—Even though all the specimens examined were fairly large as shown in the above table of dimension, they were not yet sexually mature. They were all female so that no male genital organs could not be observed. According to Hoyle (1886a, 1. c.) the right third arm is well hectocotylized. The terminal organ is broad, and tapers rapidly to an acute point, often provided with several transverse ridges in the copulatory groove which is illustrated as to be very distinct and broad. The radula of the specimens at my disposal differs from Hoyle's illustration (1904, 1. c., pl. v, fig. 2) in having much broader inner lateral teeth and a short blunt cuspus at the inner end of their broad base in addition to the sharp ordinary cuspus on the outer end.

Locality.—East of Japan (Hoyle); Alleutian Is. (Albatross!); off Kii Prov. (Albatross!); Hyuga-

nada (Albatross!). Rio Janeiro (Steenstrup); Brazil (Hoyle); Bay of Bengal (Goodrich); Andaman Sea (Goodrich); off Cocos Is. (Hoyle).

Bathymetrical distribution.—350 fms. (Hoyle); 1875 fms. (Hoyle); 193 fms. (Goodrich); 271 fms. (Goodrich); 770 fms. (Hoyle); 600 fms. (Albatross!); 584 fms. (Albatross!); 437 fms. (Albatross!).

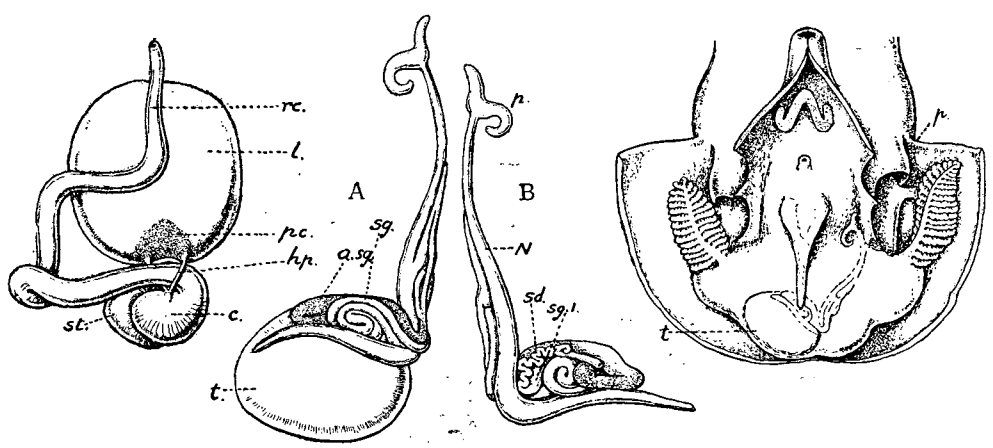
Polypus hokkaidensis Berry, 1921.

(Pl. IV, figs. 4,5; Pl. XI, fig. 5; textfigs. 24–26.)

Polypus glaber, Sasaki 1920, p. 172 (not of Rüppell's).
Polypus hokkaidensis, Berry 1921, p. 352.

This species was first announced by myself as a new species under the name of *Polypus glaber*. This name, being preoccupied, has been altered by Berry into *P. hokkaidensis*. The original specimens which were caught by the "Albatross" in Japan at three different localities, were not so fully mature as to produce spermatophores or eggs, yet sufficient to be distinguished from any of species hitherto known.

Texture loose, soft, more or less choroidal. Surface quite smooth throughout, ordinarily polished even around the eyes. Body slightly broader than long, expanded posteriad rather truncated behind; back moderately arched; belly much less so, provided with a shallow, median groove; periphery furnished with a distinct horizontal ridge around, which is strongest on both sides (Pl. IV, fig. 4). Mantle-opening narrow, extending decidedly less than half the circumference of body.



Textfig. 26.
Polypus hokkaidensis. Portion of digestive organ; ×¾.

Textfig. 25.
Polypus hokkaidensis. Internal genital organ of male sex; ×1/3. A. Ventral view. B. Dorsal view; the testis is omitted.

Textfig. 24.
Polypus hokkaidensis. Mantle of male sex, laid open; ×⅔.

Head broad, only slightly narrower than body, marked off by a quite weak constriction behind. Eyes slightly prominent. Funnel slender, extending a little more than half way to umbrella margin, its basal part almost incorporated with head so that no distinct outline of it is visible from outside. Funnel organ small, longer than broad, shorter than one-third the distance from anus to distal funnel extremity, situated nearer to the former than to the latter; W-shaped, its inner divisions about twice as long as the outer, markedly diverging posteriad (textfig. 24). Umbrella rather narrow, of equal breadth all round, extending ⅓—¼ up the arms.

Arms subequal, the formula of length being $1>2>3\fallingdotseq4$; longest pair three or four times as long as body. All squarish in section, tapering to attenuated extremities. Suckers small, arranged in two series, those in each pair so far separated from one another as their own breadth except at the base of arms, where three or four suckers are somewhat closely set in a zigzag row. They increase

in size conspicuously to about the ninth and then decrease very gradually toward the extremity (Pl. IV.fig. 5). The margins of suckers are shrivelled and folded inwards in preserved specimens so that their apertures are rendered into a squarish or pentagonal outline.

Right third arm in male hectocotilized as usual, a little shorter than the left third. Terminal organ very small, measuring only about one-twentieth the entire length of the arm, subfusiform, its proximal half being nearly cylindrical and then somewhat rapidly tapering to a blunt extremity; oral surface provided with a narrow but deep, well defined, copulatory groove and about 22 distinct transverse streaks (Pl. XI, fig. 5). Spermatophoric groove distinct, but narrow, terminating in a minute conoidal calamus. Suckers on the normal part number 52 pairs.

Radula not examined.

Penis in a male 215 mm. long, measures 12 mm. in length but bent in situ almost into the shape of a 2-shape, both extremities tapered but pointed bluntly, its expanded middle part connected with L-shaped Needham's sac by a conjunctive duct (textfig. 25).

Vagina and oviduct *s.s.* both thin and nearly straight, the former terminating far behind the anus.

Gill composed of 23 or 24 leaflets. Caecum of stomach roundish, but a little flattened dorso-ventrally and slightly involute. No ink-gland present. Nor anal valve perceptible. Liver roundish, slightly longer than broad (textfig. 26). Posterior salivary ducts united together much more posteriorly than head cartilage.

Measurement of Specimens Examined.

No. of specimen	i	ii	iii	iv
Sex	♂	♀	♀	♀
Length, total	245 mm.	185 mm.	162 mm.	155 mm.
Ventral length of mantle	44 ,,	39 ,,	35 ,,	29 ,,
Eye to posterior end of body	58 ,,	45 ,,	44 ,,	35 ,,
Breadth of body	57 ,,	40 ,,	42 ,,	36 ,,
Breadth of head	48 ,,	40 ,,	40.6 ,,	33 ,,
Eye to umbrella edge	48 ,,	40 ,,	40 ,,	32 ,,
Length of first arms	L. mm. 170 R. mm. 162	L. mm. 126 R. mm. 127	L. mm. 108 R. mm. 107	L. mm. 108 R. mm. 110
,, ,, second arms	160 ,, 160 ,,	115 ,, 115 ,,	104 ,, 99 ,,	92 ,, 100 ,,
,, ,, third arms	140 ,, 128 ,,	119 ,, 114 ,,	94 ,, 97 ,,	93 ,, 96 ,,
,, ,, fourth arms	140 ,, 153 ,,	109 ,, 109 ,,	96 ,, 95 ,,	98 ,, 98 ,,
Length of hectocotylized part	6 mm.	—	—	—
Radius of umbrella between first arms	33 ,,	32 mm.	26 mm.	30 mm.
,, ,, ,, ,, first and second arms	42 ,,	33 ,,	26 ,,	30 ,,
,, ,, ,, ,, second and third arms	45 ,,	33 ,,	26 ,,	29 ,,
,, ,, ,, ,, third and fourth arms	45 ,,	29 ,,	24 ,,	29 ,,
,, ,, ,, ,, fourth arms	28 ,,	2.7 ,,	22 ,,	25 ,,
Diameter of largest sucker of first arms	5 ,,	3.8 ,,	3 ,,	3 ,,
,, ,, ,, ,, ,, second arms	5 ,,	3.5 ,,	2.4 ,,	3 ,,
,, ,, ,, ,, ,, third arms	4.2 ,,	3.4 ,,	2.4 ,,	2.3 ,,
,, ,, ,, ,, ,, fourth arms	4 ,,	3.1 ,,	2.4 ,,	2.3 ,,

Remarks.—The present species is related to *Polypus januarii* (Str.), but differs from it in having (1) a somewhat firmer consistency, (2) a horizontal ridge around the periphery of the body, (3) shorter and subequal arms, and (4) a quite different structure of the funnel organ.

Locality.—Off Hidaka Prov. Hokkaido, 303 fms., 359 fms. (Albatross!); off Kinka San, 266 fms. (Albatross!); Suruga Bay, 503 fms. (Albatross!).

Type locality.—Off Hidaka Prov., Hokkaido.

Type.—In U. S. Nat. Mus.

Polypus ochotensis Sasaki, 1920.

(Pl. IV, figs. 6, 7; textfig. 27.)

Polypus ochotensis, Sasaki 1920. p. 174.

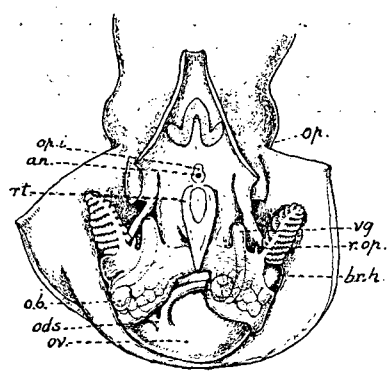
The type specimen of this species is an almost sexually mature female caught by the "Albatross" near Cape Patience, Okhosk Sea.

Superficial texture loose, soft, and flabby. Surface (Pl. IV. fig. 6) quite smooth throughout, except being finely wrinkled especially at nape, and also three obscure supraorbitalcirri are developed, of which the middle is the largest, flattened laterally and squarish in outline.

Body globose, as long as wide, broadest in the middle, moderately arched above, also convex beneath, furnished with a distinct horizontal ridge around the periphery. Mantle-opening of moderate width, extending half round the body.

Head large, only slightly narrower than body, marked off by a weak constriction either in front or behind; its dorsal surface nearly flat. Eyes but little prominent. Umbrella well developed, extending ⅓—¼ up the arms and then continued on as a narrow contractile membrane along the ventral side to the extremity; radii rather unequal, the shortest being between ventral arms.

Funnel rather short, extending less than half way to umbrella edge, incorporated with head except a short conical extremity. Funnel organ as wide as long, and two-fifths as long as the distance from anus to distal funnel extremity situated nearer to the former than to the latter, consisting of W-shaped thick fillet, of which the inner divisions are slightly greater than twice the outer in length (textfig. 27).



Textfig. 27.

Polypus ochotensis. Mantle and funnel, laid open; × ⅔.

Arms nearly uniform in length, a little longer than thrice the length of mantle. When preserved in liquids they are apt to be heavily coiled and folded upon themselves, owing to the contraction of the webs on sides (Pl. IV, fig. 7). Suckers rather small, arranged in two well-defined series except first three or four which are in a zigzag series. Margins of suckers in preserved specimens shrivelled and folded inwards so as to render their apertures triangular or quadrangular in outline. None of suckers on any arm specially enlarged but three or four pairs near the umbrella edge are somewhat larger than the others. Up to these pairs the suckers increase rather rapidly in size, but beyond these they decrease gradually toward the extremity.

Gill composed of 19 leaflets. Ink-gland present. Radula not examined.

Ovary much expanded sideways its eggs about 9 mm. long, numbering 33. Oviducts *s.s.* deviates to the right side from its usual position. Vaginae very thick, short, terminating far behind the anus.

Measurements.

Length, total	190 mm.
Ventral length of mantle...	39 „
Eye to posterior end of body	49 „
Breadth of mantle	40 „
Breadth of head	33 „
Eye to umbrella edge	46 „

	Left	Right
Length of first arms...	130 mm.	130 mm.
„ „ second arms	130 „	130 „
„ „ third arms	130 „	123 „
„ „ fourth arms	128 „	128 „
Diameter of largest sucker of first arms...	3.8 mm.	
„ „ „ „ „ second arms	3.8 „	
„ „ „ „ „ third arms	3.8 „	
„ „ „ „ „ fourth arms	3.8 „	
Radius of umbrella between first arms	40 „	
„ „ „ „ first and second arms	40 „	
„ „ „ „ second and third arms	40 „	
„ „ „ „ third and fourth arms	37 „	
Radius of umbrella between fourth arms	30 „	

Remarks.—A young male caught by the "Albatross" in Taraika Bay, Sakhalin, is referred with some hesitation to this species. Disagreeing with the female on which the above description is based, the said male has about 15 faint scattered warts on the dorsal surfaces of head and body, and the posteriormost of the three supra-orbital cirri is the largest, the body is widest posteriad, and each gill consists of 18 leaflets. The right third arm is not yet much affected by hectocotylization. It is a little shorter than the left third arm, the terminal organ measuring $^1/_{25}$ of the entire length. Neither copulatory groove nor calamus is yet distinct. The suckers on the normal part number 42 pairs. The penis is only 5 mm. long and spindle-shaped, the swollen middle part being connected with Needham's sac which is slender and bent into an L-shape. The principal measurements are as follows: total length, ca. 95 mm.; Ventral length of mantle, 19 mm.; eye to posterior end of body, 22 mm.; breadth of body, 23 mm.; breadth of head, 22 mm.; length of first arm, 65 mm.; second arm, 65 mm.; right third arm, 53 mm.; left third arm, 6.2 mm.; fourth arm, 64 mm.; diameter of largest sucker, about 2.4 mm. in every arm.

The present species resembles *Polypus hokkaidensis* Berry, but differs from it principally in having (1) three supraorbital cirri, (2) shorter and uniform arms, (3) fewer suckers on the hectocotylized arm, (4) fewer leaflets of gills, and (5) lighter coloration of the body. Besides, the present species has the ink-gland that is devoided of in that species.

Locality.—Near Cape Patience, Okhotsk Sea, 75 fms. (Albatross!); Taraika Bay, Sakhalin, 119 fms. (Albatross!).

Type locality.—Near Cape Patience, Okhotsk Sea.

Type.—In U. S. Nat. Mus.

Polypus tsugarensis Sasaki, 1920.

(Pl. IV, figs 8, 9; Pl. XI, figs. 6, 7; textfig. 28.)

Polypus tsugarensis, Sasaki 1920, p. 175, pl. xxiii, fig. 4.

This species is based on a sexually mature male caught by the "Albatross" in the Tsugaru Straights.

Animal fleshy, very firm. Surface (Pl. IV, figs. 8, 9) smooth everywhere except for a number of faint warts irregularly distributed above and behind the eyes as well as for a laterally flattened cirrus above each eye.

Body compact, broader than long, expanded and truncated posteriorly, furnished with a conspicuous horizontal ridge around the periphery. Belly nearly flat, save for a deep longitudinal groove in the middle. Mantle-opening of moderate width, extending half round the body.

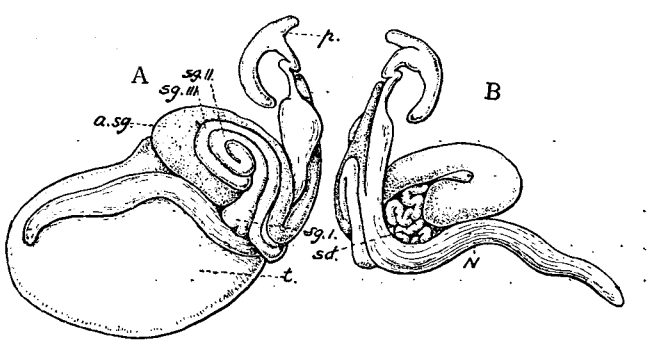
Head a little narrower than body, flat above, marked off by a weak constriction either in front or

behind. Eyes slightly prominent. Umbrella well developed especially between first and second arms as well as between lateral arms, its least development being between ventral arms. On an average it extends about a quarter up the arms and then continues itself on as a somewhat broad contractile web along the ventral side of arms nearly to the extreme tip.

Funnel rather long, extending more than halfway to the umbrella edge. Funnel organ conspicuous, slightly broader than long, about half as long the distance between anus and distal funnel extremity, situated much nearer to the former than to the latter; trilobate, the lobes all triangular, diverging, and sharply pointed distally (Pl. XI, fig. 6). The median of the three lobes decidedly longer than the remaining two, and their combined base furnished with a small triangular indentation in the middle of the posterior margin.

Arms nearly equal, about four times as long as body, tapering more gradually at the distal part than at the proximal. Suckers arranged in two well-defined rows except at the base of arms, where they are set somewhat sparsely in two alternating rows. Suckers are markedly unequal especially on the dorsal arms. On these arms they increase rapidly in size to the eighth pair, these and the next pair being characteristically enlarged, and then they decrease in size at first very rapidly but quite gradually soon afterward, continuing in this condition to the extremity. Thus characterized as in the first arms also are the suckers on the remaining arms, but less conspicuously and are by far the least in the ventral arms.

Right third arm hectocotylized, being $^{8}/_{9}$ as long as the left third. Terminal organ conical, comprizing about $^{1}/_{11}$ the entire length of the arm, provided with well-defined, transversely striated, copulatory groove (Pl. XI, fig. 7). An ample and deep spermatophoric canal terminates in a minute, conical calamus. Suckers on the normal part number 42 pairs.



Textfig. 28.

Polypus tsugarensis. *A.* Outer aspect of internal genital organs of mature male; $\times {}^{1}/_{3}$. B. Inner aspect of same; the testis is taken off; $\times {}^{1}/_{3}$.

Penis slender, 11 mm. long, bent crescentwise, of subequal thickness throughout. Needham's sac slender, bent into an L-shape, of which the horizontal part is about twice as long as the vertical part. Penis connected with the conjunctive duct of the sac in advance of the middle (textfig. 28). Spermatophoric gland coils in accompany with its accessory gland. Spermiduct thick, of rather short course, tortuous. Spermatophores 52 mm. long.

Gill composed of 19 leaflets. Caecum of stomach reniform. Ink-duct not deeply embedded in liver, the whole extent of its course being nearly traceable outside the liver.

Color in alcohol uniformly reddish brown. Three obscure transverse stripes of a deeper shade found at the frontal region of head.

Measurements.

Length, total	145 mm.
Ventral length of mantle	25 „
Eye to posterior end of body	36 „
Breadth of body	38 „
Breadth of head	30 „
Eye to umbrella edge	32 „

	Left	Right
Length of first arms	100 mm.	100 mm.
„ „ second arms	100 „	100 „

Length of third arms	98 mm.	85 mm.
„ „ fourth arms	98 „	98 „
Length of hectocotylized part	7.5 mm.	
Radius of umbrella between first arms	23 „	
„ „ „ „ first and second arms	27 „	
„ „ „ „ second and third arms	27 „	
„ „ „ „ third and fourth arms	24 „	
„ „ „ „ fourth arms	18 „	
Diameter of largest sucker of first arms	5.7 „	
„ „ „ „ „ second arms	5.5 „	
„ „ „ „ „ third arms	4.5 „	
„ „ „ „ „ fourth arms	3.5 „	

Remarks.—This species is somewhat related to *P. leioderm* Berry, but differs from it principally in having uniform arms, and markedly unequal suckers.

Type locality.—Off Fukuyama, Tsugaru Straight, 195 fms. (Albatross!).

Type.—In U. S. Nat. Mus.

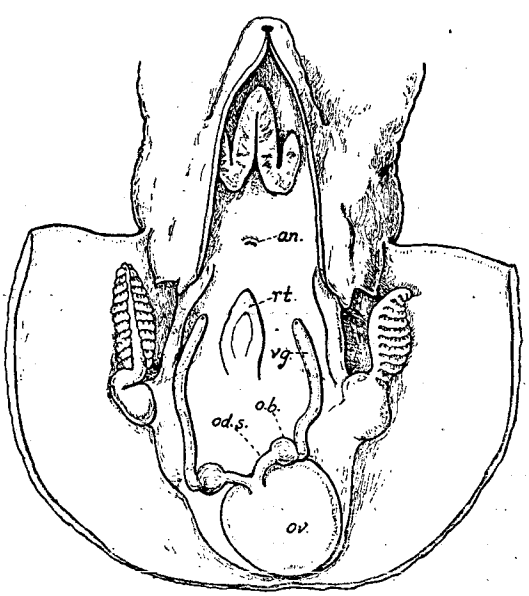
Polypus abruptus Sasaki, 1920.

(Pl. VI, fig. 1; textfigs. 29–31).

Polypus abruptus, Sasaki 1920, p. 173.

This species is based on a mature male and immature female caught by the "Albatross."

Superficial texture rather firm. Skin smooth, devoid of warts and circum-orbital cirri. Body as long as, or longer than, broad; its periphery without either distinct horizontal ridge or streak-like tubercles; belly with very faint longitudinal groove in the middle. Mantle-opening of moderate breadth, extending just half round the body.



Textfig. 29.

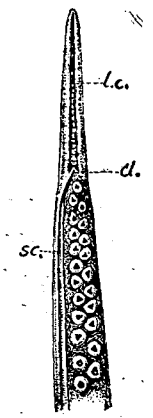
Polypus abruptus. Mantle and funnel, laid open; 2/3.

Head a little narrower than body, and marked off from it by a weak constriction. Eyes slightly prominent. Umbrella broad, equally developed all round, extending about a quarter up the arms to the fourteenth or fifteenth pair of suckers, then continued on as a rather broad contractile membrane along the ventral side of arms up to the extremity. Funnel organ conspicuous, a little longer than broad, about half as long as the distance from anus to distal funnel end, situated equidistance from both these points, W-shaped; the fillet broad, all its divisions arranged close to one another, the outer divisions half as long as the inner (textfig. 30).

Arms subequal, the formula of length being $1>2\fallingdotseq3\fallingdotseq4$; first pair about four times as long as the head and body taken together. All taper gradually and uniformly towards extremities. Suckers number 85–92 pairs in each arm, closely set in two well defined series except several at base, which are sparsely in one zigzag or two alternate series. They are very unequal in size, and commencing with a minute sucker at base, become abruptly larger*) to the fourteenth or fifteenth pair.

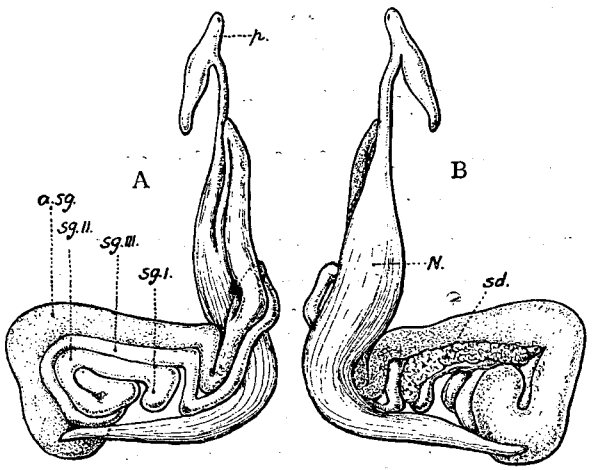
*) Hence the specific name.

The fifteenth to the seventeenth pair which are opposite to the umbrella edge, are greatly enlarged, succeeded by several pairs also abruptly diminishing in size distad; beyond these the suckers become smaller very gradually and uniformly towards the extremity (Pl. VI, fig. 1).



Textfig. 30.

Polypus abruptus. Hectocotylus; $\times 5/3$.



extfig. 31.

Polypus abruptus. Dorsal and ventral views of internal genital organs of male sex; $\times 2/3$.

Right third arm well hectocotylized, decidedly shorter than the left third; its terminal organ occupying about $1/13$ of the entire length, tapering gradually towards the extremity, furnished with a deep, well-defined, copulatory groove (textfig. 30). Non-hectocotylized part provided with 57 pairs of suckers and also a deep spermatophoric groove terminating in a conical calamus.

Gill composed of 21–23 branchial leaflets. Anal valves rudimentary.

Radula not examined.

Penis fusiform, 25 mm. long, 5 mm. thick, connected with the conjunctive duct of Needham's sac at the part one-third from the distal end (textfig. 31). Needham's sac bent into L-shape. Spermatophoric gland coils together with its accessory gland. Spermatophores about 90 mm. long.

Ovary roundish, contaning only about 80 eggs which are about 12 mm. in length. Vaginae thick, short, a bit crooked, their extremities distant from anus about as far as the gill-length.

Measurements of Male Examined.

Length, total	520 mm.	
Ventral length of mantle	85 ,,	
Eye to posterior end of body	98 ,,	
Breadth of body	65 ,,	
	Left	Right
Length of first arms	— mm.	410 mm.
,, ,, second arms	380 ,,	380 ,,
,, ,, third arms	360 ,,	300 ,,
,, ,, fourth arms	380 ,,	370 ,,
Radius of umbrella between first arms	ca. 100 mm.	
,, ,, ,, ,, first and second arms	ca. 100 ,,	
,, ,, ,, ,, second and third arms	ca. 100 ,,	
,, ,, ,, ,, third and fourth arms	ca. 100 ,,	
,, ,, ,, ,, fourth arms	ca. 90 ,,	
Diameter of largest sucker of first arms	15 ,,	
,, ,, ,, ,, ,, second arms	14 ,,	
,, ,, ,, ,, ,, third arms	12 ,,	
,, ,, ,, ,, ,, fourth arms	11 ,,	
Length of hectocotylus	23 ,,	

Remarks.—This species is related to *P. tsugarensis* Sasaki but differs from it chiefly in having a funnel organ of different shape, numerous suckers on the hectocotylized arm, and much greater

dimensions. It also stands close to *P. longispadiceus* Sasaki but is distinguished from it at least by the smooth skin, fusiform penis, L-shaped Needham's sac, and much greater dimensions.

Type locality.—Off Kii Prov., 587 fms. (Albatross!).

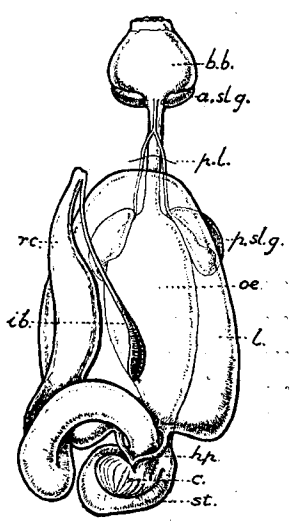
Type.—In U. S. Nat Mus.

Polypus fujitai sp. nov.

(Pl. V, fig. 1; Pl. XI, fig. 8; textfigs. 32, 33.)

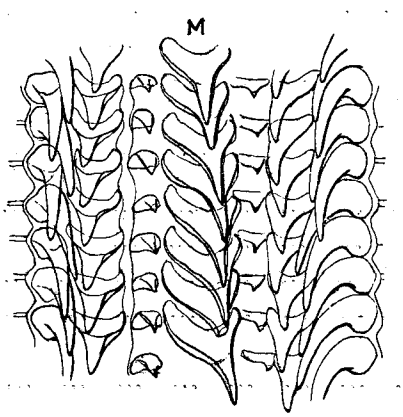
Skin somewhat loose. Surface quite smooth, and nearly polished except for transverse wrinkles at nape (Pl. V, fig. 1). Body globose, as broad as long, broadest in the middle, quite rounded behind, furnished with a faint horizontal ridge around the periphery. Belly less convex than the back, without longitudinal groove. Mantle-opening somewhat narrow, extending less than half round the body.

Head large though narrower than body, roughly cylindrical, no distinct constriction present either in front or behind. Eyes not prominet. Funnel slender, extending a little more than half way to umbrella edge, its posterior half incorporated with head. Funnel organ could not be examined, due to its imperfect preservation. Umbrella of moderate breadth, almost uniformly developed all around, extending to the eighth or ninth pair of suckers, its margin continued along the ventral side of arms up to the extremity as a broad contractile membrane which is best developed on the first arms.



Textfig. 32.

Polypus fujitae. Digestive organs; $\times 4/3$.



Textfig. 33.

Polypus fujitae. Radula; $\times 40$.

Arms long, subequal, the formula of length being $1>2>3=4$; the longest about five times the mantle-length. All slender, tapering gradually to fine extremities, coiled and folded upon themselves in preserved state, due to the contraction of the extensive contractile webs on sides. Suckers small, about 170 in number on each arm, distinctly biserial nearly throughout, more closely crowded at the distal part than at the proximal. Hectocotylus not examined, the specimen observed being female.

A conspicuous olfactory pit present in each corner of the mantle-opening (Pl. XI, fig. 8). Depressor infundibuli slender. Branchial leaflets number 23 in each gill. Kidney on each side composed of about 40 glandular lobes tightly pressed together in a layer.

Caecum of stomach rounded, a little involute (textfig. 32). Ink-bag small, its larger half imbedded in liver. Proximal part of ink-duct also sunk deep in liver. Ducts of posterior salivary gland united together above pedal ganglion.

Vaginae gently and evenly curved, their distal extremity considerably distant from anus.

Radula composed of seven series of teeth which are well characterized by their being all unicuspid (see textfig. 33).

Color in formalin brownish pink, a little ligher on the ventral surface than on the dorsal surface which is marbled with a deeper tint of the same color.

Measurements.

Length, total	240 mm.	
Ventral length of mantle	35 „	
Eye to posterior end of body	44 „	
Breadth of body	37 „	
Breadth of head	28 „	
Eye to umbrella edge	43 „	
	Left	Right
Length of first arms	190 mm.	190 mm.
„ „ second arms	180 „	170 „
„ „ third arms	165 „	160 „
„ „ fourth arms	160 „	160 „
Radius of umbrella between first arms	35 mm.	
„ „ „ „ first and second arms	35 „	
„ „ „ „ second and third arms	35 „	
„ „ „ „ third and fourth arms	34 „	
„ „ „ „ fourth arms	33 „	
Diameter of largest sucker of first arms	4 „	
„ „ „ „ „ second arms	4 „	
„ „ „ „ „ third arms	3.8 „	
„ „ „ „ „ fourth arms	3.5 „	

Remarks.—This species is based upon a single female collected by myself at Namerikawa, Etchu Prov. The specimen is not yet fully sexually mature but shows many peculiar characteristics so that I am not able to refer it to any of species hitherto known. It is named in honour of Prof. T. Fujita, to whom I wish to express my sincere gratitude for many acts of courtesy.

Type locality.—Etchu Prov.

Type.—In Hokkaido Imp. Univ.

Polypus madokai Berry, 1921.

(Pl. V, figs. 2, 3; Pl. XI, fig. 9; textfig. 34.)

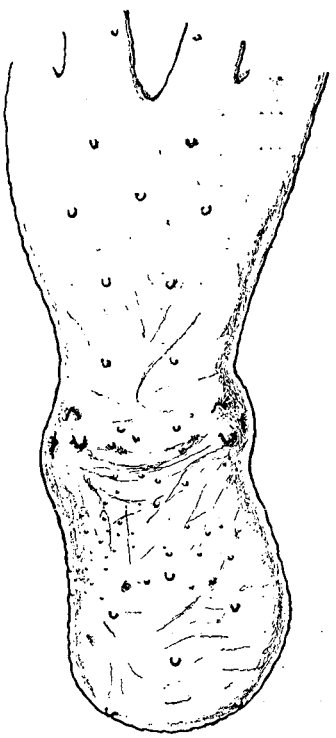
Polypus pustulosus, Sasaki 1920, p. 176 (not of Peron's)
Polypus madokai, Berry 1921, p. 353.

This species is based on a single female caught by the "Albatross" in the Sagami Sea. Consistency flabby, rather choroidal, very loose, soft. Dorsal surface somewhat sparsely and uniformly beset with minute pimple-like warts (Pl. V, fig. 2), and in addition to these there are found 20 or more, rather large, rounded regularly distributed tubercles, of which the four at the middle part of the back of the body are arranged in such a manner as to mark the four corners of a rhombus (textfig. 34). Above each eye are found two cirri, of which the posterior is the larger, laterally flattened, and nearly squarish in outline.

Body as wide as long, a little depressed dorso-ventrally, with neither horizontal ridge around the periphery, nor longitudinal groove on the belly. Mantle-opening narrow, extending less than half round the body.

Head broad, only a little narrower than body, slightly concave above, weakly marked off from body. Eyes faintly prominent. Umbrella of moderate breadth, on an average extending a quarter up the arms. Funnel conical, extending a little more than half way to umbrella edge. Funnel organ conspicuous, about as broad as long, and longer than half the distance between anus to distal funnel extremity, situated equi-distance from both of these, roughly W-shaped. Anterior lobes of the organ all rounded at end, the middle one broader than twice the lateral, and also dicidedly longer then them;

posterior lobes sharply pointed, separated by a equilateraterally triangular indentation (Pl. XI, fig. 9).



Textfig. 34.
Polypus madokai Dorsal view; ×ca. 3/5.

Arms unequal, the formula of length being 1>2>3>4; the longest about thrice as long as the head and body taken together. All thick, robust, tapering more gradurlly at the proximal part than at the distal, provided with a broad, thick contractile continuation of umbrella margin on the ventral side (Pl. V, fig. 3).

Suckers relatively large, their margins in alcohol being shrivelled and folded inwards so as to render their apertures variously angled; distinctly biserial except several next to the mouth, these being sparsely in two alternate rows. Largest suckers on each arm, situated distally beyond the umbrella edge, none of them specially enlarged even in lateral arms.

No hectocotylus observed, the specimen examined being a female.

Ink-bag large, pyriform, largely embedded in liver as usual. Proximal part of ink-duct also sunk deep in it. Anal valves rather large. Caecum of stomach large, hemispherical, slightly involute.

Vaginae nearly straight, slender, their distal enes distant as far as the gill-length.

Gill composed of 21 leaflets.

Color in formalin uniformly drab but a little lighter beneath.

Measurements.

Length, total	380 mm.	
Ventral length of mantle	63 „	
Eye to posterior end of body	80 „	
Breadth of body	64 „	
Breadth of head	60 „	
Eye to umbrella edge	100 „	
	Left	Right
Length of first arms	275 mm.	275 mm.
„ „ second arms	252 „	250 „
„ „ third arms	244 „	240 „
„ „ fourth arms	236 „	235 „
Radius of umbrella between first arms	67 mm.	
„ „ „ „ firstt and second arms	70 „	
„ „ „ „ second and third arms	68 „	
„ „ „ „ third and fourth arms	67 „	
„ „ „ „ fourth arms	50 „	
Diameter of largest sucker of first arms	7.5 „	
„ „ „ „ „ second arms	7.0 „	
„ „ „ „ „ third arms	7.0 „	
„ „ „ „ „ fourth arms	7.0 „	

Remarks.—The specimen referred to is not yet sexually mature, although it attains already fairly large size as shown in the above table. This species stands in the nearest relationship to *P. döfleini* Wülker and also *P. hokkaidensis* Berry. But from the former it is distinguished (1) by its softer consistency, (2) by the broader head, (3) by the arms of unequal length and (4) by the quite different

ornamentation of the surface. From *P. hokkaidensis* it differs in having (1) much larger dimentions, (2) different surface ornamentation, (3) more numerous branchial leaflets of gills, and (4) different structure of the funnel organ.

Type locality.—Sagami Sea, 70 fms. (Albatross!).

Type.—In U. S. Nat. Mus.

Polypus döfleini Wülker, 1910.

Japanese name: Mizudako (Hokkaido; Mutzu Prov.); Madako (Hokkaido).

(Pl. II, Pl. XI, figs. 10, 11; textfig. 35.)

Octopus punctatus, Gabb 1862, p. 170 (not *O. punctatus* Blainville 1826, p. 195).—Dall W.E. 1866, p. 243, fig. 27;—Dall W.E. 1884, p. 341.—Tryon 1879, pp. 45, 86, 117, pl. xix, fig. 3; pl. xxxiv, fig. 43.—Verrill 1882, p. 282; 1883a, p. 117, pl. iv; pl. v, fig. 2.—Orcutt 1885, p. 535.—? Hoyle 1886b, p. 100, pl. v.—Williamson 1892, p. 217.—Taylor 1895, p. 98.—Joubin 1897a, pp. 110–113, pl. ix.—Joubin 1897b, p. 98.—Jenkins & Carlson 1903, p. 262.—Baily 1907, p. 93.

Polypus punctatus, Hoyle 1909, p. 260.—Wülker 1910, p. 7.

? *Octopus hongkongensis*, Hoyle 1885a, p. 224; 1885c, p. 99.

Polypus hongkongensis, Berry 1911a, p. 302; 1912a, p. 280, pl. xxxv, fig. 3; pl. xxxvi, fig. 1; pl. xxxix, figs. 3, 4; pl. xl, fig. 1; 1912b, p. 391.—Sasaki 1920, p. 177.

Polypus döfleini, Wülker 1910, p. 7, pl. ii, figs. 1, 2; pl. iii, fig. 10.—Berry 1912b, p. 391.

Polypus apollyon, Berry 1913b, p. 72; 1 fig.

Animal gigantic, attaining about three meters in length, its consistency very soft specially when fresh, and the skin loose even in preserved state. Surface irregularly warted but easily slacking off into smooth condition. Warts of various shape but usually pointed at apex and more or less stellate at base, often connected together into longitudinal lines, much more prominent on the dorsal and lateral surfaces than on the ventral, most prominent around the eyes where they are closely set so as almost to form ridges radiating from the eye-openings. The warts in young specimens are relatively coarser, more nicely stelliform, and their distribution more uniform than in the adult. Further, some larger tubercles in addition to these warts are clearly perceptible in regular order on the dorsal surfrce and the four above the body are arranged so as to mark the four points of a rhombus.

Three or four small cirri developed above each eye; the largest of these, semilunar or subquadrate, situated slightly behind the pupil.

Body in adult nicely ovate in contour a little longer than broad, broadest near the middle, moderately arched above, faintly convex or even quite flat beneath; sides smooth, without either horizontal ridge or streak-like tubercles. Body in young, pyriform, broadest posteriad; belly provided with a distinct longitudinal groove in the middle.

Mantle-opening rather wide, extending a little more than half round the body. Funnel conical, much expanded at base, extending near halfway to umbrella edge. Funnel organ large, decidedly broader than long, a little longer than one-third the distance between anus and distal funnel extremity, situated nearly equi-distance from both these points; W-shaped, consisting of a very broad fillet; the median lobe as long as, or a little longer, than the lateral. Umbrella well developed, narrowest between ventral arms, broadest between lateral arms, where it extends about one-fourth up the arms to the thirteenth or fourteenth pair of suckers. Margin of umbrella continued along the ventral side of arms up to the extremity as a broad contractile web.

Arms very contractile, and their relative lengths variable but ordinarily subequal, the formula of length being $1 \fallingdotseq 2 \fallingdotseq 3 > 4$, or $1 \fallingdotseq 2 > 3 > 4$; on an average four to five times as long as body; their

bases very thick, altogether being broader than body. All taper gradually and uniformely towards extremities.

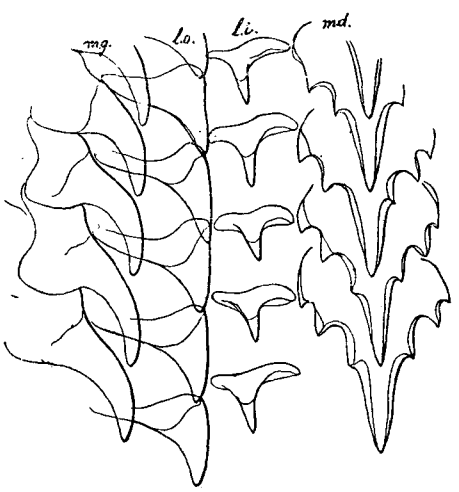
Suckers prominent, with expanded margins, which are often shrivelled in preserved specimens; rather closely arranged in two well-defined series except at the base of arms, where they lie sparsely in a single zigzag series. Suckers of lateral pairs generally on the whole a little larger than those of the remaining arms. On each arm they become rapidly larger to the eighth or ninth pair and the tenth to the thirteenth pair are the largest, whence they become gradually smaller towards the extremity; the size of the largest suckers is subject to an individual variation, sometimes they attaining an enormous size as shown in Pl. XI, fig. 2.

Right third arm prominently hectocotylized, 4/5—3/5 as long as the left third. Fully formed terminal organ vigorous, occupying 1/6—1/4 of the entire length of the arm, slightly narrowing to a blunt extremity; copulatory groove deep, well-defined, with numerous, faint, fine, transverse striations (Pl. XI, fig. 10). Spermatophoric groove wide, well-marked, terminating in an acutely pointed, conical calamus. Suckers on the normal part number 48–53 pairs.

Branchial leaflets number 24–30 in each gill.

Radula as shown in textfigure 35.

Anal valves comparatively small. Ink-bag of moderate size, its greater part embedded in liver as usual. Ink-duct thin, its proximal part sunk deep in liver. Caecum of stomach involute. Posterior salivary ducts united together near their exits on salivary glands.



Textfig. 35.

Polypus döfleini. Portion of radula; ×21.

Penis conspicuous, when fully formed, measuring about 140 mm. in length and 12 mm. in thickness, cylindrical but slightly narrowing posteriad, directly connected with Needham's sac at a short distance from the distal extremity (Pl. XI, fig. 11). Spermatophoric gland enormous, turning round in a plane in accompany with its accessory gland and Needham's sac. The accessory gland invariably forms a small caecum at a distance from the free extremity. Spermiduct thick and short.

Spermatophores enormous, being 86–115 cm. long; opaque part 35–50 cm. long, consisting of 150–165 coils of sperm cord. Etui 7 mm. thick at the aboral end, then quite gradually and nearly uniformly narrowing toward oral end. Discharging tube finely striated sideways and forming several spiral turns at a distance from oral end.

Ovary roundish, a little flattened dorso-ventrally, at maturity containing 600 or more eggs, which measure 7 or 8 mm. in length. Vaginae a bit crooked, terminating far behind the anus.

Color quite variable, but ordinarily purplish brown in formalin, much deeper above than beneath, and much more reddish and lighter than in *P. vulgaris*. Dorsal surface often irregularly marbled and blotched in various tones of deeper shade. Chromatophores excessively numerous, very minute; but when young, invariably, five or six, large, dark-brownish chromatophores are found in a longitudinal series along the aboral surface of the third and fourth arms, and also some are scattered on the belly.

Measurements of fresh Specimens Examined.

No. of specimen	i	ii	iii	iv	v	vi	vii
Sex	♂	♂	♂	♂	♀	♀	♀
Length, total	2700 mm.	2050 m.m.	1940 mm.	1900 mm.	2640 mm.	2480 mm.	1700 mm.
Eye to posterior end of body	560 ,,	360 ,,	370 ,,	360 ,,	540 ,,	480 ,,	—
Ventral length of mantle	400 ,,	280 ,,	290 ,,	250 ,,	400 ,,	360 ,,	250 ,,
Breadth of body	320 ,,	250 ,,	260 ,,	280 ,,	300 ,,	300 ,,	205 ,,
Breadth of head	180 ,,	110 ,,	120 ,,	110 ,,	180 ,,	130 ,,	130 ,,
Length of first arms	Left mm. 1950 Right mm. 1950	Left mm. 1530 Right mm. —	Left mm. 1270 Right mm. 1370	Left mm. 1330 Right mm. 1380	Left mm. 1750 Right mm. 1750	Left mm. 1780 Right mm. 1770	Left mm. 1390 Right mm. 1350
,, ,, second arms	1950 ,, —	1500 ,, 1620 ,,	1450 ,, 1380 ,,	1340 ,, —	1700 ,, 1750 ,,	1700 ,, 1780 ,,	1340 ,, —
,, ,, third arms	1870 ,, 1250 ,,	1550 ,, 1100 ,,	1380 ,, 1080 ,,	1360 ,, 930 ,,	1650 ,, 1750 ,,	1700 ,, 1700 ,,	1220 ,, —
,, ,, fourth arms	1800 ,, 1600 ,,	1480 ,, 1480 ,,	1380 ,, 1340 ,,	1200 ,, 1300 ,,	1600 ,, 1600 ,,	1600 ,, 1600 ,,	1300 ,, 1300 ,,
Length of hectocotylized part	300 mm.	280 mm.	190 mm.	180 mm.	—	—	—
Diameter of largest sucker of first arms	58 ,,	47 ,,	45 ,,	50 ,,	42 mm.	40 mm.	35 mm.
,, ,, ,, ,, ,, second arms	65 ,,	50 ,,	46 ,,	50 ,,	45 ,,	43 ,,	35 ,,
,, ,, ,, ,, ,, third arms	65 ,,	50 ,,	45 ,,	45 ,,	45 ,,	42 ,,	32 ,,
,, ,, ,, ,, ,, fourth arms	55 ,,	43 ,,	41 ,,	42 ,,	40 ,,	40 ,,	30 ,,

Remarks.—The species has been announced by many writers in several different names as is listed above. *Polypus punctatus*, which name has been most frequently used, is preoccupied by another octopus of Blainville's as is mentioned by Berry, and Hoyle's *P. hongkongensis* known from China is also most likely a different species. Therefore, according to the law of priority, Wülker's *P. dofleini* is here adopted to represent the present species. The identification with *P. dofleini* is based on two facts: (1) many of younger specimens examined, of which the hectocotylus is not yet fully formed, agree really in every particular with Wülker's illustrated description, and (2) the type specimen of *P. dofleini* was obtained from the locality where the form under consideration is an unique octopus captured in abundance.

Many of the specimens examined also agree well in essential characters with Berry's description of *P. apollyon* (1912a l. c.) so that there would be no doubt as to their identity.

The species is the commonest octopus of North Japan. It is caught for the market in a great amount on the coast of Hokkaido from October to April; the length really ranging up to three meters. Nearly all the full-grown females caught in the eariest part of the said period are yet unmated. After November or at latest December, however, females are all filled with spermatozoa either in the vaginae or in the seminal receptacles. The eggs of all the females caught before February are not yet ripen and they are most probably deposited in spring or in early summer. After November, as far as I have examined, the spermatophores contained in Needham's sac of males are about constant in number, viz. 4–8. The testis of full-sized males in November weights about 650 gm. and then continually decreases in weight as the season advances; thus it becomes in February about half as heavy as in November.

The species is very common also in Corea, where it is dried for commerce.

Locality.—Off Enoshima, Japan (Hoyle); Misaki (Wülker); Todohokke, Hokkaido (Wülker); near Tanaga I., Aleutian Is. 52 fms. (Albatross!); Seguam Pass, Aleutian Is., 135 fms. (Albatross!); Medni I., shore (Albatross!); near Shumagin Is., Alaska, 48 fms. (Albatross!); near Simushir I., Kuriles, 229 fms. (Albatross!); Shimadomari, Sakhalin (!); Wakkanai, Hokkaido (!); Shiribeshi Prov. (!); Sapporo market (!); Hakodate (!); Azamushi Mutsu Prov. (!); Etchû Prov. (!); Awa Prov. (!); Okayama (!); Fusan, Korea (!); Gensan, Korea (!); Dalny, Liao (!); near Cape Clonard, Korea, 150 fms. (Albatross!); Hyûga-nada, 437 fms. (Albatross!); Pacific Coast, San Francisco to Sitka, Alaska (Verrill); Avatcha Bay, Kamchatck (Dall); Humboldt Bay, Alaska (Berry); Shumagin Is., Alaska (Berry); Kadiak Is., Alaska (Berry); Uyak Bay Alaska (Berry); Vicinity of Port Townsend, Wash. (Berry); Victoria (Toylor); Crescent City, Cal. (Berry); Pt. Reyes, Cal. (Berry); Half Moon Bay, Cal. (Berry); Monterey Bay, Cal. (Berry); off San Nicolas I. Cal. (Berry); San Francisco (Berry); Oakland, Cal. (Berry); Santa Catalina I., Cal. (Berry); near Avalon, Cal. (Berry); off San Diego, Cal. (Berry); San Diego (Orcutt; Kelsey); near Los Coronados Is., Lower Cal. (Berry); San Pedro (Williamson).

Polypus spinosus Sasaki, 1920.

(Pl. V, figs. 5, 6; Pl. XI, figs. 12, 13.)

Polypus spinosus, Sasaki 1920, p. 177: pl. 24, fig. 1.

Two female specimens found in the "Albatross" collection, though yet sexually immature, are well characterized and referable to none of species hitherto known.

Consistency fleshy and firm, but skin rather soft and loose. Surface except the sucker-bearing surface of arms, somewhat thickly and evenly beset with comparatively large sharply pointed, rather firm, uniform warts with stellate bases (Pl. V, figs. 5, 6). A single, low, warted, cirrus present above each eye. Body relatively large, a little wider than long, rounded behind, without keel around the periphery; belly distinctly furrowed longitudinally in the middle. Mantle opening narrow, extending less than half round the body.

Head slightly narrower than body, a little concave. Neck constriction weak. Eyes large, a

little prominent. Umbrella well developed; narrowest between dorsal arms and also between ventral arms; broadest between lateral arms as well as between ventrol-lateral and ventral arms, where it extends for about one-third the entire length of these arms. Margin of umbrella continued along the ventral side of arms to the extremity as a broad contractile web, so that the arms in preserved specimens are apt to coil and fold upon themselves.

Funnel rather small, hardly extending half way to umbrella edge. Funnel organ conspicuous, decidedly broader than long and far longer than half the distance between anus and distal funnel extremity, lying slightly nearer to the latter than to the former; W-shaped, consisting of a broad fillet; the median lobe a little longer than the lateral (Pl. XI, fig. 12).

Arms subequal; lateral pairs slightly longer than the others and about thrice as long as body. Suckers small, their margin thick and folded so as to render the aperture triangular or quadrangular in outline. None of suckers specially enlarged. On each arm the first three suckers are in a zigzag series but the remainder are in two distinct series.

Hectocotylus not examined, the specimens examined being female.

Branchial leaflets number 21 or 22 in each gill.

Ink-bag relatively large, ellipsoidal, almost immersed in liver; proximal part of ink-duct also embedded in it, running straight to anus (Pl. XI, fig. 13). Anal valves large, and slender. Caecum of stomach elliptical, slightly involute. Radula not examined.

Vagina only a bit crooked; its freely projecting part very short viz. 1 mm. long, decidedly shorter than renal papilla, and distant from anus as far as the gill-length.

Color grayish drab all over but a little lighter beneath.

Measurements.

No. of specimen	i		ii	
Length, total	85 mm.		70 mm.	
Ventral length of mantle	18 ,,		12 ,,	
Eye to posterior end of body	23 ,,		19 ,,	
Breadth of body	23 ,,		17 ,,	
Breadth of head	21 ,,		16 ,,	
Eye to umbrella margin	22 ,,		19 ,,	
Length of first arms	Left 51 mm.	Right 53 mm.	Left 36 mm.	Right — mm.
,, ,, second arms	55 ,,	51 ,,	40 ,,	—
,, ,, third arms	55 ,,	53 ,,	39 ,,	—
,, ,, fourth arms	52 ,,	50 ,,	37 ,,	37 ,,
Radius of umbrella between first arms	14 mm.		10 mm.	
,, ,, ,, ,, first and second arms	15 ,,		11.5 ,,	
,, ,, ,, ,, second and third arms	18 ,,		12 ,,	
,, ,, ,, ,, third and fourth arms	18 ,,		12 ,,	
,, ,, ,, ,, fourth arms	14 ,,		10 ,,	
Diameter of largest sucker of first arm	1.8 ,,		1.3 ,,	
,, ,, ,, ,, ,, second arm	1.8 ,,		1.3 ,,	
,, ,, ,, ,, ,, third arm	1.8 ,,		1.3 ,,	
,, ,, ,, ,, ,, fourth arm	1.8 ,,		1.3 ,,	

Remarks.—This species appears to stand very near *P. californicus* Berry, but distinctly differs from it in the funnel organ and in the coloration.

Locality.—Off Fukuyama, Tsugaru Strait, 207 fms. (Albatross!); off Hakodate, 44 fms. (Albatross!).

Type locality.—Off Fukuyama, Tsugaru Strait.

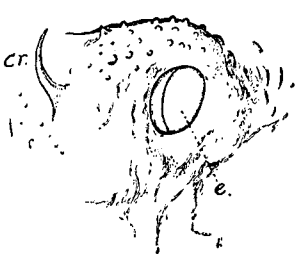
Type.—In U. S. Nat. Mus.

Polypus tenuicirrus sp. nov.

(Pl. XI, figs. 14–16; textfigs. 36, 37.)

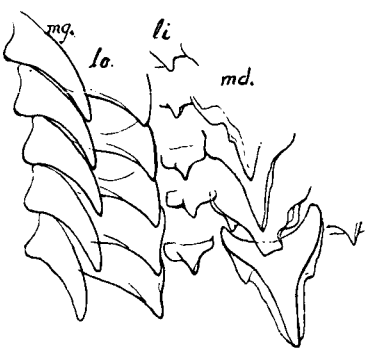
This species is based on a mature male from Awa Prov. and four young males from Kujukuri-hama both obtained by myself.

Consistency somewhat soft. Surface polished but the back and sides of head and body as well as the bases of the four dorsal arms all sparsely beset with faint, ill-defined warts. Above each eye there are two cirri, of which the posterior one is by far the longer, compressed laterally at base and attenuated at extremity (textfig. 36). Body a little longer than broad, rounded behind; sides with neither horizontal ridges nor streak-like tubercles. Mantle-opening of moderate width, extending half round the body, its corners situated below the level of eye-pupils.



Textfig. 36.

Polypus tenuicirrus. Ocular region; ×2⅔.



Textfig. 37.

Polypus tenuicirrus. Radula of immature individual; ×40.

Head relatively large, two-thirds as wide as body, marked off by a faint constriction either in front or behind. Eyes a little prominent. Umbrella rather well developed, and equally wide all around, but a little narrower between dorsal arms and also between ventral arms; in the remaining interbrachial spaces, it extends for about one-fifth the length of the arms. Margin of umbrella continued along the ventral side of arms to the extremity as a broad contractile web.

Funnel small, a little narrowed distally, fully extending halfway to umbrella edge. Funnel organ large, far broader than long, about half as long as the distance between anus and distal funnel end, lying decidedly nearer to the latter than to the former; W-shaped, consisting of a fillet of very unequal breadth; the middle lobe far broader and longer than the lateral, and rounded at end (Pl. XI, fig. 14).

Arms subequal, the formula of length being $1>2>3>4$; longest pair five and a half times as long as body. Suckers about 220 in number on each arm, biserial except proximal two or three which are uniserial. They vary in size with the length of the arms on which they are set; the largest suckers of the first arms are about two-thirds as large, in diameter, as those of the fourth arms. On each arm the suckers become gradually larger to the tenth pair, which is nearly opposite to the umbrella margin; adjacent four or five pairs are the largest, and hereafter they become very gradually smaller toward the extremity.

Right third arm prominently hectocotylized, eight-thirteenths as long as the left third, bearing only 33 pairs of suckers on the normal part. Hectocotylized part slender, attaining about one-fifth of the entire length of the arm, gradually tapering to a pointed tip; copulatory groove somewhat deep, with faint transverse streaks. Spermatophoric groove wide, and clearly marked, terminating in an acutely pointed, conical calamus one-twelfth as long as hectocotylized part.

Gill composed of 21–24 leaflets.

Ink-bag large, ovoidal, partly embedded in liver. Whole course of ink-duct traceable on the surface of liver. Anal valves minute. Caecum of stomach a little flattened, roundish in contour but with a notch anteriorly.

Radula as shown in textfigure 37.

Full-formed penis 23 mm. long, the anterior two-fifths straight, the remaining part bent crescentwice, a little narrowed caudad (Pl. XI, figs 15, 16). The junction of these two parts is connected with a long duct of Needham's sac. Full-formed Needham's sac excessively large in comparison to

spermatophoric gland. Spermiduct thick and short tightly folded upon itself so as to form a compact mass; its coelomic opening more or less fimbriated.

Spermatophores contained in Needham's sac number about 50, their length measuring 125 mm., and the thickness, 2 mm. in aboral end and 0.8 mm. in the oral. Opaque part 50 mm. long, consisting of about 85 coils of sperm cord.

Colour reddish ochre, a little lighter beneath; chromatophores minute.

Measurements.

No. of specimen	i		ii	
Length, total	920 mm.		310 mm.	
Ventral length of mantle	130 ,,		45 ,,	
Breadth of body	125 ,,		42 ,,	
Breadth of head	80 ,,		37 ,,	
Eye to posterior body-end	160 ,,		70 ,,	
Length of first arms	Left 730 mm.	Right 730 mm.	Left 220 mm.	Right — mm.
,, ,, second arms	—	670 ,,	220 ,,	230 ,,
,, ,, third arms	650 ,,	400 ,,	180 ,,	145 ,,
,, ,, fourth arms	630 ,,	630 ,,	190 ,,	200 ,,
Length of hectocotylus	80		9 mm.	
Radius of umbrella between first arms	100 ,,		40 ,,	
,, ,, ,, ,, first and second arms	110 ,,		48 ,,	
,, ,, ,, ,, second and third arms	115 ,,		48 ,,	
,, ,, ,, ,, third and fourth arms	110 ,,		48 ,,	
,, ,, ,, ,, fourth arms	90 ,,		40 ,,	
Diameter of largest suckers of first arm	21 ,,		3.5 ,,	
,, ,, ,, ,, ,, second arm	19 ,,		3.5 ,,	
,, ,, ,, ,, ,, third arm	15 ,,		3.5 ,,	
,, ,, ,, ,, ,, fourth arm	14 ,,		3.5 ,,	

Remarks.—The classification of this species is more than usually satisfactory as it is based upon no less than five specimens, and although four of these were of small size, yet they agree in essential characters so well with the large one that there is no doubt as to their identity even had they not been obtained at the same locality.

Type locality.—Awa Prov.

Type.—In Tôkyo Imp. Univ.

Polypus longispadiceus Sasaki, 1917.

(Pl. XI, figs. 17–19; textfigs. 38, 39.)

Polypus longispadiceus, Sasaki 1917, p. 366.

This species is based on four sexually mature males obtained from Rikuzen Prov.

Adult male about 300 mm. long, rather soft to the touch. Dorsal surface of body, head and bases of arms covered with single-headed roundish warts of somewhat various sizes, found in thickest distribution and best development above eyes; one of the supraorbital warts on each side is more or less cirrus-like, being a little larger than the others. Body as long as or a little longer than broad, strongly arched above, flattened beneadth and slightly acuminate behind. Mantle-opening of moderate breadth, extending half round the body.

Head broad, but narrower than body, marked off by a weak constriction either in front or behind. Eyes a little prominent. Umbrella rather well developed, broadest between lateral arms and nar-

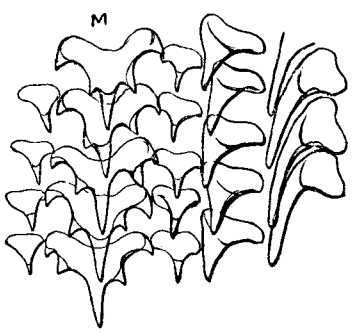
rowest between ventral arms, extending ¼—⅕ up the arms, then continued on along the ventral side of arms to the extremity as a narrow contractile web.

Funnel comparatively large, well marked off even at base, extending more than halfway to umbrella edge. Funnel organ rather large, decidedly wider than long, about half as long as the distance between anus and distal funnel extremity, lying about equidistance from both these points; W-shaped, consisting of a broad fillet; the median lobe dicidedly longer than the lateral (Pl. XI, fig. 18).

Arms slender, the formula of length being $1>2\doteqdot3>4$; the longest five or six times the mantle-length. All quadrangular in section, gradually narrowing to attenuated extremities. Suckers biserial except first three which are uniserial; varying in size in different arms; the largest found on first arms, the next largest on the second, and the smallest on the fourth. On each arm the suckers of maximum size are the tenth to twelfth pair which are situated near the umbrella margin or a little more distally; these suckers on the first and second arms show a conspicuous enlargement.

Right third arm, though prominently hectocotylized, is about equal to the left third in length or even longer than that. Terminal organ slenderly conical, of the same structural type as that of *Polypus döfleini* Wülker, comprising one-tenth of the entire length; its copulatory groove deep and well-marked. Spermatophoric groove rather broad, terminating in a distinct conical calamus. Suckers on the normal part number 49–60.

Branchial leaflets count 20–23 in each gill.



Textfig. 38.

Polypus longispadiceus. Middle region of radula; ×36.

Caecum of stomach reniform. Ink-bag ovoidal, its greater part immersed in liver as usual; the proximal part of ink-duct also hidden in the same. Anal valves minute.

Penis large, slightly tapering posteriad, mostly curved in a C-like and rarely in a 6-like manner, connected with Needham's sac near its anterior end (Pl. XI, figs. 17, 18). General shape of vas deferens *in situ* oblong, flattened a little, with the long axis transversely directed; Needham's sac running over and obliquely across spermatophoric and its accessory glands; when full of spermatophores the sac is greatly enlarged, acquiring an S- or &-like shape. Spermiduct comparatively short and thick.

Spermatophores slender, 90–105 mm. long, its opaque part 35–40 mm. long, consisting of 110–120 coils of sperm cord. Etui about 1 mm. in width at the aboral end, then evenly and gradually tapering towards the oral end.

No female genital organs observed, the specimens examined being all male.

Radula as shown in textfigure 38.

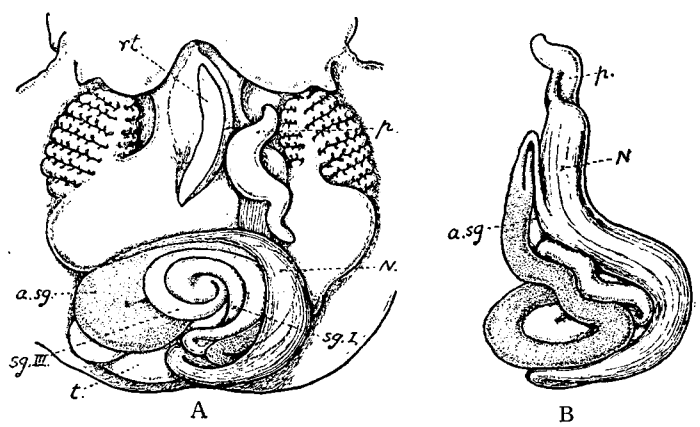
Measurements.

No. of specimen	i	ii	iii	iv
Length, total	330 mm.	307 mm.	270 mm.	265 mm.
Ventral mantle length	50 ,,	42 ,,	50 ,,	48 ,,
Eye to posterior end of body	63 ,,	52 ,,	60 ,,	58 ,,
Breadth of body	—	42 ,,	42 ,,	44 ,,
Breadth of head	32 ,,	34 ,,	33 ,,	33 ,,
Length of first arms	Left mm. —, Right mm. 255	Left mm. 240, Right mm. —	Left mm. 205, Right mm. —	Left mm. 195, Right mm. —
,, ,, second arms	— —	215 ,, 230 ,,	187 ,, 200 ,,	195 ,, 195 ,,
,, ,, third arms	205 ,, 215 ,,	195 ,, 230 ,,	180 ,, 180 ,,	180 ,, 182 ,,
,, ,, fourth arms	225 ,, 210 ,,	190 ,, 190 ,,	185 ,, 175 ,,	175 ,, 185 ,,
Length of hectocotylized part	22 mm.	23 mm.	18 mm.	19 mm.

No. of specimen	i	ii	iii	iv
Radius of umbrella between first arms	50 mm.	45 mm.	40 mm.	38 mm.
,, ,, ,, ,, first and second arms	53 ,,	49 ,,	43 ,,	40 ,,
,, ,, ,, ,, second and third arms	53 ,,	45 ,,	45 ,,	40 ,,
,, ,, ,, ,, third and fourth arms	38 ,,	30 ,,	35 ,,	35 ,,
,, ,, ,, ,, fourth arms	34 ,,	24 ,,	25 ,,	25 ,,
Diameter of largest sucker of first arm	11 ,,	9 ,,	9 ,,	9 ,,
,, ,, ,, ,, ,, second arm...	10 ,,	8 ,,	8 ,,	8 ,,
,, ,, ,, ,, ,, third arm	7 ,,	6 ,,	5 ,,	5 ,,
,, ,, ,, ,, ,, fourth arm	6 ,,	5 ,,	4 ,,	4 ,,

Remarks.—This species is somewhat related to *Polypus döfleini* Wülker but distinguished from it by the much more diminutive size and by the rounded warts of the surface as well as by the various anatomical characters.

Two mature males caught by the "Albatross" near Cape Clonard, Korea, and in Hyuga-nada respectively, are referred with a great deal of hesitation to the present species. In the Korean specimen a horizontal, keel-like ridge is developed around the periphery of the body and the suckers near the umbrella edge are more enlarged than in the other specimens examined. In the Hyuga-nada specimen the hectocotylized arm is a little shorter than the corresponding arm of the opposite side, the umbrella is broadest between the dorsal arms and the various internal genital organs show different structures as shown in text-figure 39.



Textfig. 39.

Polypus longispadiceus. A. Anatomy of the body of the male specimen from Hyuga-nada; ×⅔. B. Inner aspect of internal genital organs of the same specimen; ×⅔.

Locality.—Rikuzen Prov. (Sasaki); near Hakodate (!); near Cape Clonard, Korea, 150 fms. (Albatross!); Hyuga-nada, 437 fms. (Albatross!).

Type locality.—Rikuzen Prov.

Type.—In Tôkyo Imp. Univ.

Polypus yendoi Sasaki, 1920.

(Pl. V, figs. 7, 8; Pl. XII, figs. 1–6; textfig. 40.)

Polypus yendoi, Sasaki 1920, p. 179, pl. 24, fig. 2.

This species is based upon nine males and eight females caught by the "Albatross" at various localities as listed later.

Animal small, the adult measuring at most 30 cm. in total length; soft, somewhat flabby and more or less choroidal in consistency, invested by a loose skin. Dorsal surface in all parts sparsely best with roundish, well marked warts of various size, found in thickest distribution above and behind eyes (Pl. V, fig. 7). A number of transverse creases invariably formed at nape in preserved specimens. No cirri developed above eyes.

Body about as broad as long, widest about the middle or a little posteriorly; rounded behind,

moderately arched above; belly nearly flat, sometimes forming a faint longitudinal groove in the middle (Pl. V, fig. 8); periphery bordered with a distinct horizontal ridge around (Pl. XII, fig. 1.). Mantle-opening narrow, extending a little less than half round the body.

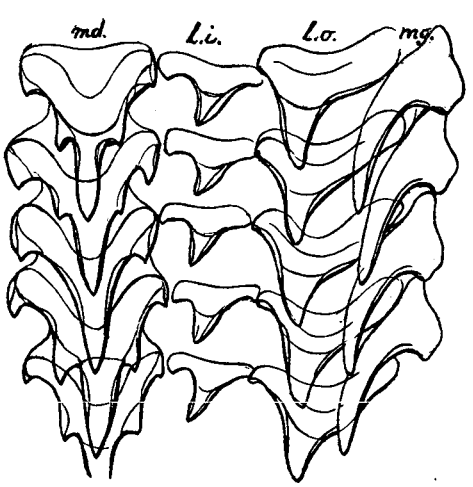
Head large, only a little narrower than body, flattened above; more distinctly marked off anteriorly than posteriorly. Eyes somewhat prominent. Umbrella well developed, broadest between ventral arms, extending about a quarter up each arm, thence it continues on along its ventral side to its extremity as a broad contractile web.

Funnel extensively incorporated with head, the freely projecting part being very short and extending about halfway to the umbrella edge. Funnel organ of moderate size, a little wider than long, and a little shorter than half the distance between anus and funnel extremity, lying nearer to the former than to the latter; W-shaped, consisting of a broad fillet; the median lobe far longer than the lateral (Pl. XII, fig. 2).

Arms subequal, the formula of length being $1>2>3\fallingdotseq4$; the longest about four times the body-length. All evenly and gradually taper off to attenuated extremities. Suckers rather small, and sparsely biserial throughout, their margin in preserved specimens shrivelled and folded inward so that the aperture reveals a variously angled outline. The largest suckers on each arm are the ninth to the eleventh pair existing opposite to the umbrella edge, and frequently show a special enlargement in the first and second arms.

Right third arm in male hectocotylized as usual, decidedly shorter than the left third. Fully formed terminal organ about one-thirteenth the entire length of the arm, its copulatory groove deep, well-difined and marked by numerous transverse streaks (Pl. XII, figs. 4, 5). Spermatophoric groove rather broad, terminating in a minute, bluntly pointed, conical calamus. Suckers on the normal part number 49–52 pairs. The development of hectocotylization is continually accentuated with age as shown in the following table:—

No. of specimen	i	ii	iii	iv	v	vi	vii	viii	ix
Ventral length of mantle	43mm.	38mm.	38mm.	32mm.	32mm.	24mm.	22mm.	22mm.	29mm.
Length of left third arm	175 ,,	142 ,,	155 ,,	145 ,,	123 ,,	150 ,,	96 ,,	98 ,,	87 ,,
Length of hectocotylized right third arm ...	165 ,,	135 ,,	140 ,,	130 ,,	113 ,,	143 ,,	92 ,,	82 ,,	72 ,,
Length of hectocotylized part ...	12 ,,	10 ,,	9 ,,	8.2 ,,	8 ,,	4 ,,	3 ,,	3 ,,	2.5 ,,



Textfig. 40.

Polypus yendoi. Portion of radula of male sex; ×47.

Radula as shown in textfigure 40.

Gill composed of 21 or 22 leaflets. Anal valves minute.

Fully formed ovary very large in comparison to other visceral organs, broader than long; its eggs also very large, measuring 17×7 mm. Vagina very thick, and short, a bit crooked, terminating far behind the anus (Pl. XII, fig. 3).

Penis elongated, nearly straight, when mature measuring about 25 mm. in length, devoid of diverticle, connected with the duct of Needham's sac near the anterior end (Pl. XII, figs. 2, 6). Needham's sac long, bent into a Z-shape. Spermatophoric gland coils together with its accessory gland. Spermiduct thick, rather short.

Spermatophores about 90 mm. long, its opaque part 25–28 mm. long, consisting of 110–120 coils of sperm cord. Etui about 1 mm. thick at the aboral end, then very gradually tapering towards the oral end.

Measurements.

No. of specimen	i	ii	iii	iv	v	vi
Sex	♂	♂	♂	♀	♀	♀
Length, total	262 mm.	237 mm.	240 mm.	290 mm.	265 mm.	260 mm.
Ventral length of mantle	43 ,,	38 ,,	38 ,,	53 ,,	45 ,,	44 ,,
Eye to posterior end of body	49 ,,	49 ,,	45 ,,	60 ,,	52 ,,	51 ,,
Breadth of body	47 ,,	38 ,,	41 ,,	60 ,,	50 ,,	50 ,,
Breadth of head	36 ,,	35 ,,	35 ,,	40 ,,	41 ,,	39 ,,
Eye to umbrella margin	51 ,,	48 ,,	47 ,,	60 ,,	53 ,,	53 ,,
Length of first arms	Left mm. 197 / Right mm. 197	Left mm. 173 / Right mm. 173	Left mm. 185 / Right mm. 180	Left mm. 220 / Right mm. 220	Left mm. 200 / Right mm. 205	Left mm. — / Right mm. 190
,, ,, second arms	190 ,, / 185 ,,	162 ,, / 162 ,,	172 ,, / 172 ,,	220 ,, / 220 ,,	180 ,, / 185 ,,	175 ,, / 175 ,,
,, ,, third arms	175 ,, / 165 ,,	155 ,, / 140 ,,	142 ,, / 135 ,,	195 ,, / 193 ,,	170 ,, / 173 ,,	157 ,, / 157 ,,
,, ,, fourth arms	170 ,, / 167 ,,	155 ,, / 155 ,,	142 ,, / 142 ,,	185 ,, / 180 ,,	165 ,, / 165 ,,	157 ,, / 155 ,,
Radius of umbrella between first arms	42 mm.	42 mm.	35 mm.	50 mm.	41 mm.	45 mm.
,, ,, ,, ,, first and second arms	44 ,,	42 ,,	37 ,,	60 ,,	41 ,,	46 ,,
,, ,, ,, ,, second and third arms	43 ,,	41 ,,	35 ,,	60 ,,	40 ,,	46 ,,
,, ,, ,, ,, third and fourth arms	40 ,,	39 ,,	27 ,,	50 ,,	38 ,,	42 ,,
,, ,, ,, ,, fourth arms	32 ,,	23 ,,	23 ,,	30 ,,	25 ,,	30 ,,
Diameter of largest sucker of first arm	8.1 ,,	6.2 ,,	7 ,,	6 ,,	6 ,,	5 ,,
,, ,, ,, ,, ,, second arm	7.8 ,,	5.4 ,,	6 ,,	6 ,,	6 ,,	5 ,,
,, ,, ,, ,, ,, third arm	6.2 ,,	4.2 ,,	5.2 ,,	5.2 ,,	4.2 ,,	4.5 ,,
,, ,, ,, ,, ,, fourth arm	5.1 ,,	3.8 ,,	5 ,,	4.2 ,,	3.9 ,,	4 ,,

Remarks.—This species stands so very close to *Polypus longispadiceus* Sasaki that I could separate them with a great deal of hesitation. The principal differences between them are: (1) in the present species, no cirrus-like wart is found above the eye; (2) the penis is straight and not curved into C- or 6-shape as in that species; (3) the hectocotylized arm is decidedly shorter than the corresponding arm of the opposite side, and its terminal organ measures at most one-thirteenth the entire length of the arm; and (4) the suckers near the umbrella margin on the first and second arms are not so markedly enlarged as in that species.

It is also related to *Polypus tsugarensis* Sasaki, but differs from it at least by the warted surface, by the much softer consistency, by the more numerous branchial leaflets, by the longer hectocotylus, and by the much longer spermatophores.

Locality.—Off Kinkasan, Rikuzen Prov. 129 fms. (Albatross!); near Cape Clonard, Korea, 67–70 fms. (Albatross!); off Yon-hai, Korea, 150 fms. (Albatross!); near Oki Is.. 116 fms. (Albatross!).

Type locality.—Near Cape Clonard, Korea.

Type.—In U. S. not. Mus.

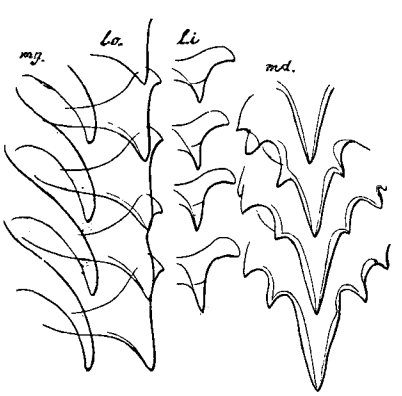
Polypus conispadiceus Sasaki, 1917.

(Pl. VI, figs. 2, 3; Pl. XII, figs. 7–9; textfigs. 41–43.)

Polypus conispadiceus, Sasaki 1917, p. 367; 1920, p. 176.

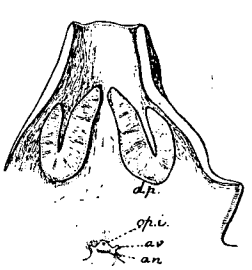
Of this species thirty-two specimens from various localities of Japan have been placed at my disposal, measuring up to 120 cm. in total length. The mated females and spermatophare-producing males measure more than 70 cm. in total length.

Consistency rather fleshy and a little firmer than in *P. döfleini* Wülker. Surface smooth and nearly polished except for some small faint warts sparsely scattered over the head. A single, distinct cirrus present above each eye. Body ovoidal a little longer than broad, widest near the middle, nicely rounded behind; belly flattened but often forming a longitudinal groove in the middle; periphery with neither streak-like tubercles nor horizontal ridge. Mantle-opening of moderate breadth, extending about half round the body.



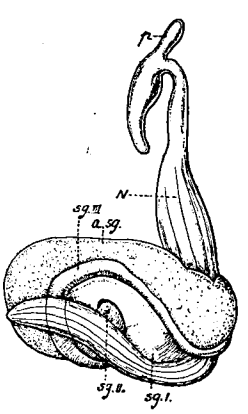
Textfig. 42.

Polypus conispadiceus. Middle portion of radula; ×30



Textfig. 41.

Polypus conispadiceus. Funnel, laid open; ×½.



Textfig. 43.

Polypus conispadiceus. Internal genital organs of male sex; ×½

Head decidedly narrower than body but proportionately broader than in *P. döfleini* Wülker, faintly marked off both anteriorly and posteriorly. Eyes only slightly, or scarcely at all prominent. Umbrella moderately and equally developed all round, but a little narrower between dorsal arms as well as between ventral arms; extending to seventh to ninth pair of suckers and then continued on along the ventral side a'most to the extremity as a broad contractile web.

Funnel short, conical, extending less than halfway to umbrella edge, weakly marked off at base. Funnel organ of moderate size, composed of two V-shaped pads clearly separated from each other,

their total breadth decidedly greater than the length, which is in turn a little shorter than the half the distance between anus to funnel extremity; situated equidistance from both these points; the inner lobe of each pad a little longer and broader than the outer (textfig. 41).

Arms equal in length but the ventral pair is a little shorter than the others which are about three times as long as the body and head taken together. All very thick at base, but thence evenly tapering off to attenuated extremities. Suckers rather small, cylindrical but a little expanded distally, somewhat sparsely set in two alternate rows except the first three, which are almost in a single straight line. On each arm they gradually increase in size to the tenth pair; the succeeding two or three pairs, which are slightly beyond the umbrella edge, attain the maximum size, followed by four or five pairs somewhat rapidly diminishing in size distad; beyond them the suckers become very gradually smaller toward extremity.

Right third arm prominently hectocotylized, tapering more rapidly at the distal part than at the proximal; its length at maturity measuring two-thirds that of the left third (Pl. VI, figs. 2, 3). Fully formed terminal organ conspicuous, vigorous, being 1/5—1/6 as long as the entire length of the arm, and nicely conical; its copulatory groove deep but narrow, furnished with fine, transverse striations. Spermatophoric groove of moderate wide, terminating in an acutely pointed conical calamus about one-eighth as long as the terminal organ. Suckers on the normal part number 26–29 pairs.

Branchial leaflets number 20–24 in each gill.

Anal valves slender. Whole course of ink-duct traceable on the surface of liver. Caecum of stomach a little involute (Pl. XII, fig. 8). Radula as shown in textfigure 42.

Mature ovary roundish, slightly expanded sideways, containing about 800 eggs, which measure up to 28 mm. in length. Vaginae a bit crooked, comparatively slender but terminating far behind the anus (Pl. XII, figs. 7, 9).

Penis cylindrical but sometimes a little expanded near the middle and sometimes a little curved, connected with the duct of Needham's sac at the part 1/4—1/3 from the anterior end; at maturity it measures about 40 mm. in length (textfig. 43). Fully formed Needham's sac well expanded, bent into an L-shape, containing up to 100 spermatophores. Spermatophoric gland coils together with its accessory gland.

Spermatophores 110–140 mm. long, their opaque part 40–60 mm. long, consisting of 46–63 coils of sperm cord.

Ground color when fresh pale grayish blue, covered with innumerable minute brownish chromatophores in all parts, and a number of small yellowish dots scattered over the dorsal surface of head and body. Formalin specimens mauve in color but the dorsal surface with faintly and irregularly marbled.

Juvenil form.—The smallest specimen examined, which measures 73 mm. in total length, differs from the fully formed individuals in having a thick, very loose, rather flabby, warty, evenly and finely wrinkled skin, yet agrees with them in the coloration, in the funnel organ, and in the number of the branchial leaflets. The right third arm is already affected by hectocotylization, much shorter than the left third; its terminal organ is about one-twenteeth the entire length of the arm.

Measurements of fresh Male Specimens Examined.

No. of specimen	i	ii	iii	iv	v	vi	vii	viii	ix	x
Length, total	900 mm.	740 mm.	740 mm.	740 mm.	720 mm.	690 mm.	660 mm.	660 mm.	630 mm.	560 mm.
Eye to body-end	210 ,,	190 ,,	190 ,,	160 ,,	160 ,,	180 ,,	160 ,,	160 ,,	160 ,,	150 ,,
Ventral length of mantle	155 ,,	140 ,,	140 ,,	125 ,,	120 ,,	140 ,,	120 ,,	100 ,,	120 ,,	100 ,,
Breadth of body	110 ,,	100 ,,	90 ,,	95 ,,	90 ,,	100 ,,	95 ,,	90 ,,	80 ,,	78 ,,
Breadth of head	80 ,,	70 ,,	60 ,,	68 ,,	—	65 ,,	60 ,,	60 ,,	55 ,,	50 ,,
Length of first arms	Left Right mm. mm. 600 600	Left Right mm. mm. 515 550	Left Right mm. mm. 375 400	Left Right mm. mm. 490 540	Left Right mm. mm. 410 490	Left Right mm. mm. 400 430	Left Right mm. mm. 450 430	Left Right mm. mm. — 480	Left Right mm. mm. 410 440	Left Right mm. mm. 400 —
,, ,, second arms	585 ,, 620 ,,	550 ,, 500 ,,	340 ,, 340 ,,	490 ,, 540 ,,	430 ,, 430 ,,	460 ,, 430 ,,	— 430 ,,	440 ,, 470 ,,	— —	400 ,, 395 ,,
,, ,, third arms	600 ,, 450 ,,	485 ,, 360 ,,	— 280 ,,	510 ,, 370 ,,	450 ,, 320 ,,	— 300 ,,	400 ,, 310 ,,	390 ,, 310 ,,	410 ,, 280 ,,	— 290 ,,
,, ,, fourth arms	570 ,, 520 ,,	490 ,, 490 ,,	340 ,, 340 ,,	370 ,, 420 ,,	430 ,, 520 ,,	— —	410 ,, 440 ,,	390 ,, 405 ,,	360 ,, 360 ,,	395 ,, 370 ,,
Length of hectocotylized part	70 mm.	53 mm.	60 mm.	60 mm.	45 mm.	63 mm.	55 mm.	45 mm.	48 mm.	38 mm.
Diameter of largest sucker of first arms...	20 ,,	15 ,,	15 ,,	16 ,,	15 ,,	15 ,,	15 ,,	12 ,,	13 ,,	12 ,,
,, ,, ,, ,, ,, second arms	20 ,,	15 ,,	14 ,,	17 ,,	15 ,,	15 ,,	15 ,,	14 ,,	13 ,,	12 ,,
,, ,, ,, ,, ,, third arms	20 ,,	13 ,,	16 ,,	17 ,,	15 ,,	13 ,,	14 ,,	13 ,,	13 ,,	11 ,,
,, ,, ,, ,, ,, fourth arms	18 ,,	16 ,,	15 ,,	16 ,,	15 ,,	14 ,,	14 ,,	13 ,,	13 ,,	11 ,,

Remark.—This species is distinguished with ease from all other known species by its vigorous, nicely conical hectocotylus. The juvenile individual has some resembrances to that of *P. döfleini* Wülker but is easily distinguished by the funnel organ, and by the branchial leaflets as well as by its bearing neither special tubercles on the dorsal surface nor special large chromatophores on the belly and ventral arms.

In two specimens caught by the "Albatross" the suckers are larger, more expanded distally, a little more closely set than in any of the other specimens examined by me (Pl. VI, figs. 2, 3). Moreover, the suckers on each arm are much more unequal, three or four pairs near the umbrella edge being specially enlarged.

Next to *P. döfleini* this is the commonest species in Hokkaido, and caught in plenty for the market.

Locality.—Sappro market (Sasaki); Oshoro, Hokkaido (!); Muroran (!); Tôkyo Bay (!); Okayama (!); Tsugaru Str., 47 fms. (Albatross!).

Type locality.—Sapporo market, Hokkaido.

Type.—In Hokkaido Imp. Univ.

Polypus hattai sp. nov.

(Pl. XII, fig. 10; textfigs. 44, 45.)

This species is based upon two males and three females from Kominato, Izu Prov. measuring up to 750 mm. in length.

Adult of moderate size and rather fleshy consistency firmer than in *Polypus valiabilis* n. sp. but softer than in *P. vulgalis.* Dorsal surface of head and body, as well as bases of the four dorsal arms all beset with low, ill-defined warts surrounded by faint circular grooves which are connected together into a network. Warts above each eye larger than the rest, especially so for the two or three in a longitudinal row, which are somewhat furuncle-like, bearing a white point in the centre.

Body oval in contour, longer than broad, broadest about the middle, rounded behind, its back moderately arched and the periphery bearing neither horizontal ridge nor streak-like tubercles; belly more or less flattened, provided with a faint longitudinal sulcus in the middle. Mantle-opening rather wide, extending ½—⅗ round the body.

Head small, about half as wide as body, faintly marked off behind but distinctly in front; its dorsal surface flattened. Eyes a little prominent.

Umbrella well developed, broadest betweenn three dorsal pairs of arms, narrowest between ventral arms, the longest radii equaling the body-length. Margin of umbrella continued along either side of each arm to the extremity as a broad fleshy contractile web.

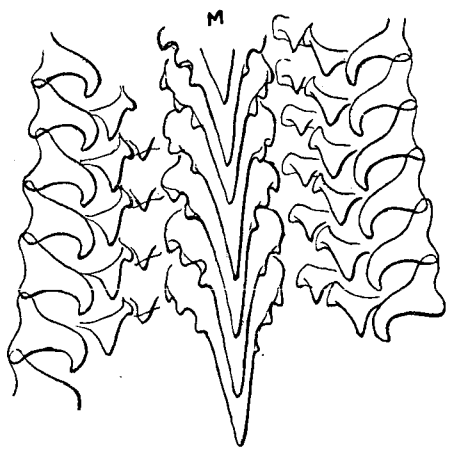
Funnel rather large, its distal half cylindrical, extending about two-thirds the distance from its proximal margin to the umbrella edge. Funnel organ about as long as broad, and longer than half the distance from anus to funnel extremity, situated about equidistance from both these points or a little more distally; nicely W-shaped, the fillet being narrow and its inner divisions longer than the outer (Pl. XII, fig. 10).

Arms long, unequal, the formula of length being $1>2>3>4$; the longest decidedly longer than twice the shortest, and about five times as long as body. All roughly quadrangular in section, the aboral surface bordered with a contractile web on either side. Suckers biserial, except first three or four on each arm, which are uniserial; varying in size in accordance with the arms on which they are situated; the largest sucker of the first arms about twice as large in diameter as that of the fourth. On each arm the suckers become larger to the tenth pair, and the succeeding five and six pairs are similarly the largest, thence they diminish in size gradually towards the extremity.

Right third arm hectocotylized, a little longer than half the left third, bearing 41 pairs of suckers on the normal part. Terminal organ small, measuring only about one-twentieth the entire length of

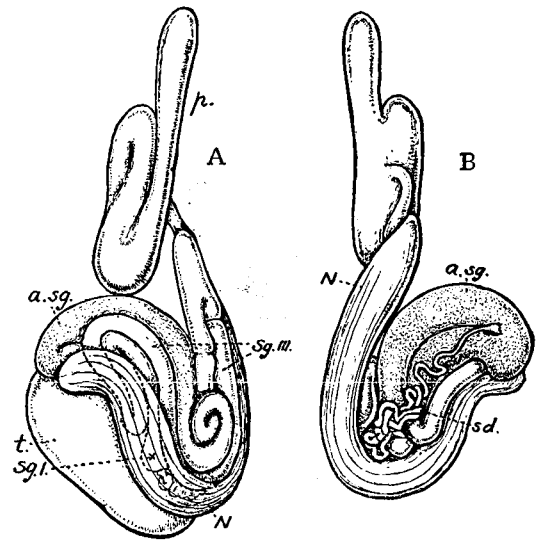
the arm even at maturity, a little flattened dorso-ventrally, the breadth at base being about one-third the length and then gradually narrowing to a quite blunt extremity; copulatory groove broad, smooth, without distinct transverse striations.

Gill composed of 25 or 26 leaflets. Anal valves of moderate size.



Textfig. 44.

Polypus hattae. Portion of radula; ×40.



Textfig. 45.

Polypus hattae. Internal genital organs of male sex; ×9/4 A. Outer aspect. B. Inner aspect; the testis is omitted.

Radula consists of seven rows of teeth as usual (textfig. 44). Median teeth characteristically slender. Outer lateral teeth with a short blunt cuspus at the inner end of the base in addition to the ordinary cuspus. Marginal teeth strongly bent at apex.

Penis large, measuring up to 35 mm. in length; roughly 6-shaped, a little thickened at the distal extremity; the rounded part consisting of the diverticle, elliptical in outline, flattened dorso-ventrally, two-thirds as long as the entire length (textfig. 45). The penis is connected with the duct of Needham's sac at one-third the length from the posterior end. Fully formed Needham's sac bent into U-shape. Spermiduct of far shorter course and much less winding than in *P. vulgaris*. Spermatophores 70 mm. long, the speam cord coiling about 50 turns.

Vaginae bent almost into an L-shape, terminating far behind the anus.

Measurements.

No. of specimen	i	ii	iii
Sex	♂	♂	♀
Length, total	720 mm.	550 mm.	490 mm.
Ventral length of body	85 ,,	72 ,,	55 ,,
Eye to body-end	120 ,,	90 ,,	20 ,,
Maximum breadth of body	72 ,,	45 ,,	46 ,,
Length of first arms	Left 550 mm. Right 560 mm.	Left — mm. Right 410 mm.	Left 370 mm. Right 360 mm.
,, ,, second arms	460 ,, 470 ,,	360 ,, 360 ,,	335 ,, 325 ,,
,, ,, third arms	425 ,, 240 ,,	280 ,, 175 ,,	270 ,, 285 ,,
,, ,, fourth arms	340 ,, 350 ,,	240 ,, —	220 ,, 240 ,,
,, ,, hectocotylized part	12 mm.	10.8 mm.	— mm.

No. of specimen	i	ii	iii
Sex	♂	♂	♀
Diameter of largest sucker of first arms	14 mm.	11 mm.	9 mm.
,, ,, ,, ,, ,, second arms	12 ,,	9 ,,	6 ,,
,, ,, ,, ,, ,, third arms	9 ,,	6 ,,	5 ,,
,, ,, ,, ,, ,, fourth arms	8 ,,	5·5 ,,	4 ,,
Radius of umbrella between first arms	85 ,,	55 ,,	40 ,,
,, ,, ,, ,, first and second arms ...	85 ,,	50 ,,	45 ,,
,, ,, ,, ,, second and third arms ...	80 ,,	45 ,,	45 ,,
,, ,, ,, ,, third and fourth arms ...	65 ,,	37 ,,	35 ,,
,, ,, ,, ,, fourth arms	60 ,,	35 ,,	32 ,,

Remarks.—This species stands near *P. varibilis* n. sp., but is clearly distinguished from it by the hectocotylization, by the penis, and by the spermatophores as well as by the funnel organ.

The species is frequently brought in plenty to Tôkyo market from its vicinity.

It is named in honour of Professor Hatta.

Type locality.—Kominato, Izu Prov.

Type.—In Hokkaido Imp. Univ.

Polypus alatus Sasaki, 1920.

(Pl. VI, fig. 4; Pl. XII, figs. 11, 12; textfig. 46.)

Polypus alatus, Sasaki 1920, p. 180, pl. xxiv, fig. 4.

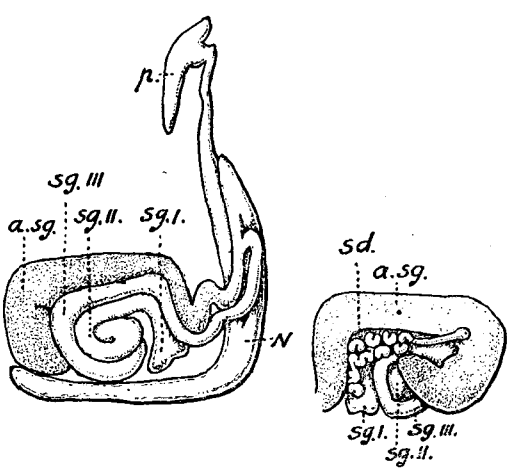
This species is based on two specimens found in the "Albatross" collection. Of these specimens one is sexually mature, measuring 44 cm. in length, and the other is immature and is 20 cm. long.

Surface quite smooth. Consistency somewhat firm and fleshy. Body compact, a little broader than long, broadest and truncated posteriorly, bordered with a horizontal ridge along the periphery. On the belly, there is formed one or two distinct longitudinal sulci (Pl. VI, fig. 4). Mantle-opening narrow, extending less than half round the body.

Head broad, but slightly narrower than body, marked off from body by a faint constriction. Eyes a little prominent.

Umbrella well developed; broadest between first arms as well as between first and second arms, narrowest between fourth arms, on an average extending for about one-fourth the length of arms, and then continued on along the ventral side almost to the extremity as a broad fleshy contractile web, which is rather broader at the distal part than at the proximal.

Funnel slender, extending a little more than halfway to the umbrella edge. Funnel organ small, slightly broader than long, one-third as long as the distance between anus and funnel extremity, situated about equidistance from both these points; W-shaped, the fillet being broadest at the outer divisions, which are about half as long as the inner (Pl. XII, fig. 11).



Textfig. 46.

Polypus alatus. Internal genital organs of the larger male referred to in the description; natural size.

Arms very unequal, the formula of length being $1>2>3>4$; the longest about five times the length of head and body measured together. Suckers small low, their margin being thin and folded; closely arranged in two well separate rows except several proximal ones which are in a single straight or zigzag row. On each arm, the suckers become larger to the vicinity of the umbrella margin, and then smaller towards the extremity, none being specially enlarged.

Right third arm hectocotylized, three-fourths as long as the left third, containing about 40–45 pairs of suckers on the normal part. Terminal organ comparatively thick and short, comprising a little less than one-twentieth of the entire length of the arm; roughly conical, and bluntly pointed; copulatory groove shallow but well defined, with numerous distinct transverse striations which extend on to the both margins of the groove (Pl. XII, fig. 12). Calamus minute, conical but bluntly pointed.

Penis elongated, fusiform, broadest in advance of the middle, where it is connected with the duct of Needham's sac (textfig. 46). The latter sac bent into an L-shape. Spermatophoric gland coils almost together with its accessory gland in a vertical plane. Spermiduct thick and of rather short course, greatly winding. Spermatophores 48. mm. long; very thin except the aboral end, which is markedly swollen, measuring 1.1 mm. in thickness; pellucid part 0.3 mm. thick.

Gill composed of 22 leaflets.

Caecum of stomach, elliptical in outline, a little involute.

Measurements.

No. of specimen	i		ii	
Length, total	440 mm.		200 mm.	
Ventral length of mantle	55 ,,		21 ,,	
Breadth of body	48 ,,		30 ,,	
Breadth of head	53 ,,		27 ,,	
Eye to posterior end of body	70 ,,		29 ,,	
Eye to umbrella edge	80 ,,		38 ,,	
Length of first arms	Left 340 mm.	Right 340 mm.	Left 152 mm.	Right 153 mm.
,, ,, second arms	260 ,,	326 ,,	143 ,,	—
,, ,, third arms	260 ,,	190 ,,	120 ,,	91 ,,
,, ,, fourth arms	260 ,,	260 ,,	114 ,,	114 ,,
Radius of umbrella between first arms	80 mm.		35 mm.	
,, ,, ,, ,, first and second arms	73 ,,		38 ,,	
,, ,, ,, ,, second and third arms	73 ,,		33 ,,	
,, ,, ,, ,, third and fourth arms	73 ,,		32 ,,	
,, ,, ,, ,, fourth arms	70 ,,		29 ,,	
Diameter of largest sucker of first arms	5 ,,		3 ,,	
,, ,, ,, ,, ,, second arms	5 ,,		2.7 ,,	
,, ,, ,, ,, ,, third arms	5 ,,		2.1 ,,	
,, ,, ,, ,, ,, fourth arms	5 ,,		2.1 ,,	
Length of hectocotylized part	9 ,,		4.8 ,,	

Remarks.—This species is somewhat related to *Polypus variabilis* n. sp., but differs from it (1) in the more closely set suckers, (2) in the W-shaped funnel organ, (3) in the broad contractile web along each arm, (4) in the more numerous suckers on the hectocotylized arm, (5) in the far smaller hectocotylized part, (6) in the fusiform penis, and (7) in the much thinner spermatophores.

Type locality—Bungo-suidô, 437 fms. (Albatross!);

Type.—In U. S. Nat. Mus.

Polypus variabilis sp. nov. **typicus** var. nov.

(Pl. I, fig. 9; Pl. III, fig. 21; Pl. XII, figs. 13, 14; textfig. 47, 48.)

Octopus macropus, Hoyle 1886b, pp. 11, 95.—Ortmann 1888, p. 643, pl. xxi, fig. 3.—Joubin 1897b, p. 99.—Sasaki 1920, p. 180.

Octopus cuvieri, Appellöf 1886, p. 6. pl. i, fig. 6.

Polypus macropus, Wülker 1910, p. 8.—Berry 1912b, p. 389.

? Octopus kagoshimensis, Ortmann 1888, p. 644, pl. xxi, fig. 2.

Of this species forty-two specimens from various localities have been pleced at my disposal. They measure up to 70 cm. in total length and 8 cm. in mantle length, the total length of sexually mature individuals being more than 50 cm.

Consistency very soft and more or less choroidal. Surface character greatly variable, due to different manners of preservation; in contracted specimens, it is quite uneven, wrinkled, and beset with unequal ill-defined warts irregularly spread over. The warts are easily slackened and flattened off so that in ill-preserved specimens the surface are quite smooth in all parts. Even in the latter case, however, there are found above each eye, 5–8, conical furuncle-like cirri, of which the largest is warty and stands slightly behind the pupil.

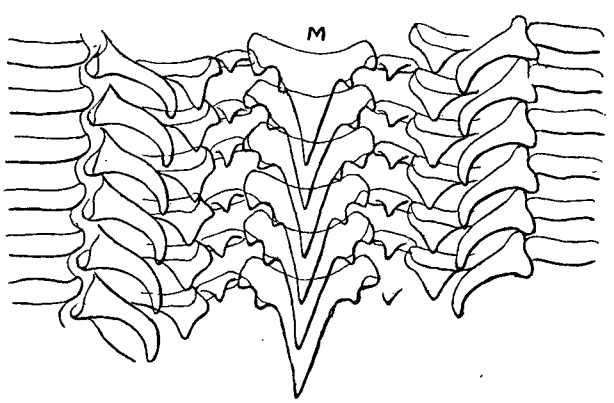
Body elongate-ovoidal, decidedly longer than or even twice as long as broad; its posterior end more or less acuminated but sometimes may be rounded; the back more convex than belly where no longitudinal groove is found in the middle; sides smooth, bearing neither horizontal ridge nor streak-like tubercles. Mantle-opening of moderate width, extending slightly more than half round the body.

Head about two-thirds as wide as body, marked off from head by a rather strong constriction. Umbrella poorly developed, narrowest between ventral arms, and broadest between dorsal arms, where its radius is nearly equal to the body-length.

Funnel large, its freely projecting part nearly cylindrical, extending fully halfway to the umbrella edge or even more forwards. Funnel organ small, consisting of two closely set V-shaped pads one-third as long as the distance from anus to funnel extremity, and situated very near the latter (Pl. XII, fig. 13). The anterior ends of each pad both sharply pointed; the posterior end also pointed but less acutely than the former.

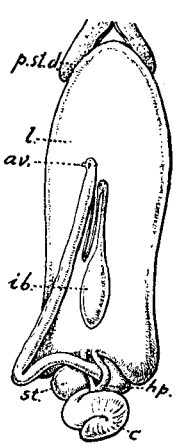
Arms very long, considerably unequal, in the formula $1>2>3\fallingdotseq4$. First arms exceedingly longer and stouter than the rest, the length measuring about twice that of third or fourth arms, and four to five times that of the head and body taken together. All four-sided at the proximal part, nearly cylindrical at the distal, provided with a ridge-like continuation of umbrella along either side.

Suckers prominent, a little expanded at the margin, which is by no means shrivelled; sparsely set in a double alternate row but first four or five on each arm arranged in a slightly zigzag line. They are often much larger in the male than in the female and also vary in size in accordance with the arms on which they are situated; the largest sucker of the first arm often being about twice as large in diameter as that of the fourth arm. On each arm, they become rapidly larger a little beyond the umbrella edge to the eighth or ninth pair of suckers, whence they diminish in size gradually towards the extremity.



Textfig. 47.

Polypus variabilis var. *typicus*. Portion of radula; ×36.



Textfig. 48.

Polypus variabils var. *typicus*. Part of digestive system; ×¾.

Right third arm prominently and peculiarly hectocotylized, at maturity being about half as long as the left third. Terminal organ conspicuous, nicely spoon-shaped, rounded distally, the lateral margins folded ventrally so as to enclose a deep, ample concavity which has 10–14, well-marked, transverse

grooves (Pl. III, fig. 21). Length of fully formed organ is 1/4—1/7 that of the whole arm. Spermatophoric groove broad, terminating in a comparatively large, bluntly pointed, conical calamus. Suckers on the normal part number 20–30 pairs.

Gill composed of 20–24 leaflets.

Radula as shown in textfigure 47.

Caecum of stomach a little turbinated. Liver elongate, its length two and a half times the breadth. Ink-duct not extended straight but forming a distinct loop in its course. (textfig. 48). Anal valves small.

Penis roughly retort-shaped or rather 6-shaped, with a very short straight extremity, and large ovoidal diverticle, this being connected with the duct of Needham's sac (Pl. XII, fig. 14). The latter sac when fully formed, bent into a U-shape.

Spermatophores about 42 mm. long and very thick throughout, measuring about 2.2 mm. in diameter at a short distance from the aboral end, then narrowing very gradually towards the oral end, where the diameter measures about 1.2 mm. Sperm cord occupies 1/3—3/8 of the entire length of etui, coiling about 40 turns. Discharging tube smooth, neither coiling nor bearing transverse streaks.

Fully formed ovary roundish, its eggs about 8 mm. long. Vaginae thick, short, nearly straight, their extremity as far distant from the anus as the gill-length. Oviducal ball hidden among visceral organs, consisting of about 27 radial sets of internal organs. Oviducal gland exceedingly developed, entirely enveloping receptacular gland, its epithelium greatly and finely folded. Receptacular gland far less extensive than the preceding, its epithelium nearly smooth.

Color greatly variable but ordinarily paler than in *P. vulgaris;* in formalin reddish drab to bluish brown and a little lighter beneath than above. While living, numerous light yellowish blotches ranging up to several millimeters are found on the dorsal surface (Pl. I, fig. 9).

Measurements.

No. of specimen	i	ii	iii	iv	v
Sex	♀	♀	♂	♂	♂
Length, total	578 mm.	675 mm.	560 mm.	525 mm.	450 mm.
Eye to posterior end of body	100 ,,	95 ,,	84 ,,	81 ,,	70 ,,
Ventral length of mantle	76 ,,	62 ,,	66 ,,	62 ,,	52 ,,
Breadth of body	43 ,,	38 ,,	44 ,,	43 ,,	28 ,,
Breadth of head	29 ,,	24 ,,	26 ,,	28 ,,	17 ,,
Eye to umbrella margin	60 ,,	55 ,,	50 ,,	47 ,,	42 ,,
Length of first arms	Left mm. 425 Right mm. 440	Left mm. 550 Right mm. 550	Left mm. 450 Right mm. 440	Left mm. 420 Right mm. —	Left mm. 356 Right mm. 360
,, ,, second arms	300 ,, 300 ,,	330 ,, 358 ,,	285 ,, 285 ,,	300 ,, 280 ,,	226 ,, 240 ,,
,, ,, third arms	238 ,, 235 ,,	135 ,, 137 ,,	235 ,, 133 ,,	215 ,, 105 ,,	200 ,, 115 ,,
,, ,, fourth arms	215 ,, 195 ,,	195 ,, 165 ,,	200 ,, 213 ,,	— —	180 ,, 198 ,,
Length of hectocotylized part	—	—	24 mm.	24 mm.	13 mm.
Diameter of largest sucker of first arms	8 mm.	5 mm.	14 ,,	12 ,,	4 ,,
,, ,, ,, ,, ,, second arms	5.3 ,,	4 ,,	6.5 ,,	5.5 ,,	2.7 ,,
,, ,, ,, ,, ,, third arms	4.5 ,,	3.2 ,,	4.5 ,,	5 ,,	2.6 ,,
,, ,, ,, ,, ,, fourth arms	4 ,,	3 ,,	4.5 ,,	4.5 ,,	2.5 ,,
Radius of umbrella between first arms	—	36 ,,	—	—	36 ,,
,, ,, ,, ,, first and second arms	—	36 ,,	—	—	35 ,,
,, ,, ,, ,, second and third arms	—	34 ,,	—	—	32 ,,
,, ,, ,, ,, third and fourth arms	—	20 ,,	—	—	20 ,,
,, ,, ,, ,, fourth arms	—	17 ,,	—	—	18 ,,

Variation.—*P. variabilis* n. sp. is very variable in various respects, hence so called specifically. In the present variety individual variation exists principally in the hectocotylization, the shape of the penis, the arrangement of suckers, and the distance of the two V-shaped pads of the funnel organ. Two male specimens obtained from Seto-umi have more numerous suckers (35 pairs) on the hectocotylized arm than the usual form and the hectocotylized part is a little shorter. In one of these specimens the penis is a little elongated, its posterior end being only slightly swollen and not enlarged to such an extent as to form the well marked diverticle. Of two specimens from Kônoura of Iki Prov. one has 37 pairs of suckers on the hectocotylized arm, and the two V-shaped pads of the funnel organ dicidedly separated from each other, while in the other specimen the suckers are more closely set than in the usual form and those on the hectocotylized arm umber 33 pairs.

Two specimens collected by the "Albatross" in Shimonoseki, and in Shimizu of Suruga respectively, are referred with a great deal of hesitation to the present species. Unlike the other specimens examined they are firm and fleshy in consistency and have each a compact and roundish body. The relative length of the arms are also more unequal than the usual form of the same size, and their suckers are less prominent and more thickly set, the hectocotylized part is conical and only one-seventeenth the entire length of the arm. The funnel organ is only slightly shorter than half the distance from anus to funnel extremity and is situated about equidistance from both these points. Their measurements and sex are shown in the following:—

Measurements.

No. of specimen	i		ii	
Sex	♂		♀	
Length, total	215(+) mm.		230 mm.	
Ventral length of mantle	24 ,,		28 ,,	
Eye to posterior end of body	29 ,,		32 ,,	
Breadth of body	22 ,,		30 ,,	
Breadth of head	19 ,,		21 ,,	
Eye to umbrella edge	25 ,,		28 ,,	
	Left	Right	Left	Right
Length of first arms	178(+) mm.	185(+) mm.	190 mm.	190 mm.
,, ,, second arms	145 ,,	150 ,,	160 ,,	—
,, ,, third arms	110 ,,	60 ,,	124 ,,	124 ,,
,, ,, fourth arms	86 ,,	86 ,,	106 ,,	106 ,,
Diameter of largest sucker of first arms	4 mm.		5.2 mm.	
,, ,, ,, ,, ,, second arms	2.2 ,,		2.5 ,,	
,, ,, ,, ,, ,, third arms	1.5 ,,		2.2 ,,	
,, ,, ,, ,, ,, fourth arms	1.4 ,,		2 ,,	
Radius of umbrella between first arms	ca. 25 ,,		33 ,,	
,, ,, ,, ,, first and second arms	ca. 20 ,,		33 ,,	
,, ,, ,, ,, second and third arms	ca. 16 ,,		28 ,,	
,, ,, ,, ,, third and fourth arms	ca. 14 ,,		24 ,,	
,, ,, ,, ,, fourth arms	ca. 14 ,,		22 ,,	
Length of hectocotylized part	3.5 ,,		—	

Remarks.—This variety has hitherto been referred to *Polypus macropus* Risso by most writers, although there are found numerous disagreements between them. According to the excellent illustrated description done by Jatta, in *P. macropus* (1) the funnel organ is distinctly and nicely W-shaped and not double V-shaped as in the present variety. (2) The hectocotylized part is small, being shorter than one-twentieth the entire length of the arm and it appears to be quite different in structure from that of the present variety, tapering to a pointed extremity and its copulatory groove not characteristically spacious. (3) The suckers are more numerous and much more closely packed together and

those on the hectocotylized arm number 70 pairs viz. about twice as many as the maximum number in the variety in question. These differences have at last compelled me to separate these two species.

What the *Octopus kagoshimensis* of Ortmann really was will probably always remain doubtful unless it is re-examined. I am rather inclined to consider that it is a juvenile specimen of the present variety.

This variety is commercially very important, being common in Honshu, especially in Seto-umi.

Locality.—Sakhaline, 42 fms. (Albatross!); Hakodate, Hokkaido (Berry); Aomori, Mutsu Prov. (Berry); Matsushima, Riduzen Prov. (Berry); Misaki, Sagami Prov. (Wülker); Yokohama (Hoyle); Tôkyo Bay (Ortmann);? Kadsiyama (Ortmann); Wakanoura (Berry); Nagasaki (?Ortmann; Appellöf); ?Kagoshima (Ortmann); Tôkyo market (!); Tôkyo Bay (!); Idzu Prov. (!); Shimizu, Suruga (Albatross!); Iki Prov. (!); Aichi Prefecture (!); Kohama, Wakasa Prov. (!); Osaka market (!); Bitchu Prov. (!); Kojima Bay (!); Tokushima (!); Shimonoseki (Albatross!); Beppu, Bungo Prov. (!); Nagasaki (Albatross!); off Osumi, 118 fms. (Albatross!); east of Tsushima, 66 fms. (Albatross!); Kantoshû (!).

Type locality.—Idzu Prov.

Type.—In Hokkaido Imp. Univ.

Polypus variabilis sp. nov. **pardalis** var. nov.

(Pl. XII, figs. 15, 16.)

This variety based on a male specimen obtained from Awa Prov. It is not yet sexually mature but already characterized enough to be separated from the typical variety.

Texture slightly firmer than the typical variety. Surface thickly beset with fine uniform warts. Above each eye there are found three conical, warted cirri. Body a little longer than broad rouuded behind, only slightly constricted behind; no distinct peripheral ridge present on sides nor longitudinal groove on belly. Mantle-opening extends half round the body.

Head slightly narrower than body, from which it is marked off by a merely slight constriction. Eyes scarcely at all prominent. Umbrella poorly and equally developed all round, extending only one-third up the arms to seventh pair of suckers. Funnel organ large, consisting of two well-separated, slenderly U-shaped pads; their length a little longer than the combined breadth and only slightly shorter than half the distance from anus to funnel extremity, lying about equidistance from both these points (Pl. XII, fig. 15).

Arms almost as in the typical variety, but their suckers more numerous, less prominent, and more closely set than in it. Suckers on hectocotylized arm number 55 pairs.

Branchial leaflets number 28 in each gill.

Penis elongated but slightly thickend at the posterior end, connected with Needhm's sac at a short distance from that end (Pl. XII, fig. 16). Needham's sac bent into an L-shape. Accessory spermatophoric gland circinate, the coil separated from that of spermatophoric gland.

Color in alcohol dark brown above, paler beneath, with well marked, characteristic paler patterns. Five of these patterns on the dorsal surface of body, much elongated, arranged in a transverse series so as to divide the surface almost into six equal parts. Patterns on arms, numerous, roundish, being 5–7 mm. across, biserially and regularly arranged at uniform intervals; they are more distinct on the more dorsal arm where they number at least 30 pairs.

Measurements.—total length 350 mm.; ventral length of mantle 40 mm.; eye to posterior end of body 50 mm.; breadth of body 37 mm.; breadth of head 35 mm.; length of left first arm 290 mm.; left second arm 220 mm.; left third arm 170 mm.; left fourth arm 180 mm.

Remarks.—This variety approaches *P. macropus* Risso more than the typical variety does, but yet differs from it in the funnel organ, in the patterns on the dorsal surface of the body and in the number of the suckers on the hectocotylized arm.

Type locality.—Awa Prov.

Type.—In Tokyo Imp. Univ.

Polypus variabilis sp. nov. **minor** var. Sasaki, 1920.

(Pl. XII, figs. 17–19; textfig. 49.)

Polipus macropus, var *minor*, Sasaki 1920, p. 181.

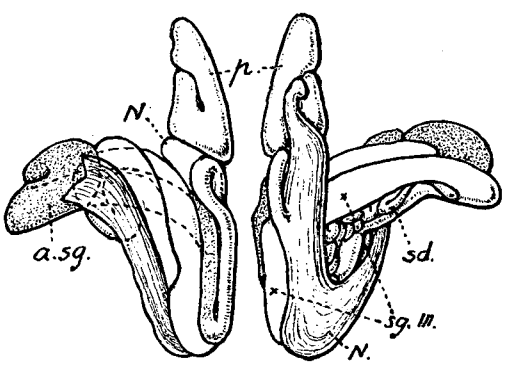
Surface faintly warted, rather soft to the touch. Body almost as in the typical variety but more strongly constricted in the anterior and more sharply pointed in the posterior end (Pl. XII, figs. 17, 18).

Head about as broad as body, concave above, marked off by strong constrictions both in front and behind. Freely projecting part of funnel slender. Funnel organ small, consisting of two, far separated, posteriorly acuminated, V-shaped pads, of which the inner lobe is ½—⅗ as long as the outer. The pads a little shorter than one-third the distance from anus to funnel extremity, situated slightly nearer to the latter than to the former (Pl. XII, fig. 16).

Arms almost as in the typical variety but relatively longer and the umbrella less extensive. Shape and arrangement of suckers as well as hectocotylization all also nearly as in the typical variety.

Gill composed of only 15–17 leaflets.

Penis comparatively large, a little coiled but roughly triangular in contour (texfig. 49). Spermatophores very much like those of the typical variety in structure but far smaller, the length being only 23 mm. and the thickness only 1 mm.; discharging tube 15 mm. long, smooth; sperm cord coils 19 turns.



Textfig. 49.

Polypus variabilis var. *minor*. Internal genital organs of mele sex; the testis is omitted; × 3.

Color grayish brown, much deeper above, irregularly marbled and striped in a deeper shade.

Measurements.

No. of specimen	i	ii
Sex	♂	♀
Length, total	182 mm.	158 mm.
Ventral length of mantle	20 ,,	17 ,,
Eyes to posterior end of body	29 ,,	20 ,,
Breadth of body	12.8 ,,	12 ,,
Breadth of head	12 ,,	11 ,,
Eyes to umbrella edge	11 ,,	14 ,,
Length of first arms	Left — mm. / Right 145 mm.	Left 95 mm. / Right 130 mm.
,, ,, second arms	115 ,, / 93 ,,	94 ,, / 92 ,,
,, ,, third arms	76 ,, / 38 ,,	66 ,, / 35 ,,
,, ,, fourth arms	65 ,, / —	— / —
Diameter of largest sucker of first arms	2.4 mm.	2.2 mm.
,, ,, ,, ,, ,, second arms	2.0 ,,	1.5 ,,
,, ,, ,, ,, ,, third arms	1.5 ,,	1.0 ,,
,, ,, ,, ,, ,, fourth arms	1.0 ,,	1.0 ,,
Radius of umbrella betw. first arms	14 ,,	—
,, ,, ,, ,, first and second arms	14 ,,	—
,, ,, ,, ,, second and third arms	12 ,,	—
,, ,, ,, ,, third and fourth arms	11 ,,	—
,, ,, ,, ,, fourth arms	8 ,,	—

Remarks.—This variety is based on two male specimens found in the "Albatross" collection and to which the above measurements are referred. Small as shown in those measurements, yet both the

specimens are already mature enough to produce spermatophores. Besides this fact, the shape of the funnel organ, the number of branchial leaflets, the shape of penis, and the size of spermatophores all shown disagreement with those of the typical variety.

Type locality.—Near Omai-saki, Suruga Bay, 47 fms. (Albatross!).

Type.—In U. S. Nat. Mus.

Polypus tenuipulvinus Sasaki, 1920.

(Pl. V, fig. 9; Pl. XII, fig. 20.)

Polypus tenuipulvinus, Sasaki 1920, p. 182, pl. xxiv, fig. 5.

Consistency firm and fleshy. Skin wrinkled in all parts, dorsal surface finely tessellated by innumerable crossed grooves; the fasets thus formed bear each a faint wart at the center. Besides, there are found some number of larger tubercles somewhat regularly distributed almost as in *P. vulgalis*.

Body compact, as long as broad, widest near the middle, somewhat truncated behind (Pl. V, fig. 9); moderately convex above, devoid of horizontal ridge around the periphory. Belly also convex, but with a shallow longitudinal sulcus in the middle.

Head a little narrower than body, marked off by constrictions both in front and behind. Eyes a little prominent. Umbrella poorly and equally developed all round. Funnel slender, extending a little more than halfway to umbrella edge. Funnel organ peculiarly characterized, consisting of two, slender, longitudinal, a bit crooked pads, which begin at the funnel extremity where they are connected with each other (Pl. XII, fig. 20). From that point they slightly diverging and widening posteriad, extend two-thirds down the distance to the anus, and then sharply turn back one-third their length, so as to form two hook-shaped ridges lying back to back.

Arms unequal, the formula of length being $1>2>3>4$ in the right side and $2>3\fallingdotseq 1>4$ in the left; the longest about twice the shortest, and about one-seventh the body-length. All roundish in section throughout, devoid of even a trace of contractile web on either side. Suckers small, prominent not expanded at the margin, which is thick and not shrivelled; rather sparsely set in two rows but at the base of arms, in a zigzag line. None of suckers specially enlarged on any arm, all gradually increasing in size to the ninth or tenth pair, then decreasing even more gradually towards the extremity.

Hectocotylization not observed, the specimen examined being female.

Radula also not examined. Caecum of stomach elongated, but bent into an L-shape. Gill composed of 16 leaflets.

Vaginae thick, straight, terminating far behind the anus.

Measurements.

Length, total	155 mm.	
Ventral length of mantle	19 „	
Eye to posterior end of body	22.5 „	
Breadth of mantle	20 „	
Breadth of head.	16 „	
	Left	Right
Length of first arms	95 mm.	105 mm.
„ „ second arms	135 „	95 „
„ „ third arms	97 „	90 „
„ „ fourth arms	73 „	70 „
Radius of umbrella between first arms	15 mm.	
„ „ „ „ first and second arms	16 „	
„ „ „ „ second and third arms	17 „	
„ „ „ „ third and fourth arms	15 „	
„ „ „ „ fourth arms	15 „	

Diameter of largest sucker of first arms...	2.1 mm.	2.1 mm.
„ „ „ „ „ second arms	2.6 „	2.5 „
„ „ „ „ „ third arms	2.0 „	2.0 „
„ „ „ „ „ fourth arms	1.6 „	1.6 „

Remarks.—The species is based upon a single female found in the "Albatross" collection. The ovary of the specimen is already relatively large, being about 10 mm. broad; its eggs appear to be nearly mature, attaining a length of about 3 mm.

The specimen is separated with some hesitation from *P. variabilis* n. sp. The principal differences from it lie (1) in the funnel organ, (2) in the surface ornamentation, (3) in the umbrella, and (4) in the shape of body as well as (5) in the number of branchial leaflets.

Type locality.—Sagami Sea, 70 fms. (Albatross!).

Type.—In U. S. Nat. Mus.

Polpus globosus (Appellöf, 1886).

(Pl. XII, figs. 21, 22; textfigs. 50–53.)

Octopus globosus, Appellöf 1886, p. 7, pl. i, figs. 4, 5.—Ortmann 1888, p. 662.—Ortmann 1891, p. 669. (pars).—Goodrich 1896, p. 19, pl. v, fig. 81.—Joubin 1897b, p. 98.—? Appellöf 1898, p. 565.

Polypus globosus, Hoyle 1909, p. 259.—Berry 1912b, p. 388.

Two male and six female specimens from various localities are in hand, being referred with little hesitation to the present species. They measure up to 25 cm. in total length, sexually mature individuals being over 19 cm. long.

Dorsal and lateral surfaces sparsely and irregularly beset with low conical pustula-like warts of various sizes (Pl. XII, fig. 21). Between the warts the skin is quite smooth and very rarely wrinkled except a few creases at the nape. Above each eye there are found five to seven of such warts, crowded together, of which two or three exceed in size and represent the usual cirri.

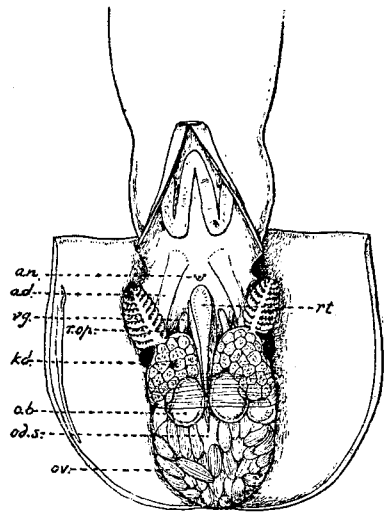
Body compact, globose, but ordinarily a little longer than broad and a little flattened dorso-ventrally; the posterior end nicely rounded. Neither horizontal ridge nor streak like tubercles developed around the periphery, but a faint groove formed along the mid-ventral line. Mantle-opening rather narrow, scarcely extending half round the body.

Head large, only a little narrower than, or even as broad as, body; flattened above, marked off by weak constrictions both in front and behind. Eyes but little prominent. Umbrella of moderate breadth, its radii about equal and 1/5—1/7 as long as arms except that between ventral arms which is decidedly shorter than the others.

Funnel conical, of moderate size, extending about halfway to umbrella margin. Funnel organ conspicuous, longer than broad, and two-fifths as long as the distance from anus to funnel extremity; situated nearer to the latter than to the former; W-shaped, consisting of a fillet of moderate and uniform breadth, of which the angles of bend are all rounded, and of which the inner divisions a little longer than the outer (textfig. 50).

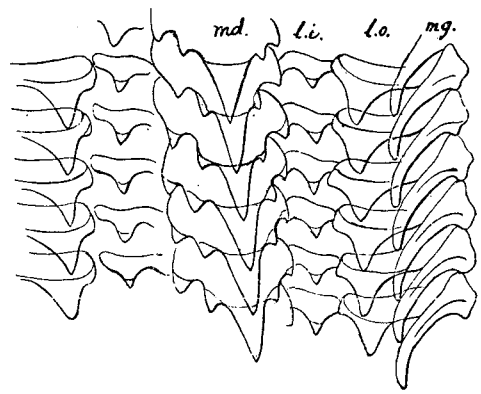
Arms unequal, the formula of length ordinarily $1>2>3>4$; the longest about a half as long again as the shortest, and four to five times the body-length. All squarish or roundish in section, devoid of contractile web on either side. Suckers somewhat prominent, cylindrical, not expanded at the margin which is firm, thick, and not shrivelled. They number 170 or more on the first and also on the second arm, and 150 or more on the third arm as well as on the fourth; rather thickly set in two series even to the base of arms. They show a similar respect as to their size in all arms; none attain any special enlargement on any arm, but they become very gradually larger to the umbrella edge and then smaller even more gradually towards the extremity; the suckers at the base of arms are not so small as usually met with in other octopi.

In the largest male examined, which measures 170 mm. in total length, and in which the spermatophores not yet developed the hectocotylized arm is about two-thirds as long as the corresponding arm of the opposite side, the distal one-fifteenth being represented by the terminal organ. This organ



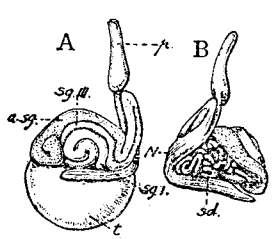
Textfig. 50.

Polypus globosus. Mantle and funnel laid open; ×4/3



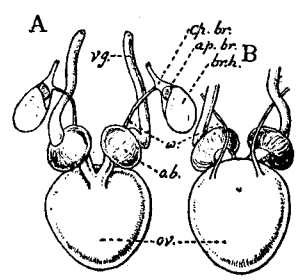
Textfig. 51.

Polypus globosus. Part of radula; ×61.



Textfig. 52.

Polypus globosus. Internal genital organs of male sex; ×4/3. A. Outer aspect. B. Inner aspect; the testis is omitted.



Textfig. 53.

Polypus globosus. Internal genital organs of female sex; ×4/3. A. Vental view. B. Dorsal view.

roughly conical, somewhat expanded at base; copulatory groove wide and deep, furnished with a pinnate ridge, the rami of which number about 15 on either side (Pl. XII, fig. 22). Spermatophoric groove wide, well-defined, terminating in a conical calamus about one-third as long as the terminal organ. Suckers on the normal part number about 38 pairs.

Branchial leaflets number 17–19 in each gill.

Radula as shown in textfigure 51. Caecum of stomach rounded, a little turbinate, coiling one turn and a half. Posterior salivary glands paired as usual but invariably coming into a close contact with each other, altogether being a placoid shape; their duct united at the central part of head. Entire course of ink-duct traceable on the surface of liver.

Penis in the largest male alluded to elongated, slightly expanded posteriorly; rounded on both sides, connected with the duct of Needham's sac near the posterior end (textfig. 52). Accessory spermatophoric gland circinate, its coil quite separated from that of spermatophoric gland.

Fully formed ovary as long as or even longer than broad; its eggs less than 100 in number, and large, measuring 10 mm. in length. Oviduct very thick and short only a bit crooked, their distal extremity distant from anus as far as the gill-length (textfig. 53). Oviducal ball very large, situated near togethe in front of ovary.

Color in alcohol uniformly drab, lighter below.

Measurements.

No. of specimen	i	ii	iii
Sex	♀	♀	♂
Length, total	195 mm.	150 mm.	170 mm.
Ventral length of mantle	40 ,,	24 ,,	28 ,,
Breadth of body	25 ,,	20 ,,	21 ,,
Breadth of head	22 ,,	20 ,,	20 ,,
Eye to Posterior end of body	45 ,,	32 ,,	30 ,,
Eye to umbrella edge	40 ,,	26 ,,	29 ,,
Length of first arms	Left 150 mm. Right 150 mm.	Left 116 mm. Right 116 mm.	Left 133 mm. Right — mm.
,, ,, second arms	140 ,, 140 ,,	98 ,, 106 ,,	123 ,, 108 ,,
,, ,, third arms	120 ,, 120 ,,	85 ,, 85 ,,	106 ,, 70 ,,
,, ,, forth arms	110 ,, 115 ,,	85 ,, 85 ,,	98 ,, 113 ,,
Radius of umbrella between first arms	22 mm.	20 mm.	23 mm.
,, ,, ,, ,, first and second arms	22 ,,	20 ,,	23 ,,
,, ,, ,, ,, second and third arms	22 ,,	20 ,,	23 ,,
,, ,, ,, ,, third and fourth arms	22 ,,	20 ,,	22 ,,
,, ,, ,, ,, fourth arms	15 ,,	18 ,,	18 ,,
Diameter of largest sucker of each arm	2.8 ,,	2 ,,	2 ,,

Remarks.—The specimens at my disposal differ from Appellöf's description in a few points: he states that the arm order is 2, 4, 1, 3, or 2, 1, 4, 3, and that the neck contriction is strong.

This species shows a resemblance to *P. variabilis* n. sp., but differs from it principally in the surface ornamentation, in the genital, and funnel organ. Further, the arms are not so considerably unequal as in that species.

Locality.—Nagasaki (Appellöf; Joubin); Nicobars (Goodrich); Kabusa Is. (Goodrich); Malacca Str. (Goodrich); Bombay (Goodrich); Ceylon (Goodrich); Ternate (Appellöf); Sagami Prov. (!); Wakasa Prov. (!); Nagasaki (!); Fukuoka (!); Kagoshima (!).

Polypus salebrosus Sasaki, 1920.

(Pl. VI, figs. 5, 6; textfig. 54.)

Polypus salebrosus, Sasaki 1920, p. 182.

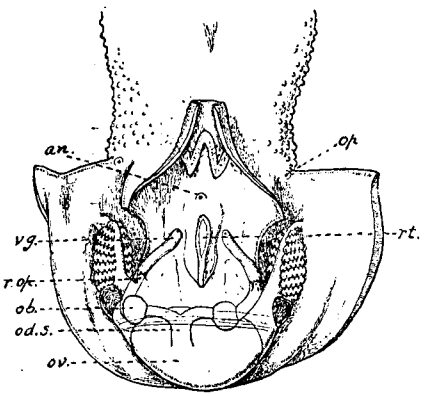
This species is based on two females found in the "Albatross" collection. The larger of these specimens seems almost mature, the ovary being fairly large in comparison to the body, and its eggs measuring 7 mm. in length.

Skin rather loose, soft. Surface quite rough in all parts, being thickly baset with coarse, well-defined, characterstic round-headed warts of various shapes, which on the lateral and ventral surface of body run together and arrange themselves in longitudinal lines (Pl. VI, figs. 5, 6).

Body subglobose, widest near the middle, rounded posteriorly, moderately vaulted above; sides bearing neither horizontal keel nor streak-like tubercles around the periphery; belly evenly convex, but slightly depressed in the middle. Mantle-opening of moderate breadth, extending just half round the body.

Head broad, but narrower than body. Neck constriction weak. Eyes a little prominent. Umbrella thick, fleshy, extending for about one-third the length of arms, but between the ventral arms its extent is only ¼—⅕ their length. Funnel short, extending less than halfway to umbrella edge. Funnel organ of moderate size, as broad as its own length, which is in turn about half the distance

from anus to funnel extremity; situated slightly nearer to the former than to the latter; W-shaped, consisting of a fillet of moderate and uniform breadth; the inner divisions decidedly longer than the outer (textfig. 54).



Textfig. 54.

Polypus salebrosus. Mantle and funnel, laid open; ×⅔.

Arms subequal, the formula of length being 4>3>2>1, the longest about two or two and a half times as long as body. All conical, thick at base, then rapidly tapering off towards extremities, destitute of a contractile web on either side. Suckers only a little prominent, their distal margin thick and not expanded at all, rather sparsely set in two alternate rows but at the base of arms they are more sparse and the first three or four are in a single line. The size of suckers does not vary in different arms. On each arm they become gradually larger to the vicinity of the umbrella edge, and then smaller also gradually towards the extremity.

Hectocotylus not observed, the specimens examined being female. Radula also not examined.

Ovary much more expanded sideways than lengthwise. Vaginae thick, slightly curved, terminating far behind the anus.

Gill composed of 19 leaflets.

Color in alcohol uniformly light cardinal to claret throughout.

Measurements.

No. of specimen	i	ii
Sex	♂	♀
Length, total	153 mm.	77 mm.
Ventral length of mantle	40 ,,	17.5 ,,
Eye to posterior end of body	45 ,,	23 ,,
Breadth of body	46 ,,	21 ,,
Breadth of head	38 ,,	21 ,,
Eye to umbrella edge	35 ,,	20 ,,
Length of first arms	Left — mm. Right 75 mm.	Left 41 mm. Right 40 mm.
,, ,, second arms	86 ,, 81 ,,	43 ,, 44 ,,
,, ,, third arms	94 ,, 87 ,,	44 ,, 45 ,,
,, ,, fourth arms	100 ,, 95 ,,	45 ,, 45 ,,
Radius of umbrella between first arms	26 mm.	15 mm.
,, ,, ,, ,, first and second arms	26 ,,	15 ,,
,, ,, ,, ,, second and third arms	26 ,,	15 ,,
,, ,, ,, ,, third and fourth arms	28 ,,	15 ,,
,, ,, ,, ,, fourth arms	20 ,,	12 ,,
Diameter of largest sucker of first arms	4 ,,	1.8 ,,
,, ,, ,, ,, ,, second arms	4 ,,	1.8 ,,
,, ,, ,, ,, ,, third arms	4 ,,	1.8 ,,
,, ,, ,, ,, ,, fourth arms	4.2 ,,	1.8 ,,

Remarks.—The establishment of this species is more than usually satisfactory, since the specimens referred to are excellently preserved and so well characterized by the surface ornamentation and the shape of arms that in these respects there is no agreement with any of species hitherto known.

Locality.—Off Kinkasan, Rikuzen Prov., 266 fms. (Albatross!); Okhotsk Sea, 440 fms. (Albatross!).

Type locality.—Off Kinkasan Rikuzen Prov.

Type.—In U. S. Nat. Mus.

Polypus validus Sasaki, 1920.

(Pl. VI, figs. 7–9; Pl. XII, fig. 23.)

Polypus validus, Sasaki 1920, p. 183, pl. xxiv, fig. 3.

The type specimen of this species collected by the "Albatross" is an adult male 20 cm. long.

Consistency rather firm, fleshy. Smooth skin found at the ventral surface of head, mid-ventral region of body, margin of umbrella, distal part of three dorsal pairs of arms and whole surface of the ventral arms. In the remaining parts the surface is beset with innumerable, conspicuous, peculiar, nearly stelliform warts composed of several lugosities each, and so well defined that the skin between them is quite smooth and even (Pl. VI, fig. 7). The warts above head and body relatively large, and somewhat separated from one another, becoming smaller, and more closely set laterad and then ventrad, thus they attain a minimum size and closest distribution along the marginal zone of the warted area, the transition from the warty to smooth condition taking place somewhat suddenly (Pl. VI, fig. 8).

Body slightly broader than long, a little flattened dorso-ventrally, broadest near the middle; posterior end faintly pointed. No horizontal keel developed along the periphery but a deep median longitudinal sulcus formed on belly. Mantle-opening of moderate breadth, extending half round the body.

Head broad, but a little narrower than body. Neck constriction very weak. Eyes scarcely at all prominent though their balls appear large. Umbrella of moderate and uniform breadth all round, extending about a quarter up the arms, then continued on along either side to the extremity as a ridge. Funnel short. Funnel organ not examined.

Arms subequal, the formula of length $1>2>3>4$; the longest a little longer than thrice the body-length. All proximally aquarish in section, but roundish distally, tapering to subtile extremeties. Suckers prominent, not expanded at the distal margin, which is neither shrivelled nor folded; arranged in two series, except the first four or five which are in a zigzag line (Pl. VI, fig. 9). The size of suckers does not vary according to the arm. On each arm they become somewhat rapidly larger to the tenth pair; from this to the forteenth pair are the largest, situated near the umbrella edge; then they diminish gradually towards the extremity.

Right third arm prominently hectocotylized, robust, much shorter and thicker than the left third, terminating quite abruptly (Pl. XII, fig. 23). Terminal organ short, thick, rigid, a little flattened dorso-ventrally, somewhat narrowing distad but the extremity is quite blunt. Copulatory groove smooth, widely and deeply excavated, marked off on sides by sharp folds. Spermatophoric groove wide, terminating in a conical calamus about one-fifth as long as the terminal organ. Suckers on the normal part number 22 pairs.

Branchial leaflets number only 15 in each gill.

Penis large, measuring 20 mm. by 4 mm., cylindrical but slightly thickened at the posterior end, connected with the duct of Needham's sac near the anterior end. Spermatophores 48 mm. long; its diameter 1.4 mm. at the aboral part, then quite gradually diminishing into 0.8 mm. at the oral end.

Measurements.

Length, total	184 mm.	
Ventral length of mantle	39 „	
Eye to posterior end of body	45 „	
Breadth of body	44 „	
Breadth of head	42 „	
	Left	Right
Length of first arms	130 mm.	130 mm.
„ „ second arms	125 „	123 „
„ „ third arms	120 „	88 „
„ „ fourth arms	117 „	120 „

Radius of umbrella between first arms	30 mm.
„ „ „ „ first and second arms	34 „
„ „ „ „ second and third arms	35 „
„ „ „ „ third and fourth arms	30 „
„ „ „ „ fourth arms	23 „
Diameter of largest sucker on each arm	3.5 „

Remarks.—This species resembles *P. californicus* Berry in the surface ornamentation but quite differs from it in hectocotylization and in the shape of suckers. The specific name "validus" is in reference to the robust build of the hectocotylized arm.

Type locality.—Near Koshiki I. Satsuma Prov., 424 fms. (Albatross!).

Type.—In U. S. Nat. Mus.

Genus **Scaeurgus** Troschel, 1857.

Scaeurgus, Troschel 1857, p. 51; 1858, pp. 299–302.—Tryon 1879, p. 127.—Hoyle 1886b, p. 14.—Steenstrup 1887a, pp. 95, 103.—Jatta 1896, pp. 50, 230.—Berry 1914a, p. 304.

Octopus (pars), Fer. et d'Orb. 1835, p. 17.—Gray 1849, pp. 11, 19.—Verany 1851, pp. 22, 25.—Tryon 1879, p. 121.

A pair of subtile horny stylets present internally. Left third arm hectocotylized. First part of spermatophoric gland marked off from the remaining part by a strong constriction at least in the Japanese specimen examined by me.

Type.—*Scaeurgus titanotus* Troschel, 1857.

Scaeurgus patagiatus Berry, 1913.

(Pl. XII, figs. 24, 25; textfigs. 55, 56.)

Scaeurgus sp., Berry 1909, p. 418.

Scaeurgus patagiatus Berry 1913c, p. 564; 1914a, p. 305, pl. xlvii, figs. 2, 3, pl. xlviii. fig. 1, textfig. 19.—Sasaki 1920, p. 184.

A mature male found in the "Albatross" collection is referred with some doubt to the present species. The following description is applicable to that specimen.

Consistency firm and fleshy. Surface, except the ventral side of head, thickly beset with rounded, well-defined warts, of which the thickest distribution is above the body and the inter- and post-orbital region of the head. The warts behind the body are the largest, though rather ill-marked, the best defined ones being above it; those around and between the eyes are the smallest, yet clearly marked. The warts on the belly and periphery of body and sometimes also on its back, show a tendency to run together and arrange themselves in longitudinal series. A single, roughly semilunar, lamelliform, warted cirrus present above each eye behind the pupil, but none is perceptible in front of it. Neither special tubercles nor ridges are perceptible above the body, but on each arm are found some in a longitudinal series along the aboral surface.

Body compact, nearly as broad as long, widest near the middle, rounded behind, its back rather highly arched; belly flat, but with a shallow longitudinal sulcus in the middle. A faint interrupted keel developed around the periphery. Mantle-opening wide, extending a little more than half round the body.

Head rather small, about two-thirds as broad as body, marked off by weak constrictions both in front and behind. Eyes prominent. Umbrella well developed, of nearly uniform breadth all round, but a little narrower between dorsal arms as well as between ventral arms. Between the lateral arms it extends about a quarter up the arms. Margin of umbrella continued along the ventral side of arms to the extremity as a contractile web.

Funnel small, nicely conical, well marked off even at base, extending less than half way to um-

brella edge. Funnel organ large, as broad as long, and half as long as the distance from anus to funnel extremity, situated slightly nearer to the latter than to the former; nicely W-shaped, consisting of a rather narrow fillet; the outer divisions slightly shorter than the inner (Pl. XII, fig. 24).

Arms subequal, the formula of length 2>4>3>1; three to four times as long as body. All regularly and gradually taper to subtile extremities, but coiled and folded upon themselves in the preserved state, owing to the contraction of contractile webs. Suckers about 90 pairs in number, prominent, each with a thin expanded margin, which is sharply warped and turn inwards probably due to contraction caused by alcohol; rather closely set biserially except at the base of arms, where they are sparse and in a zigzag line. On each arm they become rapidly larger to the seventh pair; this and next pair is especially enlarged and situated just opposite to the umbrella edge, whence they diminish in size distally, for some extent rapidly but very gradually afterwards.

Left third arm prominently hectocotylized, about four-fifths as long as the left third, and the distal one-tenth being occupied by the terminal organ. This organ nicely spoon-shaped but the lateral margins heavily curve and turn inwards so as to effect the whole apperance to be conoid-cylindraceous (textfig, 55). The copulatory groove thus enclosed by the margins is very deep and ample, lined with a nearly smooth skin. Spermatophoric canal, deep, well-defined, marked by innumerable striations; in this condition it is continued on to the calamus, which is conspicuous, attaining two-fifths the entire length of the terminal organ, shaply pointed, and deeply furrowed. Suckers on the normal part number 38 pairs.

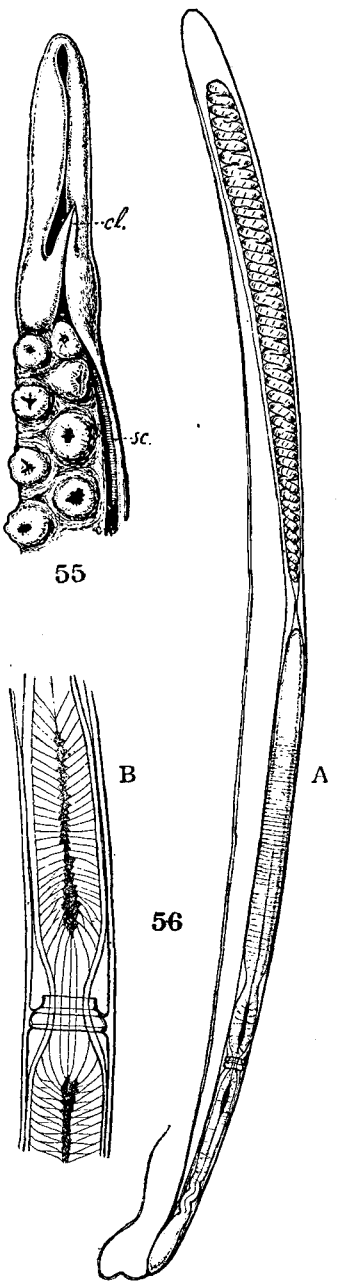
Branchial leaflets number 25 in each gill.

No radula nor horny stylets examined.

Penis situated to the left side of the median line as in *Polypus;* slender and cylindrical but bent into the shape of a U, of which the right ramus is longer than the left (Pl. XII, fig. 25). Fully-formed Needham's sac bent into an L-shape, its duct connected with the left ramus of the penis at some distance from the free extremity. First part of spermatophoric gland, pyriform, separated from its remaining part by a strong constriction.

Spermatophores 50 mm. long; its two-fifths occupied by the opaque part consisting of 40–46 coils of sperm cord (textfig. 56). The broadest part of etui situated in the opaque part at a short distance from the aboral end, measuring about 1.5 mm. in diameter, and then it narrows quite gradually toward the oral end, but slightly constricted at the origin of the pellucid part; the diameter near the aboral end is about 1. mm. The discharging sheath shows no spiral turns except a weak curve near the oral end; to the oral side of the midway along its length there is formed a fusiform division by two distiuct constrictions.

Color in alcohol, drab for the most part, faintly marbled with a light chocorate of various tones.



Textfig. 55.

Scaeurgus patagiatus. Hectocotylus; × 10/3.

Textfig. 56.

Scaeurgus patagiatus. Spermatophore. A. Total view; × 10/3. B. Portion of pellucid part; × 13.

Measuremen

Length, total	235 mm.
Ventral length of mantle	45 „
Eye to posterior end of body	57 „

Breadth of body.		46 mm.
Breadth of head.		33 „
Eye to umbrella margin		53 „
	Left	Right
Length of first arms	140 mm.	150 mm.
„ „ second arms	170 „	172 „
„ „ third arms	125 „	160 „
„ „ fourth arms	165 „	165 „
Diameter of largest sucker of first arms		9 mm.
„ „ „ „ „ secoud arms		10.8 „
„ „ „ „ „ third arms		10.8 „
„ „ „ „ „ fourth arms		10 „
Radius of umbrella between first arms		34 „
„ „ „ „ first and second arms		42 „
„ „ „ „ second and third arms		42 „
„ „ „ „ third and fourth arms		42 „
„ „ „ „ fourth arms		34 „
Length of hectocotylized part		12 „

Remarks.—The specimen referred to is much larger than those shown by Berry and disagrees with his discription in some respects: (1) no ridge-like folds are found above the body, nor any vertical papilla behind it; (2) the supraorbital cirri are not two in number but only one; (3) the umbrella is not broadest at the dorsal part but at the lateral parts; (4) the specially enlarged suckers are found not only on the third arms but also on all the other pairs; (5) the calamus of the hectocotylus is decidedly shorter than half the entire length. As far as the first three characteristics are concerned the specimen in question rather approaches Jatta's illustrations of *S. unicirrus* Delle Chiajē, but distinctly differs from it in the funnel organ and in the number of the suckers on the hectocotylized arm.

Locality.—Hawaiian Is. (Berry); south of Kyûshû, 165 fms. (Albatross!).

Suborder **Decapoda** Leach, 1817.

Sephinia, Rafinesque 1815 (fide Gray).—Gray 1849, pp. 2, 35.

Decapoda, Leach 1817, p. 137*).—d'Orb. in d'Orb. & Fér. 1835, p. 219.—d'Orb. 1845, p. 236.—Gray 1849, p. 205.—Verany 1851, p. 55.—Adams H. & A. 1858, p. 25.—Keferstein 1866, p. 1438.—Tryon 1879, pp. 101, 102.—Berry 1914a, p. 307; 1920, p. 149.—Naef 1921, p. 527.

Decacera, de Blainville 1824 (fide Verrill).—Verrill 1881c, p. 426; 1882, p. 285.

Body ordinarily slender, and pointed behind. Fins invariably developed. Head and mantle sometimes continuous at nape, but more often separated, the nape bearing a cartilaginous locking apparatus (nuchal cartilage). Funnel base also furnished with a pair of cartilaginous locking apparatus (funnel cartilages), fitting over the corresponsing cartilaginous protuberances of mantle (mantle cartilages). Usually a calcareous or horny longitudinal skeleton present, hidden in the dorsal part of mantle, but in *Spirula* it partly appears externally and is coiled, its internal cavity divided into several chambers by septa. Retractor pallii medianus very rarely developed. Funnel valve usually present. Mouth surrounded by buccal membrane in addition to inner and outer lips. Arms normally five-paired, but the fourth pair from the dorsal, known figuratively as tentacles, is greatly modified to function as highly specialized grasping organs originating in the head between and inside the roots of the third and fourth pairs of the remaining arms. Suckers invariably pedunculate, furnished with horny rings, which sometimes may be transformed into hooks.

*) Original description given by Leach: Pedes ordinardii a basi ad apicem interne antiliis pedunculatis instructi; pedum par quartum basi simplex, apice dilatatum interne planum antiliis pedunculatis instructum.

Notice.—Robson (1926) assumes that the function of the hectocotylized arm of Decapoda is not same with that of Octopoda, namely, is that of insemination, but rather that it serves for the purpose of tactile stimulation during coitus; he therefore suggests a new term "nuptial arm" for the arm in question of Decapoda. In this work, however, I prefer the term "hectocotylized arm" as has been employed hitherto. Because (1) the term is itself historical, and (2) as far as I have been able to ascertain, there is no fundamental functional difference between the arms in question of Decapoda and Octopoda. In either group the arm is to transport the spermatophores (or spermatozoa) to some part of the female body. The difference, if any, between both the groups as regards the sexual activity is, the seminal receptacles or the part where the female receives sperm products is more intimately connected with the visceral organs in Octopoda than in Decapoda.

Division **Myopsida** (d'Orbigny, 1839).

Decapoda Myopsidae (pars), d'Orb. in d'Orb. et Fér. 1839, p. 220.—d'Orb. 1845, p. 237.
Myopsidae, Keferstein 1866, p. 1441.—Verrill 1881c, p. 432.
Myopsida, Hoyle 1886b, pp. 16, 110; 1904b, p. 6.—Pfeffer 1908a, pp. 15, 24.—Naef 1912, p. 241.—Berry 1912a, p. 290; 1914a, p. 307.
Sepioidea + Metateuthoidea myopsida, Naef 1921, pp. 535, 536.

Eyelid closed, veiling the eye save for a minute pore in front of it; frequently forming a crescent-shaped fold (lidfold) in the ventral part. Tentacles often retractile into head, in which they originate. None of suckers transformed into hooks. Only a single functional oviduct present, viz. that of the left side. Photogenic organ usually absent, but sometimes may occur in mantle cavity.

Animals mostly littoral in habit; eggs fixed on various substances in the sea-bottom, separately enclosed within fibrous or horny capsules, or massed together within a common gelatinous coating.

Key to the families of Myopsids herein described.*)

(A) No cattle-bone present but horny pen (gladius) may occur.
  (a) Body elongated.
    (1) Fins large; nuchal cartilabe present, also a gladius ..... *Loliginidae.*
    (2) Fins minute; no nuchal cartilage present, nor gladius ..... *Idiosepiidae.*
  (b) Body short, rounded.
    (1) Fins terminal, tentacles exactly resembling arms at their origin ..... *Promachteuthidae.*
    (2) Fins lateral, tentacles originating in specialized sacs in head ..... *Sepiolidae.*
(B) A hard cattle-bone (calc shell) present; body ovate; fins narrow and marginal..... *Sepiidae.*

Family **Loliginidae** (d'Orbigny, 1839).

Loligidae, d'Orb. in d'Orb. et Fér. 1839, p. 297.—d'Orb. 1845, p. 318.—Gray 1849, pp. 36, 66 (pars).
Loliginidae, Adams H. & A. 1858, p. 35.—Verrill 1881c, p. 433; 1882, p. 341.—Carus 1890, p. 455.—Pfeffer 1908a, p. 24.—Naef 1912, p. 243; 1912b, p. 741; 1921, p. 535.—Berry 1914a, p. 307; 1920, p. 153.—Grimpe 1921, p. 299.

Body elongated, more or less tapering caudad. Mantle separata from head even at nape which, however, is provided with an oblong locking cartilage. Fins terminal, both rhomboidal or cardioid, half as long as body or even a little longer; but sometimes may be enormous, ovate and marginal.

Eyelid closed and evenly continuous, but a minute preocular pore; no lid-fold. A conspicuous ω-shaped olfactory crest present behind each eye. Suckers biserial on sessil arms, quadriserial on

*) According to Naef's system of classification, the families Loliginidae and Promachoteuthidae belong to the suborder *Teuthoidea* whereas all the remaining families, to the suborder *Sepioidea*, the system also followed by Grimpe (1922).

tentacles at least on their hand. Dorsal funnel retractors well separated except in *Loliolus*. Funnel cartilages elongated, slightly widening caudad, each with a median longitudinal groove. Mantle-cartilage ridge-like, longitudinal. Funnel organ composed of a conspicuous Λ-shaped dorsal pad and two oval ventral pads. Gladius well developed, nicely penniform, usually extending the whole length of body. Left ventral arm hectocotylized.

Key to the genera found in Japan.

Fins rhomboidal, a little longer than half the mantle-length .....*Loligo.*
Fins ovate, enormous, extending the whole length of mantle.....*Sepioteuthis.*

Genus **Loligo** Schneider, 1784.

Loligo, Schneider 1784, p. 110—Leach 1817, pp. 138, 140 (pars).—d'Orb. in d'Orb. et Fér. 1839, p. 305.—Gray 1849, p. 68.—Verany 1851, p. 88 (pars).—Adams H. & A. 1858, p. 36 (pars).—Tryon 1879, p. 141.—Verrill 1881c, p. 307; 1882, p. 341.—Carus 1890, p. 455.—Pfeffer 1908a, p. 25.—Naef 1912b, p. 744; 1921, p. 535.—Berry 1914a, p. 310; 1920, p. 153.

Teuthis, Gray 1849, p. 76.—Adams H. & A. 1858, p. 38.—Naef 1912b, p. 743.

Doryteuthis, Naef 1912b, p. 742.

Body elongated, tapering posteriad. Fins terminal, ordinarily a little longer than half the body length, both longitudinal-rhomboidal or cardioid. Distal part of left ventral arm hectocotylized. Nidamental glands attain an enormous size, accompanied by accessory glands. A spermatic cushion present at the ventral part of buccal membrane, resting in a pair of ramified seminal receptacles. A luminous organ may develope on each side of the rectum or of the inkbag.

Type.—Loligo vulgaris Lam. 1798.

Key to the species of *Loligo* represented in Japan.

(A) Body over 30 cm. long at maturity, greatly elongated, its length being greater than 6-times the breadth; arm-suckers with 8–15 long-teeth on the distal edge.
  (1) Tentacles large; their suckers unequal, those on hand equipped with numerous, acute, separate teeth alternately long and short.
    (a) Horny ring of arm suckers with plate-like quadrangular teeth; about distal half of left ventral arm, hectocotylized .....*L. edulis.*
    (b) Horny ring of arm suckers with triangular or conical teeth; distal one-third of left ventral arm, hectocotylized .....*L. formosana.* n. sp.
  (2) Tentacles small, thin; their suckers minute, subequal, those on the central part equipped with 10–14 long, uniform teeth on the distal margin .....*L. bleekeri.*

(B) Body less than 10 cm. long even at maturity, its length less than 4-times the breadth; horny rings of arm-suckers smooth or with very broad, close-set teeth; tentaclar suckers unequal.
  (α) All arm-suckers with dentate ring.
    (a) Central hand-suckers of tentacles with distinctly dentate ring.
      (i) No luminous organ on inkbag.
        (1) Suckers on lateral arms larger than on remaining arms, and those on the middle part equipped with 10 or more broad teeth; tentacular suckers with 20–30 squarish teeth .....*L. japonica.*
        (2) Suckers on lateral arms only a little larger than on remaining arms; their horny ring with 3–5 very broad teeth; tentacular suckers with about 20 sharp, separate teeth.....*L. beka.* n. sp.
      (ii) Luminous organ on each side of inkbag .....*L. oshimai.* n sp.
    (b) Central hand-suckers of tentacles with smooth horny ring.
      (i) Carpal suckers of tentacles with dentate ring.

(1) Larger arm-suckers with about 9 broad teeth; largest central suckers of tentacles 4- to 5- times as large in diameter as their marginal suckers .....*L. kobiensis.*
(2) Every arm-sucker with only 4 or 5 very broad teeth; tentacular suckers all rather small .....*L. gotoi* n. sp.
(ii) Carpal suckers of tentacles with smooth ring .....*L. tagoi* n. sp.
(β) Larger arm-suckers with smooth ring .....*L. aspera.*

Loligo edulis Hoyle, 1885.

Japanese name: Kensaki-ika (Honshu); Surume-ika (South Japan); Ma-ika (Yuami Prov.)

(Pl. XIII., figs. 1–4; textfigs. 57–59.)

? Loligo chinensis, Gray 1849, p. 74.—Tryon 1879, p. 145.—Ortmann 1888, p. 657, pl. xxiv; pl. xxv, figs. 2a–2d.—Berry 1912b, p. 398.—Sasaki 1914, p. 601.
Loligo edulis, Hoyle 1885b, p. 186; 1885d, p. 281; 1886b, p. 152, pl. xxiii.—Ortmann 1888, p. 663.—Brazier 1892, p. 16.—Berry 1912b, p. 398.—Sasaki 1914, p. 600.—Sasaki 1920, p. 184.
Loligo budo, Okada 1927, p. 93.

Of this species innumerable specimens from various localities have been placed at my disposal for examination, measuring up to 40 cm. in mantle-length. About medium-sized individuals among them agree in essential characters with Hoyle's description of the species.

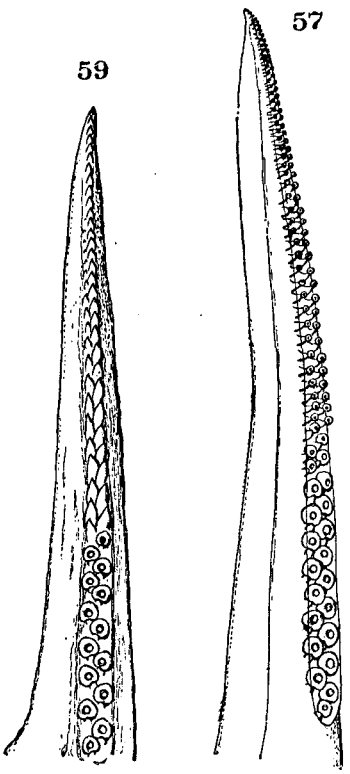
Mantle lender, of about uniform breadth for a quarter of the length from the anterior margin, then gradually tapering to a more or less acuminated extremity; the breadth in full-grown specimens is about six times of its length, but only four to five times in medium-sized specimens. Belly in male ordinarily provided with a longitudinal ridge in the middle (Pl. XIII, fig. 1). Anterior margin of mantle furnished with a rounded projection at the mid-dorsal part and widely emarginated in the ventral parts, the excavation marked off by a distinct pointed projection on either side.

Fins taken together longitudinal-rhomboidal, broadest a little in front of the middle; their lateral angles rounded and the anterior attachments a little auriculate. The length of fins becomes proportionately greater as the animals grow older, attaining, in full-grown specimens, one and a half times their combined breadth, and about two-thirds the mantle-length.

Head a little narrower than body; its length in full-sized specimens is about ten times in the mantle-length, but only about six times, in medium-sized specimens. Olfactory crest and preocular pore both present none of pecuriarities. Funnel and funnel-organ also of the ordinary shape. Funnel cartilage lanceolate, acuminate in front, widening caudad; the breadth about one-third the length. Nuchal cartilage slenderly panduriform, somewhat longer than a quarter of its own maximum breadth.

Arms unequal, the formula or length being $3>4>2>1$; the longest in full-sized specimens $\frac{1}{4}$–$\frac{1}{3}$ as long as body, but $\frac{1}{3}$–$\frac{1}{2}$, in medium-sized specimens. First pair somewhat flattened laterally, with a keel on the aboral surface. Second pair almost quadrilateral, with a web on the ventral side of the aboral surface. Third pair prominently flattened, with a strong keel on the aboral surface, the keel being widest on the halfway along the arms. Fourth pair quadrilateral, the aboral surface marked off by a sharp edge on the ventral side, and a broad web on the dorsal side, the web widening proximad as usual. Every arm provided with a fairly broad strongly costate protective membrane on either side. Suckers beserial as usual, somewhat varying in size in different arms, the largest suckers being on third arms, suckers of second arm next in order, and those of first arms on the whole the smallest of all; the largest one of third arm slightly less than, in diameter, one-second that of first arm. Horny ring in all suckers equipped with eight to eleven, long, square-cut teeth on the distal margin (Pl. XIII, fig. 3a); the proximal margin ordinarily uneven, sometimes provided with some rudimentary teeth.

Left ventral arm hectocotylized as usual, the affected part situated on the distal extremity,



Textfig. 57.
Loligo edulis. Hectocotylus of medium-sized male from Manazuru; ×2.

Textfig. 59.
Loligo edulis, forma *nagasakensis.* Hectocotylus of male specimen of 105 mm. mantle-length; ×5/3.

comprising a little more than half the entire length (textfig. 57). Normal suckers towards the base of the arm number 20–27, biserial as usual, followed by one or two minute suckers resting on enlarged basal papillae. Beyond these are found on the affected part about 100 conical papillae arranged in two series. The papillae provided on their tip with a rudimentary sucker, which is a little smaller in the dorsal series than in the ventral.

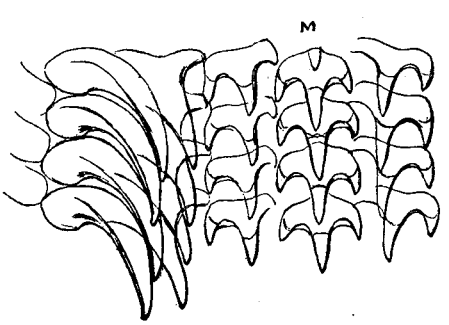
Tentacles in good preservation, ½–⅔ as long as mantle. Stem as thick as second arm, somewhat flattened laterally, distinctly four-sided. Club expanded, lanceolate in contour, triangular in section, provided with a costate protective membrane on either side, and a distinct dorsal web extending on to stem down to its base as a narrow membrane. Suckers quadriserial as usual; those on hand far larger than those on the remaining parts, and about sixteen in the middle especially large, being about one and a half times as large in diameter as those on the margin. Horny rings of these large middle suckers, equipped with about ten strong conical teeth at about uniform intervals along the whole margin. In addition to these, there are in each interdental space two or three minute supplementary teeth also of conical shape. Horny rings of marginal hand suckers, dentate almost as in the large suckers mentioned above but the teeth decidedly longer on the distal edge than on the proximal, and the supplementary teeth less numerous and comparatively longer than in those suckers. Horney rings of distal suckers equipped along the whole margin with 14–18 conical teeth which are much longer and stronger on the distal part than on the proximal; no shorter supprementary teeth present (Pl. XIII, fig. 3b).

Buccal membrane with seven projections of margin as usual; each of these furnished with 5–14, minute suckers.

On each side of rectum a fusiform luminous organ is developed, opening into the mantle cavity by a short duct (Pl. XIII, fig. 2).

Gladius in medium-sized specimens about seven times as long as broad, the vanes extending for about two-ninths the entire length.

Radula as shown in textfigure 58.



Textfig. 58.
Loligo edulis. Middle portion of radula; ×40.

Measurements of French Males.

No. of specimen	i	ii
Dorsal length of mantle	347 mm.	165 mm.
Ventral ,, ,, ,, ...	323 ,,	150 ,,
Maximum circumference of body	167 ,,	112 ,,
Length of head	31 ,,	30 ,,
Breadth of head	40 ,,	31 ,,
Length of fins	236 ,,	108 ,,
Total breadth of fins	16 ,,	98 ,,

No. of specimen	i		ii	
	Left	Right	Left	Right
Length of first arms	66 mm.	66 mm.	50 mm.	48 mm.
,, ,, second arms	78 ,,	79 ,,	63 ,,	63 ,,
,, ,, third arms	92 ,,	92 ,,	72 ,,	72 ,,
,, ,, fourth arms	83 ,,	83 ,,	64 ,,	65 ,,
,, ,, tentacles	175 ,,	175 ,,	155 ,,	151 ,,
,, ,, clubs	65 ,,	65 ,,	54 ,,	52 ,,
Diameter of largest sucker of first arms	2.5 mm.		1.8 mm.	
,, ,, ,, ,, ,, second arms	3 ,,		2 ,,	
,, ,, ,, ,, ,, third arms	3.4 ,,		2.5 ,,	
,, ,, ,, ,, ,, fourth arms	2.2 ,,		1.5 ,,	
,, ,, ,, ,, ,, tentacles	4.5 ,,		3 ,,	

Forma *nagasakensis* nov. :—to this belong the three male specimens from Nagasaki and vicinity referred to *L. chinensis* Gray in one of my previous papers (1914, l.c.). In the largest of these specimens, the papillae of the hectocotylus are devoid of any suckers, and their dorsal series extend only half up the length (textfig. 59), nearly agreeing with Ortmann's description of *L. chinensis*. The normal suckers on the hectocotylized arm number only 16, viz. far less than in the usual form. Further, many spermatophores are already contained in Needham's sac, though the mantle is yet so small as only about 10 cm. long (Pl. XIII, fig. 4).

Forma *grandipes* nov. :—to this I refer two young females from Fukuoka market. In these specimens the buccal membrane has only seven or eight suckers on each marginal projection, the distal suckers of the tentacles have quite rudimentary teeth on the proximal margin, and the tentacular clubs and their hand suckers both are much larger than in the other specimens examined by me, as shown in the following measurements :

	Forma *grandipes*		Forma *communis*	
Mantle length	150 mm.	135 mm.	165 mm.	140 mm.
Length of club	70 ,,	63 ,,	52 ,,	48 ,,
Diameter of largest sucker	5 ,,	4 ,,	3 ,,	3 ,,

Remarks.—This species is one of the commonest myopsid cephalopods found in Japan, and has a wide distribution, of which the northern limit is about the Tsugaru Strait. It is most abundant in Kyushû and is also caught in plenty around Tsushima. To it is referable the best commercial articles of dried cuttle-fish known as " *Ichibanzurumé* ".

Perhaps *L. chinensis* Gray is identical with the present species, although confirmation is impossible by so brief a description as Gray's.

Locality.—Aomori (Berry) ; Mutsu Prov. (Berry) ; Tôkyo Bay (Berry) ; Kadsiyama (Ortmann)? ; Yokohama market (Hoyle) ; Misaki (Sasaki) ; Odawara (Sasaki) ; Ôshima, Izu Prov. (Sasaki) ; Etchû Prov. (Sasaki) ; Noto Peninsula (!), Iki I. (!) ; Fuzan, Korea (!) ; Tsushima (!) ; Osaka market (!) ; Kobé market (!) ; Kii Suidô, 37–40 fms. (Albatross !) ; Shimonoseki (!) ; Nasasaki (Sasaki) ; Fukuoka market (!) ; Satsuma (Sasaki), China (Gray) ? ; Port Jackson, Australia (Brazier).

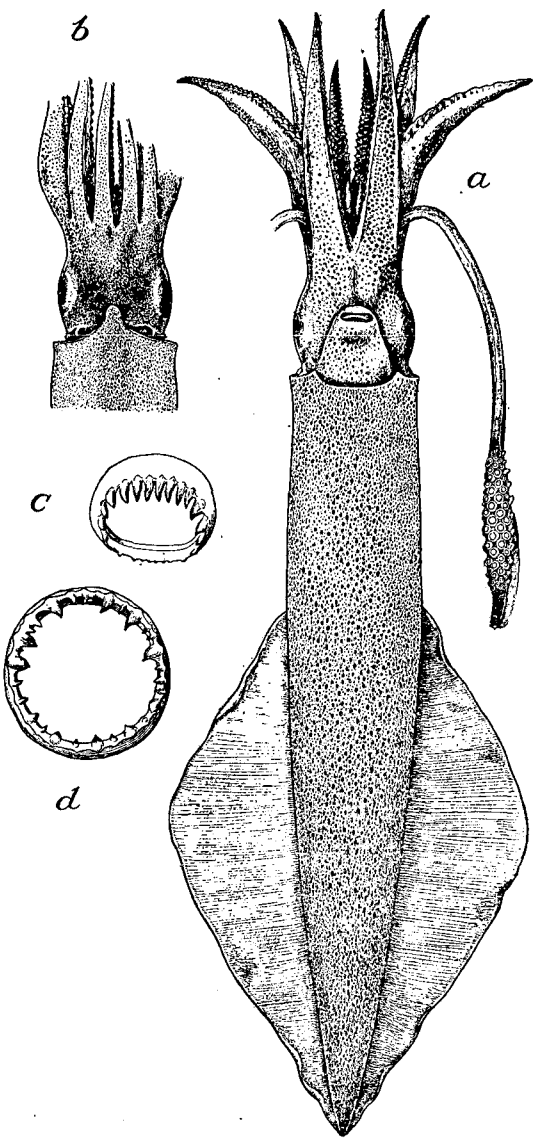
Loligo formosana sp. nov.

Formosan dialect : Juhee (柔魚).

(Pl. XXX, fig. 13 ; textfig. 161).

Mantle slender, of uniform width at the anterior one-third, then gradually and uniformly tapering posteriad and terminates in a more or less acuminated extremity ; length a little greater than five times the breadth ; no longitudinal ridge developed on belly even in the male. Dorsal anterior

margin of mantle produced forwards, forming a wide triangle with a rounded and projecting apex (textfig. 161b); ventral margin broadly emarginated below the funnel, the emargination bounded laterally by rather acute prominent angles. Fins taken together longitudinal-rhomboidal, their combined breadth being about three-fourths of their own lengths which are in turn about two-thirds the mantle length; their lateral angles rounded and the anterior ends a little auriculate.



Textfig. 161.

Loligo formosana n. sp. a. ventral view of a male from Tainan market, ×⅓. b. dorsal side of hand region of the same; c. horny ring of a proxinal sucker of third arm, ×7; d. horny ring of one of largest hand suckers, ×5.

Head small, decidedly narrower than body and about one-ninth the length of it. Olfactory crests, preocular pores and funnel organ all show no pecuriality disagreeing with the ordinary structures of the genus. Cartilaginous organ of funnel, of nape and of mantle almost same as in *L. edulis* in shape and size.

Arms rather unequal, the formula of length being 3>4>2>1; the longest is about one-third, and the shortest, about one-fourth, as long as the mantle. First pair somewhat flattened laterally, with a low keel along the whole length of the aboral surface. Second pair nearly quadrilateral in section; the ventral edge of the aboral surface projecting into a narrow web. Third pair markedly flattened dorso-ventrally, strongly keeled along the whole length of aboral surface; the keel widest near the middle of the arm. Fourth pair quadrilateral; the inner edge of aboral surface projects into a broad web which widens regularly proximad. Protective membranes of ordinary breadth, best developed in the third arm.

Suckers biserial throughout, a little unequal in size, those of the lateral arms being larger than the others, and a few near the middle of the ventro-lateral arms are the largest of all. Horny ring with 10–15 strong acute teeth on the distal margin; they are closely set in the proximal suckers but are separate in the distal ones (textfig. 161c.) Proximal margin of the ring is by no means entire as is usually the case, but produces several small irregular teeth-like protuberances.

Left ventral arm hectocotylized on the distal one-third, where the suckers are reduced into slender conical papillae arranged in two rows. They count 30 or more in each row, and become regularly smaller toward the distal extremity and this reduction of size is more rapid in the dorsal row than in the ventral. The normal suckers of the unhectocotylized proximal part count 21 pairs in the type specimen, but in other males examined, totalling 15 in number they were either 22 pairs or 23 pairs.

Tentacles slender, a little shorter than mantle, and their stem nearly equal to the first arm in thickness, Club expanded, lanceolate in outline, with a distinct aboral web along the whole length of the club. Suckers in about 30 transverse rows of four each except several at the base of the club where they count two or three in each row. Hand suckers decidedly larger than others, and the

largest are the middle twelve which are about one and a half times as large in diameter as the marginal ones and measure about double the diameter of the largest arm sucker. The horny ring of the largest hand-suckers has along the whole margin conical teeth of two kinds, i.e. larger and smaller; the former varies in number from six to twelve, and are set usually at more or less regular intervals, the intervals being occupied by one to four teeth of the said smaller kind (textfig. 161d).

Buccal membrane with seven projections of margin which have 4–7 small suckers each. The horny ring of these suckers has some ten, flattened and truncate teeth on the distal margin.

As in *L. edulis* there are developed on either side of the rectum a fusiform luminous organ. The gladius and radula also hardly differ from those of *L. edulis*.

Measurement.

Sex	♂		♀	
Dorsal length of mantle	310 mm.		170 mm.	
Ventral length of mantle	285 ,,		150 ,,	
Breadth of body	55 ,,		38 ,,	
Length of head	33 ,,		27 ,,	
Breadth of head	32 ,,		26 ,,	
Length of fins	200 ,,		170 ,,	
Total breadth of fins	140 ,,		75 ,,	
	Left	Right	Left	Right
Length of first arms	75 mm.	75 mm.	44 mm.	44 mm.
,, ,, second arms	87 ,,	87 ,,	53 ,,	58 ,,
,, ,, third arms	97 ,,	97 ,,	67 ,,	70 ,,
,, ,, fourth arms	93 ,,	90 ,,	63 ,,	63 ,,
,, ,, tentacules	265 ,,	265 ,,	180 ,,	195 ,,
,, ,, tentacular clubs	70 ,,	70 ,,	52 ,,	52 ,,
Diameter of largest sucker of the first arms	2.0 mm.		1.3 mm.	
,, ,, ,, ,, ,, ,, second arms	2.2 ,,		1.5 ,,	
,, ,, ,, ,, ,, ,, third arms	2.5 ,,		2.0 ,,	
,, ,, ,, ,, ,, ,, fourth arms	1.8 ,,		1.3 ,,	
,, ,, ,, ,, ,, ,, tentacles	4.0 ,,		3.0 ,,	

Remarks.—The present species is closely related to *L. edulis* Hoyle but differs from it in many respects. The differences are as follows: (1) the arms and tentacles are decidedly thinner, (2) their suckers are smaller than in *L. edulis*, and (3) the hectocotylized part of the left ventral arm is much shorter, accordingly there are far less numerous papillae. Moreover, there is a distinct difference in respect to the dentation of suckers. In *L. formosana* the teeth of arm suckers are triangular or conical in shape, provided with sharply pointed apex, and not quadrangular nor truncated cone as in *L. edulis*; and the teeth of largest tentacular suckers are fewer in number and more irregular in shape.

The species also shows a close affinity to *L. etheridgei* Berry from Australia; the chief difference is as follows. The unhectocotylized part of the left ventral arm of *L. etheridgei* is said to be three-fifths of the entire length so that it is shorter than that of *L. formosana*, and accordingly there are fewer suckers. Berry counted only 17 pairs, of them, whereas in *L. formosana* there were as many as 21–23 pairs as mentioned above. Besides these, the dentation of the largest tentacular suckers seems to differ in a measure: the illustrations given by Berry show that it is much more uniform in shape than in *L. formosana*.

L. formosana is said to be very common in Formosa and vicinity. I have examined (1) two specimens (1 ♂, 1 ♀) from a fish market of Tainan, of which measurements are given above, (2) twelve young specimens of 95–135 mm. mantle length, from a fish market of Taihoku, and (3) sixteen

specimens (14 ♂, 2 ♀) from the Pescadores Islands, ranging from 103 mm. to 280 mm. in mantle length; all were collected by Dr. Oshima.

Type locality.—Tainan market, Formosa.

Type.—Deposited in Hokkaido Imp. Univ.

Loligo japonica Steenstrup, 1885.

Japanese name: Bozu-ika (Etchû); Hi-ika (Tottori).

(Pl. XIV, figs. 1–6; textfigs. 60–62).

Loligo japonica, Steenstrup M.S. in Mus. Havn (fide Hoyle).—Hoyle 1885b, p. 187; 1885d, p. 290; 1886b, p. 157, pl. xxiv, figs. 7–15.—Ortmann 1888, p. 663.—Wülker 1910, p. 10.—Berry 1912b, p. 399.—Sasaki 1914, p. 602; 1920, p. 184.

Loligo tetradinamia, Ortmann 1888, p. 659, pl. xxiii, figs. 4a–4k; pl. xxv, fig. 1.—Berry 1912b, p. 399.—Sasaki 1914, p. 603.

Innumerable specimens from various localities, which are referable with satisfaction to the present species, have been placed at my disposal, measuring up to about 12 cm. in mantle-length.

Body slenderly conical, about four times as long as broad, widest anteriorly, tapering to a blunt extremity, but in mature females its middle part is a little expanded, due to the great enlargement of the nidamental glands and eggs (Pl. XIV, fig. 1). The anterior margin of the mantle dorsally in the middle forms a rounded process (Pl. XIV, fig. 2) which is relatively larger than any of other loligoes occurring in Japan; ventrally it is widely emarginated as usual, the excavation marked off on either side by a conspicuous pointed projection

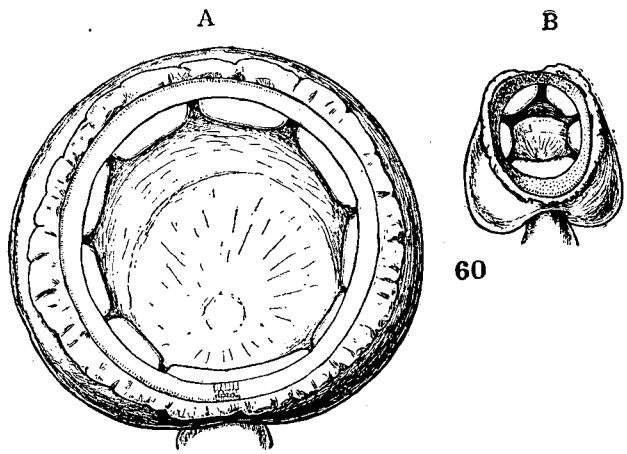
Fins taken together rhomboidal, their lateral angles rounded, and the anterior attachments a little auriculate. Length of fins slightly smaller than their total breadth and a little greater than half the mantle-length.

Head comparatively large, a little broader than body, and about one-fifth as long. Funnel comparatively large, roughly conical extending about halfway to interbrachial space. Funnel organ as shown in Pl. XIV, fig. 4. Funnel cartilages lanceolate, only slightly expanded posteriorly, the maximum breadth a little greater than one-third the length. Nuchal cartilage slenderly elliptical, but slightly narrowed in the middle and with rounded extremities; its length about three times the maximum breadth, measuring 18mm. in a female of 96mm. in mantle-length (Pl. XIV, fig. 3).

Arms unequal, the formula of length being $3>4\fallingdotseq2>1$, the longest in female about half as long as body but much longer in male. First pair by far the shortest and thinnest, flattened laterally, with a distinct aboral keel extending nearly the whole length. Second pair four-sided, with a narrow web along the ventral side of the aboral surface. Third pair flattened laterally, exceeding all the others in size as well as in carination. Fourth pair four-sided, furnished along the dorsal side of the aboral surface, with a broad web widening proximad as usual.

Arm-suckers as wide as deep, unequal in size in different arms, being far larger on lateral arms, and those of ventral lateral arm being again larger than those of the dorsal lateral. Further, the suckers on the whole are larger in male than in female, and in the male those of the lateral arms are characteristically comspicuous. Horny ring in all suckers dentate, the teeth being platelike in shape, ordinarily rectangular but sometimes semilunar, much wider than long, closely set along the whole margin; but the proximalmost is not teeth-like, being by far the widest of all (textfig. 60). The teeth vary in number in different suckers counting 7 or 8 in a basal sucker, 11–13 in a sucker of fifth or sixth pair, and 3–6 in a distal suckery.

Tentacles vary in length according to the different method of preservation, and when well preserved they measure about half as long again as the third arms. Stem as thick as second arms, nearly four-sided, or rounded-triangular. Club expanded, lanceolate in contour, triangular in section, with a distinct external keel, which extends on the stem and is continued to its base as a very narrow membrane. Protective membranes costate as usual, and are of moderate breadth.



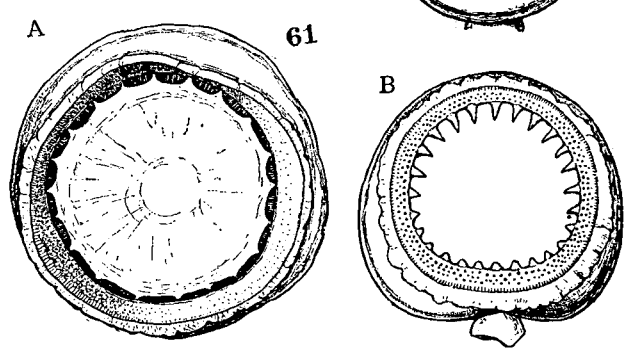
Textfig. 60.

Loligo japonica. Suckers from third arm of mature male; ×40. A. Largest sucker. B. Subterminal suckers.

whole margin of the ring. In terminal and subterminal suckers of the club the teeth are more or less conical, unequal, being longer and sharper on the distal margin of the ring than on the proximal, and are separated one from another by their own breadth. Number of teeth 24–30 in subterminal suckers and about 20 in terminal ones.

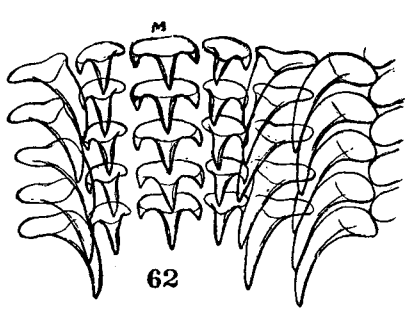
Distal half of left ventral arm hectocotylized, provided with about 75 papillae arranged in two series as usual (Pl. XIV, fig. 5). The papillae in the ventral series have a quite rudimentary sucker on the tip and are swollen up, and somewhat flattened; especially so are the proximals seven or eight which are connected together so as almost to form a thickened ventral border of the hectocotylus. The papillae in the dorsal series are conical, elongated, quite separate and have on their tip a sucker which is, though insignificant in size, yet of the ordinary structure, bearing a perfect horny ring. At the extremity of the hectocotylized part, the suckers on the tips of the papillae are relatively large and have a normal equipment each.

Tentacular suckers distinctly quadriserial throughout, unequal in size, and median twelve of the hand suckers being two or three times as large in diameter as the marginal ones. Horny rings differently dentate in different suckers (textfig. 61): in hand-and carpal suckers, the teeth are broad, closely set and very blunt; especially so in the middle hand suckers, in which they are 20–25 in number, uniform, plate-like, nearly quadrangular, broader than long, and set closely along the



Textfig. 61.

Loligo japonica. Suckers of tentacles; ×40. A. Largest sucker. B. Subterminal sucker. C. Terminal sucker.



Textfig. 62.

Loligo japonica. Middle portion of radula; ×40.

Radula as shown in textfigure 62.

Buccal membrane with seven marginal projections as usual, each provided 1–4 minute suckers.

Gladius about five times as long as broad; vanes taken together lanceolate widest in the middle; occupying posterior five-sixths of the entire length of the gladius (Pl. XIV, fig. 6).

Measurements of largest Male and Female Examined.

Sex	♀		♂	
Dorsal length of mantle	10.5 mm.		98 mm.	
Ventral length of mantle	97 ,,		89.5 ,,	
Circumference of mantle	75 ,,		74 ,,	
Maximum breadth of body	26 ,,		23.5 ,,	
Length of fins	6.5 ,,		61 ,,	
Total breadth of fins	68 ,,		66 ,,	
Length of head	18 ,,		20 ,,	
Breadth of head	27 ,,		27 ,,	
	Left	Right	Left	Right
Length of first arms	33 mm.	33 mm.	50 mm.	50 mm
,, ,, second arms	47 ,,	47 ,,	60 ,,	63 ,,
,, ,, third arms	55 ,,	54 ,,	68 ,,	68 ,,
,, ,, fourth arms	47 ,,	48 ,,	57 ,,	61 ,,
,, ,, tentacles	76 ,,	84 ,,	87 ,,	—
,, ,, clubs	31 ,,	30 ,,	35 ,,	—
Diameter of largest sucker of first arms	1.3 mm.		1.5 mm.	
,, ,, ,, ,, ,, second arms	2.6 ,,		3.5 ,,	
,, ,, ,, ,, ,, third arms	3.5 ,,		4 ,,	
,, ,, ,, ,, ,, fourth arms	1.6 ,,		2 ,,	
,, ,, ,, ,, ,, tentacles	2.5 ,,		2.9 ,,	

Remarks.—This species is very common in North Japan, being caught there in plenty for the market.

Locality.—Oshoro, Hokkaidô (Sasaki); Ishikari Prov. (!); Hakodaté (Albatross !); Muroran (!); Aomori Bay (!). Etchû Prov. (Sasaki); Samé, Mutsu Prov. (Berry); Tôkyo Bay (Ortmann, Berry); Tôkyo (Berry); Tôkyo market (Sasaki); Yokohama market (Steenstrup); Misaki (Wülker); Sagami Bay (Sasaki); Shimané Prefecture (Sasaki); Okayama (Berry); Kawatana, Hizen Prov. (Berry); Ômura Bay (Sasaki); Kôchi, Tosa Prov. (Ortman).

Loligo kobiensis Hoyle, 1885.

(Pl. XIV, figs. 7–9; textfigs. 63–65.)

Loligo kobiensis, Hoyle 1885b, p. 184.—Hoyle 1885d, p. 287.—Hoyle 1886b, p. 154, pl. xxv, figs. 1–10.—? Ortmann 1888, p. 659.—Hoyle 1905a, p. 982.—Berry 1912b, p. 398.—Sasaki 1914, p. 604.

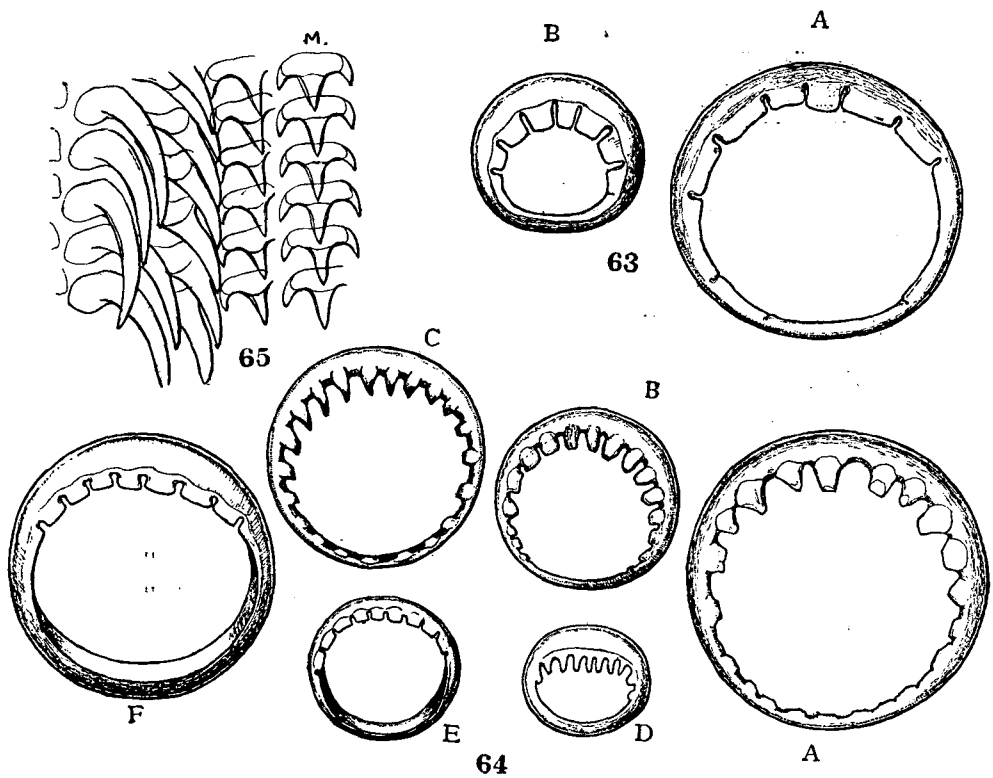
This species is represented by sixteen females in the collections at my disposal. The body length of these speciments range from 41 mm. 106 mm. In the largest individual, the nidamental glands measure 40 mm. in length.

Mantle rather slenderly conical, widest at the anterior margin, tapering caudad at first very gradually but comparatively rapidly afterwards, finally terminating in a more or less acuminate point; length about three and a half times the breadth (Pl. XIV, fig. 7). Anterior margin of mantle broadly emarginated in the middle of the ventral part, the excavation marked off by pointed projections on both sides; dorsally in the middle it forms a rounded projection which is decidedly smaller than that of *L. japonica*. Fins taken together rhomboidal; their lateral angles rounded, the anterior attachment a little indented and the length about equal to the total breadth and to ⅔–¾ the middle-length.

Head small, being narrower than body, and ¼–⅕ as long as it. Funnel, funnel-cartilage, nuchal cartilage all constructed almost as in *L. japonica* but decidedly inferior in size. In the largest specimen examined, the funnel-cartilages measure 14mm. in length and 4mm. in maximum breadth; the nuchal cartilage 15 mm. in length and 4.8mm. in maximum breadth.

Arms unequal, the formula of length being 3>4>2>1; the longest about half the mantle-lengtn. First pair by far the shortest and thinnest, somewhat flattened laterally, keeled along the whole length of the aboral surface. Second and fourth pairs somewhat quadrangular in section, the latter pair provided along the dorsal edge of the aboral surface, with a conspicuous web broadening proximad as usual. Third pair about as thick as the fourth, somewhat flattened laterally, with a rather marked keel extending the whole length of the aboral surface. Protective membranes almost as in *L. japonica.*

Arm-suckers unequal, varying in size in different arms, being far larger on lateral arms, and those of ventral lateral arm again larger than those of the dorsal lateral, and about twice as large in



Textfig. 63.

Loligo kobiensis. Horny rings from suckers of third arm; ×40. A. From largest sucker. B. From subterminal sucker.

Textfig. 64.

Loligo kobiensis. Horny rings of tentacular suckers; ×40. A. From sucker immediately distal to largest suckers referred to in the description. B. From sucker subsequent to that of A. C. From largest marginal sucker. D. From first carpal sucker. E. From second carpal sucker. F. From third carpal sucker.

Textfig. 65.

Loligo kobiensis. Middle portion of radula; ×63.

diameter as those of dorsal arm. Horny ring in all suckers, equipped with very broad rectangular teeth closely set along the distal part; the teeth number about nine in largest suckers; interdental spaces slit-like (textfig. 63).

Hectocotylization not observed, the specimens at my disposal bein all females only.

Tentacles variable in length in different specimens, but in good ones they are as long as the

mantle. Stem as thick as second arm, rounded-triangular in section and a little flattened laterally. Club expanded, lanceolate in contour, triangular in section as usual; provided with a distinct dorsal web and clearly costate protective membranes (Pl. XIV, fig. 8).

Tentacular suckers quadriserial throughout, middle three or four pairs on hand by far the largest and four to five times as large in diameter as those of the marginal row. Horny rings of these largest suckers, quite smooth, but in the remaining suckers even of carpus, they are equipped along the distal margin, with triangular or quadrangular teeth numbering 6–15 (textfig. 64). The proximal margin of the ring in these dentate suckers except of the carpus is not entire but uneven or even provided with some very short teeth.

Buccal membrane with seven marginal projections as usual; the ventral two of these are blunt and suckerless, while the others are sharp and provided each with four to six minute suckers. In mature females the membrane has on the ventral part, a spermatic pad containing internally two rasemose seminal receptacles, opening externally in a common exit, which is surrounded by a marked horseshoe-shaped fold (Pl. XIV, fig. 9).

Gladius constructed almost as in *L. japonica* but the midrib a little narrower and the vanes a little broader.

Radula as in textfigure 65; marginal teeth slender compared with those of *L. japonica*.

Measurements of largest Female Examined.

Dorsal length of mantle	106mm.	
Ventral length of mantle	98 „	
Circumference of body	78 „	
Breadth of body	29 „	
Length of fins	70 „	
Total breadth of fins	72 „	
Length of head	20 „	
Breadth of head	23 „	
	Left	Right
Length of first arms	36mm.	36mm.
„ „ second arms	48 „	48 „
„ „ third arms	54 „	54 „
„ „ fourth arms	52 „	54 „
„ „ tentacles	115 „	107 „
„ „ clubs	40 „	40 „
Diameter of largest sucker of first arms	1.1mm.	
„ „ „ „ „ second arms	1.6 „	
„ „ „ „ „ third arms	2 „	
„ „ „ „ „ fourth arms	1.1 „	
„ „ „ „ „ tentacles	5.5 „	

Remarks.—The specimens examined by me differ from Hoyle's original description of this species in the sharper end of body, in the broader fins, in the larger tentacular suckers, and in the more numerous suckers on the buccal membranes. So far as the other respects are concerned, their agreement with his description is quite satisfactory.

Locality.—Kobé Bay (Hoyle); Inland Sea (Hoyle); ? Maizuru (Ortmann); Onomichi (Berry); Nagasaki (Berry; Sasaki); Ôsaka market (!); Kolumadulu Atoll (Hoyle).

Loligo gotoi sp. nov.

(Pl. XIV, figs. 20–13; textfigs. 66, 67).

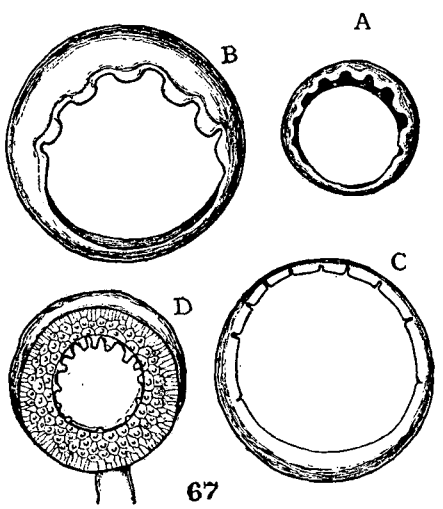
This species is based on one mature male and female, and five immature individuals obtained at Nagasaki. They measure 20–60mm. in mantle-length, and the mature female has nidamental glands about half as long as its own body.

Mantle slenderly conical, widest anteriorly, tapering caudad at first very gradually but somewhat rapidly afterwards, and finally terminating in a rather acute point; length a little greater than thrice the maximum breadth (Pl. XIV, fig. 10). Anterior margin of mantle forms at the mid-dorsal part a semilunar projection as small as in *L. kobiensis*. Fins rhomboidal, their angles all rounded; the anterior attachment a little indented, and the length decidedly less than the total breadth, and about three-fifths the mantle-length.

Head relatively almost as large as in *L. japonica*, its length being only a little less than one-fourth that of body. Funnel of moderate size. Funnel organ shows no characteristicity. Funnel cartilages about three and a half times as long as broad. Nuchal cartilage roughly elliptical, faintly constricted in the middle and quite rounded at both the extremities. The funnel-cartilage and nuchal cartilage of the mature female alluded to measured about 10 mm.

Arms long, unequal, the formula of length being $3>4>2>1$; the longest only a little shorter than the ventral mantle-length. First pair a little flattened laterally, by far the shortest, and thinnest, with a faint keel on the aboral surface. Second and fourth pairs both four-sided, the latter provided on the dorsal side of the aboral surface, with a more or less conspicuous web widening proximad. Third pair the thickest of all, more or less flattened, being strongly carinated on the aboral surface. Protective membranes distinctly costate, of uniform and moderatd breadth.

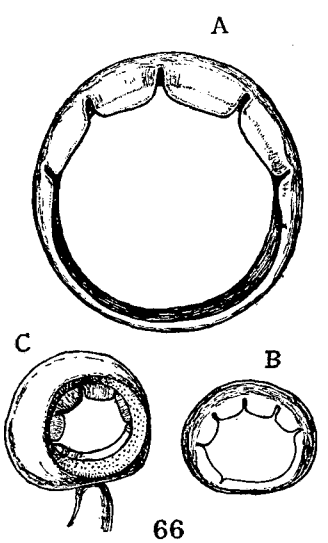
Arm-suckers unequal, varying in size in different arms, being far larger on the lateral arms, and those of ventral lateral arms again far larger than those of the dorsal lateral, and about thrice as large in diameter as those of first arm. Horny ring in all suckers similarly equipped with four or five very broad rounded-rectangular or semilunar teeth closely set along the distal half of the circumference (textfig. 66).



67

Textfig. 67.

Loligo similis. Sucker and horny rings of tentacle. A. Horny ring of first carpal sucker; ×40. B. Horny ring of proximalmost hand-sucker; ×40. C. Horny ring of sucker just distal to largest suckers referred to in the description; ×16. D. Entire view of one of distal suckers; ×63.



66

Textfig. 66.

Loligo similis. Sucker and horny rings from third arm; ×20. A. Horny ring of one of largest suckers (7th.–10th. pair). B. Horny ring of proximalmost sucker. C. Entire view of one of distal suckers.

Distal two-thirds of right third arm hectocotylized, provided with about 75 sucker-less papillae arranged in two series (Pl. XIV, fig. 11). The papillae of the dorsal series, small, and rounded, while those of the ventral series are greatly swollen and connected together into a prominent ridge, weak constrictions only showing their individual demarkations. On the proximal one-third of the arm are found only five or six pairs of normal suckers. A narrow protective membrane developed on dorsal side but none on the ventral.

Tentacles as long as, or even somewhat longer than body. Stem as thick as first arms, a little flattened laterally. Club a little expanded, lanceolate in contour, with protective membranes and dorsal web both of moderate breadth (Pl. XIV, fig. 12). Suckers quadriserial throughout; about eight in the middle of the hand are by far the largest, yet a little smaller than the corresponding ones of *L. kobiensis*. The horny rings of these largest suckers are quite smooth, but in the suckers just

distal to these largest ones, the distal margin of the ring has several slit-like indentations (textfig. 67c). Horny ring of the remaining suckers invariably dentate on the distal margin, and the teeth of marginal and distal suckers are 7–10 in number and quite unequal (textfig. 67D); but in carpal suckers they count 5–8 and are separate, uniform, and plate-like (textfig. 67A, B).

Buccal membrane with two blunt ventral and five sharp dorsal projections of margin, all provided with 1–4 small suckers at the end. Spermatic cushion in female almost as in *L. kobiensis* but less conspicuous.

Radula constructed almost as in *L. japonica*.

Gladius also as in *L. japonica* but the breadth is greater, being one-fourth the length (Pl. XIV, fig. 13).

Measurements of mature Male and Female.

Sex.	♂	♀
Dorsal length of mantle	56 mm.	60 mm.
Ventral length of mantle	51 ,,	53 ,,
Breadth of mantle	17 ,,	18 ,,
Length of fins	34 ,,	35 ,,
Total breadth of fins	40 ,,	45 ,,
Length of head	16 ,,	17 ,,
Breadth of head	16 ,,	17 ,,
Length of first arms	22 ,,	25 ,,
,, ,, second arms	39 ,,	43 ,,
,, ,, third arms	44 ,,	50 ,,
,, ,, fourth arms	40 ,,	48 ,,
,, ,, tentacles	65 ,,	100 ,,
,, ,, clubs	20 ,,	30 ,,
Diameter of largest sucker of first arms	0.7 ,,	0.7 ,,
,, ,, ,, ,, ,, second arms	1.2 ,,	1.2 ,,
,, ,, ,, ,, ,, third arms	2.1 ,,	20 ,,
,, ,, ,, ,, ,, fourth arms	1 ,,	.8 ,,
,, ,, ,, ,, ,, tentacles	1.5 ,,	2.4 ,,

Remarks.—This species is closely related to *L. kobiensis* Hoyle, but differs from it chiefly in having larger suckers on the third arms, smaller suckers on the tentacular hand, and fewer and more rounded horny teeth in all arm-suckers. The specific name is applied in honour of Professor Goto of the Tôkyo Imp. University.

Type locality.—Nagasaki.

Type.—In Hokkaido Imp. Univ.

Loligo tagoi sp. nov.

(Pl. XIV, fig. 14; textfigs. 68, 69).

The female specimen from Tosa that I referred to *L. kobiensis* in one of my previous papers, is here separated from that species after a great deal of hesitation. The specimen is sexually mature, being full of ripe eggs in the ovary and having nidamental glands about half as long as the mantle.

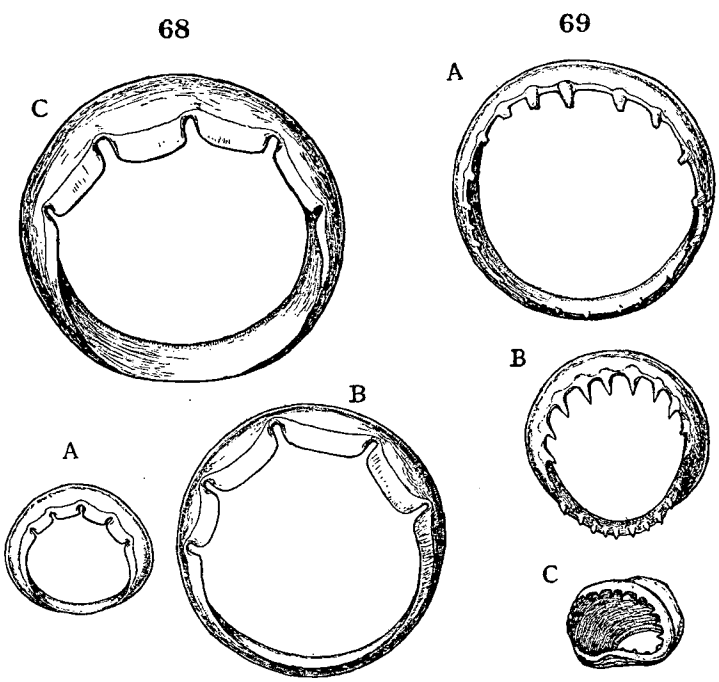
Body slenderly conico-cylindrical, slightly expanded anteriorly, tapering caudad at first very gradually but somewhat rapidly afterwards and the posterior end rather acute (Pl. XIV, fig. 14). Length of body a little greater than thrice the breadth. Dorsal margin of mantle forms in the middle

a semilunar projection, which is about equal in size to that of *L. kobiensis*. Fins rhomboidal, their lateral angles more or less acuminate, and the length slightly less than the total breadth and slightly longer than half the entire length of mantle.

Head a little narrower than mantle, and a little shorter than a quarter of its own length. Funnel, funnel-organ, and funnel cartilages all almost as in *L. kobiensis*.

Arms very long, unequal, the formula of length being $3>4>2>1$; the longest only a little shorter than the ventral length of mantle. First and third arms both more or less compressed laterally, the former is by far the shortest and thinnest of all arms, while the latter is the longest and thickest; both pairs with a keel on the aboral surface. Second and fourth pairs four-sided, the latter provided along the dorsal side, with a broad web widening proximad as usual. Protective membranes on any arm, of moderate and uniform breadth.

Arm-suckers unequal in different arms, those of third arm on the whole being the largest of all; those of the second arm next in order, and those of first arm the smallest; the largest sucker of the third arm is about thrice as large in diameter as that of the first. Horny ring in all sucker invariably equipped with four, very broad, rounded rectangular, plate-like teeth closely set along the distal half of the circumference; the remaining proximal margin forms an entire prominent border textfig. 68).



Textfig. 68.

Loligo tagoi. Horny rings of third-arm suckers; ×40. A. From one of suckers of first row. B. From one of suckers of fourth row. D. From one of suckers of tenth row.

Textfig. 69.

Loligo tagoi. Horny rings of tentacular suckers; ×40. A. From distal suckers adjacent to largest suckers of hand. B. From largest marginal suckers. C. From one of minute distal suckers of club.

No hectocotylus examined, the specimen in hand being female.

Tentacles about twice as long as largest pair of arms. Stem as thick as second arms, a little flattened laterally. Club a little shorter than one-third the entire length of tentacle, a little expanded, lanceolate in contour, with a dorsal web and protective membranes both of moderate breadth.

Tentacular suckers quadriserial throughout, about eight in the middle of hand, conspicuous, being a little larger than the largest arm-sucker. Horny ring in these large suckers as well as in carpal suckers, quite smooth. In the two suckers just distal to the said large suckers, the ring has about twenty, small, square-cut, far separate teeth, whieh are somewhat larger in the distal margin than in the proximal (textfig. 69A). Horny ring in marginal hand suckers, equipped on the whole margin, with 20–23, acute, conical teeth, which are far larger on the distal margin than on the proximal; the interdental spaces as wide as, or even wider than the bases of teeth (textfig. 69B). Horny ring in distal suckers dentate almost as in marginal suckers, but the teeth are a little shorter (textfig. 69C).

Skin smooth, without calcareous lugosities.

Gladius and radula both not examined.

Measurements.

Dorsal length of mantle	75 mm.
Ventral „ „ „	67 „
Maximum breadth of body	13 „
Length of head	20 „
Length of fins	40 „
Total breadth of fins	45 „
Length of first arms	27 „
„ „ second arms	42 „
„ „ third arms	58 „
„ „ fourth arms	55 „
„ „ tentacles	120 „
„ „ clubs	34 „
Diameter of largest sucker of first arms	2.0 „
„ „ „ „ „ second arms	1.8 „
„ „ „ „ „ third arms	2.6 „
„ „ „ „ „ fourth arms	1.2 „
„ „ „ „ „ tentacles	3.5 „

Remarks.—The difference of this species from *L. kobiensis* consists (1) in the smaller fins, (2) in the more unequal arms, (3) in the more unequal arm-suckers, (4) in the fewer teeth in the same suckers, (5) in the smaller size of clubs and their suckers, and (6) in the smooth horny rings of the carpal suckers.

The species is also related to *L. gotoi* n. sp., but differs from it also in the smaller fins, and in the smooth horny rings of the carpal suckers.

The species is named in honour of my friend, Mr. Tago, who is the collector of the specimen referred to, and to whom I am greatly indebted for his constant kindness during my present work.

Type locality.—Urado, Tosa Prov.

Type.—In Tôkyo Imp. Univ.

Loligo aspera Ortmann, 1888.

Loligo aspera, Ortmann 1888, p. 661, pl. xxv, figs. 3a–3d.—Berry 1912b, p. 401.—Sasaki 1914, p. 604.

No new observation on the species has been made since it was first described by Ortmann. Therefore, there is no way but to extract it from his description.

Body about two and a half times as long as broad; tapering to a blunt extremity. Fins about half as long as body, rhomboidal, their lateral angles rounded. Head about as wide as body; eyes noticeably large.

Arms: 3, 4, 1, 2, rounded on the back or bluntly edged; fourth pair with narrow lateral web. Suckers of third arm very large, the others vary in size in accordance with the length of the arms on which they are set. Horny ring smooth, but in smaller suckers (especially of the first arms) it is equipped with a few blunt teeth. Hectocotylus developed in the middle of left ventral arm, where the suckers are disappearing and a crenulated ridge is found.

Buccal membrane with seven, suckerless, blunt point. Spermatic pad small.

Tentacles as long as body; club lanceolate. Suckers in four series; of which the two inner series are proximally composed of about eight large suckers as large as largest arm-suckers. Distal suckers very small.

Skin, especially of the back, roughly granulated with calcareous grains.

Total length in a full-grown male, 71 mm., ventral mantle length 42 mm., longest arm 21 mm.

Locality.—Kochi (Ortmann).

Loligo beka sp. nov.

Vernacular name : Beka (Okayama).

(Pl. XIII, fig. 5 ; textfigs. 70–72).

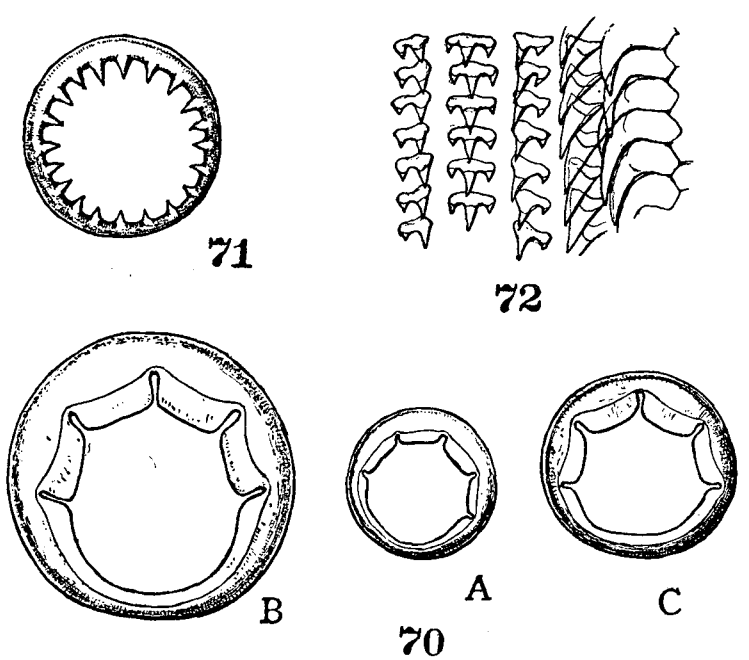
Loligo sumatrensis, Appellöf 1886, p. 32, pl. *i*, fig. 11 ; pl. *iii*, figs. 11–15.—Ortmann 1888, p. 664.—Berry 1912b, p. 399.—Sasaki 1914, p. 604.

This species is represented by ten mature and innumerable juvenile specimens in the collections at my disposal. They measure up to about 70mm. in mantle-length, the sexually mature ones being over 55mm.

Body somewhat thin-walled, roughly conical, of uniform breadth in its anterior one-third, and then tapering to a somewhat acuminate extremity. Anterior margin of mantle dorsally provided with a rounded projection in the middle, and ventrally widely excavated crescentwise. Fins taken together rhomboidal, their lateral angles rounded ; length about equal to the total breadth and greater than half the mantle-length.

Head as wide as, or a little narrower than, body, and about its one-fourth in length provided on either side with a preocular pit and olfactory crest, both of the usual structure.

Arms unequal, the formula of length being $3>2>4>1$; the longest a little longer than half the mantle-length ; the carination on back and the protective membranes on sides both poorly developed. Suckers small, only a little unequal, varying in size with the length of the arms on which they are situated ; the largest sucker of the third arm is less than twice in diameter, that of the first. Horny ring in all suckers equipped with three to five, very broad, neary rectangular, plate-like teeth which are about twice as wide as long or even much wider, closely set along the distal three-fifths of the circumference (textfig. 70).



70

Textfig. 70.

Loligo sumatrensis. Horny rings of third-arm suckers of the Chinese specimen referred to in the description ; ×26. A. From proximalmost sucker. B. From largest sucker. C. From one of distal suckers,

Textfig. 71.

Loligo sumatrensis. Horny ring from one of larger tentacular suckers of same specimen ; ×30.

Textfig. 72.

Loligo sumatrensis. Kadula of immature specimen from the Ariake Sea ; ×80.

Distal two-thirds of left ventral arm hectocotylized, furnished with about fifty swollen, cushion-like papillae connected together in two longitudinal series. The papillae of the ventral series more thickened than those of the dorsal, especially greatly thickened are several of their proximal ones. In the dorsal series the papillae are all provided with a minute rudimentary sucker on their tip, while in the ventral series only several at the extremity bear such a sucker each. On the proximal one-third of the arm are found about twelve or thirteen suckers of the usual biserial arrangement. These suckers are of normal structure, and equal in size to the

corresponding suckers of the right third arm, but two or three distalmost are a little abnormally small, and their pedicells and basal papillae are both enlarged.

Tentacles about as long as body. Club somewhat small compared with that of *L. japonica*, only a little expanded, lanceolate in contour; the dorsal web and protective membranes both constructed almost as in *L. kabiensis*. Suckers small, quadriserial throughout; rhachial ones of hand larger than its marginal ones their diameter being a little less than twice that of the latter. Horny ring in all suckers equipped with sharp, conical, far separate teeth, which are a little longer on the distal margin than on the proximal, and number about twenty in the rhachial suckers of hand (textfig. 71).

Radula as shown in textfigure 72.

Buccal membrane with seven marginal projections, of which the dorsal five have 3–7, minute suckers on their tip. Inner surface of the membrane finely wrinkled; in mature females it is provided, on the ventral part, with a broad membranous spermatic pad. In the females examined, the spermatophres were fixed not only on the pad, but also around the neck and on the proximal part of arms.

Measurements.

Sex.	♀	♂
Dorsal length of mantle	67 mm.	53 mm.
Ventral length of mantle	56 ,,	44 ,,
Maximum breadth of mantle	20 ,,	18 ,,
Length of fins	40 ,,	35 ,,
Total breadth of fins	41 ,,	35 ,,
Length of head	16 ,,	17 ,,
Breadth of head	16 ,,	15 ,,
Length of first arms	Left 25 mm. Right 25 mm.	Left 26 mm. Right 26 mm.
,, ,, second arms	35 ,, 35 ,,	35 ,, 35 ,,
,, ,, third arms	40 ,, 40 ,,	37 ,, 37 ,,
,, ,, fourth arms	35 ,, 35 ,,	30 ,, 32 ,,
,, ,, tentacles	65 ,, 60 ,,	53 ,, 65 ,,
,, ,, clubs	23 ,, 22 ,,	13 ,, 15 ,,
Diameter of largest sucker of first arms	0.8 mm.	0.8 mm.
,, ,, ,, ,, ,, second arms	1. ,,	1.3 ,,
,, ,, ,, ,, ,, third arms	1.2 ,,	1.4 ,,
,, ,, ,, ,, ,, fourth arms	0.8 ,,	0.8 ,,
,, ,, ,, ,, ,, tentacles	0.9 ,,	0.7 ,,

Remarks.—Innumerable juvenile specimens collected by Prof. Kishinoué in the Ariake Sea are referred without hesitation to the present species. Their mantle-length measures 20–33 mm. The fins are yet small, being half as long as the body or even much shorter, and the formula of arms is 3>4>2>1 instead of 3>2>4>1; the chromatophores are regularly distributed on the head and arms as shown in Pl. XIII, Fig. 5.

In Japan this species is confined to the southern half, and is common in Kojima Gulf where it is caught in plenty for the market under the name of "Beka".

Locality.—Hainan I. China (!); Nagasaki (Appellöff); Ariake Sea (!); Omura Bay (!); Okayama market (Sasaki); Kojima Bay (!).

Type locality.—Kojima Bay.

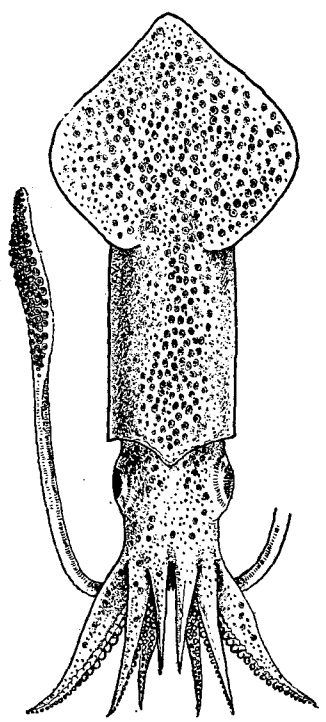
Type.—In Hokkaido Imp. Univ.

Loligo oshimai sp. nov.

Formosan dialect: Shochoon (小管).

(Pl. XXX, fig. 14; textfigs. 162–164.)

Mantle subspindle-shaped, parallel-sided half down the length from the anterior margin, then gradually tapering posteriorly where it termihates in a rather blunt extremity; the length about three and a half times the breadth. Anterior margin of mantle protruded dorsally over the head in a low triangle, and ventrally, broadly emarginated crescentwise beneadth the funnel. Fins relatively small, being only half as long as body; their total breadth about equal to the length; anterior ends a little auriculate, lateral angles rounded; posterior ends forming together a right angle (textfig. 162).

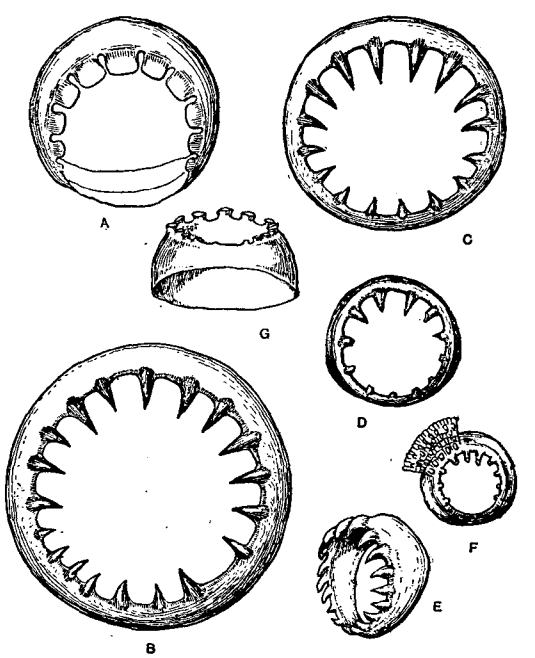


Textfig. 162.

Loligo oshimai. n. sp. Female, ×⅔.

Head of moderate size, about as broad, and one-fourth as long, as body. Funnel cartilage one-fourth as broad as long, with a well-difined longitudinal groove which fits over a ridgelike mantle cartilage; the latter a bit crooked and as long as, or slightly shorter than, the groove of funnel cartilage.

Arms rather unequal, the formula of length being 3>4>2>1; comparatively short, the longest being about half, and the shortest about one-third the mantle length. First and third pairs flattened, keeled along the whole length. Second and fourth pairs quadrangular in section. Web well developed on the outer side of fourth pair as usual. Protective membrances narrow.



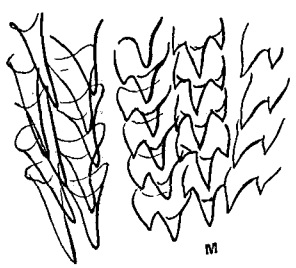
Textfig. 163.

Horny risgs of *Loligo oshimai* n. sp. A. From a suker of the sixth row from the base of the third arm, ×30; B. From the largest rachial sucker of the tentacle, ×30; C. From the largest marginal sucker of the tentacle, ×60; D. From a Carpal sucker of the tentacle, × Ca. 50; E. From a larger distal sucker of the tentacle, ×30; F. From a smaller distal sucker of the tentalcle, ×30; G. From a sucker of the buccal membrane, ×80.

Suckers number 38–42 pairs in each arm, arranged in two alternate rows; small, a little unqual, those of third arms the largest, those of second arms come next in order, and those of first and fourth arms are of nearly equal size and half as large in diameter as those of third arms. Horny ring equipped on the distal two-thirds of the margin with plate-like teeth which are roughly rectangular and a little broader than long; the remaining part of the margin nearly entire and a little projecting forwards (textfig. 163A). The teeth range 6–10 in number in suckers of proximal ten rows. They are definitely separated one from another by narrow interdental spaces.

Tentacles slender, a little longer than body; their stem about as thick as first arms. Club only a little expanded, lanceolate, occupying distal one-third of the tentacle; dorsal web relatively narrow, extending but little on to stem. Suckers small, the largest only slightly larger than the largest arm sucker. Hand suckers nearly equal in size, but ten or more of rachial rows are little larger than

others. Horny ring of the hand suckers, with 15–20 sharply pointed conical teeth which are separated by interspaces broader than their own thickness (textfig. 163B). In the suckers of rachial rows, the teeth are of uniform shape, but those of the distal margin are a little longer than those of the proximal. Such a difference in length of teeth still more marked in the marginal suckers, but otherwise these suckers show a quite similar dentation as the rachial suckers (textfig. 163C). Horny ring of carpal suckers also furnished with conical teeth as in the above mentioned suckers, but the teeth are much less numerous (8–12) and some are often truncate at apex (textfig. 163D). In smaller suckers of the distal portion of the club the teeth are by no means sharply pointed but always blunt or truncated at apex, and range 8–11 in number (textfig. 163F).



Textfig. 164.
Loligo oshimai n. sp.
Radula, ×40.

Gladius of ordinary shape, their breadth in a stretched condition is a little broader than one-sixth the length, and the breadth of the rachis is about two-fifths the entire breadth of the gradius.

Radula as shown in textfig. 164.

Buccal membrane with seven distinct marginal projections which have a few minute suckers each. Horny ring of these suckers, with blunt or truncated cylindical teeth and bordered with a broad strongly papillated area (textfig. 163G). Inner surface of the membranes deeply and longitudinally winkled; spermatic pad on the ventral part single, low, and not surrounded by any horseshoe-shaped fold.

Inkbag relatively large, furnished, on either side, with a oval luminous organ.

Measurements of a Mature Female Examined.

Dorsal length of mantle	90mm.	
Ventral length of mantle	75 „	
Breadth of mantle	26 „	
Length of head	18 „	
Breadth of head	23 „	
Length of fins	46 „	
Total breadth of fins	47 „	
	Left	Right
Length of first arms	30mm.	30mm.
„ „ second arms	37 „	37 „
„ „ third arms	43 „	46 „
„ „ fourth arms	38 „	40 „
„ „ tentacles	93 „	85 „
„ „ tentacular clubs	28 „	25 „
Diameter of largest sucker of first arms	0.9mm.	
„ „ „ „ „ second arms	1.2 „	
„ „ „ „ „ third arms	1.4 „	
„ „ „ „ „ fourth arms	0.7 „	
„ „ „ „ „ tentacles	1.5 „	

Remarks.—Eight female specimens purchased by Dr. Oshima at a fish market of Tainan, Formosa, on April 15, 1920, have been at my disposal, their mantle ranging from 65 mm. to 93 mm., in length. A half of the number have the mantle measuring above 85 mm. in length, and are sexually mature with ripen eggs, and the nidamental glands measure 25–28 in length.

The species is very near *Loligo beka* n. sp., which has been referred with doubt by Appellöf to *L. sumatrensis*. The differences from this species consist in (1) its having more numerous teeth in the arm-suckers, (2) the presence on either side of the ink bag, of a luminous organ which is destitute in that form, and (3) in that the arm-formula is clearly 3>4>2>1 and not 3>2>4>1.

When the present species is compared with d'Orbigny's description and illustrations of *L. suma-*

trensis the discrepancies are as follows: (1) in *L. oshimai* the horny rings of the tentacular handsuckers have acutely pointed teeth, while in *L. sumatrensis* they may be smooth or provided with several quadrangular teeth, and (2) the buccal membrane has on the projections minute suckers, which are said to be absent in that species.

In respect to dentation of suckers, this species rather approaches *L. duvaucelii* of d'Obignuy, but from this it differs at least in having larger fins, less carinated arms, and more slender clubs which have much less unequal suckers.

Type locality.—Tainan market, Formosa.

Type.—In Hokkaido Imp. Univ.

Loligo bleekeri Keferstein, 1866.

Local name: Yari-ika (Tôkyo); Saya-naga (Etchû Prov.); Shakuhachi-ika (Nagasaki).

(Pl. XIII., figs. 6–10; textfig. 73.)

Loligo bleekeri, Keferstein 1866, p. 1402, pl. cxxii, figs. 9, 10; pl. cxxvii, fig. 14.—Tryon 1879, p. 149, pl. lvii, figs. 185, 186.—Brock 1882, p. 604.—Appellöf 1886, p. 31, pl. i, figs. 7–10.—Ortmann 1888, p. 664.—Joubin 1894a, p. 56.—Wülker 1910, pp. 10, 36, pl. iv. fig. 30 (digestive system).—Berry 1912b, p. 399.—Sasaki 1914, p. 604.—Sasaki 1920, p. 184.

To this species I refer with great satisfaction fifty-four specimens collected at various localities as listed below. They measure up to 35 cm. in mantle-length.

Mantle very slender, from six to seven times as long as broad; nearly cylindrical in its anterior one-third, then very gradually tapering to a sharply pointed extremity (Pl. XIII, fig. 6).

Belly in male invariably furnished with a distinct longitudinal ridge in the middle; in female, it is usually obscure. Anterior margin of mantle with a small rounded projection in the mid-dorsal part, and widely excavated in the ventral part. Fins taken together rhomboidal, widest one-third of the way back, somewhat attenuated posteriorly, their anterior lateral edges slighly convex, and the posterior lateral edges a little concave. Length of fins in full-grown specimens far greater than their total breadth, and also far over half the mantle-length.

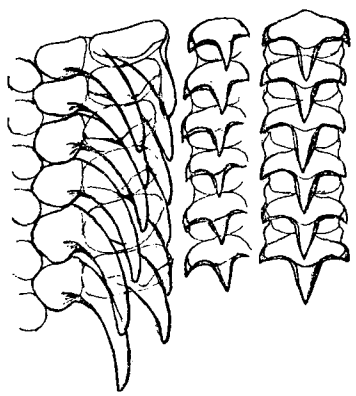
Head very small, a little narrower than body, its length in full-sized specimens goes about ten times in the mantle length, and in medium-sized specimens, eight to nine times. Preocular pit and olfactory crest both present none of pecuriarities. Funnel comparatively large. Funnel cartilages a little longer than a quarter of its own maximum breadth. Nuchal cartilage slenderly panduriform, much more acuminate posteriorly than anteriorly, its length about four and a half times the maximum breadth.

Arms very short, somewhat unequal, the formula of length being $3>2>4>1$; the longest attains about a quarter of the mantle length. Second and fourth pairs four-sided, while the first and third pairs are more or less flattened laterally, provided with a keel on the back as usual. Suckers small, subequal, only a little varying in size with the length of the arms on which they are situated; biserial as usual. Horny ring in all suckers equipped on the distal two-thirds of the circumference, with rather large, blunt or square-cut teeth, which are longer on the more distal margin of the ring; the interdental spaces decidedly narrower than the breadth of teeth (Pl. XIII, fig. 9a). The teeth of proximal suckers number 10–14, and those of distal suckers, 4–7.

Left ventral arm prominently hectocotylized, its distal part being abnormally thickened and the extreme tip blunt (Pl. XIII, fig. 7). On the proximal three-fourths or sometimes two-thirds of the arm are found about fifty suckers of the usual biserial arrangement and normal size; but as proceeded distad the pedicells of these suckers become longer and their bases thicker. On the remaining distal part are found also about fifty suckers arranged in two series. These suckers all show, however, an abnormality, reduced in size and their basal papillae becoming thickened. The abnormality is especially marked in the dorsal series, in which the suckers are almost disappearing, and in which their basal papillae are greatly thickened and are transformed into bisuspid lamelliform appendages tightly

arranged into a ctenoid structure. Further, on the distal part is found a broad, longitudinal, serrated membrane between the two series of the abnormal suckers.

Tentacles only 1/3–1/2 as long as mantle, thinner than any arm, nearly triangular in section. Club only slightly expanded, lanceolate in contour, with a dorsal web narrowing proximad; protective membranes rather narrow, yet distinctly costate as usual. Suckers numerous, small, on carpus arranged in two series on hand; in four series at the distal part of the club they are closely set in 6–8 series (Pl. XIII, fig. 8). They are rather uniform, but rachial ones on the hand are a little larger than its marginal ones. Horny ring in all suckers equipped with small, elongate, blunt, separate teeth along the whole margin (Pl. XIII, fig. 9b). The teeth number about 30 or more in larger suckers and 10–14 on the distal margin are much longer than the rest.



Textfig. 73.
Loligo bleekeri. Portion of radula; ×80.

Buccal membrane markedly folded internally, with seven, conspicuous, marginal projections, each furnished with 20–30 minute suckers.

Radula as shown in textfigure 73.

Gladius slender, one-ninth as broad as long, nicely penniform, but the margins of vanes folded ventral, curving round so as to form a hollow slender cone shaply pointed posteriorly (Pl. XIII, fig. 10). Length of vanes about seven-ninths the entire length of gladius.

Measurements of Fresh Male Specimens.

Sex	♀	♂
Dorsal length of mantle	318 mm.	280 mm.
Ventral length of mantle	303 ,,	264 ,,
Circumference of body	140 ,,	120 ,,
Maximum breadth of body	50 ,,	40 ,,
Length of fins	207 ,,	182 ,,
Total breadth of fins	155 ,,	132 ,,
Length of head	30 ,,	23.5 ,,
Breadth of head	39 ,,	31 ,,
	Left Right	Left Right
Length of first arms	76 mm. 76 mm.	58 mm. 58 mm.
,, ,, second arms	81 ,, 81 ,,	62 ,, 61 ,,
,, ,, third arms	86 ,, 86 ,,	66 ,, 66 ,,
,, ,, fourth arms	72 ,, 71 ,,	58 ,, 58 ,,
,, ,, tentacles	110 ,, 105 ,,	80 ,, 80 ,,
,, ,, clubs	50 ,, 50 ,,	32 ,, 33 ,,
Diameter of largest sucker of first arms	2.0 mm.	1.2 mm.
,, ,, ,, ,, ,, second arms	2.2 ,,	1.4 ,,
,, ,, ,, ,, ,, third arms	2.5 ,,	1.5 ,,
,, ,, ,, ,, ,, fourth arms	1.8 ,,	1.2 ,,
,, ,, ,, ,, ,, tentacles	1.0 ,,	0.8 ,,

Remarks.—This species is one of the commonest and most widely distributed cuttlefish in Japan. It is caught everywhere in plenty for the market, and sometimes is cured; if so, then it is called "*Sasazurumé*" by the traders.

Locality.—Japan (Keferstein); Akkeshi, Hokkaidô (!); Takashima, Hok. (!); Oshoro; Hok. (!); Furubira, Hok. (!); Hakodaté (!); Muroran (!); Azamusei, Mutsu Prov. (!); Samé, Mutsu Prov. (!);

Niigata (!); Etchû Prov. (Sasaki); Sagami Bay (Sasaki); Misaki (Wülker; Sasaki); Tôkyo market (!); Nagasaki (Appellöf); Satsuma Prov. (Sasaki); east of Tsushima, 66 fms. (Albatross!); Fuzan, Korea (!); Amboina (Joubin).

Genus **Sepioteuthis** de Blainville, 1824.

Sepioteuthis, Blainville 1824 (fide Hoyle).—d'Orb. in d'Orb. et Fér. 1839, p. 297 (pars).—d'Orb. 1845, p. 319 (pars).—Gray 1849, p. 78.—Verany 1851, p. 75.—Adams H. & A. 1858, p. 38 (pars).—Verrill 1882, p. 373.—Hoyle 1910a, p. 412—Wülker 1913, p. 460.—Berry 1914a, p. 308; 1920, p. 154.—Naef 1921, p. 535.

Body conico-cylindrical, ending rather bluntly behind. Fins enormous, marginal; at maturity, extending the whole length of mantle; both together ovate. Hectocotylization affecting the distal part of left ventral arm. Spermatic pad present on the ventral part of buccal membrane, containing internally a pair of ramified seminal receptacles.

Type :—Sepioteuthis sepiacea Blv. 1824,= *S. sepioidea* Blv. 1823 (fide Hoyle).

Sepioteuthis lessoniana Férussac, 1826.

Vernacular name : Aori-ika (Tôkyo, Etchû); Mizu-ika (Nagasaki); Kutsu-ika (Noto Pen.); Shiro-ika (Okinawa).

(Pl. XIV., figs. 15–17; Pl. XXIX, figs. 8, 9; textfigs. 74–77.)

Sepioteuthis lessoniana, Férussac, in d'Orb. 1826, p. 155; 1845, p. 326.—d'Orb. et Fér. 1839, p. 302, Sepioteuthis, pl. i; pl. vi, figs. 9–14.—Gray 1849, p. 80.—Keferstein 1866, p. 1402, pl. cxxii, fig. 7.—Tryon 1879, p. 152, pl. lxii, fig. 212; pl. lxiv, fig. 213.—Appellöf 1886, p. 32, pl. i, fig. 11; pl. iii, figs. 11–15.—Hoyle 1886b, p. 151.—Ortmann 1888, p. 657; 1891, p. 676.—Brazier 1892, p. 14.—Joubin 1894a, p. 39; 1898b, p. 26.—Wülker 1910, pp. 11, 26. pl. iii, fig. 28; pl. iv, figs. 29, 31; 1913, p. 452.—Berry 1912b, p. 401, pl. vi, figs. 3, 5.—Sasaki 1914, p. 606; 1920, p. 185.

Sepioteuthis sinensis, d'Orb. in d'Orb. et Fér. 1839, p. 304.—d'Orb. 1845, p. 329.—Tryon 1879, p. 154.—Sasaki 1914, p. 607.

? Sepioteuthis mauritiana, d'Orb. et Fér; 1839, p. 304, Sepioteuthis pl. v, figs. 1–4. pl. vii, figs. 1–5.—Brazier 1892, p. 15.

? Sepioteuthis lunulata, d'Orb. et Fér. 1839, p. 300, Sepioteuthis pl. iii, fig. 1; pl. vi, figs. 1–8.—Brazier 1892, p. 13.—Hoyle 1904, p. 31.

? Sepioteuthis brevis, Owen 1881, p. 137, pl. xxvi, fig. 1.—Wülker 1910, p. 11.—Sasaki 1914, p. 607.

? Sepioteuthis sieboldi, Joubin 1898b, p. 27.—Sasaki 1914, p. 607.

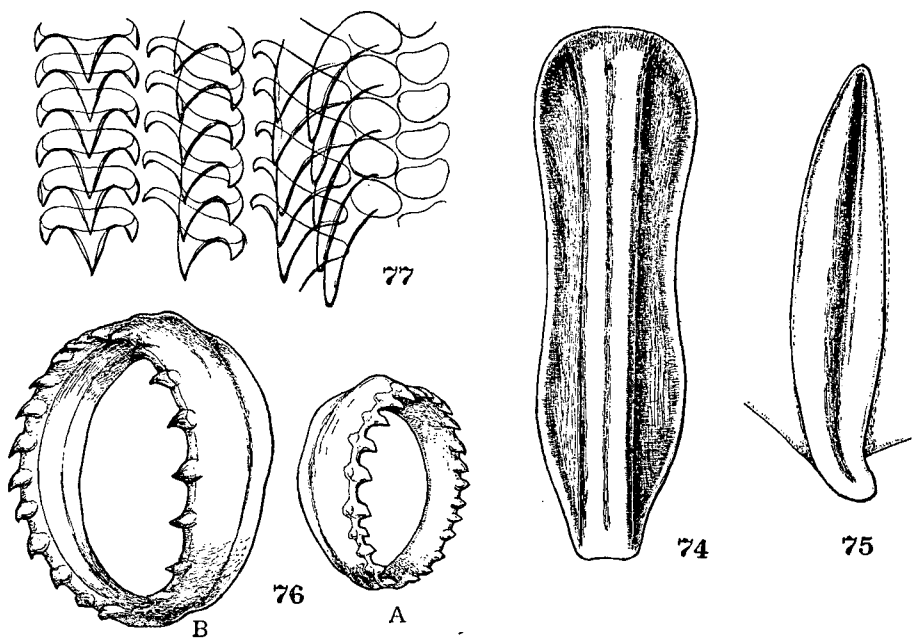
? Sepioteuthis arctipinnis, Berry 1914a, p. 308; pl. liv, fig. 1; textfigs. 20, 21.

? Sepioteuthis malayana, Wülker 1913, pp. 478, 479, 483.

Body conico-cylindrical, ending bluntly behind, a little flattened dorso-ventrally, thick-walled; length at maturity about three and a half times the maximum breadth. Anterior margin of mantle projects a little on the dorsal side in a very low triangle, and is widely emarginated cresentwise on the ventral side, the excavation marked off on sides by pointed projections. Fins in adult, enormous, thick, muscular, nearly extending the whole length of the sides of mantle; both together ovate in contour, broadest about the middle, the total breadth about three-fourths the length (Pl. XIV, fig. 15). Fins in young, proportionally narrower, with the broadest part more posteriorly, and the attachment to body less extensive than in adult.

Head large, only a little narrower than, or even as wide as body, rounded on sides a little flattened dorso-ventrally, with a distinct pore in front of each eye. Olfactory crest conspicuous, ω-shaped as in *Loligo*. A distinct olfactory pit is sheltered within the ventral bay of the ω. Nuchal cartilage roughly

panduriform, more rounded, and a little more expanded anteriorly than posteriorly, a little longer than three times of its own maximum breadth; mid-rib conspicuous, prominent about one-third as the entire breadth of the cartilage, and sharply marked off from vane-like parts which are a little depressed (textfig. 74). The cartilage in a male of 32cm. mantle length, measures 70mm. in length.



Textfig. 74.

Sepioteuthis lessoniana. Nuchal cartilage of male specimen of 34cm. mantle-length; natural size.

Textfig. 75.

Sepioteuthis lessoniana. Left funnel-cartilage of same specimen; natural size.

Textfig. 76.

Sepioteuthis lessoniana Horny rings of same specimen; ×8. A. From one of suckers of sixth row on third arm. B. From largest sucker of tentacle.

Textfig. 77.

Sepioteuthis lessoniana. Radula of female specimen of 29cm. mantles length; ×20.

Funnel large, roughly conical, extending forwards a little beyond the center of head. Funnel organ composed of a conspicuous Λ-shaped dorsal pad, and two ovate ventral pads ⅔–¾ as long as the former. Funnel cartilage lanceolate, widest near the middle; the posterior end a little blunter than the anterior, and somewhat bent outwards (textfig. 75). In the aforesaid male the dorsal funnel pad measures 75 mm. in length, and the funnel cartilage, 54mm. in length, and 13 mm. in maximum breadth.

Arms unequal, the formula of length being $3 \fallingdotseq > 4 > 2 > 1$; or $3 > 4 > 2 > 1$; the longest about half the mantle-length. First pair by far the thinnest of all and about ⅔–¾ as long as third pair; its aboral surface carinated in the distal two-thirds, but rounded in the remaining parts. Second pair sometimes four-sided with a distinct thick web on the ventral side of the aboral surface, but more often three-sided, the web standing keel-like and the dorsal edge of the aboral surface being quite rounded off. Third pair thickest of all, and flattened, its dorsal surface strongly carinated. Fourth pair four-sided, its aboral surface marked off on the ventral side by a sharp edge and on the dorsal side by a broad web widening proximad as in *Loligo*. Protective membranes strongly trabeculated, narrowest on the ventral arm. On the remaining arms their breadth varies with the size of the arms on which they are situated, and on each arm the membrane of the ventral side seems a little broader than that of the dorsal.

Arm-suckers roughly helmet-shaped, biserial throughout. They vary only a little in size in different arms, being larger on lateral arms and again larger on ventral lateral arm. On each arm they become gradually larger to the sixth or seventh pair and thence they decrease in size very gradually to the extremity. Their horny ring is dentate on the whole margin (textfig. 76A); the teeth are sharp and conical, but sometimes may be more or less plate-like and triangular or squarish; always larger on the distal margin of the ring than the proximal margin, numbering 20–30 in each ring.

Left ventral arm hectocotylized at the extremity that involves about a quarter of the entire length

of the arm (Pl. XIV, fig. 16). On this part, there are found 50–60, sharply pointed, slightly compressed, sucker-less, conical papillae arranged in two series. On the remaining proximal part, there are biserial suckers about as many as the aforesaid papillae; they are normal in structure and size, except seven or eight distalmost, which are abnormally small and attached to swollen and elongated peduncles.

Tentacles as long as, or even longer than, mantle. Stem a little thicker than second arm, four-sided, but sometimes the ventral edge of the aboral surface may be quite rounded off; if so, then the whole shape of the stem is much like that of three-sided prism. Club large, expanded, lanceolate in contour, triangular in section, comprising the distal one-third of tentacle; dorsal web widening and thickening distad; proximally it is continued on to the stem down to its base as a ridge.

Tentacular suckers quadriserial but at the extremity they may be much crowded in five or six series. Hand suckers of two central series only a little larger than those of both marginal series, but even the latter are larger than the suckers of the other parts, although from these the hand suckers can not be clearly separated by any sudden gap of size as occurs in some species of *Loligo*. Horny ring in all suckers, dentate almost as in arm-suckers, but usually the teeth are more slender and farther separate (textfig. 76B). The teeth in central hand suckers are nearly uniform, but in the others they are unequal, being sharper on the distal margin of the ring than on the proximal margin.

Buccal membrane suspended by seven strong ribs, which markedly project beyond the margin. The projections of margin, armed with 4–11, minute suckers on their tip; the suckers are of the ordinary structure, furnished with dentate horny rings; the teeth are conical, and far separate, numbering about 20 in largest suckers.

Anal appendages large, thick, obcordate, distinctly pedunculate.

Spermatophores 14–15 mm. long, with structures as shown in Plate XIV, figure 17.

Gladius nicely penniform, with a distinct submarginal thickening and a strong rachis evenly narrowing posteriad; the length about six times the maximum breadth.

Radula as shown in textfigure 77.

Color greatly variable in the different state of preservation; in good preservation generally it is grayish or violet brown. Chromatophores large, numerous in the dorsal surface of all parts, but rare in the ventral surface of head and body, and absent beneath the fins. In a still excellent state of preservation there may appear on the combined dorsal surface of body and fins, numerous, transverse-fusiform, ill-defined markings of much deeper shade than the ground color. The markings have a transverse white streak in the midde. Their number is subject to individual variation, but generally ranging from 50 to 100; the distribution also seems not fixed, but generally rarer on the periphery than on the center. In addition to these there may occur about ten, round, black spots arranged in a series along each lateral margin.

Measurements of largest Male Examined.

Ventral length of mantle	355 mm.	
Dorsal length of mantle	322 ,,	
Circumference of mantle	26.8 ,,	
Maximum breadth of mantle	100 ,,	
Length of fins	345 ,,	
Total breadth of fins	300 ,,	
Length of head	58 ,,	
Breadth of head	82 ,,	
	Left	Right
Length of first arms	103 mm.	103 mm.
,, ,, second arms	138 ,,	136 ,,
,, ,, third arms	153 ,,	150 ,,
,, ,, fourth arms	145 ,,	143 ,,
,, ,, tentacles	305 ,,	300 ,,
,, ,, clubs	128 ,,	130 ,,

Diameter of largest sucker of first arms ... ... 4mm.
" " " " " second arms ... ... 5 "
" " " " " third arms ... ... 6 "
" " " " " fourth arms ... ... 4 "
" " " " " tentacles ... ... 7.4 "

Remarks.—A vast number of specimens found in diverse collections have been at my disposal, some of which are listed in the following.

No.	Specimens	Mantle-length	Locality	Collector	Date	Where Preserved
i	1♂	330mm.	Asari, Hokkaidô.	Sasaki	July, 1911	Hokkaido Imp. Univ.
ii	8 juv.	42–73mm.	Oshoro, Hok.	Sasaki	Sept. 10, 1911	do.
iii	3♂, 7♀	250–340mm.	Sappro market	Sasaki	June, 1915	do.
iv	1♀	300mm.	Namerikawa, Toyama Bay.	Sasaki	June, 1889	Tôkyo Imp. Univ.
v	1♂	355 mm.	do.	—	July, 1913	Fish Inst. Namerikawa
vi	2♂	145mm., 160mm.	Noto Pen.	Sasaki	March 7, 1912	Hokkaido Imp. Univ.
vii	1♂	200mm.	Miyazu, Tango	—	July, 8. 1908	Tôkyo Imp. Univ.
viii	7♂	—	Tôkyo market	—	Aug., 1885	do.
ix	1♂, 2♀	190–255mm.	Misaki	—	Aug., 1906	do.
x	1♂	—	Haneda, Musashi	—	—	do.
xi	1♂	207mm.	Enoura, Suruga	—	—	do.
xii	2 juv.	55mm., 80mm.	Gokasho, Ise	Akatsûka	July, 1910	Hokkaido Imp. Univ.
xiii	1♂	22mm.	Tokushima	Sasaki	—	do.
xiv	4♂, 2♀	—	Takamatsu, Sanuki	—	—	Tôkyo Imp. Univ.
xv	1♂	107mm.	Oshima, Izu	—	April, 1887	do.
xvi	1♂	—	Bonin Is.	—	—	do.
xvii	3♂, 1♀	150–330mm.	do.	K. Arima	—	Hokkaido Imp. Univ.
xviii	2 juv.	42mm., 45mm.	Nagasaki	K. Kaneko	—	do.
xix	5♂, 3♀	—	Kagoshima market	—	April 17, 1896	Tôkyo Imp. Univ.
xx	1 juv.	—	do.	Albatross	—	U.S. Nat. Mûs.
xxi	1 juv.	40mm.	Loochoo	m. Tominaga & S. Taku.	—	Hokkaido Imp. Univ.
xxii	3♂, 4♀	78–117mm.	do.	K. Makino	Aug. 24, 1920	do.
xxiii	1♂	300mm.	Taihoku market, Formosa	M. Oshima	March 14, 1921	do.
xxiv	1♂	340mm.	Tainan market, Formosa	do.	April 19, 1920	Formosan Mûs.
xxv	13 juv.	46–130mm.	Pescadores Is.	do.	July 5, 1920	do.
xxvi	1♂, 1♀	153mm., 160mm.	Taihoku market, Formosa	do.	July 15, 1920	Hokkaido Imp. Univ.
xxvii	2♂, 1♀	130–160mm.	do.	do.	do.	Formosan Mûs.

All these specimens well agree with one another even in details of the spermatophore, although their localities are so far distant. Of course individual variations may be found in every particular. The only discernible variation which is probably attributable to different localities is that the teeth of both arm and tentacular suckers are more slender and sharper in Formosan and Bonin specimens than those from other localities.

As seen from the above list, the species is so widely extended in distribution as almost covering the Japanese waters, the northern limit being Hokkaido, where it is very rare and is caught only in such a year when warmer water-currents from the south abound around the island. In Kiushiu and Loochoo the species is very common and the egg clusters may frequently be found in spring in bays or inclosed coasts where it grows larger but disappears before arriving at a full size. The full sized one is rather oceanic in habit so that fishermen often take them as a distinct form.

The Japanese specimens referred to agree very well with Berry's descriptions on *S. arctipinnis* so that I am greatly inclined to consider that this species is synonimous with S. lessoniana. The differences between *S. lessoniana* and *S. arctipinnis* pointed out by Berry may occur between the Japanese specimens in question, even between those caught at a locality, but linked by graduated series of intermediate forms, seeming not to be due to the specific distinction.

In Japan the species is caught for the market, and the dried specimens are called "*Mozurumé*" or "*Mizuzurumé*" by traders.

Locality.—Asari, Hokkaido (Sasaki); Sapporo market (!); Oshoro, Hokkaido (!); Hakodaté (!); Muroran (!); Samé, Mutsu Prov. (!); Etchû Prov. (Sasaki); Echizen Prov. (Berry); Noto Pen. (!); Miyazu, Tango (Sasaki); Tsushima (!); Fusan, Korea (Berry); Tôkyo Bay (Ortmann); Tôkyo market (Sasaki); Misaki (Wülker; Berry; Sasaki); Haneda, Musashi (Sasaki); Enoura, Suruga (Sasaki); Ôshima, Izu (Sasaki); Isé Prov. (!); Ôsaka market (!); Takamatsu, Sanuki (Sasaki); Nagasaki (Appellöf, Sasaki); Kagoshima (Ortmann); Kagoshima market (Sasaki; Albatross!); Bonin Is. (Sasaki); Riu-kiu Is. (!). ? Hawaiian Is. (Berry); Fiji (Hoyle); Apia, Samoa (Berry); Amboina (Joubin); Morotai (Joubin); Obi (Joubin); Ternata (Hoyle); Java (Fér. et d'Orb.; Keferstein; Joubin); Timor (Joubin); New Guiner (Fér. et d'Orb.); Papous (Fér et d'Orb.); Cape Febre (Fér. et d'Orb.); Uji Is. (Brazier); Erazer's Is. (Brazier); Queensland (Brazier); Torres Straits (Brazier); Salomon Is. (Brazier); New Zealand (Gray; Brazier); Indian Oc. (Fér. et d'Orb.; Joubin); Ceylon (Ortmann); Trincomali (Fér. et d'Orb.); Malabar (Fér. et d'Orb.): Cap Haitien (Joubin).

Family **Promachoteuthidae** Naef, 1912.

Promachoteuthidae, Naef 1912, p. 244.

Body short, rounded; fins large ovate, extending beyond the posterior end of body. Mantle free all round. Funnel short, slender, and with everted margin. Head small, narrow; eves not prominent, without lid-folds; but with preocular pores. Arms long, conical, with biserial pedunculate spherical suckers. Tentacles exactly resembling the arms at their origin.

Genus **Promachoteuthis** Hoyle, 1885.

Promachoteuthis, Hoyle 1885, p. 273; 1886b, p. 120.

Type.—*Promachoteuthis megaptera* Hoyle, 1885.

Promachoteuthis megaptera Hoyle, 1885.

Promachoteuthis megaptera, Hoyle 1885, p. 273, fig. 109; 1885b, p. 182; 1885d, p. 284; 1886b, p. 120, pl. xiv, figs. 10–14; woodcut 3.—Berry 1912b, p. 417.—Sasaki 1914, p. 599.

Eventhough this species has not been represented in any of the collections studies by me, I had an opportunity to examine the type specimen of the species. But due to its mutilated condition I could not go further than the original description given by Hoyle, except that the outer lip though very indistinct was certainly discernible, disagreeing with his description.

Body short, about half as broad as long, barrel-shaped or rather sub campaniform, bluntly pointed behind. Mantle margin evenly truncated, free all round. Fins large, wider than long, both together transversely elliptical, extending a little beyond the posterior end of body.

Head very small, almost the whole of its sides occupied by eyes. Eye not prominent, entirely covered over by a continuous transparent lid, which has no reduprication; but a distinct pore is found at a point in front of and below the eye. No trace of umbrella present. Buccal membrane well developed, with seven suckerless marginal projections, not connected with arms by ligaments as usual. A very thin outer lip and a thick, papillate inner lip present. Funnel short, narrow, with the distal margin everted much like that of the neck of a flask. Funnel cartilages oval, with a depression fitting into linear, ridge-like mantle-cartilages.

Arms unequal, fourth pair the shortest of all, the others subequal; on an average about as long as body; smoothly conical, tapering evenly to fine points. Suckers spherical, pedunculte as usual, their aperture lateral, directed inwards; biserial throughout, numbering about 16 pairs in each arm. Horny ring smooth, surrounded by a few large papillae.

Tentacles thicker and longer than arms, exactly resembling them at their origin, and being obviously serially homologous with them.

Surface smooth. Color dull purplish madder, paler on fins, arms, and tentacles.

Total length 50 mm., length of body 15 mm.

Locality—South-east of Noshima, 1875 fms. (Hoyle).

Family **Idiosepiidae** Appellöf, 1898.

Idiosepii Steenstrup 1881, pp. 233, 239 (pars).*)

Idiosepiidae, Fischer 1882, p. 350.—Appellöf 1898a, pp. 571, 623.—Hoyle 1904b, pp. 2, 7.—Naef 1912, p. 243.

Body elongated, pointed behind. Head separated from the dorsal margin of mantle, devoid of nuchal resisting cartilage, but the collar-like portion of funnel base is connected with the internal surface of mantle at the mid-dorsal region. Eyelid continuous, without forming any lid-fold, but a minute lachrymal pore present as usual. Olfactory crest absent, though pit-organ well developed. Fins minute, subovate, separate, and subterminal. Arm-suckers biserial. Tentacular suckers bi- to quadriserial. Retractor pallii redianus somewhat developed. Both ventral arms hectocotylized. Oviducts of both sides developed, but the left one is only functional. Gladius quite rudimentary.

Genus **Idiosepius** Steenstrup 1881.

Idiosepius, Steenstrup 1881, pp. 219, 233, 236, 240; 1887, pp. 67–72, 116, 119, 120, 121.—Appellöf 1898a, p. 570.—Brock 1884, pp. 105–114.—Hoyle 1904b, p. 7; 1910, p. 410.—Berry 1921, p. 355.

Idiosepion, Fischer 1882, p. 350.

Microteuthis, Ortmann 1888, p. 648.

Naefidium, Grimpe 1920, p. 210.

This is a unique genus of the family and now involves four different species**), of which only one has been known to inhabit the Japanese waters.

Type—Idiosepius pygmaeus Stp. 1881.

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*) Steenstrup includes *Idiosepius* and *Spirula* together in Idiosepii, but the latter genus is now generally considered to form itself a family quite distinct from the Idiosepeidae.

**) A synopsis of the four species is appended here:—

1) *I. pygmæus* Steenstrup.—Ventral arms of male, with only a single sucker at base otherwise naked, and smooth, the right arm much thicker than the left arm; tentacles very conspicuously more slender than arms. From Southern China to Dutch E. Indies.

2) *I.* (*Naefidium*) *picteti* Joubin.—Ventral arms of male, with only a single sucker at base, the right arm much shorter, but broader than the left arm, heavily transversely plicate on oral surface and with a deep, longitudinal groove on aboral surface, the left arm bilobate at tip by the projection of a small, tongue-like process on the oral surface; tentacles thinner than arms, with short club. Amboina.

3) *I. paradoxus* Ortmann.—Ventral arms of male, with several suckers; the right arm with a longitudinal groove on aboral surface, the left arm with a small semilunar membrane at tip; tentacles as thick as arms, bearing suckers for more than half their length. Seas of Japan.

4) *I. notoides* Berry.—Ventral arms of male, with 7–11 suckers, the right arm a trifle shorter than the left arm, with simple, sharply pointed tip the left ventral arm furnished at tip with a part of much compressed, recurved flaps; tentacles as thick as arms, bearing suckers nearly along the whole exposed part. South Australia.

Idiosepius paradoxa (Ortmann, 1888).

(Pl. XV, figs. 1–3 ; textfigs. 78, 79.)

Idiosepius pygmaeus, Wülker 1910, p. 22.—Sasaki 1914, p. 599 ; 1920, p. 191 ; 1923a, pp. 209–213, textfigs. 1–3.

Microteuthis paradoxa, Ortmann 1888, p. 649, pl. xxii, fig. 4.—Joubin 1902, p. 105, fig. 15.

Idiosepius paradoxa, Berry 1912b, p. 405 ; 1921, p. 359, textfig. 65.

A large number of specimens of this species from several localities of Japan, have been at my disposal. They measure up to 15 mm. in mantle length.

Body subfusiform, or conico-cylindrical, pointed behind ; in preserved specimens it is a little bowed ventral so that in profile the belly is straight or even a little concave while the back is arched. The posterior two-thirds of the back is transformed into an adhesive organ with a wrinkled and glandular surface. In preserved specimens the organ is distinctly recognized as an opague longitudinal-elliptical area with a much wrinkled surface. Anterior margin of mantle free all round, obliquely truncated, the dorsal part projecting a little forward, but not to any special lobe.

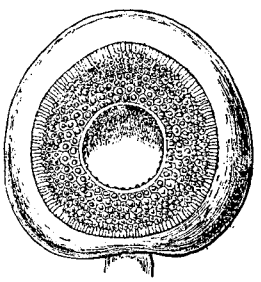
Fins small, subovate, about one-third as long, and half as broad, as mantle ; distinctly, auricelate both before and behind ; attachment subterminal and oblique.

Head about as wide as mantle-opening and one-third as long as body, evenly rounded on sides, marked off behind by a distinct neck groove. Eye covered with an oval transparent integument without distinct lid-fold. Olfactory pit-organ present on each ventro-lateral surface of head near neck groove. Umbrella but little developed except between third and fourth arms, where it extends ⅓–½ up the arms. Nuchal cartilage absent.

Funnel short, conical, with wide base, extending much less than halfway to the angle between ventral arms. Funnel organ composed of a large dorsal pad with three radiating lobes, and two small cardiform ventral pad. Of the three lobes of the dorsal pad, the anterior is by far the narrowest, tapering to a sharp point while the remaining two are roughly triangular, widening towards the posterior extremities. Funnel cartilages ovate, deeply depressed at the middle ; the depression being deepest anteriorly. Mantle cartilage ridge-like, longitudinal, about as long as funnel cartilage.

Arms on an average one-third as long as the dorsal length of mantle; subequal, second pair the longest, first pair the shortest. All rounded on back, without distinct keel, tapering at first gradually but rather rapidly afterwards. Protective membranes thick, about half as broad as the length of suckers. Suckers in full-grown specimens number about 30 on each arm, biserial ; their size nearly equal in different arm. On each arm they become smaller distad at first very gradually, but rather rapidly afterwards. Horny ring with numerous, minute, granuliform teeth; papillate area broad, composed of several series of papillates plate, and a radiate margin (textfig. 78).

Tentacles as thick as arms and a little shorter than twice their length. Club not expanded, nor well-defined, tapering distad more gradually proximally than distally ; sucker-bearing surface flattened, occupying the distal



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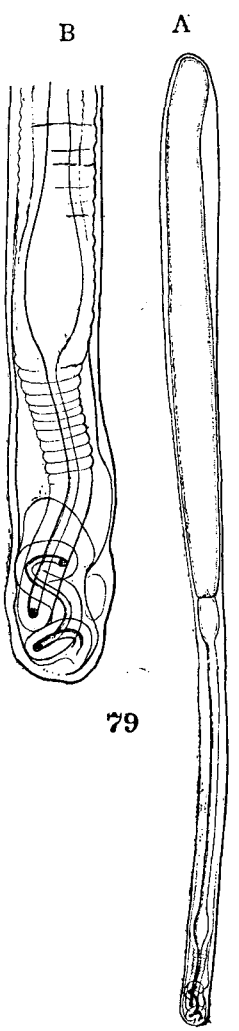

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Textfig. 78.

Idiosepius pygmaeus. One of larger arm-suckers, ×ca. 80.

Textfig. 79.

Idiosepius pygmaeus. Spermatophore. A. Total view; ×53. B. Aboral part; ×223.

two-thirds of tentacle. Protective membranes almost as in arms. Suckers 40–50 in number, arranged in two to four series ; their shape and size much like those of arms.

Both ventral arms hectocotylized. In the right arm both the margins of the aboral surface are bent back so as to form an incomplete canal there, while in the left arm a small semilunar membrane grows near the extremity. The suckers of these arms number at most seven in each and are thickly crowded on a small proximal area ; in the remaining part the oral surface is quite smooth.

Buccal membrane thin ; no connectives discernible nor marginal projections nor even ribs. On the ventral part of the membrane in females is found a rounded spermatic pad. The spermatophores are fixed not only on the pad but also beneath the head, on the nape, on the bases of the arms, and even on the mantle.

Spermatophores 2–2.5 mm. long. Sperm cord thick, not coiling, quite terminal, occupying a little more than half the length of etui. Intermediate organ quite simple (textfig 79).

Gladius absent.

Chromatophores comparatively large, evenly distributed but closest above body and absent beneath fins. Visceral integument with many large chromatophores.

Measurements of largest Male and Female Examined.

Sex.	♀		♂	
Dorsal length of mantle	15 mm.		12 mm.	
Ventral length of mantle	11.5 ,,		10 ,,	
Breadth of body	7 ,,		6 ,,	
Breadth of head	5.2 ,,		5 ,,	
Length of fins	Left 5 mm.	Right 4.8 mm.	Left 4.5 mm.	Right 4.5 mm.
Breadth of fins	3.2 ,,	3.2 ,,	2.6 ,,	2.7 ,,
Length of first arms	4.0 ,,	4.0 ,,	4.0 ,,	4.0 ,,
,, ,, second arms	4.5 ,,	4.5 ,,	4.2 ,,	4.2 ,,
,, ,, third arms	4.2 ,,	4.2 ,,	4.0 ,,	4.0 ,,
,, ,, fourth arms	4.2 ,,	4.2 ,,	3.6 ,,	4.0 ,,
,, ,, tentacles	8.0 ,,	8.0 ,,	6.0 ,,	6.0 ,,

Remarks.—The species is littoral in habit, usually adhering its back on the undersurface of sea weeds, and in harmony with this behaviour a special adhesive organ is developed on the back as mentioned before. Its food consists chiefly of gammalids as large as its own body, and which frequent among sea weeds. The bite is made with great skill on the back of gammalids just at the part where the heart is situated, and the eating takes pleace deliberately under sea weeds, whereby the buccal mass of the squid acts almost like the introvert of some gastropods, extending as long as its first arm, and moves quite actively and freely in all directions so that the soft internal tissues may be totally eaten out without breaking the extrenal chitinous skin.

The mating habit resembles that of *Loligo*. A male in heat when occasioned to approach within several centimeters of a female, darts with a special quickness towards the latter's head and fixes there the spermatophores, whereby the hectocotylized arms are certainly used eventhough their action is so quick as hardly capable of observation.

Locality.—Inland Sea (Sasaki) ; near Onomichi (Sasaki) ; Ise Prov. (Sasaki) ; Misaki (Sasaki) ; Kadsiyama (Ortmann) ; Oki Is. (Sasaki): Sado I. (Sasaki); Aomori Bay (!); Hakodate (Albatross!); Takashima, Hokkaido (!) Oshoro, Hok. (Sasaki).

Family **Sepiolidae** (Leach, 1817).*)

Sepiolidae, Leach 1817, p. 137 (pars).—Keferstein 1866, p. 1443.—Verrill 1881c, pp. 347, 416; 1882, p. 375.—Carus 1890, p. 451.—Joubin 1902, p. 80, etc.—Pfeffer 1908a, pp. 24, 31.—Naef 1912, pp. 243, 344; 1921, p. 536.—Berry 1914a, p. 311; 1920, p. 154.—Grimpe 1921, p. 299.
Sepiolini, Steenstrup 1861a, p. 69 (fide Jatta); 1881, p. 237.—Jatta 1896, p. 122.
Sepioladae, Appellöf 1898a, p. 623.

Mantle short, saccular, rounded behind. Fins separate, subovate, attached laterally to the middle of mantle. Head large, almost as broad as body, often continuous with mantle at nape; if not so, then invariably there is a cartilaginous resisting apparatus. Each eye covered over by a transparent continuous integument which forms an incomplete- or even complete-circular lid-fold. Preocular pore present but very often indistinguishable. Olfactory pit-organ present behind each eye, surrounded by a circular ridge. Retractor pallii medianus well developed. Sometimes a large saddle-shaped luminous organ exists in the pallial cavity, associated with the inkgland. Internal shell in a rudimentary condition of a thin, short gladius, though even this sometimes may be entirely absent. Hectocotylization affects one or both dorsal arms or left ventral arm in the male. Females with left oviduct only, when mature thay have spermatophores fixed near the genital opening or on the buccal membrane.

Key to the subfamilies of the Sepiolidae represented in Japan.

(A) Mantle and head continuous at nape.
  (α) Mantle and funnel-base articulate with each other on either side by plug and socket.
    (a) Saddle-shaped luminous organ well developed (except in *Inioteuthis*); left dorsal arm hectocotylized ..... *Sepiolinae.*
    (b) Saddle-shaped luminous organ rudimentary, both dorsal arms hectocotylized..... ..... *Stoloteuthinae.*
  (β) Mantle and funnel-base undetachably connected together by a broad ligament on either side (except in *Sepioloidea*); left ventral arm hectocotylized ..... *Sepiadarinae.*
(B) Mantle margin free all round..... ..... *Rossinae.*

Subfamily **Sepiolinae** (Hoyle, 1904).

Sepiolini Appellöf 1898a, p. 623 (pars).
Sepiolinae, Hoyle 1904b, p. 7.—Naef 1912, p. 246; 1921, p. 536.—Berry 1914a, p. 311; 1920. p. 154.

Mantle continuous with head at nape; its ventral margin articulates with funnel base by cartilaginous plug and socket on either side, not protruding greatly forward. Fins considerably auriculate anteriorly. Eye-lid forms a conspicuous but incompletely circular fold. Umbrella broadest between third and fourth arms, where it forms no complete sheath for the base of tentacles. Saddle-shaped luminous organ well developed except in *Inioteuthis*. Left dorsal arm in male prominently hectocotylized, with one or two muscular prominences at the proximal part. Female with a specialized sac in mantle cavity near the genital opening for the reception of spermatophores. The latter, as far as known, with thin sperm cord tightly coiling upon itself as in *Polypus*. Gladius rudimentary or even absent.

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*) Grimpe establishes for this family a tribus under the name of Sepioloidea (1921, p. 299) or Sepiolaemorphae (1922, p. 42).

Key to the genera found in Japan.

(A) Suckers biserial throughout.
  (a) Saddle-shaped, luminous organ present ..... *Sepiola.*
  (b) Saddle-shaped luminous organ absent ..... *Inioteuthis.*
(B) Suckers quadriserial throughout..... *Euprymna.*

Genus **Sepiola** Leach, 1817.*)

Sepiola, Schneider 1784, p. 116?—Leach 1817, p. 137.—d'Orb. in d'Orb. et Fér. 1839, p. 224 (pars).—Verany 1851, p. 56.—Gray 1849, pp. 67, 91 (pars).—Adams H. & A. 1858, p. 40 (pars)—Pfeffer 1908a, p. 46 (pars),—Naef 1912, p. 248; 1912a, p. 267; 1921, p. 536.—Berry 1920, p. 154.

Nuchal commissure about one-third as broad as head or even a little broader. Fins subovate, rather large, being longer than half the body-length; attached laterally to the middle of body. Third arm of the male sharply bent into S-shape and folded upon mouth. Arm-suckers biserial throughout but may be in 4–8 series on the extremity of ventral arms; equally small in female but large and unequal in male. Tentacular suckers of moderate size, in 8–16 series; their peduncles of normal structure. Left dorsal arm prominently hectocotylied. Saddle-shaped luminous organ well developed. Gladius usually present but may be absent.

Type.—*Sepiola sepiola* Leach, 1817 (= *S. rondeletii* Schneider, 1784.)

Key to the species represented in Japan.

(A) Hectocotylized arm with a nipple-like projection near the base. ..... *S. parva.*
(B) Hectocotylized arm with a marked birostrate projection near the base ..... *S. birostrata.*

Sepiola parva Sasaki, 1914.

(Pl. XV, figs. 4, 5.; textfig. 80.)

Sepiola parva, Sasaki 1913, p. 252, 1 fig. (Japanese).
Inioteuthis parva, Sasaki 1914, p. 595, pl. xi, figs. 9, 10.

This species is based on two male specimens from Tokyo Bay. On repeated careful examinations of the specimens I have persuaded myself of the validity of the species.

Body about as long as broad, quite rounded behind, a little flattened dorso-ventrally. Anterior margin of mantle slightly emarginated in the mid-ventral part; dorsally it is connected with head by a commissural integument one-third as wide as body. Fins moderately large, being a little longer than half the mantle length, nearly orbicular or rather subovate, being slightly longer than broad, attached to the dorso-lateral surfaces of mantle at the middle of its length; the anterior origin conspicuously indented so that the line of attachment is very short, being only half the fin-length.

Head large, about as broad as body, its dorsal surface flat or even slightly concave. Eyes very large, full. No olfactory pit-organ perceptible nor preocular pore. Funnel long, extending to the angle between ventral arms; well marked off throughout, widely conical at base, and tubular distally. Funnel valve longitudinal-ovate, attached to one-third the length of dorsal wall from its anterior end. Funnel organ composed of a triangular dorsal pad, and two oval ventral pads, the former measuring 2 mm. in length, and the latter, 2.6 mm. Funnel cartilage oblong, both extremities similary rounded, measuring 1 mm. by 3 mm.; the longitudinal groove rather shallow, extending the whole length of the cartilage. Mantle cartilage linear, ridge-like about twice as long as funnel cartilage, beginning near mantle margin.

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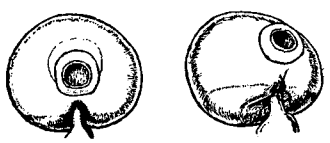
*) Original description given by Leach: Pinnae laterali-dorsales distantes. Pedes ordinarii æquales. Collum postice cum sacco coalitum. Latera freno parvo instructa.

Arms subequal, the formula of length being $3>2>4=1$, the longest as long as mantle. All rounded on back, without carination, gradually tapering to subtile extremities. Protective membranes quite rudimentary. Umbrella wide between third and fourth arms, wanting between ventral arms; in the remaining interbrachial spaces it is only slightly developed, the formula of radii being I–I>I–II>II–III. The web of umbrella between the third and fourth arms does not form any sheath for the base of tentacles.

Arm-suckers subglobular, their aperture very small and round; pedicels very short, their basal papillae comparatively large, mammiform. The suckers are rather sparsely set, but distinctly arranged in two series; their size differ in different arms as follows: In the first arm of the right side, there are about thirty equally small suckers. In the second arm, proximal fourteen suckers are very large, except the two basalmost, which are as small as those of the first arm; distally there are about eight small terminal ones. Third arm is similarly provided with suckers as the second, the only difference being that the large suckers number about sixteen and the small terminal ones about twelve. In the fourth arm, there are in all about twenty-five suckers, of which the middle ones are a little larger than the rest, but not so large as the largest ones in the second and third arms. The suckers in all the arms have small horny rings with entire edge.



Textfig. 80.

Sepiola parva. Largest arm-suckers; ×23.

Left dorsal arm prominently hectocotylized; slightly shorter, but decidedly thicker than the right dorsal. The suckers on it are arranged in two series, right and left, as in the remaining arms. The left series is made up as follows: two basalmost suckers small; then there is a large, nipple-like protuberance, followed by two small suckers; after that there come two or three large ones, in their turn followed distally by a close series of eleven or twelve peculiar unstalked and cylindrical suckers. In the right series, there are at base two small suckers, which are a little larger than the opposite ones of the left series; then there follow four suckers, which are about as large as the largest ones of the left; finally there occur about eleven or twelve suckers similar to, but a little shorter than, those in corresponding postion of the other side.

Tentacles slightly shorter than twice the length of longest arm. Stem thinner than any of arms, its oral surface flattened and the aboral surface rounded. Club expanded, crescentic, flattened, comprizing about one-sixth the entire length of tentacle; dorsal web broad, extending on to stem for some distance. Suckers uniform, minute, arranged in about eight series.

Buccal membrane narrow; no perceptible or marginal projections.

Saddle-shaped luminous organ well developed, associated with ink-gland as usual, its lateral portions projectiong into mantle cavity.

In Needham's sac were found four rather rudimentary spermatophores with very short sperm cord. But a fully formed one was contained in the spermatophoric gland. This measured 14mm. in length, its sperm cord coiling almost as in *Polipus*.

For the measurements the reader is referred to the original description of the species (1914 p. 596).

Type Locality.—Tôkyo Bay.

Type.—In Tôkyo Imp. Univ.

Sepiola birostrata Sasaki, 1918.

(Pl. XV, figs. 6–8; textfigs. 81–84.)

Sepiola inioteuthis, Sasaki 1913, p. 251, 1 textfig.

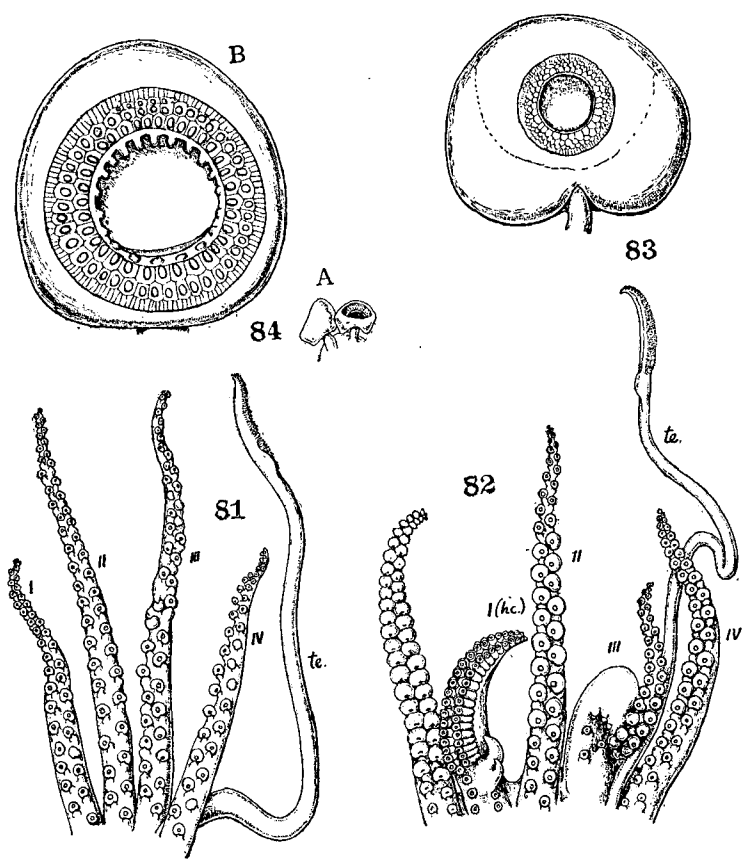
Sepiola birostrata, Sasaki 1918, p. 255 (Japanese); 1920, p. 185.

A large number of specimens of this species from various localities of Japan are found in the collections studied by me, their mantle measuring up to 22mm. in length.

Body a little longer than broad, parallel-sided in the anterior half, quite rounded posteriorly, but

in mature males it is more or less conical, expanded anteriorly, and somewhat pointed posteriorly (Pl. XV, fig. 6). Anterior margin of mantle connected with head at nape by a commissural integument narrower than one-third the body-breadth; ventral margin emarginated crescentwise in the middle, the excavation marked off by borders a little projecting forward. Fins semilunar or subovate, blunter posteriorly than anteriorly, about five-sevenths as broad as long; their size variable, being ½–¾ as long as body; attached to the dorso-lateral surfaces of body at the middle of its length. Anterior orgin of fins deeply indented so that the line of attachment measures only ½–¾ the entire length.

Head in good specimens as wide as, or even broader than, body; slightly concave above. Eye large, full, covered with a transparent lid which forms an incompletely circular fold; no preocular pore perceptible. Olfactory pit-organ behind each eye, relatively large, bordered with a prominent circular ridge. Umbrella somewhat developed between third and fourth arms, where it extends about a quarter up the arms, without forming any sheath for the tentacular base. In the remaining intesbrachial spaces the umbrella is equally very narrow, but is quite rudimentary between the ventral arms.



Textfig. 81.
Sepiola birostrata. Arms of female sex; ×ca. 3.

Textfig. 82.
Sepiola birostrata. Arms of male sex; ×2.

Textfig. 83.
Sepiola birostrata. Largest arm-sucker of male sex; ×33.

Textfig. 84.
Sepiola birostrata. Suckers towards the base of club. A. Side and ventral view; ×40. B. Frontal view. ×217.

Funnel slender, extending less than to the angle between ventral arm, clearly marked off throughout, widely conical at base and tubular distally. A pair of strong funnel adductors present on sides, but none on back. Funnel organ composed of a triangular dorsal pad, and two elliptical ventral pads; the two posterior angles of the former a little project laterad and posteriad; the anterior angle more or less rounded, with a minute cuspidation at the extreme end extending for two-fifths the length of the dorsal wall of funnel. Funnel valve in female, of moderate size, but very minute in male (Pl. XV, fig. 7); in both sexes it is situated midway from the dorsal pad to the extremity of funnel. Funnel cartilage oblong, a little longer than three times of its own breadth, similarly rounded at both ends. Measurements in a male of 19 mm. in mantle length: dorsal pad of funnel organ 5 mm. long; ventral pads 3 mm. by 8 mm.; funnel valve 0.9 mm. long; funnel cartilage 5 mm. long. Mantle cartilage very slender as usual, a little shorter than twice the length of funnel cartilage, beginning at a distance from mantle margin as a faint streak which develops into a ridge posteriorly.

Arms subequal, the formula of length being $2 \fallingdotseq 3 > 4 \fallingdotseq 1$, the longest about as long as body.

All evenly taper to subtile extremities, rounded on back but may be carinated in the distal half or even throughout the length. In the ventral arms, there is developed a web on the dorsal side of the aboral surface, widening proximad. Third arms of both sides in mature males peculiarly thickened proximally, abruptly narrowed near the middle, then tapering to attennated extremities, invariably strongly curved into the shape of an S and tightly folded upon mouth. Protective membranes all quite rudimentary.

Arm-suckers subglobular, numbering about 40 on each arm, rather sparsely set in two series throughout; their aperture small, round (textfig. 83). Peduncles of suckers short, but their basal papilla large and nipple-like. Horny ring in all suckers, smooth its papillate area comparatively narrow. For other respects the suckers are subject to a sexual dimorphism. In the female the suckers are small and uniform except for that those of the lateral arms are slightly larger than those of the remaining arms (textfig. 81). In the male, the suckers are large except basal and terminal ones, which are as small as in the female; those of the right dorsal arm are soft, glandular, and often deformed or compressed (textfig. 82). Further, in the third arm four or five pairs of suckers on the thickened proximal part are rudimentary or even wanting.

Left dorsal arm in male prominently hectocotylized, $^1/_2$–$^4/_5$ as long as the right dorsal, and much thicker than the larter terminating abruptly; the aboral surface with a web which is often contracted so as to render the arm curve crescentwise. On the base of the arm there are found four or five, minute suckers, followed by a large rounded swelling on the ventral side; the swelling produces two conical sharply pointed recurved rostra, of which the anterior one is usually much larger than the posterior. The remaining part of the arm, which occupies about two-thirds of the entire length, is a little twisted around the long axis of the arm so that its sucker-bearing surface, forms an angle with that of the base; there are found about forty papillae tightly packed together in two series. The papillae are more or less prismatic, and have a rudimentary sucker on the blunt apex; those of the outer series are decidedly larger, and hence are much compressed from closer contact with one another, than those of the inner series.

Tentacles slender, decidedly thinner than any of arms; their length somewhat variable due to their great elasticity, but in good specimens they are generally twice the length of ventral arms. Stem more or less four-sided; the oral surface flat or even slightly concave. Club about one-fourth the entire length of tentacle, slightly expanded, flattened, usually a little curvate crescentwise; dorsal web very narrow. A broad, thick, semilunar membrane present on the dorsal side of carpus, often connected with the dorsal web.

Tentaclar suckers minute, nearly unifom; proximalmost the largest, then very gradually diminishing in size towards the extremity; at the same time they become more numerous and more closely set, numbering only four in a row at base, but about sixteen in a row at subterminal part. Individual suckers very short, their aperture very wide. Horny ring in proximal suckers with about twenty blunt well-separate teeth, of which seven or eight on the proximal margin of the ring are minute and situated on the outer aspect of the margin, deviating from their usual position of the extreme edge. Papillate area of the ring, broad, conspicuously papillate as shown in textfigure 84.

Saddle-shaped luminous organ well developed, associated with inkgland as usual, its lateral portions projecting into mantle cavity. Light not strong, but gentle, whitish, faintly tinged with cobalt.

Spermatophores in full-grown males, about 13 mm. long. Sperm cord slender, but tightly coiling upon itself as in octopus and occupying less than one-third of etui. Discharging sheath about half the entire length of spermatophores, tinged with brown. Intermediate part somewhat complex, as shown in Pl. XV, fig. 8. The spermatophores are fixed to the female into a specialized sac existing near the genital opening.

Measurements of largest Male and Female Examined.

Sex.	♂		♀	
Ventral length of mantle	22 mm.		19 mm.	
Maximum breadth of body	16 ,,		16.5 ,,	
Breadth of head	16 ,,		16.5 ,,	
Length of fins	14 ,,		12 ,,	
Breadth of fins	10 ,,		9 ,,	
Length of first arms	Left 13 mm.	Right 19 mm.	Left 13 mm.	Right 13 mm.
,, ,, second arms	24 ,,	24 ,,	17 ,,	17 ,,
,, ,, third arms	24 ,,	—	16 ,,	16 ,,
,, ,, fourth arms	16 ,,	16 ,,	12 ,,	12 ,,
,, ,, tentacles	34 ,,	34 ,,	23 ,,	23 ,,
,, ,, clubs	5·5 ,,	5·5 ,,	5 ,,	5 ,,
Diameter of lagest arm-sucker	1 mm.		0.5 mm.	

Remarks.—Younger specimens examined show graduated developmental stages of the hectocotylization : in specimens with about 8 mm. mantle-length the torsion of the distal part is not yet distinct and the differenciation of suckers is also not conspicuous except that two sucker-less papillae are already formed ; the third arms of these specimens are of quite normal structure. The smallest of the specimens that have fully formed hectocotylus measures 10 mm. in mantle length. Even in this specimen, the third arms are not fully modified and no spermatophores are formed. The fully modified third arms are found only in the specimens which have fully mature internal genital organs.

The species stands very close to *S. parva*, but differs from it in having (1) more elongated body, (2) marked birostrate projection near the base of the hectocotylized arm, and (3) soft deformed suckers on the right first arm as well as (4) in that the third arms are tightly folded upon the mouth and have rudimentary suckers on the proximal part.

Locality.—Nemuro Strait, 86–300 fms. (Albatross !) ; Takashima, Hokkaido (!) ; Oshoro, Hok. (!) ; Tsugaru Strait (Albatross (!)); Sado Is. (Albatross !); Etchû Prov. (!), Wakasa Bay, 130–144 fms. (Albatross !) ; near Oki Is., 100–116 fms. (Albatross !) ; near Cape Clonard, Korea, 150 fms. (Albatross !) ; off Kinka-san, 82–266 fms. (Albatross !) ; Bungo Prov. (!).

Type locality.—Toyama Bay.

Type.—In Sc. Coll. Tokyo.

Genus **Inioteuthis** Verrill, 1881.

Inioteuthis, Verrill 1881c, p. 417, foot note.—Ortmann 1888, p. 646.—Berry 1920, p. 155.
Sepiola (pars), Near 1912, p. 247 ; 1912a, p. 267.
Sepietta, Naef 1912, p. 248 ; 1912a, pp. 262, 266 ; 1916, p. 3 ; 1921, p. 536.

Nuchal commissure narrower than one-third the head-breadth. Fins of small or moderate size, attached laterally near the middle of body. Third pair in male, thickened at base, curved into S-shape and folded upon mouth. Suckers in female, equally small, and in male large and unequal ; but their arrangement is biserial in both cases. Left dorsal arm hectocotylized, with a huge muscular projection near the base ; most of suckers rather normally developed. Tentacular club flattened and crescentiform ; suckers similarly minute, arranged in 8–32 series, their peduncle of normal shape. Gladius rudimentary or even may be absent. No luminous organ developed in mantle cavity. Spermatophores with coiling sperm-cord, their intermediate organ of simple structure.

Type.—Inioteuthis japonica Verrill, 1881.

Inioteuthis japonica Verrill, 1881.

(Pl. XV, figs. 9–11 ; textfigs. 85–87.)

Inioteuthis japonica, Verrill 1881c, p. 417, foot note.—Ortmann 1888, p. 647, pl. xxi, fig. 6 ; pl. xxii, fig. 2.—Joubin 1897b, p. 101.—Joubin 1902, p. 95, fig. 10.—Hoyle 1904, p. 27.—Wülker 1910, p. 10.—Berry 1912b, p. 405, pl. v, fig. 5.—Massy 1927, p. 153.

Out of innumerable specimens of sepiolids at my disposal only two which are both male, are referred to this species. Of the two specimens one was found among sepiolids from Toyama Bay, whereas the other was obtained by Dr. Oshima from a fish market of Tainan, Formosa, April 15, 1920.

Body conoidal, a little longer than broad, widest anteriorly terminating in a blunt point posteriorly (Pl. XV, fig. 9).

Anterior margin of mantle slightly emarginated in the mid-ventral part ; dorsally it is connected with head by a commissural integument about one-third as wide as the body. Fins small, about half as long as body, subovate, much blunter posteriorly than anteriorly, attached laterally to the middle of body ; anterior origin deeply indented so that the line of attachment is only a little longer than half the fin-length.

Head as wide as the broadest part of body, slightly concave above, much broader than thick. Eyes large, covered with a transparent integument, which forms a deep crescentic reduplication ventrally. Preocular pore undiscernible. Olfactory pit-organ present behind each eye as usual, surrounded by a prominent circular ridge. Umbrella by far broadest between third and fourth arms, where it exteuds one-third up the arms ; in the remaining interbrachial spaces it is similarly very narrow, but is quite rudimentary between ventral arms. Buccal membrane wrinkled internally, with seven connectives ; its ribs and marginal projections quite rudimentary.

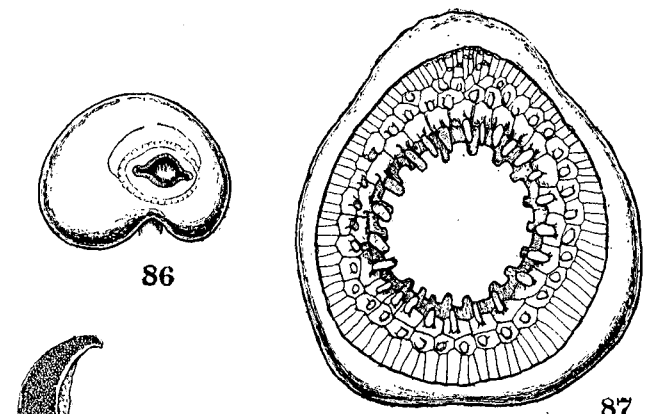
Funnel comparatively large, its basal part wide, and the distal part tubular, but a little narrowing distad and extending slightly less than to the angle between ventral arms. Funnel organ composed of a nicely $\wedge$-shaped dorsal pad and two pyriform ventral pads ; both conspicuous, heavy, and more thickened posteriorly than anteriorly (Pl. XV, fig. 10). Anterior end of the dorsal pad, acuminate ; its two posterior lobes extend posteriorly far beyond the renal apertures. Funnel valve tongue-shaped, a little larger than in the male of *Sepiola birostrata ;* situated nearer to the dorsal pad than to funnel extremity. Funnel cartilage oblong, parallel-sided, and similarly rounded at ends. Measurements : funnel cartilage 4 mm. by 1.4 mm. ; funnel valve 1 mm. long ; dorsal pad of funnel organ 9 mm. long ; ventral pad 7.5 mm. long. Mantle cartilage linear, ridge-like, about half as long again as funnel cartilage, beginning abruptly some distance from mantle margin and of about uniform thickness throughout.

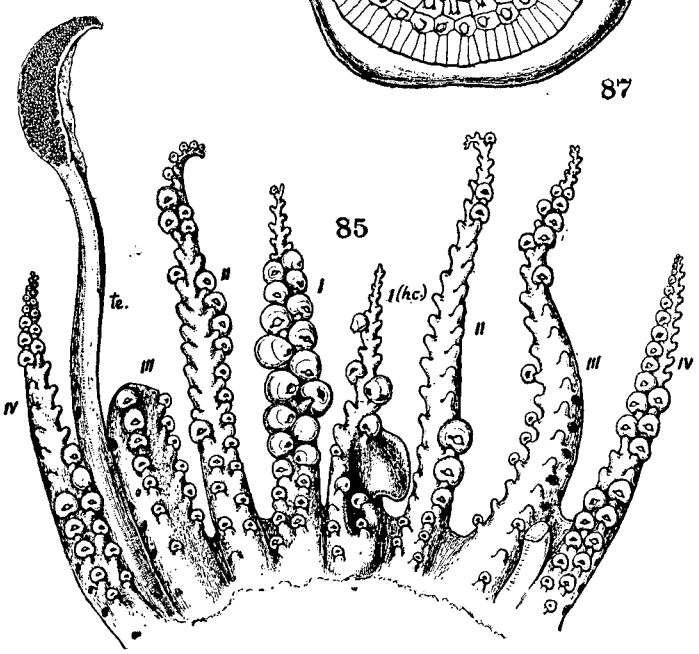
Arms unequal, the formula of length $2 \fallingdotseq 3 > 4 \fallingdotseq 1$; the longest a little longer than body. All rounded on back, tapering to attenuated extremities. Third pair curved almost into the shape of an S and folded upon mouth. In the fourth pair, a web is developed on the dorsal side, widening proximad, where it is connected with the umbrella.

Arm-suckers number about 18 pairs in right first arm, about 23 pairs in second arm, and about 20 pairs in third as well as in fourth arm ; biserial throughout ; subglobular, their aperture small, projecting forward ; peduncles short, but their basal papilla very prominent and more or less nipple-shaped. Horny ring with entire margin, which encloses in larger suckers a transverse-spindlical aperture with a deep sinuation on either side (textfig. 86). The suckers markedly vary in size in different arms ; and even on an arm they may be markedly unequal (textfig. 85).

Left first arm prominently hectocotylized, decidedly shorter than the right first, much thickened at base, then evenly and rapidly tapering to a subtile extremity. On the oral surface of the proximal part there is found an ample cave-like excavation, which is much deepened proximad, and much more sharply marked off on the dorsal side than on the ventral. From the ventral margin of the excavation there projects outwards a conspicuous, flattened process somewhat suggestive of

the concha of human ear. Suckers remaining in situe number only ten, although the basal papillae of their peduncles count about 25 standing in two series as in the other arms. The suckers are unequal in size and of normal shape, none appearing to undergo any special change.





Textfig. 85.
Inioteuthis inioteuthis. Inner aspects of arms; × ca. 3.

Textfig. 86.
Inioteuthis inioteuthis. Largest arm-sucker; × 18.

Textfig. 87.
Inioteuthis inioteuthis. Tentacular sucker; × 160.

Tentacles a little longer than body. Stem a little thinner than arms, its oral surface flattened. Club comparatively large, comprising a quarter of the tentacle, crescentiform, the concave side bordered by a narrow web continued on to stem for a short distance. Suckers numerous, minute, nearly equal in size, numbering about six in an oblique transverse row at carpus, then successively increasing in number to the middle of club where they count 16 in a oblique row; from the middle their number in each row again decreases successively and at the extremity it becomes as few as at the carpus. Horny ring armed with about 20, short, blunt teeth evenly distributed on the whole margin; papillate area composed of a radiated margin and two series of polygonal, papillated plates, the papillae of which are well developed especially on the inner series (textfig. 87). Peduncles of suckers of normal shape, their basal part not so markedly elongated as in *Eupryma.*

Anal appendages small compared with *Sepiola birostrata.* No luminous organ developed in mantle cavity. Penis constructed almost as in the said species but much thinner. Spermatophores hairly, 9 mm. long., color-less throughout; sperm cord coiling loosely about 18 turns; intermediate part simple but long (Pl. XV, fig. 11).

Chromatophores large, deep purplish brown, much fewer beneath than above, and absent underneath the fins.

Measurements.

Ventral length of mantle	18 mm.	
Maximum breadth of body	13 „	
Breadth of head	13 „	
	Left	Right
Length of fins	8.5 mm.	9 mm.
Breadth of fins	6.3 „	6.5 „
Length of first arms	12 „	16 „
„ „ second arms	18 „	18 „

Length of third arms	ca. 18mm.	ca. 18mm.
„ „ fourth arms	15 „	15 „
„ „ tentacles	22 „	23 „
„ „ clubs	6 „	6 „
Diameter of largest sucker of arms	1.4mm.	

Locality :—Matsushima, Rikuzen Prov, (Berry); Tôkyo Bay (Verrill; Ortmann; Berry); Misaki (Wülker); the mouth of Uraga Channel (Wülker); Enoshima (Berry); Nagasaki (Joubin); Toyama Bay (!); Tainan market, Formosa (!). Lion's Head, N. 78 E. (Massy), Sebastian Bluff W.W. ¾ W. (Massy); Struys Point W. by W. ½ W. Massy.

Genus **Euprymna** Steenstrup 1887.

Euprymna, Steenstrup 1887, p. 66; 1887a, pp. 89, 90.—Hoyle 1904, p. 24.—Wülker 1910, pp. 9, 26.—Naef 1912, p. 247; 1921, p. 536.—Berry 1914a, p. 311; 1920, p. 155.

Nuchal commissure far broader than one-third the head breadth. Fins rather small, attached a little nearer to mantle margin than to its posterior end. Third arms of the male, of normal structure. Arm-suckers in oblique rows of four each; similarly minute in female, but in male they are unequal, and large, several in one or both marginal series being specially enlarged. Tentacular club rounded in section; suckers excessively numerous and minute, their peduncular bases greatly elogated and columnar. Left dorsal arm hectocotylized; provided with swollen, modified suckers tightly palisaded in 2–4 series on the distal half. Saddle-shaped luminous organ well developed. Spermatophores with spiral sperm cord; intermediate organ of rather complex structure. Gladius, none.

Type.—Inioteuthis morsei Verrill, 1881.

Key to the species found in Japan.

(A) Second and fourth arms of male sex, with conspicuous suckers on both sides; tentacular suckers slenderly goblet-shaped.....*E. berryi* n. sp.

(B) Second, third, and fourth arms of male sex, with conspicuous suckers on the ventral side; tentacular suckers shallow and nearly globular.....*E. morsei.*

Euprymna berryi sp. nov.

Vernacular name: Mini-ika (Tôkyo; Sagami Prov.; Kagoshima); Dango-ika (Etchu Prov.); Hidoko-ika (Nagasaki).

(Pl. XV, figs. 12, 13; textfig. 88.)

Inioteuthis morsei Verrill 1881c, p. 417, foot note. pp.—Appellöf 1889, p. 15, pl. ii, figs. 15, 16; pl. iii, figs. 16, 19, 20, 23.—Hoyle 1886b, p. 112, pl. xiv, figs. 1–9.—Ortmann 1888, pp. 647, 665, pl. xxi, fig. 7; pl. xxii, fig. 3.—Goodrich 1896, p. 3.—Joubin 1897b, p. 101; 1902, p. 97, figs. 11, 12.

Sepiola bursa, Pfeffer 1884, p. 6, fig. 6.

Euprymna morsei, Steenstrup 1887a, pp. 66, 89.—Hoyle 1904, p. 26; 1904a, p. 198; 1905a, p. 981.—Berry 1909, p. 418; 1912b, p. 408, pl. vi, figs. 1, 2.—Wülker 1910, p. 9, pl. i, fig. 9; pl. iii, figs. 23, 24; pl. iv, fig. 40.—Naef 1912a, p. 247.—Sasaki 1914, p. 589; 1920, p. 187.

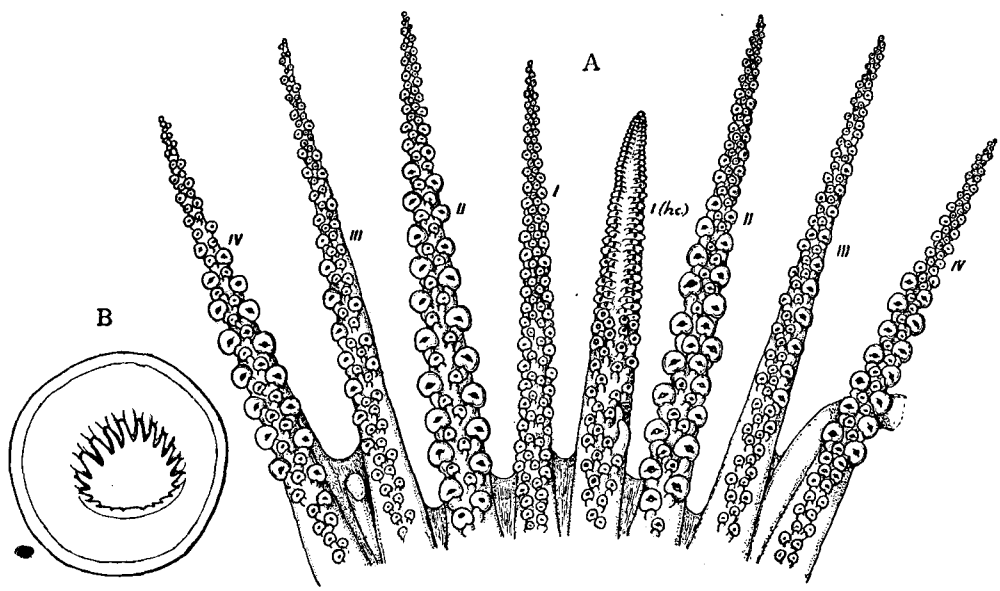
Of this species about ninty-two specimens from various localities as listed later, have been at my disposal for examination. They measure up to 5 cm. in mantle length, the sexually mature ones being over about 2 cm.

Mantle purse-like in shape and slightly flattened dorsoventrally as in other sepiolids. For particulars it shows a sexual dimorphism; in the male, being more or less conical, broadest anteriorly and somewhat pointed posteriorly, while in the female it is parallel-sided in the anterior two-thirds, quite rounded posteriorly; the breadth of body in the former sex $^5/_6$–$^3/_4$ the length, but $^3/_4$–$^2/_3$ in the

latter sex. Anterior margin of mantle connected with head at nape, the commissural integument being half as broad as the body, or even broader; ventral margin a little projects forwards, but in the middle it is slightly emarginated cresentwise. Fins semilunar or subovate, comparatively small, being only a little longer than half the body-length, attached much nearer to the anterior margin of mantle than to its posterior end; anterior origin deeply indented so that the line of attachment measures only two-thirds the fin length.

Head as wide as body, flat above, furrowed below. Eye large, covered with a transparent lid which is marked off from the surrounding surface by a deeply crescentic or incompletely circular fold. Preocular pit not discernible. Umbrella a little developed except between ventral arms where it is quite wanting; its radii in the remaining interbrachial spaces are unequal, the formula usually being III–IV > I–I > I–II > II–III.

Funnel slender, fully extending to ventral interbrachial space; its distal half tubular, and the proximal half expanded, distinctly marked off from head. Funnel organ composed of a roughly triangular dorsal pad and two pyriform ventral pads (Pl. XV, fig. 12). Anterior end of the former



Textfig. 88.

Euprymna morsei. A. Inner aspect of arms; ×¾. B. Horny ring from one of distal suckers of hectocotylized arm; ×77.

pad quite rounded with a minute projection in the middle, reaching two-fifths the distance up to funnel extremity; both the posterior ends also blunt thought projection a little laterad and posteriad. Funnel valve of moderate size, ovate but acuminate in front, situated nearer to the dorsal pad of funnel organ than to the extremity of funnel. Funnel cartilage oblong, similarly rounded at both ends, measuring in a female of 5 cm. mantle length, 10 × 4 mm. Mantle cartilage linear, straight, ridge-like, a little shorter than twice the length of funnel cartilage, beginning at a distance from mantle margin.

Arms long, subequal, the formula of length ordinarily being 2 > 3 > 1 > 4, but may be 2 = 3 > 1 = 4 or 2 > 3 > 4 > 1; the longest decidedly longer than body. All gradually taper to attenuated extremities; first and second pairs rounded on back; third pair with a keel extending the whole length of the back fourth pair with a broad web on the dorsal side. Protective membrane very narrow or rather rudimentary.

Arm-suckers globular, arranged in oblique rows of four each except at base of arms, where they are biserial. Peduncles of suckers short, thin, and brittle, quite obliquely attached to suckers; their basal papillae swollen, expanded distally, scale-like, may be more or less imbricated with one another. For other respects the suckers show a marked sexual dimorphism: in female, numbering about 120 on each arm, rather uniform, only slightly varying in size even in different arms.

Arm-suckers in male (textfig. 88A) considerably unequal, varying in size according to the arm. The suckers on first right arm almost as on the corresponding arm of the female, being similarly small, but those of marginal series slightly larger than those of the central. The suckers of second and fourth arms markedly unequal, several of both the marginal series being twice or even thrice as large in diameter as the corresponding ones of the central series. These large suckers on the second arm, numbering about ten in each marginal series, being at the extreme base of the arm and extend more than halfway along its length, followed by two or three suckers of intermediate size. On the fourth arm, however, the basal 8–10 suckers are not so large as on the second arm, but small and uniform, and then come in the marginal series large suckers as met with in that arm, numbering six or seven on either side. Suckers on third arm also unequal, being larger in the marginal series than in the central series, and five or six in the ventral marginal series being by far the largest of all, though decidedly smaller than the aforesaid large suckers of the second and fourth arms.

Horny ring smooth in all arm-suckers. Margin of the ring in smaller suckers encloses a circular or oval aperture. In larger suckers the margin projects outwards, and the aperture is invariably much elongated transversely, with a distinct sinus on either side.

Left first arm in male, prominently hectocotylized, being decidedly thicker and shorter than the right first, terminating abruptly. On the proximal half of the arm, there are fonnd 33–40 normal suckers arranged in oblique rows of four each ; at the middle of this part are two prominent, sucker-less, nipple-like protuberances standing among the suckers of the most ventral series. Beyond the normal suckers there come 70–80, tightly palisaded papillae, crowded in 2–4 series on the distal half of the arm. These papillae are a little compressed from behind to before, due to the close contact with one another, and have a slit-like aperture at their rounded distal end. Within the aperture is inclosed a rudimentary sucker, the horny ring of which has about 15, acutely pointed, triangular teeth closely set two-thirds round the margin (textfig. 88B).

Tentacles variable in length due to the preservation, but in good specimens ordinarily they are shorter than twice the body-length. Stem a little thinner than any of arms, its oral surface flattened or even slightly concave, distinctly marked off on sides. Club a little thicker than stem, round in section, coiled upon itself in preserved specimens ; the distal extremity sharply pointed, a little recurved, stiff, and naked ; dorsal web begins near the extremity, extending on to stem some distance below the club. Suckers excessively numerous, minute, elongated into goblet-shape ; peduncles of moderate length, but their basal papillae columnar, exceedingly elongated, as thick as the diameter of suckers, and closely packed together. Horny ring very characteristic, its papillate area being very broad and cup-shaped, the remaining part long, urceolate ; aperture minute, smoothly edged, situated at the centre of the broad papillate area, leading into a passage, which communicates at right angles with the cavity of the urceolate part of the ring.

Saddle-shaped luminous organ well developed, its lateral parts projecting into mantle cavity. Anal valves of moderate size. Penis very short, papilliform.

Spermatophores in full-grown males 16 mm. long. Sperm cord tightly and somewhat irregularly coiling upon itself about 35 turns, occupying about a quarter of the entire length of etui (Pl. XV, fig. 13). Intermediate organ very long, comprising the greater half of the discharging part, divided into four parts by constrictions.

Measurements of largest Male and Female Examined.

Sex	♀	♂
Ventral length of mantle	50 mm.	42 mm.
Maximum breadth of body	32 ,,	32 ,,
Breadth of head	30 ,,	30 ,,
Length of fins	27 ,,	25 ,,
Breadth of fins	16 ,,	17 ,,

Sex	♀		♂	
	Left	Right	Left	Right
Length of first arms...	35 mm.	36 mm.	31 mm.	37 mm.
,, ,, second arms	45 ,,	45 ,,	50 ,,	50 ,,
,, ,, third arms	43 ,,	43 ,,	50 ,,	50 ,,
,, ,, fourth arms	34 ,,	34 ,,	45 ,,	45 ,,
,, ,, tentacles	52 ,,	55 ,,	80 ,,	75 ,,
Diameter of largest arm-sucker	1.1 mm.		2.2 mm	

Remarks.—Through the kindness of Mr. Berry I was able to ascertain that the present species has hitherto been erroneously referred to *E. morsei* by all writers. The tentacular suckers of the type specimen of the latter species, which Mr. Berry has kindly sent me by mounting them into a preparation, are without doubt those of the species which I named *E. similis* (1913), whereas the suckers which Hoyle (1886) illustrated as the tentacular suckers of *E. morsei*, satisfactorily tally with those of *E. berryi* now under consideration.

This species is the commonest sepiolic occurring in Japan, being found in both the Japan Sea and the Pacific Ocean; but in Hokkaido it is not yet known, the northern limit of distribution appearing to be the northern part of Honshu.

Locality.—Uzen Prov. (!); Etchû Prov. (Sasaki); Noto Peninsula (!); Miyazu Bay (Sasaki); Shimo-osa Prov. (Sasaki); Tôkyo Bay (Ortmann, Berry); Kanagawa Prefecture (Sasaki); Kadsiyama (Ortmann); Misaki (Sasaki, Wülker); Dzushi, Sagami Prov. (Wülker); Shimizu, Suruga (Albatross!); Wakano-ura (Berry); Kôbé Bay (Hoyle); Sumoto, Awaji Prov. (Sasaki); Onomichi (Berry); Ohmura Bay (Sasaki); Beppu, Bungo Prov. (Sasaki); Nagasaki (Appellöff; Joubin; Berry, Sasaki); Hososhima, Hiuga Prov. (Sasaki); Kagoshima (Ortmann; Sasaki); Takao, Formosa (Berry); Akôcho, Formosa (!); Tainan market, Formosa (!). Hongkong (Pfeffer, Berry); Philippines (Joubin); Andamans (Goodrich); Kolumadulu Atoll, Indian Sea (Hoyle); Ceylon (Hoyle).

Euprymna morsei Verrill, 1881.

(Pl. XV, fig. 14; textfig. 89.)

Inioteuthis morsei, Verrill 1881, p. 417, foot note, pp

Euprymna similis, Sasaki 1913, p. 249, 1 fig. (Japanese); 1914, p. 591, pl. xi, figs. 5–8; 1920, p. 187.

Sixty-two specimens of this species have been at my disposal far examination measuring 15–37 mm. in mantle-length.

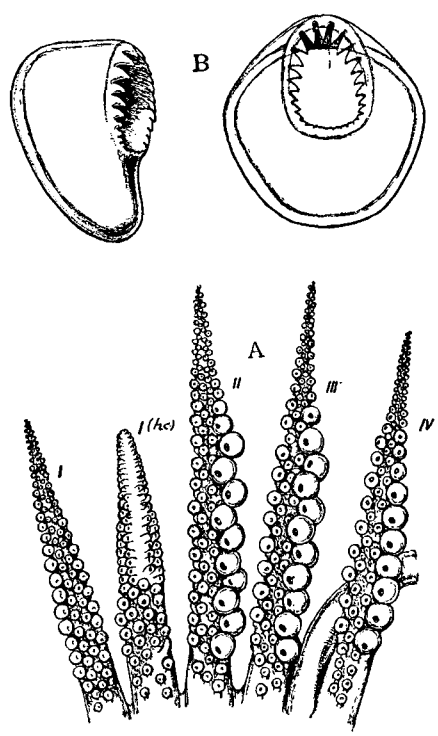
Mantle succular as in other sepiolids, ⅔–¾ as broad as long, parallel-sided in the anterior two-thirds, rounded posteriorly where it is more or less expanded in the mature female, due to the development of eggs and nidamental glands. Anterior margin of mantle connected with head at nape, the commissural integument far broader than half the body-breadth so that the mantle aperture extends but a very short distance past the eye which it partially encompasses posteriorly. Ventral margin of mantle a little projects forwards, but in the middle it is shallowly emarginated crescentwise. Fins almost as in E. *berryi*.

Head, eyes, olfactory pit-organ, and funnel, all also resemble those of *E. berryi*. Funnel organ composed of Λ-shaped dorsal pad and two ovate ventral pads, both being very thick. The posterior lobes of the dorsal pad less than half its entire length and rounded at extremity anterior end of the pad also rounded with a distinct projection at the utmost point. Funnel cartilage oblong, similarly rounded at both ends, a little shorter than three times of its own maximum breadth.

Arms rather unequal, the formula of length being $2>3>4>1$, but may be $2>3>4\fallingdotseq1$, or $2>3>1>4$; the longest as long as or even a little longer than mantle. All slender, gradually and evenly tapering towards extremities. Carination on their aboral surface very weak, and generally

best developed in third arm. A relatively broad web developed on the dorsal side of fourth arm. Umbrella rudimentary except between third and fourth arms where it extends a quarter up the arms.

Arm-suckers subglobular, with a small aperture, their peduncle thin, but its base thickened and similarly characterized as in *E. berryi;* quadriserial but biserial at both base and extremity. Size of suckers greatly differs in the sexes. In the female they are all equally small, while in the male those of marginal series are always larger those of central series, and again, those of ventral marginal series are much larger than those of dorsal marginal series (textfig. 89A). The last characterization is especially conspicuous in the three ventral pairs of arms, in which larger suckers of ventral marginal series are about thrice as large in diameter as the corresponding ones of central series; these larger suckers number about ten in lateral arms and about seven in ventral arms. Horny ring with an entire margin, of which incloses a circular or transverse-ovate aperture in smaller suckers, while in larger suckers the opening is roughly transverse fusiform, with an indentation on either side, forming a distinct upper and lower, lip-like margins slightly projecting forwards.



Textfig. 89.

Euprymna similis. A. Inner aspect of arms; ×2. B. Two views of horny ring from one of distal suckers of hectocotylized arm; ×77.

Left dorsal arm prominently hectocotylized, strikingly resembling that of *E berryi* in all respects. The arm shorter and decidedly thicker than right dorsal arm, terminating abruptly. On the proximal one third of the arm occur 25–35, small, nearly uniform suckers, which are biserial to the third or fourth transverse row, hereafter becoming quadriserial; one or two nipple-like protuberances, which have sometimes a sucker on the apex, are found among the suckers of the ventral marginal series. On the distal two-thirds of the arm are found 55–65, swollen, papillae, tightly palisaded in 2–4 series so that they are compressed from behind forwards. The papillae have on the apex a sucker with a longitudinally lengthened aperture, within which is enclosed a dentate horny ring; the teeth number 16–20, acutely pointed, triangular, closely set two-thirds round the margin (textfig. 89B).

Tentacles variable in length, but in good specimens, about half as long again as mantle. Stem a little thinner than any of arms, its aboral surface rounded and the oral surface flattened or even slightly concave. Club slightly expanded, roundish in section, rather short being about one-sixth the entire length of tentacles; circinate and uncinate as in *E. berryi;* dorsal web also as in that species. Oral surface of club villous in appearance, due to the presence of innumerable, considerably minute suckers closely crowded except at the distal end, which is naked. Individual suckers as wide as deep, their peduncle long, its basal papillae still far longer, columnar. Aperture of horny ring minute, though wide as compared with that of *E. berryi,* entire-edged; papillate area broad, shallowly concave.

Saddle-shaped luminous organ well developed as in *E. berryi.* Anal valves large. Penis very short. Gladius absent.

Spermatophores in fully grown males, 16 mm. long. Sperm cord tightly coiling upon itself, occupying more than one-third the entire length of etui (Pl. XV, fig. 14). Intermediate organ constructed similarly as in *E. berryi* but much shorter.

Chromatophores rather large, purplish brown in preserved specimens, thickly crowded all over, but more so above than below, and rarer on fins especially on its ventral side and wanting on funnel and on the proximal part of tentacles. In preserved specimens the dorsal surface, especially of head is covered with thick wrinkled somewhat grayish superficial integument.

Measurements of largest Male and Female Specimens Examined.

Sex	♂		♀	
Ventral length of mantle	33 mm.		37 mm.	
Maximum breadth of body	21 ,,		25 ,,	
Breadth of head	20 ,,		24 ,,	
Breadth of nuchal commissural integument	12 ,,		15 ,,	
Length of fins	19 ,,		23 ,,	
Breadth of fins	15 ,,		14 ,,	
	Left	Light	Laft	Right
Lengte of first arms	22 mm.	24 mm.	29 mm.	29 mm.
,, ,, second arms	—	—	35 ,,	36 ,,
,, ,, third arms	28 ,,	28 ,,	33 ,,	33 ,,
,, ,, fourth arms	24 ,,	24 ,,	28 ,,	28 ,,
,, ,, tentacles	35 ,,	36 ,,	40 ,,	42 ,,
Diameter of largest arm-sucker	2 mm.		8 mm.	

Remarks.—The original description given by Verrill is very brief, lacking many points of specific importance. This is in part due to the fact that the type specimen is a female, which is quite like that of *E. berryi* except for the tentacular suckers which are decidedly shorter in *E. morsei* than in *E. berryi*. On the examination of these suckers of the type specimen alluded to, I have determined in this work to refer the present form to *E morsei*.

The species very common in Hokkaido, extending southward to the middle part of Japan.

Locality.—Teshio Prov., Hokkaido (!); Takashima, Hok. (Sasaki); Oshoro, Hok. (Sasaki); off Kikonai, Oshima Prov., Hok. (Sasaki); Hakodaté (Albatross !); Aomori Bay (!); Rikuzen Prov. (!); Tôkyo Bay (Verrill); Misaki (Sasaki); Beppu, Bungo Prov. (!).

Subfamily **Stoloteuthinae** (Berry, 1914).

Stoloteuthinae, Berry 1914a, p. 315 (amend).

Mantle continuous with head at nape, its ventral margin articulates with the base of funnel by plug and socket on either side, and protrudes forward often as much as to form a broad lobe underlying head. Fins often enormous; prominently auriculate in front. Umbrella comparatively well-developed, but without forming any complete sheath for tentacular base. Eyelid forms a conspicuous, completely or nearly completely circular fold. Arm-suckers biserial throughout. Both dorsal arms hectocotylized, but the modification weak, consisting chiefly in the greater or smaller size and often more crowded condition of suckers. Gladius, none. Saddle-shaped luminous organ in pallial cavity, rather rudimentary.

Genus **Sepiolina** Naef, 1912.

Sepiolina, Naef 1912, p. 248; 1921, p. 536.

Belly embellished with a broad U-shaped pearly zone along the periphery. Nuchal commissure about one-third as broad as body. Fins of moderate size. Tentacular club rounded in section. Arm-suckers in female equally small but in male unequal and large, several pairs at the middle of lateral arms being specially enlarged. Both dorsal arms similarly hectocotylized, the modification consisting chiefly in the diminution of suckers in size. Sperm cord of spermatophores thick, not coiling. Nidamental organs of both sides similarly developed. Saddle-shaped luminous organ

reduced to a discoidal organ slightly projecting into pallial cavity. Umbrella comparatively broad especially between dorsal arms of the male.

Type.—*Stoloteuthis nipponensis* (Berry, 1912).

Sepiolina nipponensis (Berry, 1911).

(Pl. XV, figs. 15–17; Pl. XVI, figs. 1, 2; textfigs. 90, 91).

Stoloteuthis nipponensis, Berry 1911b, p. 39, 1 fig.; 1912a, p. 414, pl. v, figs. 1–4.
Sepiolina nipponensis, Naef 1912, p. 248.—Sasaki 1914, p. 597; 1920, p. 187.

Twenty specimens at my disposal are referred without hesitation to this species. They rauge from 14 mm. to 23 mm. in mantle length.

Mantle shaped like a purse, its ventral measurement about three-fourths as broad as long; a little expanded anteriorly, rounded posteriorly (Pl. XV, figs. 15, 16). Anterior margin of mantle connected with head at nape by a broad commissural integument one-third as broad as body; ventral margin projects a little forward, but not so much as to cover the whole ventral surface of head, and is distinctly emarginated crescentwise in the middle.

Fins of rather moderate size, semilunar or subovate, attached to the middle part of the dorso-lateral surface of mantle; anterior end distinctly auriculate, not reaching to mantle margin; posterior end also auriculate but very faintly. Length of fins, $^3/_4$–$^4/_5$ the breadth, and $^1/_2$–$^2/_3$ the ventral length of mantle. Insertion line of fins $^2/_3$–$^5/_6$ their entire length.

Head large, as wide as, or even broader than, body. Eyes large, with a circular lid-fold, which is far deeper ventrally than dorsally. Size of the area enclosed by lid-fold varies greatly according to the state of preservation, sometimes being very small; if so, then the eyes are at a glance much like those of cegopsids. Olfactory pit-organ situated behind each eye as usual, surrounded by a prominent fold.

Funnel small, conical, extending far less than to the angle between ventral arms, sunk deep in mantle cavity, only a short terminal part protruding into the exterior. Funnel cartilage elongated, about four times as long as broad, with parallel sides and similarly rounded ends; its longitudinal groove deep, a little curved, deepest near the anterior end. Mantle cartilage ridge-like, a little longer than funnel cartilage, slightly curved, crescentwise, thickest in advance of the middle; the anterior origin distinctly defined, its distance from mantle margin greater than half the entire length of the cartilage. Lateral funnel adductors prominent, connected with funnel base at the anterior end of funnel cartilage. Funnel organ composed of a $\wedge$-sharped dorsal pad and two ovate ventral pads; the former with its anterior end at the midway along the dorsal wall of funnel; the latter about as long as the former, a little blunter posteriorly than anteriorly (Pl. XV, fig. 17). Funnel valve rather large, ovate, situated nearer to the extremity of funnel than to the dorsal pad.

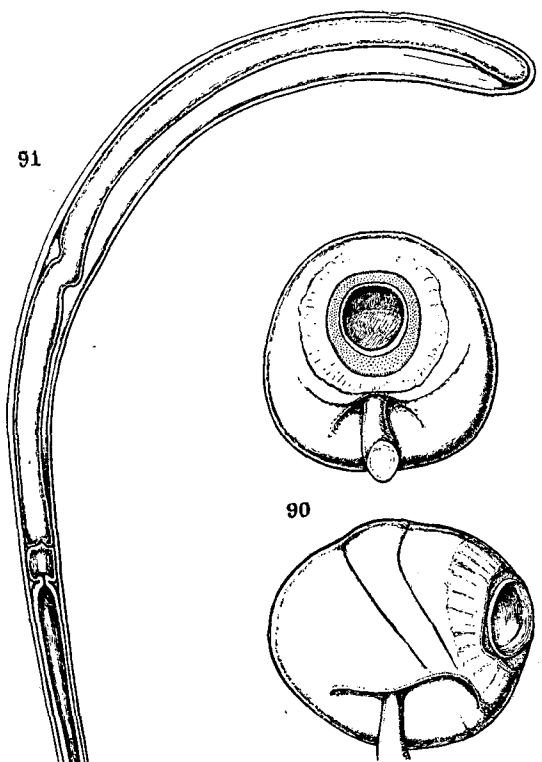
Umbrella fairly well developed except between ventral arms where it is quite rudimentary as usual. Radii between arms somewhat differ in the sexes: in the female they are about uniform, extending about one-third up the arms, while in the male they are nnequal, the longest between first arms often extending beyonk the halfway along these arms.

Arms subequal, the formula of length being $2 \fallingdotseq 3 > 1 \fallingdotseq 4$, but generally in the male the first pair is slightly longer than the fourth, while in the female the reverse of that seems to be true. All more or less compressed laterally, keeled on the aboral surface except ventral arms, which are roughly quadrangular in section provided with a narrow web on the dorsal side of the aboral surface.

Arm-suckers roundish (textfig. 90), distinctly biserial throughout, with smooth horny ring, which encloses a circular or ovate aperture, and of which the papillate area is very narrow. As regards the other respects the suckers show a marked sexual dimorphism: In the female they are numerous, counting about 25 pairs on each arm, and similarly small, but those of lateral arms are slightly larger than the other (Pl. XVI, fig. 1). On each arm they become at first larger, but smaller afterwards, towards the extremity; both quite gradually. In the male the suckers are very large, except on

the dorsal arms, and are greatly unequal, those of lateral arms being considerably larger than those of ventral arms (Pl. XVI, fig. 2). In lateral arms, the suckers number about 15 pairs, and though small at first soon become very large, the seventh to ninth pairs being of the maximum size ; at the subterminal part they become abruptly smaller, terminating in six pairs of minute suckers.

Both dorsal arms in male hectocotylized, being similarly constructed in all respects except that the right arm is usually slightly longer than the left one. They are a little thickened compared with the other arms, but neither swelling nor protuberance is formed anywhere. They have each about 22, similarly minute, short-peduncled suckers sparsely set in two series,



Textfig. 90.

Sepiolina nipponensis. Largest arm-suckers of male sex ; × 30.

Tentacles elastic, variable in length, being one to two times the mantle-length. Stem a little thinner than arms ; the oral surface flattened, marked off by sharp edges. Club slightly thickened, sharply-pointed at extremity, rounded in section, furnished with a narrow dorsal web, which begins near the extremity and extends on to the stem a short distance from the club. Suckers numerous, equally minute, subglobular, arranged in about sixteen series in the middle part of club ; peduncles normal ; horny rings smooth.

A discoidal luminous organ associated with ink-gland, slightly projecting into mantle cavity, representing the saddle-shaped organ of some other sepiolids. Penis large, much projecting freely into mantle cavity.

Spermatophores of fully grown males, 8–9 mm. long. Sperm cord thick, not coiling, occupying a half of the leugth of etui. Discharging tube striated. Intermediate part very yong comprising half the length of non-spermatic part (textfig. 91).

Textfig. 91.

Sepiolina nipponensis Total view of spermatophore ; × 30.

Color in formalin, cardinal brown, deeper above ; chromatophores much smaller than *Euprymna*. Ventral surface of mantle embellished on either side with a broad, pearly zone, which begins at the anterior margin of mantle, proceeding caudad along the periphery, and which is united with the corresponding one of the opposite side at the posterior end, thus forming a U-shaped marking. The marking in fresh specimens is very clear, but becomes indistinct when they are long preserved.

Measurements of largest Male and Female Examined.

Sex	♂	♀
Ventral length of mantle	23 mm.	22 mm.
Maximum breadth of body	16 ,,	15 ,,
Breadth of head	16 ,,	14 ,,
Breadth of nuchal commissure	6 ,,	6 ,,
Length of fins	14 ,,	12 ,,
Breadth of fins	11 ,,	10 ,,
Length of first arms	Left 16.5 mm. Right 18 mm.	Left 11.5 mm. Right 11 mm.
,, ,, second arms	21 ,, 20 ,,	13 ,, 13 ,,
,, ,, third arms	21 ,, 21 ,,	14 ,, 14 ,,
,, ,, fourth arms	18 ,, 18 ,,	12 ,, 12 ,,
,, ,, tentacles	30 ,, 32 ,,	23 ,, 25 ,,
Diameter of largest arm-sucker	1.3 mm.	0.5 mm.

Remarks.—The specimens referred to deviate a little from Berry's original description, (1) in having broader umbrella especially between the dorsal arms of the male sex, (2) in that fins are not so large as to extend to the anterior margin of mantle, and (3) in that the order of arms is 2, 3, 1, 4 or 2, 3, 4, 1 instead of 2, 1, 3, 4.

Locality.—Suruga Bay (Berry); do. 124–131 fms. (Albatross!); near Goto Is., Kyushu, 139 fms. (Albatross!); Kagoshima (Sasaki); Van Diemen Strait, 115–119 fms. (Albatross!).

Subfamily **Sepiadariinae***) (Hoyle, 1904).

Sepiadarii, Steenstrup 1881, pp. 233, 239.—Appellöf 1898, p. 623.
Sepiadariidae, Fischer, 1882. p. 350.—Grimpe 1922, p. 48.
Sepiadariinae, Hoyle 1904b, p. 7.—Naef 1912, p. 246, 248; 1921, p. 536.—Berry 1920, p. 155; 1921, p. 347.

Mantle continuous with head at nape, its ventral margin not greatly projecting forwards, connected with funnel base by either ligament or plug and socket on either side. Fins comparatively narrow and feebly auriculate so that they approach in structure those of the Sepiidae. Umbrella forms a sheath for the base of tentacles between third and fourth arms. Arm-suckers in four series at least on the distal half of each arms. Distal part of left ventral arm hectocotylized. Presence of luminous organ has not yet proved. Gladius also absent.

Genus **Sepiadarium** Steenstrup, 1881.

Sepiadarium, Steenstrup 1881, p. 214; 1887, p. 67–72, 116, 120.—Fischer 1882, p. 350.—Brock 1884, p. 105–114.—Appellöf 1898, p. 570.—Hoyle 1904b, p. 7.—Naef 1912, p. 248.—Robson 1914, p. 677.

Ventral margin of mantle undetachably connected with funnel base by broad ligaments on both sides. Fins small, ovate, situated nearer to the posterior end of mantle than to its anterior margin. Lid-fold of eye small, cresentic, situated much nearer to neck groove than to umbrella edge. Arm-suckers biserial in the proximal half of each arm, quadriserial in the remaining parts; those of biserial part decidedly larger in male than in female. Left ventral arm hectocotylized, bearing numerous transverse lamellae uniserially arranged on the distal half. Umbrella forms a complete sheath for the base of tentacles. Spermatophores minute; sperm cord thick and not coiling; intermediate organ complex. Female without spermatophore receptacle in pallial cavity, but its buccal membrane serves the same function.**)

Type.—*Sepiadarium kochii* Steenstrup, 1881.

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*) The subfamily contains two genera, i.e. *Sepioloidea* and *Sepiadarium*. The former genus is characterized by having a cartilaginous socket and nodule for articulation of the mantle to the funnel, whereas *Sepiadarium* the mantle is firmly fused with the base of the funnel as mentioned in the diagnosis of the genus. According to Grimpa's view (1922) this subfamily forms itself an independent family, separated from other subfamilies of the Sepiolidae. This is rearly an improvement of the classification. But here it is still retained in the Sepiolidae to take equilibrium with the Rossinae which also possesses many peculiarities different from those of other subfamilies.

**) Three species are known at present to belong to this genus. But their specific distinctions are so very scanty that an accurate comparison with one another by means of a number of actual specimens might certainly reduce the number of species. A key to the species is appended:—

I. Fins nearly $^4/_5$ as long as mantle ..... *S. auritum* Robson.
II. Fins less than half as long as mantle.
  1. Tentacle with 8 rows of minute suckers; hectocotylized arm furnished with a series of transverse plate-like lamellae on distal part and 7–9 pairs of suckers on proximal part, and also a longitudinal fold on a side..... *S. kochii* Steenstrup.
  2. Tentacle with about 6 rows of relatively large suckers; hectocotylized arm with a series of somewhat pointed tongue-shaped lamellae on distal part and 9½ or 10 pairs of suckers on proximal part, but no lateral longitudinal fold..... *S. austrinum* Berry.

Sepiadarium kochii Steenstrup, 1881.

(Pl. XV, figs. 18, 19.)

Sepiadarium kochii, Steenstrup 1881, p. 214, pl. i, figs. 1–10.—Brock 1887, p. 595.—Goodrich 1896, p. 3.—Appellöf, 1898a, p. 593, pl. xxxii, figs. 9, 10; pl. xxxiii, figs. 14, 19, 21; pl. xxxiv, figs, 23, 25, 27.—Hoyle 1904a, p, 198.—Sasaki 1914, p. 597.—Berry 1921, 352.

This species is represented by twenty specimens in the collections at my disposal, they measure 10–16 mm. in mantle length.

Animal small, squat. Body about as long as broad, a little flattened dorso-ventrally, with parallel sides in the anterior half; posterior end quite blunt or even truncate. Anterior margin of mantle connected with head at nape by a narrow commissural integument about one-third as broad as body; ventral margin not projecting, but a little emarginated crescentwise in the middle. Fins small, longitudinal-ovate blunter posteriorly, shorter than half the mantle-length, attached to the posterior part of the dorso-lateral aspect of body. Anterior part of fins weakly auriculate so that the line of attachment is only a little shorter than the entire length of fins.

Head large, as broad as, or a little narrower than, body; flattened both above and below. Eyeballs fairly large, but the transparent eyelid narrow, situated about one-third the distance from neck groove to interbranchial space, forming a small crescentic fold ventrally. Minute lacrymal pore discernible. Olfactory pit-organ present behind and below the lid-fold, marked off by a small circular fold.

Funnel rather small; its distal two-thirds tubular, a little narrowing distad, extending less than to the angle between ventral arms; the basal part faintly marked off from head, and connected undetachably with mantle on either side by a broad ligament instead of the usual plug and socket. Funnel organ composed of a $\wedge$-shaped, dorsal pad, and two, ovate, ventral pads; the former extends to the centre of the dorsal wall of funnel, with a short projection at its tip (Pl. XV, fig. 18). Funnel valve large, tongue-shaped, attached to halfway from the dorsal pad to the extremity of funnel. Funnel adductors all embedded below the surface.

Umbrella narrow, equally developed all round, its radii attaining a length of about one-fifth that of arms, but between the ventral arms its rudimentary condition is none the less as usual. It formes a complete sheath for the base of tentacles.

Arms rather short, subequal, the formula of length being $2 \fallingdotseq 3 > 1 > 4$; the longest about as long as mantle. All with a weak carination on back, but in bad specimens it is quite obliterated. The carination of the fourth arm is not so lateral in position as to be called web. Protective membranes quite rudimentary in all arms.

Arm-suckers subglobular, a little flattened obliquely, each with a minute round aperture; peduncles normal, their base not so prominent as in other sepiolids. Horny ring smooth; papillate area narrow, on the whole widest at the ventral part, not concave, but flat or even convex. On each arm the suckers are in two series up to the middle, whence they become quadriserial, and abruptly diminish in size. The biserial suckers towards the base number eight or nine pairs. In the female they are all equally small, while in the male they are large and unequal, at first increasing in size, but decreasing afterwards, and the largest suckers are in the fourth or fifth pair, being far larger than those of the female.

Left ventral arm prominently hectocotylized; shorter and thicker than the right ventral, terminating bluntly, On the proximal $\frac{1}{2}$–$\frac{2}{3}$ of the arm are found 7–9 pairs of suckers, which are though of normal strncture, smaller than the corresponding ones of the right ventral arm. The remaining distal part of the arm has about twenty transverse lamellae closely set in a single series so as to present the appearance of a comb. The lamellae represent each two peduncular bases of suckers united together and hence often they have two quite rudimentary suckers on the truncated tip. Besides these, there is developed a longitudinal membranous fold on the outer side of the oral surface along the whole extent of the hectocotylized part.

Tentacles variable in length, but in good specimens ordinarily as long as head and body taken together Stem slightly thinner than any of arms, slightly flattened laterally; oral surface flat. Club expanded, ordinarily crescentiform, with a broad dorsal web extending from the extremity to the carpal portion a little beyond the sucker-bearing part. Suckers equally minute, as broad as deep, arranged in eight series, their aperture wide and round; peduncles of normal structure. Horny ring in all suckers, smooth, with broad papillate area.

Radula composed of seven series of unicuspid teeth; both median and marginal teeth, slender; the latter the longest, outer lateral teeth the smallest.

Left oviduct developed as usual, its distal part largely projecting into mantle-cavity. Nidamental glands of both sides equally developed. Ripe ovarial eggs about 3.5 mm. in diameter, roundish. No spermatophore receptacle is developed in the mantle cavity of females.

Spermatophores minute, measuring only about 3.5 mm. in length, its aboral end expanded and the oral end invariably bent a little. Sperm cord very thick, not coiled, occupying about a half of the entire length of etui. Intermediate organ very long, of complex structure as shown in Pl. XV, fig. 19. The spermatophores are fixed to the female on its buccal membrane as in the Loliginidae Idiosepiidae and Sepiidae.

Color in alcohol, dull gray, much paler below; chromatophores minute.

Measurements of Largest Male and Female Examined.

Sex	♀		♂	
Ventral length of mantle	16 mm.		13.5 mm.	
Maximum breadth of body	14 ,,		12 ,,	
Breadth of head	12.5 ,,		11 ,,	
Breadth of nuchal commissure	5.8 ,,		5 ,,	
Length of fins	Left 7 mm.	Right 8 mm.	Left 5.5 mm.	Right 5.5 mm.
Breadth of fins	5 ,,	5 ,,	4 ,,	4 ,,
Extent of mantle before fins	8 ,,	8 ,,	6 ,,	6.5 ,,
Length of first arms	15 ,,	15 ,,	14 ,,	14 ,,
,, ,, second arms	16 ,,	16 ,,	16 ,,	15 ,,
,, ,, third arms	16 ,,	16 ,,	16 ,,	16 ,,
,, ,, fourth arms	13 ,,	14 ,,	13 ,,	—
,, ,, tentacles	25 ,,	25 ,,	21 ,,	—
Diameter of largest arm-sucker	0.4 mm.		0.8 mm.	

Remarks.—*S. auritum* Robson is distinguished from *S. kochii* principally by the basal plates of the radular teeth and by the size of the fins. As far as the specimens at my disposal show, the said plates are subject to individual variation and the fins also show a range in size, so that it is very doubtful whether these distinctions have weight specifically as might be expected.

A Chief distinction of *S. austrinum* offered by Berry consists in hectocotylization: as compared with two other congeners (1) the lamellae of the hectocatylized part of *S. austrinum* are conical rather than transversely ridge-shaped, (2) they are not longitudinally folded or crenulate, (3) there are fewer of them, and (4) the marginal membranes so conspicuously developed in the other forms are here almost or quite lacking.

The specimens referred to agree with Appellöf's description rather than with Steenstrup's; from which their discrepancies are already pointed out in a previous paper of mine (1914).

Locality.—Namerikawa, Etchû Prov. (!); Musashi Prov. (Sasaki); Tôkyo Bay (!); Suruga Prov. (Sasaki), Bungo Prov. (Sasaki); Nagasaki (Sasaki); Satsuma Prov. (Sasaki). Hongkong (Steenstrup; Berry); Amboina (Brock); W. Australia (Robson); Andamans (Goodrich); Ceylon (Goodrich); India (Steenstrup).

Subfamily **Rossinae** (Hoyle, 1904).

Rossinae, Hoyle 1904b, p. 7 (pars).—Naef 1912, p. 245 ; 1921, p. 536.—Berry 1920, p. 154.
Rossiae, Appellöf 1898a, p. 625.
Rossinae, Grimpe 1921, p. 299.

Anterior margin of mantle free all round, but articulating with both head and funnel base by cartilaginons plug and socket ; ventral part not projecting so greatly as to form a special lobe. Fins of moderate or fairly large size, and more or less auriculated in front. Umbrella narrow, not forming complete special sheath for tentacular base. Arm-suckers in 2–4 series. One or both dorsal arms hectocotylized. No luminous organ associated with ink-bag. Gladius present.

Genus **Rossia** Owen, 1835.

Rossia, Owen 1835, p. 93 (fide Jatta).—Gray 1849, p. 88 (pars).—Adams H. & A., 1858, p. 39 (pars).—Verany 1851, p. 63 (pars).—Jatta 1896, p. 134.—Pfeffer 1908a, p. 31.—Berry 1912a, p. 290 ; 1620, p. 154.—Naef 1921, p. 536.

Animals mostly of robust built. Both dorsal arms hectocotylized, bearing a longitudinal groove on the outer lateral aspect ; their suckers may be somewhat reduced in size. Spermatophores with thick, non-coiling sperm cord.

Type.—Rossia palbebrosa Owen, 1834 (=*R. glaucopis* Lovén, 1845).

Key to the species found in Japan.

(A) Tentacular suckers in about 8 series ; recium without papilliform organ.
  (a) Animal rather firm in consistency ; nuchal cartilage rapidly tapering posteriad ; suckers of hectocotylus reduced in size ..... *R. pacifica.*
  (b) Animal rather soft in consistency ; nuchal cartilage with nearly parallel sides ; suckers of hectocotylus of nearly normal size ..... *R. mollisella.*

(B) Tentacular suckers in about 24 series ; recutum with papilliform organ on either side ..... *R. bipapillata.*

Rossia pacifica Berry, 1911.

(Pl. XVI, figs. 3–6 ; textfigs. 92–94.)

Rossia pacifica, Berry 1911, p. 591 ; 1912a, p. 290, pls. xli–xlii ; xliii, figs. 1–4 ; pl. xliv, figs. 1, 5.—Sasaki 1913, p. 399 ; 1914, p. 598 ; 1920, p. 188.
? Rossia sp. Berry 1912b, p. 417.
Rossia borealis, Sasaki, 1913, p. 247.

About one hundred specimens of this species have been at my disposal for examination, measuring up to 8 cm. in mantle length.

Mantle in male expanded anteriorly, but in female, of the same breadth in the anterior half ; yet in both sexes, it is quite rounded posteriorly and ¾–⅔ as broad as long. Anterior margin of mantle free all round ; the ventral part projecting a little forwards, but forming a faint crescentic emargination in the middle. Fins ½–⅔ as broad as their own length, which is in turn about three-fifths the mantle-length ; attached laterally to the middle of body, the anterior tip a little projecting beyond the attachment line, which is more or less oblique to the horizontal plane of the body and measures about ⅘ the entire length fins.

Head large, as wide as body ; dorsal surface flat or slightly concave ; ventral surface forms a shallow excavation, enabling itself to make the funnel rest in it. Eye large, a little prominent; covered with a thin transparent integument, which is marked off from the general surface of head by a reniform or semicircular lid-fold. Lacrymal pore discernible. A small but prominent, truncated

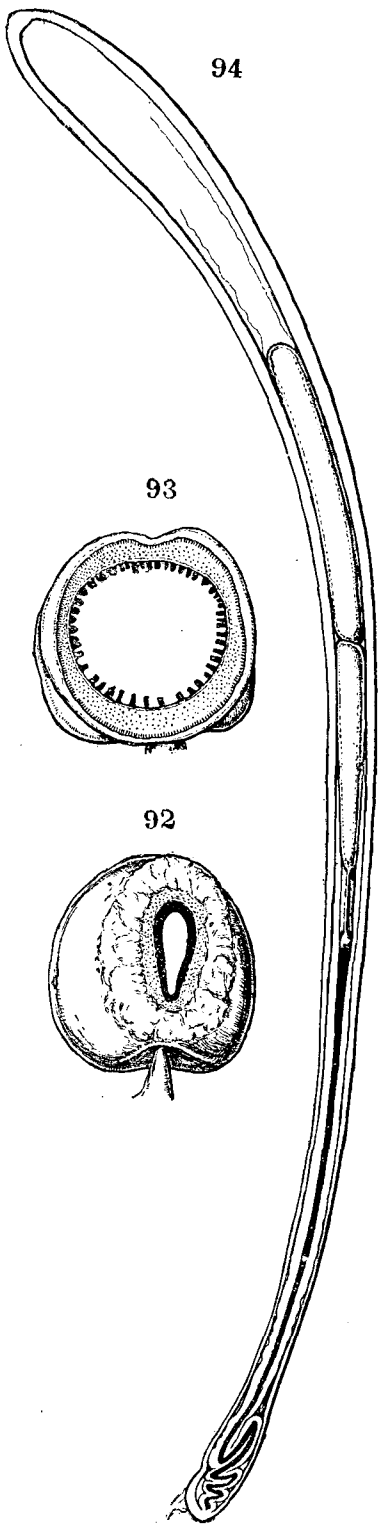
cone exists behind and a little below the eye, having a minute pit on its apex. Nuchal cartilage ovate, measuring 6.5 × 13 mm. in the largest specimen examined, tapering posteriad, with a longitudinal ridge in the middle, marked off by groovelike, depressions on sides, the ridge itself also bearing a fine groove along the crest (Pl. XVI, fig. 4).

Funnel conical, comparatively large, thick-walled, extending less than to the angle between ventral arms, its proximal part not clearly separated from head ; ill-defined lateral adductor inserted near funnel-cartilage. Funnel organ conspicuous, composed of a Λ-shaped dorsal pad and two pyriform ventral pads ; the former has a strong cuspidation at the anterior end, and an angular projection on the outer side of its each lateral half (Pl. XVI, fig. 3). Funnel valve orbicular, rather large, measuring 5.2 mm. in the largest specimen examined; inserted somewhat in front of the halfway from the dorsal pad to the distal end of funnel. Funnel cartilage oblong, measuring 6 × 15 mm. in the largest specimen, with parallel sides and similary rounded ends; longitudinal groove deepest near the middle, slightly curved. Mantle cartilage ridgelike, longer than funnel cartilage by a quarter of the latter length, highest near the middle, a little curved crescentwise, arising abruptly at a distance from mantle margin.

Arms stout, thick, rather unequal, the formula of length being usually 3>2>4>1, but may be 3≒2>4≒1 or 3>2≒4>1. Length of respective arms variable due to its great elasticity, but in good female specimens the longest pair is a little longer than the mantle. In all arms, the carination is more or less developed on the aboral surface, but in the ventral arm it makes itself out as a broad web running along the dorsal side of the aboral surface. Third arm joined with fourth arm by a well developed umbrella web functioning as a incomplete sheath for tentacle; in the remaining interbrachial spaces the umbrella is developed as a narrow web, but between the ventral arms, it is quite rudimentary as usual. Protective membranes very narrow, associated with peduncular bases of suckers.

Arm-suckers subglobular, their aperture small, circular, but more often longitudinal-ovate or even slit-like especially in male (textfig. 92); peduncles short and brittle; their bases expanded horizontally into the appearance of scales more or less overlapping one-another at the margins; horny ring smooth. The suckers, arranged in two series, but in adult often extremely crowded along the middle of arms so as to render themselves tri-or quadriserial. Size of suckers differs in the different sexes; in the female, they are equally small, while in the male they are large and unequal, especially in ahe lateral arm, where they are closely crowded, largest at the middle, then comparatively rapidly diminishing in size, and unequal even in each transverse row.

Both dorsal arms hectocotylized in a similar way. They have a narrow protective membrane on the dorsal side and much wider one on the ventral. Besides, on this side is found on the lateral surface a marked longitudinal groove defined by a mem-



Textfig. 92.
Rossia pacifica. One of larger arm-suckers of male sex; × 13.

Textfig. 93.
Rossia pacifica. One of proximal tentacular suckers of some specimen; × 40.

Textfig. 94.
Rossia pacifica. Total view of spermatophore; × 12.

branous fold beginning near the base and extending two-thirds up the length. Suckers of these arms, similarly reduced in size, being only one-third as large in diameter as those of lateral arm, numbering about 60 on either arm, arranged in two to four series.

Tentacles greatly veriable in both length and shape possibly due to their great elasticity: in contracted specimens, shorter than body, with four-sided stems as arms, and with much expanded crescentic clubs (Pl. XVI, fig. 5); but in extended specimens they are twice or even thrice as long as the body and have greatly elongated, lanceolate clubs as wide as the stems which are decidedly thinner than arms. Clubs bordered all round with a continuous protective membrane so that the sucker-bearing surface is completely marked off from the remaining surface; dorsal web broad, beginning at carpus and extending to the very tip. Suckers (textfig. 93) shallower than broad, with wide apertures and normal peduncles, forming oblique rows composed of eight each, but appearing to be in 5–6 series at the proximal part; unequal in size, largest dorsally near the base, then gradually decreasing in size ventrad and distad. Horny ring dentate on the whole edge; the teeth being short, blunt, somewhat varying in shape, and numbering about 45 in largest suckers.

Gladius is far shorter than mantle, a little variable in shape, and becomes relatively broader as the animal grows older. In full-grown females it is more or less spatulate consisting of a strong rachis and delicate vane. The rachis is strongest and widest near the anterior end, then evenly narrows cauded, bordered with thickened margin. The vane begins near the middle of the rachis, extending far beyond its posterior end and terminating in a blunt or even rounded extremity.

Nidamental glands of both sides grow similarly very large, coming into contact with each other along their whole inner sides. Ripe ovarial eggs 5 × 9 mm. Spermatophore receptacle present in pallial cavity.

Spermatophores 16.5 mm. long; sperm cord thick, and not coiling; intermediate organ of simple structure (textfig. 64).

Buccal membrane thick, greatly wrinkled internally, both ribs and marginal projections undiscernible, but connectives distinct, numering seven, of which the ventral two originate very near together in the membrane.

Surface entirely smooth, except for wrinkles due to the spirit. In life it is dotted with reddish brown chromatophores smaller and paler than in *Euprymna*. They are much more numerous above than beneath and absent on the ventral surface of the fins. A greenish lustre is diffused here and there over the surface. The horny rings are green as usual.

Measurements of Male and Female Specimen Examined.

Sex	♀	♀
Dorsal length of mantle	76 mm.	45 mm.
Ventral length of mantle	79 ,,	47 ,,
Maximum breadth of mantle	44 ,,	35 ,,
Breadth of head	44 ,,	36 ,,
Length of fins	28 ,,	15 ,,
Breadth of fins	48 ,,	20 ,,
Anterior origin of fins from mantle origin	15 ,,	11 ,,
Length of insertion-line of fins	42 ,,	24 ,,
Length of first arms	Left 45 mm. / Right 45 mm.	Left 40 mm. / Right 40 mm.
,, ,, second arms	56 ,, / 56 ,,	45 ,, / 45 ,,
,, ,, third arms	60 ,, / 60 ,,	50 ,, / 50 ,,
,, ,, fourth arms	55 ,, / 55 ,,	42 ,, / 43 ,,
,, ,, tentacles	92 ,, / 90 ,,	60 ,, / 60 ,,
,, ,, clubs	29 ,, / 28 ,,	10 ,, / 10 ,,
Diameter of largest sucker of first arms	2.3 mm.	1 mm.
,, ,, ,, ,, ,, second arms	2.5 ,,	3.0 ,,
,, ,, ,, ,, ,, third arms	2.5 ,,	3.2 ,,
,, ,, ,, ,, ,, fourth arms	2.5 ,,	2.9 ,,

Remarks.—The agreement of the specimens at my disposal with Berry's original description is quite satisfactary, except for five specimens (1 ♂, 3 ♀) from Hakodaté, which noticeably differ from his description so that I was obliged to separate them under a name of *R. borealis* in one of my previous papers. The principal differences are as follows: (1) in the specimens under consideration the arms and tentacles both are much longer than in his description especially in the male where the arms are twice, and the tentacles, four times, the body length. (2) The suckers are nearly biserial throughout even in full-sized specimens, and in the male they are no means so much enlarged as mentioned by Berry. (3) The hectocotylized first arms are slender and have 30, minute, abnormal suckers on the proximal half, but the suckers of the distal half are large and normal; the groove on the lateral aspect is indistinct. On examining numerous specimens at my disposal I have come to a consideration that these differences are in part caused by the ill preservation and in part from the monstrosity, which is, though rarely, met with also in cephalopods as in other animals.

Locality.—Near Semipochnoid I. Aleutian Is., 54 fms. (Albatross!); near Attu Is. Aleutians, 135 fms. (Albatross!); near Korsakova, Sakhalin, 21 fms. (Albatross!); near Rebun Is. Hokkaido, 142–190 fms. (Albatross!); Teshio Prov. Hok. (!); Nemuro Straiht, 86 fms. (Albatross!); Takashima, Hok. (Sasaki); Sapporo market (!); near Kamoi-saki Hok. 92 fms. (Albatross!); Tsugaru Strait, 195 fms. (Albatross!); Hakodate (Sasaki); off Hidaka Prov., Hok. 61 fms. (Albatross!); north of Sado Is., 176–200 fms. (Albatross!); Etchû Prov., (Sasaki); Noto Peninsula, 114–163 fms. (Albatross!); off Echizen Prov. 130–135 fms. (Albatross!); Wakasa Bay, 144 fms. (Albatross!); near Oki Is. 100–116 fms. (Albatross!); near Capa Clonard, Korea, 60–150 fms. (Albgtross!); off Kinka-san, 107–192 fms. (Albatross!). Alaska (Berry); S. Washington (Berry); California (Berry).

Rossia mollicella Sasaki, 1920.

(Pl. XVI, figs. 7–10; textfigs. 95–97.)

Rossia mollicella, Sasaki 1920, p. 189, pl. 25, fig. 1.

This species is based on one male and three female specimens found in the "Albatross" collection. The male was adult while the females were all young.

Mantle expanded anteriorly, rounded posteriorly, as wide as long or a little narrower. Anterior margin of mantle free all round, its dorsal part forming an obtuse angle in the middle, and the ventral part projecting forwards to some extent, but forming a faint emargination in the middle (Pl. XVI, fig. 7). Fins thin, very large, their length being about two-thirds the mantle-length; nearly semilunar, about four-fifths as broad as long, the indentation of the anterior origin feeble so that the line of attachment is only a little shorter than the entire length.

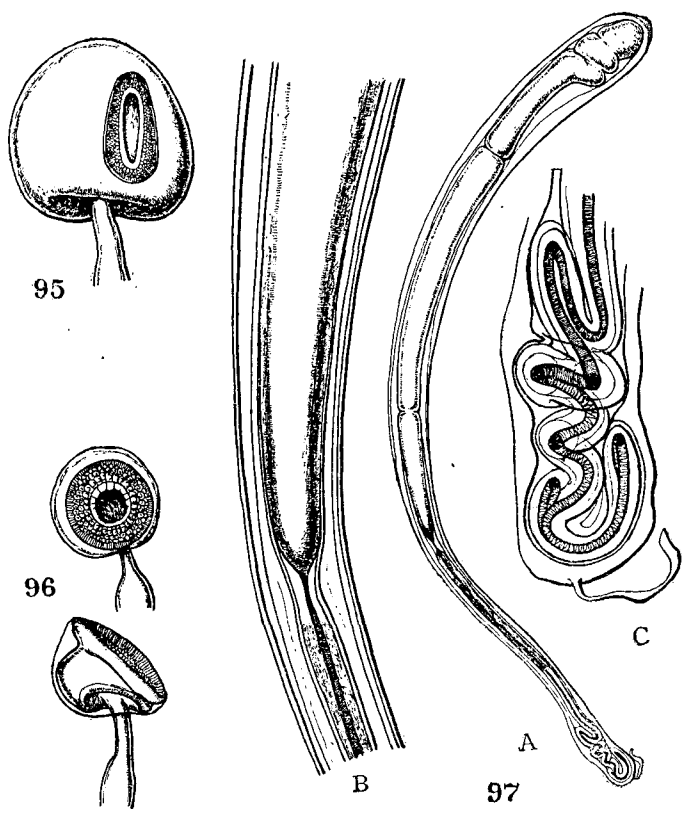
Head very large, decidedly broader than mantle, expanded laterally due to the location of enormous eyeballs; concave both above and below but much less in degree in the former. Eyelid almost as in *R. pacifica*. Nuchal cartilage oblong, a little shorter than twice the breath of its own, nearly parallelsided and similarly rounded on both ends, measuring 9.7 mm. in length in the largest specimen examined (Pl. XVI, fig. 8).

Funnel broad, expanded at base, tubular distally, hidden within pallial cavity to a great extent. Lateral funnel adductors well defined. Funnel organ and valve both as in *R. pacifica*. Funnel cartilage oblong, a little longer than twice the breadth of its own, bordered all around with a thin margin, of which the anterior part is folded back; the longitudinal groove deepest in front of the middle, and slightly curved. Mantle cartilage ridgelike, half as long again as funnel, cartilage, abruptly beginning at a distance from mantle margin, but posteriorly it gradually disappears.

Arms unequal, the formula of length being $3 \fallingdotseq 2 > 1 > 4$ in the largest specimen examined; the longest a little longer than the mantle length. Dorsal arms rounded on back save for a faint keel; lateral arms somewhat flattened; ventral arms nearly four-sided, furnished on the dorsal side a web, which becomes wider proximally attaining a breadth equal to that of the arms at base.

Arm-suckers subglobular, with longitudinally lengthened apertures (textfig. 95), biserial through-

out; on the whole a little larger in male than in female, specially so for the suckers of lateral arms; peduncles are of the ordinary structure; but their bases associated with the narrow protective membrane, are flattened into the appearance of serial scales a little overlapping one another at the margins.



Textfig. 95.
Rossia mollicella. Largest sucker of second arm of male specimen referred to in the description.

Textfig. 96.
Rossia mollicella Tentacular suckers; ×47.

Textfig. 97.
Rossia mollicella. Spermatophore. A. Total view; ×8. B. Pellucid portion. C. Oral end.

Horny ring smooth; papillate area narrow, composed of about seven rows of facetts with very faint papillae; the papillae of the innermost of the seven rows do not form any circle of denticles as is said by Verrill in *Rossia megaptera.*

Umbrella similarly narrow all round, extending to third pair of suckers, but between the ventral arms it is quite rudimentary as usual.

Both dorsal arms hectocotylized, being quite similarly constructed in every respect. On the lateral aspect of the outer side is found a deep groove marked off by a wide fold, running throughout the length. The suckers of these arms are affected but little by the hectocotylization, numbering only 42 and being only a little smaller than those of the lateral arms.

Tentacles when bent back, reach the posterior end of mantle. Stem about as thick as, or a little thinner than, arms; foursided. Club occupying a quarter of tentacle, not expanded, bent round, with a narrow semilunar membrane on the dorsal side of carpus. Tentacular suckers (textfig. 96) numerous, minute, nearly uniform, arranged in about eight series, horny ring smooth on the extreme edge but decorated on the outer aspect of the margin, with about ten faint thickenings; papillate area composed of a radiated margin and four rows of papillate facetts, of which the papillae are short and are far larger in the inner row than in the outer.

Buccal membrane wrinkled internally, both ribs and marginal projections indiscernible, but connectives distinct, thin and seven in number.

Radula composed of seven series of slender unicuspid teeth. Median and inner lateral teeth nearly equal in length. Outer lateral teeth a little longer than the median. Marginal teeth nearly equal to the combined length of three succeeding median teeth (Pl. XVI, fig. 9).

Gladius about nine times as long as broad and a little shorter than half the mantle length (Pl. XVI, fig. 10). Rachis of nearly equal breadth in the anterior half, then tapering caudad in an equable manner, its thickened margin broader than in *R. pacificus.* Vane lanceolate, widest near the middle, narrowing towards both ends; posteriorly it extends only a little beyond the end of the rachis and terminates in an acute point.

Spermatophores 13.4 mm. long. constructed as shown in textfig. 97.

Surface smooth; very soft to the touch, the integument being rather flabby. Color in spirit, purplish brown throughout and deep even beneath body but the funnel are much paler and the tentacles colorless as usual.

The principal measurements of all the specimens examined are appended :

No. of specimen	i	ii	iii	iv
Sex	♂	♀	♀	♀
Dorsal length of mantle	36 mm.	22 mm.	ca 12 mm.	ca 15 mm.
Ventral length of mantle	39 ,,	24 ,,	ca 13 ,,	—
Maximum breadth of mantle	33 ,,	25 ,,	11 ,,	11.7 ,,
Length of head	38 ,,	16 ,,	8 ,,	10 ,,
Breadth of head	37 ,,	25 ,,	14.5 ,,	16 ,,
Length of fins	Left 24 mm. Right 26 mm.	Left 19 mm. Right 19 mm.	Left 8 mm. Right 9 mm.	Left 10 mm. Right 10 mm.
Breadth of fins	26 ,, 26 ,,	15 ,, 18 ,,	6.5 ,, 6.5 ,,	7 ,, 7 ,,
Anterior origin of fins from mantle margin	5 ,, 5 ,,	4 ,, 3 ,,	— —	— —
Line attachment of fins	23 ,, 23 ,,	15 ,, 15 ,,	6.5 ,, 6.5 ,,	7 ,, 7 ,,
Length of first arms	32 ,, 32 ,,	15 ,, 15 ,,	7 ,, 7 ,,	8 ,, 8 ,,
,, ,, second arms	40 ,, 40 ,,	21 ,, 21 ,,	9 ,, 9 ,,	11 ,, 11 ,,
,, ,, third arms	41 ,, 42 ,,	23 ,, —	12 ,, 12 ,,	15 ,, 15 ,,
,, ,, fourth arms	28 ,, 28 ,,	19 ,, 19 ,,	12 ,, 12 ,,	13 ,, 13 ,,
,, ,, tentacles	44 ,, 50 ,,	— 45 ,,	22 ,, 22 ,,	18 ,, 18 ,,
Diameter of largest sucker of first arms	12 mm.	8 mm.	—	—
,, ,, ,, ,, ,, second arms	19 ,,	11 ,,	—	—
,, ,, ,, ,, ,, third arms	19 ,,	11 ,,	—	—
,, ,, ,, ,, ,, fourth arms	15 ,,	8 ,,	—	—
,, ,, ,, ,, ,, tentacles	0.4 ,,	—	—	—

Remarks.—The largest female alluded to in the above table differs from the remaining specimens in several respects so that its identification with them is with a great deal of hesitation. The differences are that (1) in the specimen in question the integument is not flabby but rather firm, (2) the head is as broad as the body, (3) the fins are much larger than in the other specimens and their anterior end extends far beyond the anterior origin of attachment, (4) the horny ring in both the arm and tentacular suckers has a little larger papillate on the papillate area, and (5) the ring of the tentacular suckers is armed with distinct teeth on the outer aspect of the margin instead of the mere thickenings.

The species is related more closely to *R. megaptera* Verrill than to *R. pacifica* Berry, but differs from even that species as shown in the following table.

	Rossia mollicella	*Rossia megaptera*
Ventral margin of mantle :	projecting forwards more than the dorsal margin ;	projecting forwards less than the dorsal margin.
Length of tentacles :	less than the length of head and mantle taken together ;	equal to twice the length of head and body taken together.
Arm formula :	$3 \fallingdotseq 2 > 1 > 4$;	$3 > 2 \fallingdotseq 4 > 1$.
Aperture of arm-suckers :	narrow and slit-like ;	wide end nearly circular.
Papillate area of arm-suckers :	narrow and composed of minute facetts with very faint papillae ;	of moderate breadth, composed of distinctly papillate facetts.

Locality.—Off Kii Prov., 244–440 fms. (Albatross !) ; off Kinka-san, 399 fms. (Albatross !),
Type locality.—Off Kii Prov.
Type.—In U. S. Nat. Mus.

Rossia bipapillata Sasaki, 1920.

(Pl. XVI, figs. 18, 19 ; textfigs. 98, 99).

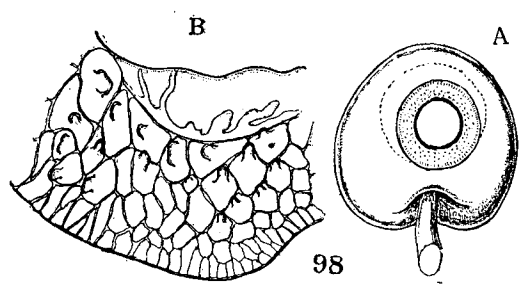
Rossia bipapillata, Sasaki 1920, p. 190, Pl. xxv, fig. 3.

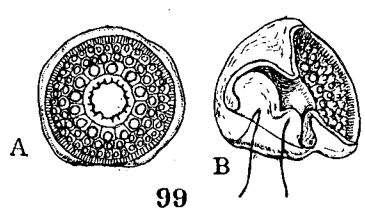
The species is based on a female specimen found in the " Albatross " collection. The specimen was not yet mature but was so well characterized that it could not be referred to any of species hitherto known.

Mantle a little longer than broad, of nearly equal breadth in the anterior half, rounded posteriorly. Dorsal margin of mantle free as is usual in the genus, slightly projecting forwards and forming an obtuse angle in the middle ; ventral margin projecting as far as the dorsal margin and forming a shallow crescentic emargination in the middle. Fins large, being only a little shorter than body ; semicircular, about half as long again as broad, their anterior origin somewhat indented, and the most anterior edge extending a little beyond mantle margin. They are attached laterally to the middle of body, the line of attachment being about three-fourths the entire length.

Head very large, wider than mantle, expanded laterally, bearing large eye-balls, slightly concave above. Transparent eye-lid comparatively large, with a crescentic fold ventrally. Umbrella very narrow, equally developed all round, but between ventral arms it is quite rudimentary as usual.

Funnel short, conical ; its distal part not slender, and extending far less than to the angle between the ventral arms. Funnel organ composed of a conspicuous horse shoe-shaped dorsal pad and two ovate ventral pads (Pl. XVI, fig. 18). The former pad forms a short rounded lobes projecting shoulder-like on sides of the anterior margin. Funnel valve situated much nearer to the extremity of funnel than to the dorsal pad. Funnel cartilage oblong, slightly longer than twice their own breadth, slightly narrowed in the middle; the margin rather firm and thickened at the anterior part which is characteristically bent backward (Pl. XVI, fig. 19). Lateral adductors of funnel well defined.





Textfig. 98.

Rossia bipapillata. A. Largest arm-sucker ; × 27. B. Portion of horny ring of A ; × 223.

Textfig. 99.

Rossia bipapillata. Tentacular suckers ; × 223. A. Frontal view. B. Side view.

Arms long, subequal ; the formula of length being $3 > 2 > 1 \fallingdotseq 4$; the longest as long as mantle. First and third arms with a faint keel on the aboral surface. Second and fourth arms four-sided, the former provided with a narrow web on the ventral side of aboral surface and the latter with a broad web on the dorsal side. Protective membranes very narrow in all arms, serrated at margin.

Arm-suckers subglobular, nearly uniform, but diminishing gradually towards the extremities of arms ; distinctly diserial throughout ; aperture circular (textfig. 98). Horny ring smooth ; papillate area composed of an irregularly radiated, narrow margin, and about four, irregular rows of plates with a minute, indistinct papilla each.

Tentacles about three-times as long as the mantle length. Stem three-sided, only a little thinner than arms. Club cylindrical, faintly expanded, tapering to slender extremity. On carpus is found on the dorsal side a narrow web about half as long as the club. Suckers exceedingly numerous, very minute, forming oblique rows composed of

24 each; equal in size, triangular in lateral view (textfig. 99). Horny ring with small circular aperature, the margin bearing about ten short round-headed papillate on the outer aspects; papillate area very broad, composed of a radiated margin and three rows of papillate facetts.

A papilliform organ of unknown function developed on either side of rectum.

Surface smooth, soft to the touch, the integument being flabby.

Measurements.

Dorsal length of mantle	19mm.	
Ventral length of mantle	19 „	
Maximum breadth of mantle	16 „	
Length of head	15 „	
Breadth of head	19 „	
	Left	Right
Length of fins	16mm.	16mm.
Breadth of fins	11 „	10 „
Distance from mantle margin to the anterior origin of fins	3 „	4 „
Line of attachment of fins	13 „	13 „
Length of first arms	15 „	15 „
„ „ second arms	17 „	17 „
„ „ third arms	20 „	19 „
„ „ fourth arms	15 „	14 „
„ „ tentacles	55 „	—
„ „ clubs	9 „	—
Radii of umbrella	2.5mm.	
Diameter of largest sucker of each arms	0.8 „	

Remarks.—The species seem to stand closest to *Rossia mastigophora* Chun, particularly in having a papillary organ on each side of the rectum, and their specific difference consists in the shape of the funnel organ and also in the formula of arm length. It is also related to *R. mollicella* n. sp., but differs from it in the funnel organ, in the funnel cartilage, and in the suckers of the arms as well as of the tentacles. Further, the papillary organs of the rectum are not found in that species.

Type locality.—Suruga Bay, 131 fms. (Albatross !).

Type.—In U. S. Nat. Mus.

Family **Sepiidae** (Leach, 1817).

Sepiidae, Leach 1817, p. 138 (pars). Adams, H. & A. 1858, p. 41 (pars).—Tryon 1879, p. 103.—Preffer 1908a, p. 24.—Naef 1912, p. 242 ; 1921, p. 536.—Berry 1921, p. 155.

Sepidae, d'Orb. in d'Orb. et Fér. 1835, p. 220 (pars).

Sepiadae, Owen 1838 (fide Gray).—Keferstein 1866, p. 1441,—Gray 1849, p. 96.—DE Rochebrune 1884a, p. 77.

Sepiarii, Steenstrup 1861a, p. 1 (fide Jatta).

Eusepii, Carus 1890, p. 453.

Mantle roughly roundish or ovate or elliptical in contour, somewhat flattened dorso-ventrally, bordered with a narrow fin on either side.**) Eye-vid continuous, but forming a crescentic reduplication ventrally and a minute lachrymal pore in front. A olfactory pit-organ present behind each eye.

*) This family is very frequently put under a tribe named e.g. Sepioidea by Naef (1912), or Sepiaemorphae by Grimpe, and the former writer divides the family further into two subfamilies, i.e. Belosepiinae and Sepiinae, to the former being referred fossil cuttlefish *Belosepia* Voltz 1830, whereas all living forms of the family are involved in the Sepiidae.

**) A special case if *Sepia confusa*, in which the fins of the male according to Massy and Robson (1923), are united posteriorly into a tail-like elongation adapted to some reproductive habit.

Funnel cartilage ovate or more or less crescent-shaped, with a deep longitudinal groove in the middle. Arm-suckers almost quadriserial. Tentacles retractile into special spaces in head ; club more or less crescent-shaped, its suckers arranged in several or more numerous series, Hectocotylization affects left ventral arm (very rarely also right ventral arm), consisting chiefly in the diminution of some suckers in size. Seminal receptacles developed in the ventral part of buccal membrane. Gonoduct of left side developed. Ink-bag large, often extending to the blind end of mantle. Shell internal, elliptical or lanceolate or rhomoidal, calcareous, thick.

Key to the genera occurring in Japan.

(A) A spine present behind body but no glandular pore ; shell elliptical with rostrum .....*Sepia.*

(B) A glandular pore present behind body but no spine ; shell elliptical, its posterior end flattened, without rostrum .....*Sepiella.*

(C) Neither spine nor glandular pore present behind body ; shell nicely rhomboidal no rostrum .....*Metasepia.*

Genus **Sepia** Linné, 1758.

Sepia, Linné 1758 (fide Hoyle).—Leach 1817, pp. 138, 140.—d'Orb. et Fér. 1839, p. 250 (pars).—Gray 1849, p. 96 (pars.)—Verany 1851, p. 65.—Adams H. & A. 1858, p. 42 (pars).—Tryon 1879, p. 187 (pars).—Pfeffer 1908a, p. 56.—Berry 1912b, p. 417 ; 1920, p. 153.—Naef 1921, p. 536.

Doratosepion, de Rochebrune 1884a, p. 95.

Body roughly ovate or elliptical in contour, more or less pointed behind, where it has usually a spine, but is provided by no means with glgndular pore. Dorsal margin of mantle projects over head in a triangular or tongue-shaped lobe. Nuchal cartilage also tongue-shaped, with a distinct median groove ; the margin deeply detached. Longitudinal groove of funnel cartilage devoid of special depression in the middle. Shell elliptical or lanceolate, extending the whole length of body ; rostrum, outer, and inner cones all more or less developed, but one or two of them though rarely, may be rudimentary.

This is a large genus, represented by nineteenth species*) even in the Japanese waters only. Some of them are grouped together into the subgenus *Doratosepion* by Berry. Although I adopted this view in one of my previous paper, here I am obliged to give it up, since the distinction of the subgenus has become to me very vague with my own progress of the study an the subject.

Type.—Sepia officinalis L. 1758.

Key to the species found in Japan.

(A) Shell elliptical, outercone broad and marginal, with distinct rostrum.

(*a*) Rim of inner cone built stout especially in the posterior part.

(a) Rim of inner cone greatly thickened in the posterior part, forming a callosity filling up the posterior hollow of shell.

(i) Tentacular suckers unequal, 7 or 8 in two median series, being 3–4 times the diameter of marginal ones .....*S. torosa.*

(ii) Tentacular suckers greatly unequal, about three nearest the middle of club being several times the diameter of marginal ones.

(f) Paler spots of various sixes on the back ; rounded callosity of shell, with long horns extending anteriorly to ca. ⅓ the length of shell..... *S. formosana.*

(ff) Transverse stripes of metalic rustre on the back : flattened callosity of shell with short horns extending anteriorly to ca. ⅕ the length of shell .....*S. tigris* n. sp.

(b) Rim of inner cone gradually thickening posteriad forming a U- or V-shaped, prominent ridge bordering the posterior hollow of shell ; tentacular suckers small, nearly uniform.

(i) Dorsal surface of shell almost evenly convex ; rostrum short .....*S. subaculeata.*

*) *Sepia myrsus* Gray which has been listed with doubt by Hoyle in the Japanese found is here excluded.

(ii) Dorsal surface of shell with distinct longitudinal ridges and grooves; rostrum long .....*S. aculeata.*

(β) Rim of inner cone thin throughout.

(a) Rim of inner cone forming posteriorly a thin shelf-like broder across the posterior hollow of shell; tentacular suckers uniform, tentacular suckers minute and uniform...*S. esculenta.*

(b) Shell devoid of ridges and grooves on the dorsal surface; rim of inner cone somewhat broad, but apressed on shell-border throughout, tentacular suckers greatly unequal in size .....*S. hercules.*

(c) Shell with longitudinal ridges and grooves on the dorsal surface, the rim of inner one V-shaped, streak-like; tentacular suckers uniform .....*S. robsoni* n. sp.

(B) Shell lanceolate-rhomboidal; outer cone developed in the posterior half, forming posteriorly a small, nearly cup-shaped lobe; rim of inner cone thin, parabolic, its greater part lying on outer cone; three median suckers on tentacular club decidedly the largest of all...*S. carinata.*

(C) Shell somewhat lanceolate, with small, cup-shaped outer cone; rostrum rudimentary; tentacular suckers unequal .....*S. erostrata* n. sp.

(D) Shell lanceolate, tapering posteriorly, into small discoidal or cup-shaped outer cone distinctly rostrate behind; rim of inner cone V-shaped, consisting of two nearly straight linear ridges.

(α) Tentacular suckers uniform.

(a) No spots on back; arms subequal; shell comparatively wide, shorter than four times the breadth of its own .....*S. appellöfi.*

(b) 100 or more longitudinal spots present on back; arms unequal (at least in male); shell slender, longer than five times the breadth of its own.....*S. pardalis*

(β) Tentacular suckers unequal in size.

(a) Arms in male considerably unequal.

(I) First arms the longest in male.

(i) Tentacular suckers markedly unequal; first arms in male whip-like, but thickened at the distal end.

(1) Both ventral arms hectocotylized; shell strongly carinated on the ventral side... .....*S. longipes.*

(2) Only left ventral arm hectocotylized; shell gently convex on the ventral side... .....*S. lorigera.*

(ii) Tentacular suckers uniform; first arms in male not thickened at the distal end..... .....*S. tenuipes* n. sp.

(II) Second arms the longest in male.

(i) Second arms in male, 4–6 times as long as mantle, very gradually tapering into filiform extremities.....*S. peterseni.*

(ii) Second arms in male, thick, cylindrical, with blunt extremities .....*S. andreana.*

(b) Arms of about equal length even in male, but first arms may be a little longer than the rest.

(I) Posterior end of each fin forms a thickened and expanded lobe.

(i) First arms about half as long as dorsal side of mantle, which length is in turn less than twice the breadth; gill composed of about 73 leaflets .....*S. tokioensis.*

(ii) First arms shorter than half the dorsal length of mantle, which is in turn greater than twice the breadth; will composed of about 65 leaflets .....*S. misakiensis.*

(II) Posterior ends of fins not thickened nor expanded.....*S. kobiensis.*

Sepia torosa Ortmann, 1888.

(Pl. XVI, fig. 11; textfigs. 100, 101.)

Sepia torosa, Ortmann 1888, p. 652, pl. xxiii, fig. 2.—Ortmann 1891, p. 674.—Berry 1912b, p. 420.—Sasaki 1914, p. 608.

I refer to this species two specimens at my disposal, one of which collected in Satsuma Prov. of Japan and the other in the Philippines. But their identification with this species is with a great deal of hesitation, since Ortmann's original description and illustration are not very complete. The following description is based on the specimen a fullsized male from Satsuma Prov.

Body short, roughly oval in outline, widest near the middle, a little tapered behind, somewhat flattened dorso-ventrally. Mantle margin shallowly emarginate in the ventral parts ; dorsally forming a broad bluntly angular projection longer than one-seventh of the entire length of mantle. Fins broad, abour one-fourth the breadth of body, beginning 3 mm. from mantle margin, widening caudad and finally approaching within a few mm. of each other.

Head broad, as wide as mantle opening. Funnel conical, with a blunt extremity reaching nearly the angle between ventral arms. Umbrella very narrow, extending to third or fourth transverse row of suckers, but between ventral arms it is quite rudimentary as usual.

Arms subequal, but fourth pair decidedly longer and thicker than the others, being about two-thirds the dorsal length of mantle. First and second pairs nearly conical, while the third and fourth are more or less compressed dorso-ventrally, bearing a conspicuous keel along the aboral surface. Suckers quadriserial throughout, their horny ring apparently smooth except in distal suckers where the margin of the ring is quite uneven.

Left ventral arm hectocotylized in the middle part. On this arm the first ten rows of suckers are of normal size, succeeded by five or six rows of minute ones which are situated on the hectocotylized part. Beyond these, the suckers regain their normal dimensions.

Tentacles slender, longer than head and body taken together. Club about one-seventh the entire length of tentacle, a little expanded, somewhat crescent-shaped, bordered with protective membranes of moderate breadth ; dorsal web also of moderate breadth, beginning at carpus and extending to the extreme tip of club, a little wider distally than proximally. Suckers form very oblique rows composed of eight each, so that at a glance they seem to be in about five series ; unequal in size, middle seven or eight being very large, 3–4 times as large in diameter as marginal suckers. In these large suckers the horny ring has no teeth except some irregular sinuations of the margin, while in the remaining suckers the ring is equipped with numerous, long, blunt teeth.

Buccal membrane with the usual seven projections of margin, each of which bears a few minute suckers. Spermatic pad not observed, the specimen referred to being male.

Shell nicely elliptical in outline, but slightly blunter posteriorly than anteriorly, the well developed outer cone giving the blunder contour to the posterior extremity ; bordered with a rather broad chitinous margin which is uninterrupted even below the rostrum (Pl. XVI, Fig. 11). Breadth of shell greater than one-third the length. Dorsal surface a little convex, with a faint median ridge, and bordered with a narrow naked area on either side ; calcareous rugosities arranged in regular lines nearly concentric arrangement. Ventral surface highly convex at the middle part, with rather shallow but wide groove along the median line. Striated area marked off anteriorly by two, nearly straight lines meeting each other at a rounded angle. Rim of inner cone begins one-fourth the length of shell from the posterior extremity ; it is at first very thin but soon attains a great thickness, forming posteriorly a large, shield-shaped callosity filling up the hollow of shell. The callosity, flat anteriorly but convex and rounded posteriorly, its edge-line showing a nicely parabolic curve. Rostrum small. Locular index about 35.

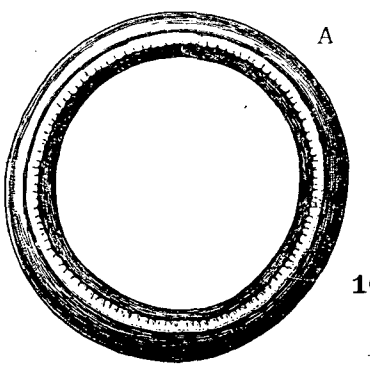
Dimensions.

Dorsal length, of mantle	143 mm.
Ventral length of mantle	120 ,,
Breadth of mantle	82 ,,
Breadth of head	62 ,,
Maximum breadth of fins	20 ,,

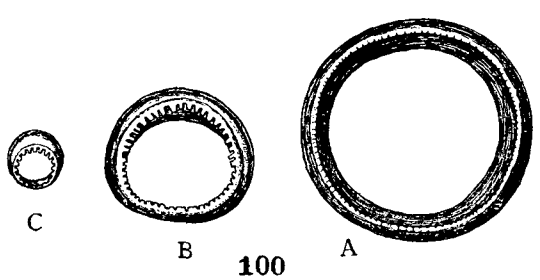
	Left	Right
Length of first arms	70 mm.	—mm.

Length of second arms	—mm.	74mm.
„ „ third arms	60 „	64 „
„ „ fourth arms	95 „	96 „
„ „ tentacles	260 „	260 „
„ „ clubs	35 „	34 „
Diameter of largest sucker of arms	5mm.	
„ „ „ „ „ tentacles	3.5 „	
Length of shell	143 „	
Breadth of shell	52 „	
Thickness of shell	15 „	
Maximum breadth of naked margin of shell	6 „	

Remarks.—The horny ring of proximal arm-suckers in the specimen from Satsuma appears to be smooth as mentioned above, but when carefully examined with transmitted light it reveals innumerable teeth, fused up tightly into a plate. The distinction of the teeth is very clear in the distal suckers where the margin of the ring is not entire but quite uneven. In the specimen from the Philippine Islands, which has 72 mm. mantle length, the union of the teeth is confined to the suckers towards the base of arms (textfig. 100). In the remaining suckers the ring has distinctly separated teeth, which are cut square at their tip and are as fine as written by Ortmann. The teeth, united or separated, number about 130 in basal suckers, about 50 in middle ones, and 15–20 in distal ones.



101



100

Textfig. 100.

Sepia torosa Horny rings from arm-suckers of the Philippine specimen referred to in the description; × 223. A. From basalmost sucker. B. From one of middle suckers. C. From one of distal suckers.

Textfig. 101.

Sepia torosa Horny rings of tentacular suckers of same specimen; × 40. A. From largest sucker. B. From one of subterminal marginal suckers.

The smooth horny ring of larger tentacular suckers are also formed by slender teeth united together as in the arm-suckers. The teeth distinguished by transmitted light number about 200 in the largest sucker in the Philippine specimen (textfig. 101), whilst in the Satsuma specimen they are more numerous but are not capable of counting exactly owing to their perfact fusion in several places.

As far as the tentacular suckers are concerned, the Philippine specimen approaches *S. formosana* Berry, the middle three being largest of all.

Lscality:—Tôkyo Bay (Ortmann); Satsuma Prov. (Sasaki); Amboina (Ortmann); Philippines (!).

Sepia formosana Berry, 1912.

Formosan dialect: Sowcartsun; or Batchar.

(Pl. XXX, figs. 9–11. textfigs. 165, 166.)

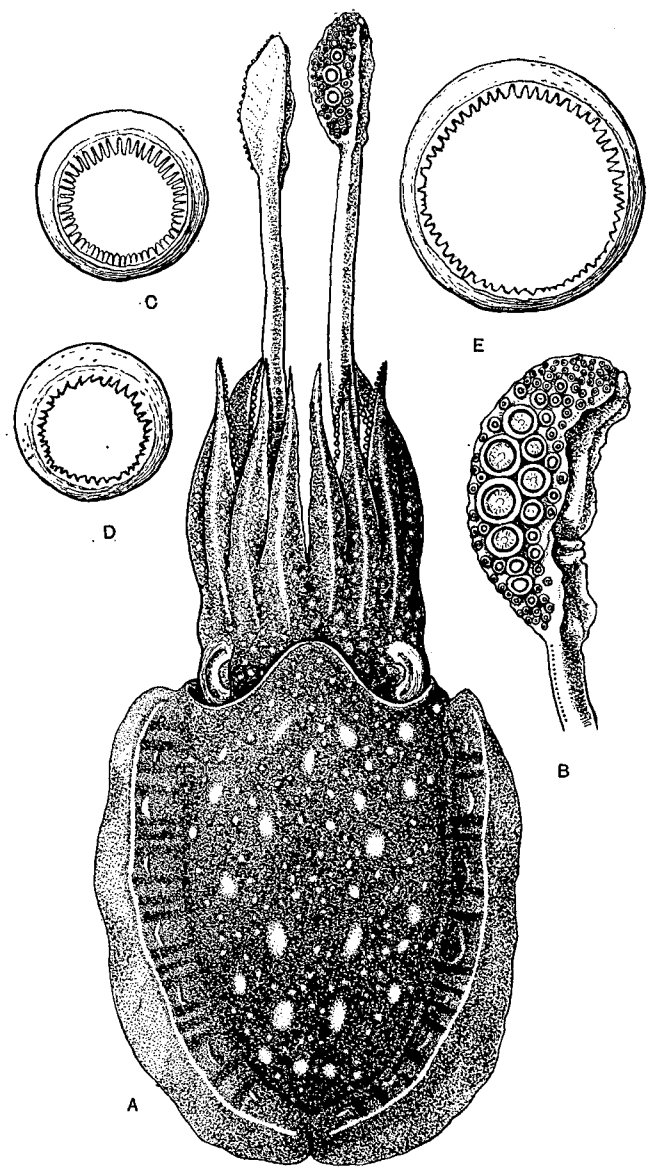
Sepia formosana, Berry 1912b, p. 420, pl. ix, fig. 7.—Sasaki 1914, p. 608.

List of Specimens Examined.

Specimens.	Mantle-length.	Locality.	Date.	Collector.	Where preserved.
1 ♀	173 mm.	Tainan market, Formosa.	April 15, 1920.	Dr. M. Oshima	Formosan Mus.

Specimens.	Mantle-length.	Locality.	Date.	Collector.	Where preferved.
4 juv.	29 mm.–100 mm.	Ako market, Formosa.	April 20, 1920.	Dr. M. Oshima	Hok. Imp. Univ.
18 juv.	34 mm.– 83 mm.	Pescadores Is.	July 5, 1920.	do.	do.

Body roughly elliptical, about half as broad as long, the broadest part being a little before the middle and the posterior end rather blunt, without showing rostrum. Mantle margin protruded dorsally over the head in a rounded projection the length of which comprises about one-tenth that of the mantle; ventrally it is emarginated evenly and weakly as usual. Fins of nearly uniform breadth but a little narrowed at both extremities; the broadest a little behind the middle, is about one-fourth as broad as the body. They begin very near the mantle margin, traverse backward along the periphery of the dorsal surface of the mantle, and extend to within 5 mm. of each other posteriorly; the posterior ends of the fins are separated from one another by a quite smooth space.



Textfig. 165.

Sepia formosana Berry. A. Juvenile individual from Akô market, with distinct patterus on the back, ×⅔; B. tentacular club of the largest specimen referred to, slightly reduced; C. horny ring of distal tentacular sucker of the same specimen, ×40; D. horny ring from proximal sucker of the third arm of a juv specimen of 41 mm. mantle length, ×36; E. horny ring from the largest tentacular sutker of a juv specimen of 29 mm. mantle length, ×36.

Head narrower than body, and about one-fourth as long as the latter. Funnel cartilage ovate as usual, its longitudinal groove crescentic and deepest a little before the middle, and there is a shallow depression on the margin of the groove just ventral to the deepest part. Funnel organ and its valve, both of so ordinary shape. Umbrella broadest between lateral arms where it extends to the third or fourth row of suckers; between ventral arms it is obliterated as usual.

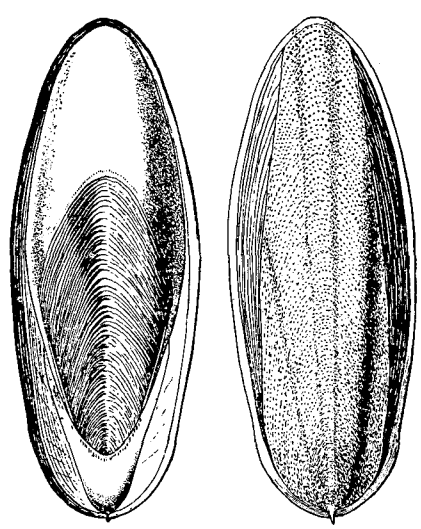
Arms nearly equal in length, and a little longer than half the mantle length. Carination of their aboral surface rather ill developed except in the fourth arms which is markedly caricated outside. Suckers quadriserial except several at base, which are bi- or tri-serial; those visible with the naked eye count about 40 quartets in the dorsal three pairs of arms and about 50 quartets in the ventral pair. Beyond these at the extremity of each arm there are some ten quartets of suckers of microscopic size. They increase in size very gradually to about the seventh row and then decrease rather rapidly distal to the microscopic suckers above mentioned. Horny ring apparently smooth, the whole margin being composed of numerous slender teeth tightly parisaded

together into a continous plate. But in the distal suckers the teeth are more or less separated so that the margin of the ring is irregularly zigzag, Papillate area composed of ten or more concentric rows of plates with a very low papilla each.

Tentacles about one and a half times as long as mantle; their stalk rather thick, only slightly thinner than the thinnest arm. Club expanded, widely crescent-shaped; comprising about one-fifth of the entire length of the tentacle; dorsal web of moderate breadth, extending down to the stem a little beyond the carpus. Suckers count about 100 in number, arranged in slanting series of eight suckers in a row, but at the hand and carpal portions this eight-serial arrangement is compressed into apparently four or five rows. They are very unequal in size, especially unequal are those of the hand portion, where two or three near the middle are of considerable size (textfig. 165B). At the distal portion of the club they become regularly smaller distad except three at the extreme end, which are peculiarly larger than the other. The horny ring of larger tentacular suckers is smooth, but that of smaller suckers has numerous slender and blunt teeth closely set together along the whole margin (textfig. 165C); papillate area nearly like that of arm suckers.

Buccal membrane deeply wrinkled internally, with usual seven points, but two ventralmost of which are nearly rounded off, due to the swelling up of the part of the membrane where these points belong. Spermatic pad irregularly massive and wrinkled all over. The points of the margin have each one or two suckers except the two ventralmost which have no sucker. The horny ring of these suckers are like that of arm suckers.

Doasal surfaces of the head and body irregularly mottled with considerable number of ill-defined paler patches ranging from a quite minute size to a diameter of 5 mm. Besides these, there are above the body several crescentic paler streaks arranged in a longitudinal row within and parallel to a shining line which meanders weakly along the base of fins. In some places these and streaks protrude a little above the general surfaces. The interspaces between the spots and streaks of head and body as well as the dorsal surfaces of the arms are all deeply shaded with minute dark brown chromttophores. On the periphery of the dorsal surface of the mantle, the chromatophores group themselves into a series of two or three transverse stripes, but disappeared in ill preserved specimens. In good preservation a shining longitudinal line is also left along the dorsal surface of arms, extending proximally to above the head (textfig. 165A).



Textfig. 166.

Sepia formosana Berry. Shell of the largest specimen referred to, × ½.

Shell elliptical, broader than one-third of its own length, broadest near the middle, its anterior end bluntly pointed, while the posterior end is rounded and a little expanded, due to the great development of the outer done. Chitinons border rather broad, continuous even below the rostrum. Dorsal surface evenly convex, but there are developed two longitudinal grooves which define a faint median ridge between themselves; naked margin broad, its maximum breadth being a little broader than one-fifth that of the shell; calcareous rugosties of the median part in concentric line (textfig. 166A). Ventral surface convex anteriorly, concave posteriorly; median groove conspicuous and deep, but its extention is limited within the striated area. Rims of the inner cone which begin near middle of the lateral boundary ridge of striated area, are at first very thin, and lie quite flat on the outer cone but widen backwards, forming posteriorly a large flat, shield shaped callosity filling up the posterior hollow of the shell (textfig. 166B). Rostrum small. Locular index 31–38.

Measurements.

Sex	♀		♂	
Dorsal length of mantle	173 mm.		100 mm.	
Ventral length of mantle	156 ,,		92 ,,	
Breadth of body	88 ,,		60 ,,	
Length of head	47 ,,		22 ,,	
Breadth of head	60 ,,		41 ,,	
Maximum breadth of fins	20 ,,		13 ,,	
Length of first arms	Left 98 mm.	Right 90 mm.	Left 43 mm.	Right 43 mm.
,, ,, second arms	98 ,,	98 ,,	41 ,,	41 ,,
,, ,, third arms	98 ,,	92 ,,	41 ,,	41 ,,
,, ,, fourth arms	98 ,,	98 ,,	43 ,,	43 ,,
,, ,, tentacles	275 ,,	275 ,,	110 ,,	100 ,,
,, ,, clubs	48 ,,	48 ,,	28 ,,	28 ,,
Diameter of largest sucker of first arms	2.4 mm.		2.0 mm.	
,, ,, ,, ,, ,, second arms	2.4 ,,		2.0 ,,	
,, ,, ,, ,, ,, third arms	2.4 ,,		2.0 ,,	
,, ,, ,, ,, ,, fourth arms	2.3 ,,		2.0 ,,	
,, ,, ,, ,, ,, tentacles	7.0 ,,		4.0 ,,	
Maximum breadth of shell	63.0 ,,		39.0 ,,	
Maximum thickness of shell	16.0 ,,		9.0 ,,	
Length of rostrum	4.0 ,,		3.0 ,,	

Remarks.—The specimens examined disagree with the original description of the species, (1) by having patterns and tubercles on the back, and (2) by having narrower fins which are not continuous as described by Berry. These differences are, however, probably not specific, but are due to the different mode of preservation. The largest specimen, which is given in the above measurements is sexually fully mature, having the ripen eggs and large nidamental glands 67 mm. long. It is larger by ca. 100 mm. than the original specimen described by Berry and shows several differences from his description chiefly in respect to the relative length of various organs, which are probably attribulable to the different stage of growth. In this respect the agreement with the description is most satisfactory in medium-sized specimens examined. In still smaller specimens, whose mantle measuresb elow 60 mm. in length, the horny ring of both the arm- and tentacular suckers is distinctly dentate and not smooth as illustrated by Berry and also disagreeing with that of larger specimens now before me (textfig. 165 d and e).

Locality.—Takao, Formosa (Berry); Tainan market, Formosa (!); Akô market, Formosa (!), Pescadores Is. (!)

Sepia tigris sp. nov.

(Pl. XXVIII, figs. 13–16; textfig. 167.)

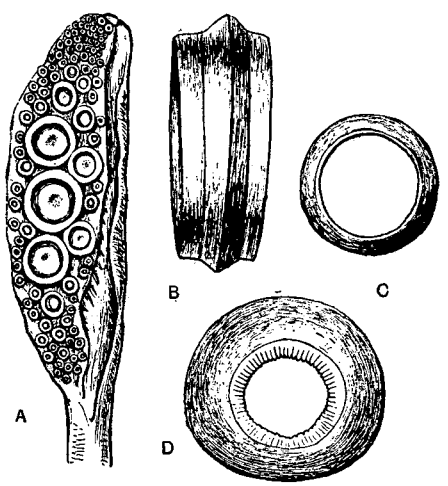
The species is fased on one mature male, which was purchased by Dr. Oshima at a fish market of Taihoku Formosa in March of 1921.

Body subelliptical, nearly parallel-sided half down the length, then tapering caudad so that the posterior half is an equilateral triangle in contour, and terminating posterior in a sharp spine; the maximum breadth about half the dorsal length. Dorsal margin of mantle is protruded over the head in a rounded projection, which occupies one-seventh of the dorsal length of the mantle; the ventral margin very weakly concave. Fins begin anteriorly within a few mm. of the mantle margin with

a little auriculate ends, traverse along the periphery of the body, and extend so far posteriorly as almost to touch with each other above the spine. They widen gradually posteriad at first, and attain their maximum two-thirds breadth down the length; hereafter they again narrow gradually cauded; the maximum breadth is a little greater one-fourth that of the body.

Head a little narrower than body and about one-fourth as long as it. Funnel large, extending just to the notch between the ventral arms. Funnel organ of ordinary structure, conposed of a Λ-shaped ventral pad and two oval dorsal pads. Funnel cartilage auriform, narrowed posteriorly, with a deep crescentic groove extending for the anterior two-thirds of the cartilage, and just ventral to the groove there is another elliptical desperession (Pl. XXVIII, fig. 16). Mantle cartilage composed of two crescentic ridges arranged closely side by side; the more external of the two is much largery -and far higher than the other.

Arms nearly equal but lateral pairs a little shorter than the others. All gradually taper toward the extremities which are peculiarly attenuated. Carination of arms, very weak except on the ventral pair which are markedly carinated. Protective membranes rather broad. Suckers of moderate size; and uniform for every arm quadriserial except on the attenuated extremities where they are biserial; horny ring smooth but under microscope showing many striations due to close approximation of parisaded teeth; in the distal suckers such teeth are better discernible and may be separated from one onother in places (textfig. 167b).



Textfig. 167.

Sepia tigris n. sp. A. Tentacular club, × ca⅔; B. horny ring from larger tentacular sucker, × 7; C. horny ring from most distal tentacular sucker, × 20; D. horny ring from distal arm sucker, × 36.

Left ventral arm hectocotylized at the part a little proximal to the middle. At the base there are about 3 quartets normal suckers, which are succeeded by about 6 quartets of minute suckers affected by hectocotylization. Beyond these the suckers regain normal dimensions.

Tentacles much longer than body and thinner than arms. Club expanded, occupying distal one-fifth of the tentacle; dorsal web extending proximally only a little beyond the most proximal sucker. Suckers about 100 in number, arrangned in eight series in the distal and proximal parts and about 5 series in the middle parts, greatly unequal, three in the middle being by far the largest, and the middle one of the three still exceed in size to the other two and is about three times in diameter the largest sucker of arms; and the sucker distal to these three and also that proximal as well as two or three just ventral are also fairly large, yet only ½–⅔ as large in diameter as the largest one (textfig. 167a). Horny ring entire in all suckers and with a characteristic hoop-like ridge along the periphery (Textfig. 169b and c).

Buccal membrane with seven ribs projecting beyond the margin; the ribs may have a small sucker at the extremity.

Dorsal surfaces of body, head and arms all embellished with distinct transverse stripes of iridescent rustre. The stripes are thick on the pertphery of body as well as on the arms while they are very fine and numerous at the anterior and central parts of body as well as above the head. Along the base of fins there is a longitudinal line of similar nature as the stripes (Pl. XXVIII, fig. 13).

The interspaces between the stripes or line are thickly covered with miuute deep brown chromatophores which are most closely crowded in the central parts of the body and head. The ventral surface of the cuttlefish is also dotted with similar chromatophores but in much rarer distribution than on the dorsal surface.

Shell longly elliptical, the broadest part being a little before the middle, the anterior and posterior ends parabolic with a nearly similar curvature; the maximum breadth one-third the length.

Dorsal surface convex, the convexity becoming greater posteriad; and there are in the middle

parts three low longitudinal ridges diverging anteriod. Calc tubercles tend to run together in concentric lines. Naked area broadest a little before the middle when it attains one-fifth the breadth of the shell (Pl. XXVIII, fig. 14). Ventral surface convex anteriorly and concave posteriorly. Striated area with a ∧-shaped anterior boundary line and a broad median longitudinal groove, bordered by a ridge-like rim of the inner cone on each side. The posterior concavity of the shell is totally filled up by a broad shield-shaped callosity with a little concave polished surface.

The anterior horns of the callosity projects forwards about ⅕ the way forward of the shell and cover over the lateral rim of the inner cone (Pl. XXVIII. fig. 15). The auterior margin of the callosity is very thin and sharply edged while the posterior end is thick and more or less rounded.

Rostrum short. Locular index 21.

Measurements.

Dorsal length of mantle	210	mm.
Ventral length of mantle	180	„
Maximum breadth of mantle	110	„
Dorsal projection of mantle	30	„
Length, of head	50	„
Breadth of head	75	„
Breadth of fins at their anterior part	12	„
„ „ „ „ „ middle part	20	„
„ „ „ „ „ posterior part	30	„
Mantle extent before fins	2	„

	Left	Right
Length of first arms	—mm.	140 mm.
„ „ second arms	— „	130 „
„ „ third arms	135 „	130 „
„ „ fourth arms	145 „	145 „
„ „ tentacles	340 „	360 „
„ „ clubs	65 „	65 „

Diameter of largest sucker of first arms	3	mm.
„ „ „ „ „ second arms	3	„
„ „ „ „ „ third arms	3	„
„ „ „ „ „ fourth arms	2.5	„
„ „ „ „ „ tentacles	9	„
Breadth of shell	68	„
Maximum thickness of shell	18	„
Length of callosity at the posterior hollow	25	„
Length of rostrum	5	„
Length of last loculus	40	„
Length index	21	„

Remarks.—The species is closely related to *S. formosana* Berry, but differs from it as tabulated below.

	Sepia tigris.	*Sepia formosana.*
Body:	Acuminated behind;	rather blunt behind.
Surface ornamentation of the back:	Numerous stripes of shining lustre which run mostly cross-wise but may meander in various directions in places;	Numerous ill-defined blotches of various sizes which may be thrown into tubercles.

	Sepia tigris.	*Sepia formosana.*
Arms:	with peculiarly attenuated extremities;	evenly and normally thins off towards the extremities.
Shell:	one-third as broad as long, and a little acuminated in both ends;	broader than one-third of its own breadth, and rounded in both ends.
Callosity of the posterior concavity of the shell:	with concave surface and short anterior horns;	with convex surface and long anteiror horns.

Type locality.—Taihoku market, Formosa.
Type.—Deposited in Formosan Mus.

Sepia aculeata Van Hasselt, 1834.

Formosan dialect: Basser (目賊).

(Pl. XVI, fig. 12.; textfigs. 102, 103.)

Sepia aculeata Van Hasselt MS., in d'Orb. et Fér. 1834, p. 287, Seiches, pls. v, xxv.—d'Orb. 1845, p. 296.—Gray, 1849, p. 105.—Steenstrup 1875, p. 473, pl. ii, fig. 4.—Tryon 1879, p. 195, pl. xc, fig. 415; pl. xci, figs. 416, 417.—Goodrish 1896, p. 3.—Joubin 1898b, p. 25.—Wülker 1910, p. 11; 1913, p. 455—Berry 1912b, p. 418.—Massy 1916a, p. 223.

List of specimens examined

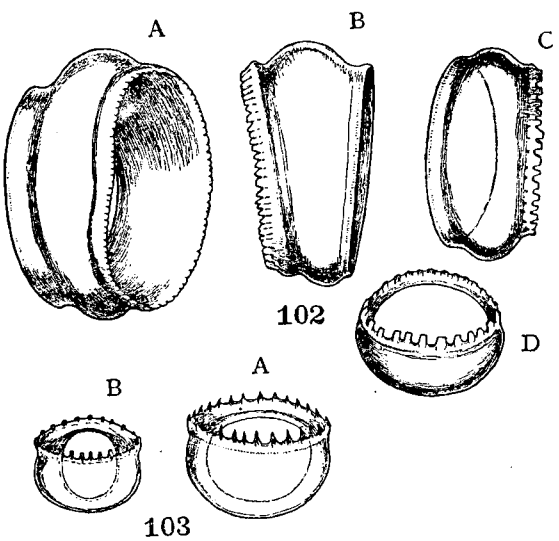
i. One female, from Hainan Island, China (preserved in Tokyo Imp. Univ.)
ii. One male and female, and one juv. obtained by Dr. M. Oshima at Tainan market, Formosa, April 15, 1920 (male: preserved in Formosan Mus.; female: in Hokkaido Imp. Univ.).
iii. One juv. collected by the same collector at Ako, Formosa, April 20, 1920. (deposited in Hok. Imp. Univ.).
iv. One juv. collected by the same collector at the Pescadores Is. July 5, 1920 (deposited in Hok. Imp. Univ.).

Mantle ovate in contour, about half as broad as long, widest about one-third the length from the anterior margin, somewhat pointed behind. Dorsal projection of mantle margin rounded at spex whence it sweeps down on either side outwards and backwards; length about one-tenth the entire length of mantle. Ventral magrin evenly concave, without forming any lateral projections. Fins begin very near the mantle margin, and run backwards along the dorso-lateral aspect of the mantle as is usual in the Sepiidae, extending to whithin a few mm. of each other behind. They are rather narrow in the anterior parts but become wider as they traverse backwards, attaining in the posterior parts their maximum breadth, which is about one-fourth that of the mantle. The posterior part is neither specially expanded nor thickened as in *S. misakiensis* Wülker.

Head a little narrower than mantle margin, about one-fifth as long as the dorsal side of mantle. Funnel conical, rather large, but not extending to ventral interbrachial space. Funnel valve pointed at tip. Dorsal pad of funnel organ crescent-shaped, consisting of a fillet decidedly broader than ventral pads which are conspicuous and pyriform. Umbrella best developed between lateral arms, where it extends to the third row of suckers; between the ventral arms it is quite rudimentary as usual.

Arms subequal, the formula of length being $4>3>2>1$ or $4\fallingdotseq3>2\fallingdotseq1$; where the longest on in the male is much longer, and in the female, decidedly shorter, than half the dorsal length of mantle; thickness directly proportional with the length. All taper regularly distad; first pair rounded on back, without keel; the remaining pairs more or less flattened dorso-ventrally, especially the fourth, which is furnished with a marked keel on the outer side. Protective membranes of moderate breadth in all arms.

Arm-suckers almost quadriserial, counting about 40 quartets in the first arm, about 45 quartets in the second, about 50 quartets in the third, and about 55 quartets in the fourth. They differ sexually in size and shape: larger and more roundish, and the aperture is relatively smaller, in male than in female. In either sex, however, the suckers of the ventral arems are a little smaller than those of the remaining arms which are about uniform. Horny ring smooth apparently, but when carefully examined under microscope its margin shows numerous palisaded teeth fused up into a continuous plate. In the female the teeth are more or less separate, especially in smaller distal suckers (textfig. 102), Papillate area consists of numerous, minute facetts arranged in several series, each facett with a relatively large, but short, papilla at the centre.



Textfig. 102.

Sepia aculeata. Horny rings of arm-suckers; ×47. A. From basalmost sucker. B. From one of suckers of tenth row. C. From one of suckers of fifteenth row. D. From one of suckers of twenty-seventh row.

Textfig. 103.

Sepia aculeata. Horny rings of tentacular suckers; ×53. A. From one of larger suckers. B. From one of carpal suckers.

Left ventral arm hectocotylized in a subbasal part. Three or four quartets of normal suckers on the extreme base are succeeded on the ventral side of the arm by about five pairs of minute abnormal suckers. The corresponding suckers of the dorsal side have almost disappeared, rendering the surface of the arm naked and smooth. Beyond these, the suckers regain their normal dimension,

Tentacles slender, far thinner than arms, and a little longer than twice the length of mantle. Club a little expanded, elongated, comprising distal 1/5–1/7 of the tentacle; dorsal web rather narrow but a little widening towards the distal end of club. Suckers equally minute, attaining a diameter of one-fourth that of the largest arm-sucker; exceedingly numerous, being over 500 in number, arranged in a slanting series of 12 or more in a row. Horny ring with 20–26, seporate teeth set at equal intervals on the whole margin (textfig. 103).

Buccal membrane with ordinary seven points of margin, each of which bears a few minute suckers with a horny ring quite like that of arm suckers.

The dorsal surface of the mantle is decorated with numerous fine transverse stripes. They meander especially in the middle region so as to cross one another, weaving themselves into a thick network. A marginal shining streak runs along the whole extent of fins. Arms are also furnished on the back with a longitudinal shining streak which extends backwards to the central region of the head.

Shell elliptical in outline, widest near the middle, and about two and a half times the maximum breadth of its own; posterior end rounded and very slightly expanded, while the anterior end is bluntly angular (Pl. XVI, fig. 12). Border of shell wide, especially at the posterior part due to the great development of outer cone; chitinous margin uninterrupted even under rostrum. Dorsal surface convex, with three longitudinal ridges defined by four grooves; bordered around with a narrow naked margin; calcareous deposition thick, its coarser rugosities forming concentric lines. Ventral surface gently and evenly convex in the middle region, without forming any median groove. Inner cone markedly developed; its limbs arising one-third the length shell from the posterior end, at first thin, and lying flat on the outer cone, but becoming thicker and very prominent afterwards so that it forms a broad, stout border for the deep posterior hollow of the shell. Anterior edge of the border, sharp. Striated area flat at the middle, marked off from last loculus by M-shaped line. Locular index 43. Rostrum long and stout.

Measurements of mature Male and Female from Formosa.

Sex	♀		♂	
Dorsal length of mantle	160 mm.		175 mm.	
Ventral length of mantle	150 ,,		160 ,,	
Breadth of body	83 ,,		85 ,,	
Length of head	50 ,,		50 ,,	
Breadth of head	50 ,,		61 ,,	
Fin breadth at the anterior part	Left 22 mm.	Right 19 mm.	Left 18 mm.	Right 19 mm.
,, ,, ,, ,, middle	20 ,,	19 ,,	20 ,,	20 ,,
,, ,, ,, ,, posterior part	20 ,,	19 ,,	21 ,,	20 ,,
Maximum breadth of fins	22 ,,	19 ,,	21 ,,	20 ,,
Mantle extent before fins	3 ,,	0 ,,	9 ,,	4 ,,
Length of first arms	105 ,,	105 ,,	75 ,,	73 ,,
,, ,, second arms	103 ,,	198 ,,	82 ,,	80 ,,
,, ,, third arms	103 ,,	195 ,,	82 ,,	82 ,,
,, ,, fourth arms	118 ,,	125 ,,	84 ,,	87 ,,
,, ,, tentacles	368 ,,	390 ,,	290 ,,	310 ,,
,, ,, clubs	55 ,,	57 ,,	63 ,,	65 ,,
Diameter of largest sucker of first arms	2.5 mm.		1.8 mm.	
,, ,, ,, ,, ,, second arms	2.5 ,,		1.8 ,,	
,, ,, ,, ,, ,, third arms	2.4 ,,		1.8 ,,	
,, ,, ,, ,, ,, fourth arms	2.3 ,,		1.5 ,,	
,, ,, ,, ,, ,, tentacles	0.7 ,,		0.7 ,,	
Length of rostrum of shell	6.0 ,,		4.0 ,,	
Maximum breadth of shell	55.0 ,,		62.0 ,,	
Maximum thickness of shell	14.0 ,,		15.0 ,,	
Length of last loculus of shell	25.0 ,,		25.0 ,,	
Locular index	16.0 ,,		14.0 ,,	

Remarks.—In the mature female alluded to, the spermatic peds were developed at the ventral part of the buccal membrane. They were longly spindle-shaped, were arranged side by side, and had a minute aperture near their distal end, whereabout several spermatophores were fixed to the integument.

Wülker and Berry list this species among the Japanese fauna of cephalopods, based upon specimens from Misaki and Tsuruga respectively. The actual existence of the species in such northern waters of Japan is, however, doubtful to me since the species may be casily confound with *S. subaculeata* Sasaki, which is not rare in these parts of Japan.

Locality:—? Misaki (Wülker); ?Tsuruga, Echizen Prov. (Wülker); Tainan market, Formosa (!); Ako, Formosa (!); Hainan I., China (!); Indian Ocean (Van Hasselt); Java (Van Hasselt); St. Vincent (Joubin); Irawaddy delta (Goodrish); Port Blair (Goodrich); Andaman Sea (Goodrich); Bohama (Joubin); Nassau harbor (Joubin); near Aru J. (Wülker).

Sepia subaculeata Sasaki, 1914.

(Pl. XVI, figs. 13, 14; Pl. XVII, fig. 1; textfig. 104.)

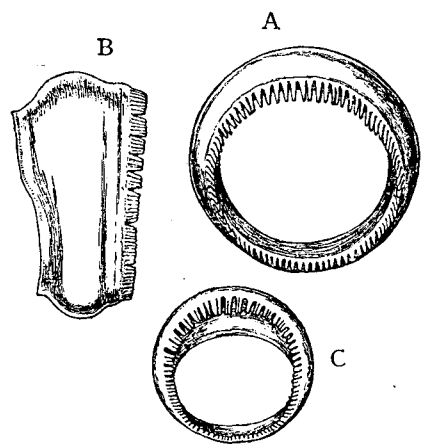
Sepia subaculeata, Sasaki 1914, p. 609, pl. xii, figs. 6, 7.

This species is represented by eighteen specimens in the collections at my disposal. They measure up to 215 mm. in mantle length.

Body roughtly elliptical in contour, about half as broad as long, broadest near the middle, rapidly tapered behind ; thickwalled (Pl. XVII, fig. 1) Ventral margin of mantle very weakly emarginated in the middle ; dorsal margin projecting in the middle into a round-tipped robe comprizing about one-seventh the dorsal length of mantle, markedly emarginated crescentwise on either side.

Fins comparatively broad, their maximum breadth only a little less than a quarter of the mantle breadth, extending to within a few mm. of mantle margin in front and coming almost to contact with each other posteriorly.

Arms subequal, the formula of length being $4>1>2\fallingdotseq3$; the longest about two-fifths the mantle length. All compressed laterally, and more or less keeled on back, especially the ventral arm, which is by far the thickest, the ventral aspect being triangular in contour. Protective membranes broad, uniform, trabeculate. Suckers distinctly quadriserial throughout. Horny ring in proximal suckers apparently smooth, but this is rendered by the close union of innumerable, slender teeth, so that the margin shows sometimes an uneven contour. Similar teeth are found also in distal suckers, but here they are distinctly separated (textfig. 104).



Textfig. 104.

Sepia subaculeata. Horny rinsg from arm-suckers of male specimen fo 180 mm. mantle-length. A. From one of middle suckers of third arm; ×23. B. From one of sub-terminal suckers; ×27.

Left ventral arm hectocotylized at the part a little distal to the base (Pl. XVI, fig. 13). The suckers on this arm are normal up to the sixth row, and the four succeeding rows, which are in the hectocotylized part, are much reduced in size. Beyond these, the suckers quite regain their normal dimensions.

Tentacles as long as, or even a little longer than, head and body taken together. Stem a little thinner than first arm, its aboral surface rounded or bluntly edged along the median line; oral surface flat, or even slightly concave, clearly marked off by folds on sides. Club flattened and a little expanded, occupying about one-fifth of the entire length of tentacle. Dorsal web of moderate breadth begins at the level of the first sucker and extends to within a few mm. of the distal end of club, very gradually widening towards the same end.

Tentacular suckers number 200–250, small, nearly uniform but those of the middle part of club are larger than the others, and a little greater than half the diameter of largest arm-suckers. They are arranged in about eight series at the middle part of club, but in 10–12 series at both the proximal and distal parts. Horny ring dentate on the whole margin, the teeth being slender and truncate in proximal suckers but acuminate in the others ; they number about 80 in a larger sucker.

Buccal membrane with the usual seven marginal projections bearing one or two minute suckers each.

Dorsal surface of mantle in alcohol deep brown, marked with numerous, transverse, wavy, shining stripes of lighter greenish or bluish hue, and about 50, transverse-fusiform patterns distributed evenly, but not quite regularly. Further, a silvery line runs along the base of each fin.

Shell slenderly elliptical in outline, widest near the middle, a little blunter posteriorly than anteriorly, with a well developed outer cone giving the posterior end the blunter contour (Pl. XVI, fig. 14). Length of shell a little less than three times the breadth. Dorsal surface moderately and evenly convex except for a very faint median ridge running throughout the length; naked area narrow; calcareous rugosities arranged in lines of nearly concentric arrangement. Ventral surface convex in the middle, but provided with a conspicuous median groove, the deepest part of which is in the anterior part of the striated area. This area marked off anteriorly by two straight lines meeting at an acute angle. Inner cone well developed, with a conspicuous V-shaped rim, which begins one-third the length of shell from the posterior end, becoming regularly thicker posteriad and encloses a deep roughly conical posterior hollow of shell. The rim is not apressed on the outer cone nor sharply edged as in *S. aculeata* but stands out, separated from the outer cone and rounded at edge. Locular index about

34, but may be much less. Rostrum small, measuring only 3 mm. in the largest specimen examined.

For the measurements the reader is referred to one of my previous papers (1904, p. 610).

Remarks.—This species is very near *S. aculeata*, but differs from it principally in the tentacular suckers and in the shell. It is rather common in the middle and southern parts of Japan where it is caught for the market; the dried commercial articles belong to what is called "Kôtsuki-zurume" by the traders.

Locality.—Tôkyo market (Sasaki); Awa Prov. (!); Tokushima Prefecture (!); Hizen Prov. (!); Miyazuki Prefecture (!).

Type locality.—Tôkyo market.

Type. In Tôkyo Imp. Univ.

Sepia esculenta Hoyle, 1885.

Japanese name: Kôika (Tôkyo; Sagami Prov.); Kaika (Etchû Prov.).

(Pl. I, fig. 5; Pl. XVI, figs. 15–17.)

Sepia esculenta, Hoyle 1885b, p. 188; 1885d, p. 291; 1886b, p. 129, pl. xvii, figs. 1–5; pl. xviii, figs. 1–6.—Appelöf 1886, p. 28, pl. iii, figs. 1–6.—Ortmann 1888, p. 649.—Joubin 1897b, p. 102.—Pilsbry 1895, p. 2.—Hedley 1906, p. 463.—Berry 1912b, p. 418.—Sasaki 1914, p. 611; 1920, p. 191.—Massy 1916a, p. 225.

? Sepia hoylei, Ortmann 1888, p. 650, pl. xxii, fig. 5, pl. xxiii, fig. 1.

Thirty-two specimens of this species are found in the collections at my disposal, measureing up to 175 mm. in mantle length.

Body roughly ovate in contour, but more or less conical behind, the maximum breadth a little greater than half the dorsal length, existing near the middle. Ventral margin of mantle slightly emarginated while the dorsal margin protrudes in a triangular lobe about one-seventh as long as the mantle. Fins 1/6–1/5 as broad as body, extending to within several mm. of mantle margin in front as well as of each other behind, and becoming a little wider posteriad.

Head broad, about as wide as mantle opening. Funnel of moderate size, extending slightly less than to the angle between ventral arms. Umbrella badly developed, extending to fourth to sixth row of suckers except between ventral arms where its rudimentary condition is none the less as usual.

Arms subequal, the formula of length usually being $4>1>3>2$ or $4>1>2>3$; the longest a little longer than half the dorsal length of mantle. All more or less flattened laterally especially the ventral pair which has a conspicuous keel along the aboral surface. Protective membranes of moderate breadth and feebly trabeculate. Suckers clearly quadriserial throughout, nearly uniform, but very gradually decreasing in size towards the extremity of arms. Horny ring in proximal suckers, with an entire margin formed of innumerable, slender, truncate teeth tightly fused together so that the extreme edge often shows uneven contour. In distal suckers the teeth are separated from one another on the distal edge of the ring, but still often remain fused on the proximal edge; the separated distal teeth in these suckers are elongated or equarish, numbering 10–20.

Left ventral arm hectocotylized as is usual in the genus, the affected part situated much nearer to the base than to the extremity. The suckers on this arm are normal up to the fourth or fifth row; the succeeding two rows are somewhat reduced in size, followed by about four rows of rudimentary ones which are on the hectocotylized part. Beyond these, the suckers regain their normal condition.

Tentacles variable in length, but in good specimens, usually as long as head and body taken together. Stem a little thinner than arms; aboral surface rounded, and oral surface flat, bordered with folds on sides. Club flattened, expanded into crescentic or semicircular contour, occupying about one-eighth of tentacle. Dorsal web of moderate breadth begins on the level of the proximalmost sucker, extending to within a few mm. of the extreme tip of club and gradually widens distad. Sockers small, uniform, apparentry in about ten series but numbering about sixteen in an obliquely transverse row. Horny ring dentate along the whole margin, the teeth numbering 30–40, blunt, as wide as interdental spaces.

Buccal membrane with seven, sucker-less projections of margin, but the ventral two of these are quite rounded off in the female. In the adult of the same sex these developes on the ventral part of the membrane a conspicuous ovoidal sperm pad (Pl. XVI, fig. 15), which is smooth on the distal part and deeply wrinkled at base, containing a pair of pinnate seminal receptacles.

Spermatophores about 17mm. long, constructed as shown in Pl. XVI, fig. 16.

Dorsal surface of mantle in life thickly striped with numerous chocorate brown transverse lines of various thickness, and sparsely dotted with minute yellowish tubercles. A silvery line marks the boundary between the fin and mantle on either side. Just within the line are found several streak-like yellowish tubercles arranged in a longitudinal series.

Shell broad, $^1/_3$–$^2/_5$ as wide as long, elliptical, but less blunter anteriorly than posteriorly where it is specially a littre expanded, due to the great development of the outer cone (Pl. XVI, fig. 17). Dorsal surface arched in the posterior part and nearly flat in the anterior, covered with numerous calcareous rugosities in nearly concentric lines except on the naked margin, of which the maximum breadth is one-seventh that of the whole shell. Median longitudinal region of the surface elevated into a ridge marked off by shallow grooves on sides. Ventral surface is subject to individual variations, ranging from a condition prominently elevated in the middle and deeply furrowed along the median line to the other much less elevated and faintly furrowed. In the former case, the striated area is marked off anteriorly by V-shaped line and the locular index is 25–40 while in the latter case the boundary line of the striated area is nearly arched and not pointed in the middle, and the index 15–23. The former case occurs in the slender form of shell, but the latter is met with in the shorter form quite independent of the age or the sex of the animal.

Inner cone of shell rather well developed. The rim starts about one-fourth the length of shell from its posterior end, gradually becoming wider caudad, but is thin throughout and apressed on the outer cone except in the posterior end where it is separate from that cone, forming a thin, crescentic shelf-like border overhanging the posterior hollow of shell.

Measurements of largest Specimen (Male) Examined.

Dorsal length of mantle	175mm.	
Ventral length of mantle	145 „	
Maximum breadth of mantle	95 „	
Maximum breadth of head	60 „	
	Left	Right
Mantle extent before fins	6mm.	3mm.
Maximum breadth of fins	18 „	18 „
Length of first arms	77 „	77 „
„ „ second arms	76 „	76 „
„ „ third arms	75 „	75 „
„ „ fourth arms	80 „	78 „
„ „ tentacles	210 „	215 „
Diameter of largest arm-sucker	2mm.	

Remarks.—The specimens examined by me so well agree with Hoyle's description of the species that there is no doubt as to their identity. Some younger specimens examined by me very well agree with the original description of *Sepia hoylei* given by Ortmann, so I am greatly inclined to consider this species to be identical with *S. esculenta*. The species is one of the commonest Sepia found in the middle part of Japan, being especially abandunt on the coast of the Pacific side, where it is caught in plenty for the market.

Locality.—Etchû Prov. (Sasaki); Noto Pininsula (!); Tango Prov. (Sasaki); Tôkyo market (Sasaki); Tôkyo Bay (Ortmann); Tôkyo (Berry); Haneda, Musashi Prov. (Sasaki); Yokohama market (Hoyle); Yokohama (Pilsbry); Izu Prov. (!); Ise Prov. (Sasaki); Tsuruga, Tango Prov. (Albatross!); near Tokushima (!); Bingo Prov. (Sasaki); Moji (Massy); Higo Prov. (Sasaki); Tosa Prov. (!). Queensland (Hedley).

Sepia hercules Pilsbry, 1894.

Japanese name : *Kobushimé* (Loochoo Is. & Kagoshima).

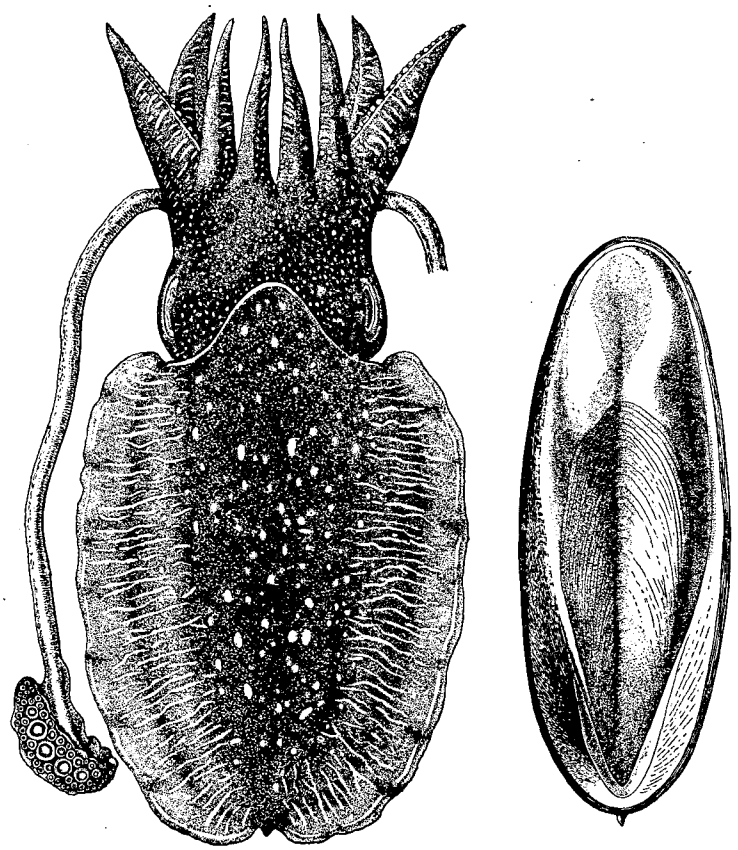
(Textfigs. 158, 169.)

Sepia hercules, Pilsbry 1894, p. 144; 1895, p. 2, pl. i, figs. 1, 2.—Berry 1912b, p. 419.—Sasaki 1914. p. 612.

? Sepia latimanus d'Orb. et Fér, 1839, p. 283, Seiches Pl. xii, figs. 1–6, Pl. xvii, figs. 16, 17.

One shell and three complete specimens have been at my disposal.

Body ovate in contour ⅗–⅔ broad and long, flattened dorso-ventrally, widest a little before the middle and terminating behind in an acute point. Anterior margin of mantle slightly excavated below and projecting above in a rounded lobe which occupies ⅕–⅙ of the dorsol length of the mantle (textfig. 168).



Textfig. 168.

Sepia hercules Pilsbry. Female specimen from Loochoo (×¼) and its shell.

Fins peripheral as usual, beginning very near the anterior margin of mantle and proceding caudad along its lateral margin, approach within few mm. of each other behind; their anterior ends auriculate but not the posterior. They widen very gradually backwards, attaining their maximum breadth some distance behind the middle, whence they again narrow a little towards the posterior end. The broadest part measures about ¼–⅓ the breadth of the mantle.

Head large, somewhat flattened dorso-ventrally, only a little narrower than mantle-opening, Umbrella fairly well developed, extending to the eighth or ninth row of suckers, but between the ventral pair it is rudimentary.

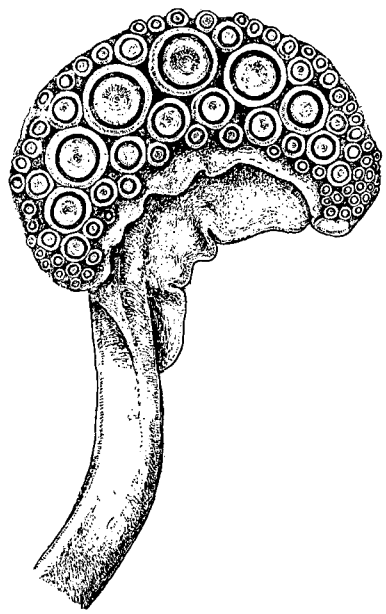
Funnel relatively large, extending near the space between the ventral armes. Funnel cartilage auriform, narrowed posteriorly; lock-groove <-shaped, extending for the anterior two-thirds of the cartilage. The groove is deepest in the middle, but it does not form any specially deepened pit. Funnel organ and valve, of ordinary shape.

Buccal membrane slightly wrinkled; ribs seven in number as usual, projecting beyond the margin in acute points, which have no suckers. Outer lip thin and smooth; inner lip thick and papillate.

Arms subequal, the formula of length being 4>3>2>1; the longest a little longer than half the dorsal length of mantle. All taper gradually and evenly towards the extremities. First and second pairs rounded on back. Third pair roughly quadrangular, the aboral surface marked off in the ventral side by a sharp edge. Fourth pair somewhat flattened dorso-ventrally, with a marked crination on back. Protective membranes of moderate breadth, and equal in all arms.

Suckers of sessile arms, distinctly quadriserial, arranged in 60 or more oblique rows. They in-

crease in size, toward the middle of the arm, where several rows of subkers are equally largest; thence they become gradually smaller towards the extremities. Horny ring of proximal suckers smooth, but by magnification there are discernible numerous slender blunt teeth tightly fused together into a continuous plate. In the distal suckers the teeth are well defined and are often separated from one another into distinct teeth. Papillate area consists of 30 or more oblique rows of minute plates with a large blunt papilla each.



Textfig. 169.

Sepia hercules Pilsbry. Right tentacular club of a female of 370 mm. mantle lenght, × ⅔.

Tentacles in extended state as long as head and body taken together; stem a little thinner than arms. Club about one-eighth the entire length of the tentacle, expanded, cresentic or reniform; sucker-bearing surface completely surrounded by a pliant free margin, the proximal part of which forms a deeply auriculate lobe fixed by a ligament to the stem. Dorsal web broad, extending from the tip to some distance below the sucker-bearing surface.

Tentacular suckers about 85 in number, arranged in about five longitudinal rows. They are greatly unequal in size, those of the middle row being the largest; especially large are three or four at the middle of the row, being five or six times larger in diameter, than the marginal suckers. The next largest suckers are in the row next dorsal as well as in that next ventral, to the above mentioned row, attaining a diameter of two to four times that of the marginal suckers. Horny ring quite smooth in any sucker; papillate area much like that of arm suckers.

In preserved specimens the dorsal surface of the mantle is purplish brown, which deepens into deep sepia at the central region. On this region there are scattered about 100 roundish longitudinal-ovate or elliptical, shining sports, which range up to 15 mm. in the longest diameter in the largest specimen examined. On the periphery of the dorsal surface the spots are replaced by numerous transverse stripes, which become thinner toward the fins, terminating in dotted lines. Besides these, the fin is embellished by a distinct shining line along the whole margin. The dorsal surface of the head has also numerous shining spots. But these spots are all roundish, of nearly equal size, and are as large as the smallest spot of the mantle. Similar spots are also found on the proximal part of the sessile arms, but on the distal part they are replaced by transverse stripes.

Shell elliptical, about two-fifths as broad as long, widest near the middle, nicely parabolic at both the ends, bordered around with chitinous margin, which is continuous beneath the rostrum (textfig. 168). Dorsal surface evenly convex, with no groove nor ridge but covered with coarse chalcareous tubercles arranged in concentric lines. Naked area very narrow, measuring only one-fifteenth the maximum breadth of the shell. Ventral surface convex anteriorly, concave posteriorly; striated area traversed along the median longitudinal line by a distinct groove, which is deepest near the anterior boundary line. Inner cone V-shaped, its rim relatively broad but is flattened and lines flat upon the broad magin of the shell so that it forms no marked ridge as to enclose the posterior concavity. Rostrum thick but short, conical.

Measurements.

No. of specimen	i	ii	iii
Locality	Loochoo	Loochoo	Oshima
Sex	♀	♂	Juv.
Dorsal length of mantle	370 mm.	260 mm.	165 mm.
Ventral length of mantle	270 ,,	215 ,,	140 ,,
Maximum breadth of mantle	200 ,,	150 ,,	95 ,,

No. of specimen	i	ii	iii
Locality	Loochoo	Loochoo	Oshima
Sex	♀	♂	Juv.
Dorsal projection of mantle	75 mm.	50 mm.	25 mm.
Breadth of head	150 ,,	110 ,,	60 ,,
Length of head	130 ,,	80 ,,	60 ,,
Breadth of fins at its anterior part	42 ,,	38 ,,	15 ,,
Breadth of fins at its posterior part	55 ,,	42 ,,	20 ,,
Mantle extent before fins	Left 7 mm. Right 7 mm.	Left 7 mm. Right 7 mm.	Left 3 mm. Right 5 mm.
Length of first arms	160 ,, 160 ,,	135 ,, 135 ,,	75 ,, 80 ,,
,, ,, second arms	170 ,, 170 ,,	145 ,, —	80 ,, 80 ,,
,, ,, third arms	180 ,, 180 ,,	150 ,, 150 ,,	80 ,, 80 ,,
,, ,, fourth arms	200 ,, 200 ,,	175 ,, 175 ,,	80 ,, 80 ,,
,, ,, tentacles	400 ,, 400 ,,	— —	— —
,, ,, tentacles club	80 ,, 80 ,,	— —	— —
Diameter of largest arm sucker	5.2 mm.	4.3 mm.	2.0 mm.
,, ,, ,, tentacular sucker	13.0 ,,	—	—
Length of shell	370 ,,	260 ,,	165 ,,
Breadth of shell	130 ,,	100 ,,	56 ,,
Thickness of shell	50 ,,	32 ,,	20 ,,
Length of last loculus	120 ,,	95 ,,	60 ,,
Length of rostrum	17 ,,	12 ,,	7 ,,

Remarks.—Pilsbry erected the species with an incomplete shell and no soft part of the animal has hitherto been known. Now examining the complete specimens, I am greatly inclined to consider the species to be synonym with *Sepia latimanus* d'Orbigny and Férrusac. The only notable diffence consists in the dosal patterns of the animal. *S. latimanus* has no shining spot nor strip on the dorsal surfaces like the specimens referred to which difference may occur, however, very often in Sepia due to the different preservation.

In the Loochoo Island and also in Oshima of the prefecture of Kagoshima, the species is rather common particularly in May and June when it spawns on sea weeds. Fishermen fish it for the market with a harpoon or a stake net. The specimens whose measurements are given above I have obtained also from these localities through the kindness of my former assistant, Mr. K. Makino. As mentioned in one of my previous papers, Late Mr. K. Aoki collected a shell of this species in the neighbourhood of Misaki, a locality far distant from the said islands. Its surface is greatly worn and is beset with groups of Lepas, which suggests its long floating on the warmer current coming from the south.

Locality.—Loochoo Is. (Pilsbry); Nawa, Loochoo Is. (!); Oshima, Kagoshima Pref. (!); Misaki (Sasaki).

Sepia robsoni sp. nov.

(Pl. XVII, figs. 2, 3.)

Sepia elliptica, Wülker 1910, p. 11?—Berry 1912b, p. 419?—Sasaki 1914, p. 612, pl. xi, figs. 11, 12, 1920, p. 192.

There have been at my disposal eighteen specimens of this species collected at several different localities as listed later.

Body short, a little broader than a half of its own length, roughly ovate in contour, widest near the middle or a little more anteriorly, terminating very bluntly behind (Pl. XVII, fig. 2). Mantle

margin faintly emarginated in the ventral part but dorsally projecting over head in a broad, bluntly pointed, triangular lobe occupying 1/8–1/9 of the dorsal length of mantle. Fins about one-fifth the mantle breadth, extending to 2–6mm. from mantle margin in front and to 2–4mm. from each other behind, where they are normal and not lobed.

Head as wide as mantle-opening, much contracted into mantle cavity. Funnel conical, extending less than to the angle between ventral arms. Umbrella very narrow, extending only to third or fourth row of suckers but quite rudimentary between ventral arms as usual.

Arms subequal, the formula of length being $4 \fallingdotseq 1 > 2 > 3$ or $4 \fallingdotseq 1 > 3 > 2$; the longest a little less than one-third the dorsal length of mantle. First and second pairs nearly rounded on back while the third and fourth are a little flattened, keeled along the aboral surface. The keel especially well developed in fourth pair. Suckers quadriserial except at the extremity where they may be biserial. Horny ring in proximal suckers smooth save for a few sinuations of margin, while in the distal suckers it is dentate on the distal margin.

Middle one-third of left ventral arm hectocotylized, bearing 8–10 transverse rows of rudimentary suckers, of which those of the two dorsal series are again more reduced in size. Except these rudimentary ones the suckers are quite normal and number about six rows more proximally than the hectocotylized part.

Tentacles about as long as body. Stem equal to first arm in thickness, its oral surface flattened as usual. Club flattened, expanded, semicircular or crescent-shaped, occupying about one-eighth of tentacle; dorsal web of moderate breadth throughout, beginning at carpus below first sucker. Suckers far smaller than those of arms, nearly uniform, apparently in 8–10 series but numbering about sixteen in an oblique-transverse row. Horny ring dentate on the whole margin, the teeth numbering about twenty in each ring, somewhat unequal, being a little longer on the distal margin than on the proximal.

Buccal membrane with the usual seven marginal projections, but in the female the ventral two of these are nearly rounded off. In the adult of the same sex the ventral part of the membrane has a pair of rounded spermatic pads.

Shell broad, ovo-lanceolate, being somewhat acuminate in the anterior end, but the posterior end is rounded and a little expanded due to the spacious extention of the outer cone (Pl. XVI, fig. 3). Chitinous margin narrow, but uninterrupted even below rostrum. Dorsal surface nearly flattened in the anterior part and convex in the posterior, furnished with three, faint, longitudinal, ridges defined by four shallow grooves; naked area much narrowed in both anterior and posterier regions. Calcareous rugosities arranged in lines nearly parallel to the anterior border of shell. Ventral surface convex in the anterior part, and concave in the posterior, with nearly flat striated area, and a faint groove running along the median line. Anterior end of striated area obtusely angular or truncated or arched. Inner cone poorly developed, consisting of thin, V-shaped rim evenly bordering the striated area. Locular index 30–35. Rostrum of moderate size, turning posteriad but may be curved in various directions.

Measurements of largest Male and Female Examined.

No. of specimen	i		ii	
Sex	♂		♀	
Dorsal length of mantle	76 mm.		83 mm.	
Ventral length of mantle	67 ,,		74 ,,	
Maximum breadth of mantle	37 ,,		43 ,,	
Maximum breadth of head	35 ,,		36 ,,	
Mantle extent before fins	Left 5 mm.	Right 6 mm.	Left 1 mm.	Right 2 mm.
Maximum breath of fins	7 ,,	8 ,,	9 ,,	9 ,,

No. of specimen	i		ii	
Sex	♂		♀	
Length of first arms	Left 30 mm.	Right 28 mm.	Left 31 mm.	Right 29 mm.
,, ,, second arms	23 ,,	28 ,,	31 ,,	29 ,,
,, ,, third arms	20 ,,	24 ,,	28 ,,	26 ,,
,, ,, fourth arms	30 ,,	31 ,,	31 ,,	29 ,,
,, ,, tentacles...	75 ,,	72 ,,	90 ,,	80 ,,
,, ,, clubs	10 ,,	10 ,,	13 ,,	12 ,,
Diameter of largest arm-sucker	1 mm.		1 mm.	
,, ,, ,, tentacular sucker	1.2 ,,		1.3 ,,	

Remarks.—I have hitherto erroneously referred this species to *S. elliptica*, which fact I have discovered by examining the type specimen of the species preserved in the British Museum. The chief difference of these species consists in the structure of the shell. In *S. elliptica* the rim of the inner cone curves round posteriorly, where it rises into a special wall, and it is by no means so thin nor so simply V-shaped as in *S. robsoni*. Furthermore, there is found a difference in the horny ring of the arm suckers : in *S. elliptica* the ring is distinctly dentate as mentioned by Hoyle, which is not the case of *S. robsoni* as I described. I query wheather *S. elliptica* given by Wülker (1910) and also by Berry (1912) in the Japanese faunal list is properly identified, because the species is very close to *S. robsoni*, and I have never met with real *S. elliptica*, in spite of there having been at my disposal thousands of specimens of Sepia collected from every part of the Japanese Archipelago.

Locality.—Krusenstern Strait, Japan Sea (Albatross!); Tôkyo market (Sasaki); Tôkyo Bay (Sasaki);? Misaki (Wülker);? Wakanoura (Berry); Shimonoseki (!);? Nagasaki (Berry); Akune, Satsuma Prov. (Sasaki); near Sata-misaki, Ôsumi Prov., 70 fms. (Albatross!).

Type locality. Tôkyo Bay.

Type. In Tôkyo Imp. Univ.

Sepia carinata Sasaki, 1920.

(Pl. XVII, figs. 4–6; textfig. 105.)

Sepia carinata Sasaki 1920, p. 192, Pl. xxv, fig. 2; Pl. xxvi, fig. 1.

This species is based on two specimens collected by the "Albatross" in the Sagami Sea.

Mantle a little narrower than a half of its own dorsal length, broadest in the anterior margin, then narrowing caudad at first very gradually but rapidly afterwards, and pointed behind (Pl. XVII, fig. 4). Dorsal margin of mantle protrudes far over the head in a triangular lobe about one-fifth the entire length; ventral margin forms a deep excavation in the middle third.

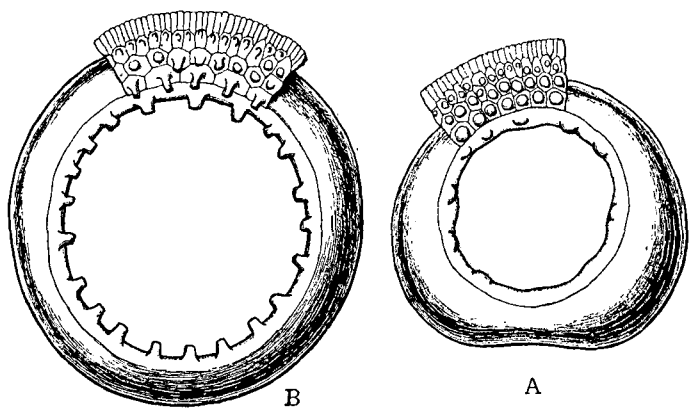
Fins rather wide, about one-fifth as wide as mantle, commencing at some distance from mantle margin and extending so far backwards that their bases come almost into contact with each other above rostrum.

Head large, a little wider than, and one-third as long as, mantle. Funnel small, conical, the extremity reaching two-fifths up to ventral interbrachial space.

Arms subequal, lateral pairs shorter than the rest, which are about one-third as long as mantle. First and second pairs both nearly conical, but the former with a distinct keel along the whole length, and the latter with a web on the ventral side. Third and fourth pairs flattened, triangular in ventral view; very broad, especially the latter; each with a sharp edge on outer side. Umbrella feebly developed, broader between dorsal arms as well as between lateral arms, where it extends to the third row of suckers.

Arm-suckers thickly set in four series, except at the extreme base and tip of arms, where they

are biserial; nearly uniform, but those of the two median series slightly larger than those of the outer. Horny ring smooth, but sometimes armed with very short, broad, unequal teeth on the margin (text-fig. 105A). Papillate area composed of about three series of papillate facetts and a radiated border; papillae comparatively large, but very short, and rounded.



Textfig. 105.

Sepia carinata. Horny rings. A. From largest sucker of arms; ×93. B. From largest sucker of tentacles; ×100.

Tentacles about as long as mantle, with three-sided stems thinner than arms. Club somewhat flattened, expanded, curved into crescent-shape, occupying distal one-sixth of tentacle (Pl. XVII, fig. 5). Suckers apparently in five-series, but numbering eight in an oblique-transverse row; unequal, about three in a submedian series being by far the largest, and as large as arm-suckers. The next largest suckers on the club are found in both the series next ventral and dorsal to the aforesaid submedian series. Horny rings of the largest suckers with about twenty, blunt or square-cut, far separated teeth arranged at equi-distance from one another on the whole margin (textfig. 105B). Papillate area of the ring composed of three series of papillate facetts and a radiate border; papillae of innermost series as long as or even longer than the teeth but decidedly thinner, with truncate or expanded apices.

Shell very broad, thin, two and a half times as long as its own maximum breadth, which is, in turn, three or four times as broad as the thickness (Pl. XVII, fig. 6). Dorsal surface evenly convex, but its antero-mesial part flattened except for a faint broad longitudinal ridge marked off by two shallow grooves on sides; the post-mesial part characteristically elevated into a short but broad longitudinal ridge. Calcareous deposition very thin but considerably extensive so that the naked area is almost obliterated. Ventral surface shallowly concave in the posterior parts but convex in the anterior, the convexity equaling that of dorsal surface in depth; median groove very narrow and shallow especially in last loculus. Anterior end of striated area arcuate but broadly truncate at apex. Outer cone starts at the vicinity of the anterior end of striated area, forming a part of shell margin on both sides of the same area, and is abruptly expanded in the posterior parts into a broad, cup-shaped cone. Inner cone poorly developed, its rim very thin throughout, not directly bordering the striated area. The rim begins near half way along the shell on the interspace between the striated area and the shell margin, and traverses into the narrower part of the outer cone, arising it diagonally. Posteriorly the same rim enters the expanded part of the outer cone, without forming any actual cone of its own, but a thickened arch overhanging the shallow posterior hollow of the shell. The locular index in one of the specimens examined is 44, and in the other, 42.

Measurements.

Sex	♂	♀
Dorsal length of mantle...	26 mm.	25 mm.
Ventral length of mantle	19 ,,	19 ,,
Maximum breadth of mantle	14 ,,	13.5 ,,
Length, of head	9 ,,	7 ,,
Breadth of head	15 ,,	14 ,,
Maximum breadth of fins	2.5 ,,	2.5 ,,

Sex	♂		♀	
Mantle extent before fins	Left 3 mm.	Right 2.5 mm.	Left 3 mm.	Right 4 mm.
Length of first arms	9 ,,	9 ,,	9 ,,	9 ,,
,, ,, second arms	7 ,,	7 ,,	7 ,,	7 ,,
,, ,, third arms	7 ,,	7 ,,	7 ,,	7 ,,
,, ,, fourth arms	9 ,,	9 ,,	8 ,,	8 ,,
,, ,, tentacles...	25 ,,	23 ,,	—	—
,, ,, clubs	4 ,,	4 ,,	—	—
Diameter of largest arm sucker	0.5 mm.		4.5 mm.	
,, ,, ,, tentacular sucker	0.4 ,,		3.4 ,,	
Breadth of shell	11 ,,		10 ,,	
Thickness of shell	3.5 ,,		2.5 ,,	
Length of rostrum	1.8 ,,		1.5 ,,	

Remarks.—The specimens referred to, though yet young, show many distinctive characters in the shell so that they are impossible to refer to any of hitherto known species.

Type locality.—Sagami Sea.

Type.—In U. S. Nat. Mus.

Sepia erostrata sp. nov.

(Pl. XVII., figs. 7–9.)

This species is based on a mature male caught by myself at Manazuru in the Sagami Prov. on March 23, 1915.

Body elongated, being only a little shorter than three times of its own maximum breadth, nearly parallel-sided in the anterior half, then gradually tapering into a rounded and non-rostrate, posterior end (Pl. XVII, fig. 7). Ventral margin of mantle distinctly emarginated crescentwise in the middle, the dorsal margin protruding over head in a triangular lobe one-ninth as long as the dorsal surface of mantle. Fins about a quarter of the mantle breadth, their anterior ends somewhat auriculate, about 4 mm. distant from mantle margin; the posterior ends clearly separated from each other by a naked space about as long as the fin breadth.

Head equal to mantle in breadth. Funnel short, extending only halfway up to the angle between ventral arms. Umbrella poorly developed, broadest between dorsal arms, quite rudimentary between ventral arms.

Arms unequal, the formula of length being $1>4>2\fallingdotseq3$. Dorsal and ventral arms both very long, tapering more rapidly in the proximal parts, than in the distal so as to terminate in almost subtile extremities, the former arm attaining a length of two-thirds that of mantle and being rounded on back while the latter has a narrow web on the dorsal side. Lateral arms shorter than one-third the dorsal length of mantle, rapidly and evenly tapering off distad.

Arm-suckers in lateral arms obliquely quadriserial in the proximal parts and biserial in the distal. In the dorsal and ventral arms no suckers are found left on the extremity, probably due to unnatural cause; in the proximal part they are obliquely quadriserial. Suckers small, a little unequal in each arm, those of the inner series being larger than those of the outer. Horny ring of proximal suckers equipped on the distal half, with very irregular teeth closely set so that their bases are connected with one another. Teeth in distal suckers, separated, numbering 10–15 in each ring.

No hectcotylization was made out except that in the left ventral arm the suckers of the middle part, which were the distalmost of those left in situ, were smaller than the corresponding ones of the right ventral arm.

Tentacles as long as mantle, with stems far thinner than arms. Club flattened, expanded, crescent-shaped, with a narrow dorsal web extending into carpus a little beyond the most proximal sucker

(Pl. XVII, fig. 8). Suckers unequal in size, irregularly arranged, central six or seven being much larger than the remainder, and some rudimentary ones found here and there. Horny ring smooth in all suckers.

Buccal membrane with seven, sucker-less projections of margin. No spermatic pad examined, the specimen referred to being male.

Branchial leaflets number about 50 in each gill. Spermatophores 5 mm. long, their sperm cord 2.8 mm. long, occupying the middle part of etui.

Color in spirit, deep grayish brown even on belly but especially deep in the dorsal surface of head, mantle and arms. Surface quite smooth throughout.

Shell lanceolate, broadest a little in front of the middle, and only a little more narrowed posteriorly than anteriorly; five times as long, and about half as thick, as the maximum breadth of its own (Pl. XVII, fig. 9). Outer cone narrow, terminating in a small cup-like expansion which has no marked rostrum behind but a low rounded eminence. Chitinous margin narrow, uninterrupted. Dorsal surface slightly convex, with a very faint median ridge and very fine calcareous deposits; naked area very narrow, less than one-fifth of the maximum breadth of the surface. Ventral surface strongly convex in the anterior parts and a little concave near the posterior end. Striated area with a faint, streak-like, median groove, and faint, parallel lines; of which the last one is nearly semicircular. Rim of inner cone thin and narrow throughout so that it forms no actual cone nor encloses any concavity behind; it begins near the half way along the shell and runs in an feeble curve backwards, bordering the striated area throughout. Last loculus with an elongated depression in the middle representing the anterior part of the median groove of the ventral surface. Locular index about 25.

Measurements.

Dorsal length of mantle	45 mm.	
Ventral length of mantle	38 ,,	
Maximum breadth of mantle	16 ,,	
Length of head	13 ,,	
Maximum breadth of head	17 ,,	
Mantle extent before fins	3.5 ,,	
Maximum breadth of fins	4 ,,	
Distance between posterior ends of fins	5 ,,	
	Left	Right
Length of first arms	30 mm.	30 mm.
,, ,, second arms	13 ,,	13 ,,
,, ,, third arms	13 ,,	13 ,,
,, ,, fourth arms	25 ,,	25 ,,
,, ,, tentacles	40 ,,	—
,, ,, clubs	5.5 ,,	—
Length of shell	45 mm.	
Breadth of shell	9 ,,	
Thickness of shell	4 ,,	

Remarks.—This species is well characterized by the posterior end of the body, by the suckers of the tentacles, and by the shell, so that it can not be referred to any species hitherto known.

Type locality.—Manazuru, Sagami Prov.

Type.—In Tôkyo Imp. Univ.

Sepia appellöfi Wülker, 1910.

(Pl. XVII, figs. 10–12; textfig. 106.)

Sepia appellöfi, Wülker 1910, p. 14, figs. 8, 15–18.—Sasaki 1920, p. 193.

Sepia (*Doratosepion*) *appellöfi*, Berry 1912b, p. 424.—Sasaki 1914, p. 618.

Nineteen specimens of this species have been at my disposal, measuring up to 89 mm. in mantle length. They agree quite satisfactorily with the original description given by Wülker.

Body short, about half as broad as long, parallel-sided in the anterior half, then tapering to a blunt posterior end with a conspicuous spine (Pl. XVII, fig. 10). Ventral emargination of mantle margin very shallow, its dorsal projection triangular or tongue-shaped more or less short, being about one-seventh as long as the dorsal surface of mantle.

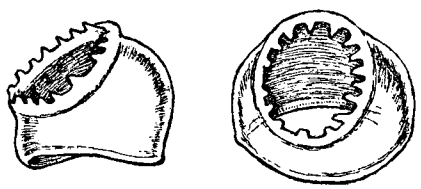
Fins narrow, $^1/_6$–$^1/_{11}$ as wide as mantle, extending to within several mm. of mantle margin in front as well as behind of each other, where they are not specially thickened nor lobed.

Head as wide as, or narrower than, mantle margin. Funnel conical, comparatively large but not reaching up to ventral interbrachial space. Umbrella slightly developed, extending to second row of suckers between first arms and also between the first and second, and to fifth row between the second and third as well as between the third and fourth; between fourth arms it is quite rudimentary as usual.

Arms $^1/_3$–$^1/_2$ as long as mantle, subequal, the formula of length variable, being $1>2>3\fallingdotseq4$ in a large female from Satsuma, $2>4>3>1$ or $2>3>4>1$ or $4\fallingdotseq1>2\fallingdotseq3$ in specimens from Tôkyo market, and $4>3>2\fallingdotseq1$ in Wülker's case. First arm rounded on back, tapering to a slender extremity which is sometimes flattend dorso-ventrally. Second arm shaped almost as in the first but not flattened at the extremity. Third and fourth arms compressed from side to side, and keeled on back, the keel being much marked in the fourth. Suckers quadriserial except at the extremity of first and second arms where they are biserial, but in Wülker's case they are said to be quadriserial throughout. Horny ring smooth.

Left ventral arm hectocotylized in the distal one-third. On this arm the suckers are normal up to the twelfth row, and the remainder, which are on the hectocotylized part, are rudimentary.

Tentacles longer than head and body taken together, with slender stems thinner than arms. Club $^1/_{10}$–$^1/_7$ the length of tentacle, expanded, crescent-shaped, its dorsal web of moderate breadth, extending to carpus. Suckers small, uniform, numbering eight in an oblique-transverse row. Horny ring smooth in some specimens from Tôkyo market, agreeing with Wülker's description, but in all others examined they were distinctly dentate, the teeth being short, pointed or cut square, and numbering 15–20 in each sucker (textfig. 106).



Textfig. 106.

Sepia appelliöfi. Horny rings from tentacular suckers of male specimen obtained in Tokyo market; ×80.

Branchial leaflets number about 65 in each gill. Spermatophores about 6 mm. long, spermatic cord about 4mm long. Buccal membrane with seven, sucker-less rather indistinct points of margin.

Surface in formalin, dotted with brown chromatophores which are rich on the dorsal surface and sparse on the ventral. Dorsal surface of head and body sparsely speckled with slightly elevated spots of melon color, and the corresponding surface of fins with a longitudinal series of several streak-like tubercles of a similar color.

Shell elongate-rhomboidal, about one-third as thick, and about four times as long, as the maximum breadth of its own (Pl. XVII, fig. 11). But in the young it is very wide, in a specimen of 32mm. mantle length being about two-fifths as broad as long (Pl. XVII, fig. 12). Dorsal surface convex, with a distinct median ridge marked off by distinct grooves on sides; the two longitudinal quarters in the middle, covered with fine calcareous deposits, of which the coarser rugosities run together and arrange themselves in transverse lines. The posterior half of the calcareous area is bordered with a narrow, but distinct, ridge on either side. Ventral surface convex in the anterior parts, nearly flat near the posterior end, with a narrow, and shallow median groove. Inner cone feebly developed, with thin limbs, which begin one-third the length of shell from its posterior end, and evenly converge posteriad, bordering the striated area. At the posterior end the limbs meet each other at a rounded angle, without forming any actual cone enclosing cavity. Posterior boundary line of last loculus W-shaped. Locular index 38–42. Rostrum long, strong, often attaining a length of 7mm.

Principal Measurements of Some of Specimens Examined.

Locality of specimen	Satsuma Prov.	Misaki	Tôkyo market				
Sex	♀	♀	♂	♀	♀	♀	♀
Dorsal length of mantle	89 mm.	74 mm.	60 mm.	57 mm.	55 mm.	47 mm.	44 mm.
Ventral length of mantle	73 ,,	57 ,,	49 ,,	46 ,,	42 ,,	38 ,,	34 ,,
Maximum breadth of mantle	40 ,,	38 ,,	30 ,,	28 ,,	28 ,,	25 ,,	24 ,,
Breadth of head	29 ,,	27 ,,	22 ,,	21 ,,	20 ,,	20 ,,	19 ,,
Mantle extent before fins	Left mm. 4 Right mm. 4	Left mm. 3 Right mm. 3	Left mm. 4 Right mm. 3	Left mm. 5 Right mm. 6	Left mm. 4 Right mm. 5	Left mm. 3 Right mm. 3	Left mm. 2 Right mm. 4
Maximum breadth of fins	5 ,, 5 ,,	3 ,, 3 ,,	3 ,, 3 ,,	3 ,, 3 ,,	3 ,, 3 ,,	3 ,, 2 ,,	2 ,, 2 ,,
Length of first arms	50 ,, 50 ,,	41 ,, 46 ,,	27 ,, 27 ,,	29 ,, 29 ,,	26 ,, 26 ,,	23 ,, 20 ,,	21 ,, 19 ,,
,, ,, second arms	45 ,, 45 ,,	— 36 ,,	26 ,, 20 ,,	25 ,, —	26 ,, 25 ,,	24 ,, 23 ,,	20 ,, —
,, ,, third arms	42 ,, 40 ,,	34 ,, 38 ,,	26 ,, 20 ,,	25 ,, —	23 ,, 25 ,,	20 ,, 15 ,,	— 18 ,,
,, ,, fourth arms	40 ,, 43 ,,	36 ,, 40 ,,	27 ,, 22 ,,	30 ,, 25 ,,	24 ,, 28 ,,	23 ,, 23 ,,	22 ,, 21 ,,
,, ,, tentacles	80 ,, 80 ,,	103 ,, 105 ,,	95 ,, 95 ,,	90 ,, 100 ,,	— 65 ,,	— 85 ,,	— 91 ,,
,, ,, clubs	15 ,, 15 ,,	13 ,, 13 ,,	10 ,, 10 ,,	10 ,, 10 ,,	— 8 ,,	— 6 ,,	— 8 ,,
Diameter of largest arm-sucker	1.2 mm.	1.5 mm.	0.9 mm.	0.9 mm.	0.9 mm.	8 mm.	8 mm.
,, ,, ,, tentaclar sucker	0.5 ,,	0.3 ,,	0.3 ,,	0.3 ,,	0.2 ,,	—	0.2 ,,
Breadth of shell.	14 ,,	20 ,,	—	16 ,,	14 ,,	15 ,,	—
Thickness of shell	8 ,,	7 ,,	—	7 ,,	5.8 ,,	5 ,,	—
Maximum breadth of naked area	10 ,,	4 ,,	—	3 ,,	2.8 ,,	2 ,,	—

Locality.—Misaki (Wülker; Sasaki); Sagami Sea, 58 fms. (Albatross!); Tôkyo market (Sasaki); Krusenstern Straight, 59 fms. (Albatross!); west of Amakusa I. 53 fms. (Albatross!); Satuma Prov. (Sasaki); off Sata-misaki, Ôsumi Prov., 152 fms. (Albatross!).

Sepia pardalis Sasaki, 1914.

Sepia pardalis, Sasaki 1914, p. 614, pl. xii, figs. 1–3.

This species is represent by two male specimens in the collections at my disposal.

Mantle about 230 mm. long 75 mm. broad, roughly elongateelliptical in outline, the broadest part being a little anterior to the middle, whence it tapers caudad to a pointed end. Ventral margin of mantle weakly emarginated, its dorsal margin protruding far over the head in a tongue-shaped lobe about 1/6–1/8 as long as the entire dorsal surface of mantle. Fins about one-sixth as broad as mantle, their anterior end distant 9 mm. from mantle margin, and the posterior end 8 mm. from that of the corresponding fin of the opposite side, without forming any special lobe.

Head very short, being only about one-sixth the dorsal length of mantle. Umbrella slightly developed, extending only to from second to fifth row of suckers but between ventral arms it is quite rudimentary as usual.

Arms comparatively short, unequal, the formula of length being $1>2>3>4$, where the longest is 1/2–3/4 as long as the body. First pair elongate more or less whip-like, the distal half being slenderly attenuated but a little thickened at the subterminal part which is bordered with broad trabeculate protective membranes. Second pair four-sided and of ordinarly shape, evenly and gradually tapering to the fine point. Third arm nearly as the second, but the ventral edge of the aboral surface is developed into a carination. Forth pair tapers rapidly distad and markedly flattened dorso-ventrally, carination well developed on the outer side. Protective membrane fairly well developed in the proximal parts except on the ventral side of the ventral arms. Suckers on the distal half of first arm and on the distal one-third of second and third arms, arranged in double series, while in the remaining parts of the above mentioned arms as well as in the whole extent of the fourth arm they are in four series. Horny ring of distal suckers with long blunt teeth separated by distinct interspaces; that of proximal suckers nearly smooth, owing to the close approximation of the teeth.

Left ventral arm hectocotylized in the distal one-third, where the suckers are rudimentary, while in the remaining part they are quite normal, forming about seventeen transverse rows.

Tentacles a little shorter than the dorsal length of mantle; stem as thick as first arm. Club flattend, expanded, occupying about one-sixth of tentacle; dorsal web of moderate breadth, beginning near proximalmost suckers. Suckers uniform, for smaller than arm-suckers, counting 300 or more, arrangest in eight series. Horny ring dentate on the whole edge, the teeth being 40–50 in number, blunt, or square-cut more or less sharpened longer on the distal margin than on the proximal.

Color in alcohol, reddish brown, but much paler beneath; chromatophores minute, 100 or more, streak-like, well-defined spots are found on the dorsal surface of mantle, distributed somewhat symmetrically on both sides of the median line, each spot marked out by a paler margin.

Shell slender, lanceolate, a little narrower than one-fifth of its own length, broadest a little in front of the middle, terminating in a small discoidal outer cone. Chitinous margin comparatively broad, uninterrupted. Dorsal surface strongly convex, with a distinct median ridge marked off by two deep grooves on sides; median one-third of the surface covered with calcareous deposits, coarser rugosities of which are arranged in longitudinal lines, slightly diverging from the posterior end anteriad. Ventral surface slightly concave in posterior part and markedly convex in the anterior, traversed by an irregularly excavated median groove. Striated area marked with numerous longitudinal streaks; its anterior border deeply indented in two places. Rim of inner cone comparatively broad, but flattened into an only slightly elevated V-shaped ridge bordering the striated area and extending nearly two-fifths the length of shell from posterior end. Locular index about 30. Rostrum was broken in the only specimen examined, but seemed to be rather strong judging from its stump remaining in situ.

The principal measurements and illustrations are given in one of my previous papers (1914, p. 615).

Remarks.—This species is easily distinguished from other congenerics by its elongated and spotted mantle. It seems not to be very rare, although I subjected only two specimens to a through search.

Locality.—Awa Prov. (Sasaki); Tôkyo market (!).

Type locality.—Awa Prov.

Type.—In Sc. Coll. Tôkyo.

Sepies longipes Sasaki, 1914.

(Pl. XVII, fig. 13; textfig. 107.)

Sepia (*Doratosepion*) *longipes*, Sasaki 1914, p. 619, pl. xii, figs. 4, 5.

Six specimens of this species have been at my disposal, measuring up to 235 mm. in mantle-length.

Body wide, roughly oval in contour, wider than a half of its own dorsal length, the widest part being near the middle, whence it rapidly tapers to the rostate end. Anterior margin of mantle slightly emarginated in the mid-ventral parts, projecting dorsally over the head in a large triangular lobe about one-fifth as long as the dorsal surface of mantle. Fins wide, their maximum breadth being about one-fifth that of body; the anterior origin about 10 mm. distant from mantle margin and the posterior end nearly in contact with that of the oppsite side, without forming any special lobe.

Head large but a little narrower than mantle-opening. Funnel rather large, conical, extending less than to ventral interbrackial space. Umbrella very narrow, extending to fourth row of suckers except between ventral arms, where it is quite rudimentary as usual.

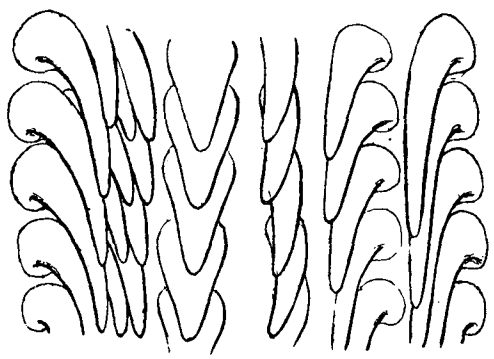
Arms sexually dimorphic. Arms in male very long, considerably unequal, the formula of length being $1>2>3>4$. First pair about twice as long as the dorsal side of mantle, elongated almost into the shape of a whip, but the distal part is somewhat thickened, bordered with rather broad, trabeculate, protective membranes, and marked off from the proximal part by a strong constriction. Second pair equal to the dorsal side of mantle in length, rounded on back, tapering to slender extremity. Third pair four-sided at base, but three-sided in the remaining parts, where a feeble keel is developed. Fourth pair three-sided even at base, strongly carinated on back.

In the female they are subequal, the formula of length being $2>1>3>4$; the longest a little shorter than the dorsal length of mantle. All similarly taper to slender extremities, bnt the two dorsal pairs rounded on back while the remaining pairs are three-sided and keeled on back.

Arms-suckers vary in the different sexes. On the dorsal arms of the male they are obliquely quadriserial in the proximal one-third and biserial in the remaining parts. They are of normal size up to the sixth or seventh row whence they abnormally diminish in size, becoming rudimentary on the distal part of the arms. The peduncular bases of the suckers becomes, however, larger in reverse proproportion with the suckers, those of the rudimentary suckers being conspicuously enlarged. All these characterizations on the first arms similarly occur also on the second arms, but the suckers are a little more extensively quadriserial and their rudimentary condition at the distal part less marked. In the female, however, the suckers and their peduncular bases of these two pairs of arms are quite normal and the former are quadriserial in the proximal two-thirds of the arms. The suckers of the third and fourth arms in both sexes are nearly quadriserial throughout, but they may be biserial in a short distal parts, and are normally constructed everywhere. Horny ring in all suckers nearly smooth, but many sinuations of the morgin which are not deep enough to form teeth, are found in the ring of the terminal suckers.

Both dorsal arms affected by hectocotylization. The arm of the left side hectocotylized in the distal two-fifths, which is furrowed longitudially and has rudimentary suckers in four series. On the proximal three-fifths are found twelve transverse rows of normal suckers also of quadriserial arrangement. The arm of the right side less markedly hectocotylized than that of the left, and the rudimentary suckers, which are less reduced in size than those of the left arm, are confined beyond the fourteenth row.

Tentacles twice as long as the ventral side of mantle, their stem equaling arms in thickness. Club expanded, crescent-shaped, occupying about one-eighth of tentacle; dorsal web of moderate breadth, extending into carpus beyond the most proximal sucker. Suckers apparently in three or four series but numbering eight in an oblique row; considerably unequal, four at the middle of club being by far the largest of all. Horny ring of these largest suckers entire in margin, but those of smaller suckers are are armed with many, blunt, slender teeth closely set on the whole edge.



Textfig 107.
Sepia longipes. Radula; ×80.

Buccal membrane with seven, sucker-less projections of margin, but in the female the two ventralmost are almost rounded off and there are developed two spermatic pads at their bases.

Shell lanceolate, the broadest part being a little anterior to the middle, whence it evenly narrows caudad, terminating in a small, cup-shaped, outer cone; the anterior margin forms a hypaboric curve (Pl. XVII, fig. 13). Chitinous margin broad, uninterrupted, a little widening posteriad, auriculate on sides of outer cone. Dorsal surface convex, traversed by a longitudinal ridge well defined by two distinct grooves; the median one-third of the surface with calcareous deposits, of which coarser rugosities run together and arrange themselves in transverse lines in the anterior half, and in longitudinal lines on sides of the posterior part; the outermost of the latter lines on either side is specially conspicuous and somewhat separated from others. Striated area flat in the posterior parts, markedly carinated in the anterior parts, its anterior boundary deeply indented in the middle. A faint median groove traceable throughout the length of shell but nearly obliterated on the crest of the keel of striated area. Rim of inner cone thin and narrow throughout, V-shaped bordering striated area and not forming any concavity posteriorly. Locular index about 40. Rostrum rather strong.

Radula as shown in textfig. 107.

Remarks.—This species is somewhat related to *S. lorigera* Wülker, but differs from it in the broader body, in the longer arms, in the carinated shell, and in that the hectocotylization affects both the arms of the ventral pair.

Type locality.—Chôshi, Kazusa Prov.

Type.—In Tôkyo Imp. Univ.

Sepia lorigera Wülker, 1910.

(Pl. XVII, fig. 14; textfig. 108.)

Sepia lorigera, Wülker 1910, pp. 12, 13, figs. 3, 4, 10–14.
Sepia (*Doratosepion*) *lorigera*, Berry 1912b, p. 422.—Sasaki 1914, p. 619.

Thirteen specimens of this species have been at my disposal, measuring up to 24cm. in mantle length.

Mantle roughly elliptical, broadest near the middle or a little more anteriorly, more or less acuminated behind, length being about two and a half times the breadth. Dorsal margin of mantle protrudes far over head in a prominent, tongue-shaped lobe about one-seventh as long as mantle; ventral margin distinctly emarginated below funnel. Fins begin within 10mm. of mantle margin, extending posteriorly to within 50 mm. of each other; their widest part situated much posterior to the middle, attaining a breadth of about one-sixth that of mantle.

Head as wide as mantle opening, and 1/5–1/6 as long as the dorsal side of mantle. Funnel of moderate size, extending a little beyond the center of head. Umbrella best developed between second

Measurements of Specimens Examined.

No. of specimen	i	ii	iii	iv	v	vi
Sex	♂	♂	♀	♀	♀	♀
Dorsal length of mantle	235 mm.	220 mm.	178 mm.	157 mm.	150 mm.	147 mm.
Ventral length of mantle	183 ,,	175 ,,	135 ,,	123 ,,	120 ,,	106 ,,
Maximum breadth of mantle	120 ,,	115 ,,	90 ,,	80 ,,	75 ,,	75 ,,
Breadth of head	75 ,,	75 ,,	57 ,,	54 ,,	57 ,,	50 ,,
Mantle extent before fins	Left mm. 9 / Right mm. 11	Left mm. 6 / Right mm. 6	Left mm. 8 / Right mm. 7	Left mm. 14 ,, / Right mm. 13 ,,	Left mm. 5 / Right mm. 3	Left mm. 10 ,, / Right mm. 8 ,,
Maximnm breadth of fins	16 ,, 15 ,,	20 ,, 23 ,,	14 ,, 16 ,,	14 ,, 13 ,,	10 ,, 15 ,,	17 ,, 14 ,,
Length of first arms	525 ,, 485 ,,	420 ,, 420 ,,	120 ,, 120 ,,	110 ,, 115 ,,	115 ,, 103 ,,	105 ,, 105 ,,
,, ,, second arms	275 ,, 285 ,,	215 ,, 210 ,,	130 ,, 125 ,,	125 ,, 120 ,,	120 ,, 130 ,,	110 ,, 120 ,,
,, ,, third arms	150 ,, 160 ,,	135 ,, 140 ,,	100 ,, 95 ,,	105 ,, 95 ,,	95 ,, 85 ,,	90 ,, 90 ,,
,, ,, fourth arms	155 ,, 155 ,,	147 ,, 140 ,,	85 ,, 85 ,,	80 ,, 76 ,,	80 ,, 80 ,,	78 ,, 78 ,,
,, ,, tentacles	355 ,, 370 ,,	350 ,, 355 ,,	280 ,, 300 ,,	280 ,, 280 ,,	270 ,, 260 ,,	27 ,, 27 ,,
,, ,, clubs	45 ,, 45 ,,	42 ,, 45 ,,	35 ,, 37 ,,	32 ,, 35 ,,	37 ,, 35 ,,	32 ,, 32 ,,
Diameter of largest arm-sucker	3.5 mm.	3.5 mm.	3 mm.	—	2.5 mm.	2.5 mm.
,, ,, ,, tentaclar sucker	8 ,,	8 ,,	7 ,,	6.8 mm.	6.5 ,,	6 ,,

and third arms and also between third and fourth arms where it extends to the third or fourth row of suckers; between ventral arms it is quite rudimentary as usual.

Arms in male, unequally long, in formula $1>2>3\fallingdotseq4$, but in female subequal, the formula being $1\fallingdotseq2>3>4$. These sexual dimorphisms depend most upon those of the first arm. This arm of the male is exceedingly elongated almost into the shape of a whip, about twice as long as the dorsal side of the mantle. It tapers in the usual way for a length at base, the remaining part being characteristically slender, filiform and of the same diameter except the extremity, which is markedly thickened, bordered by broad trabeculate protective membranes. The extremity is folded and coiled round in a plane in preserved specimens; when extended, it forms together with protective membranes a lanceolate outline measuring 45 × 23 mm. in the largest specimen examined. The first arm of the female is of quite normal structure, attaining a length of ½–¾ that of mantle. The remaining arms are normally constructed in the male and female as well; but they are on the whole a little shorter in the former than in the latter. Third and fourth arms carinated on back, especially the latter. Distal one-third of left ventral arm affected by hectocotylization, bearing minute rudimentary suckers, the peduncular bases of which are characteristically swollen into transverse ridges. On the unaffected part of the arm are found about fifteeth rows of normal suckers.

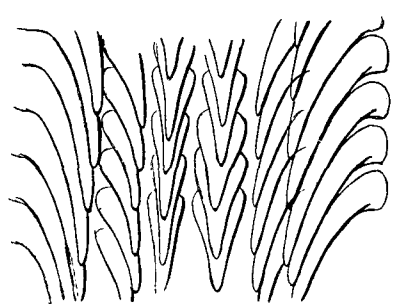
Arm-suckers quadriserial expect at the extremity of the three dorsal pairs of arms where they are biserial. On the first arm of the male the suckers are rudimentary on the distal part and their quadriserial arrangement is limited to the proximal one-sixth of the arm. The terminal suckers of the second arm of the same sex are also somewhat rudimentary. Suckers on each arm a little unequal, being decidedly larger in the inner series than in the outer. Horny ring with innumerable, slender teeth tightly fused up so that it appears to be nearly entire at margin.

Tentacles variable in length, but in good specimens about as long as, or a little longer than, mantle; stem a little thinner than arms, with a flat oral surface. Club about one-seventh the length of tentacle, expanded, kidney-shaped or crescent-shaped, with a dorsal web extending a little beyond the most proximal sucker. Suckers apparently quadriserial, but numbering eight in an oblique row; greatly unequal in size, about four at the middle part of club being by far the largest of all. Horny ring in these largest suckers almost as in larger arm-suckers; same in smaller tentaclar suckers, equipped with 20–30, long, blunt teeth.

Buccal membrane with seven, suckerless projections of margin.

Color in alcohol, uniformly reddish brown; chromatophores very rich in the dorsal surface and very rare in the ventral. On the ventral surface of mantle are found, two longitudinal stripes, one on each side running parallel with the lateral margin. No yellowish dots nor tubercles are on the surface.

Shell lanceolate, ¼–⅕ as broad as its own length, the widest part being a little anterior to the middle; posteriorly it tapers in a equable manner to a small, cup-shaped, outer cone (Pl. XVII, fig. 14). Chitinous margin comparatively broad, a little widening posteriad. Dorsal surface markedly convex, traversed by a prominent median longitudinal ridge marked off by two deep furrows. Median one-third of the surface covered with coarser calcareous rugosities forming transverse lines on the median region and longitudinal lines on the lateral parts. The outermost of these longitudinal lines on either side is conspicuous and separated from the remainder. Ventral surface a little concave in the posterior part and strongly convex in the anterior, with a median groove extending the whole length. Rim of inner cone very thin and narrow throughout, nicely V-shaped, bordering four-fifths the length of striated area. Anterior end of striated area with a deep indentation in the middle. Locular index 38.5–45. Rostrum strong, measuring 7 mm. in the largest specimen examined.



Textfig. 108.

Sepia lorigera. Radula; × 37.

Radula composed of seven series of slender unicuspid teeth (textfig. 108).

Measurements.

No. of specimen	i	ii	iii	iv	v	vi	vii	viii
Sex	♂	♂	♂	♂	♂	♀	♀	♀
Dorsal length of mantle	240 mm.	210 mm.	182 mm.	160 mm.	102 mm.	155 mm.	148 mm.	88 mm.
Ventral length of mantle	198 ,,	180 ,,	155 ,,	136 ,,	85 ,,	122 ,,	124 ,,	72 ,,
Maximum breadth of mantle	85 ,,	80 ,,	70 ,,	57 ,,	43 ,,	66 ,,	57 ,,	35 ,,
Breadth of head	67 ,,	65 ,,	5.2 ,,	50 ,,	38 ,,	44 ,,	46 ,,	33 ,,
Mantle extent before fins	10 ,,	9 ,,	9 ,,	9 ,,	5 ,,	3 ,,	5 ,,	3 ,,
Maximum breadth of fins	15 ,,	13 ,,	13 ,,	10 ,,	7 ,,	14 ,,	8 ,,	8 ,,
Length of first arm (right)	480 ,,	477 ,,	318 ,,	190 ,,	65 ,,	120 ,,	83 ,,	29 ,,
,, ,, second arm (right)	100 ,,	95 ,,	85 ,,	52 ,,	35 ,,	120 ,,	84 ,,	26 ,,
,, ,, third arm (right)	82 ,,	80 ,,	75 ,,	51 ,,	32 ,,	95 ,,	85 ,,	24 ,,
,, ,, fourth arm (right)	85 ,,	80 ,,	70 ,,	50 ,,	30 ,,	68 ,,	65 ,,	24 ,,
,, ,, tentacles	250 ,,	265 ,,	240 ,,	168 ,,	95 ,,	280 ,,	300 ,,	90 ,,
,, ,, clubs	35 ,,	30 ,,	30 ,,	25 ,,	18 ,,	35 ,,	23 ,,	14 ,,
Diameters of largest arm-sucker	2.3 ,,	2.2 ,,	2 ,,	1.5 ,,	1.2 ,,	1.5 ,,	1.5 ,,	1.1 ,,
,, ,, ,, tentacular sucker	6 ,,	5 ,,	5 ,,	4.5 ,,	3.5 ,,	4 ,,	4 ,,	2.5 ,,
Length of shell	—	209 ,,	—	160 ,,	101 ,,	155 ,,	—	88 ,,
Breadth of shell	—	45 ,,	—	35 ,,	25 ,,	38 ,,	—	22 ,,
Thickness of shell	—	15 ,,	—	10 ,,	10 ,,	16 ,,	—	9 ,,
Length of rostrum	7 ,,	6 ,,	—	5.5 ,,	5 ,,	5 ,,	—	5 ,,

Remarks.—The arms, as shown in the above table, become more unequal in length, and the whip-like feature of the dorsal arms is accentuated, as the animal grows older.

Larger males of the specimens examined agree quite satisfactorily with Wülker's original description of the species.

Locality.—Misaki (Wülker); Tôkyo market (Sasaki); Isé Prov. (Sasaki); Manazuru, Sagami Prov. (!).

Sepia tenuipes sp. nov.

(Pl. XVIII, figs. 1–9.)

? Sepia andreanoides, Ortmann 1888 p. 653 (not of Hoyle).
Sepia (*Doratosepion*) *andreanoides*, Sasaki 1914, p. 614.

Twenty specimens of this species have been at my disposal, measuring up to 105 mm. in mantle length.

Mantle roughly elliptical in outline, 2½–3 times as long as broad, more or less pointed behind (Pl. XVIII, fig. 1). Ventral part of anterior margin slightly emarginated crescentwise; dorsal part projecting over head into a broadly triangular lobe about one-tenth as long the dorsal side of mantle. Fins of moderate breadth, being one-fifth the maximum breadth of mantle, extending to within 6 mm. of mantle margin anteriorly and within 8 mm. of each other posteriorly; the posterior end normal and not specially thickened nor lobed.

Head rather small, slightly narrower than mantle opening, about one-fifth as long as the dorsal side of mantle. Funnel somewhat small, conical, extending far less than to ventral interbrachial space. Umbrella poorly developed as is usual in congenerics.

Arms sexually dimorphic. In the male, they are of unequal length, the dorsal pair being about twice as long as the remaining pairs, which are nearly uniform. The dorsal pair tapers comparatively quickly for a length at base and then very gently, terminating in a long filiform extermity. On the thicker portion towards the base, suckers are obliquely quadriserial, but in the remaining parts distinctly biserial. Lateral pairs of the usual structure, regularly tapering off distad, furnished for the greater part with quadriserial suckers and at the extremity with biserial ones. Ventral pair thickest of all, compressed, bearing a strong keel on back so that its ventral aspect is slenderly triangular; suckers on this pair quadriserial throughout. Hectocotylization affects the distal half of left ventral arm, consisting in the longitudinal furrowing and in the reducement of suckers in size. The unaffected part of the arm has seven or eight transverse rows of normal suckers, and then follow the rudimentary ones of the affected part, but at the extremity the suckers regain their normal sizes (Pl. XVIII, fig. 2).

Arms in female, of about uniform length, being about two and a half times the dorsal length of mantle (Pl. XVIII, fig. 3). Dorsal pair of the usual shape, evenly tapering distad, but the extremity is rather blunt due to the good development of protective membranes; suckers quadriserial except on the distal one-third where they are biserial. Lateral pairs of normal structure in the proximal two-fifths only, whence they abruptly narrow so that the distal half is characteristically filiform, flattened from oral to aboral side and of uniform breadth. On this part the suckers are nearly rudimentary and uniform, distinctly biserial, running along the margins so that the broad median region of the part remains naked on the thicker part towards the base, the suckers being normal and quadriserial. Ventral pair of arms exactly as in the male, of course the hectocotylization of the latter excepted.

In both the sexes, the suckers on each arm are a little unequal, being a little larger in the inner two series than in the marginal of both sides. Horny ring of proximal suckers smooth, but that of distal ones may be equipped with squarish teeth closely set on the whole margin (Pl. XVIII, figs. 4, 5).

Tentacles slender, as long as head and body taken together. Club small, $^1/_{10}$–$^1/_{12}$ the entire length of tentacle, expanded, crescent-shaped and bordered on the dorsal side with a web of the usual breadth and structure (Pl. XVIII, fig. 6). Suckers uniform, minute, about one-third the diameter of the largest arm-sucker, arranged in eight series. Horny ring with about 25, square-cut teeth disposed at nearly regular intervals on the whole margin (Pl. XVIII, fig. 7).

Buccal membrane with seven, sucker-less points of margin, but in the female the two ventralmost are rounded off and a pair of oval, spermatic pads are developed near this part of the membrane.

Branchial leaflets count about 50–60 in each gill

Spermatophores 6–7.5 mm. long, with sperm cord a little longer than a half of its own length (Pl. XVIII, fig. 8). On the cord, there are usually discernible innumerable fine transverse striations.

Ripe ova of the largest female examined, clavate, measuring 2.5 × 11 mm.; nidamental glands of the same specimen, roughly pyriform and 7.5 × 13 mm.

Chromatophores much richer on the dorsal side. On the belly, there are two faint, longitudinal, more or less iridescent stripes one on each side running parallel with the lateral margin.

Shell slender, lanceolate, widest about one-third the length from the anterior end which is rounded; posterior part tapered gradually and evenly (Pl. XVIII, fig. 9). Width less in male than in female, being about one-fifth in the former, and one-fourth in the latter, of the length. Outer cone small, cup-shaped, terminal. Chitinous margin comparatively broad. Dorsal surface nearly flat in male, slightly convex in female, but its posterior part in both sexes is arched lengthwise as is usual in the genus; along the median line, there runs a faint median ridge marked off by two furrows. Median one-third of the surface covered with calcareous rugosities, coarser ones of which form longitudinal lines. Ventral surface markedly convex for the greater part, the greatest depth being at the anterior part of striated area; median groove shallow, narrow, and of about uniform depth, extending nearly the whole length. Rim of inner cone very thin throughout, V-shaped, bordering the striated area. It is a little prominent in the posterior parts where it encloses a narrow space; anteriorly it becomes evenly and gradually narrower and lower, and disappears before reaching the middle of shell. Locular index 26–32 in male, 36 in female.

Measurements of largest Male and Female Examined.

Sex	♂		♀	
Dorsal length of mantle	105 mm.		81 mm.	
Ventral length of mantle	92 ,,		68 ,,	
Maximum breadth of mantle	39 ,,		36 ,,	
Breadth of head	31 ,,		27 ,,	
Extent of mantle before fins	Left 5 mm.	Right 5 mm.	Left 4 mm.	Right 4 mm.
Maximum breadth of fins	9 ,,	9 ,,	7 ,,	6 ,,
Length of first arms	73 ,,	75 ,,	31 ,,	31 ,,
,, ,, second arms	37 ,,	37 ,,	32 ,,	32 ,,
,, ,, third arms	37 ,,	37 ,,	32 ,,	32 ,,
,, ,, fourth arms	38 ,,	38 ,,	30 ,,	30 ,,
,, ,, tentacles	120 ,,	120 ,,	90 ,,	100 ,,
,, ,, clubs	12 ,,	12 ,,	9 ,,	9 ,,
Diameter of largest arm sucker	1.0 mm.		0.9 mm.	
,, ,, ,, tentacular sucker	0.3 ,,		0.3 ,,	
Length of shell exclusive of rostrum	100.0 ,,		77.0 ,,	
Maximum breadth of shell	19.0 ,,		19.0 ,,	
Thickness of shell	7.5 ,,		7.5 ,,	
Maximum breadth of naked area	5.0 ,,		6.0 ,,	
Length of rostrum	5.0 ,,		4.0 ,,	

Remarks.—The specimens referred to agree very well with Ortmann's description of *S. andreanoides* Hoyle; so I have hitherto referred them to that species. But, on a repeated re-examination of them I have found their marked discrepancies from Hoyle's original description of that species so that

I am have given them a new name. The principal differences between these two species consist (1) in the shape of body, (2) in the first arm of the male, (3) in the lateral arm of the female, and (4) in the shape of the shell. I am greatly inclined to consider that the Ortmann's *S. andreanoides* is not identical with that of Hoyle's, but is more probably referable to the species now under consideration.

Locality.—Tôkyo market (Sasaki); Ibaraki Prefecture (Sasaki); Awa Prov. (!).

Type locality. Ibaraki Pref.

Type.—Tôkyo Imp. Univ.

Sepia peterseni Appellöf, 1886.

(Pl. XIII, figs. 10, 11; Pl. XIX, fig. 27; textfig. 109.)

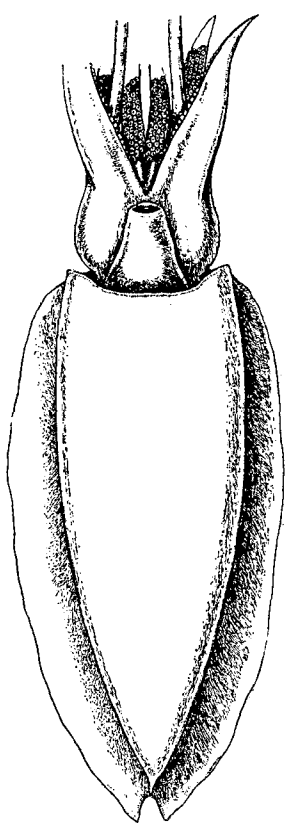
Sepia peterseni, Appellöf 1886, p. 23, pl. ii, figs. 1–6; pl. iii, fig. 21.—Wülker 1910, p. 14.—Sasaki 1920, p. 194.

Sepia (*Doratosepion*) *peterseni*, Berry 1912b, p. 423—Sasaki 1914, p. 618.

This species is represented by forty-six specimens in the collection at my disposal. They are all male measuring up to 118 mm. in mantle length.

Body conico-cylindrical, but a little flattened dorsoventrally, nearly parallel-sided in the anterior one-third, then tapering to an acuminate end (textfig. 109). Maximum breadth of body in full-grown specimens, $^1/_3$–$^2/_5$ of its dorsal length. Ventral margin of mantle distinctly emarginated crescentwise; dorsal margin protruding far over head in a prominent triangular lobe occupying $^1/_{10}$–$^1/_8$ of the entire dorsal length of mantle. Fins broad about one-fourth as wide as body, their anterior origin situated very near mantle margin and the posterior end separated from that of the corresponding fin in the opposite side by a narrow gap.

Head rather small, narrower than mantle opening; $^1/_5$–$^1/_6$ as long as the dorsal side of mantle. Funnel comparatively large, with a broad extremity nearly reaching ventral interbrachial space. Umbrella best developed between the second and third arms and also between the third and fourth, where it extends up to the third row of suckers.



Textfig. 109.

Sepia petersèni. Ventral view of male sex; ×$^2/_3$.

Arms exceedingly unequal, the formula of length being 2 > 1 > 4≒3. Second arm by far the longest especially in full-sized males, attaining a length of 4–6 times that of mantle and regularly tapering to subtile extremity (Pl. XVIII, fig. 10). It is of normal structure in the proximal one-third; the remaining part is flattened laterally almost into the shape of a tapered tape, so that the protective membranes of both side to come into contact with each other. First arm a little shorter than half the length of mantle, rounded on back, with an attenuate extremity. Third and fourth arms both only about one-third as long as mantle, flattened from side to side, keeled on back especially the fourth; rather rapidly tapering off so that their extremity is far less attenuate than in the first arm. Suckers on second arm obliquely quadriserial up to ninth or tenth row, then becoming biserial, but on entering the flattened part they are still more reduced in arrangement, so as to make themselves arrange in a single, very sparse series held between two protective membranes folded together. On the distal half of the arm where the protective membranes are fused up to their distal edges, no suckers can be seen externally. Suckers on first and third arms obliquely quadriserial in the proximal parts and biserial in the distal, while on the fourth they are quadriserial throughout. Horny ring smooth in all suckers.

Left ventral arm hectocotylized in the distal one-third where the suckers are rudimentary. In the remaining proximal parts, there are found about ten rows of normal suckers.

Tentacles about as long as the dorsal side of mantle, with stems decidedly thinner than arms. Club expanded, crescent-shaped, including about one-eighth of the entire length of tentacle; dorsal web of moderate breadth, extending the whole length of club. Suckers apparently in five or six series, but numbering eight in each oblique-transverse row; unequal in size, middle five or six being the largest of all and a little larger than largest ones of arms. Horny ring with irregular teeth, which in the largest suckers number 30–40 and are closely set.

Buccal membrane with seven suckerless projections of margin. Spermatic pad not examined, the specimens examined being all male. Gill composed of 73–75 leaflets.

Spermatophores 6.5–7.5 mm. long; sperm cord 4–5 mm. long, occupying the middle part of etui. In all the spermatophores examined there are found crystals at the oral end of sperm sheath.

Shell lanceolate, slender and thick, being about six times as long, and about two-fifths as thick, as the maximum breadth of its own; broadest about one-third the length from the anterior end and then regularly narrowing to a small cup-shaped outer cone (Pl. XIX, fig. 27). Chitinous margin narrow, uninterrupted. Dorsal surface slightly convex, the median longitudinal region again elevated into a faint ridge marked off by very sharrow grooves on sides. Median one-third of the surface covered with fine calcareous deposits, the coarser grains of which form longitudinal lines. Ventral surface highly arched in the anterior parts; median groove narrow, shallow but traceable along the whole length. Anterior boundary line of striated area variable in shape but usually semicircular and retused. Locular index 30–42. Rim of inner cone V-shaped and very narrow, but the posterior end a little widened forming a small, flattened cone enclosing a very narrow but relatively deep hollow. Rostrum long, being about 5 mm. in full-sized specimens.

Color in alcohol brownish buff, much paler below. Back sparsely dotted with faint yellowish tubercles, of which seven or eight in a series along each fin are larger than the rest and streak-like. Posterior part of fins decorated with a short longitudinal stripe of metallic lustre. Belly smooth, bearing neither streak-like tubercles nor any kind of stripe.

Remarks.—Larger individuals examined agree well with Appellöf's original description. The most distinctive character of the species is the considerable length of the second arms. This is, however, quite insignificant in the young, becoming conspicuous with age, as might be inferred from the measurements above mentioned. The young is less characterized also in other respects, and recalls *S. andreanoides* Hoyle in many points (Pl. XVIII, fig. 11).

Locality.—Kagoshima market (Sasaki); Nagasaki (Appellöf; Sasaki); Nagato Prov. (Sasaki); Korea (!); Kii-suido, 33–40 fms. (Albatross!); Isé Prov. (Sasaki); Mikawa Prov. (Sasaki); Misaki (Wülker); Odawara, Suruga Prov. (!); Tôkyo market (Sasaki); Etchu Prov. (!).

Sepia andreana Steenstrup, 1875.

Japanese name: Hari-ika (Shimo-osa Prov.); Kaika (Hokkaido).

(Pl. I, fig. 6; Pl. XVIII, figs. 12, 13.)

Sepia andreana, Steenstrup 1875, p. 474, pl. 1, figs. 11–19.—Tryon 1879, p. 193, pl. lxxxix, fig. 408; pl. xc, figs. 409, 410.—Wülker 1910, pp. 19, 22, 24—Sasaki 1920, p. 193.

Doratosepion andreana, de Rochebrune 1884a, p. 96.

Sepia (*Doratosepion*) *andreana*, Berry 1912b, p. 422,—Sasaki 1914, p. 613.

About three hundred specimens of this species have been at my disposal, measuring up to about 12 cm. in mantle length. Somewhat younger ones of them agree with Steenstrup's original description.

Mantle roughly elliptical, bluntly terminating behind, where a spine projects as is usual in the genus. Dorsal length of mantle about two and a half times the maximum breadth on an average, though the body of the male is a little more slender than that of the female. Mantle margin gently emarginated in the mid-ventral part, while the mid-dorsal part projects far over the head in a broad

Measurements.

No. of specimen	i	ii	iii	iv	v	vi	vii	viii
Dorsal length of mantle	118 mm.	105 mm.	92 mm.	77 mm.	59 mm.	58 mm.	41 mm.	30 mm.
Ventral length of mantle	100 ,,	90 ,,	81 ,,	71 ,,	51 ,,	47 ,,	36 ,,	27.5 ,,
Breadth of Mantle	40 ,,	34 ,,	34 ,,	29 ,,	24 ,,	24 ,,	16 ,,	11 ,,
Length of head	20 ,,	20 ,,	18 ,,	17 ,,	15 ,,	10 ,,	9 ,,	8 ,,
Breadth of head	25 ,,	27 ,,	24 ,,	25.5 ,,	21 ,,	20 ,,	14 ,,	10 ,,
Mantle extent before fins	Left Right mm. mm. 3 4	Left Right mm. mm. 3 4	Left Right mm. mm. 3 2	Left Right mm. mm. 1.5 1.5	Left Right mm. mm. 1.5 1.5	Left Right mm. mm. 1.5 1.5	Left Right — —	Left Right — —
Maximum breadth of fins	10 ,, 10 ,,	9 ,, 9 ,,	8 ,, 8 ,,	8 ,, 8.5 ,,	6.5 ,, 6.5 ,,	— —	mm. mm. 3.5 3.5	mm. mm. 2.5 2.5
Length of first arms	50 ,, 50 ,,	45 ,, —	40 ,, 40 ,,	30 30	28 ,, 32 ,,	20 ,, 20 ,,	12 ,, 12 ,,	9 ,, 9 ,,
,, ,, second arms	270 ,, 265 ,,	260 ,, 250 ,,	170 ,, 180 ,,	115 ,, 120 ,,	72 ,, 72 ,,	35 ,, 35 ,,	20 ,, 20 ,,	12 ,, 12 ,,
,, ,, third arms	42 ,, 42 ,,	40 ,, 40 ,,	27 ,, 27 ,,	25 ,, 25 ,,	26 ,, 27 ,,	15 ,, 15 ,,	11 ,, 11 ,,	8 ,, 8 ,,
,, ,, fourth arms	42 ,, 42 ,,	40 ,, 40 ,,	30 ,, 30 ,,	28 ,, 27 ,,	29 ,, 29 ,,	18 ,, 18 ,,	13 ,, 13 ,,	9 ,, 9 ,,
,, ,, tentacles	130 ,, 130 ,,	110 ,, 110 ,,	70 ,, 80 ,,	— —	55 ,, 55 ,,	54 ,, 53 ,,	33 ,, 33 ,,	17 ,, 17 ,,
,, ,, clubs	16 ,, 15 ,,	12 ,, 12 ,,	11 ,, 11 ,,	— —	9 ,, 9 ,,	8 ,, 8 ,,	5 ,, 5 ,,	4 ,, 4 ,,
Diameter of largest arm-sucker	1.0 mm.	1.0 mm.	1.0 mm.	0.8 mm.	0.7 mm.	0.7 mm.	—	—
,, ,, tentacular sucker	1.4 ,,	1.4 ,,	1.1 ,,	—	0.8 ,,	0.8 ,,	—	—
Breadth of shell	19.0 ,,	17.0 ,,	16.0 ,,	15.0 ,,	12.0 ,,	12.0 ,,	—	—
Thickness of shell	7.0 ,,	6.5 ,,	7.0 ,,	6.0 ,,	5.0 ,,	5.0 ,,	—	—
Length of rostrum	5.0 ,,	5.0 ,,	4.0 ,,	3.5 ,,	3.5 ,,	2.5 ,,	—	—

triangular lobe including $^1/_8$–$^1/_{10}$ of the dorsal length of mantle. Fins about one-fourth the breadth of mantle; anterior origin distant 8 mm. from mantle margin; posterior end separated from that of the corresponding fin of the opposite side by a semicircular gap about 6 mm. in diameter.

Head rather small, as wide as, or even narrower than, mantle-opening; length about one-fifth that of mantle. Umbrella poorly developed, its radii unequal in the different interbrachial spaces, the formula of length being II−III>I−I≒I>III−IV>IV−IV.

Arms dimorphic in the different sexes. In the adult male, they are markedly unequal, the formula of length being 2>4>3≒1 (Pl. XVIII, fig. 12). Second pair about thrice as long as the others which are of roughly uniform length; nearly cylindrical, with a rounded extremity and not tapering off as usual. Remaining three pairs of arms all of the ordinary shape, regularly tapering to slender extremities. Fourth pair the thickest among these and also the longest though just by little being a little longer than one-third the length of mantle. Aboral carination developed in this pair and in the third as well, but in the latter it is less prominent and makes itself out as a web along the ventral side of the aboral surface. First pair the thinnest of all and rounded on back.

Arms in female, subequal, the formula of length being 2>1>4>3 or 2>1≒4≒3. All of the usual shape, regularly tapering off, but the first pair is slightly expanded at the extremity; their length about half that of mantle. Carination of the aboral surface almost as in the male.

On the second arm of the male the suckers are obliquely quadriserial in the proximal one-third, then becoming biserial; in the distal parts they are rudimentary, and arranged sparsely. On the same arm of the female, they are quadriserial in the proximal two-fifths, and biserial in the remaining parts. At the extremity the biserial arrangement is well defined, the suckers on one side separated from those on the other side by a broad medial space. This characterization similarly occurs also on the third arm of the same sex. On the first arm of both sexes and the third arm of the male the suckers are quadriserial, except at the extremity, where the arrangement is biserial though ill-defined, while the fourth arm has quadriserial ones throughout. Horny ring devoid of teeth except in the distal minute suckers where it has squarish teeth closely set on the distal three quadrants of the ring-margin.

Hectocotylization affects the distal half of left ventral arm. The suckers of this arm are of normal dimensions up to the tenth row and then follow rudimentary suckers of the affected part, attaching to swollen peduncular bases.

Tentacles slender about as long as head and body taken together, with stems thinner than arms. Club of moderate size, including about one-tenth of the entire length of tentacle, expanded, semicircular or reniform, bordered with a broad web on the dorsal side. Suckers in eight oblique series, unequal, about four in the middle of club being about thrice the diameter of marginal ones. Horny ring equipped on the whole margin, with fine slender teeth somewhat resembling horny tubercles of papillate area.

Buccal membrane with seven, suckerless points of margin. In the female there developes in the ventral part of the membrane a pair of ovoidal spermatic pads with racemose seminal receptacles. Branchial leaflets number about 65 in each gill. Spermatophores 5.8–6.5 mm. long, of no characteristic feature.

Color of back when fresh (Pl. I, fig. 6), yellowish buff in the lateral parts, light brown along the median zone, sparsely dotted with very faint yellowish tubercles, of which 5–7 in a series along each fin are specially distinct and streak-like. Each lateral margin of belly decorated with a clear iridescent zone. Three dorsal pairs of arms embellished with an orange stripe of metallic lustre along the median line of the aboral surface.

Shell slender, lanceolate, terminating bluntly at the anterior end and sharply at the posterior, which has a small, discoidal outer cone; maximum breadth in adult males about equal to, and in adult females a little greater than, one-sixth of the length. Sides show a more or less angular contour especially in the female. Chitinous margin narrow. Dorsal surface convex, its median line again elevated into a faint ridge; naked area on either side about one-fourth as broad as the entire surface; the remaining area covered with calcareous rugosities, coarser ones of which run together and arrange themselves in longitudinal lines. Ventral surface also convex except at the posterior part, the convexity

Measurements.

No. of specimen	i	ii	iii	iv	v	vi	vii
Sex	♂	♂	♂	♂	♂	♀	♀
Dorsal length of mantle	110 mm.	95 mm.	70 mm.	55 mm.	43 mm.	105 mm.	65 mm.
Ventral length of mantle	93 ,,	82 ,,	60 ,,	47 ,,	35 ,,	90 ,,	56 ,,
Maximum breadth of mantle	37 ,,	35 ,,	30 ,,	23 ,,	19 ,,	40 ,,	28 ,,
Length of head	22 ,,	20 ,,	16 ,,	12 ,,	10 ,,	20 ,,	17 ,,
Breadth of head	31 ,,	30 ,,	26 ,,	18 ,,	15 ,,	35 ,,	24 ,,
Mantle extent before fins	Left 5 mm. Right 4 mm.	Left 5 mm. Right 5 mm.	Left 5 mm. Right 4 mm.	Left 3 mm. Right 4 mm.	Left 2 mm. Right 2 mm.	Left 6 mm. Right 8 mm.	Left 4 mm. Right 5 mm.
Maximum breadth of fins	10 ,, 10 ,,	10 ,, 10 ,,	6 ,, 7 ,,	5 ,, 5 ,,	4 ,, 3.5 ,,	9 ,, 8 ,,	8 ,, 5 ,,
Length of first arms	39 ,, 39 ,,	30 ,, 30 ,,	28 ,, 28 ,,	19 ,, 18 ,,	18 ,, 18 ,,	43 ,, 44 ,,	30 ,, 30 ,,
,, ,, second arms	110 ,, 115 ,,	90 ,, 90 ,,	46 ,, 46 ,,	31 ,, 30 ,,	22 ,, 23 ,,	47 ,, 48 ,,	32 ,, 32 ,,
,, ,, third arms	37 ,, 37 ,,	32 ,, 30 ,,	24 ,, 24 ,,	20 ,, 18 ,,	14 ,, 15 ,,	42 ,, 43 ,,	30 ,, 29 ,,
,, ,, fourth arms	41 ,, 41 ,,	40 ,, 39 ,,	28 ,, 28 ,,	24 ,, 23 ,,	19 ,, 20 ,,	40 ,, 40 ,,	32 ,, 32 ,,
,, ,, tentacles	123 ,, 110 ,,	100 ,, 100 ,,	82 ,, 82 ,,	70 ,, 70 ,,	70 ,, 70 ,,	110 ,, 110 ,,	90 ,, 75 ,,
,, ,, clubs	13 ,, 10 ,,	12 ,, 10 ,,	10 ,, 10 ,,	8 ,, 8 ,,	7 ,, 7 ,,	11 ,, 11 ,,	8 ,, 8 ,,
Diameter of largest arm-suckers	1.4 mm.	1.1 mm.	0.9 mm.	0.7 mm.	0.6 mm.	1.2 mm.	7.0 mm.
,, ,, tentacular suckers	1.6 ,,	1.3 ,,	1.0 ,,	0.7 ,,	0.6 ,,	1.4 ,,	9.0 ,,
Breadth of shell	17.0 ,,	16.0 ,,	13.5 ,,	13.0 ,,	11.5 ,,	22.0 ,,	15.0 ,,
Thickness of shell	7.0 ,,	6.0 ,,	5.5 ,,	4.5 ,,	3.8 ,,	6.0 ,,	4.5 ,,

being greatest at the anterior part of striated area. Boundary line of the latter area semicircular or triangular but often retuse. Median longitudinal groove of the surface faint, though traceable along the whole length. Inner cone poorly developed, consisting of a very narrow V-shaped rim, of which the posterior part is a little prominent and encloses a narrow but comparatively deep space. Locular index 17–27. Rostrum rather long.

Remarks.—This is well difined species distinctly characterized by the second arms of the male. The peculiarity of these arms are, however, not marked in younger specimens, where they are, though longer than the others, of quite normal shape, evenly tapering to fine extremities (Pl. XVIII, fig. 13). The hectocotylization becomes marked when the male is over about 70 mm. in mantle length; seminal receptacles are filled with sperm in females with mantle longer than about 60 mm. Such males and females are met with most in spring as well as in early summer and least in autumn.

Locality.—Hako Dati [Hakodaté?], Japan (Steenstrup); Hakodaté?, Hokkaido (Sasaki); Hakodaté market (Albatross!) Hakodaté (Albatross!); Tsugaru Strait (!); Mori, Hok. (!); Oshoro Hok. (!); Sapporo market (!); Shimo-osa Prov. (Sasaki); Awa Prov. (Saski).

Sepia tokioensis Ortmann, 1888.

Local name; Suji-ika (Awa Prov.).

(textfig. 110).

Sepia tokioensis, Ortmann 1888, p. 653, pl. xxiii, fig. 3.—Wülker 1910, p. 14.
Sepia (*Doratosepion*) *tokioensis*, Berry 1012b, p. 423?—Sasaki 1914, p. 616.

This species is represented by twenty-six specimens in the collections at my disposal. They are all male measuring up to 88mm. in mantle length.

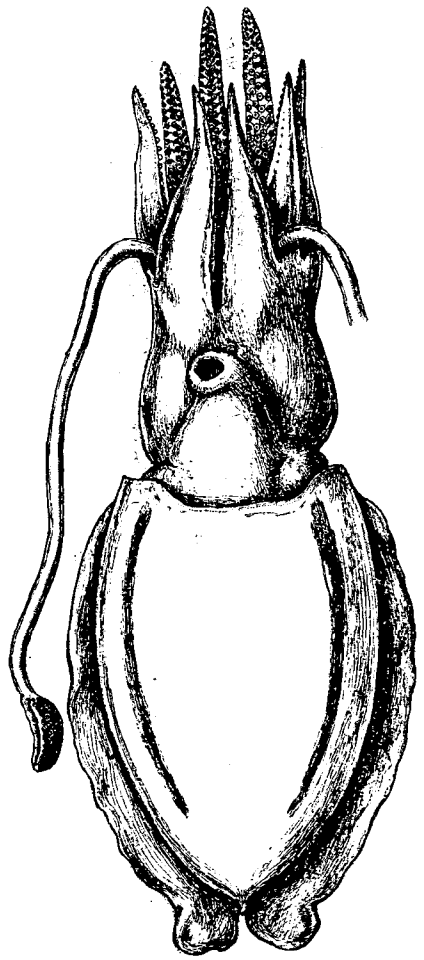
Body roughly ovate in contour, broadest near the middle, shorter than twice the maximum breadth of its own (textfig. 110). Anterior margin of mantle distinctly emarginated at the ventral part, while its dorsal part protrudes over the head in a triangular lobe comprising $^1/_9$–$^1/_{10}$ of the length of the back. Fins about one-sixth the breadth of body, extending to within 5 mm. of mantle margin in front and within 3 mm. of each other behind, where they are thickened and expanded into lobes marked off from the remaining parts by notches.

Head ordinarily narrower than mantle opening, about one-sixth as long as the dorsal side of mantle. Funnel slendar, thin-walled, extending nearly to ventral interbrachial space. Umbrella best developed between first arms, next in breadth between the second and third as well as between the third and fourth; quite rudimentary between fourth arms as usual.

Arms subequal, the formula of length being $1>2>3\fallingdotseq4$ or $1>4>2>3$. First arms decidedly longer than the rest which are of roughly equal length. All more or less compressed from side to side, keeled on back, terminating rather bluntly. Protective membranes comparatively wide, even at the extremity especially in the two dorsal pairs of arms. Suckers distinctly, but rather sparsely, quadriserial even at the extremity; small, somewhat unequal, being a little larger in the series than in the outer. Peduncular bases of suckers somewhat conspicuous. Horny ring smooth except for a few sinuations of margin.

No hectocotylization discernible except for that the distal suckers of the left ventral arm are slightly smaller than those of the right ventral.

Tentacles variable in length, but ordinarily half as long again as the dorsal side of mantle, with stems thinner than arms. Club small, $^1/_{10}$–$^1/_{13}$ the entire length of tentacles, expanded, crescent-shaped, with dorsal web of moderate breadth. Suckers apparently in five or six series but numbering eight in an oblique row; unequal in size, four or five in the middle of club being larger than the rest. Horny ring armed with close-set teeth, the number of which is in direct proportion with the size of ring and is about 60 in the largest one.



Textfig. 110.

Sepia tokioensis. Ventral view of male sex; × natural size.

Gill composed of 73 leaflets. Spermatophores 5–6mm. long, its sperm cord 3–4 mm. long, occupying the middle part of etui.

Color in formalin grayish brown, much paler below. Dorsal surface sparsely dotted with faint slightly elevated yellowish tubercles, of which several in a series along each fin are larger than the rest and streak-like. Belly embellished on each side with a faint longitudinal iridescent line running parallel with the lateral margin and extending ⅔–¾ down the surface from anterior margin.

Shell slender, roughly elongate-rhomboidal, widest one-third of the way back, 4–5 times as long, and $^{2}/_{5}$–$^{1}/_{2}$ as thick, as the maximum breadth of its own. Outer cone small, discoidal and terminal. Chitinous margin comparatively broad. Dorsal surface convex, the median line again slightly elevated; the median one-third of the surface covered with calcareous rugosities, coarser ones of which form longitudinal lines in the lateral part. Ventral surface convex in the anterior parts, the maximum depth of the convexity equaling that of dorsal surface; traversed by a narrow, but distinct, groove along the median line. Rim of inner cone very narrow, V-shaped bordering the striated area; its posterior end a little prominent forming a flattened cone about as long as rostrum and enclosing a very narrow, but relatively deep, space. Anterior boundary line of striated area semicircular but retuse. Locular index 26–38. Rostrum about 4mm. in full-sized specimens.

Measurements.

No. of specimen	i	ii	iii	iv	v
Dorsal length of mantle	88 mm.	82 mm.	78 mm.	74 mm.	45 mm.
Ventral length of mantle	77 ,,	70 ,,	67 ,,	60 ,,	39 ,,
Breadth of mantle	46 ,,	46 ,,	44 ,,	42 ,,	27 ,,
Breadth of head	—	29 ,,	28 ,,	26 ,,	17 ,,
	Left Right	Left Right	Left Right	Left Right	Left Right
Maximum breadth of fins	mm. mm. 9 12	mm. mm. 8 7	mm mm. 7 9	mm. mm. 5 5	mm. mm. — —
Length of first arms	54 ,, 54 ,,	44 ,, 44 ,,	41 ,, 42 ,,	34 ,, 34 ,,	18 ,, 17 ,,
,, ,, second arms	49 ,, 47 ,,	38 ,, 38 ,,	37 ,, 36 ,,	29 ,, 29 ,,	16 ,, 16 ,,
,, ,, third arms	46 ,, 44 ,,	35 ,, 34 ,,	35 ,, 35 ,,	25 ,, 24 ,,	16 ,, 16 ,,
,, ,, fourth arms	40 ,, 40 ,,	32 ,, 32 ,,	35 ,, 35 ,,	25 ,, 23 ,,	16 ,, 18 ,,
,, ,, tentacles	—	— 120 ,,	— 95 ,,	125 ,, 115 ,,	— —
,, ,, clubs	—	— 11 ,,	— 7 ,,	8 ,, 8 ,,	— —
Diameter of largest arm-sucker	1.0 mm.	1 mm.	1.0 mm.	1.0 mm.	— mm.
,, ,, ,, tentacular sucker	1.5 ,,	1.2 ,,	1.2 ,,	1.3 ,,	1.0 ,,
Breadth of shell	18.0 ,,	18.0 ,,	18.0 ,,	17.0 ,,	12.0 ,,
Thickness of shell	8.0 ,,	7.0 ,,	7.0 ,,	8.0 ,,	5.0 ,,
Length of rostrum	4.0 ,,	4.0 ,,	3.0 ,,	3.0 ,,	2.0 ,,

Remarks.—The specimens referred to disagree with Ortmann's original description in some noteworthy points. According to him (1) the extremity of arms is slender, (2) the fourth arms are as long as the first, (3) distal suckers on each arm are biserial instead of quadriserial, and (4) the locular index is 36–40, being much greater than in the specimens now before me.

I am rather surprised that the species has been reported from Aomori by Berry. As far as I have ascertained, the northern boundary of distribution is about Kinka-san, and in the Tsugaru straits including Aomori Bay the genus *Sepia* is represented by only *S. andreana* Steenstrup, the female of which closely resembles the species under consideration.

Locality.—Aomori (Berry); near Kinka-san (!); Mito market (!); Shimo-osa Prov. (Sasaki); Awa Prov. (Sasaki); Tôkyo market (Sasaki); Tôkyo Bay (Ortmann); Yokohama market (!); Misaki (Wülker); Nagasaki (!).

Sepia misakiensis Wülker, 1910.

(Pl. XVIII, figs. 14, 15.)

Sepia misakiensis, Wülker 1910, p. 15, figs. 5, 6, 19–22.—Sasaki 1920, p. 194.
Sepia (*Daratosepion*) *misakiensis*, Berry 1912b, p. 424.—Sasaki 1914, p. 617.

This species is represented by three specimens in the collections at my disposal. They all agree satisfactorily with Wülker's original description and closely approaches *S. tokioensis* as he said.

Body roughly elliptical in contour, more slender than *S. tokioensis*, its dorsal length being more than twice the maximum breadth (Pl. XVIII, fig. 14). Dorsal part of mantle margin projects into a triadgular lobe comprising $^1/_{11}$–$^1/_{10}$ of the dorsal length of mantle; its ventral part distinctly emarginated. Fins broad, the maximum breadth being more than one-forth that of mantle; their posterior end thickened and expanded into special lobe as in *S. tokioensis*.

Head slightly narrower than mantle opening, and about one-fifth as long as its dorsal side. Funnel rather short, extending less than to ventral interbrachial space.

Arms subequal, the formula of length being $1>2>3\fallingdotseq 4$. First pair decidedly longer than the rest, but far shorter than half the dorsal length of mantle; compressed laterally, strongly carinated on back, bordered with broad costate protective membranes even at the extremity, which is thick and bent round inward, due to the contraction of the protective membranes. Second arm resembles the first but decidedly shorter. Third and fourth arms similarly compressed and keeled on back as the preceding arms, but regularly tapering to subtile extremities and the protective membranes very narrow. Suckers and their peduncular bases almost as in *S. tokioensis;* on each arm, there are found about 35 transverse rows of four each. Horny ring also as in that species.

The hectocotylization was indistinct in all the specimens examined, both the ventral arms being similar in all respects. Wülker points out "sie scheint in einer Verminderung der Saugnäpfe am Grunde des vierten linken Armes zu bestehen".

Tentacles thick and very short as compared with those of *S. tokioensis*, being thinner only a little than arms and shorter than mantle. Club expanded, crescent-shaped, comprising $^1/_8$–$^1/_7$ of the entire length of tentacle. Suckers and their horny ring both resemble also those of *S. tokioensis;* the former arranged in about fourteen oblique rows of eight in each (Pl. XVIII, fig. 15).

Color in alcohol grayish brown, but much paler beneath. A little elevated yellowish dots sparsely scattered over head and mantle, and several streak-like tubercles in a series along each fin. Belly with two longitudinal lines, one on each side running parallel with the lateral margin two-thirds down the length.

Spermatophores 5.5 mm. long, of about uniform breadth; sperm cord 2.8 mm. long, with innumerable transverse striations situated in the middle of etui. Branchial leaflets number about 65 in each gill.

Shell slender, lanceolate, a little longer than four times of its own maximum breadth, which is in turn two and one-third times the thickness; the broadest part slightly anterior to the point one-third

of the length from the anterior end. Outer cone terminal, small, discoidal. Chitinous margin of moderate breadth. Dorsal surface gently convex, with a faint ridge along the median line. About median one-third of the surface covered with fine calcareous deposits, the comparatively coarser ones of which form longitudinal lines on the lateral parts and transverse lines in the median region. Ventral surface convex in the anterior parts, the maximum depth of the convexity being greater than that of the dorsal surface. Rim of inner cone very narrow, arising halfway along the shell, very gradually thickening backwards, and forming posteriorly a flattened cone two-thirds as long as rostrum, which is about 3 mm. in the largest specimen now before me. Last locular line arcuate, with a deep indentation in the middle. Locular index about 38.

Measurements.

No. of specimen	i		ii		iii	
Dorsal length of mantle	67 mm.		67 mm.		59 mm.	
Ventral length of mantle	61 ,,		60 ,,		55 ,,	
Maximum breadth of mantle	32 ,,		32 ,,		24 ,,	
Breadth of head	23 ,,		23 ,,		22 ,,	
	Left	Right	Left	Right	Left	Right
Mantle extent before fins	3 mm.	3 mm.	3 mm.	4 mm.	4 mm.	3 mm.
Maximum breadth of fins	9 ,,	9 ,,	8 ,,	9 ,,	8 ,,	9 ,,
Length of first arms	29 ,,	29 ,,	30 ,,	30 ,,	25 ,,	25 ,,
,, ,, second arms	25 ,,	25 ,,	27 ,,	27 ,,	21 ,,	21 ,,
,, ,, third arms	23 ,,	23 ,,	24 ,,	24 ,,	20 ,,	20 ,,
,, ,, fourth arms	23 ,,	22 ,,	25 ,,	25 ,,	20 ,,	20 ,,
,, ,, tentacles	60 ,,	—	60 ,,	63 ,,	50 ,,	50 ,,
,, ,, clubs	9 ,,	—	8 ,,	9 ,,	6 ,,	6 ,,
Breadth of shell	17 mm.		—		14 mm.	
Thickness of shell	8 ,,		—		6 ,,	
Length of rostrum	3 ,,		—		2 ,,	

Locality.—Misaki (Wülker, Sasaki); mouth of Uraga channel (Wülker); Yaku-shima, south of Kiu-shiu, 84 fms. (Albatross!).

Sepia kobiensis Hoyle, 1885.

Sepia kobiensis, Hoyle 1885b, p. 195; 1885d, p. 300; 1886b, p. 142, pl. xviii, figs. 7–14.—Appellöf 1886, p. 20, pl. iii, fig. 7.—Ortmann 1888, p. 654,—Wülker 1910, p. 16?—Sasaki 1920, p. 194.

Sepia (*Doratosepion*) *kobiensis*, Berry 1912b, p. 423.—Sasaki 1914, p. 617.—Massy 1916, p. 230.

Sepia andreanoides, Hoyle 1885b, p. 193; 1885d; p. 297; 1886b, p. 139, pl. xxi, figs. 11–19; pl. xxii, fig. 11.

Sepia (*Doratosepion*) *andreanoides*, Massy 1916a, p. 229.

This is one of the commonest *Sepia* in Japan and at the same time the hardest form to identify owing to its marked variation. The characteristics of the species which I have determined with the specimens at my disposal, are as follows:—

Body subelliptical, 2–2½ times as long as wide, broadest anteriorly, more or less tapered behind, where it has a spine; length less then 70 mm. Fins rather narrow, being at most one-fifth the maximum breadth of body, usually much narrower, their posterior end neither lobed nor connected with that of the corresponding fin of the opposite side. Funnel short. Arms ordinarily equal in length but the dorsal pair in the male may be decidedly longer than the rest; suckers quadriserial, but often

biserirl at the extremity of dorsal and lateral arms, with nearly or quite smooth horny ring. Hectocotylization affects the distal half of left ventral arm except the extreme end, consisting in the abnormal development of the ventral protective membrane and in the diminution of suckers in size especially on the ventral side. Tentacles usually slendet; club small, crescentshaped, with 80–100, minute suckers, apparently in five series, and of which five or four in the middle of the club are usually a little larger than the rest; horny ring with 20–32, blunt teeth. Shell lanceolate or slenderly elliptical, ¼–⅕ as wide as long, with small discoidal or cup-shaped outer cone and rather long rostrum; median one-third of dorsal surface covered with calcareous rugosities, rim of inner cone very narrow, more or less V-shaped, its postrerior part usually a little prominent, forming flattened cone enclosing a very narrow space.

Localities hitherto reported:—? Hakodate, Hizen (Berry), Maizuru, Tango Prov. (Ortmann); Tôkyo Bay (Ortmann); Kadji-yama (Ortmann); ? Yokohama market (Hoyle); Misaki (Wülker); Enoura, Suruga Prov. (Sasaki); Kôbe Bay (Hoyle); Nagasaki (Appellöf; Berry); Kagoshima (Ortmann). Persian Gulf (Massy); Burma (Massy); Kolumadulu Atoll (Hoyle); Laccadive Sea (Massy); Ceylon (Massy).

Remarks.—The specimens which I have examined, show marked variations; these being not linked by intermediate forms. I separate it therefore into six varieties until our further knowledge on the subject should necessitate a change. The following is a key to these varieties:—

(A) Shell in both sexes lanceolate, regularly tapered posteriorly; rim of inner cone nicely V-shaped, its posterior part roughly conical though flattened dorso-ventrally, enclosing a very narrow but comparatively deep hollow.

(α) Tentacles slender, decidedly thinner than arms; their suckers usually not markedly unequal; horny ring of largest suckers weakly dentate.

(a) Breadth of shell in female below 22% of the length.

(1) Tentacular suckers unequal.....var. *typica.*

(2) Tentacular suckers rather equal .....var. *toyamensis.*

(b) Breadth of shell in female over 22% of its length.

(3) Tentacular suckers usually a little unequal; arms in male about equal .... var. *andreanoides.*

(4) Tentacular suckers a little unequal; dorsal arms in male decidedly longer than the rest..... var. *beppuana.*

(β) Tentacles as thick as dorsal arms, their suckers markedly unequal, horny ring of largest suckers strongly dentate.....var. *crassa.*

(B) Shell in male, slenderly elliptical; posterior rim of inner cone in both sexes narrow, flattened, forming a parabolic curve; horny ring of largest tentacular suckers with about 25 strong teeth on the extreme edge of the margin.....var. *albatrossii.*

Sepia kobiensis var. **typica** mihi.

(Pl. XIX, figs. 1–4; textfig. 111.)

Sepia kobiensis, Hoyle 1885b, p. 195; 1885d, p. 300; 1886b, p. 142, pl. xviii, figs. 7–14.—Sasaki 1920, p. 194 (pars).

Two female specimens collected by the "Albatross" agree satisfactorily with Hoyle's original description of the species.*) They are both not yet fully mature, the nidamental glands measuring only 3 mm. in length.

Body subelliptical, broadest one-third of the way back, pointed behind, a little compressed dorso-ventrally; maximum breadth about 38% of the dorsal length (Pl. XIX, fig. 1). Dorsal margin of mantle produces in a triangular lobe comprising about 9% of the dorsal length; ventral margin dis-

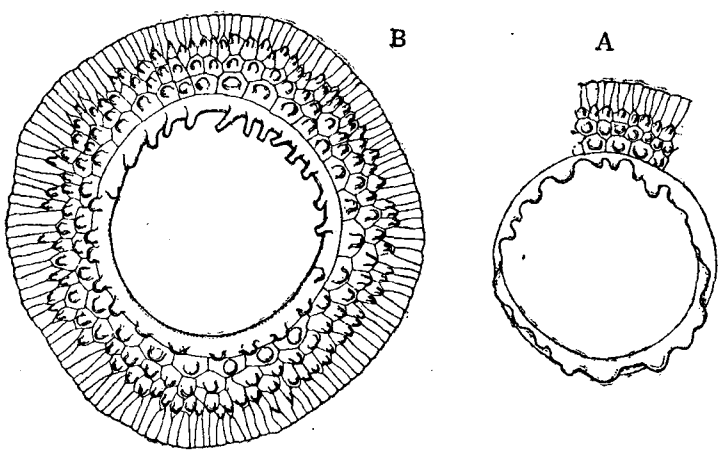
*) The agreement is also satisfactorily even compared with the type specimen of the species preserved in the British Museum, London.

tinctly emarginated at the middle part. Fins very narrow, only about one-fifth the breadth of body, extending to the point 2 or 3mm. from mantle margin in front and to within 2mm. of each other behind.

Head as wide, and one-fourth as long, as mantle. Eyes prominent laterally. Funnel short, reaching about halfway to ventral interbrachial space. Umbrella but little developed, its greatest extent being between dorsal arms where it extends to the third row of suckers.

Arms nearly equal, the formula of length being $4>1\fallingdotseq2>3$, or $4\fallingdotseq1>2>3$; the longest shorter than one-third the length of mantle. First pair subconical, but with a distinct keel on back, tapering to fine extremity. Second pair almost as in the first except for having no keel. Third pair compressed, with a web on the ventral side of the aboral surface; fourth pair more compressed and much stouter than the former, with a prominent keel along the outer edge. The latter two pairs taper rather rapidly so that their extremity is not so slender as in the former two pairs.

Arm-suckers subglobular, obliquely stalked; aperture rather small, with a notch at the distal margin; quadriserial except at the extreme base and distal $\frac{1}{4}$–$\frac{1}{3}$ of arms; in these places they are biserial. The biserial arrangement especially marked on the distal part of lateral arms, where the suckers of one side are separated from those of the other side by a broad median space. Suckers on each arm slightly smaller in outer rows than in the inner. Horny ring ordinarily smooth but occassionally its margin is very uneven, provided with many sinuations (textfig. 111A); papillate area consisting of about three series of papillate facetts, bordered with radiated margin; papillae short, round-headed.



Textfig. 111.

Sepia kobiensis var. *typica*. A. Part of horny ring of arm-sucker; × 150. B. Horny ring of tentacular sucker; × 150.

Tentacles about as long as, or shorter than, mantle. Stem thinner than arms; three-sided; aboral surface slightly concave, marked off on sides by narrow folds, and with a faint streak along the median line. Club expanded, bordered on the dorsal side with a broad web which extends proximally a little beyond the carpus (Pl. XIX, fig. 2). Suckers hemispherical, with broad apertures, numbering about 80, apparently in five series but in very oblique rows of eight in each; unequal; four or five which belong to a longitudinal series near by the dorsal margin, are the largest of all and five or six of the next ventral series come next in size. Horny ring of the largest suckers with about 25, blunt, separate teeth which are longer and thinner in the distal margin than in the proximal (textfig. 111B).

Surface smooth but sparsely dotted with faint tubercles, several of which in a longitudinal series along each fin as well as on either side of the belly are especially marked and are streak-like. Colour in alcohol dark purplish gray above, paler below; chromatophores rather large.

Shell very slender, lanceolate, rounded in the anterior end, widest one-third of the way back, then regularly tapering posteriorly (Pl. XIX, fig. 3). Outer cone small, discoidal. Length about four and a half times the maximum breadth, which is in turn half the maximum thickness. Chitinous margin very narrow. Dorsal surface evenly convex except for a faint ridge along the median line. Middle two quarters of the surface invested with calcareous layer, which is so thin that all the locular lines lying underneath are clearly visible on the surface. Ventral surface more strongly convex than the dorsal, traversed along the whole length by a shallow but distinct groove. Last locular line arcuate, but with a very faint notch in the middle. Locular index 35–40. Rim of inner cone arises

halfway along the shell, becoming a little wider towards the posterior end where it is a little expanded but flat and appressed on the outer cone (Pl. XIX, fig. 4).

Measurements.

Sex	♂		♀	
Dorsal length of mantle	31.5 mm.		23.0 mm.	
Ventral length of mantle	29.0 ,,		21.0 ,,	
Maximum breadth of mantle	12.5 ,,		9.0 ,,	
Length of head	8.0 ,,		6.0 ,,	
Breadth of head	12.5 ,,		9.5 ,,	
Maximum breadth of fins	27.0 ,,		1.5 ,,	
Mantle extent in front of fins	2.5 ,,		1.8 ,,	
Length of first arms	Left 8.0 mm.	Right 8.0 mm.	Left 6.0 mm.	Right 6.0 mm.
,, ,, second arms	8.0 ,,	8.0 ,,	5.2 ,,	5.2 ,,
,, ,, third arms	7.5 ,,	7.5 ,,	4.8 ,,	4.8 ,,
,, ,, fourth arms	9.0 ,,	9.0 ,,	6.0 ,,	6.0 ,,
,, ,, tentacles	27.0 ,,	—	24.0 ,,	—
,, ,, clubs	3.0 ,,	—	2.5 ,,	—
Diameter of largest sucker of arms	0.4 mm.		?	
,, ,, ,, ,, ,, tentacles	0.3 ,,		?	
Breadth of shell	7.0 ,,		5.5 mm.	
Thickness of shell	3.5 ,,		2.9 ,,	
Length of rostrum	1.2 ,,		1.0 ,,	

Remarks.—The only discrepancies from Hoyle's description are that the longest arms are not the second pair but the fourth, and that the fins extend straight to above the spine and do not pass on to the ventral surface of the mantle as mentioned by Hoyle.

The variety differs from the others in the more grayish color, in the more slender and thicker shell, in having less numerous tentacular suckers, the largest of which ones appear at a glance situated very near the dorsal margin of the club, not in its middle part, and in that the horny ring of arm-suckers sometimes has irregular blunt teeth.

Locality.—Kôbe Bay (Hoyle); near Yakushima, south of Kiushiu, 39 fms. (Albatross!).

Sepia kobiensis var. **andreanoides** Hoyle, 1885.

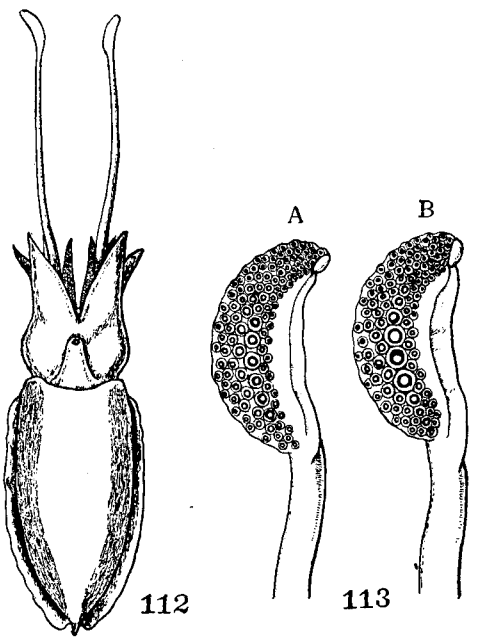
(Pl. I, fig. 7; Pl. XIX, figs. 5–7; textfigs. 112–114.)

Sepia kobiensis, Appellöf 1886, p. 20, pl. iii, fig. 7; Sasaki 1920, p. 194 (pars).
Sepia andreanoides Hoyle 1885b, p. 193; 1886b, p. 139, pl. xxi, figs. 11–19, pl. xxii, fig. 11.

This variety is based on about two hundred specimens collected by myself at Manazuru, Sagami Prov., where it is caught in plenty for the market. They range up to 65 mm. in length, the nidamental glands of the mature female measuring about 6 × 4 mm.

Body roughly elliptical broadest one-third of the way back, bluntly pointed behind; maximum breadth 33–45 % of the dorsal length. Projection of the mid-dorsal margin of mantle broad, triangular, being 10–12% of the dorsal length. Fins when fresh about one-fifth as broad as mantle, variable in preserved specimens, often shrunken into a diminutive breadth.

Head as wide as mantle opening; length 1/4–1/5 that of the back of body. Funnel comparatively small, extending far less than to ventral interbrachial space. Least development of umbrella is between first and second arms, but its rudimentary condition between fourth arms is as usual.



Textfig. 112.

Sepia kobiensis var. *sagamiana*. Ventral view of female sex; ×2/3.

Textfig. 113.

Sepia kobiensis var. *sagamiana*. Club showing two extreme limits of variation in respect to the relative sizes of suckers; ×4.

Arms nearly equal, the formula of length being usually $1 \doteqdot 4 > 2 \doteqdot 3$; all shorter than half the dorsal length of mantle, more or less carinated on back, especially the fourth. Suckers quadriserial except at the extremities of lateral arms and sometimes also of dorsal arm; at these extremities they form a distinct biserial arrangement. Suckers on each arm somewhat unequal in size, those of the inner series being a little larger than those of the outer. Horny ring smooth in all suckers.

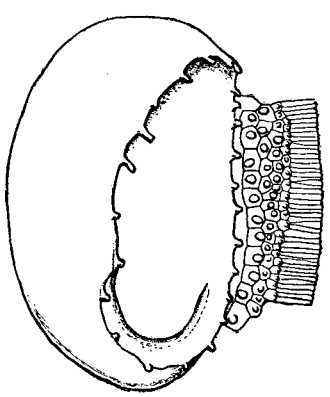
Hectocotylus developed on the subterminal part of left ventral arm. Suckers on this arm normal up to eighth row; adjoining seven or eight (sometimes nine) rows which are on the hectocotylus, are greatly reduced in size, especially those belonging to the two ventral series. Beyond these, the suckers resume their normal sizes.

Tentacles, though variable in length, usually about as long as the dorsal side of mantle, their stem decidedly thinner than arms. Club small, comprising only one-tenth of the entire length of tentacle, armed with about 100 suckers in oblique rows of eight in each and which are nearly uniform, but four or five near the middle of club are a little larger than the rest (textfig. 113). Horny ring with long, but blunt, far separate teeth counting 20–32 in larger suckers (textfig. 114).

Buccal membrane thick, deeply wrinkled, with seven, blunt, sucker-less points of margin. Ventral part of the membrane in mature females, provided with two ovoid spermatic pads containing ramified seminal receptacles.

Spermatophores about 5 mm. long; sperm cord only 2.5–2.8 mm. long.

Color in life, deep brown when irritated, and yellowish buff when quiet. Dorsal surface sparsely dotted with minute yellowish tubercles, of which about seven in a series along each fin are specially marked and streak-like. Each arm embellished with a reddish shining line along its dorsal aspect and extending on to the back of head (Pl. I, fig. 7). Posterior end of fins also decorated with a similar line though very short. Belly bordered on either side with a faint pearly zone which has about five minute streak-like tubercles in a longitudinal series (textfig. 112).



Textfig. 114.

Sepia kobiensis var. *sagamiana*. Horny ring of largest tentacular sucker; ×10.

Shell slender, lanceolate, much more sharpened posteriorly than anteriorly; length in mature males a little greater, and in mature females a little less, than five times the breadth; outer cone small, discoidal. Chitinous margin rather narrow. Dorsal surface slightly convex, with a faint, median ridge marked off by two shallow grooves. About median one-third of the surface covered with calcareous rugosities arranged in longitudinal lines. Ventral surface convex, the depth of convexity being greater than that of the dorsal surface, traversed by a faint median groove. Last locular line semicircular or triangular, but with a very shallow sinus at the apex. Inner

Measurements of fresh Specimens.

No. of Specimen	i	ii	iii	iv	v	vi
Sex	♀	♀	♀	♂	♂	♂
Dorsal length of mantle	69.0 mm.	66.5 mm.	62.0 mm.	58.0 mm.	53.5 mm.	50.0 mm.
Ventral length of mantle	58.0 ,,	59.0 ,,	55.0 ,,	49.0 ,,	46.0 ,,	44.6 ,,
Breadth of mantle	27.0 ,,	27.0 ,,	25.5 ,,	25.0 ,,	22.0 ,,	20.6 ,,
Breadth of head	25.0 ,,	25.0 ,,	23.5 ,,	22.0 ,,	20.0 ,,	20.0 ,,
Maximum breadth of fins	Left mm. 4.5 Right mm. 5	Left mm. 6.5 Right mm. 5.0	Left mm. 4.0 Right mm. 4.0	Left mm. 4.0 Right mm. 4.0	Left mm. 4.0 Right mm. 4.0	Left mm. 3.0 Right mm. 4.0
Mantle extent before fins	3.5 ,, 3.5 ,,	3.5 ,, 3.0 ,,	3.5 ,, 3.5 ,,	3.2 ,, 3.0 ,,	3.0 ,, 3.0 ,,	3.0 ,, 3.5 ,,
Length of first arms	24.0 ,, 25.0 ,,	24.0 ,, 24.0 ,,	23.0 ,, 23.0 ,,	22.0 ,, 22.0 ,,	20.0 ,, 20.0 ,,	18.0 ,, 19.0 ,,
,, ,, second arms	24.0 ,, 24.0 ,,	23.0 ,, 23.0 ,,	22.5 ,, 22.0 ,,	19.0 ,, 20.0 ,,	17.0 ,, 17.0 ,,	16.0 ,, 16.0 ,,
,, ,, third arms	25.0 ,, 24.0 ,,	23.0 ,, 23.0 ,,	22.0 ,, 23.0 ,,	18.0 ,, 19.0 ,,	17.0 ,, 17.0 ,,	16.0 ,, 16.0 ,,
,, ,, fourth arms	25.0 ,, 25.0 ,,	24.0 ,, 24.0 ,,	23.0 ,, 23.0 ,,	20.0 ,, 21.0 ,,	19.0 ,, 20.0 ,,	18.0 ,, 18.0 ,,
,, ,, tentacles	75.0 ,, 70.0 ,,	63.0 ,, 65.0 ,,	60.0 ,, 60.0 ,,	65.0 ,, 65.0 ,,	58.0 ,, 58.0 ,,	60.0 ,, 60.0 ,,
,, ,, clubs	7.5 ,, 7.5 ,,	7.0 ,, 6.0 ,,	6.0 ,, 6.0 ,,	7.0 ,, 7.0 ,,	5.8 ,, 6.0 ,,	6.0 ,, 5.0 ,,
Diameter of largest arm-sucker	0.9 mm.	0.9 mm.	0.8 mm.	0.8 mm.	0.8 mm.	0.7 mm.
,, ,, ,, tentacular sucker	0.5 ,,	0.6 ,,	0.4 ,,	0.4 ,,	0.4 ,,	0.38 ,,
Breadth of shell	12.8 ,,	13.0 ,,	12.0 ,,	10.2 ,,	9.6 ,,	9.5 ,,
Breadth of posterior rim of inner cone	3.0 ,,	3.0 ,,	2.5 ,,	3.0 ,,	2.0 ,,	1.5 ,,
Length of rostrum	5.0 ,,	4.6 ,,	4.6 ,,	4.5 ,,	4.0 ,,	4.0 ,,

cone poorly developed, with a thin rim arising a little posterior to the middle, and forming behind a flattened cone about half as long as rostrum. Locular index 28–40. Rostrum comparatively long, attaining about 5 mm. in full-sized specimens.

Remarks.—The specimens examined agree very well with *S. andreanoides* Hoyle; the agreement was also satisfactorily even when they were compared with its type specimen preserved in the British Museum, London. The only difference from it is that the tentaclur suckers are not quite uniform as is said in that species. But the relative sizes of the said suckers are subject to individual variation, ranging from decidedly unequal to nearly equal condition and hence the difference seems to be not so very important as might be taken as a specific distinction.

Though this variety agrees with Appellöf's description of *S. kobiensis*, it differs distinctly from real Hoyle's *S. kobiensis*. The shell of all specimens at my disposal is not so slender as given by Hoyle. The breadth of shell is ordinarily about 24% of the length in the male and 26% in the female but ranging 22–27% in the former sex and 23–29% in the latter. According to Hoyle, however, the breadth and length are 7 mm. and 41 mm. respectivery so that the breadth is about 20% of the length, this is less than the minimum limit of either sexes mentioned above.

Locality.—Tôkyo market (!); Manazuru, Sagami Prov. (!); Yokohama market (Hoyle); Sagami Sea, 58 fms. (Albatross!); Isé Prov. (!); Tsuruga (Albatross!); Krusenstern Strait (Albatross!); Nagasaki (Appellöf); west of Amakusa, Kiushiu, 53 fms. (Albatross!); near Sata-misaki, Kiusiu 58–70 fms. (Albatross!).

Sepia kobiensis var **toyamensis** var. nov.

(Pl. XIX, figs. 8–12; textfig. 115.)

This variety is based on five mature specimens caught by myself in Toyama Bay.

Body roughly elliptical, about two and a half times as long as broad, widest about one-third of the way back. Projection of the mid-dorsal margin of mantle triangular, about one-tenth of the entire dorsal length. Fins of moderate breadth; distance from their anterior origin to mantle margin and that between their own posterior ends are both 2–4 mm. even in full-sized specimens.

Head a little narrower than mantle margin, 21–24% of the dorsal length of body. Funnel short, extending to two-thirds up the distance to ventral interbrachial space. Umbrella broadest between lateral arms where it extends to the third row of suckers; in the remaining interbrachial spaces its extention is about equal, but between ventral arms it is absent as usual.

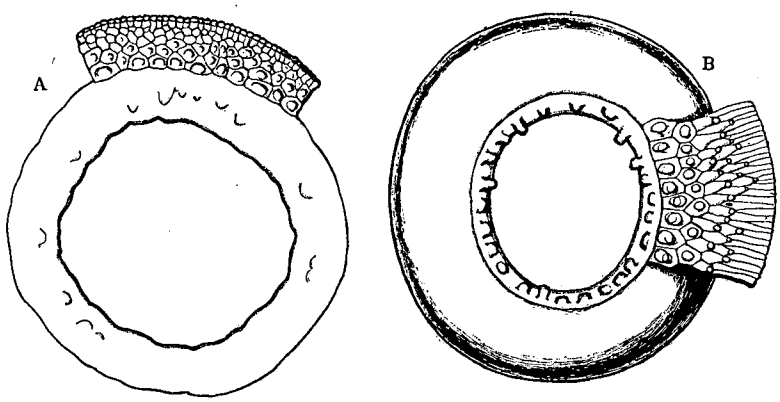
Arms in female nearly equal, the formula of length being $1 \fallingdotseq 4 > 2 \fallingdotseq 3$, or $1 \fallingdotseq 2 \fallingdotseq 3 > 4$; the same in male unequal, first pair being ⅓–¼ as long again as the rest and a little longer than half the entire length of mantle. First and second arms both rounded on back, without keel; third and fourth arms more or less flattened and keeled on back.

Arm-suckers quadriserial except on the distal quarter of arms as well as on the extreme base, on these places their arrangement is biserial. At the extremity of the lateral arms, the biserial arrangement is often very distinct, the suckers of one side separated from those of the other by a broad median space. Suckers on each arm about uniform but slightly larger in the inner series than in the outer. Horny ring smooth in all suckers; papillate area comparatively narrow, composed of four or five series of facetts which have indistinct, broad, and very short papillae (textfig. 115A); radiated border comparatively narrow.

Left ventral arm prominently hectocotylized in the distal half where a groove is formed along the median line defined by a thickened fold on either side; the fold of the ventral side is especially wide, thick, fleshy, and usually has numerous transverse furrows (Pl. XIX, fig. 8). On the proximal half of the arm, there are found 24–27 normal suckers arranged in four series, of which the two ventral series often do not extend to the hectocotylized part. On this part the suckers are found only on the dorsal side in a zigzag series, and are reduced in size, but at the extremity, they again somewhat resume their normal condition.

Tentacles about as long as mantle, their stem thinner than arms. Club small, including only

$^1/_{12}$–$^1/_{10}$ of the entire length of tentacle. Suckers number about 85, arranged apparently in five or six series, minute, about uniform but five or six in the middle of the club may be slightly larger than the other (Pl. XIX, fig. 9). Horny ring of these suckers equipped with about 25, blunt, broad, and short teeth on the outer aspect of the border, the extreme edge of the ring remaining quite smooth (textfig. 115B). Papillate area broad, consisting of four or five concentric series of papillate facetts, bordered with a broad, finely radiated margin. Papillae of the innermost series of the facetts conspicuous, table-shaped, with expanded extremity.



Textfig. 115.

Sepia kobiensis var. *toyamensis*. Horny rings of largest arm-sucker (A) and largest tentacular sucker (B); ×17.

Spermatophores 6–6.5 mm. long, sperm pad 3.5–3.8 mm. situated in the middle of etui.

Shell nicely lanceolate; breadth 20–23 % of the length. Thickness in male about one-third, and in female about a half, of the breadth. Sides in male evenly arched in contour (Pl. XIX, fig. 11); in female bluntly angular (Pl. XIX, fig. 10). Dorsal surface a little convex, with a faint median ridge, the convexity being decidedly less in male than in female. Median one-third of the surface covered with calcareous rugosities in longitudinal lines. Ventral surface also convex except at the posterior part, the convexity being far greater in male than in female; a faint groove traceable along the whole length of the surface. Anterior boundary line of striated area arched, but sometimes with a shallow sinus in the middle. Rim of inner cone arises two-thirds the length of shell from its anterior extremity, gradually widening towards the posterior end where it is slightly expanded, but appressed on the outer cone, enclosing a very narrow space (Pl. XIX, fig. 12). Breadth of hindmost part of the rim a little less than the length of rostrum, this being a little over 3 mm. in full-sized specimens. Locular index 23–30.

Measurements.

No. of specimen	i	ii	iii	iv	v
Sex	♀	♀	♂	♂	♂
Dorsal length of mantle	70.0 mm.	67.0 mm.	64.0 mm.	62.0 mm.	55.0 mm.
Ventral length of mantle	62.0 ,,	59.0 ,,	56.0 ,,	54.0 ,,	50.0 ,,
Maximum breadth of mantle	27.0 ,,	25.0 ,,	26.0 ,,	24.0 ,,	21.0 ,,
Length of head	15.0 ,,	15.0 ,,	14.0 ,,	14.0 ,,	14.0 ,,
Breadth of head	23 0 ,,	22.0 ,,	22.0 ,,	21.0 ,,	19.5 ,,
Maximum breadth of fins	7.0 ,,	5.0 ,,	7.0 ,,	4.0 ,,	4.0 ,,
Mantle extent before fins	3.0 ,,	4.0 ,,	2.0 ,,	3.0 ,,	3.0 ,,
Length of first arms	Left mm. 27.0 Right mm. 27.0	Left mm. 21.0 Right mm. 21.0	Left mm. 33.0 Right mm. 33.0	Left mm. 32.0 Right mm. 32.0	Left mm. 30.0 Right mm. 30.0
,, ,, second arms	25.0 ,, 25.0 ,,	21.0 ,, 20.0 ,,	23.0 ,, 23.0 ,,	22.0 ,, 22.0 ,,	20.0 ,, 20.0 ,,
,, ,, third arms	25.0 ,, 24.0 ,,	21.0 ,, 20.0 ,,	23.0 ,, 23.0 ,,	22.0 ,, 22.0 ,,	19.0 ,, 20.0 ,,
,, ,, fourth arms	27.0 ,, 27.0 ,,	21.0 ,, 21.0 ,,	23.0 ,, 22.0 ,,	20.0 ,, 22.0 ,,	22.0 ,, 22.0 ,,
Length of tentacles	62 0 ,, 65.0 ,,	45.0 ,, 43.0 ,,	— —	45.0 ,, 45.0 ,,	70.0 ,, 70.0 ,,
,, ,, clubs	4.5 ,, 4.5 ,,	4.5 ,, 4.5 ,,	— —	5.0 ,, 5.0 ,,	5.0 ,, 5.0 ,,

No. of specimen	i	ii	iii	iv	v
Sex.	♀	♀	♂	♂	♂
Diameter of largest arm-sucker ...	1.0 mm.	1.0 mm.	1.0 mm.	1.0 mm.	0.8 mm.
,, ,, ,, tentacular ...	0.4 ,,	0.4 ,,	0.5 ,,	0.4 ,,	0.3 ,,
Breadth of shell	16.0 ,,	14.0 ,,	11.0 ,,	12.5 ,,	12.0 ,,
Thickness of shell	5.0 ,,	5.0 ,,	5.0 ,,	6.0 ,,	4.5 ,,
Length of rostrum	3.3 ,,	3.0 ,,	3.0 ,,	3.0 ,,	3.0 ,,

Remarks.—This variety stands rather nearer to var. *andreanoides* than to var. *typica* especially in having nearly uniform suckers on the tentacular clubs, and also in that the longest arm is the first. The chief difference from var. *andreanoides* consists (1) in the first arms, (2) in the dentation of tentacular suckers, and (3) in the shell.

Type locality.—Toyama Bay.

Type.—In Hokkaido Imp. Univ.

Sepia kobiensis var. **beppuana** var. nov.

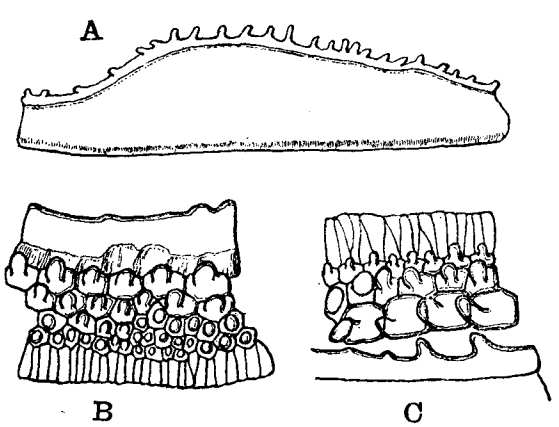
(Pl. XIX, figs. 13–15; textfig. 116.)

Sepia kobiensis, Sasaki 1920, p. 194 (pars).

This variety is based on eighteen specimens from Beppu, Bungo Prov. Most of them are sexually mature, the largest one measuring 70 mm. mantle length.

Body (Pl. XIX, fig. 13) nearly equal to var. *andreanoides* in shape; breadth 31–43% of the length. Fins broad, being $^2/_9$–$^2/_7$ as broad as mantle, extending nearly to mantle margin anteriorly and to within a few mm. of each other posteriorly.

Arms sexually dimorphic. In the male they are unequal, the formula of length being $1>2>3>4$. First pair decidedly the longest of all, with attenuated extremity; suckers on this arm nearly biserial (Pl. XIX, fig. 14). In the female the arms are nearly uniform, resembling those of var. *andreanoides* in all respects. Hectocotylization also almost as in that variety, but the normal suckers towards the base number less than 27 and the minute suckers on the hectocotylized part only 12–15 (Pl. XIX, fig. 15)



Textfig. 116.

Sepia kobiensis var. *beppuana*. A. Portion of horny ring of arm-sucker; ×220. B. Horny ring of largest tentacular sucker broken and extended; ×80. C. Portion of B, with portion of papillate area; ×220.

Tentacles as long as mantle, their stem far thinner than arms. Club small, occupying about one-eleventh of the entire length of tentacle. Suckers apparently in five or six series, unequal, about four in the middle of the club being a little larger than the others. Horny ring (textfig. 116) with weak, blunt, irregular teeth on the extreme edge; they number about 25 in largest suckers.

Shell almost as in var. *andreanoides* sexually dimorphic, much thicker and more slender in male, the breadth in this sex 17–18% of the length, while in the female it is 20–22%. Rim of inner cone a little widened posteriorly where it forms a flattened cone a little shorter than rostrum. Locular index 25–27 in male and 29–36 in female.

Streak-like tubercles present in a series along each fin and also on belly on either side.

Measurements.

No. of specimen	i	ii	iii	iv	v	vi
Sex	♂	♂	♂	♀	♀	♀
Dorsal length of mantle	57 mm.	52 mm.	50 mm.	70 mm.	58 mm.	53 mm.
Ventral length of mantle	50 ,,	45 ,,	41 ,,	60 ,,	50 ,,	46 ,,
Breadth of mantle	25 ,,	20 ,,	20 ,,	30 ,,	24 ,,	25 ,,
Maximum breadth of fins	Left 6 mm. Right 6 mm.	Left 6 mm. Right 6 mm.	Left 5 mm. Right 5 mm.	Left 8 mm. Right 8 mm.	Left 7 mm. Right 7 mm.	Left 6 mm. Right 7 mm.
Length of first arms	35 ,, 35 ,,	30 ,, 30 ,,	26 ,, 26 ,,	22 ,, 23 ,,	22 ,, 22 ,,	21 ,, 21 ,,
,, ,, second arms	31 ,, 31 ,,	28 ,, 25 ,,	25 ,, 25 ,,	23 ,, 23 ,,	22 ,, 22 ,,	20 ,, 19 ,,
,, ,, third arms	30 ,, 30 ,,	26 ,, 25 ,,	22 ,, 22 ,,	23 ,, 26 ,,	22 ,, 22 ,,	20 ,, 20 ,,
,, ,, fourth arms	23 ,, 24 ,,	18 ,, 18 ,,	17 ,, 17 ,,	20 ,, 23 ,,	19 ,, 19 ,,	15 ,, 16 ,,
,, ,, tentacles	— —	50 ,, 60 ,,	60 ,, —	— —	65 ,, 50 ,,	53 ,, 53 ,,
,, ,, clubs	— —	5 ,, 5 ,,	5 ,, —	— —	5 ,, 5 ,,	5 ,, 5 ,,
Breadth of shell	10 mm.	9 mm.	9 mm.	14 mm.	13 mm.	12 mm.
Thickness of shell	4 ,,	4 ,,	4 ,,	5 ,,	5 ,,	5 ,,
Breadth of naked area of shell	5 ,,	4 ,,	4 ,,	5 ,,	5 ,,	5 ,,

Remarks.—Six specimens collected by the "Albatross" in the Krusenstern Strait are referred to the present variety. In the largest male of these the proximal normal suckers of the hectocotylized arm number about 24.

The variety differs from var. *andreanoides* to which it is nearest, principally in the fins, in the first arms of males, and in the hectocotylization

Type locality.—Beppu, Bungo Prov.

Type.—In Tôkyo. Imp. Univ.

Sepia kobiensis var. **crassa** var. nov.

(Pl. XIX, figs. 16–18.)

Sepia (*Doratosepion*) *kobiensis*, Sasaki 1914, p. 617.

Sepia kobiensis, Sasaki 1920, p. 194 (pars).

This variety is based on seven specimens from various localities. They are all female measuring up to 62 mm. in mantle length.

Body roughly elliptical in contour, only a little broader than its own depth, widest near the middle, rounded behind where a spine projects as is usual in the genus (Pl. XIX, fig. 16); breadth 32–46% of the length. Mantle very thick, compared with the other varieties; projection of mid-dorsal margin triangular, including about one-tenth of the entire dorsal length. Fins begin at a short distance from mantle margin, extending posteriorly to within a few mm. of each other, and become wider at the same time, the maximum breadth being about one-fourth that of body.

Head comparatively small, being about $\frac{1}{4}$–$\frac{1}{5}$ as long as mantle. Funnel conical, extending to within a short distance of the angle between ventral arms.

Arms nearly equal, the formula of length being $2>1\fallingdotseq3\fallingdotseq4$, or $2>1\fallingdotseq4>3$ in larger specimens. Second arm slightly longer than the rest, but far shorter than one-third of the dorsal length of mantle. Suckers quadriserial except at the extreme base and distal extremity of arms where they are biserial. The biserial arrangement especially extensive and distinct at the extremity of lateral arms where the suckers of one side are separated from those of the other by a wide space. Horny ring nearly, but not quite, smooth.

Tentacles far shorter than body, their stem three-sided, about as thick as first arms. Club about one-seventh the entire length of tentacle; suckers apparently in five or six series, distinctly unequal, about four near the middle of the club by far the largest. Horny ring distinctly dentate on the extreme edge of the whole margin, the teeth being more or less irregular but always cut square at the end (Pl. XIX, fig. 17).

Colour in alcohol, dark brown, much paler below.

Shell resembles that of the female of var. *sagamiana* but much thicker; with bluntly angular sides, widest one-third from the anterior end, then regularly tapering towards the posterior end, where a small discoidal outer cone is attached (Pl. XIX, fig. 18). Breadth 20–24% of the length; thickness $^{6}/_{15}$–$^{1}/_{2}$ the breadth. Rim of inner cone gradually and evenly widens toward the posterior end, where it forms a flattened cone a little shorter than rostrum. Ventral surface prominently convex in the anterior parts the maximum depth of the convexity far greater than that of dorsal side. Locular index 36–40.

Measurement.

No. of specimen	i	ii	iii	iv	v
Dorsal length of mantle	62 mm.	56 mm.	50 mm.	40 mm.	36 mm.
Ventral length of mantle	55 ,,	51 ,,	44 ,,	34 ,,	29 ,,
Maximum breadth of mantle	25 ,,	26 ,,	21 ,,	16 ,,	14 ,,
Mantle extent before fins	5 ,,	—	2.5 ,,	2 ,,	2 ,,
Maximum breadth of fins	6 ,,	6 ,,	5 ,,	4 ,,	3 ,,

No. of specimen	i	ii	iii	iv	v
Length of nidamental glands	11 mm.	10 mm.	4 mm.	4 mm.	—
,, ,, first arms	Left 16 mm. Right 16 mm.	Left 16 mm. Right 16 mm.	Left 15 mm. Right 15 mm.	Left 12 mm. Right 12 mm.	Left 9 mm. Right 9 mm.
,, ,, second arms	17 ,, 17 ,,	17 ,, 17 ,,	16 ,, 16 ,,	12 ,, 12 ,,	9 ,, 10 ,,
,, ,, third arms	16 ,, 16 ,,	16 ,, 16 ,,	13 ,, 14 ,,	11 ,, 11 ,,	7 ,, 8 ,,
,, ,, fourth arms...	16 ,, 16 ,,	16 ,, 16 ,,	15 ,, 15 ,,	12 ,, 12 ,,	9 ,, 9 ,,
,, ,, tentacles	45 ,, —	— —	40 ,, 39 ,,	22 ,, 24 ,,	— 30 ,,

Remarks.—This variety is distinguished from othes by the stout built of tentacles and shell, which suggested its variety name.

Locality.—Enoura, Suruga Prov. (Sasaki); Shimizu, Suruga Prov. (Albatross!); Hososhima, Hyuga Prov. (!); Akune, Satsuma (Albatross!).

Type locality.—Enoura, Suruga Prov.

Type.—In Tôkyo Imp. Univ.

Sepia kobiensis var. **albatrossii** Sasaki, 1920.

(Pl. XIX, figs. 19–26; textfig. 117.)

Sepia kobiensis var. *albatrossii*, Sasaki 1920, p. 195. pl. xxvi, figs, 2, 3.

This variety is based on one male and two females collected by the "Albatross" in the Krusenstern Strait. The male seems to be adult, having numerous spermatophores in Needham's sac while the females are most probably young, having no ripe egg in the ovary and the nidamentary glands as small as only 1.5 mm. in length.

Body roughly elliptical in outline, broadest two-fifths of the way back, somewhat compressed dorso-ventrally (Pl. XIX, fig. 19); breadth in male 41% of the length, and in female 44–46%. Dorsal projection of margin triangular, comprising $^1/_{10}$–$^1/_{11}$ of the dorsal length of mantle. Fins very narrow, only one-eighth as wide as mantle, extending nearly to mantle margin anteriorly and to within 2 mm. of each other posteriorly.

Head as wide as mantle opening, its length equal to about a quarter of the dorsal length of mantle. Funnel rather short, conical, with a blunt extremity, which is sharply bent downwards and even in the stretched condition does not reach the ventral interbrachial space. Umbrella ill developed, its broadest part situated between first arms, extending to the second or third row of suckers, the next broadest between lateral arms.

Arms sexually dimorphic. In the male, they are unequal, the formula of length being $1>4>2>3$. First arm slender, by far the longest, being about 38% of the mantle length, rounded on back, but this has a faint keel on the proximal half. Second arm conical, without marked keel on back, tapering to a slender extremity. Third and fourth arms compressed from side to side of their own, somewhat rapidly narrowing distad and sharply keeled on back.

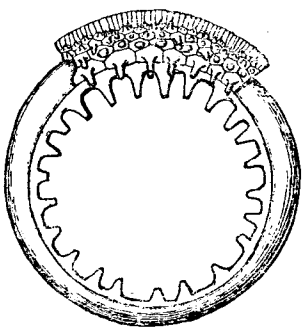
Arms in female subequal, the formula of length being $1\fallingdotseq4>2>3$; the first shorter than one-third the length of mantle and thicker than in male. All more or less compressed and keeled on back; the carination being strong except on the second arm where it is very weak.

Arm-suckers subglobular, small, numbering about 75 on the first three pairs of arms, and about 100 on the fourth pair; quadriserial except at the extreme base and tip of arms where they are biserial. The biserial arrangement is most extensive in the first arm of the male, where it extends for the distal one-third. On each arm the suckers of the two central series are a little larger than those of the marginal series; but the reverse is true at the distal part of the first arms of the female. Horny ring smooth, papillate area composed of three or four series of facetts, bordered with a broad radiated margin.

Left ventral arm hectocotylized in male, but equaling the right ventral in thickness and length

(Pl. XIX, fig. 20). The suckers are of normal size to the eight row, then become suddenly smaller and in this condition they continue up to the extremity.

Tentacles slender, longer than mantle, their stem three-sided and thinner than arms. Club small, about one-tenth as long as stem, a little expanded, crescent-sharped; dorsal web broad, beginning on carpus more proximally than the first sucker (Pl. XIX, fig. 21). Suckers number about 100, in oblique transverse rows of eight in each; unequal, five in a submedian series being by far the largest. Horny ring of these suckers equipped along the extreme edge of the whole margin, with 20–24, strong teeth, which are mostly triangular or conical, but may be rounded or truncated at the tip (textfig. 117). Papillate area composed of four or five series of facetts, bordered with radiated margin as usual; papillae of the innermost series by far the strongest, but a little shorter and decidedly thinner than teeth.



Textfig. 117.

Sepia kobiensis var. *albatrossi*. Horny ring of largest tentacular sucker; ×63.

Buccal membrane thick, with feeble ribs and blunt points of margin, each of these seven in number. About 50 leaflets present in each gill. Spermatophores of nearly uniform breadth, about 3 mm. long; sperm cord 1.8 mm. long, situated in the middle of etui (Pl. XIX, fig. 22).

Surface sparsely and more or less regularly dotted with minute tubercles, of which three pairs on the dorsal surface of the mantle, a series on each side of the ventral surface, a series along each fin, a transverse series above the head between eyes, and ridge-like one below each eye all are specially marked. Color in alcohol drab, deeper above. Dorsal surface of mantle tinged with reddish brown in the median longitudinal region.

Shell somewhat differs in shape in different sexes. In the male it is slenderly elliptical, about five times as long as broad; sides nicely and moderately arcuate (Pl. XIX, fig. 23). Dorsal surface slightly convex, its median two quarters covered with a very thin calcareous layer, the grains of which are very fine, forming longitudinal lines at the lateral parts and transverse lines at the median part. Ventral surface highly convex at the region where the last locular line is situated; this line is arcuate, without forming any notch in the middle. Median longitudinal groove of the surface very shallow, especially on last loculus. Parallel lines of striated area extend outwards beyond the rim of inner cone; the latter starts at the middle part of shell, becoming distinct very gradually posteriad, but narrow and flattened throughout, without forming any actual cone (Pl. XIX, fig. 25). Locular index 34.4. Rostrum fine.

Shell in female, slenderly rhomboidal, each side forming a rounded angle and one-third back the length (Pl. XIX, fig. 24), Length equal to four times of the maximum breadth, which is in turn one-third of the thickness. Calcareous layer on dorsal surface very thin, and no demarkation is discernible between the invested, and naked part. The remaining characters are the same as in the male.

Measurements.

No.	i	ii	iii
Sex	♂	♀	♀
Dorsal length of mantle	34.0 mm.	28.0 mm.	26.5 mm.
Ventral length of mantle	31.0 ,,	25.0 ,,	24.0 ,,
Maximum breadth of mantle	14.0 ,,	13.0 ,,	11.5 ,,
Length of head	8.2 ,,	6.5 ,,	6.0 ,,
Breadth of head	13.0 ,,	12.0 ,,	12.0 ,,
Mantle extent before fins	6.5 ,,	2.0 ,,	1.2 ,,
Maximum breadth of fins	2.0 ,,	3.0 ,,	1.8 ,,
Length of first arms	Left 13.0mm. Right 13.0mm.	Left 8.0mm. Right 8.0mm.	Left 8.0mm. Right 8.0mm.

No.	i	ii	iii
Sex	♂	♀	♀
Length of second arms	9.0mm. 9.0mm.	6.5mm. 6.5mm.	7.5mm. 7.5mm.
,, ,, third arms	8.0 ,, 8.0 ,,	6.0 ,, 6.0 ,,	7.0 ,, 7.0 ,,
,, ,, fourth arms	10.0 ,, 10.0 ,,	8.0 ,, —	8.0 ,, —
,, ,, tentacles	40.0 ,, 45 0 ,,	30.0 ,, 35.0 ,,	34.0 ,, 36.0 ,,
,, ,, clubs	4.0 ,, 4.0 ,,	3.5 ,, 3.0 ,,	3.0 ,, 4.0 ,,
Diameter of largest arm-sucker	0.4 mm.	0.4 mm.	0.4 mm.
,, ,, ,, tentacular sucker	0.6 ,,	0.6 ,,	0.5 ,,
Breadth of shell	7.0 ,,	7.0 ,,	7.0 ,,
Thickness of shell	4.0 ,,	2.4 ,,	2.5 ,,
Length of rostrum	1.5 ,,	1.2 ,,	—

Remarks.—Two females caught by the "Albatross", one near Yakushima, the other at the same locality as the original specimens, are referred with some hesitation to the variety. They differ from the original ones in having much narrower rim of the inner cone (Pl. XIX, fig. 26), broader shell, and greater locular index (38). The principal measurements are appended below.—

No.	i	ii
Dorsal length of mantle	21 mm.	21 mm.
Ventral length of mantle	19 ,,	18.5 ,,
Maximum breadth of mantle	11 ,,	10 ,,
,, ,, ,, fins	2 ,,	1.5 ,,
Length of first arms	7 ,,	7 ,,
,, ,, second arms	5.5 ,,	6.5 ,,
,, ,, third arms	5.5 ,,	6.5 ,,
,, ,, fourth arms	7 ,,	8 ,,
Breadth of shell	6 ,,	7 ,,

The present variety is well characterized by the shell of the male, which is narrowed in nearly equable manner at both the extremities and does not regularly taper posteriad as in the other varieties. Further, the rim of inner cone is less prominent even at the posterior end where it lies flat on the outer cone, without forming any actual cone.

Locality.—Okinoshima, Krusenstern Strait, 59 fms. (Albatross!); Yakushima, south of Kiushiu, 83 fms. (Albatross!).

Type locality.—Okinoshima, Krusenstern Strait.

Type.—In U. S. Nat. Mus.

Genus **Metasepia** (Hoyle, 1886).

Sepia (*Metasepia*), Hoyle 1886b, p. 145.

Metasepia, Berry 1912b, p. 424; 1920, p. 155,—Naef 1921, p. 536.

Mantle saccular as broad as long, quite rounded behind where it has neither glandular pore nor spine; dorsal margin only slightly projecting forwards. Longitudinal groove of funnel cartilage with a special depression in the middle. Nuchal cartilage semicircular, without any groove along the median line; its margin very narrow and thin. Arm-suckers quadriserial. Shell much shorter than mantle, nicely rhomboidal, without rostrum; inner cone rudimentary; outer cone absent.

Type.—*Sepia* (*Metasepia*) *Pfefferi* Hoyle, 1885.

Metasepia tullbergi (Appellöf, 1886).

Japanese name: Hana-ika (Nagasaki).

(Pl. XVIII, figs. 16–19; textfig. 118.)

Sepia tullbergi, Appellöf 1886, p. 26, pl. ii, figs. 7–14.
Sepia (*Metasepia*) *tullbergi*, Ortmann 1888, p. 556.—Joubin 1897b, p. 103.
Metasepia tullbergi, Berry 1912b, p. 424.—Sasaki 1914, p. 621.

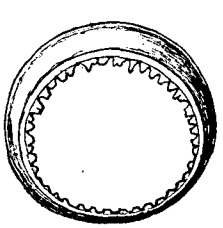
This species is here represented by eight specimens, one of which was collected by Dr. Oshima from Formosa, whilst the others by myself from Kiushiu. They agree in every particular with Appellöf's original description.

Mantle saccular about as long as wide, broadest near the middle, quite rounded behind where neither glandular pore nor spine is found (Pl. XVIII, fig. 16). Dorsal part of anterior margin projects only a little forming an angle of 130°–150° in the middle; ventral part widely, but shallowly, emarginated. Fins narrow, slightly widening posteriad, the maximum breadth being only 1/7–1/8 that of body. They commerce within 5 mm. of mantle margin, traversing posteriad along the lateral margin of the dorsal surface of mantle and finally approach 3–5 mm. to each other.

Head much narrower than mantle opening and about half as long as body. Nuchal cartilage semicircular, without longitudinal groove along the median line; margin very narrow and thin. Umbrella relatively broad, extending 1/3–1/4 up the arms, except between ventral arms, where it is quite rodimentary as in *Sepia*. Funnel comparatively large, conical, widely expanded at base, fully extending to the angle between ventral arms. Funnel cartilarge roughly kidney-shaped, its inner margin being slightly concave whilst the outer margin is distinctly convex, the median longitudinal groove with a special depression in front of the middle, articulating with a short but prominent, roundheaded, mantle cartilarge. Dorsal pad of funnel organ widely ∧-shaped, extending only 1/5–1/4 up the dorsal wall, the apical angle about 60°; ventral pads broad, pyriform.

Arms nearly equal, the formula of length usually 4>3>2>1, the longest about three-fourths the dorsal length of mantle. All more or less keeled on back especially the fourth, which is by far the thickest. Protective membranes of moderate breadth. Suckers small, uniform, sparsely set in four series throughout; horny ring dentate, the teeth being irregular but short and closely set. None of arms hectocotylized.

Tentacles slender, as long as, or longer than, head and body taken together, their stem a little thinner than arms. Club a little expanded, crescent-shaped, comprising about one-tenth of the entire length of tentacle; dorsal web of moderate breadth, extending on to stem far beyond carpus (Pl. XVIII, fig. 17). Suckers a little over 50 in number in each arm, apparently in five or six series; unequal in size, four or five in the second row from the dorsal side of club being the largest of all, and three or four in the third row come next in size. Horny ring equipped with short, blunt teeth, which in the largest suckers number about 45 and are closely set on the whole margin (textfig. 118), while in the smaller ones they are less numerous and are somewhat separate from one another.



Textfig. 118.
Metasepia tullbergi.
Horny ring of largest tentacular sucker; ×33.

Buccal membrane with seven, blunt, sucker-less points of margin. In the female, two oval spermatic pads are developed in the ventral part of the membrane.

Branchial leaflets only about 45 in each gill.

Spermatophores 4 mm. long, sperm cord 25 mm. long, constructed almost similarly as in *Sepia* (Pl. XVIII, fig. 18).

Color in alcohol, dull grayish brown nearly throughout, the color-less part being only the sucker-bearing surface of arms and the entire surface of tentacles. The coloration deepens almost into black on the dorsal surface of the head and mantle as well as on the aboral surface of arms. In comparatively fresh specimens the distal part of arms is tinged with pink.

Measurements in Millimeter.

Locality	Kiushiu							Formosa
No. of specimen	i	ii	iii	iv	v	vi	vii	viii
Sex	♀	♀	♀	♀	♀	♂	♂	♀
Dorsal length of mantle	41	39	38	35	34	32	23	42
Ventral length of mantle	37	34	32	30	30	29	18	39
Breadth of mantle	37	35	32	30	30	30	20	31
Breadth of head	24	23	22	20	—	18	16	23
Distance between posterior ends of fins	5	4	5	5	3	4	3	—
	Left Right	Left Right	Left Right	Left Right	Left Right	Left Right	Left Right	Left Right
Mantle extent before fins	5 4	3 3	4 4	2 3	4 3	3 3	2 3	4 4
Maximum breadth of fins	4 4	5 5	4 3	2 3	3 3	3 —	2 2	4 4
Length of first arms	— —	— —	20 20	20 18	18 18	13 12	11 9	19 19
,, ,, second arms	26 27	25 24	24 25	20 18	— 21	15 18	12 13	25 25
,, ,, third arms	27 27	25 24	24 25	24 23	— 23	19 21	13 13	25 25
,, ,, fourth arms	30 30	27 27	24 24	23 23	22 22	20 21	13 13	25 25
,, ,, tentacles	— —	— 70	— 70	— —	— 45	60 55	— —	65 —
,, ,, clubs	— 7	— 6	— 7	— —	— 5	6 5	—	5 —
Diameter of largest arm-sucker	0.7	0.7	0.6	0.5	0.5	0.5	0.35	0.6
,, ,, ,, tentacular sucker	0.9	0.9	0.9	—	0.8	0.8	—	0.8
Length of shell	33	—	31	30	28	28	20	35
Breadth of shell	17	—	15	14	14	13	9	15
Thickness of shell	6.5	—	6	5	5.2	5	4	5
Locular index	40	—	41	40	41	38	41	38
Length of nidamental gland	8	8	8	7	5	—	—	15

Shell nicely lozenge-shaped in contour, but the anterior end a little rounded, while the posterior is sharply pointed (Pl. XVIII, fig. 19). Length about twice the breadth which is in turn twice as large as the thickness. Chitinous margin relatively broad, uninterrupted, a little widening towards both the extremities; in the posterior extremity it forms on the dorsal surface a small, keel-like, vertical plate projecting dorsally and posteriorly. Dorsal surface slightly and evenly convex, without ridge or groove. Ventral surface strongly convex at the middle part, but the striated area shows a broad, but rather shallow, groove in the middle. This area marked off anteriorly by two straight lines meeting at an obtuse angle. Rim of inner cone V-shaped, arising one-third the length of shell from its posterior end; quite thin at first but becoming a little wider and more prominent posteriorly where it forms no actual cone. Neither calcareous rostrum nor outer cone present. Locular index 38–41.

Remarks.—The specimen from Formosa disagrees in several points with those from Kiushiu, probably due to the different states of preservation. On the dorsal surface of the mantle there is a pair of streaks running longitudinally so as to divide the area into three subequal zones, and each of the streaks is thrown into ridges or tubercles in two or three places. Besides these there are about 5 streak-like ridges arranged in a line along the attaching zone of the fins. The ventral surface is also furnished with a U-soaped streak along its periphery and parallel to the contour line. As in the dorsal surface, also in the ventral surface the streak is brought into ridges in two or three places. The head is also provided with some number of tubercular streaks, of which the most conspicuous one is above each eye a little behind the pupil standing like a cirrus as often found in Polypus. The tubercular streaks are very indistinct in the specimens from Kiushiu, but they are distinctly illustrated by Appellöf whose specimen originated also from Kiushiu (Nagasaki).

The present species is closely related to *M. pfefferi* Hoyle. According to Hoyle, the latter species differs from *M. tullbegi* in that: (1) the funnel cartilage has the deepest part in the middle and not near the anterior end, (2) no tubercle is found on the back nor on the head, (3) the teeth of the suckers of the sessile arms are finer and more acute, not so broadly triangular, as indicated in Appellöf's illustrations, (4) the tentacles are decidedly shorter and their large suckers are not so conspicuous, the dentation of which is much finer and not so regular, and finally (5) the posterior extremity of the shell does not give rise to any structure at all like the horny lamella as found in *M. tullbergi.*

Locality.—Kadsiyama (Ortmann); Nagasaki (Appellöf, Joubin, Sasaki); Kagoshima (Ort.); Akochô, formosa (!).

Genus **Sepiella** (Gray, 1849).

Sepia (*Sepiella*), Gray 1849, p. 106.—Tryon 1879, p. 195.
Sepiella, Steenstrup 1881, p. 233.—Berry 1920, p. 155.—Naef 1921, p. 536.

Mantle roughly ovate in contour, rounded behind where it has a glandular pore instead of spine; the mid-dorsal part of anterior margin projects far over head. Nuchal cartilage tongue-shaped, with a distinct median groove, the margin deeply detached. Longitudinal groove of funnel cartilage with a deep depression near the middle. Shell only a little shorter than mantle, elliptical or ovo-lanceolate; outer cone flattened into a broad thin horny plate without rostrum; inner cone rudimentary.

Type.—*Sepia ornata* Rang 1837.

Sepiella japonica sp. nov.

Japanese name: Maika (Nagato), Shiriyake-ika (Sanyodo); Sowcartzun (Formosa).

(Pl. XVIII., figs. 20–23; Pl. XIX., fig. 28. textfig. 170.)

Sepia sinensis d'Orb. in d'Orb. et Fér. 1839, p. 289, Seiches pl. ix, figs. 1, 2, (pars).—Berry 1912b, p. 417.
Sepia inermis (pars), Gray 1849, p. 104.—Tryon 1879, p. 169.

Sepiella maindroni,—Hoyle 1886b, p. 149, pl. xxii, figs. 1–10.—Wülker 1910, p. 20.—Berry 1912b, p. 424.—Sasaki 1914, p. 621, textfig. 1.

? Sepiella inermis, Joubin 1897b, p. 103.—Berry 1912b, p. 424.—Sasaki 1914, p. 62.

Sepiella? sinensis, Sasaki 1914, p. 62.

List of the specimens examined.

Specimens	Mantle-length	Locality	Date	Collecter	Where preserved
10 ♂	112–124 mm.	Himi, Etchû	May 9, 1913	Sasaki	Hok. Imp. Univ.
1 ♂	180 mm.	do.	May 8, 1913	do.	do.
2 ♀	—	Tôkyo market	—	do.	do.
1 ♂, 5 ♀	—	Haneda, Musashi	—	—	Imp. Mus. Tôkyo
1 ♂, 1 ♀	130 mm. in each	Natagiri, Sagami prov.	—	—	Tôkyo Imp. Univ.
1 ♂	110 mm.	Toms, Bingi	—	—	Fish. Bur. Tôkyo
2 ♀	—	Nagato	April, 1919	Sasaki	Hok. Imp. Univ.
1 ♂	80 mm.	Tokushima pref.	June, 1920	do.	do.
1 ♀	—	Tosa	April, 1918	—	Tôkyo Imp. Univ.
1 juv.	68 mm.	Nagasaki	May, 1918	—	do.
1 ♀	93 mm.	Miyazaki pref.	May, 1920	—	Hok. Imp. Univ.
1 ♂	133 mm.	Tainan market, Formosa	April, 1920	Oshima	Formosan Mus.

Body roughly ovate in contour, about twice as long as its own maximum breadth which is situated about one-third of the way back; posterior end rounded, with a conspicuos glandular pore instead of spine. Anterior margin of mantle projects over head into a triangular lobe comprising about one-seventh of the entire dorsal length; ventrally it is weakly emarginated crescentwise. Fins begin at a distance from mantle margin, traversing posteriad along the dorso-lateral surface of mantle and finally connected with each other behind, leaving only a sinuation at their junction (textfig. 170). They are at first comparatively narrow but widen posteriad, attaining their maximum breadth a distance anterior to the posterior end; the said breadth being 1/6–1/5 that of the mantle.

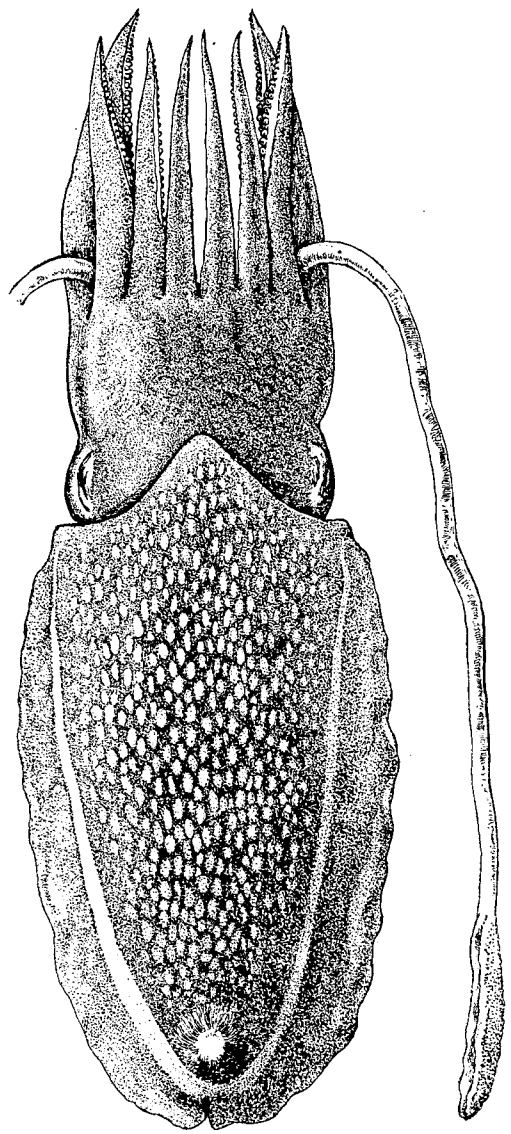
Head broad, as wide as mantle opening, its length being 1/4–1/3 the dorsal length of mantle. Eyes with a semicircular lid-fold ventrally. Umbrella broadest between lateral arms, next broadest between dorsal arms, and absent between ventral arms. Funnel conical, comparatively large, extending only a little less than to the space between ventral arms. Funnel organ composed of a ∧-shaped dorsal pad and two pyriform ventral pads. Funnel cartilage crescent-shaped, a little longer than twice the breadth, its longitudinal groove with a deep, pit-like depression near the middle, articulating with a short, but prominent, round-headed, mantle cartilage.

Arms nearly equal, the formula of length 4>3>2>1, the longest a little longer than half the dorsal length of mantle. Two dorsal pairs rounded on back while the remaining pairs are keeled, especially the fourth. Protective membranes thick but narrow. Suckers number over 200 on each arm, thickly crowded in four series throughout, nearly uniform but very gradually and evenly decreasing in size towards the extremity of arms. Horny ring in male distinctly dentate on the distal margin, the teeth being slender, closely set, and numbering about 30 in larger suckers (Pl. XVIII, fig. 20). In mature males the teeth are united together so as to render the ring smooth on the whole margin.

Hectocotylization affects the proximal 1/3–1/4 of left ventral arm, where are 40–50 suckers greatly reduced in size (Pl. XIX, fig. 28). They are in four series, but the ventral two of the four are brought into a close zigzag line running along the ventral margin of the affected part.

Tentacles variable in length but in good preservation being as long as mantle, their stem as thick as first arm. Club slender, occupying 1/5–1/3 of tentacle, only a little thicker than stem; dorsal web begins proximally at a short distance distal to the first sucker and becomes wider distally. Suckers

innumerable, minute, uniform, arranged in oblique rows of 16–32 in each. Horny ring dentate, the teeth numbering 15–20, blunt, separate, and much longer on the distal margin than on the proximal (Pl. XVIII, fig. 21).



Textfig. 170.

Sepiella heylei n.n. A mature male from Formosa; ×⅔.

Buccal membrane deeply folded with seven distinct, suckerless points of margin. Branchial leaflets number about 70 in each gill.

Spermatophores slender, about 11 mm. long, and 0.25 mm. thick; sperm cord about 9 mm. long, faintly striated transversely (Pl. XVIII, fig. 22).

Color of preserved specimens grayish brown, much deeper above than below. In fresh specimens, there are found numerous, roundish or oblong, shining spots evenly distributed on the back. They measure 5–8 in diameter in full-grown individuals. Along the attachment of each fin there runs a broad shining longitudinal streak which becomes gradually wider caudad. It is continous posteriorly with that of the opposite fin. Just anterior to the jnnction there is a reddish stain which is probably connected with the caudal gland characteristic of this genus (see textfig. 170). The stain well agrees with the pattern illustrated by d'Orbigny in *S. inermis* and also in *S. ornata.*

Shell similarly constructed in the different sexes; elliptical, but the anterior extremity, somewhat pointed, and the posterior terminal part rounded and slightly expanded into a flattened chitinous plate (Pl. XVIII, fig. 23). Maximum breadth of shell a little less than one-third of its length and a little greater than twice its thicknass. Chitinous margin broad, uninterrupted. Dorsal surface moderately convex, its median line again thrown into a moderate longitudinal ridge; post-lateral parts covered with a V-shaped chitinous lamella which is continuous with the above-mentioned chitinous plate posteriorly. Ventral surface strongly convex in the middle, traversed by a faint groove along the median line. Last locular line variable in shape but usually finely waved semicircular on the whole. Locular index decreases with age, becoming about 40 when fully grown. Inner cone rudimentary, consisting of an uninterrupted V-shaped rim far distant from the posterior end of shell.

Measurement.

No. of specimen	i	ii	iii	iv	v
Sex	♂	♂	♂	♀	♀
Dorsal length of mantle	180 mm.	107 mm.	77 mm.	115 mm.	86 mm.
Ventral length of mantle	160 ,,	83 ,,	69 ,,	93 ,,	73 ,,
Breadth of mantle	90 ,,	65 ,,	43 ,,	65 ,,	47 ,,
Length of head	45 ,,	35 ,,	22 ,,	40 ,,	23 ,,
Breadth of head	65 ,,	44 ,,	34 ,,	45 ,,	35 ,,

No. of specimen	i	ii	iii	iv	v
Sex	♂	♂	♂	♀	♀
Mantle extent before fins...	Left 17mm. Right 12mm.	Left 10mm. Right 10mm.	Left 8mm. Right 9mm.	Left 10mm. Right 11mm.	Left 8mm. Right 7mm.
Maximum breadth of fins...	26 ,, 22 ,,	7 ,, 8 ,,	11 ,, 10 ,,	9 ,, 8 ,,	8 ,, 7 ,,
Length of first arms	92 ,, 96 ,,	37 ,, 36 ,,	38 ,, 37 ,,	36 ,, 38 ,,	30 ,, 30 ,,
,, ,, second arms	100 ,, 90 ,,	40 ,, 40 ,,	36 ,, 38 ,,	41 ,, 41 ,,	28 ,, 30 ,,
,, ,, third arms...	108 ,, 80 ,,	43 ,, 45 ,,	35 ,, 38 ,,	45 ,, 44 ,,	32 ,, 31 ,,
,, ,, fourth arms	115 ,, 95 ,,	46 ,, 45 ,,	40 ,, 40 ,,	45 ,, 50 ,,	35 ,, 35 ,,
,, ,, tentacles	170 ,, —	210 ,, —	—	155 ,, 150 ,,	— —
,, ,, clubs	60 ,, —	45 ,, —	—	40 ,, 40 ,,	— —
Diameter of largest arm-sucker... ...	2.0 mm.	1.5 mm.	—	1.5 mm.	1.0 mm.
,, ,, ,, tentacular sucker	0.8 ,,	0.3 ,,	—	0.3 ,,	0.28 ,,
Length of shell	175 ,,	103 ,,	—	113 ,,	—
Breadth of shell	52 ,,	32 ,,	—	34 ,,	—
Thickness of shell	22 ,,	14 ,,	—	15 ,,	—

Remarks.—Hoyle has identifined a female specimen of this species from the Inland Sea of Japan as *Sepiella maindroni* de Rochebrune; henceforth this name has hitherto most frequently been used for the Japanese species. But as the original description of *S. maindroni* is not so complete as might be wished being very brief and lacking many points of specific importance, the species has hitherto been left doubtful in its validity.

Sepia sinensis is the name given by d'Orbigny to a cuttlefish said to stand described in a Japanese encyclopaedic work. Judging from his statement, the work referred to seems most probably to be Terajima's "Wakansansaizue" (l. c.) but the two accompanying illustrations are taken from other books. One of these is Katsuma's "Uotsukushi" (l. c.). The original description of the "Wakansansaizue" does not exactly indicate any species of sepiids, but the two appended illustrations may be properly referable to the species under consideration.

Sepiella inermis which differs distinctly from *S. japonica* in the surface ornamentation, in the hectocolylization, and in the structure of the shell, is listed by Joubin among the Japanese fauna based upon a specimen from Nagasaki. I have great doubt as to his identification, since the actual existence of this species in the Japanese waters is very doubtful.

S. japonica is one of the commonest *Sepia* in the Middle and South Japan, where it is caught in plenty for the market, the dried commercial articles going under the name of "Ko-zurumé" or "Kôtsuki-zurumé".

Locality.—Etchû Prov. (Sasaki); Tôkyo market (!) Haneda, Musashi Prov. (Sasaki); Natagiri, Sagami Prov. (Sasaki); Misaki (Wülker); Bingo Prov. (Sasaki); Inland Sea (Hoyle); Nagato Prov. (!); Tokushima prefecture (!); Tosa Prov. (Sasaki); Nagasaki (Sasaki); Miyazaki Prefecture (!).

Type locality.—Etchû Prov.

Type. In Hokkaido Imp. Univ.

Division **Oegopsida** (d'Orbigny 1839).

Dacapoda Oegopsidae, d'Orb. 1839, p. 320; 1845, p. 367.

Oegopsidae, Keferstein 1866, p. 1444.—Verrill 1881c, p. 427.—Pfeffer 1900, p. 148.

Oegopsida Hoyle 1886b, pp. 32, 162.—Chun 1910, p. 3.—Pfeffer 1908a, pp. 15, 61; 1912, p. 1. —Berry 1912a, p. 297; 1914a, p. 321.

Chondrophora, Gray 1849, p. 37 (pars).—Adam, H. & A. 1858, p. 26.

Teuthoidea (*Metateuthoidea oegopsida*), Naef 1921, p. 535.

Eyelid widely opend, the opening usually sinuated in front. Suckers frequently transformed into hooks. As a rule two functional oviducts present. Complex photogenic organs of polymorphic structure and undoubtedly polyphyletic origin are of repeated occurrence.

Animals mostly pelagic or abyssal in habit.

Key to the families of oegopsids represented in Japan.

(A) Mantle margin free all round, but rarely connected with funnel cartilage (*Liberata*).
  (α) No hooks even in adult.
    (a) Texture firm, fleshy; no photophores on surface.
      (1) Funnel cartlilage lanceolate, its groove straight and simple; animals of gigantic size... ..... *Architeuthidae.*
      (2) Funnel cartilage triangular, its groove distinctly⊣-or⊥-shaped; animals usually of moderate size.
        (i) Fins about half as long as body, funnel cartilage with⊥-shaped groove..... ..... *Ommastrephidae.*
        (ii) Fins enormous, extending the whole length of body, funnel cartilage with⊣-shaped groove ..... *Thysanoteuthidae.*
    (b) Texture soft, more or less choroidal; photophores often present on surface.
      (3) Body shorter than twice its own breadth; numerous large photophores on the ventral surface of head and mantle as well as on the aboral surface of arms.....*Histioteuthidae.*
      (4) Body longer than thrice its own breadth; no photophores on head nor any on mantle, but some may occur on tentacles and ventral arms.....*Chiroteuthidae.*
  (β) Hooks present in adult.
    (c) Brachial armatures biserial.
      (5) No hooks on arms, but some on tentacles ..... *Onychoteuthidae.*
      (6) Hooks present on arms, ordinarily also on tentacles.....*Enoploteuthidae.*
    (d) Brachial armatures quadriserial .....*Gonatidae.*
(B) Mantle margin invariably fused with head at nape and with funnel base on either side (*consuta*) .....*Cranchidae.*

Subdivision 1. **Liberata** (Chun, 1910).

Oegopsida libera, Chun 1910, p. 52.

Mantle margin free all around, but funnel cartilage rarely fused with mantle cartilage. Funnel valve invariably present. Depressor infundibuli normal, and mantle cavity not comparted.

Family **Architeuthidae** Pfeffer, 1900.

Architeuthidae, Pfeffer 1900, p. 152; 1908a, p. 81; 1912, p. 1.

Animals of gigantic size, body often being two or three meters long. Body elongated, sharply pointed behind. Anterior margin of mantle free all round, projecting on the dorsal size into an obtuse triangle and emarginated crescentwise on the ventral side. Fins relatively small terminal, their combined outline longitudinal-ovate, sharply pointed behind; no indentation in the anterior attachment. Olfactory crest composed of a broad transverse and one or two rather rudimentary longitudinal folds. No nuchal fold. Funnel groove well defined; inner surface quite smooth. Funnel adductors bi-paired, all submedian. Nuchal cartilage spatulate. Funnel cartilage lanceolate, with a single longitudinal groove. Mantle-cartilage ridge-like, longitudinal. Buccal membrane with seven processes of margin; connectives also seven, membranous, fastened to the dorsal sides of arms, but the connection with the third arm is on its ventral side. Arms and tentacles both bear suckers only and no hooks. Suckers on arms biserial; same on clubs quadriserial. Connective series and carpal cluster on tentacles well developed, each composed of suckers and pads. Gladius shorter than mantle,

lanceolate, more sharply tapered posteriorly than anteriorly, bearing an end- cone but no cartilaginous spine.

Genus **Architeuthis** Steenstrup, 1857.

Architeuthis Steenstrup 1857a, p. 182.—Verrill 1880, p. 238.—Pfeffer 1900, p. 173; 1908a, p. 81; 1912, p. 2.
Megaloteuthis, Kent 1874, p. 178.
Dinoteuthis, More 1875, p. 123.
Megateuthis, Hilgendorf, 1880, p. 65.
Plectoteuthis, Owen 1881, p. 156.
Dubioteuthis, Joubin 1900, p. 102.

Architeuthis japonica Pfeffer, 1912.

(Pl. XX, figs. 1–11.)

? *Megateuthis martensii*, Hilgendorf 1880, p. 65.
Mitsukuri & Ikeda, 1895, p. 39, pl. x (sine nom.).
? *Architeuthis martensii*, Steenstrup 1882, p. 157.—Berry 1912b, p. 433.—Pfeffer 1912, p. 31.—Sasaki 1916, p. 90.
Architeuthis japonica, Pfeffer 1912, p. 27.—Sasaki 1916, p. 89.

I obtained a fresh specimen of this interesting species from Tôkyo market on Jan. 10th. 1918. It was said to have been caught in Awa Province, viz. the same locality, as that of the type.

Body subfusiform, a little longer than one-third of its own maximum breadth, slightly constricted just behind the anterior margin; the maximum breadth being at the point one-third of the way back. From the middle, the body tapers caudad. The taper is at first very gradual, but soon becomes rapid; in the posterior one-third it is again restored to the former gradual condition. End-part of body slender, attenuated terminating in a sharp point (Pl. XX, fig. 1). In Mitsukuri and Ikeda's spcimen, however, the body is said to be nicely conical, evenly tapering to a sharp point.

Mantle very thick, fleshy. Dorsal part of its anterior margin a little protrudes in a broad, triangular lobe, which forms an angle of about 120° in the middle. Ventral side of the margin gently emarginated crescentwise, the concavity marked off on either side by an obtuse angle. Posterior part of belly quite smooth and devoid of any longitudinal ridge as found in *Architeuthis physeteris* (Joubin).

Fins terminal, comparatively small, their combined outline nearly ovate, but sharply pointed behind, extending posteriad as narrow keel-like membranes along the sides of the end-part of body. Anterior origin of fins not indented so that it shows a quite different feature from Verrill's illustrations on *Architeuthis princeps* and *A. harveyi*. Length of fins about two-fifths that of body. Proportion which the total breadth of the fins bears to their length lies between $^3/_4$ and $^5/_7$.

Head somewhat narrower than body, and about its one-fourth in length. Eyeball large, its diameter equaling about a half of the head-depth. Eye opening also wide, with a shallow sinus in the anterior margin far below the middle.

Neck marked off from head by a sharp edge. Funnel groove deep, sharply defined by a horse-shoe-shaped fold, the posterior ends of which are widen into broad thick membranes holding the funnel laterally. Internal surface of the groove, quite smooth, destitute of any kind of fold. Olfactory crest composed of a broad transverse fold which begins ventrally near the boundary of the funnel groove, extending to the dorso-lateral part of the neck. The fold forms two nodule-like thickenings: one, conspicuous, situated near the ventral origin of the fold, and the other, faint, existing near the middle of its course; these thickenings seem to represent the longitudinal crest-folds found in some other oegopsids.

Nuchal cartilage spatulate, the distal half expanded into a rounded quadrangle a little longer

than broad; the remaining part slightly narrower than half the breadth of the preceding part, but the posterior end slightly expanded and rounded (Pl. XX, fig. 2). Median ridge of the cartilage, gently raised, and gradually fading off sideways; with a fine groove along its crest. Each side of the expanded part thrown into a longitudinal ridge much lower than the median. Dorsal mantle cartilage as in Pl. XX, fig. 3.

Funnel relatively large, conical, widely expanded at base, its distal part tubular, of equal breadth, and bent ventrad. Funnel adductors bipaired all submedian; those of the same side connected together by a thin vertical membrane. Funnel organ conspicuous (Pl. XX, fig. 4); its dorsal pad nicely Λ-shaped, extending beyond anus posteriorly and more than halfway along the distance between anus and funnel-extremity anteriorly. Ventral pads of the organ number two as usual, elongate-cresentic, about one-third as broad as long, far shorter than the former pad, but a little broader than its lobes. Funnel valve broad, semilunar, attached to dorsal wall in advance of halfway along the distance from dorsal pad to funnel-extremity.

Funnel cartilage lanceolate, about thrice as long as broad, a little more acutely pointed anteriorly than posteriorly and more strongly arcuate in the ventral margin than in the dorsal (Pl. XX, fig. 5). The cartilage has a wide straight longitudinal groove near the dorsal margin and defined on the ventral side by a prominent ridge. Mantle cartilage ridge-like, a little longer than funnel cartilage, curved a little in the anterior part, gradually sinking, but a little windening, caudad (Pl. XX, fig. 6).

Buccal membrane broad, thin, with seven indistinct ribs protruding a little beyond the margin. Connectives also seven, membranous, fastened to the dorsal side of arms, but the third arms are connected on the ventral side. Inner-surface of buccal membrane nearly smooth, devoid of chromatophores.

Arms unequal, the formula of length being $4>3>2>1$; all longer than body, the longest being ¼–½ as long again as the shortest. All gradually and evenly tapering towards the extremities. Three dorsal pairs somewhat flattened laterally, but rounded on back except for a weak keel extending up to the extremity. Ventral pair nearly quadrangular in section, the aboral surface marked off on sides by narrow webs, of which the dorsal one is decidedly broader than the ventral, and gradually widens proximad. Protective membranes of moderate breadth, broadest on the dorsal side of lateral arms, where their ribs measure about one and a half times the length of suckers.

Arm-suckers subglobular, quite eccentrically peduncled so as to render their aperture face laterad; the aperture nearly round, but transversely elongated in the proximal suckers. Suckers on each arm in two alternating rows, set at uniform intervals, numbering roughly 110 pairs on three dorsal pairs of arms and about 125 pairs on ventral arms; increasing in size up to the seventh or eighth pair, then decreasing very gradually towards the extremity. Suckers vary in size with the length of arms on which they are set. On the whole, they are largest on the second arms; those of the third arms come next in size, and the smallest ones are on the ventral arms. Horny ring dentate in all suckers (Pl. XX, figs. 7–10). The teeth in proximal suckers number 45–55, triangular, sharply pointed, closely set on the whole margin and a little longer on the distal margin than on the proximal. In the suckers beyond about the thirteenth pair, the teeth on the proximal part of the ring become still smaller and tend to fuse with one-another; thus in the suckers distal to the thirteeth pair they are tightly fused up into a smooth border a little projecting foreward, the separate teeth on the distal and lateral margin numbering only 15, all told. In the subterminal suckers there are only four or five separate teeth on the distal parts of the ring while the remaining part projects as a comparatively broad, smooth, plate-like border. The above mentioned characterization is, however, exceptional for the ventral arms where the teeth are less numerous in each ring and the fusion of the proximal ones occurs from suckers more proximal than on the remaining arms.

Hectocotylization as yet unknown, but in the specimen at my disposal it seems to have affected the left ventral arm which is amputated at its middle. The part remaining in situ has many ruptured spermatophores fixed here and there.

Tentacles were also lost in the same specimen. According to Mitsukuri and Ikeda, they are

three and a half times as long as head and body taken together; their stem far thinner than arms. Club comprises about one-eighth of the entire length of tentacle, bordered with trabeculate protective membranes. Suckers in four oblique rows, of which the two median on the hand portion are composed of very large basin-shaped suckers with peduncles thicker and shorter than those of the sessile arms. In the two outer series the suckers are very small, eccentrically attached to slender peduncles. Suckers on carpus small, crowded in several irregular series but becoming sparse and biserial proximally; in this condition they continue on to the base of the stem, forming a typical arrangement of connective suckers. Scattered among these are found fixing pads, of which the diameter is about the same as that of the suckers. Horny ring of hand suckers, beset with fine, nearly equal teeth; same of carpal and connective suckers, toothless.

Visceral sac relatively small, situated rather posteriorly, thick-walled, evenly covered with small yellowish brown chromatophores which extend on to the ventral pallial artery. Renal openings ostium-like, longitudinal-elliptical. Needham's sac enormous, extending to the level of the tip of gills; the wall of the distal extremity splitted into five lobes. Gill composed of about 120, slender leaflets.

Spermatophores about 120 mm. long; their aboral end 1.5 mm. thick, then evenly and gradually tapering towards oral end which measures about 0.8 mm. in thickness.

Radula consists of seven rows of teeth; median teeth tricuspid; inner lateral teeth bicuspid; the others unicuspid.

Gladius lanceolate, narrowing more gradually posteriad than anteriad, the maximum breadth two-fifths of the way back; sides evenly and gently arcuate in the two quarters at the middle (Pl. XX, fig. 11). Anterior one-sixth especially narrowed, terminating in an angle of about 50°. Posterior two-sevenths a little expanded, traversed by a pair of straight longitudinal ridges, which diverse anteriad from the posterior end of gladius, marking off the marginal parts of both sides from the remaining central part. Margins of posterior part folded ventrally so as to form a slender hollow end-cone, which is not complete ventrally except at a short end-part. No cartilaginous spine grows behind. Rhachis of gladius not thickened nor clearly marked off from vanes, but merely projecting dorsad and revealing an arch in cross section.

Measurements of Specimen Examined by Me.

Dorsal length of mantle	1100 mm.	
Ventral length of mantle	950 „	
Greatest circumference of mantle	800 „	
Circumference of mantle at its anterior margin	720 „	
Length of emarginated part of ventral mantle margin	190 „	
Length of fins	400 „	
Total breadth of fins	320 „	
Diameter of funnel extremity	80 „	
Breadth of funnel base between funnel-cartilages	165 „	
Length of ventral funnel wall	165 „	
Breadth of funnel valve	85 „	
Length of funnel cartilages	125 „	
Breadth of funnel cartilages	40 „	
Length of mantle cartilages	130 „	
Length of nuchal cartilage	79 „	
Maximum breadth of nuchal cartilage	64 „	
Breadth of the posterior part of nuchal cartilage	16 „	
Circumference of arm-bases	650 „	
	Left	Right
Length of first arms	550 mm.	1180 mm.
„ „ second arms	1050 „	1380 „

Length of third arms	550 mm.	650 mm.
„ „ fourth arms	780 „	1400 „
Diameter of largest sucker of first arms	17 mm.	
„ „ „ „ „ second arms	19 „	
„ „ „ „ „ third arms	18 „	
„ „ „ „ „ fourth arms	15 „	
Length of gladius	1040 „	
Maximum breadth of gladius	120 „	
Length of anterior narrow part of gladius	ca. 150 „	
„ „ posterior expanded part of gladius	270 „	

Remarks.—The specimen in hand agrees very well with Mitsukuri and Ikeda's description, but is much larger than their specimen.

It is also agrees in every particular with Hilgendorf's description of *Megateuthis martensii*, although this is not so complete as might have been wished. *M. martensii* was based upon two enormous, but defective, specimens purchased in the same market as the specimen in hand. The locality where these specimens were actually caught, was certainly in the vicinity of Tôkyo Bay, since at that time communication was still difficult in Japan. In one of the two Hilgendorf's specimens, which proved of great service in his systematic search, the mantle is said to have measured 186 cm. in length, so that it must have been 76 cm. longer than that of the specimen now before me, and about twice as long as that of Mitsukuri and Ikeda's specimen.

Locality.—Awa Prov. (Mitsukuri & Ikeda); Tôkyo market (!).

Family **Onychoteuthidae** Gray, 1849.

Onychoteuthidae, Gray 1849, pp. 36, 45 (pars).—Adams, H. & A. 1858, p. 30 (pars).—Tryon 1879, p. 168 (pars).—Pfeffer 1900, p. 154; 1908a, p. 63; 1912, p. 39.—Berry 1914a, p. 322.

Animals of moderate or large size, muscular and firm in consistency. Body elongated, attenuated posteriorly; fins terminal, sagittate. Eye-opening with a distinct sinus in front. Funnel groove well-defined around. Funnel cartilage elongated, more or less acutely pointed in front, with a single longitudinal groove; mantle cartilage ridge-like, linear. Olfactory crest well developed; sometimes nuchal fold also developed. Ribs of buccal membrane usually number seven, rarely eight. Arms equipped with biserial suckers only and no hooks. Tentacles ordinarily with a well-marked carpal fixing apparatus composed of suckers and pads; hand portion in young, with quadriserial suckers, of which those of the two inner series, as the animal grows older, usually undergo a change into hooks and those of the two outer series often disappear. Gladius slender, its posterior part more or less expanded into spoon-shaped lanceola with end-cone and cartilaginous spine.

Subfamily **Onychoteuthinae** Pfeffer, 1912.

Onychoteuthinae Pfeffer 1912, p. 43.

Buccal membrane with seven ribs; aquiferous pores six. No photophores present except in *Onychoteuthis*.

Key to the genera found in Japan.

Nuchal folds present ..... *Onychoteuthis*.
No nuchal folds ..... *Moroteuthis*.

Genus **Onychoteuthis** Lichtenstein, 1818.

Onychoteuthis, Lichtenstein 1818, p. 1591 (fide Hoyle); 1818a, p. 223.—d'Orb. et Fér. 1839, p. 328 (pars).—d'Orb. 1845, p. 383 (pars).—Adams, H. & A. 1858, p. 32 (pars).—Tryon

1879, p. 168 (pars).—Pfeffer 1900, pp. 156, 158; 1908a, p. 64; 1912, p. 70.—Berry 1914a, p. 322.

Body of moderate size, attenuated posteriorly, with broadly sagittate fins. Nuchal folds present. Arms with biserial suckers of normal shape. Armatures on the hand of tentacles, composed of biserial hooks only; fixing apparatus on the carpus, consisting of suckers and pads, distinctly marked off around by fold. No hectocotylization. Gladius slender, furnished with dorsal carination, which appears through the dorsal integument as a well-marked dark streak; posterior part a little expanded into a narrow spoon-shaped end-cone bearing a short cartilaginous spine. Photophores present within mantle cavity.

Type.—*Loligo banksii* Leach, 1817 (=*Onychoteuthis bergii* Lichtenstein, 1818).

Onychoteuthis banksii (Leach, 1817).

Japanese name: Tsume-ika (Tokachi Prov.)

(Pl. XX, fig. 12; Pl. XXX, figs. 1,2).

Loligo banksii, Leach 1817, p. 141.

Onychoteuthis banksii, Fér. et d'Orb. 1839, p. 330, Onychot. pls. i-v, vii, ix, pl. xii, figs. 1-9.—Gray 1849, p. 53.—Goodrich 1896, p. 11.—Pfeffer 1900, p. 159.—Hoyle 1904, p. 35.—Hoyle 1904b, p. 19.—Pfeffer 1908a, p. 65, figs. 71-77.—Pfeffer 1912, p. 70, pl. iii, figs. 13-25, pls. iv-vi.—Berry 1914a, p. 322, text-fig. 31.—Sasaki 1916, p. 90.—Massy 1916b, p. 165.—Issel 1920a, p. 9, figs. 5, 6.—Grimps 1925, p. 73, figs. 26-27; 1927, p. 11; 4 textfigs.

Onychoteuthis borcali-japonicus, Okada 1927, pp. 4-7.

This species is represented by fifteen specimens in the collections I have had access to. They measure up to about 29 cm. in mantle length, the larger ones of them being much larger than those described by Pfeffer. The following description is connected with these Japanese specimens.

Body subfusiform, $\frac{1}{4}$-$\frac{1}{6}$ as broad as long, parallel sided in the anterior two-fifths, then tapering to a slender end-part, which sometimes exhibits a marked keel on the ventral surface. Anterior margin of mantle projects a little in the mid-dorsal part while the ventral part is emarginated crescent-wise, the excavated part marked off on sides by short angular projections.

Fins terminal, a little longer than half the length of body, united together into a rhombus broader than long. Both lateral and posterior angles somewhat pointed. Postero-lateral edges straight; antero-lateral edges convex. Anterior origins somewhat indented.

Head as wide as mantle, and $\frac{1}{7}$-$\frac{1}{10}$ as long as its dorsal length, marked off from neck by a conspicuous circular ridge. Eye-openings, when fully expanded, somewhat squarish, wider than half the thickness of head, with a distinct sinus on the anterior margin a little below the middle. Olfactory crests and nuchal folds form a ruche around the neck; the ruche composed of ten longitudinal folds on either side, of which the ventral six are proximally connected with a delicate transverse membrane. Funnel-groove deep marked off by a sharp ogee-arched edge; internally with no foveola nor folds. Funnel broad, conical, connected dorsally with the centre of funnel-groove by two stout, flattened adductors. Funnel cartilage elongated, about one-third as broad as long, and longer than half the length of funnel; pointed anteriorly, widening posteriad; longitudinal groove narrow, straight. Mantle cartilage ridge-like, linear, straight, about twice as long as funnel-cartilage. Funnel organ composed of a conspicuous $\wedge$-shaped dorsal pad, and two small elliptical ventral pads.

Arms subequal; formula mostly $4>2>3>1$; the longest about half as long as mantle. All carinated on back especially the third and fourth pairs; on these arms the carination is as high as the thickness of arms. Suckers biserial throughout, nearly equal in size but those of lateral arms slightly larger than those of the rest. Horny ring smooth.

Tentacles variable in length but generally as long as head and body taken together; stem com-

pressed a little, nearly quadrilateral, with a narrow fold running along the dorsal edge of oral surface. Club expanded a little, 1/5–1/3 the entire length of tentacle, with a narrow dorsal web along the distal two-thirds; ventral protective membrane well developed, but feebly trabeculate. Principal armatures of tentacles consist of about 25 hooks in two series; of these the first ten are short, and nearly uniform, but hereafter those of the dorsal series become longer while those of the ventral series diminish in size. On the extremity are found a small round cluster of twelve minute suckers, and on the carpus a well-defined oral fixing apparatus comprising 8—10 suckers and as many pads.

Buccal membrane with seven strong ribs, which are united, by so many connectives, with the dorsal surfaces of the first and second arms and the ventral surfaces of the third and fourth.

Gladius slender, strongly carinated at the posterior part (Pl. XX, fig. 12). Vanes very narrow, broadest one-third of the way back, then becoming gradually narrower posteriad and folded ventrally at the same time. But at the posterior end they again become a little wider, forming a spoon-shaped lanceola with a shallowly excavated end-cone, to the dorsal surface of which is attached a short cartilaginous spine.

Two pallial luminous organs present, anterior and posterior. The anterior is situated on the liver capsule near the anus, whereas the posterior is on the inkbag. They are longitudinal-oval or elliptical in shape and the posterior one is much larger than the anterior. They are connected with each other by a narrow commissural tissue running along the rectum. The details in structure are given by Okada (1927).

The principal measurements of the female specimens from Hidaka Prov. are appended:—

No. of specimen	i	ii	iii	iv
Dorsal length of mantle	232 mm.	243 mm.	220 mm.	220 mm.
Ventral length of mantle	218 ,,	220 ,,	208 ,,	205 ,,
Breadth of mantle	55 ,,	60 ,,	55 ,,	55 ,,
Breadth of head	40 ,,	38 ,,	35 ,,	36 ,,
Length of head	35 ,,	38 ,,	30 ,,	35 ,,
Length of fins	132 ,,	135 ,,	120 ,,	125 ,,
Total breadth of fins	170 ,,	175 ,,	155 ,,	160 ,,
Length of first arms	Left mm. 100 Right mm. 102	Left mm. 85 Right mm. 85	Left mm. 90 Right mm. 95	Left mm. 80 Right mm. 80
,, ,, second arms	115 ,, 115 ,,	105 ,, 100 ,,	103 ,, 100 ,,	95 ,, 95 ,,
,, ,, third arms	108 ,, 108 ,,	95 ,, 95 ,,	95 ,, 95 ,,	95 ,, 95 ,,
,, ,, fourth arms	115 ,, 115 ,,	110 ,, 110 ,,	105 ,, 105 ,,	105 ,, 105 ,,
,, ,, tentacles	260 ,, 260 ,,	270 ,, 270 ,,	240 ,, 240 ,,	250 ,, 250 ,,
,, ,, clubs	60 ,, 60 ,,	60 ,, 60 ,,	55 ,, 55 ,,	60 ,, 60 ,,
Length of nidamental gland	43 mm.	45 mm.	26 mm.	33 mm.
,, ,, funnel cartilage	29 ,,	30 ,,	26 ,,	29 ,,
,, ,, mantle cartilage	55 ,,	60 ,,	55 ,,	58 ,,

Remarks.—This species is widely distributed, and can be collected in all the oceans at numerous localitie sas given by Pfeffer (1912, pp. 79–88). In Japan it has hitherto been known only from Formosa. The specimens in hand were caught at Tokachi Prov., Kushiro Prov., and Hidaka Prov., all these localities being in the eastern coasts of Hokkaido; it is at times caught in plenty and is cured for the market.

Okada (1927) distinguishes the Japanese boreal form from those hitherto known, naming it *O. boreali-japonicus*. The chief point of distinction given by him is as follows: *les organes photogènes qui se trouvent sur le côté gauche de l'intestin et sont reliés entre eux par une étroite commissure ou pont.* Besides this he gives in other parts of his paper some differences in size as well as in Structure of

luminous organs. To my regret I am not able to offer here any definite opinion upon his view as no specimen from other countries is represented in the collections at my disposal. But it should not be forgotten that the developement of luminous organs sometimes differs with age as well as with the season of the year, and it seems to be risky to determine the specific relationships merely by the structure of the luminous organs of a small number of specimens.*

Genus **Moroteuthis** Verrill, 1881.

Moroteuthis, Verrill 1881c, p. 393; 1882, p. 419.—Pfeffer 1900, pp. 156, 161; 1908a, p. 68; 1912, p. 104.

Skin muscular, firm, warty. Body subfusiform, with a slender end-part and sagittate fins. Funnel groove well-defined around, internally smooth or with a ⊥-shaped ridge. Funnel cartilarge lanceolate; mantle cartilage ridge-like, linear, not longer than twice the length of the former. No nuchal folds present. Eye-opening distinctly sinuated at the anterior margin far below the middle. Ribs and connectives of buccal membrane number seven each; its aquiferous pores six. Arms equipped with biserial suckers only and no hooks. Tentacles with biserial hooks on the hand, small crowded suckers at the distal extremity, and well-defined fixing apparatus on the carpus. Gladius slender, lanceolate, with neither carination nor distinct end-cone, but a conspicuous cartilaginous spine attached to the posterior end.

Type.—Ommastrephes robusta Dall, 1876.

Key to the species found in Japan.

(a) Funnel groove smooth; middle and lateral teeth of radula faintly tri- or bicuspid ..... *M. robusta.*

(b) Funnel groove with ⊥-shaped ridge; middle and lateral teeth of radula distinctly tri- and bicuspid respectively ..... *M. lönnbergii*

Moroteuthis robusta (Dall Mass.) Verrill, 1876.

(Pl. XXX, fig. 7; textfigs. 171, 172.)

Ommastrephes robustus, Verrill 1876, Amer. Jour. Sc. xii, p. 236.

Onychoteuthis (or *Lestoteuthis?*) *robusta*, Verrill 1880, pp. 195, 246, pls. xxiii, xxiv.

Moroteuthis robusta, Verrill 1881, pp. 275, 419, pls. 13, 14; 1881, p. 393.—Pfeffer 1900, p. 161; 1908, p. 68, figs. 78, 79a, b; 1908, p. 294; 1912, p. 105.—Ishikawa & Wakiya, 1914, p. 435, pls. xliii, xliv.

Ancistroteuthis robusta, Steenstrup 1882, p. 50.—Thompson 1900, p. 992, fig. 9.

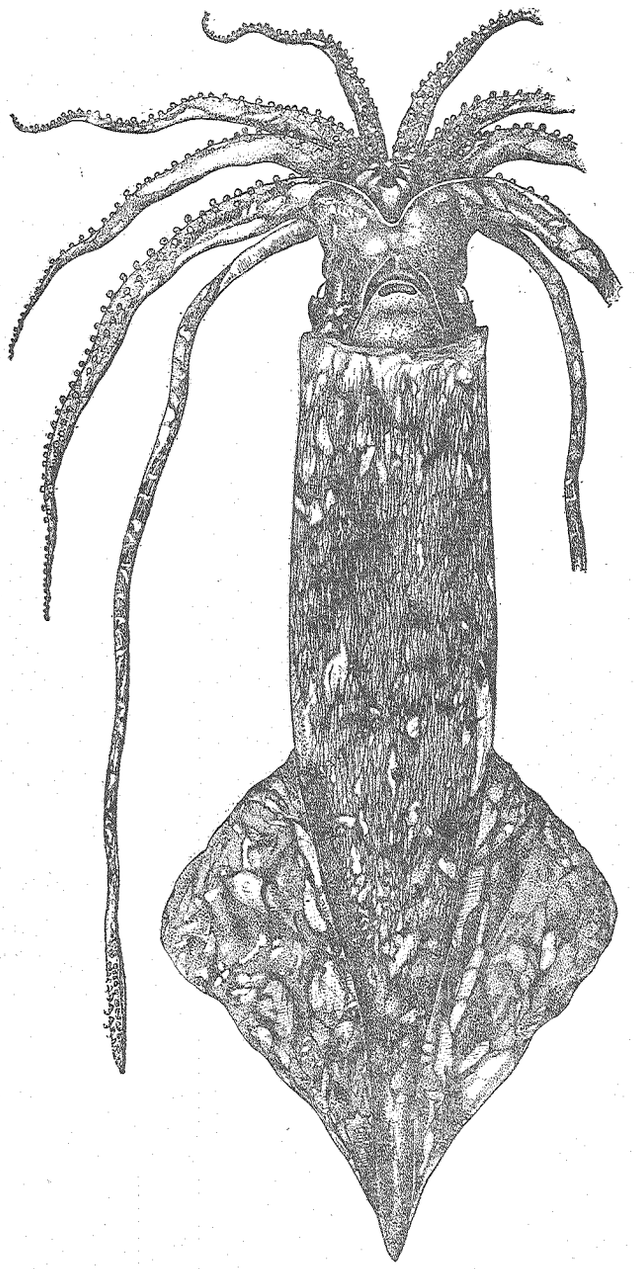
I have examined two specimens of the species, one of which was caught by a fishermen with a fixed net near Muroran on Oct. 16, 1921, whereas the other was discovered on the beach near Abashiri by one of natives on Nov. 13, 1924, both the localities being in Hokkaido. They were in much better condition than any specimens hitherto described, especially that from Abashiri, which was quite fresh and still of perfect condition when it was brought to me so that I found out many specific characteristics unknown till then.

Animal gigantic; while fresh very soft to the touch and as gracious as *Gonatus*, and never so firm as in *Ommastrephes*.

Trunk subspindlical, with a truncated anterior end, and a somewhat attenuated posterior extremity. When traced in detail from before posteriad along the length, it very gradually widens at first to one-third down the length, whereby attaining the muximum breadth, which measures a little less than one-fifth the length. From this point it gradually narrows posteriad to the vicinity of the anterior origin of the fins, and thence tapers rapidly caudad, but from the middle region of the fins

*) Okada's description is based on the specimens obtained by me from Tokachi, Hokkaido, and which are now preserved in the Hokkaido Imperial University. This note is given in favour of some use for the case when the form would be recognised to be a species new to science, as Okada omits the note in his description.

the tapering is again slackened and thus terminating in an attenuated end-part (textfig. 171). This part is solid, containing no visceral organ nor mantle cavity. In the specimen from Abashiri, the part was about 350 mm long and 70 mm. thick.



Textfig. 171.

Moroteuthis robusta (Dall mass.). A female from Abashiri, Hokkaido. $\times 1/12$.

Mantle rather thin relative to the size of the animal, yet it measured 30 mm. in thickness near the broadest part of the body in the Abashiri specimen. Anterior margin of the mantle weakly emarginated ventrally between the faint projections of the ventral mantle locking cartilages; dorsally the margin forms a blunt angle in the middle where it resists internally the nuchal cartilage of the head. Surface sculpture of the mantle quite peculiar, consisting of numerous longitudinal ridges 1–3 mm. wide which is easily torn away by rough handling of the surface. Sections show that the ridges are formed by intercalation of the longitudinal fibrous bandles in cutis. The ridges run parallel with one another, though very frequently may go together in their way back; the interspaces between the ridges range from one to a double breadth of the latter. They are most well defined in the anterior one-third of the mantle, whence they decrease gradually in height posteriad, becoming very indistinct or even quite fading out before reaching the middle region of the fin. The end-part of the body is quite smooth.

Fins large, with a length a little greater than half that of the mantle; taken together sagittate, with an acute posterior extremity; decidedly longer than broad, the broadest part lying about one third the length. Anterior origins weakly auriculate on both sides of the body, their extreme ends of attachment are separated from each other by half the breadth of the body; the interspace measured 170 mm. in breadth in the Abashiri specimen. Antero-lateral edges convex, the convexity evenly continuing to those of the rounded lateral angles. Post-lateral edges much longer than the preceding, and nearly straight except the most posterior part which is weakly concave. This part runs down along each side of the end-part of the body, regularly narrowing caudad and disappears some distance anterior to the extreme end of the body. This unfinned part was 50 mm. in the Abashiri specimen. Thus the fins are not strictly terminal in respect to the attachment to the body. They are smooth throughout and thin at the margin, but becomes as thick as the mantle near their attachment.

Head roughly rounded cubical in shape, with nearly flattened dorsal and lateral surfaces; the

breadth exceeds a little the length, which is in turn about equal to the depth. Posteriorly it is sharply separated from the neck by a sharp edge, of which the dorsal part forms a blunt angle at the nape.

Funnel excavation wide and deep, well marked anteriorly and laterally by a horseshoe-shaped ridge; the inside is smooth except for a ⊥-shaped ridge, of which the base line runs parallel to the anterior boundary ridge and the vertical line extends anteriorly to the same ridge, bisecting the area enclosed.

Eye-opening wide, the greatest diameter is about one-third the depth of the head, the anterior margin produces a deep sinus which extends between the third and fourth arms. Lid thin except at the sinus where it is particularly thickened.

Olfactory crest composed of three longitudianl folds of nearly equal size. They begin equally from the posterior boundary edge of the head and run posteriad, but suddenly curve upward to the vicinity of the nape before their reaching the posterior boundary angle of the neck. In the middle one and the dorsalmost of the three, the upward part joins with each other so that a narrow continous membrane is formed parallel to the posterior angle of the neck.

Funnel subconical, with a truncated anterior end which in the Abashiri specimen measured 65 mm. in breadth. The measurements of other parts of the funnel in the same specimen were as follows: the length along the median line of the funnel was 160 mm. and that from the anterior end to the posterior angle of the locking cartilage, 246 mm. Funnel valve broad (70 mm. in the transverse diameter in the said specimen), roughly semilunar, the distal margin extending within a short distance of that of the funnel. Funnel organ consists of relatively small, thin pads. Dorsal pad of inverted V-shape, of which the inner margin consists of two straight lines meeting each other anteriorly at an angle of 50°, while the outer margin delineates an irregular curve: it forms at the anterior angle a semicircle which has a minute cuspidation at the apex, and on either side of this part the margin swings in to form a shallow bay there; the remaining part which corresponds approximately the posterior half, is straight, and meets posteriorly with the inner margin of the pad at a very acute angle. The pad has a faint ridge which runs parallel with the outer contour along the middle line of the breadth. The pad takes a posterior position, as compared with its allied species: the anterior end marks about the centre of the dorsal wall and the posterior ends lie on the level with the anus. Ventral pads elongate almond-shaped in outline, three and half times as long as broad, more acutely pointed posteriorly than anteriorly, more highly convex in the dorsal margin than on the ventral, and situated nearer to the posterior margin of the funnel than to the anterior margin. Measurements of the organ in the Abashiri specimen: depth of the dorsal organ, 130mm; length of each arm of the same, 200 mm; maximum breadth of the arms, 23 mm; length of the ventral pad, 87 mm., breadth of the same, 26 mm.

Funnel cartilage lanceolate, very slightly narrowing, anteriad, its breadth is a little less than one-third the length, and more sharply pointed anteriorly than posteriorly, with a shallow median furrow which extends throughout the length, and curves weakly laterally. Its measurements in the Abashiri specimen measured 135 mm. in length and 43 mm. in breadth, while that of the Muroran specimen were 110 mm. long and 20 mm. in breadth.

Mantle cartilage consists of a longitudinal ridge about twice as long as the funnel cartilage, its anterior half is a little curved and prominent, while the posterior half is nearly straight and decreased in height posteriad.

Arms unequal, the formula of length being $4>3=2>1$, in which the longest is about half the length of the mantle; slender, evenly tapering distad. Thickness of their proximal portion, proportional to their length in order. First and fourth arms quadrangular in section whereas the second and third arms are more or less dorso-ventrally flattened, provided with a keel along the median line of the aboral surface. The keel of the third arm is much stronger than that of the second, and extends for about proximal two-thirds of the length. The web of the outer side of the fourth arm is very broad and still widens proximally where it joins with the base of the third arm forming a sheath for the tentacle. Narrow protective membrane on each side of the oral surface, spanned by short but strong ribs. Interbrachial webs very narrow, especially between the ventral arms.

Arm-suckers very small relative to the size of the arms, grobular in shape, obliquely pedunculate as usual, with a wide aperture which is armed with a smooth horny ring. They arrange themselves in two sparse longitudinal rows throughout. I counted 50–60 pairs in each arm in the Muroran specimen, in which most arms have perfect extremities. Several proximal pairs of suckers become larger very gradually distad, then come several other pairs of about similar size, whence the suckers become smaller very gradually to minute ones at the extremity.

Tentacular arms slender, nearly as long as the body, decreasing in thickness very gradually distad, the proximal part is about as thick as lateral arms. Club only a little expanded, nicely lanceolate, attenuated at the distal extremity, with a narrow dorsal web which extends for the distal two-thirds of the length; very narrow protective membrane on each side.

Carpal adhesive organ oval in shape, enclosed by a low ridge, with about ten suckers and pads, of which the arrangement in the specimens examined were as follows:

Specimen from Abashiri		*Specimen from Muroran*	
Right	Left	Right	Left
s	p	p	p
p p	s s	s s	s s
s s s	p p p	p p p	p p p
p p p	s s s	s s s s	s s s s
s s s s	p p p p	p p p p p	p p p p
p p p p	s s s s	s s s	s s s
s s s	p p p	p p	p p
p	s	s	s

Notice: p and s in the above table indicate a pad and a sucker respectively.

The suckers of the organ are pail-shaped, and each with a very short peduncle and a wide aperture with a smooth horny ring.

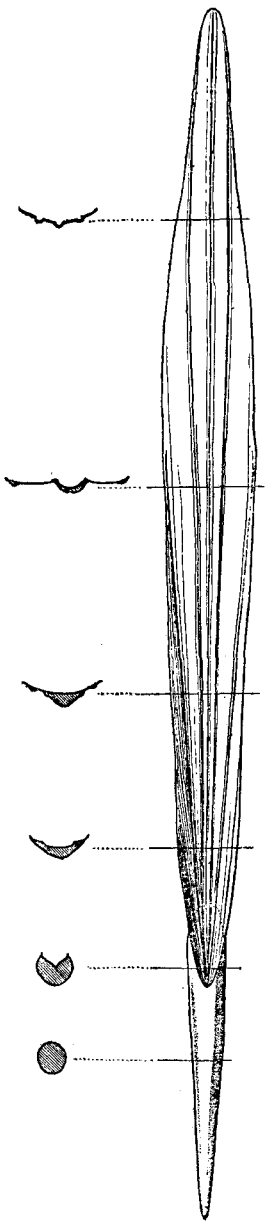
Armatures of the hand portion consist of 36 hooks arranged in two sparce longitudinal series, those of the ventral series are on the whole larger than those of the dorsal, and in each series several of the basal ones gradually increase in size distad and the succeeding 3 or 4 are the largest, whence they decrease in size distally.

Buccal membrane broad, spanned by seven ribs, each of which projects in an acute point beyond the free margin of the membrane. Each rib is fastened to the base of the corresponding arm by one membranous ligament except the dorsalmost, which is connected by a double ligaments with the both arms of the first pair. These ligaments and those of the second dorsal ribs are joined to the dorsal protective membranes of their opposite arms, while the ligaments of the remaining ribs are connected with the ventral protective membranes of the corresponding arms.

Outer lip almost as thick as the thickest part of the buccal membrane, irregularly wrinkled. Inner lip very thick and papillate distally as usual. Mandible and radula well agree with the description by Verrill, Cephalic cartilage soft, being nowhere chondrified.

Gladius lanceolate, extending for the whole dorsal length of the mantle, consisting of a rachis, lateral vanes and a posterior cartilaginous rod (textfig. 172). The rachis widens at first backward, and attains its maximum size near one-fifth the length from the anterior end, whence it narrows gradually and regularly caudad. The vanes originate on either side of the rachis about one-eighth the length from the anterior end where the gladius attains its maximum dimension. From this point it becomes very gradually narrower backward and forms an end-cone at the junction to the posterior cartilaginous rod. As is usual the case the vanes compose together with the rachis an arch, enclosing ventrally a shallow concavity, of which the central part is enclusted by a cartilaginous substance. The substance is, however, not of uniform breadth and thickness, but becomes thicker and broader caudad. The cartilaginous rod is slenderly conical, regularly tapering caudad, and occupies about posterior one-third of the entire length of the gladius. It is quite round everywhere, in section solid, and consists of concentric cartilaginous layers, but the anterior end fitting the end-cone, en-

closes an oblique concavity, the dorsal margin of which extends forewards about one-fifth the entire length of the rod.



Textfig. 172.
Moroteuthis robusta (Dall mass.). Ventral view of shell of specimen from Abashiri, × ca. $^1/_{10}$.

Whole external surface of the head, neck, body, fins and funnel are similarly deep reddish brown. This can be said also for the arms and tentacles, but their oral and ventral surfaces are of a little lighter tint. The outer surface of the buccal membrane is also of the same colour, although the inner surface is quite colourless. Inner and outer lips also colourless. Inner surfaces of the funnel and mantle as well as the visceral sac tinged with the similar brown, but the intencity varies greatly in different parts; the deepest is the funnel and the anterior part of the mantle except around the ventral resisting cartilage which is characteristically faint in colour. Blood vessels exposed to the mantle cavity are also fairly deep in colour. Gill leaflets clear greenish yellow, margined by the brownish blood vessels, so that the gill as a whole exhibits a vivid contrast of the colorations. Gladius colourless throughout and transparent, but the cartilaginous rod is translucent.

The Abashiri specimen was dissected, but no marked specific characteristic was made out. The inkbag was very small as compared with the size of the body measuring only 40 mm. by 10 mm. but the duct was very long, extending nearly along the whole length of the rectum. The ovary was about 250 mm. long, 200 mm. wide and 140 mm. thick, and separated by median septum into lateral halves, each of which contained numerous mature eggs measuring about 1 mm. in length and 0.76 mm. in width. The oviduct of the each side winded finely in a close zigzag way, the wind numbered 15. The nidamental glands measured 400 mm. in length and 80 mm. in breadth.

Dimensions other than those given above in the specimens examined were as follows.

Remarks.—The present species has hitherto been known by five specimens, three of which were those discovered by Dall near Iliuliuk, Unalaska, and have been materialized for the original description of the species. The fourth specimen is that of Thompson, obtained also in Unalaska. The fifth specimen was described by Ishikawa and Wakiya, and is said to have been found in the stomack of a sperm whale which was captured in the open sea off the south of the Tsugaru Straits.

The specimens at my disposal constitute thus the sixth and seventh known to science and correspond in size to Thompson's specimen, and also to the second largest of Dall's, and is far larger than Ishikawa and Wakiya's. They well agree with the original description except in a few respects. 1) The eye-opening is much broader in mine than in Dall's, in which its diameter is said to be 25 mm. 2) In his specimens the mantle is said to be firm and dense, not soft as in my case, and 3) the cartilaginous rod of the gladius is deep brown or amber- colour, and 4) the vanes of the same is very narrow as compared with mine. But these differences except the last are very probably due to defferent states of preservation. Indeed, of the two specimens examined, the one from Muroran, being preserved for fairly long time in alcohol, has much firmer consistency than the other, and the gladius is brownish throughout. The difference to be taken into consideration between mine and Dall's is the difference of the breadth of the vanes of the gladius, which I am, however, greatly inclined to consider as due to the imperfect state of gladius in the side of Dall's.

According to the descriptions by Thomposon and by Ishikawa and Wakiya, the cutis has characteristic longitudinal and transverse or more or less oblique and transverse folds. In the speci-

Locality of specimen	Abashiri		Muroran	
Dorsal length of mantle...	1615 mm.		1450 mm.	
Ventral length of mantle	1565 ,,		1360 ,,	
Circumference of the body at the anterior end	670 ,,		—	
,, ,, ,, at the broadest part	920 ,,		815 ,,	
,, ,, ,, ,, ,, origin of fins	730 ,,		—	
Length of head...	166 ,,		145 ,,	
Depth of head	155 ,,		—	
Breadth of head	200 ,,		—	
Length of fins	800 ,,		740 ,,	
Total breadth of fins	700 ,,		650 ,,	
Length of first arms	Left 590 mm.	Right 600 mm.	Left 330(−)mm.	Right 600 mm.
,, ,, second arms	620 ,,	615(−)mm.	310(−) ,,	700 ,,
,, ,, third arms	717 ,,	664(−) ,,	710 mm.	700 ,,
,, ,, forth arms	750 ,,	494(−) ,,	730 ,,	725 ,,
,, ,, tentacles...	1346(−)mm.	1367 mm.	1100 ,,	1350 ,,
,, ,, tentacular clubs	114(−) ,,	210 ,,	20(−)mm.	200 ,,
Length of gladius	1610 mm.		1446 mm.	
,, ,, horny part of gladius	1300 ,,		120 ,,	
Breadth of the same	120 ,,		117 ,,	
Length of cartilaginous rod	390 ,,		370 ,,	
Maximum diameter of	45 ,,		42 ,,	

mens at my disposal, however, these were not made out at least in the fresh specimen from Abashiri, although the specimen from Muroran which was brought to me in preserved state, the cutis showed similar folding here and there as given by the said writers. Other differences of the present specimens from that description by Ishikawa and Wakiya are that in their case the sinus of the eye-lid ends directly at the base of the third arm not turning toward the space between the third and fourth arms, and there is a distinct furrow along the mid-dorsal line of the mantle, which is quite destitute of in my case. Moreover, the fins are said to be unsymetrical in shape instead of symmetrical as in my case.

The species seems not very rare in boreal seas of the Asiatic side of the North Pacific. Its discovery on their coast has often been reported to me the localities informed are: Etrup I. Kunashiri I. both belonging to Kurile group, and Nemuro and Kushiro, two provinces in Hokkaido.

Locality.—Unalaska (Dall, Stimpson), South of Tsugaru Straits (Ishikawa and Wakiya), Abashiri (!), Muroran (!).

Moroteuthis lönnbergii Ishikawa & Wakiya, 1914.

Japanese name: Kagi-ika (Sagami Prov.)

(Pl. XX, fig. 13; textfig. 119.)

Moroteuthis lönnbergii, Ishikawa & Wakiya 1914a, p. 445, pls. xlv, xlvi.—Sasaki 1916, p. 91.

This species is represented by seven female specimens in the collections at my disposal. Although they are not yet fully mature their mantle already measures up to 210 mm. in length. The largest specimen of Ishikawa and Ikeda's is said to have a mantle-length of 275 mm.

Body cylindrical in its anterior half, whence it tapers at first rapidly but gradually afterwards so as to form a slender end-part. Length about five times the breadth. Anterior margin of mantle

projects at the mid-dorsal part in a broad and very low triangle. Ventral part of the margin broadly excavated in the middle, the excavated part delimited by short angular projections on sides.

Fins taken together sagittate, acutely pointed behind, the broadest part existing a little in front of the middle. Antero-lateral edges a little convex; postero-lateral edges also convex in the anterior parts but distinctly concave in the posterior. Length about equal to the total breadth and also to a half of mantle-length, a little disagreeing with Ishikawa and Wakiya's description.

Head in good preservation as broad as mantle opening and distinctly marked off from neck by a more or less prominent ridge. This forms a blunt angle in the mid-dorsal part, extending laterally and then ventrally in a wavy course. Eye-opening furnished with a deep subventral sinus extending towards the space between third and fourth arms; dorsal margin of sinus much thickened. Funnel groove comparatively deep, well defined by a sharp edge, of which the posterior parts are raised into folds holding the funnel laterally. In the groove is found a horseshoe-shaped ridge running parallel with the boundary edge and connected with it by a short longitudinal ridge anteriorly. Olfactory crest on each side composed of three longitudinal folds. The ventralmost of these three is the narrowest, confluent with the posterior boundary fold of the funnel grove, while the remaining two are more or less semilunar, connected with a narrow, but long, transverse fold posteriorly. No nuchal folds present. Nuchal cartilage conspicuous, about twice as long as the collar-like portion of funnel is high; roughly panduriform, constricted near the middle; posterior end a little more acuminated than the anterior; maximum breadth about a quarter of the length; median ridge with a distinct groove along the crest.

Funnel conical, extending halfway to the space between ventral arms; posterior margin of collar-like part emarginated at dorso-lateral part, then extending dorsally and caudally so as to a marked projection along either side of nuchal cartilage. Funnel cartilage pliant, slender, about four times as long as broad; sides parallel or slightly concave; extremities rounded, but the anterior is a little sharpened. Locking groove runs the whole length of the cartilage along its median line, the inner border being much more prominent than the outer. The corresponding cartilage of mantle consists of a straight, streak-like ridge about half as long again as the former cartilage.

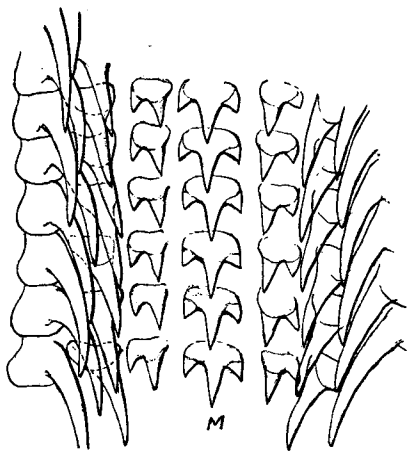
Arms subequal, the formula of length being $4>3>2>1$ or $4>3\fallingdotseq2>1$ or $4>2>3>1$; the longest about two-thirds the length of mantle. Third pair flattened dorso-ventrally, the others quadrangular in section. All with either web or carination on the aboral surface; the carination especially well developed on the third arm where it is as high as the length of suckers. Protective membranes uniform, and narrow, the breadth being less than the length of suckers. Suckers biserial; none modified into hooks; horny ring smooth.

Tentacles about as long as mantle. Stem nearly quadrilateral, provided on the aboral surface with a narrow membrane extending to the base proximally and to some distance up the club distally; oral surface flat, marked off by folds on sides. Club expanded a little, lanceolate, comprising a quarter of tentacle; the distal two-thirds occupied by dorsal web, which rather rapidly fades out posteriorly, without connecting itself with the aboral membrane of stem. Well-marked oral fixing apparatus present on carpus, bearing about eight suckers and pads, encircled by a fold. Hand portion equipped with about twenty-six hooks arranged in two series. In the ventral series, hooks become longer to the sixth or seventh, then diminish in size, the distalmost being much smaller than the proximalmost. Hooks in the dorsal series are on the whole much smaller than those of the ventral and the largest is the sixth, then suddenly diminish in size distally. Extremity of club furnished with 10–12 minute suckers crowded in a rounded group.

Buccal membrane very thick, broad, with seven strong ribs markedly projecting beyond the margin. Connectives also seven, the dorsalmost deeply bifurcate; connected with the dorsal surfaces of first and second arms and the ventral surfaces of the third and fourth. Outer lip thin, inner lip very thick, papillous. Pores six in number.

Skin firm, fleshy, warty. Warts on mantle wrinkle-like, running lengthwise, anastomosing one another by oblique branches. They measure 0.3–0.8 mm. in breadth, distant from one another as far as their own breadth. Warts on head shorter and more closely set than on mantle but less prominent.

Radula consists of seven rows of teeth. Median teeth distinctly tricuspid, the lateral cuspi about half as long as the central. Inner lateral teeth bicuspid, a little shorter than the former teeth. Outer lateral teeth unicuspid, as long as two succeeding inner lateral teeth measured together. Marginal teeth also unicuspid attaining a length of three succeeding inner lateral teeth combined together (text-fig. 119).



Textfig. 119.

Moroteuthis lönnbergii. Radula; × 40.

Gladius slender, lanceolate, arched dorsally, its axial region again elevated so that the whole cross section is the form of a trifoliate arch (Pl XX, fig. 13). Vanes narrow; rudimentary in the anterior one-six of the length, then widening to the point about two-fifths the length of gladius from its anterior extremity. Hereafter they evenly and gradually narrow caudad, without forming any expansion or any end-cone posteriorly. To the dorsal side of this extremity is attached, however, a conspicuous cartilaginous spine about one-third as long as the remaining parts of the gladius. The spine regularly tapers to a very short point, compressed laterally, the dorsal edge flattened and the ventral comparatively sharp, so that the whole apperance is almost like that of a knife blade.

Remarks.—The specimens examined, upon which the above description is based, agree in principal characters with Ishikawa and Wakiya's original statement and there is no doubt as to their identity.

The species is often caught in Sagami Bay, but not in so great a quantity as economically valued.

Locality.—Misaki (Ishikawa & Wakiya; Sasaki); Hayama (Ishikawa & Wakiya); off Atami (Sasaki); Manazuru (!), all the localities being in Sagami Bay.

Family **Enoploteuthidae** Pfeffer, 1900.

Enoploteuthidae, Pfeffer 1900, pp. 152, 163; 1908a, p. 73; 1912, p. 118.—Hoyle 1904b, p. 10.—Chun 1910, p. 52.—Berry 1914a, p. 325.

Veranyidae, Chun 1910, pp. 139, 143.

Onychoteuthidae, Carus 1890, p. 448 (pars).

Animals usually of small size; muscular in consistency, but partly may be choroidal or membranous. Body conical or hemifusiform; posterior end bluntly or sharply pointed. Fins usually large, terminal or subterminal. Eye-opening ordinarily sinuated in front. No nuchal folds present. Olfactory crest usually developed, often bearing tuberculus olfactorius. Funnel-groove rather ill-defined, with no foveola nor any folds internally. Funnel cartilage ovate or lanceolate, with a simple longitudinal groove. Arms in adult equipped with numerous biserial suckers in two series; their extremity usually with minute suckers also in two series. Tentacles in adult, furnished with more or less well-defined fixing apparatus on their carpus, and uni- to biserial hooks as well as uni- to quadriserial suckers on their club (in *Pyroteuthis* and in the young of other genera there are found suckers only on the tentacles; the latter disappear in the Octopodoteuthinae as the animal grows older). Buccal membrane with 6–8 ribs and connectives. Gladius penni-form, with no hollow end-cone nor any cartilaginous spine behind. Photophores almost invariably present; they may occur in skin, on eye-balls, at the extremity of arms, or in mantle cavity. So far as known, hectocotylization affects either arm of the ventral pair.

Key to the subfamilies and genera represented in Japan.

(A) Innumerable minute photophores on the ventral surface of both mantle and head, as well as on the aboral surface of ventral arms; some larger ones on eye-balls .....
.....Subfam. *Enoploteuthinae.*

(a) Photophores on mantle and head, grouping themselves in several longitudinal zones; no marked photophores at the tip of ventral arms; biserial hooks on tentacles ..... Gen. *Enoploteuthis.*

(b) Photophores on mantle and head, evenly distributed; no marked photophores on the tip of ventral arms; uniserial hooks on tentacles ..... Gen. *Abralia.*

(c) Photophores on mantle and head, evenly distributed; three marked photophores at the tip of ventral arms; uniserial hooks on tentacles; right ventral arm hectocotylized ..... Gen. *Watasenia.*

(B) Large round photophores sparsely and regularly scattered on the ventral surface of mantle; no (at least not marked) photophores on eye-balls ..... Subfam. *Ancistrochirinae.*

(d) Large photophores on mantle and head; numerous biserial hooks on tentacles; body bluntly ended hehind ..... Gen. *Thelidioteuthis.*

(C) No photophores on mantle, head and eye-balls ..... Sabfam. *Octopodoteuthinae.*

(e) Tentacles absent in adult though present in young ..... Gen. *Octopydoteuthis*

Subfamily **Enoploteuthinae** Chun 1910.

Enoplomorphae, Chun 1908, p. 86. (pars).
Enoploteuthinae Tribus *Enoplomorphae*, Chun 1910 pp. 56, 78 (pars).
Enoploteuthinae, Pfeffer 1912, pp. 124, 125.—Berry 1914a, p. 325.

Body somewhat sharply pointed behind but not forming any attenuated end-part projecting far beyond fins. Fins terminal or nearly so, large, sagittate; extending at most for two-thirds the length of mantle. Buccal membrane, free with eight ribs and connectives. Innumerable minute photophores occur on the ventral surface of mantle and head; usually also some on the aboral surface of arms. Small or large photophores present in a series along the ventral periphery of eye-balls.

Genus **Enoploteuthis** d'Orbigny, 1839.

Enoploteuthis, d'Orb. in d'Orb. et Fér. 1839, p. 336 (pars).—Gray 1849, p. 46 (pars).—Adams, H. & A. 1858, p. 30 (pars).—Tryon 1879, p. 172 (pars).—Pfeffer 1900, p. 165; 1912, p. 126.—Hoyle 1904b, p. 12.

Body conical, muscular, but choroidal at the end-part. Fins nearly terminal, broadly sagittate, ⅔–¾ as long as mantle. Buccal membrane evenly reddish throughout; ribs, processes, and connectives numbering eight each. Arms in adult, furnished with biserial hooks on the proximal part and biserial suckers on the distal. Tentacles with well defined fixing apparatus on the carpus, biserial hooks on the hand, and quadriserial suckers on the distal extremity. Right ventral arm hectocotylized, provided with hooks, suckers and two semilunar membranes. Gladius penniform, devoid of distinct end-cone. Innumerable minute uniform photophores form several longitudinal zones on mantle and head, four zones on funnel, two or three zones on fourth arms, and a single zone on third arms. 8–10 small photophores arranged in a series along the ventral periphery of eyeballs.

Type.—Loligo leptura Leach, 1817.

Enoploteuthis chunii Ishikawa, 1914.

(Pl. XXI, figs. 1–5; textfigs. 120–122.)

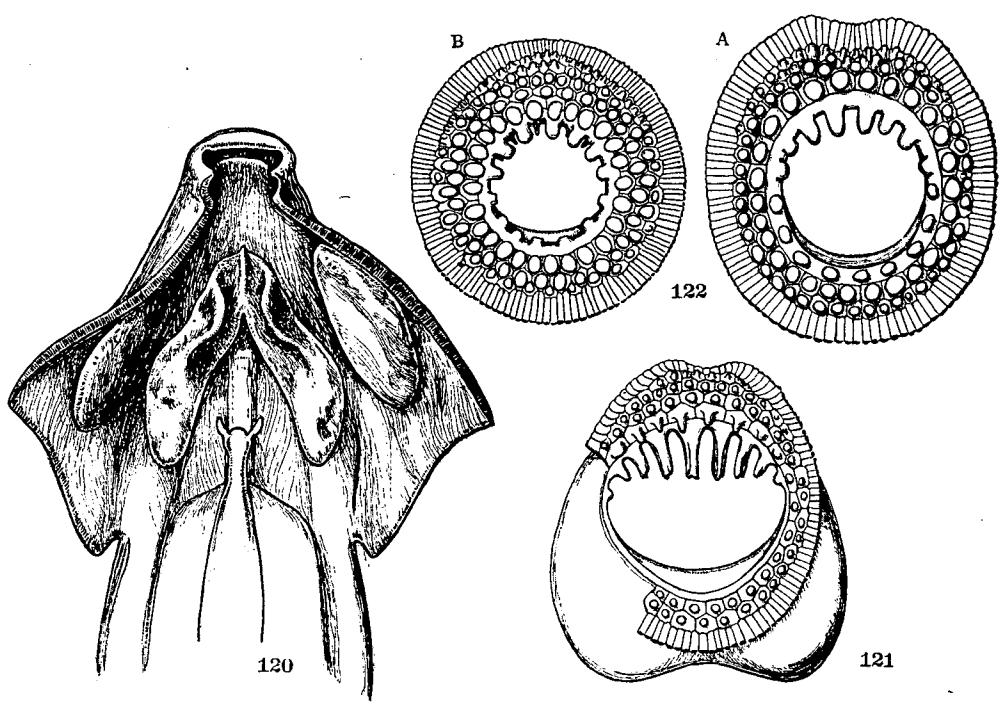
Enoploteuthis chunii, Ishikawa 1914, p, 401, pls. xxxviii, xxxix.—Sasaki 1916, p. 91; 1920, p. 195.

Two male and four female specimens which I have collected at Toyama Bay are referred without hesitation to this species.

Body rather muscular, but choroidal at the end-part; nicely conical, a little longer than one-third

of its own maximum breadth (Pl. XXI, fig. 1). Anterior margin of mantle projects slightly in the mid-dorsal parts; its ventral part broadly emarginated at the middle, the emarginated part marked off on sides by angular projections, and showing another faint projection in the middle. Fins together broadly sagittate, the combined breadth somewhat greater than the length, which measures in turn more than two-thirds the length of body; lateral angles rounded; posterior part attenuated, extending posteriad along the end-part of body, but not so far as to reach its extreme end.

Head comparatively large, slightly narrower than mantle-opening, a little depressed dorso-ventrally, marked off from neck by a quite blunt edge. Eyes large; their opening wide, ovate, furnished with a distinct sinus on the anterior margin a little below the middle. Olfactory crest composed of three longitudinal folds: the lowermost the smallest, triangular, running dorsal and posteriad; the middle the longest, parallel with the former; the uppermost the thickest and broadest, though very short, semilunar, extending straight posteriad, and finally coming into contact with the middle fold at the posterior end. From this end starts a thin narrow fold traversing the neck transverselly to the nuchal region. Nuchal cartilage ovo-lanceolate, a little narrowing posteriad, sometimes slightly constricted near the middle, traversed along the median line by a marked ridge, which has a faint groove along the crest (Pl. XXI, fig. 2). Maximum breadth of the cartilage equal to about one-third of its length, this being in turn a little shorter than height of the collar-like portion of funnel.



Textfig. 120.

Enoploteuthis chunii. Funnel laid open: ×3.

Textfig. 121.

Enoploteuthis chunii. Largest sucker of third arm; ×65.

Textfig. 122.

Enoploteuthis chunii. Horny rings of tentacular suckers; ×75. A. From one of suckers of hand portion. B. From largest sucker of distal portion.

Funnel comparatively small, extending less than to the middle of head; adductors number two, strong, dorsally attached. Funnel groove somewhat deep, ill-defined in front but clearly marked off on either side by a fold, which is confluent with the lowermost fold of the olfactory crest posteriorly. Dorsal pad of funnel organ Λ-shaped, each ramus with a roughly semilunar longitudinal fold at the anterior part (textfig. 120); the fold sometimes is thick and situated very near

the outer margin of the ramus, if so, then it appears very much like an elevated margin of the latter. Ventral pads of the same organ elliptical, a little broader than the rami of the former pad. Funnel cartilage slenderly ovate, acuminate anteriorly, rounded posteriorly, two and a half times as long as its own maximum breadth; locking groove longitudinal, rather shallow, situated nearer to the outer margin than to the inner, and its inner side much more sharply edged than its outer side. Mantle cartilage composed of a nearly straight streak-like ridge half as long again as the preceding cartilage.

Arms long, subequal, the formula of length being $4>2\fallingdotseq3>1$; the longest about two-thirds the length of mantle. First pair flattened from side to side, while the remaining pairs are quadrangular in section; on the former, a broad keel traverses the whole length, attaining at about the middle its maximum breadth which measures over than the breadth of the arms. First and second pairs with a narrow keel on about the distal half; on the latter pair the keel is a little broader and deviates towards the ventral side, making itself out as a web. Fourth pair with a broad web along the outer side, having an uniform breadth in the proximal half, then evenly and gradually narrowing towards the extremity. Protective membrane broadest on the ventral side of third arms where it measures more than the height of suckers, strongly trabeculated; next broadest on the ventral side of second arms, and narrowest on the dorsal side of fourth arms. Armatures composed of hooks and suckers, the former occupying the proximal $\frac{2}{3}$–$\frac{3}{4}$ of arms and the latter, the remaining distal part. Their number in four specimens examined is given in the following table:

No. of Specimen	Sex & Mantle-length	Left arm								Right arm							
		IV		III		II		I		I		II		III		IV	
		Hook	Sucker	Hook	Sucker	Hook	Sucker	Hook	Sucker	Hook	Sucker	Hook	Sucker	Hook	Sucker	Hook	Sucker
i	♀, 87 mm.	31	28	24	34	26	38	24	33	25	35	27	33	25	35	27	30
ii	♀, 81 ,,	29	26	23	30	25	31	24	28	22	31	25	33	22	35	27	26
iii	♀, 60 ,,	23	25	21	27	23	28	20	27	21	26	23	27	22	28	23	22
iv	♂, 63 ,,	26	29	22	30	22	28	22	26	22	25	22	28	21	27	26	21
v	♂, 62 ,,	26	28	22	29	21	27	21	25	21	24	21	28	21	27	26	21

Horny ring of arm-suckers dentate on the distal margin; the teeth much like those of a comb, numbering 8–10, the inner the longer (textfig. 121). Facetts of papillate area arranged in three or four rows at the distal part and in two rows at the proximal; their papillae very faint in the proximal facetts but comparatively marked on the distal facetts, especially marked and long are those of the innermost row of the distal facetts.

Hectocotylization affects the distal part of right ventral arm (Pl. XXI, fig. 3). In the subterminal part of the arm, the narrow protective membranes of both sides are swollen into two elongate semilunar membranes. The membranes are equal in breadth and length; but the ventral one is situated a little more proximally than the dorsal. The hooks of this arm, as shown in the above table, number 26, of which the distal six are set opposite the ventral semilunar membrane. The terminal part of the arm beyond the semilunar membranes shows about twenty small suckers.

Tentacles slender, about one and a half times the length of mantle; stem as thick as the thinnest of arms, four-sided, with a very faint fold along the whole length of the aboral surfacc. Club slightly expanded, occupying the distal $\frac{1}{4}$–$\frac{1}{6}$ of tentacles; to the ventral side of the proximal part is attached an elongte-semilunar fold, which is about one-third as long as the club itself (Pl. XXI, fig. 4). Dorsal web begins one-third up the club, then gradually widens distad, proximally continuing with the aboral

fold of stem. Fixing apparatus on carpus well defined, though not marked off by any distinct membrane, oval in outline, provided with about five small suckers and five pads as well as two or three pad-like peduncular bases of suckers. Hand portion of club equipped with about nine hooks in two series, ventral and dorsal. Hooks of the ventral series larger than those of the dorsal; especially larger are the second and third ones of that series from its proximal end. Besides the hooks, there are at the base of this portion a few minute suckers, which vary in number in the different individuals. Horny ring of these suckers equipped with 20–23 blunt teeth set at equal intervals along the whole margin (textfig. 122). Distal 5–8 of these teeth comparatively long, directed proximad; the remaining ones very short growing on the outer surface of the margin so that its extreme edge remains entire. Distal portion of club provided with about 90 minute suckers thickly crowded in four series; their horny ring dentate almost as in the handsuckers, but the teeth are a little less numerous and more regular.

Buccal membrane compratively broad, uniformly purplish, supported by eight strong ribs, which project far beyond the margin of the membrane. Connectives also number eight, attached to the dorsal surfaces of arms, but the third arm is connected on the ventral surface. Inner surface of the membrane thickly papillose.

Gladius penniform, about seven times as long as its own maximum breadth, shorter than mantle. Rhachis with a sharp keel, which is visible on the back of the animal as a median blackish streak. Vanes begin one-fifth down the rhachis, rapidly widening to the end of the next fifth and then gradually narrows posteriad but again a little expanded in the last fifth. Margins of vanes very thin, distinctly separated from the central part by two straight lines meeting together at an angle of about 20°.

Mantle, funnel, head and two ventral pairs of arms all decorated on the ventral surface with numerous minute photophores of apparently uniform structure. Photophores of mantle arranged at its anterior half in eight longitudinal zones, each of which consists of two or three irregular rows of the organs; the outermost zone on either side exhibits the most irregular and sparsest grouping of all. All the zones are continuous in the posterior half of the mantle so that the organs are evenly distributed there.

Photopores on head crowded in five longitudinal zones consisting two or three irregular rows of organs each. Median unpaired zone begins within the funnel groove, running straight to the space between the ventral arms where it is divided into two branches; these proceed the inner edge of the said arms towards their extremities. Other photophores of head as well as those of funnel and arms, arranged roughly likewise as those of *Enoploteuthis leptura*.

Photophores on eye-ball small, eight or nine in number, arranged in a weakly zigzag row along the ventral periphery (Pl. XXI, fig. 5). The two of both ends of the row a little larger than the rest, attaining a diameter of about 0.8 mm. in a specimen of 87 mm. mantle length.

The principal measurements of the specimen examined are appended:

No. of specimen	i	ii	iii	iv	v
Sex	♀	♀	♀	♂	♂
Dorsal length of mantle	87 mm.	81 mm.	60 mm.	63 mm.	62 mm.
Ventral length of mantle...	81 ,,	76 ,,	54 ,,	57 ,,	56 ,,
Circumference of anterior margin of mantle	64 ,,	60 ,,	54 ,,	50 ,,	49 ,,
Breadth of mantle	25 ,,	23 ,,	21 ,,	20 ,,	19 ,,
Distance from anterior edge of fin to hind end of mantle	62 ,,	59 ,,	45 ,,	47 ,,	47 ,,
Total breadth of fins...	65 ,,	63 ,,	50 ,,	51 ,,	50 ,,
Length of head	24 ,,	24 ,,	19.5 ,,	20 ,,	19 ,,
Breadth of head...	23 ,,	20 ,,	16.5 ,,	17 ,,	17 ,,

No. of specimen	i	ii	iii	iv	v
Sex	♀	♀	♀	♂	♂
	Left Right	Left Right	Left Right	Left Right	Left Right
Length of first arms	44 mm. 45 mm.	45 mm. 45 mm.	38 mm. 37 mm.	40 mm. 40 mm.	38 mm. 38 mm.
,, ,, second arms	46 ,, 46 ,,	48 ,, 48 ,,	40 ,, 40 ,,	44 ,, 44 ,,	39 ,, 39 ,,
,, ,, third arms	44 ,, 44 ,,	47 ,, 48 ,,	40 ,, 40 ,,	43 ,, 43 ,,	39 ,, 39 ,,
,, ,, fourth arms	52 ,, 52 ,,	51 ,, 51 ,,	41 ,, 41 ,,	45 ,, 45 ,,	41 ,, 41 ,,
,, ,, tentacles	120 ,, 120 ,,	107 ,, 107 ,,	71 ,, 72 ,,	— 75 ,,	85 ,, 85 ,,
,, ,, clubs	20 ,, 20 ,,	17.5 ,, 7.5 ,,	15 ,, 15 ,,	— 16 ,,	14 ,, 14 ,,

Remarks.—The agreement of the specimens referred to with Prof. Ishikawa's original description is almost satisfactory except in the funnel organ, in the olfactory crest, in the gladius, and in the suckers. The discrepancy in the last organ is noteworthy: the tentacular suckers in the specimens now before me are somewhat like what he has depicted as an arm-sucker, and this in my specimens strikingly resembles the sucker illustrated by him as a tentacular sucker.

This cuttle fish is often caught, mixed in large schools of *Watasenia scintillans* in the coast of Etchû Prov. Prof. Ishikawa's and my specimens both have come from that region.

Locality.—Toyama Bay (Ishikawa; Sasaki); Bungo-suido, from stomach of fish (Albatross!).

Genus **Abralia** Gray, 1849*).

Abralia, Gray 1849, pp. 46, 50.—Adams, H & A. 1858, p. 31.—Pfeffer 1900, pp. 166, 167; 1912, p. 762.—Chun 1910, p. 57.—Berry 1914a, p. 326.
Asteroteuthis, Pfeffer 1908a, p. 292; 1912, pp. 124, 128.

Body conical or subfusiform, muscular but somewhat choroidal at the end-part. Fins broadly sagittate, nearly terminal and about two-thirds as long as mantle. Arms in adult with biserial hooks on the proximal parts and biserial suckers on the distal. Left ventral arm hectocotylized, with hooks and two semilunar membranes, but devoid of suckers. Tentrcles with an ill-defined fixing apparatus on the carpus, uniserial hooks and biserial suckers on the hand, and quadriserial suckers on the distal part. Buccal membrane sparsely dotted with reddish chromatophores; ribs, processes, and connectives numbering eight each. Innumerable minute photophores uniformely distributed on the ventral surface of animal, consisting of two or three different kinds of structure. Five photophores present on each eye-ball.

Type Onychoteuthis armata Quoy and Gaimad 1832.

Key to the species found in Japan and vicinity.

Only 3 hooks on each tentacle .....*A. andamanica.*
6 or 7 hooks on each tentacles .....*A. multihamata* n. sp.

Abralia andamanica Goodrich, 1896.

(Pl. XXI, figs. 6–8; textfig. 123.)

Abralia andamanica, Goodrich 1896, p. 9, pl. ii, figs. 38–45.—Sasaki 1916, p. 92.
Asteroteuthis andamanica, Pfeffer 1912, p. 92.

This species is represented by two mature male specimens from Sagami Bay in the collections at

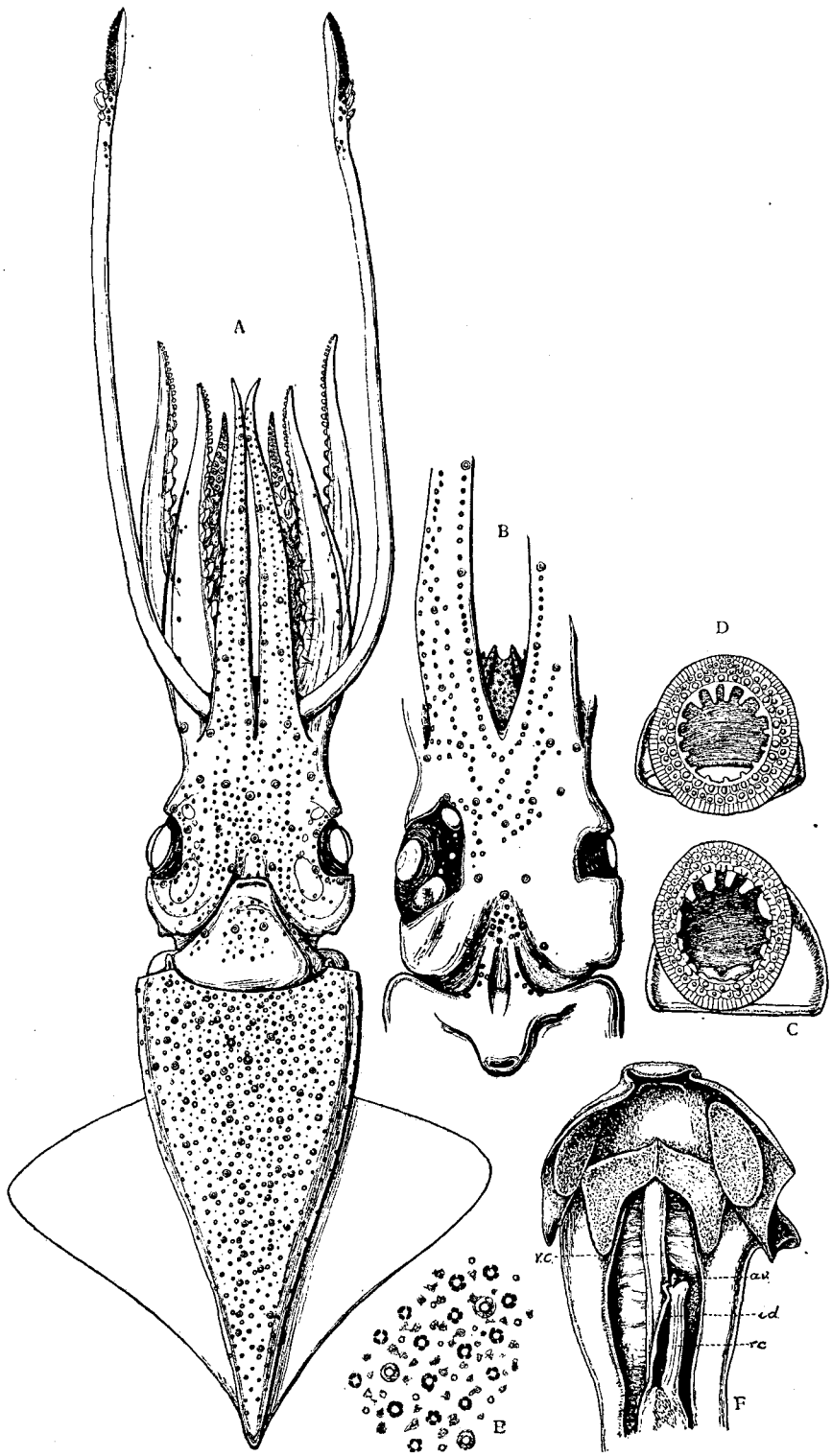
*) Original Description by Gray: Body smooth, granular beneath, with scattered larger tubercles.—Head granular. —Sessile arms elongate, with a single series of alternating hooks at the base, and double row of hemispherical cups at the tip. Tentacular arms long, slender; club distinct, with a few long acute hooks alternating with a series of cups and with two rows of cups only at the tip. Shell lanceolate, sinuous at the edge near the tip; central ridge narrow, keeled, and produced above.

my disposal. They agree very well with Goodrich's original description; their mantles measure 34 mm. and 35 mm. respectively.

Body about two and a half times as long as broad, broadest at the anterior margin, then tapering to a slender end-part; sides a little convex in the anterior parts and slightly concave in the posterior (text-fig. 123A). Consistency of body muscular except at its posterior extremity which is more or less choroidal. Anterior margin of mantle prolonged a little in the mid-dorsal part. Ventral part of the margin broadly emarginated crescentwise in the middle, the emarginated part marked off by rather prominent, angular projections on sides.

Fins taken together broadly sagittate, broadest about one-third down the length, and narrowly extending posteriad along the end-part of body, but not reaching its extreme end. Lateral angles rounded. Antero-lateral margins slightly convex. Postero-lateral margin at first slightly convex but markedly concave afterwards. Length of fins equal to their combined breadth, and obout two-thirds as long as mantle.

Head large, as wide as mantle open-



Textfig. 123.

Abralia andamanica. A. Ventral view; ×2. B. Funnel laid open; ×3. C. Largest arm-sucker; ×120. D. Largest tentacular sucker; ×90. E. Pallial photophores; ×5. F. Head region; the right eye is dissected to show its photophores, and the funnel is pulled down to show photophores on its retractors and in its groove; ×$^5/_2$.

ing, slightly shorter than half the length of mantle. Neck not distinctly marked off from head, though well constricted as usual. Olfactory crest consists of only a single semilunar fold instead of two as mentioned by Goodrich. Eyes large, their opening also wide, bearing a distinct sinus near the middle of the anterior margin. Funnel groove ill-defined especially in front; laterally marked off by thick, bluntly edged folds.

Funnel comparatively wide, conical, extending less than to the middle of head; adductors two in number, submedian. Funnel organ conspicuous, its dorsal pad horseshoe-shaped, with a short cuspidation in the anterior end the shoulder-like parts a little projecting; ventral pads ovate as usual (textfig. 123B). Funnel cartilage panduri-form, a little longer than twice its own maximum breadth, more expanded posteriorly than anteriorly, less concave on the outer margin than on the inner; longitudinal groove shallow, situated a little nearer to the outer margin than to the inner, more strongly marked off internally than externally. Nuchal cartilage shaped almost like the preceeding cartilage, but more slender, bilaterally symmetrical, and the anterior extremity more expanded than the posterior.

Buccal membrane comparatively broad, covered with separated reddish chromatophores, papillose internally; its ribs number eight, strong, projecting beyond the margin as so many distinct processes. Connectives also eight, joined with the dorsal surfaces of arms, but third arm is connected on the ventral surface.

Arms subequal, the formula of length being $2>4>3>1$, the longest about two-thirds as long as body. All more or less quadrangular in section except third pair which is somewhat flattened from side to side. Carination of their aboral surface, on the whole, rather poorly developed; only, narrow one existing at the distal part of second arm, and comparatively broad one along the whole length of third arm. On the fourth arm it markes itself out as a broad web along the dorsal side. A broad protective membrane present on the ventral side of the three dorsal pairs of arms, and very narrow one on the dorsal side of these arms and also on each side of ventral arm.

Equipments of arms composed of hooks and suakers in two series, the former occupying the proximal $\frac{2}{3}$–$\frac{3}{4}$ of arms, and the latter, the remaining distal part. Their number are given in the following table.

		Right arms				Left arms			
		IV	III	II	I	I	II	III	IV
Sp. No. 1.	Hooks	13	13	14	13	12	13	13	14
	Suckers Larger	15	11	11	10	10	12	11	0
	Suckers Smaller ...	0	26	26	25	25	24	24	0
Sp. No. 2.	Hooks	14	13	13	13	13	12	13	14
	Suckers Larger	14	11	11	11	10	12	11	0
	Suckers Smaller ...	0	26	26	26	25	25	26	0

Horny ring of arm-suckers dentate on the whole margin (textfig. 123C). Teeth broad, unequal, distal four or five decidedly longer than broad, the adjacent one on either side considerably broader than long, and usually largest of all; the remainder also broader than long, closely set, three or four proximal most being quite short and indistinct. From inside of these proximal teeth there projects in the ring a horny border with a distinct indentation in the middle. Papillate area consists of two series of facetts at the proximal part and three or four series at the distal; papillae comparatively small, roundish, and longer on the distal margin than on the proximal.

Left ventral arm hectocotylized, provided on the subterminal part two elongate semilunar folds, which are continuous with the narrow protective membranes of the arm (Pl. XXI, fig. 6). The ventral of the semilunar folds is situated a little more proximally than the dorsal one. The hooks of this arm, as shown in the above table number fourteen, the three distalmost of which are situated just opposite the ventral semilunar fold. The terminal part of the arm beyond the semilunar folds is quite naked and devoid of suckers and hooks.

Tentacles about equal to the combined length of head and body. Stem thinner than arms, a little compressed laterally, its oral surface flat, without forming boundary folds on sides. Club slender, about one-seventh the entire length of tentacles, ensiform, a little expanded, with a broad dorsal web extending for the distal three-fourths (Pl. XXI, fig. 7). Fixing apparatus on carpus, not well-marked, composed of three minute suckers and 2–4 pads, without encircling itself by distinct boundary fold. Hand portion short, armed with one small and two large hooks as well as with several suckers; the former set on the ventral side in a single series and the latter on the dorsal side in two sparse series. Distal sucker-bearing part of club longer than hand portion, the suckers there numbering 70–80. Horny ring of these suckers equipped with 15–18 teeth, sparsely but regularly set on the whole margin; distal four or five of these being far longer than the rest (textfig. 123D).

Gladius penniform; with no end-cone; maximum breadth a little greater than one-fifth the length (Pl. XXI, fig. 8). Rhachis sharply carinated on back, the keel appearing externally on the median line of the mantle as a dark streak. Vanes somewhat broad, attached to the posterior two-thirds of rhachis, the widest part existing in the middle of the gladius; then they narrow caudad, at first gradually but rapidly afterwards. At their posterior part there is distinguishable a thin crescentic border marked off from the remaining part by a faint line.

Whole ventral surface of the animal, uniformly embellished with innumerable minute photophores, which are not uniform in appearance as *Enoploteuthis chunii*, but may be classified into three kinds (textfig. 123E): (1) those containing large amount of pigment, occurring most commonly on the ventral surfaces of mantle, funnel, head and two ventral pairs of arms, and in a less number on funnel protractors. (2) Those of small size found on mantle intermixed among the first kind but less numerously than the latter; they occur also on other parts, though more sparsely than on mantle. (3) Those of comparatively large size, with small amount of pigment, occurring most rarely of all and distributed regularly among the preceding kinds.

Eye-ball decorated with two enormous and three minute photophores in a series along the ventral periphery (textfig. 123F). The enormous ones, oval in contour, situated at both ends of the series; the one of the proximal end is about twice as large in diameter as the other of the opposite end. The three minute photophores, round and nearly uniform, but the middle one is a little larger than the others.

For the measurements of the specimens under consideration, the reader is referred to one of my previous papers (1916 l. c., p. 92).

Locality.—Andaman Sea (Goodrich); Odawara, Sagami Prov. (Sasaki).

Abralia multihamata sp. nov.

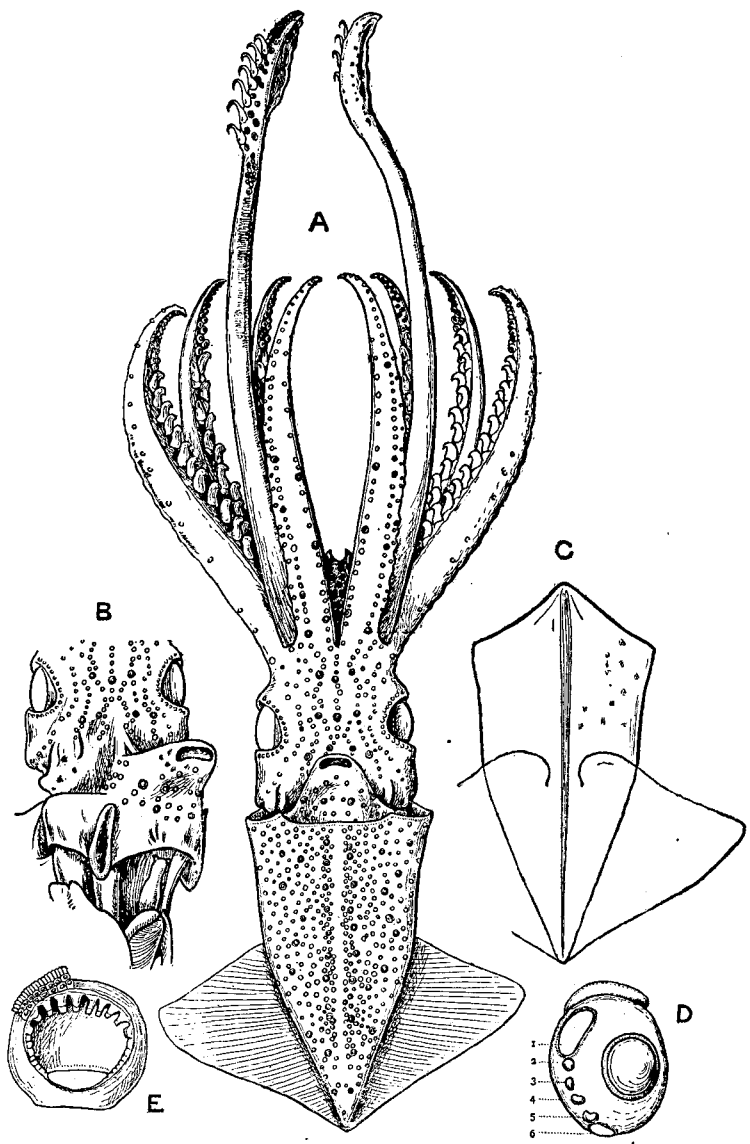
(Pl. XXIX, figs. 6,7; textfigs. 173–175.)

Body conical, broadest anteriorly, gradually tapering half down the length, but thenceforth the taper becomes more or less rapid, and terminates in a sharply pointed posterior extremity. Breadth of body a little greater than one-third of its dorsal length. Dorsal part of mantle margin, protruded over the head in a triangular lobe whilst the ventral part is broadly but shallowly emarginated in the middle, the emargination being sharply marked off laterally by pointed projections.

Fins broad, their total breadth being one and a half times their own length which is in turn about two-thirds the dorsal length of the body. They are markedly auriculate anteriorly, with deeply indented anterior origins of attachment. Excluding this structure the total outline of the fins shows a nice, transversely elongate rhombus with pointed lateral angles. Their anterior margins nearly straight or slightly concave while the posterior margins are slightly convex in the outer parts and slightly concave in the inner parts.

Head large, nearly as wide as body, and only a little shorter than half the ventral length of the body. Eye-openings wide, their diameter equaling about half the depth of head, nearly circular, with no sinus in front. Neck well constricted, but at nape it evenly continues on to the head without any distinct demarcation. On either side of the neck there are three obliquely longitudinal semilunar folds,

of which the dorsalmost is the narrowest. Funnel excavation of moderate depth, not sharply demarked around, with a pair of well-separate retractor infundibuli in the middle. The funnel itself is short, extending less than to the centre of the head. Funnel organ consists of a ∧-shaped dorsal pad and a pair of elliptical ventral pads. Funnel cartilage slender, a little widening posteriad, about one-third as broad as long, with a longitudinal groove widening posteriad. The corresponding cartilage on the mantle is ridge-like, nearly straight, and is as long as the funnel cartilage. Nuchal cartilage about one-fourth as broad as its own length, and a little longer than funnel cartilage, widening anteriad, evenly convex, but a distinct groove runs along the median longitudinal line.



Textfig. 173.

Abralia multihamata n. sp. A. Ventral view of a female, ×5/3; B. Ventral surface of the head region with the funnel put aside to show luminous organs in the funnel excavation; ×5/3; C. Dorsal view of mantle and fin, ×5/3; D. Eye-ball to show luminous organs (1-6), co. 2; E. Horny ring of arm sucker. ×46.

Arms as long as, or a little shorter than body; their formula of length most frequently $4>2\fallingdotseq 3>1$, rarely $4\fallingdotseq 2\fallingdotseq 3$ or $2>4\fallingdotseq 3>1$. All gradually taper distad to attenuated extremities. The first and second pairs are rounded on back, with no distinct keel, while the remaining pairs are carinated outside especially the fourth on which the keel is web-like. Protective membranes similarly narrow.

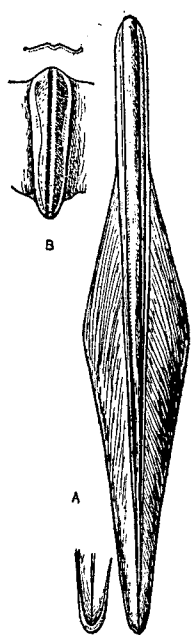
Equipments of arms consist of relatively large hooks on the proximal part and smaller suckers on the extremity, both arranged biserially. The hooks count 13 or 14 in the dorsal arm, 14–17 in the lateral, and 17–19 in the ventral, extending for proximal three quarters of the arm. On the remaining distal extremity there are some thirty suckers grandually diminishing in size distad. Horny ring of these suckers, dentate in the distal and lateral margins. In larger suckers the distal teeth counting about 10, are separate, square-cut and diminish in length laterad; the lateral teeth on either side are also as many as the distal in number, but much shorter and more closely set to one another.

Tentacles about twice as long as shortest arm; stem flattened internally and rounded externally. Club excluding the carpal adhesive organ, measures about a quarter of the entire length of the tentacle; slender but a little broader than stem, usually a little curved crescentwise. Dorsal web of club, of moderate breadth, extending two-thirds down the length from distal end. Hand position with a longitudinal series of 6 or 7 large hooks on the ventral side and 6 or 7 pairs of small suckers on the

dorsal side, both regularly alternating with each other. Distal part of club, with minute quadriserial suckers, which gradually diminish distad in size and number 15–20 quatets. Adhesive organ on carpus, consisting of 4 or 5 minute suckers, and 7 or 9 fixing pads, all aggregated together forming a ronghly oval general outline, though not defined around with any distinct boundary ridge.

Horny ring of tentacular suckers dentate with blunt, irregular, separate teeth, but that of suckers of the adhesive organ is quite smooth. In larger hand suckers the teeth count about 30, set along the whole margin, whereas in smaller distal suckers they are only in the distal margin and count only 7–10 in all.

Buccal membrane broad, with 8 ribs projecting in sharp points beyond the margin. Its inner surface deeply wrinkled, somewhat villous, and colorless while the external surface is smooth and has large chromatophores of thin distribution. Connectives as many as ribs, joined to the dorsal side of the sucker-bearing surface of arms, but that to the third arm run to the ventral side of the corresponding surface. Pore exists at very intercostal part except between dorsal pair where a thin membrane expands.



Textfig. 174.
Abralia multihamata n. sp. A. Gladius, ×5/2; B. Nuchal cartilage, ×3.

Gladius penniform, giving rise laterally from posterior three quarters of the length vanes which both together form a slenderly rhonzenge-shaped, outline more strongly sharpened posteriorly than anteriorly, so the transverse diameter of the rhozenge crosses about one-third of its length from the anterior origin (textfig. 174). Posteriorly the gladius terminates in a blunt extremity of which the margins curving ventrad, enclose a hollow concavity.

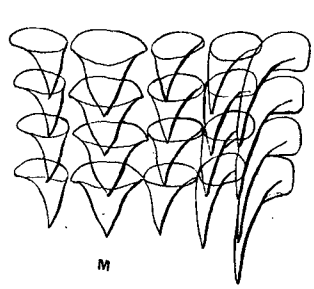
Radula composed of 7 rows of unicuspid teeth as shown in textfig. 175.

Chromatophores relatively large rather sparse in distribution except above the eyes where they are crowled. Besides the chromatophores, the ventral surface of the animal is embellished with numerous minute luminous organs consisting of two different kinds, one kind of which is much rarer, a little larger, of paler appearance, and more regularly distributed than the other. On the mantle both kinds told number a little more than 400, and are distributed in the ventral half of the whole surface, most closely crowding themselves on either side of the mid-longitudinal zone which is quite free from the organs.

On the head there are about 160 organs of more regular arrangement than on the mantle, some grouping themselves in lines. On the margin of the eye-openings they count about 25 organs forming a thick row along the ventral half circumference. The funnel has also about 25 organs on the ventral surface and 7 or 8 organs on the base of each adductor muscle.

The third and fourth arms are also furnished with similar luminous organs on the aboral surface. In the fourth arm they are in three longitudinal rows, the middle row of which extends to the extreme tip of the arm, consisting of about 40 organs; the most ventral row, composed of 20–30 organs, extend for the proximal 4/5, and the dorsalmost, containing 15–17 organs, runs up to only 3/4 the length from the base.

In the third arm, there are on the ventral side of the aboral surface about 15 organs sparsely set in a line extending to the extremity; on the dorsal side, 4 or 5 organs form a short line extending half up the arm from the base.



Textfig. 175.
Abralia multihamata n. sp. Radula, ×40.

The eye ball has 6 luminous organs of special kind arranged in a row along the ventral half periphery. Of the six, both organs terminal of the row are far larger, and have less distinctly defined outline than the others. These longer ones are inveriably oval or elliptical in outline whereas the remaining ones vary in shape, sometimes being round, sometimes reniform, sometimes elliptical, and sometimes pyriform, and all subject to individual variations.

Measurement of Specimens, and Numbers of Equipments of Their Arms and Tentacles.

No. of specimen	i	ii	iii	iv	v	vi	vii
Dorsal length of mantle	32 mm.	32 mm.	30 mm.	30 mm.	29 mm.	29 mm.	25 mm.
Ventral length of mantle	27 ,,	25 ,,	23 ,,	24 ,,	22 ,,	22 ,,	18 ,,
Maximum breadth of mantle	13 ,,	13 ,,	12 ,,	13 ,,	11 ,,	11 ,,	9 ,,
Breadth of head	12 ,,	12 ,,	10 ,,	11 ,,	10 ,,	10 ,,	9 ,,
Length of head	12 ,,	12 ,,	11 ,,	11 ,,	11 ,,	11 ,,	9 ,,
Length of fins	20 ,,	18 ,,	19 ,,	17 ,,	17 ,,	16 ,,	14 ,,
Total breadth of fins	30 ,,	31 ,,	28 ,,	27 ,,	28 ,,	27 ,,	24 ,,
Length of first arms	Left mm. 25 Right mm. 25	Left mm. 28 Right mm. 29	Left mm. 24 Right mm. 24	Left mm. 26 Right mm. 26	Left mm. 25 Right mm. 25	Left mm. 24 Right mm. 23	Left mm. 18 Right mm. 18
,, ,, second arms	27 ,, 27 ,,	31 ,, 32 ,,	27 ,, 27 ,,	28 ,, 28 ,,	28 ,, 28 ,,	25 ,, 25 ,,	20 ,, 20 ,,
,, ,, third arms	27 ,, 27 ,,	30 ,, 30 ,,	27 ,, 27 ,,	28 ,, 28 ,,	26 ,, 26 ,,	25 ,, 25 ,,	20 ,, 20 ,,
,, ,, fourth arms	28 ,, 28 ,,	30 ,, 30 ,,	29 ,, 29 ,,	29 ,, 29 ,,	27 ,, 27 ,,	25 ,, 25 ,,	20 ,, 20 ,,
,, ,, tentacles	53 ,, 52 ,,	55 ,, 48 ,,	51 ,, 52 ,,	56 ,, 60 ,,	45 ,, 45 ,,	43 ,, 46 ,,	40 ,, 40 ,,
,, ,, tentacular clubs	15 ,, 15 ,,	14 ,, 15 ,,	14 ,, 15 ,,	13 ,, 13 ,,	10 ,, 10 ,,	12 ,, 12 ,,	10 ,, 10 ,,
Number of hooks on first arms	14 ,, 13 ,,	13 ,, 14 ,,	14 ,, 14 ,,	23 ,, 13 ,,	13 ,, 14 ,,	13 ,, 13 ,,	13 ,, 15 ,,
,, ,, ,, ,, second arms	16 ,, 16 ,,	15 ,, 15 ,,	16 ,, 15 ,,	15 ,, 15 ,,	15 ,, 14 ,,	14 ,, 14 ,,	16 ,, 16 ,,
,, ,, ,, ,, third arms	17 ,, 15 ,,	15 ,, 15 ,,	15 ,, 16 ,,	15 ,, 15 ,,	16 ,, 15 ,,	14 ,, 15 ,,	14 ,, 15 ,,
,, ,, ,, ,, fourth arms	19 ,, 19 ,,	18 ,, 18 ,,	18 ,, 18 ,,	17 ,, 17 ,,	17 ,, 17 ,,	19 ,, 17 ,,	17 ,, 19 ,,
,, ,, ,, ,, tentacles	7 ,, 7 ,,	6 ,, 7 ,,	6 ,, 6 ,,	6 ,, 7 ,,	7 ,, 7 ,,	6 ,, 6 ,,	6 ,, 7 ,,
,, ,, suckers of fix. org.	4 ,, 5 ,,	5 ,, 4 ,,	4 ,, 4 ,,	4 ,, 4 ,,	4 ,, 3 ,,	4 ,, 4 ,,	4 ,, 4 ,,

Remarks.—The species is allied to *Abralia astrosticta* Berry, *A. andamanica* Goodrich, *A. trigonura* Berry and *A. veranyi* (Ruppel). *A. astrosticta* differs from the present species chiefly in having smaller fins, shorter arms and uniform ocular photophores. Furthermore there is a marked difference between the two species in respect to the arrangement of integumental photophores. The difference from *A. andamanica* and *A. veranyi* consists principally in the number of tentacular hooks and in the structure and arrangement of integumental photophores. Similar disagreements in photophores also occur with *A. trigonura* although this species shows the closest similarity to *A. multihamata* in tentacular equipments.

The present species agrees also in many points with d'Orbigny's description of *A. armata* Quoy & Gainard, but this species, being greatly doubtful in validity, the comparison with even the orginal description has no weight in specific identification.

The species seems not very rare in Formosa. I have examined twelve specimens obtained there seven of which collected by Dr. M. Oshima at Akochô on April 20, 1920, while the remainder I obtained from Taihoku market April 23, 1925. The specific description made above is based on those from Akochô.

Type locality.—Akochô, Formosa.

Type.—Deposited in Formosan Mus.

Genus **Watasenia** Ishikawa, 1913.*)

Watasenia, Ishikawa 1913a, pp. 162, 366.

Body conical or conico-cylindrical, nearly muscular throughout. Fins terminal, broadly sagittate, shorter than two-thirds the length of mantle. Neck with four longitudinal folds on either side. Arms in adult, with biserial hooks on the proximal part and biserial suckers on the distal. Right ventral arm hectocotylized, furnished with hooks and two semilunar membranes but devoid of suckers. Tentacles with ill defined fixing apparatus on the carpus, a few large hooks and several suckers on the hand, and numerous suckers of quadriserial arrangement on the distal part. Buccal membrane deeply purplish throughout; ribs, projections and connectives numbering eight each. Innumerable minute photophores of one kind decorate the ventral surface of the animal, those of the mantle not grouping themselves into longitudinal zones. Five minute photophores in a series on each eye-ball. Three large ovoidal photophores on the extremity of ventral arms.

Type.—Abraliopsis scintillans Berry, 1911.

Watasenia scintillans (Berry, 1911).

Japanese name: Hotaru-ika, Matsu-ika, Ko-ika (Etchu Prov.);
Beni-ika, Gumi-ika (Odawara, Sagami Prov.).

(Pl. XXI, figs. 9, 10; textfig. 124.)

Watasé 1905, p. 119, 1 textfig. (sine nom.).
Abraliopsis jubini, Watasé 1906, p. 195 (nom. nud.).
? Abraliopsis sp. Nishikawa 1906a, pp. 310–312; pl. vi, figs 1–15.
Abraliopsis scintillans, Berry 1911c, p. 93; 1912b, p. 424, pls. vii, viii, ix, figs. 1–6; 1913a, p. 591.
Abraliopsis (*Nepioteuthion*) *nishikawa*, Pfeffer 1912, pp. 139, 140, 149.
Abraliopsis (*Composoteuthis*) *nishikawae*, Pfeffer 1912, pp. 150, 162,
Watasenia scintillans, Ishikawa 1913a. pp. 162, 336; 6 figs.—Sasaki 1914a, p. 75, pls. i, ii; Sasaki 1916, p. 94; 1920, p. 196.
Watasea scintillans, Okada 1927, p. 94.

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*) Ishikawa (1913) established this genus first under the name *Watasea*, but soon afterwards he changed it into *Watasenia* as the former generic name had already been applied to a group of fishes.

Innumerable specimens of the species, caught at various localities of Japan, have been at my disposal. Their mantle length ranges up to about 70 mm. in the female and about 55 mm. in the male.

Body sexually a little dimorphic; that in male broadest at the anterior margin, then regularly tapering off posteriad, the maximum breadth being only slightly less than one-fourth the length. Same in female cylindrical in the anterior $^{2}/_{7}$–$^{3}/_{7}$, then tapering to an acuminate end, the breadth being about two-sevenths the length.

Consistency of body in both sexes nearly muscular even at the posterior end. Anterior margin of mantle slightly projects at the mid-dorsal part; the ventral margin broadly but shallowly emarginated at the middle, the emarginated part marked off by a bluntly angular projection on either side, but not forming any point in the middle as in *Enoploteuthis chunii*.

Fins taken together broadly sagittate, forming marked auriculation anteriorly, and extending as narrow membranes along the end-part of body to its extreme end. Lateral angles rather rounded; the line connecting these lines near one-third the length of fins from the anterior end. Relative length of fins varies in different sexes; that in the male equaling about their combined breadth and only a little longer than a half of the mantle-length. Same in the female, less than the total breadth and equaling about two-thirds of the mantle length.

Head rather large, as wide as mantle, and shorter than one-third of the its length, roughly quadrangular in section. Eye-opening wide, nearly semicircular; posterior margin nearly straight; anterior margin rounded, with a distinct sinus in the middle. Neck marked off from head by a distinct edge, and continuous with funnel groove ventrally; the latter ill-defined in front but well marked off on sides by thick prominent folds. Olfactory crest on each side, composed of four longitudinal folds, of which the dorsal two are much longer than the others and continuous with each other posteriorly so as to form an ornamentation curved like a festoon (Pl. XXI, fig. 9). Third fold from the dorsal, the shortest, semilunar and oblique. Fourth fold, which is the ventralmost of all, is indistinct, being quite confluent with the lateral boundary fold of funnel groove.

Funnel conical, short extending only about one-third up the distance to ventral interbrachial space; adductors two in number, dorsally attached. Dorsal pad of funnel organ ∧-shaped; anterior end somewhat rounded but cuspidate at the apex; posterior lobes roughly triangular and with a longitudinal fold in the anterior parts. Ventral pads nicely ovate, very short as compared with those of *E. chunii* (Pl. XXI, fig. 10). Funnel cartilage elongate-elliptical, but its posterior part expanded cutwards so that the outer margin of the cartilage is slightly concave near the middle; longitudinal groove situated slightly nearer to the outer margin than to the inner. Maximum breadth of the cartilage, about one-third its length. Mantle cartilage consists of streak-like ridge a little longer than the preceding cartilage. Nuchal cartilage resembles funnel cartilage in shape and size, but bilaterally symmetrical and regularly narrowing posteriad.

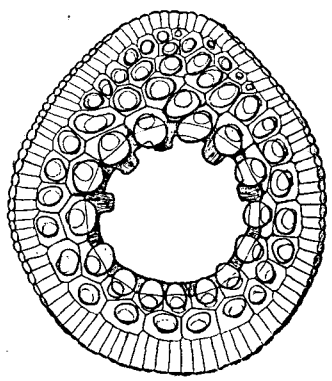
Arms subequal, the formula of length being $4>3\fallingdotseq2>1$; the longest in the male a little longer, in the female a little shorter, than half the length of body. All carinated on back, especially the third where the keel extends the whole length of the aboral surface as a broad membrane. On the fourth arm the keel is situated on the dorsal side, and stands like a web as usual. Protective membrane of ventral side very well developed on three dorsal pairs of arms; especially broad is that of the third pair. The membrane of dorsal side of these three pairs as well as those of both sides of the remaining pair are rudimentary.

Equipments of arms consist of biserial hooks and suckers. The hooks number 5–7 pairs, extending two-thirds up each arm, and the suckers about twenty pairs crowded on their distal one-third; but the ventral arm is equipped with eleven or twelve hooks only in a sparse zigzag series, and which extend more distally than on the remaining arms. Horny ring almost like that of *E. chunii*.

Right ventral arm hectocotylized. The rudimentary protective membranes of this arm are developed into two semilunar membranes at the subterminal part. These semilunar membranes are almost similar in shape and size, but the dorsal one is situated a little more proximally than the ventral.

The armatures of the arm consist of about twelve hooks as on the corresponding arm of the opposite side. Of these hooks the distalmost is situated opposite the dorsal semilunar membrane.

Tentacles a little shorter than body; stem about as thick as first arm, a little narrowing distad, its oral surface flattend but not marked off on sides by folds. Club but little expanded, nearly ensiform, occupying the distal 1/6–1/5 of tentacle, furnished with a semilunar fold on the ventral side of carpus. Dorsal web comparativery narrow, extending for the distal two-thirds of club. Fixing apparatus on carpus, composed of four suckers and so many pads, not marked off by fold. Hand portion of club shorter than half the length of its distal portion, armed with two large hooks on the ventral side, and 5–7, small suckers in two series on the dorsal side. Distal portion of club furnished with about 75 minute suckers in four series. Horny ring of these suckers equipped with a few quadrangular teeth on the distal margin but may be quite smooth throughout; papillate area very broad, bordered with a broad radiated margin; papillae conspicuous, markedly expanded at their apex, biserial proximally and tri-or quadrial distally; those of the innermost series by far the largest and shaped almost like a round table (textfig. 124).



Textfig. 124.

Watasenia scintillans. Horny ring from one of suckers of tentacular club; ×225.

Buccal membrane deeply purplish throughout, supported by eight strong ribs, which extends beyond the margin as so many sharp processes. Connectives also eight in number, attached to the dorsal surfaces of arms, but the third arm is connected on its ventral side. Inner surface of the membrane thickly papillose.

Gladius penniform, a little shorter than the length of body. Rhachis sharply carinated on back, the keel appearing externally on the dorsal surface of mantle as a distinct median streak. Vanes sexually dimorphic. In the male they begin two-ninths down the rhachis and then rapidly widens, attaining their maximum breadth near the halfway along the rhachis. From this point they gradually narrow posteriad, but their terminal part is again a little expanded and its extreme end is rather blunt, forming together with that of the opposite side a shallow and narrow concavity as in *E. chunii*. Narrow thin margins of vanes are marked off from the central part by straight lines. Maximum breadth of gladius in this sex, is about one-seventh its length.

Gladius of female, much broader than that of male, its maximum breadth being about one-fifth of the length. The vanes begin much more anteriorly and their margins are broader than in the male.

Radula composed of seven series of unicuspid teeth. Median teeth nearly equal to the inner lateral in size. Outer lateral teeth twice, and the marginal thrice, as long as the median.

Ventral surface of head, mantle, and funnel as well as aboral surface of the two ventral pairs of arms all decorated with numerous minute pearly photophores, which appear to be one kind of structure though a little varied in size. The photophores on mantle number 450–540 in the male and 570–685 in the female, evenly distributed at nearly uniform intervals, but become a little sparser posteriad and also laterad. Same on funnel number about 36 on its ventral surface and about 11 on each lateral surface. On head are found about 180 photophores in more or less regular longitudinal rows, those of the margin of eye-openings are large and small alternately in a series. The photophores of fourth arm are in the serial continuation with those of head, forming three longitudinal rows. The middle of these rows consists of about 28 organs extending up to the end of the arm, and two or three distalmost of which exist beyond the three conspicuous photophores characteristic of the genus. The innermost of the three rows is composed of sixteen; and the outermost, of six organs. On the third arm is found only a single series of about seven photophores.

The three photophores of the extremity of ventral arms ovoidal in shape and nearly uniform in size, but the middle one is slightly larger than the others, measuring about 1.4 × 1 mm. In life they are greenish white, covered with a few large chromatophores, which are, in preserved specimens, expanded so as to envelope entirely each of the organs.

Eye-balls with five small pearly photophores arranged in a series along the ventral periphery. They are nearly uniform, but the two at the ends of the series are a little larger than the others.

Color reddish brown, much deeper above than beneath.

Measurements.

Sex	♂	♀
Dorsal length of mantle	53 mm.	67 mm.
Ventral length of mantle	50 ,,	63 ,,
Maximum breadth of mantle	14 ,,	18 ,,
Length of head	15 ,,	17 ,,
Breadth of head	14 ,,	18 ,,
Length of fins	34 ,,	45 ,,
Total breadth of fins	33 ,,	51 ,,
Length of first arms	Left 24 mm. Right 24 mm.	Left 26 mm. Right 26 mm.
,, ,, second arms	26 ,, 26 ,,	29 ,, 30 ,,
,, ,, third arms	26 ,, 25·5 ,,	29 ,, 29 ,,
,, ,, forth arms	28 ,, 27 ,,	33 ,, 33 ,,
,, ,, tentacles	42 ,, 42 ,,	54 ,, 54 ,,
,, ,, shell	34 mm.	46 mm.
Breadth of shell	6 ,,	14 ,,

Remarks.—Abraliopsis nishikawae Pfeffer consists of the two kinds of larval squids previously described by the late Mr. Nishikawa (1906a). I have referred the older of these two to the species under consideration, leaving the younger in that species of Pfeffer's. On a further study on the development of various cephalopods here I am inclined to consider the younger also to be the present species although the certainty is impossible in the case of so immature creatures.

The catching of this species in Etchu Prov. and its vicinity is carried on commonly from the latter part of April and to the end of May; the total amount of the annual catch reaching generally about 1.000 tons though it shows some fluctuations. It is prepared for food of the natives, but a large amount of it is salted for the market as fish-bait.

The species is also abundant on the southern part of Sagami Bay though not so much as in Etchû Province. The Sagami specimens at my disposal are generally a little smaller than those of Etchû Prov. and have wider mantle, a little longer arms and less numerous photophores.

Locality.—Japan (Berry); Okhotsk Sea (Sasaki); Volcanic Bay, Hokkaido (!); east of Noto Peninsula, 527–548 fms. (Albatross!); Etchû Prov. (Watase; Ishikawa; Sasaki); near Cape Clonard, Korea, 70-150 fms. (Albatross!); off Kinkazan, Rikuzen Prov. 129–182 fms. (Albatross!); Awa Prov. (Sasaki); Sagami Prov. (Sasaki); Suruga Prov. (Nishikawa).

Subfamily **Ancistrochirinae** Pfeffer, 1912.

Ancistrochirinae, Pfeffer 1912, p. 174.

Buccal membrane with seven or eight ribs; its connectives also seven or eight. Tentacles present even in adult, with well-defined fixing apparatus on the carpus, 15 or more hooks on the hand, a small number of minute suckers on the distal end. Fairly large photophores regularly distributed on the ventral surface of animals; small ones may occur on the stem of tentacles.

Genus **Thelidioteuthis** Pfeffer, 1900.

Thelidioteuthis, Pfeffer 1900 pp. 165, 167; 1912, p. 177.—Chun 1910, pp. 57, 104.

Animals nearly muscular in consistency. Body conical, two or three times as long as broad,

bluntly pointed behind. Fins very broad, terminal; both together transversally oval or rhomboidal. Neck and funnel groove both rather well defined. Arms as long as, or longer than, body; equipped with hooks on the proximal part, and suckers on the distal. Tentacles of the adult with well-defined fixing apparatus on the carpus, numerous hooks in two series on the hand, and some minute suckers on the distal portion; same of the young, equipped on the hand, with two series of hooks and one series of suckers or with four series of suckers only. Large photophores regularly distributed on belly in seven transverse rows of 4, 2, 4, 2, 4, 2, 4 organs in each same on head, numbering about fourteen.

Type.—*Loligo alessandrinii* Verany, 1851.

Thelidioteuthis alessandrinii (Verany, 1851).

(Pl. XXI, figs. 11–16.)

Loligo alessandrinii, Verany 1851, p. 99, pl. xxxv, figs. f-h.
Enoploteuthis polyonyx, Troschel 1857, p. 67, pl. iv, fig. 9.
Abralia megalops, Verrill 1883, p. 105, pl. iii, fig. 4; Verrill 1884, p. 143, pl. xxviii, fig. 2, pl. xliv, figs. 2, 2a.
Enoploteuthis pallida, Pfeffer 1884, p. 18, figs. 23, 23a, 23b,
Calliteuthis alessandrinii, Appellöf 1889, p. 27, figs. 7–11.
Thelidioteuthis polyonyx, Pfeffer 1900, p. 167.
Thelidioteuthis alessandrinii, Chun 1910, p. 104, pl. vii, figs. 16, 17,—Pfeffer 1912, p. 178, pl. xviii, figs. 1–29.—Berry 1912b, p. 432.—Sasaki 1916, p. 95; 1920, p. 196.

An excellent specimen found in the "Albatross" collection is referred with a little hesitation to the present species. The following description is connected with it.

Body rather muscular and somewhat firm, but its end-part more or less choroidal and soft. Mantle roughly conico-cylindrical, about two-fifths as broad as long, the broadest part being the anterior margin, just posterior to which is found a gentle constriction, followed by a slight expansion; posterior end quite blunt (Pl. XXI, fig. 11). Dorsal part of mantle margin slightly convex, and pointed in the middle; its ventral part with a rather deep emargination distinctly marked off on sides.

Fins terminal, enormous, distinctly auriculate at the anterior end, connected with each other posteriorly; their total outline transverse-rhomboidal, having somewhat pointed lateral angles. Anterio-lateral edges straight or slightly convex. Postero-lateral edges convex at the anterior part, but concave at the posterior, narrowly extending along the end part of body to its extreme tip. Length of fins equal to about three-fifths of their combined breadth, and to 84% of the body-length.

Head slightly wider than mantle opening. Eyes but little prominent. Eye opening nearly circular, shortly sinuated near the middle of the anterior margin. Neck marked off from head by a blunt edge, bearing no olfactory crest but tuberculus olfactorius on each side.

Nuchal cartilage ovo-lanceolate, 4.3 mm. long, 2 mm. broad uniformly and gradually narrowing posteriad, fused with the corresponding cartilage of mantle posteriorly; there are along the median line a distinct ridge with a narrow groove on its crest. The above said cartilage of mantle somewhat ensiform, narrowing cephalad, at first gradually but rapidly afterwards.

Funnel small, conical, shortly extending beyond mantle cavity. Funnel groove on head, fairly deep, but its boundary edge rounded. Funnel adductors bipaired, separated, submedian, one pair situated below the other, Funnel cartilage slenderly kindney-shaped, the outer margin being concave, the posterior end a little more expanded than the anterior (Pl. XXI, fig. 12). Longitudinal groove of the cartilage, straight, situated nearer to the outer margin than to the inner, extending the whole length of the cartilage but becoming fainter at both extremities; its inner fold more prominent than the outer. Length of the cartilage about three times its maximum breadth, and about half the entire length of funnel, measuring 4.7 mm. Corresponding cartilage of mantle composed of a nearly straight streak-like ridge as long as preceding cartilage. Dorsal pad of funnel organ $\wedge$-shaped with rounded posterior ends; ventral pads oval, far shorter than the former.

Arms slender, subequal, the formula of length being $2 \fallingdotseq 3 > 1 > 4$; the longest a little longer than mantle. All nearly cylindrical, not carinated on back, but ventral pair with a broad web on the dorsal side as usual. Protective membranes similarly narrow, feebly trabeculate but extending the whole length of arms. Umbrella slightly developed but quite obliterated between ventral arms.

Equipments of arms composed of hooks and suckers. The hooks number 16 on first arm, 18 on the second and also on the fourth, and 20 on the third, all sparsely set in two alternating series. They begin about 4 mm. from the base of arms, extending about two-thirds up their length, whence they are succeeded by the suckers closely crowded in two series. The hooks of each arm are subequal, but become slightly smaller both distally and proximally, the largest being those of the third and fourth pairs, which in the fourth arm measure about 0.6 mm. and in the remaining arms, about 1 mm.

The suckers occupy the distal one-third of each arm, numbering on lateral pairs about 22, and on the remaining pairs about 25; minute, decidedly smaller than any of hooks. Proximal suckers ovoidal, with comparatively narrow ovate apertures; the remaining suckers hemispherical with wide circular apertures (Pl. XXI, fig. 13). Horny ring dentate on the distal margin; the teeth number 5–7, bluntly pointed, the inner the larger.

Tentacles a little longer than mantle; stem as thick as arms, compressed laterally, nearly four-sided. Club lanceolate, slightly expanded, occupying about a quarter of tentacle (Pl. XXI, fig. 14). Dorsal web of moderate breadth, extending three-fourths down the club; ventral protective membrane a little broader than the dorsal one. Fixing apparatus on carpus, consists of four minute suckers and three or five pads, encircled by an indistinct circular fold. No suckers on hand, but sixteen hooks found there in two alternating rows, occupying about three-quarters of club, and larger and more unequal in the ventral series than in the dorsal. Distal portion of club with about 40 minute suckers in four crowded series. Horny ring of these suckers with blunt teeth on the whole margin. In the suckers at the middle of this portion are found about thirteen teeth, which are much stronger on the distal edge of the ring than on the proximal (Pl. XXI, fig. 15).

Buccal membrane supported by seven ribs, which extend beyond the margin as so many distinct processes (Pl. XXI, fig. 16). Connective also seven; the distalmost of these, shallowly bifurcate. They are connected with the dorsal side of arms, but the third arm is conneted on the ventral side. Inner surface of the membrane concentrically wrinkled, without papillae.

Belly embellished with twenty large photophores regularly distributed in seven transverse rows of 4, 2, 4, 2, 4, 2, 4, in each. Back of body with two organs near its anterior margin. Photophores on head number fourteen, four of which are on the ventral surface (two outside funnel groove, the other two on its inside), and five on each lateral surface (one on the anterior margin of eye-opening, one on its anterior dorsal margin, two on its ventro-posterior margin and one at the base of second arm).

Besides the large photophores above mentioned, these are innumerable minute ones on the ventral surfaces of head, mantle and arms, grouping themselves into several zones. Of such zones, at least three are discernible on the belly. The anterior most of the three is a U-shaped zone extending from the lateral parts of the anterior margin of mantle to between the two large photophores of the second row. The central zone is situated halfway along the length of mantle between the fourth and fifth rows of the large photophores. The posteriormost zone is $\wedge$-shaped, situated between the last two rows of the large photophores.

On the head is found two longitudinal zones of the minute photophores. They begin outside the funnel groove, run along its margins, approaching each other in front of the groove, and then extend straight forwards. The ventral arms have a similar zone of the minute photophores along their inner side of the aboral surface; the lateral arms also have another on the aboral surface, but this zone is much thinner than that of the former arms.

Aboral surface of tentacles ornamented with eight large and about sixteen small photophores arranged uniserially in the following order (the large organs shown by the Roman figures, the small ones by the Arabian, and the distalmost written at the beginning).

Left tentacle: I, 3, I, 3, I, 4, I, 2?, I, 3? I, 3, I, ?, I.
Right ,, : I, 3, I, 3, I, 3?, I, 2?, I, 2? I, 3?, II, I.

They are arranged at nearly uniform intervals, the distalmost existing at the base of club, and the proximalmost on the extreme base of stem, covered by the dorsal web of ventral arm.

The measurements of the specimen examined are appended:

Dorsal length of mantle	25 mm.	
Ventral length of mantle	24 ,,	
Maximum breadth of mantle	10 ,,	
Length of head	10 ,,	
Maximum breadth of head	13 ,,	
Total breadth of fins	34 ,,	
Length of fins	21 ,,	
	Left	Right
Length of first arms	22 mm.	22 mm.
,, ,, second arms	25 ,,	27 ,,
,, ,, third arms	26 ,,	26 ,,
,, ,, fourth arms	19 ,,	17 ,,
,, ,, tentacles	29 ,,	27 ,,
,, ,, clubs	6.5 ,,	7 ,,

Remarks.—The specimen referred to differs from Pfeffer's description, in many respects: According to him the neck is not smooth but has distinct longitudinal and transverse folds on either side; the total outline of the fins is roughly ovate and not rhomboidal; of the buccal membrane, the ribs, projections and connectives number eight each instead of seven. Further in the present specimens, innumerable minute photophores are found on the ventral surface in zonary arrangement, a fact not mentioned by him and also by any of othe writers, which, however, seems to be an important character of this species.

Locality.—Kagoshima Bay (Berry); Hiuga-nada 578 fms. (Albatross!). Polynesia (Pfeffer); Indian Oc. (Chun); Mediterranean (Verany; Troschel; Appellöf; Pfeffer); South Atlantic (Pfeffer); east coast of North America (Verrill); West Indies (Verrill).

Subfamily **Octopodoteuthinae** Pfeffer, 1912.

Veranyidae, Chun 1910, pp. 139, 143.
Octopodoteuthinae, Pfeffer 1912, p. 212.

Body short, conical, with blunt posterior end. Ribs and connectives of buccal membrane number only six each. Tentacles absent in adult, but present in young, bearing a few minute suckers on the carpus and several large suckers in two series on the hand. Photophores absent or at least undiscernible.

Genus **Octopodoteuthis** Rüppell, 1844.

Octopodoteuthis, Rüppell 1844, p. 135.—Krohn 1845, p. 47.—Adams, H. & A. 1858, p. 31.—Pfeffer 1900, pp. 164, 166; 1908a, p. 74; 1912, p. 213.—Hoyle 1904, p. 11.
Verania, Krohn 1847, pp. 38, 39.—Tryon 1879, pp. 107, 175.—Appellöf 1889, p. 6.

Consistency partly choroidal. Body conical, about twice as long as broad or even shorter; posterior end blunt. Fins terminal, very broad, both together transverse-ovate or rhomboidal, bluntly pointed on sides and sharply posteriorly. Neck constricted, marked off anteriorly by a blunt edge; no distinct olfactory crest developed, but a subglobular tuberculus olfactorius. Funnel groove feebly marked off around. Funnel cartilage small, oval, its longitudinal groove a little elongated, widening posteriad. Nuchal cartilage elongate, slightly and regularly widening cephalad. Buccal membrane

supported by six weak ribs; its connectives also six, one of which exists between first arms, and another between ventral arms. Arms a little swollen at the extremity, equipped with numerous hooks closely set in two series along the greater part, and a few suckers on the subterminal part. Protective membranes and aboral carination present on each arm though all narrow. Tentacles absent in adult, but present in young, furnish with a few minute suckers on the carpus and several large ones on the hand. Gladius penniform.

Teype.—Octopodoteuthis sicula Rüppell, 1844,

Octopodoteuthis sicula Rüppell, 1844.

(Pl. XXI, fig. 17–19; textfig. 125.)

Octopodoteuthis sicula, Rüppell 1844, p. 135 (fide Appellöf).—Krohn 1845, p. 47, pl. v, figs. A—F.—Gray 1849, p. 51.—Adams, H & A. 1858' p. 32.—Pfeffer 1884, p. 28; 1900, p. 166; 1908a p. 74, fig. 85; 1912, p. 212, pl. xix, figs. 1–16.—Massy 1907, p. 381; 1908, p. 28; 1913, p. 2.—Sasaki 1916, p. 96—Issel, 1920a, p. 10.

Verania sicula, Krohn 1847, p. 38.—Weiss 1889, p. 87, pl. viii, figs. 1–3.—Appellöf 1889, p. 6, figs. 12–23.—Jatta 1896, p. 92 pl. vii, fig. 14; pl. xiii, figs. 1–12.—Ficalbi 1899, p. 83.

Onychoteuthis (*Verania*) *sicula*, Verany 1851, p. 86, pl. xxviii.

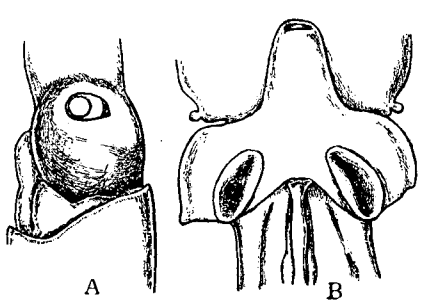
Octopodoteuthis, Chun 1910, pp. 139, 144, pl. xvii.

A single specimen collected by Professor Oka, of which I have made a brief note in one of my previous papers, is the unique example of this species at my disposal.

Deeper parts of whole body muscular, invested with a thick soft choroidal skin. Mantle nicely conical, half as wide as long, broadest anteriorly, tapering regularly caudad to a rather blunt end (Pl. XXI, fig. 17). Mantle margin even, with neither dorsal projcetion nor ventral emargination, disagreeing with the illustration given by Pfeffer.

Fins broad, mascular throughout, perfectly connected together along the mid-dorsal line of mantle, forming nearly a transverse-ellipse with a short acumination in the middle of the posterior edge-line (Pl. XXI, fig. 18). Anteritr origin slightly auriculate. Anterior end of the attachment plane distinctly visible through the superficial integument as a semicircular bay. Length of fins about two-thirds of their total breadth, and 78% of the mantle-length.

Head large, as wide as, or only a little narrower than, mantle; length about one-third that of mantle. Eyes large, swollen, prominent. Eye-opening small, pyriform, the sharper end turning dorsad, with no distinct sinus in front (textfig. 125A). Funnel groove fairly deep, but not bordered by a distinct edge-fold; two funnel adductors present inside, separated, submedian. Neck constricted, without distinct anterior boundary fold; a minute roundish tuberculus olfactorius present on each side, but no folds developed there. Nuchal cartilage oblong, about three times as long as broad, slightly narrowing posteriad, faintly furrowed along the median line, measuring 3.4 mm. in length.



Textfig. 125.

Octopodoteuthis sicula. A. Lateral view of head; ×ca. 2. B. Funnel; ×ca. 3.

Funnel short, hardly extending to the center of head. Funnel cartilage ovate, small, its length about half the breadth, and about one-third the length of funnel; longitudinal groove not extending to the extremities of the cartilage and widening posteriad (textfig. 125B). Dorsol pad of funnel organ conspicuous, divided into one anterior and two posterior lobes separated by arcuate bays (Pl. XXI, fig. 19). The anterior lobe truncated at tip, which is elevated into a cushion of inverted isosceles triangle; the posterior lobes rounded, much larger than the former Ventral pads of funnel organ pyriform or ovate, with the sharper end in front. Disagreeing with Appellöf's statement there is found a distinct, though narrow, valve on the dorsal wall halfway between its distal end and the dorsal pad.

Arms slender somewhat unequal; the formula of length $3>2\fallingdotseq 1>4$; the longest slightly shorter than mantle. All regularly taper towards the extremities, which are, however, a little swollen into the appearance of a minute spindle. Soft thick carination present on each arm along the aboral surface. Protective membranes poorly developed, but that of the ventral side on the first three pairs of arms and that of the dorsal side on the fourth arms are distinctly visible to the naked eye, their edge being serrated.

Equipments of arms composed of hooks and suckers, in two series. The hooks number 23 pairs on dorsal arm, 24 pairs on the lateral, and 26 pairs on the ventral. On each arm they extend up to the subterminal part; then follow the suckers in two or three pairs. The distalmost of the latter situated at the base of the spindle-shaped extremity.

Tentacles absent, as the specimen referred to was adult.

Buccal membrane very narrow, its ribs and processes, very weak, apparently numbering six each as pointed out by Pfeffer (1912, p. 214). Connectives also six; the dorsalmost of these connected with the dorsal surfaces of first arms and the ventralmost with the ventral surfaces of fourth arms. The remaining four of the six connectives are joined with the four lateral arms as usual; their attachement part in the dorsal lateral arms is on the dorsal surface and in the ventral lateral arm on the ventral surface. Inner lip thick, papillate; outer lip thin, membranous.

Gladius not examined.

For the measurements, the reader is referred to one of my previous papers (1916 l. c., p. 96).

Locality.—Sagami Bay (Chun); Awa Prov. (Ssasaki); West Sumatra (Chun); Indian north-equatorial current (Chun); Gulf of Aden (Chun); Agulhas current (Chun); Neapel (Jatta); Sicily (Gray; Krohn); Messina (Appellöf; Pfeffer; Issel); south-western coast of Ireland (Massy).

Family **Histioteuthidae** Verrill, 1881.

Loligopsidae (pars), d'Orbigny, in d'Orb. et Fér. 1839, p. 320.—Verany 1851, p. 11.
Chiroteuthidae (pars), Gray 1849, p. 42.—Adams H. & A. 1858, p. 28.
Taonoteuthi (pars), Steenstrup 1861a, p. 69.—Goodrich 1896, pp. 12, 15.—Jatta 1896, p. 107.
Histioteuthidae, Verrill 1881c, p. 431; 1882, p. 330.—Pfeffer 1900, p. 168; 1908a, p. 75; 1912, p. 243.—Hoyle 1904, p. 42; 1904b, pp. 3, 13.—Chun 1910, pp. 147, 169.
Taonoteuthidae Subf, *Histioteuthinae*, Joubin 1900, p. 88.

Texture soft, nearly choroidal. Surface embellished with numerous, conspicuous photophores. Mantle conical or cup-shaped, shorter than half the maximum breadth of its own. Fins of moderate breadth, extending a little beyond the posterior end of body; their combined outline of a Cassinian oval. Eye and its opening both very large, the latter with an obscure notch in front. Neck constricted, with tuberculus olfactorius on either side, but no distinct olfactory crest. Funnel groove feebly marked off, devoid of any folds internally. Funnel cartilage oblong, more or less acuminate in front, with a deep longitudinal groove in the middle, Nuchal cartilage ovo-lanceolate, narrowing posteriad. Arms long and thick, four-sided, their equipments consisting of biserial suckers. Protective membranes often form a broad internal umbrella between first three pairs of arms. Tentacles long; their club expanded into a spindle-shape in outline. Uniserial connective group of suckers and pads present on the stem, and at least four series of suckers on the club. Buccal membrane 7-ribbed; joined by seven connectives with the ventral surface of third arm and the dorsal surfaces of the remaining arms. Gladius penniform, without end-cone and cartilaginous spine. Dorsal arms ordinarily hectocotylized.

Key to the genera and species found in Japan.

(A) Photophores sparse, internal umbrella obliterated (gen. *Stigmatoteuthis.*)
  (a) Tentaclar suckers considerably unequal ..... *S. döfleini.*
  (b) Tentacular suckers raters uniform ..... *S. japonica*
(B) Photophores numerous, internal umbrella somewhat developed (gen. *Meleagroteuthis*)..... ..... *M. separata.*

Genus **Stigmatoteuthis** Pfeffer, 1900.

Stigmatoteuthis, Pfeffer 1900, p. 170; 1912, pp. 249, 279.
Calliteuthis Subg. *Stigmatoteuthis*, Chun 1910, p. 170. (pars).

Cutanous photophores sparsely distributed; those on ventral arms in three longitudinal series. Remaining arms embellished with a series of larger photophores on the ventral side and a series of smaller photophores on the dorsal side. No horny tubercles on arms, nor any on mantle. Dorsal web of tentacular club widens proximad terminating in a free, acute, retroverted point. Internal umbrella little developed. Dentate horny ring present in suckers of both arms and tentacles.

Type.—Histiopsis hoylei Goodrich, 1896.

Stigmatoteuthis döfleini Pfeffer, 1912.

Japanese name: Kurage-dako (Awa Prov.; Tôkyo-market).

(Pl. XXII, figs. 1–3; textfigs. 126, 127.)

Calliteuthis reversa, Chun 1906, pp. 747, 751, 752, figs. 2, 4, 5.
Calliteuthis ocellata, Chun 1910, pp. 152, 155, 156, 157, 158, 161, 162, 164, 165, 167, 170, textfigs. 22, 23; text-pl. i, figs. 1, 2.—Berry 1912b, p. 432 (pars).
Stigmatoteuthis döfleini, Pfeffer 1912, p. 288.—Sasaki 1916, p. 98; 1920, p. 197.

Of this interesting species one female and two male specimens have been at my disposal for examination. Their mantle measures up to about 210 mm. in length.

Texture of whole body nearly choroidal. Skin thickly beset with colorless warts (Pl. XXII, fig. 1). Mantle conoidal, tapering caudad, at first gradually but comparatively rapidly afterwards (textfig. 126A); length a little shorter than twice the maximum breadth. Anterior margin of mantle projects a little at the dorsal part, which forms an angle of about 130° in the middle. Ventral part of the margin with a broad and shallow emargination marked off by quite blunt projections on sides. Fins a little indented at the anterior origin as well as in the middle of their combined posterior edge; their total outline is a Cassinian oval. Length of fins about two-thirds as long as their combined breadth. In a specimen of 140 mm. mantle-length, it measures 30% of the mantle-length and in another of 97 mm. mantle-length, 39%.

Head large, as broad as mantle-opening, its length being ½–⅔ times the dorsal length of mantle. Eyes unequal in size; that of the left side in the smallest specimen examined, and that of right side in the remaining specimens being twice as large in diameter as that of the opposite side. Eye-opening wide, nearly round, with an indistinct shallow notch in the middle of its anterior margin.

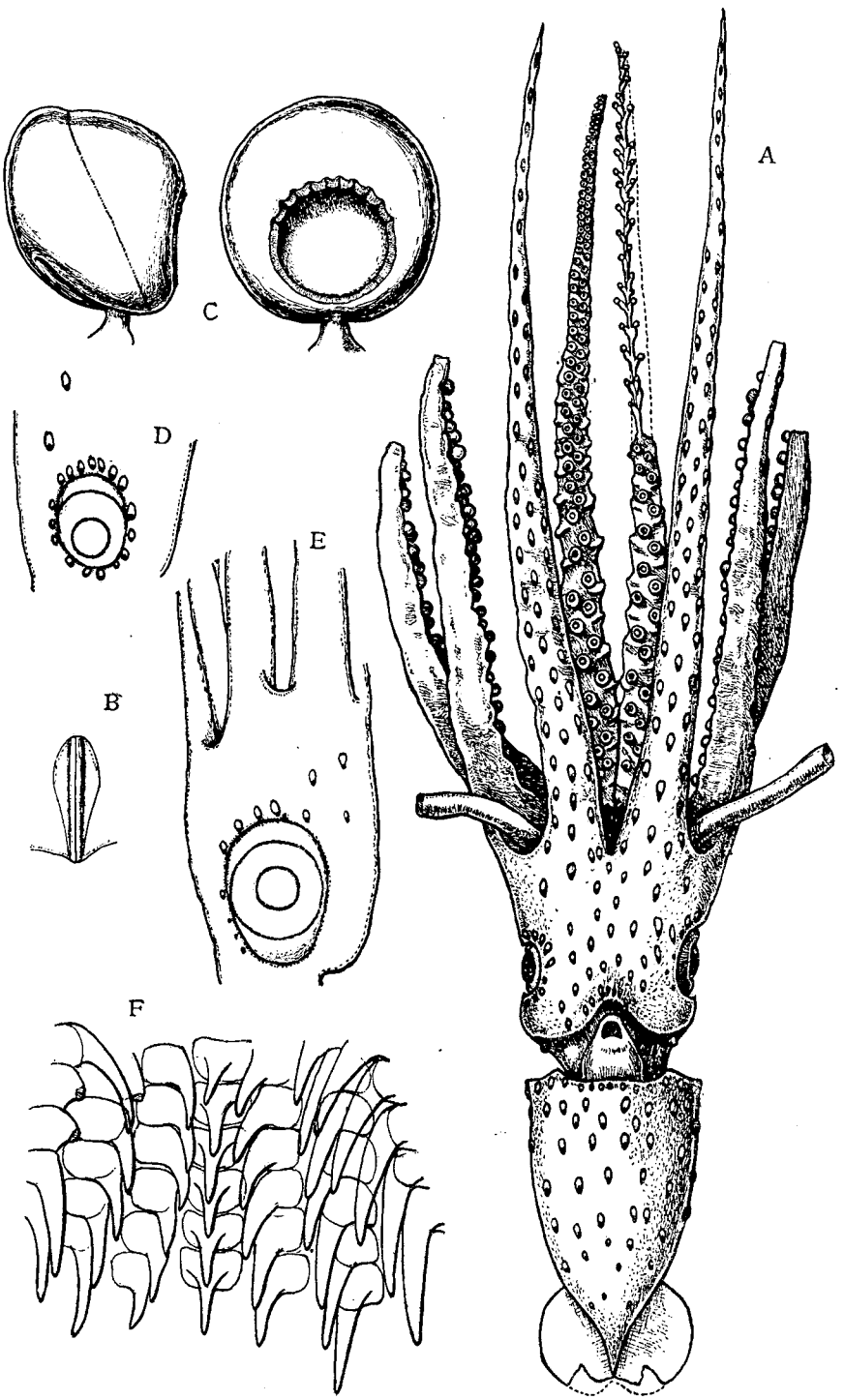
Neck constricted, separated from head by a blunt edge. Nipple-like tuberculus olfactorius present on either side, but no olfactory crest. Nuchal cartilage roughly cuneiform, rounded anteriorly, tapering caudad, traversed throughout the length by a conspicuous ridge, which has a fine groove along its crest (textfig. 126B). In the aforesaid specimen of 140 mm. mantle-length the cartilage measures 22 mm. in length by 7.5 mm. in breadth.

Funnel very short, extending only a little beyond neck. Funnel groove shallow, ill-defined, marked off by a blunt arcuate edge, which gently swings sideways continuing with the anterior boundary edge of neck; Adductors sunk below the integument. Dorsal pad of funnel organ Λ-shaped, traversed by a fold of a similar shape along the entire length of the ribbon. Funnel valve comparatively small, semilunar. Funnel cartilage ovo-lanceolate, three times as long as broad and a little shorter than half the length of funnel, becoming wider posteriad; inner margin straight or slightly concave; outer margin convex. Longitudinal groove of the cartilage narrowed anteriorly, becoming wider posteriad, the greatest depth existing nearer to the posterior end than to the anterior. Mantle cartilage ridge-like, as long as the groove of the preceding cartilage, slightly curved crescentwise, but the broadest and thickest part situated much posterior to the middle.

Arms very long, thick, subequal, the formula of length being $2>3>4>1$; the longest about

thrice as long as mantle. All nearly four-sided; their oral surface very wide, in the proximal parts, becoming narrower and uneven towards the extremity. Aboral surface of arms convex marked on both sides by edges which do not give rise to conspicuous webs or carinations. Protective membranes thick, soft, their breadth about equal to half the length of suckers, with crenulated or serrated margin.

Arm-suckers (text-fig. 126c) subglobular, a little flattened very obliquely attached to peduncles, which grow on the protective membranes; their aperture small, round, situated proximally. Arrangement of suckers biserial throughout, very sparce at the proximal part of arms, becoming much closer towards the distal end. On the first three pairs of arms the suckers are rather unequal, and are very small at base, becoming gradually larger to the middle where ten or more suckers are similarly very large, being about half as large in diameter as the thickness of arms; then they decrease in size comparatively rapidly towards the extremity. On the forth arms the suckers are subequally small in the proximal two-thirds, then diminish in size distad. The largest suckers of these arms are about half as large in diameter as those of the remaining arms.



Textfig. 126.

Stigmatoteuthis döfleini A. Ventral view of male sex; ×⅓. B. Nuchal cartilage; ×⅔. C. Arm-suckers; ×ca. 6. D. Right eye-opening; ×⅔. E. Left eye-opening; ×⅔. F. Radula; ×40.

Horny ring of arm-suckers furnished at the distal margin with numerous distinct quadrangular close-set teeth, the number of which varies according to different suckers as shown in the following table.

Arm \ No. of row of sucker		i	iii	v	vii	ix	xi	xiii	xv	xvii	xix	xxi	xxiii
Sp. No. 1.	I	11	17	16	19	18	11	14	9	9	8	10	—
	II	14	16	12	—	15	17	18	9	9	9	6	4
	III	7	7	15	16	17	17	11	11	—	6	8	5
	IV	13	13	14	18	15	18	18	17	14	16	—	—
Sp. No. 2.	I	8	—	—	—	—	—	11	8	—	—	—	—
	II	6	—	5	9	7	6	12	—	—	—	—	—
	III	5	7	6	—	—	6	—	—	—	—	—	—
	IV	6	—	—	—	—	—	—	—	—	—	—	—
Sp. No. 3.	I	5	8	9	7	9	8	8	4	6	5	3	4
	II	7	6	8	9	9	10	9	8	6	—	—	—
	III	4	4	8	8	8	7	9	8	—	—	—	—
	IV	5	6	5	6	8	7	5	7	—	—	—	—

Both dorsal arms hectocotylized, as fully mentioned by Chun (1906, 1910).

Tentacles about four times the length of mantle; stem a little flattened, with a flat oral surface. Club lanceolate, comprising about one-seventh the length of tentacle (Pl. XXII, fig. 2). Distal two-thirds of club traversed by a triangular dorsal web, which becomes wider proximad but terminates there in a free, acute retroverted point. Eleven suckers and pads form an uniserial connective group of stem, beginning to occur at about two-thirds the length of tentacle from its base and reaching up to the proximal part of club. They are at first sparsely set, becoming closer afterwards.

Tentacular suckers, excluding those of the connective group, may be divided into two groups consisting of about five series each: (1) suckers of the hand portion, which are considerably unequal, those of the median series being 6–12 times as large in diameter as those of margin series, while those of submedian series are about half as large as those of the median series. (2) Suckers of the distal portion, which are practically serial continuations of those of the hand portion, are numerous, minute, about equally sized, being smaller than the marginal suckers of the hand portion.

Largest tentacular suckers short, pail-like in shape, with very wide apertures. Their horny rings armed with fifty or more, fine, acute teeth along the whole margin, the interdental spaces being nearly as wide as the bases of teeth Suckers of the ventral submedian series and some proximal ones of the hand portion characteristically differ from all others in that they are of a somewhat quadrangular contour and the fundus of their hollow is raised to about the level of the aperture. Their horny rings are provided, along the whole edge, with about thirty, thick, triangular, outwardly directed teeth, the points of which inclose a space of a quadrangular shape, the two or three teeth at each corner of that space being thicker and longnr than the rest (Pl. XXII, fig. 3).

Umbrella somewhat developed. In the aforesaid female of 97 mm. mantle length its radii measure 26 mm. at the interspace between first arms, 24 mm. between first and second arms, 20 mm. between second and third arms, 15 mm. between third and fourth arms, and 10 mm. between fourth arms.

Buccal membrane very broad, with seven strong ribs projecting a little beyond the margin. Connectives also seven in number, more or less membranous, joined with dorsal surfaces of arms, but the third arm is connected on the ventral surface. Dorsalmost connective deeply bifulcate, forming in company with dorsal protective membranes a narrow internal umbrella spanning between the bases of first arms.

Conspicuous eye-shaped photophores embellished the surface. Those of mantle more or less regularly distributed on the ventral surface. Anterior edge of this surface always shows nine small organs along the emarginated part, and more laterally four slightly larger ones on either side. For the rest the surface is provided with about forty photophores, of which the posterior ten are smaller than

those more anteriorly situated. On the dorsal surface of mantle, there are found about as many photophores as on the ventral side but all are smaller in size; especially small are the twenty-four situated in the median region.

Photophores of head irregularly distributed throughout. Its ventral surface exhibits about thirty-three large ones, of which eight are arranged in a series just in front of the funnel groove. Besides the thirty-three, the margin of the right eye-opening shows a series of seventeen large organs (textfig. 126D), and that of the left eye-opening a series composed of five large ones in front and of four minute ones behind. The dorsal surface of head has five large and about eleven minute photophores (textfig. 126E).

Photophores of ventral arms are arranged in the proximal half of their aboral surface, in three series; more distally, they occur in two series, and finally in the terminal parts they form a single series; the series of longest extent being the middle series made up of twenty-five organs. Photophores of first, second and third arm-pairs consist of a single series of large organs on the ventral side and of a single series of minute ones on the dorsal side of the aboral surface.

Spermatophores 9 mm. long; spermatic cord 4 mm. long, finely striated cross-wise (textfig. 127).

Radula composed of seven series of unicuspid teeth, which, as regards their length, show the following relations: median=inner lateral=½ outer lateral=⅓ marginal (textfig. 126F).

The before-mentioned specimen of 140 mm. mantle length has a posterior half of the gladius left in situ. This is the unique gladius available to my examination of the species, and almost agrees with the illustration given by Chun (1910, p. 157).

Whole external surface of mantle, head and arms mottled with reddish brown chromatophores. Inner surface of mantle, funnel, and buccal membrane, as well as the whole surface of branchial vessels, and depressor infundibuli are uniformly tinged with a deep brown, while the anterior part of neck as well as of funnel groove show a deep dull brown hue.

The principal measurements are given in one of my previous papers (1914, p. 99).

Remarks.—The "Albatross" collection contains a much destroyed specimen consisting of fragments of three arms. I refer this to the species under consideration, although certainty is impossible in the case of so defective a specimen. The arms are probably the first, second, and third of the left side. The third arm possesses on the aboral surface a distinct stout subtriangular keel, which recalls very much that of *Meleagroteuthis*, and which is not clearly marked in the other specimens examined. The color is claret throughout, but much deeper in the oral surface than in the lateral and aboral surfaces.

Locality.—Sagami Bay (Pfeffers; Sasaki); Yokohama market (Sasaki); Ibaraki Prefecture (Sasaki); ? off Totomi Prov. 662 fms. (Albatross!).



Textfig. 127. *Stigmatoteuthis döfleini.* Spermatophore; ×14.

Stigmatoteuthis japonica Pfeffer, 1912.

Calliteuthis reversa, Hoyle 1886b, p. 183 pl. xxxiii, figs. 12–15.
Calliteuthis ocellata (pars), Berry 1912b, p. 432.
Stigmatoteuthis japonica, Pfeffer 1912, p. 284.—Sasaki 1916, p. 98.

Stigmatoteuthis japonica is the name given by Pfeffer to a cuttle fish previously mentioned by Hoyle in the "Challenger" Report under the name of *Calliteuthis reversa* Verrill. According to Hoyle, the animal agrees very well with Verrill's description and figures of that species but the articulation of the funnel to the mantle is a little more complicated: funnel cartilage of a pear-shaped hollow, the deeper portion being posterior; mantle cartilage ridge-like, divided into two portions, of which the posterior is much the more prominent,

and separate by a distinct gap from the anterior, which is low and narrow.

Tentacular suckers, as far as appear in Hoyle's illustrations, subequal, arranged in continuous longitudinal rows which number about six on the hand portion, diminishing into four, then into three and finally into two as they approach the distal extremity of club. At the same time, the individual suckers become gradually and somewhat regularly smaller distad, the largest ones forming the second and third transverse rows. An uniserial connective group of six suckers and five fixing pads is found on the stem, running diagonally from its ventral margin to the dorsal margin of the carpus. Horny ring of larger suckers has eleven or more, slender clearly separate teeth on the distal half of the margin.

The gladius depicted by Hoyle is rounghly penniform. Vanes deeply arched above, comprising about two-thirds the entire length of gladius; the combined outline roughly elliptical, but the posterior end curiously expanded. The measurements of gladius taken from Hoyle's illustrations are 30 mm. by 9 mm.

Locality.—Hyalonema ground off Ino Sima Island (Hople); east of the North Island, New Zealand (Hoyle).

Genus **Meleagroteuthis** Pfeffer, 1900.

Meleagroteuthis, Pfeffer 1900, p. 170; 1912, p. 290.—Hoyle 1904b, p. 13.

Cutenous photophores numerous, closely set, especially on the ventral surface of animals. Those of ventral arms in eight or nine series at base; same of the remaining arms in one to five series. A single row of horny tubercles usually present along the mid-dorsai line of mantle and also on the aboral surface of first, second and third arms. Protective membranes of those arms expanded at base, and connected with one-another into a narrow internal umbrella spanning between these arms. Third arm with a conspicuous triangular keel on back. Dorsal web of tentacular club narrow and of normal shape.

Type.—Meleagroteuthis hoylei Pfeffer 1900.

Meleagroteuthis separata Sasaki, 1915.

(Pl. XXII, figs. 4–6.)

Meleagroteuthis separata, Sasaki 1915, p. 131; textfigs 1, 2; 1916, p. 103.

A thorough re-examination of the type specimen has convinced me of the validity of the species.

Animal soft, graceful, choroidal. Skin quite smooth, but closely beset with numerous nearly uniform photophores. Mantle thick, nearly conical in shape, about half as long again as its own maximum breadth, which is situated one-fifth down the length (Pl. XXII, fig. 4). Dorsal part of mantle margin convex, forming an angle of 120° in the middle; the ventral part only slightly concave.

Fins nearly terminal, very little extending beyond the hind end of body; both together of a Cassinian oval with the long axis transversely, the combined posterior edge notched in the middle, and the anterior origin a little indented. Length of fins about three-fifths of their total breadth and 45% of the mantle length (Pl. XXII, fig. 5).

Head enormous, broader, and only a little shorter, than mantle. Eyes exceedingly unequal, the eye-ball and eye-opening of the left side being much greater than those of the right side. Anterior margin of eye-opening with a faint sinus near the middle.

Neck strongly constricted, marked off from head by a blunt but distinct edge, of which the mid-ventral part forms a low arch bordering the anterior part of funnel groove. This groove shallow; it is though well-marked anteriorly, ill-defined on sides, where only soft, very low ridges mark off the groove from the remaining part of neck. Distinct tuberculus olfactorius present on either side of neck. Nuchal cartilage ovo-lanceolate, a little, tapering posteriad, measuring 8 mm. by 3 mm.

Funnel conical, very short but wide. Adductors unipaired, dorsally attached. Funnel cartilage

nearly ovate, somewhat acuminated in front, with an elongate deep depression in the middle. Length of the cartilage a little over half that of funnel. Mantle cartilage of a crescent-shaped ridge, highest near the middle, about as long as the preceding cartilage.

Arms long, nearly equal, about twice as long as mantle, gradually and evenly tapering off distad, nearly four-sided. Neither distinct web nor keel present on the aboral surface of arms, but third arm with a short triangular keel near the middle of the length.

Umbrella best developed between the first two pairs of arms, where it extends about 6 or 7 mm. up the arms. In the remaining interbrachial spaces it is similarly very narrow but is quite obliterated between ventral arms.

Protective membranes of arms narrow; espeeially narrow are those of ventral arms. The proximal parts of the membranes united together into an internal umbrella, of which the radii measure about 13 mm. between the first three pairs of arms.

Buccal membrane with seven distinct ribs extending beyond the margin. Connectives also number seven, the dorsal three of which are deeply bifulcate and incorporated into the internal umbrella; the remaining four undivided, hanging over the sulcus around the membrane. The relations of attachment between connectives and arms are as follows:—

First connective ⟶ the dorsal surfaces of both first arms.
Second ,, ⟶ the ventral surface of a first arm and the dorsal surface of a second arm.
Third ,, ⟶ the ventral surface of a second arm and the dorsal surface of a third arm.
Fourth ,, ⟶ the dorsal surface of a fourth arm.

Arm-suckers subglobular, small, biserial, marginally attached. Those of ventral arms a little smaller and more closely set than those of the remaining arms. The latter are very sparsely set in the proximal parts but attain a closer arrangement in the distal parts. Horny ring with irregular horny substance covering over the margin so that no dentation is discernible.

Tentacles slender much longer than twice the length of mantle. Stem far thinner than arms, nearly three-sided; a little flattened from aboral to oval side; the latter side flat, bordered laterally by edges which are not so sharp as to make "*Faden*" of Pfeffer's marked by groves (1912, p. 292). Club expanded, spindle-shaped in outline, comprising about one-tenth of tentacle. The extremities of clubs were somewhat dissimilar, that of the right club being more slender than that of the left, probably due to the abnormality of either of the two (Pl. XXII, fig. 6).

Tentacular suckers exhibit the principal characteristic of the species discriminating it from *M. hoylei*. The suckers may be divided into three groups: (1) Connective group of stem, consisting of nine or ten suckers and eight to ten pads arranged in a single series; it begins on the ventral side of the oral surface about two-thirds up stem, runs diagonally into the dorsal side of carpus and then goes further up to the middle part of club along its dorsal margin. (2) Hand group, consisting of unequal suckers arranged in four longitudinal rows, of which the ventralmost is composed of seven or eight suckers a little larger than those of the connective group. The second row is made of five suckers as small as those of the ventralmost series. The third row which is situated in the middle of club, is formed of only three suckers a little larger than any suckers of both the preceding rows. The fourth row, i. e. the dorsalmost of the four rows and the one next ventral to the connective group on club, has only two or three suckers which are the largest of all the tentacular suckers, being twice or thrice as large in diameter as those of the ventralmost series. (3) Distal group, composed of suckers much smaller than those of the connective group and not in any serial continuation with the hand group as in *M. hoylei*, but entirely separated from it by a smooth space.

Individual suckers of tentacles shallow; aperture much wider than that of arm-suckers, surrounded by radial muscles, which are best developed in the largest suckers. Margin of horny rings covered with a horny substance, exhibiting no dentation.

A longitudinal series of horny tubercles present on the aboral surface of first three pairs of arms and also on the back of mantle; that of first arm consists of ten or eleven large tubercles and some smaller ones, extending from near its middle down to the frontal part of head. Same of the second

composed of ten or eleven tubercles, extending down to the anterior margin of umbrella. Same of third arm is the least extensive, consisting of only eight or nine tubercles.

The tubercular row of the mantle begins to occur at the middle point of the dorsal anterior margin and traverses straight for some distance caudad, then curves into the right side, almost reaching the anterior origin of the right fin. The tubercles of this row are not so numerous as in *M. hoylei*, but number only seventeen, and are small and uniform.

Whole external surface of the animal embellished with numerous longitudinal-oval photophores, larger ones of which measure 0.6 mm. by 0.4 mm. Photophores of belly closely crowded more or less regularly in oblique rows, but becoming somewhat sparser at the end-part of body. Along the whole edge of mantle opening, photophores are arranged in a series of about 38, of which about 25 are visible from the ventral side. 24 photophores may be counted along the median longitudinal line of belly though they do not exhibit any regular line. On the back of body the organs are very sparse and show very irregular arrangement, those of the left side being a little more sparsely distributed and smaller in size than those of the right side.

Photophores on the ventral surface of head as closely crowded as on the corresponding surface of mantle, and in regular oblique rows as well. Those nearest to the anterior boundary edge of neck form a regular transverse series of 24, with the thickest arrangement in front of the funnel groove. In a transverse row which extends between both eye-openings they seem to number about 20 as stated by Pfeffer in *M. hoylei*. On the dorsal surface of head they are found in the outer region only and are much smaller and sparser than on the ventral surface; their distribution is very irregular, being more numerous on the right side than on the left.

On the lateral surfaces of head, photophores also vary in size and distribution in right and left. On the right side, the organs are numerous, closely set, but become sparser towards the dorsal side; there is a longitudinal area free from organs in the middle, crossing the eye-opening and extending from neck to the angle between third and fourth arms. The eye-lid of this side is provided with 24 organs around the whole edge of the opening. The left lateral surface of head has very few and minute organs, and there are none around the margin of the eye-opening.

Photophores of arms are the serial continuations of those of head and form more or less regular longitudinal series. They are most numerous and of thickest distribution on the right ventral arm. On this arm they number nine longitudinal rows at the extreme base, become reduced into six rows in the middle and finally into a singular row at the extremity. The longitudinal rows which extends to the extremity in the second of the nine rows at base from the ventral side. On the third arms there are three longitudinal rows of the photophores; two series of which are situated on the aboral surface more ventral than the median tubercular series, the longer one of the two series is the ventralmost of all and reaches the extreme end of the arms, comprising about forty organs. The dorsalmost of the three series, is on the aboral surface more dorsal than the median tubercular series, composed of only a small number of smaller photophores.

On the second arms are found also three series of the photophores as on the third. Of the three series, the longer two are on the aboral surface more ventral than the tubercular series, and the middle series is the longest, extending up to the extremity of arms, and consists of about thirty-three organs. The dorsalmost of the three series resembles very much that of the third arm but consists of much less numerous photophores.

The photophores of the first arms are rather rudimentary, irregularly distributed and by far less numberous than on the remaining arms.

Measurements.

Dorsal length of mantle	31 mm.
Ventral length of mantle	25 „
Breadth of mantle	20 „
Ventral length of head	19 „
Breadth of head	22 „

Total breadth of fins	24 mm.	
Length of fins...	14 ,,	
	Left	Right
Length of first arm...	52 mm.	50 mm.
,, ,, second arm	52 (?) ,,	49 (?) ,,
,, ,, third arm	55 ,,	52 (?) ,,
,, ,, fourth arm	40 ,,	47 ,,
,, ,, tentacle	80 ,,	80 ,,

Type locality.—Misaki, Sagami Prov. 400 fms. (Sasaki).
Type.—In Tôkyo Imp. Univ.

Family **Gonatidae** Hoyle, 1886.

Gonatidae, Hoyle 1886b, p. 173.—Garus 1890, p. 450.—Pfeffer 1908a, p. 68; 1912, p. 229.

Body elongated, conico-cylindrical, more or less attenuated at the posterior end. Fins terminal, either rhomboidal or cordate. Funnel cartilage slender, with a single longitudinal groove, which articulates with a lineal ridge-like mantle cartilage. Buccal membrane 7-ribbed; connectives also seven. Equipments of arms, quadriserial at least at the proximal half, consisting of suckers only in the young, but when the animal grows older those of the two central series in the first three pairs of arms undergo a change into hooks. Tentacles may be absent, but more often present, provided with multiserial suckers, some of which may be transformed into hooks at maturity. Gladius in adult slender, furnished with a comparatively large end-cone, sometimes also with a cartilaginous spine at the tip.

The known species of this family are of more or less abyssal habit, the whole body constituted of somewhat soft and more or less choroidal tissues. Some species undergo a marked metamorphosis while developing, so that the specific identification has been dealt with great difficulty.

Key to the genera and species of this family.

(A) Tentacles present (gen. *Gonatus*).
  (a) Tentacular armatures composed of suckers and hooks, radula composed of only five series of teeth .....*Gonatus fabricii.*
  (b) Tentacular armatures composed of suckers only even at maturily; radula with seven series of teeth .....*Gonatus magister.*
(B) Tentacles absent (gen. *Gonatopsis*).
  (c) 8–12 longitudinal rows of suckers on the extremity of arms .....*Gonatopsis octopedutus.*
  (d) 4 longitudinal rows of suckers on the extremity of arms .....*Gonatopsis borealis.*

Genus **Gonatus** Gray, 1849.

Gonatus, Gray 1849, p. 67.—Adams, H. & A. 1858, p. 36.—Tryon 1879, pp. 106, 168.—Verrill 1882, p. 288.—Hoyle 1886b, p. 174; 1889, p. 117.—Berry 1912a, p. 308.—Pfeffer 1908a, p. 70; 1912, p. 230.
Onychoteuthis (pars), Adams, H. & A. 1858, p. 32.
Lestoteuthis, Verrill 1880b, p. 251; 1871c, p. 390; 1882, p. 415.—Steenstrup 1881a, p. 9.
Cheloteuthis, Verrill 1881b, p. 110; 1881c, p. 293; 1882, p. 286.

Olfactory crest on either side of neck, composed of three longitudinal folds, the ventralmost of which is provided with a small membranous tuberculus olfactarius. Arms of ordinary structure even at their extremity; armatures quadriserial throughout, consisting of hooks and suckers. Tentacles present throughout the life; when young, they are provided with suckers only, of which those on the middle part of the club sometimes may undergo a change into hooks at maturity. Gladius in adult, slender, furnished with an end-cone and solid cartilaginous spine at the tip.

Type.—*Onychoteuthis ? amoena* Mϕller 1842 [=*Gonatus fabricii* (Lichtenstein 1818)].

Gonatus fabricii (Lichtenstein, 1818).

(Pl. XXII, figs. 7–18; textfig. 128.)

Onychoteuthis fabricii, Lichtenstein 1818, p. 13 (fide Pfeffer).
Onychoteuthis ? amœna, Mϕller 1842, p. 76.
Onychoteuthis kamtschatica, Middendorff 1849, p. 189, pl. xii, figs. 1–6.
Gonatus amœna, Gray 1849, p. 68.—Adams 1858, p. 36, pl. iv, fig. 2.—Verrill 1881c, pp. 291, 388, 390, 428.
Gonatus amœnus, Sars 1878, p. 336, pl. xxxi, figs. 1–15; pl. xvii, fig. 2.
Lestoteuthis Kamtschatica, Verrill 1880b, p. 251.
Gonatus fabricii, Steenstrup 1881a, p. 9, pl. i.—Verrill 1880a, p. 291, pl. xlv, figs. 1–1b, 2–2d; 1882, p. 289, pl. xv, figs. 1–1c, 2–2d.—Steenstrup 1882, p. 143, pl, i.—Hoyle 1886b, pp. 41, 174; 1889, pp. 117–135, pl. xiii, xiv.—Carus 1890, p. 450.—Appellöf 1892, p. 9.—Pfeffer 1900, p. 163; 1908a, p. 71, figs. 80–84; 1912, p. 230, pl. xv, figs. 17–22.—Berry 1912a, p. 308, pl. liii, figs. 1–4; pl. liii; pl. liv, figs. 1–4; pl. lv; 1912b, p. 424.—Sasaki 1916, p. 96; 1920, p. 197.
Cheloteuthis rapax, Verrill 1881b, p. 110, pl. ii, figs. 1–1f; 1881c, p. 293; 1882, p. 286, pl. xv, figs. 3–3f, 4.
Lestoteuthis fabricii, Verrill 1881c, pp. 291, 293, 387–390, 428, pl. xlv, figs. 1, 2; pl. xlix, fig. 1; pl. lv, fig. 1; 1882, p. 416, pl. xlv, figs. 1–1d.—Dall 1886, p. 209.
Gonatus antarctius, Lönnberg 1898, p. 51, pl. v, fig. 4.

Twelve specimens of this species are found in the "Albatross" collection, consisting of two mature, one adolescent and nine larval individuals. Their differences in shape between these developmental stages are so marked that their separate descriptions are properly advisable.

Adult.—Body about four times as long as its own maximum breadth, nearly cylindrical in the anterior half, then tapering regularly caudad to an acuminate end. Dorsal part of mantle-margin even and without median process; the ventral part shallowly but broadly emarginated crescentwise; the emarginated part marked off by a bluntly angular projections on either side.

Fins terminal, fleshy, connected together posteriorly, their total outline rhomboidal, but the lateral angles rounded, and the anterior origins deeply indented. Antero-lateral edges a little convex; postero-lateral edges nearly straight but may be slightly convex in the anterior parts and slightly concave in the posterior parts. Posterior end pointed in an angle of 40°–80°. Length about equal to, or a little less than, the combined breadth, and decidedly less than half the length of mantle.

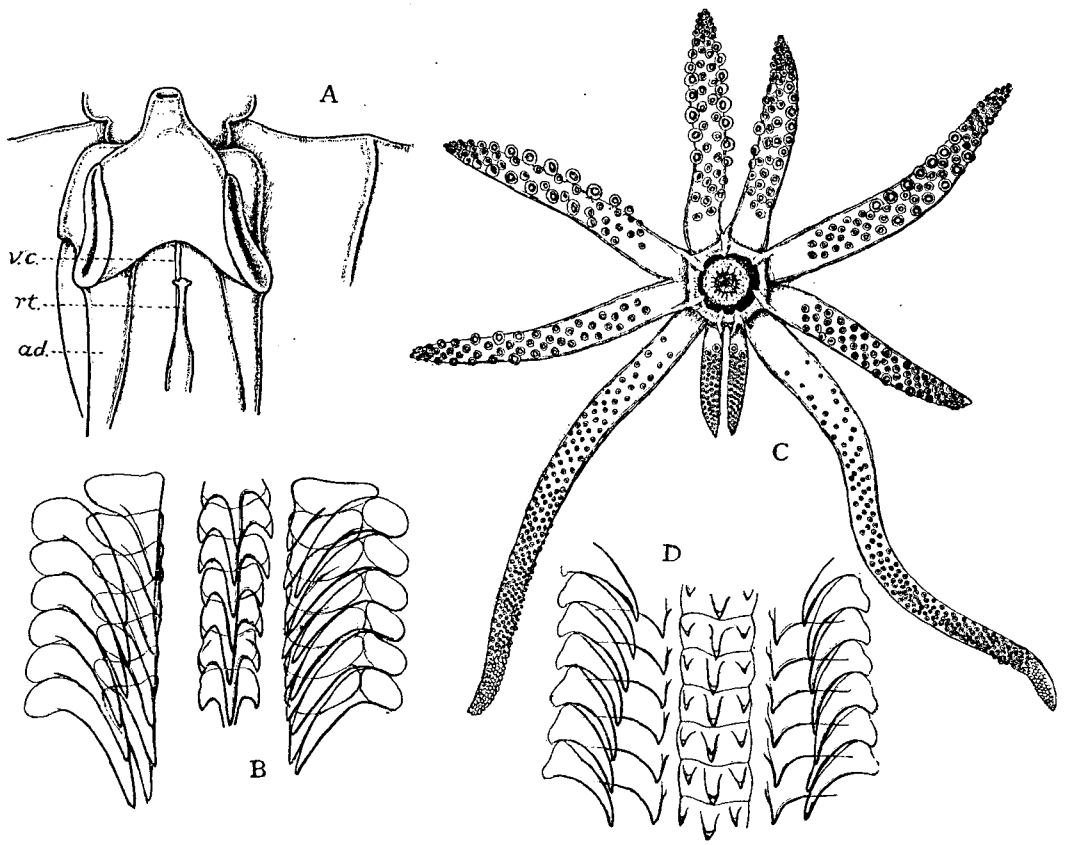
Head a little broader than body. Eye a little prominent with very large eye-ball. Eye-opening roundish, with a distinct sinus in the antero-ventral margin. Funnel groove smooth, distinctly marked off by a continuous horseshoe-shaped fold.

Neck marked off from head by a more or less distinct edge. Olfactory crest on either side, composed of three longitudinal folds, of which the ventralmost is semilunar, confluent with the boundary fold of funnel groove; the remaining two folds run obliquely dorsal and posteriad, connected with a narrow transverse fold posteriorly. Nuchal cartilage elongated, slightly expanded on both ends; a strong longitudinal ridge runs throughout the length, defined by grooves laterally (Pl. XXII, fig. 8). In a specimen of 180 mm. mantle length the cartilage measures 21.9 mm. by 6 mm.

Funnel very short, usually only a little extending beyond mantle cavity. Funnel cartilage lanceolate, about four times as long as broad, and longer than half the length of funnel; a little narrowing anteriorly; outer margin a little concave; inner margin usually convex. Longitudinal groove of the cartilage situated in the middle, slightly widening posteriad, marked off more sharply in the inner side than in the outer. Mantle cartilage ridge-like, linear, a little longer than the preceding cartilage (textfig. 128A).

Arms subequal, the formula of length being $3>4\fallingdotseq 2>1$, but Pfeffer mentions it to be 3, 2, 4, 1; the longest about half as long as the mantle. Keels, webs and protective membranes of arms all constructed almost as in Pfeffer's statements.

Equipments of arms quadriserial even at the extremity. On the ventral arms, they number over 100, all represented by suckers. On the remaining arms they number about 100, those of the outer two series of which are suckers. But those of the inner two series are mostly hooks, only a few at



Textfig. 128.

Gonatus fabricii. A. Funnel of adult specimen; ×⅔. B. Radula of same specimen; ×33. C. Arms of largest larva examined; ×ca. 3. D. Radula of larva of 13 mm. mantle length; ×180.

base and several at the extremity being represented by suckers. The hooks are far larger than the suckers, their length often being four or five times the diameter of the suckers in the same transverse row. Horny ring of suckers dentate, the teeth numbering 12 or 13 in the middle suckers of ventral arms (Pl. XXII, fig. 9).

Tentacles about twice as long as arms, robust, clearly four-sided. Club agreeing with Verrill's description and illustrations; lanceolate as usual, but its hand portion well expanded, being far wider than stem, while the distal portion, which measures about one-third the entire length, is characteristically slender and nearly of uniform breadth throughout, terminating in a rounded tip (Pl. XXII, fig. 7). Dorsal web stands keel-like at the proximal part, arising abruptly at its origin and is bent over laterad as it goes towards the extremity. The slender distal portion is provided with four regular series of small crowded suckers, and there is at the extreme tip a special circular row of eleven minute suckers.

On the hand portion the suckers are less regularly and much more sparsely set than on the distal portion, and divided into two groups, which pass down the marginal regions of club, leaving its central part bare. On this area, however, are found a longitudinal series of seven hooks, of which the distalmost is of moderate size, followed by an enormous one; the remaining hooks are all very small, and decrease in size proximad. The ventral one of the two sucker-groups above mentioned far extends

on to stem, where the the arrangement of the suckers are uniserial. Distally the group becomes abruptly thinner, disappearing opposite the base of the largest hook. The dorsal group of the suckers is thickely crowded distally and thins off proximally, disappearing before reaching the carpus. It runs at first along the extreme margin of the club, but soon deviates internally, and finally takes a submedian portion.

Towards the base of the club is found along the dorsal margin a single series of five, large, peculiar, short-pedicelled suckers, which regularly alternate with round fixing pads. This series is continuous with the connective group of suckers on the stem. The latter group also consists of suckers and pads regularly alternating with each other and runs in a zigzag line along the dorsal margin of the flat oral surface of the stem down to its base.

Radula composed of only five series of teeth instead of the usual seven series, well agreeing with Verrill's illustrations. Median teeth distinctly tricuspid, and the remaining teeth unicuspid and much larger than the former (textfig. 128B).

Color in formalin deep purplish brown throughout.

The mature specimens referred to are both male, yet no hectocotylization is discernible.

Measurements.

Dorsal length of mantle	180 mm.	
Ventral length of mantle	170 ,,	
Breadth of mantle	42 ,,	
Length of fins	82 ,,	
Total breadth of fins	81 ,,	
	Left	Right
Length of first arms.	70 mm.	70 mm.
,, ,, second arms	82 ,,	82 ,,
,, ,, third arms	90 ,,	—
,, ,, fourth arms	85 ,,	85 ,,
,, ,, tentacles	170 ,,	—

Adolescent stage.—Consistency softer, body wider, and its wall thinner than in adult. Fins taken together broadly cardi-form, being distinctly wider than long; indentation of their anterior origin deep; posterior end extending a little beyond the end of body. Ventral emargination of the anterior margin of mantle shallow, feebly marked off on sides (Pl. XXII, fig. 10).

Head much narrower than mantle opening; constructed almost as in cranchiids, the anterior half forming a slender foursided prism and the posterior half wide, with exposed and projecting eye-balls. Funnel broad, but short, extending merely one third up the head, and fixed by a pair of adductor muscles to the funnel groove, which is not so well marked as in the adult. Both funnel and mantle cartilages as in the adult (Pl. XXII, fig. 11).

Arms unequal, the formula of length being $2 \doteqdot 3 > 4 \doteqdot 1$, and comparatively much longer than those of the adult, the longest decidedly exceding the body-length. Armatures quadriserial throughout as in the adult, but their inner two series of the first three arm-pairs include more numerous suckers and less numerous hooks. The following table shows the number of these suckers and hooks on their respective arms:—

	Suckers at base	Hooks	Suckers at extremity	Total
I arm Right	13	28	13	54
I arm Left	14	24	18	56
II arm Right	2	40	16	58
II arm Left	5	38	15	58
III arm Right	2	40	16	58
III arm Left	2	42	14	58

The fourth pair of arms has suckers only, about 84 of which are included in the inner two series. The horny ring of these suckers has four or six teeth on the distal margin (Pl. XXII, fig. 12).

Tentacles longer than arms, their stem four-sided, with a quite flattened oral surface. Club lanceolate in outline, expanded proximally and narrowed at the distal half, where the quadriserial suckers are rather unequal in size, those of the ventralmost series being decidedly larger than the rest (Pl. XXII, fig. 13). The quadriserial arrangement of the suckers on the distal part undergoes a sudden change in the middle of the club into an octoserial, which developes further into an arrangement of more numerous series as the suckers go further downwards. In the proximal parts the suckers group themselves into zones traversing the margins towards the carpus. The suckers of these two zones are much smaller than those of the distal part and crowded into 6–8 series in each zone. Along the interspace between these too zones, there is found a longitudinal series of about ten suckers, the two distalmost of which are much larger than the rest. And, of the two the proximal one is by far the larger, undergoing a change into a hook.

On the stem of tentacles, there are found connective suckers regularly alternating with fixing pads in a zig-zag line, and which run along the dorsal margin of the oral surface, joined distally with the sucker-zone of the dorsal side of the club. On the ventral margin of the oral surface also are found a groupe of minute suckers in two or three series, extending nearly to the carpus.

Radula as in adult, consisting of five series of teeth.

Measurements.

Dorsal length of body	40 mm.
Ventral length of body	39 „
Breadth of body	16 „
Breadth of head	10.6 „
Length of fins	17 „
Total breadth of fins	31 „
Length of first arms	30 „
„ „ second arms	37 „
„ „ third arms	37 „
„ „ fourth arms	23 „
„ „ tentacles	41 „
„ „ clubs	9 „

Larval stage (Pl. XXII, figs. 14, 15, 17).—Whole external appearance resembles very much that of a crauchiid: body semi-transparent, nearly barrel-shaped, with somewhat membranous wall. Along the mid-dorsal line of mantle appears a part of the gladius dilating posteriorly into a slender longitudinal rhombus. Anterior margin of mantle nearly truncate save for a faint projection in the middle of the dorsal part. Fins minute, semi-circular, attached to the extreme end of body, their combined posterior edge forms a shallow and wide identation in the middle.

Head a little depressed dorso-ventrally, constricted in front (Pl. XXII, fig. 16); invariably far narrower than mantle-opening, and deeply contracted into mantle cavity. Eyes project anteriorly and laterally, with small circular openings. A minute papillary tuberculus olfactorius present on either side of neck. Funnel, funnel-cartilage, and mantle-cartilage all nearly as in the adult.

Arms short, rounded on back, tapering to blunt extremities. Ventral arms much shorter than the others, which are of nearly equal length. The largest larva examined has a formula of $2>3>1>4$, the longest being about two-thirds the length of body. Armatures composed of suckers only, in four series. The suckers of the first three pairs of arms, uniform, except in the largest larva referred to, where the suckers of the outer two series on these arms are much larger than those of the inner two series. They number in a larva of 13 mm. mantle-length, about 33 on the first, as well as on the third arm, and about 44 on the second arm. The suckers of the fourth arms are much more numerous than on the preceding arms, exceedingly minute and nearly uniform except some proxi-

mal ones, which are at least twice as great in diameter as the succeeding ones and which vary from two to seven in number in the different larvae examined. (textfig. 128c).

Tentacles ordinarily sub-cylindrical in the proximal half, then gradually tapering off distad. Their relative length variable but a little longer than half the length of mantle in the largest larva mentioned above. Armatures consist of suckers only, but some at the extremity are only nipple-like and without horny rings. They extend nearly the whole length of tentacles. Their arrangement is biserial at base, but becomes quadriserial near the middle and finally octoserial at the extremity.

Gladius penniform, strikingly resembling that of Loligo. Vanes comprise the posterior two-thirds, both lanceolate in shape, narrowing with equal proportion towards both the extremities. End-cone, and cartilaginous spine not yet developed (Pl. XXII, fig. 18).

Radula as in adult (textfig. 128D).

Chromatophores only a few and very large (Pl. XXII, fig. 15).

Principal measurements of some of the larvae referred to:

No. of specimen	i	ii	iii	iv	v	vi
Length of body	14 mm.	13 mm.	11 mm.	10 mm.	9.2 mm.	4 mm.
Breadth of body	6.5 ,,	6 ,,	5.3 ,,	5 ,,	4.6 ,,	2.3 ,,
Length of first arms	3.5 ,,	3 ,,	1.2 ,,	1.4 ,,	1 ,,	rudiment
,, ,, second arms	4 ,,	3 ,,	2.5 ,,	2 ,,	1.7 ,,	do.
,, ,, third arms	4 ,,	3 ,,	2 ,,	1.4 ,,	1 ,,	do.
,, ,, fourth arms	2.5 ,,	1.8 ,,	0.8 ,,	0.7 ,,	0.6 ,,	do.
,, ,, tentacles	7 ,,	6.4 ,,	5 ,,	5 ,,	4 ,,	1.8 mm.

Remarks.—The adolescent stage examined is a little different from that hitherto described, so that its identification with the present species is with a great deal of hesitation. Compared with Sar's illustrations it has much longer arms and a head quite differently shaped.

Distribution.—The species has a very vast distribution as listed by Pfeffer, extending from the arctic to the antarctic, covering both the Pacific and the Atlantic, although a few have been known from the tropical regions. There are between the arctic and the antarctic forms some local variations chiefly in regard to the number and shape of armatures of the arms and also of the tentacles (see Lönnberg 1898, pp. 51–54, and Pfeffer 1912, p. 240).

The localities known in Japan and vicinity are as follows:—Kamchatka (Middendorff); Bering Sea (Dall); Japan (Steenstrup); Milne Bay, Simushir I., Kurile group (Albatross!); Bowers Bank, Bering Sea (Albatross!); near Near Is., Aleutians (Albatross!); east of Kamchatka (Albatross!); south of Alaska (Albatross!); near Commander Is. (Albatross!).

Gonatus magister Berry, 1913.

Japanese name: Dosu-ika (Etchu Prov.).

(Pl. XXII, figs. 19–22; textfigs. 129, 130.)

Gonatus fabricii (?), Berry 1912a, p. 310, pl. lii, figs. 1, 2; pl. liii; pl. liv, figs. 1–4, pl. lv, figs. 1, 3–7.

Gonatus magister, Berry 1913b, p. 76.—Sasaki 1916, p. 97; 1920, p. 198.

Gonatus septemdentatus, Sasaki 1915, p. 185.

Whole body rather soft, more or less choroidal in consistency and easily mutilated. Mantle cylindrical in the anterior half, then narrowing caudad; end-part, which comprises about one-third of the entire length, is slender, tapering gradually to a rather blunt extremity. Breadth of body 22–30% of the length, this ranging from 82 mm. to 220 mm. in the specimens examined. Anterior margin of mantle cut ventrally in the middle region into a broad emargination which is delimited laterally by two angular projections; dorsal part of the margin produces a little in the middle into an obtuse angle.

Fins broad, both roughly rhomboidal but forming a distinct auriculation at the anterior end; antero-lateral edges slightly convex and the postero-lateral edges nearly straight. The combined breadth of fins in the largest specimen examined is about one-sixth as great again as their length, which is in turn a little longer than half the length of body. In the smallest specimen examined these proportions of the measurements occur somewhat in a different way: the length is greater than twice the combined breadth and less than one-third the length of body.

Head ordinarily as broad as mantle-opening, its length about one-fourth that of body or even greater; dorsal surface arched; sides rounded; ventral surface flat, but the mid-posterior part excavated into a distinct funnel groove marked off by a faint fold around. In the groove is found no foveola, but sometimes six or seven indistinct longitudinal folds may be discernible. Eye-ball very large. Eye-opening wide, with a marked sinus in the anterior margin a little below the middle. The sinus is directed towards the interspace betwen the third and fourth arms; its margins especially that of the dorsal side greatly thickened. Neck strongly constricted, but its anterior boundary fold is rather faint (Pl. XXII, fig. 19). Olfactory organ on each side composed of three narrow longitudinal folds, the ventralmost of which has a small semi-circular membrane on the outer aspect. The two remaining folds are connected together posteriorly by an inconspicuous transverse fold, which, thus connecting them, still extends dorsad beyond them. Nuchal cartilage panduriform, narrowed in the middle, nearly similarly expanded at both ends, with a shallow indentation in the anterior margin on either side of the middle point; a marked longitudinal ridge passes throughout the length, with a groove along its crest (Pl. XXII, fig. 20).

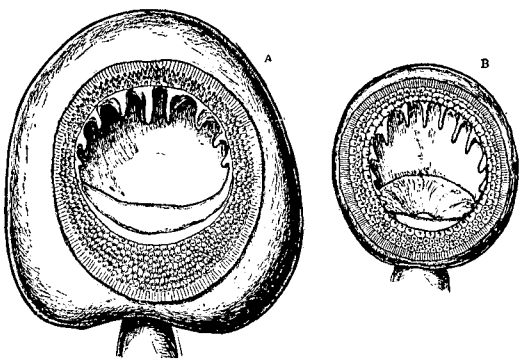
Funnel short, roughly conical; the distal end blunt, reaching one-third up the head. Collar-like portion broad, the whole posterior margin free even at nape. Funnel organ composed of a $\wedge$-shaped dorsal pad and two slenderly ovate ventral pads; the former extends from the level of anus half-way up to the distal funnel-extremity, its rhamus a little dilating posteriad. The ventral pads far shorter, and a little thinner, than the dorsal pad. Funnel cartilage broader than that of *G. fabricii*, slenderly pyriform in outline, rounded and expanded behind, then regularly tapering off forwards, furnished with a broad median groove, which also becomes regularly narrower forwards. Length of the cartilages about three times their maximum breadth and about half the entire length of funnel, measuring 25 mm, in a specimen of 170 mm. mantle length. Mantle cartilage ridge-like, not simply linear as in *G. fabricii*, but becoming much broader and lower posteriad; length decidedly greater than that of funnel cartilage.

Arms subequal, the formula of length being $2>3>1\fallingdotseq4$ or $2\fallingdotseq3>1\fallingdotseq4$, the longest about half as long as mantle. All more or less four-sided except third arms, which are compressed from side to side, with a marked keel along the whole length of the aboral surface. Second arms furnished with a sharp edge on the ventral side of the aboral surface; fourth arms with a conspicuous web along the outer side. Umbrella obliterated as in *G. fabricii*. Protective membranes narrow, and uniform.

Equipments of arms in four series throughout; consisting of suckers only on ventral arms, but of suckers and hooks on the remaining arms. On these arms the suckers form the marginal two series, and the hooks, the central two series except at both the base and extremity where the four series are composed of suckers only. The quadriserial suckers at the extremity are more numerous than in *G. fabricii* and occupy $\frac{1}{4}$–$\frac{1}{3}$ of the entire length of arms. The hooks of the central series are a little larger than the suckers of the marginal series, but not so large as in *G. fabricii;* their number greatly varies with age in direct proportion and is about 25 in each arm in the larger specimens examined. Horny ring of suckers dentate on the distal half of the circumference, the remaining part forming a crescent-shaped border, the middle region of which sometimes bent, projecting forwards. Teeth strong, triangular, compressed laterally; numbering about 10 in larger suckers and becoming larger distad in the ring (textfig. 129A).

Tentacles as thick as arms, variable in length, but ordinarily as long as, or shorter than, mantle, Stem compressed laterally, the oral surface flat, marked off by blunt edges on sides; the aboral surface furnished with a narrow membrane extending from the base to the middle of club. The club comprises the distal one-third of tentacles, and is expanded lanceolately, but the distal part is peculiarly narrowed, terminating bluntly. Dorsal web developed on the distal one-third of club, becoming wider distad.

Tentacular armatures composed of suckers only even in the largest individual examined. The suckers numerous, crowded on the entire oral surface, occupying the distal half of tentacle; equally minute but those of the middle region of the sucker-bearing part are a little larger than the remainder. They form oblique-transverse rows, each of which consists of about 12 suckers at the carpal region, about 25 at the widest part of the hand portion, and about 6 at the slender distalpart. Besides these, there is at the extreme tip of tentacles a circular row of eleven suckers, and also are along the extreme dorsal margin of the proximal two-thirds of the sucker-bearing part 50–60 minute uniserial connective suckers regularly alternating with so many fixing pads. Horny ring of suckers dentate on the distal four-fifths of the circumference; teeth somewhat resembling those of arm-suckers in shape, and numbering about 15 in each of the larger suckers (textfig. 129B).



Textfig. 129.

Gonatus magister. A. Largest sucker of fourth arm; ×27. B. Largest tentacular sucker; ×27.

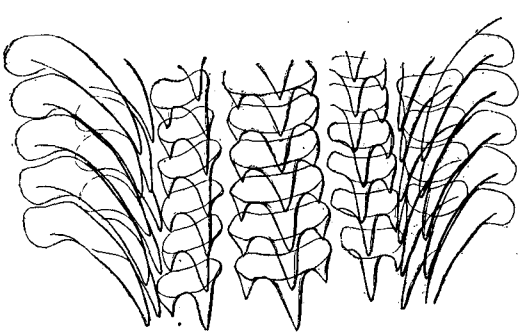
Gladius almost as in *G. fabricii* but the vanes are more extensive, comprising about four-fifths of the entire length (Pl. XXII, fig. 21).

Radula eomposed of seven series of teeth instead of five series as in *G. fabricii*. Median teeth tricuspid; inner lateral teeth bicuspid; both outer lateral and marginal teeth unicuspid, being much longer than both the preceding ones; especially long are the marginal teeth which are about three times as long as the median (textfig. 130).

Color in life deep reddish brown throughout; chromatophores minute, crowded over the whole external surface, imbedded in the skin, which comes off easily.

The measurements are given in one of my previous papers (1915, p. 185).

Remarks.—Nine specimens of this species have been at my disposal. Their mantle-length ranges from 82 mm. to 220 mm. all are not yet fully mature and are female except one measuring 158 mm. in mantle-length. No hectocotylization is discernible in the unique male. The nidamental gland of the largest female measures 50 mm. in length.



Textfig. 130.

Gonatus magister. Radula; ×40.

On the coast of Etchû Prov. this species is caught together with shrimps at 100 fathoms or more. It is said to be edible, but is not cured for the market so that it has no commercial value even at Etchû Prov.

Locality.—Near Cape Clonard, Korea, 400 fms. (Albatross!); Toyama Bay (Sasaki); off Iwanai, Hokkaido, 428 fms. (Albatross!); near Bowers Bank, Bering Sea, 557 fms. (Albatross!). Victoria, B. C. (Berry); Puget Sound, Wash. (Berry),

Genus **Gonatopsis** Sasaki, 1920.

Body elongated. Fins terminal rather broad, both reni-form. Funnel cartilages slender, with a longitudinal groove articulating with ridge-like linear mantle cartilage. Distal part of arms peculiarly attenuated, provided with long pedicelled suckers in ten or more series. Armatures of the remaining proximal part in four series, the median two of which are composed of hooks and the marginal two series, of suckers; but in the ventral arms the four series are all composed of suckers only. Tentacles absent

Type.—*Gonatopsis octopedatus* Sasaki, 1920.

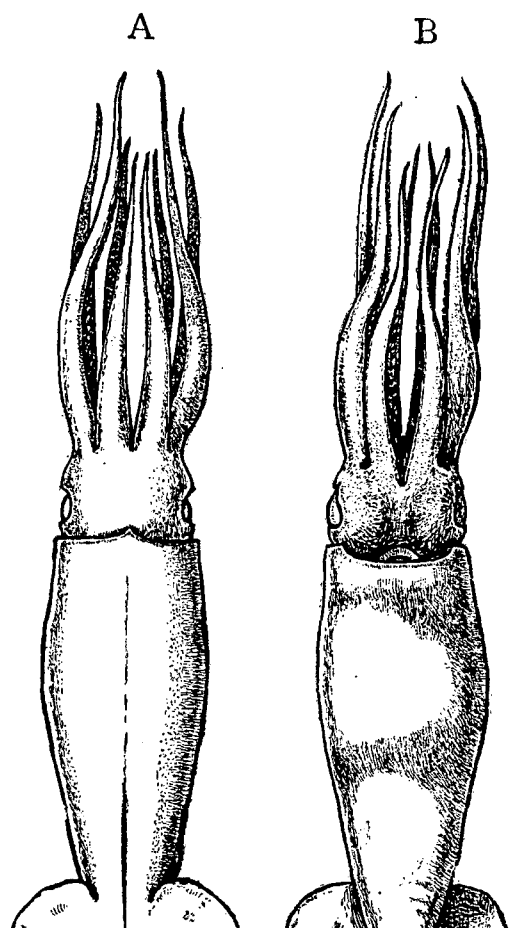
Gonatopsis octopedatus Sasaki 1920.

(Pl. XXII, fig 23; textfigs. 131, 132).

Gonatopsis octopedatus, Sasaki 1920, p. 198, pl. xxvi, fig. 5.

This specis is based upon a single specimen found in the "Albatross" collection.

Consistency rather soft and more or less choroidal as in *Gonatus*. Body elongated, thrice as long as broad, widest one-third down from the anterior end, then tapering off caudad (textfig. 131). Anterior margin of mantle forms a small pointed projection in the mid-dorsal part. Ventral part of the margin broadly but shallowly emarginated crescentwise, showing a point on either side of the emargination. Fins terminal, both together of kidney-shape, deeply indented at the anterior attachment, forming no points anywhere. Total breadth of fins far exceeding their length, which is in turn about three and a half times the length of body.



Textfig. 131.

Gonatopsis octopedatus. A. Dorsal view; natural size. B. Ventral view; natural size.

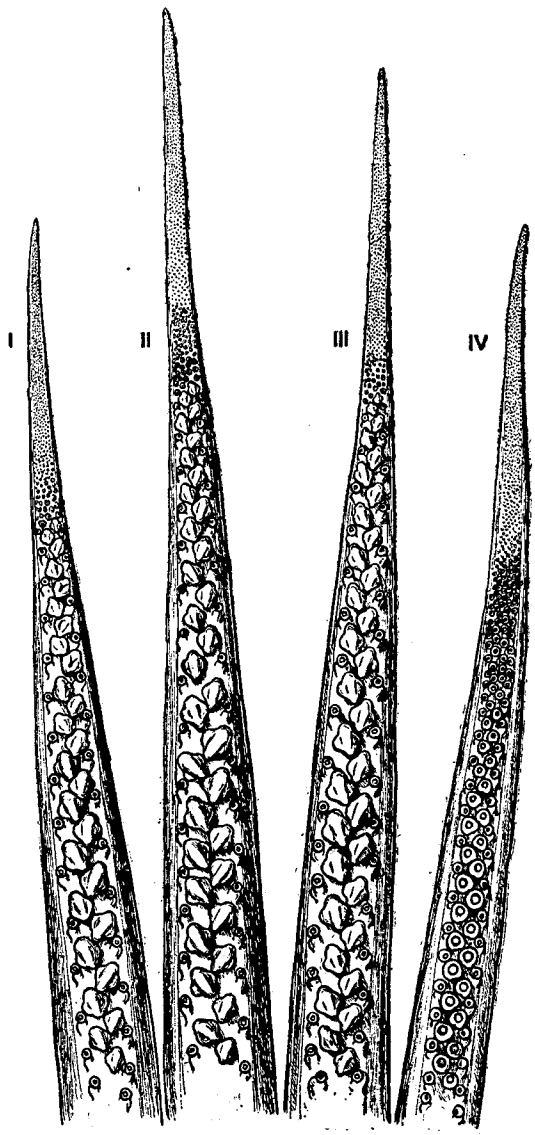
Head a little narrower than body. Eyeball large. Eye opening wide, vertically elongated, their anterior margin forming a deep sinus a little below the middle. Neck strongly constricted, but its anterior boundary fold is quite obliterated. Funnel groove ill-defined. Olfactory crest indiscernible owing to its ill-preservation, but tuberculus olfactorius is well preserved and nipple-shaped. Nuchal cartilage elongated, with nearly equal breadth throughout, but slightly widening cephalad, where its breadth is about one-fourth the length.

Funnel short but broad, sunk deep in mantle cavity. Funnel organ situated on the posterior part of funnel wall, consisting of a $\wedge$- shaped dorsal pad and two oval ventral pads as in *Gonatus*. Funnel cartilage elongated, nearly lanceolate but a bit curved, a little narrower than a quarter of its own length, and a little longer than half the length of funnel, more sharpened anteriorly than posteriorly; longitudinal groove narrow throughout, extending the whole length of the cartilage, marked off by a stronger ridge ventrally than dorsally. Mantle cartilage ridge-like, linear, a little longer than the funnel cartilage (Pl. XXII, fig. 23).

Arms slender, subequal; the formula of length being $2>3>1\fallingdotseq4$, the longest being five-sixths the length of body. All comparrtively rapidly taper two-thirds up the length; the remaining distal one-third somewhat characteristically attenuated but terminating in a comparatively blunt extremity. Neither keel nor web developed except on the ventral arms, where a narrow web is discernible along the dorso-lateral aspect.

Armatures of arms composed of hooks and suckers, but on the ventral arms they are represented by the suckers only (textfig. 132). On each arm the armatures are quadriserial two-thirds up the length, whence they form 6-serial arrangement, which soon develops into an 8-serial arrangement, and then a 10-to 12-serial as the suckers are proceeded distad; at the same time they undergo a change into minute long-pedicelled nearly uniform suckers. On the first three pairs of arms, the marginal two series of the quadriserial armatures at the proximal part are also composed of small long-pedicelled suckers, while the median two series consist of large hooks. The largest of these are

in the seventh or eighth transverse row, their length equaling five or six times the diameter of the marginal suckers in the same transverse row. Horny ring of suckers smooth but may be provided with protuberances of quite irregular shape.



Textfig. 132.

Gonatus octopedatus. Inner aspect of arms : ×8/3.

As has been noticed above, the ventral arms have suckers only. Of these suckers those of the two central series at the proximal part, which correspond to the hooks of the other arms, are not so large as these hooks, their diameter being only twice that of the marginal suckers. The horny ring of those central suckers is also smooth as that of the marginal ones.

Tentacles absent, but represented by round-headed indistinct tubercles held between third and fourth pairs of arms.

Buccal membrane relatively broad, with seven marginal projections; internal surface finely wrinkled. Outer lip thin; inner lip thick and papillate as usual.

Radula not examined.

Measurements.

Length, total	130 mm	
Dorsal length of body	65 „	
Ventral length of body	61 „	
Maximum breadth of body ...	22 „	
Length of head...	10 „	
Breadth of head	19 „	
Length of fins	19 „	
Total breadth of fins...	30 „	
	Left	Right
Length of first arms... ...	45 mm.	45 mm.
„ „ second arms ...	55 „	55 „
„ „ third arms ...	52 „	52 „
„ „ fourth arm ...	45 „	53 „

Remarks.—The internal genital organs of the specimen referred to show still primitive condition so that it seems to attain a further development in size.

Type locality.—Near Cape Patience, Sakhalin I. 440 fms.

Type.—In the U. S. Nat. Mus.

Gonatopsis borealis Sasaki, 1923.

Japanese name: Tako-ika (Octopod-squid).

(Pl. XXX, figs. 3–6.)

Gonatopsis borealis, Sasaki, 1923b, pp. 203–207, 1 textfig.

Skin rather soft to the touch, quite smooth, lacking ridges; neither photophore, nor special mark noticeable, the whole surface being evenly dark reddish brown in colour. Mantle cylindrical in its anterior half, whence it tapers caudad at first rather rapidly but gradually afterwards, thus finally forming an attenuated end-part; breadth a little less than a quarter of the length. Fins taken together sagittate in outline; length, about ⅔ their total breadth, and about ²/₅ the length of mantle.

Head as broad as, or even a little broader than, the mantle opening. Neck strongly constricted, separated from head by a circular ridge which ventrally, sharply marks off the funnel excavation from the general surface of the head. No special fold in the excavation. Eye relatively large, with a wide opening which has a deep sinus in front. Olfactory crest composed of four longitudinal folds, two dorsalmost of which are joined together posteriorly so as to enclose a bay in front. The ventralmost, the smallest, forming a part of each lateral boundary ridge of funnel excavation. Funnel of moderate size, with a relatively large semilunar valve, which projects into the anterior opening of the funnel. Funnel organ formed of one ∧-shaped dorsal, and two elliptical ventral, pads; the former extends a distance on the funnel depressors. Funnel cartilage lanceolate, more or less tapering forwards, with a rounded free posterior margin; lacking socket longitudinally furrowed, becoming regularly wider and shallower posteriad; plug of mantle slenderly wedge-shaped, evenly widening and flattening caudad. Nuchal cartilage panduriform, ⅓ as broad as long, with a gentle constriction near the middle of the length.

Arms equal in length, but the third slightly longer than the others and about $^{2}/_{5}$ the length of mantle; quadrangular in section except the third which is flattened dorso-ventrally. Carinations and protective membranes both of ordinary development. Armatures quadriserial throughout, consisting of suckers and hooks. In the three dorsal pairs, their four proximal rows consist of only suckers, there follow 16–20 transverse rows of two small suckers of outer side and two large hooks of inner side each; beyond these, there are 9–12 transverse rows of minute suckers at the extremity. In the fourth pair of arms, the armatures are only suckers in about 35–45 transverse rows. Suckers of all arms have about 10 triangular teeth at the distal half of the horny ring. No arm is modified into hectocotylus. Grasping arms absent.

Buccal membrane with seven suckerless projections of margin, each suspended by a strong rib. Radular teeth in 7 longitudinal rows; the median tricuspid, the first lateral bicuspid, and the others unicuspid.

Gladius slenderly lanceolate or rather penniform, about $^{1}/_{11}$ as broad as long, posteriorly with a hollow end-cone, the dorsal wall of which comprises ⅓–16 the length of the rachis. No cartilaginous incrustation on the ventral side, nor similar spine at the end.

Principal anatomical characteristics were also examined: Nervous tentacularis is quite obliterated. The superficial division of the cerebral ganglion is very distinct unlike Hoyle's illustration of *Gonatus fabricii*. It resembles somewhat that of *Stenoteuthis bartrami* described by Richter, but lobus basalis posterior is far larger than in that species. The structure of the cephalic cartilage shows again a marked dissimilarity from that given by Hoyle in *G. fabricii*. It is roughly saddle-shaped, with the concavity turning forward, and when seen from above, its outline is nearly shield-shape, and not horseshoe-shape; the lateral margin of each side is not so markedly expanded as to form any special wing-like lobe.

Remarks.—The present species is related to *Genatopsis octopedatus*, but differs from this as is tabulated below.

	Gonatopsis borealis.	*G. octopedatus.*
Fins taken together:	sagittate;	reniform.
Nuchal locking cartilage:	panduriform, with a gentle constriction near the middle;	elongate, very slightly widening cephalad.
Ventral locking cartilage of mantle:	slenderly wedge-shaped, widening caudad;	linear, narrow throughout.
Arm formula:	3>1=2=4;	2>3>1=4.
Length of longest arm:	⅔ the length of body;	$^{5}/_{6}$ the length of body.
Suckers on the extremity of arms:	in 4 longitudinal rows;	in 8–12 longitudinal rows.

Numerous specimens have been brought to my hand, eight of which obtained by the late Mr. G. Yamaguchi and Mr. K. Shirai were specially in good preservation and ranged from 140 mm. to 255 mm. in the length of mantle.

Specimens examined have mostly come from Kushiro, but also include those from Nemuro and Tokachi. These localities cover the eastern coast of Hokkaido strongly influenced by a cold current "Oyashiwo". Most of the specimens of Yamaguch and Shirai referred to were caught on 28th July, 15–30 miles off Kushiro, where the water temperature showed 11.6°C at the surface and 2.5°C at the depth of 20 fathoms below the surface. According to the reports of Mr. Yamaguchi and Mr. Shirai who made researches on the habits of the species by angling from the experimental boat "Sangyo-maru" 1922, whenever *Ommastrephes sloani pacificus* was abundant, *Gonatopsis borealis* was very rare, the reverse being also the case, or when both the species happened to be met with at the some region of the sea, the latter species was always angled from a much greater depth than the former. All these facts point to the conclusion that *Gonatopsis borealis* is physiologically adapted to a much colder water than *Ommastrephes sloani pacificus*, which generally inhabits water than above 10°C in temperature.

Type locality.—Kushiro, Hokkaido.

Type.—In Hokkaido Imp. Univ.

Family **Ommastrephidae** Gill, 1871.

Onychoteuthidae, Gray 1849, pp. 36, 45, (pars).—Adams, H. & A. 1858, p. 30.

Ommastrephini, Steenstrup 1861, p. 1. (fide Jatta); 1880a, p. 89.—Joubin 1895a, p. 31; 1900, p. 44.—Hoyle 1886b, pp. 32, 162 (pars).

Ommastrephidae, Gill 1871, p. 1.—Tryon 1879, pp. 102, 175.—Verrill 1882, p. 290 (pars).—Carus J. V. 1890, p. 455 (pars).—Jatta 1896, p. 55 (pars).—Hoyle 1886b, p. 32 (pars); 1904b, pp. 3, 15.—Berry 1914a, p. 338.

Ommatostrephidae, Pfeffer 1900, p. 176, 1908a, p. 87; 1912, p. 368.—Chun 1910, p. 201.

Body hemifusiform, 4–6 times as long as broad. Fins terminal, shorter than half the length of body; both together more or less sagittate. Eye-openings distinctly sinuated in the anterior margin. Neck marked off from head by a sharp edge; devoid of nuchal folds. Olfactory crest on either side, composed of three conspicuous longitudinal folds connected with a transverse fold behind. Nuchal cartilage more or less spatulate, with the expanded part in front. Funnel groove well-defined, often forming foveola or other folds at the anterior part. Funnel adductors bipaired: one pair of submedian, and the other pair of lateral position. Funnel cartilage with a ⊥-shaped groove, sometimes joined with mantle cartilage by a ligament. Buccal membrane with seven ribs projecting beyond the margin; connectives also seven, attached to third arm on its ventral side, and to the remaining arms on their dorsal side. Arms of moderate size, and of nearly equal length, but sometimes may be more or less unequal in length; webs and carinations well developed on their aboral surfaces; protective membranes of moderate breadth but some may be very broad. Armatures of arms composed of biserial suckers. Tentacular armatures also represented by suckers only; those on the carpus, in 2–4 series, without forming well-defined fixing apparatus; on the hand, in four series, of which the central two series consist of large suckers, and the marginal two series of small suckers. On the distal portion of tentacles the suckers are equally small, and form 4–8 series. Gladius very thin, chiefly consisting of the rhachis except in a short posterior part where the vanes are a little developed, forming a slender lanceola with a short endcone. Hectocotylization in one or both of the ventral arms. Photogenic organs of very rare occurrance.

Key to the subfamilies and genera herein described.

(A) Foveola of funnel groove may have longitudinal folds internally, but invariably devoid of pocket-like folds externally .....Subfam. *Ommastrephinae.*

(a) Hand-suckers of tentacles equipped with numerous, long, sharp teeth alternating with small plate-like supplementary teeth .....Genus *Ommastrephes.*

(B) Foveola provided with longitudinal folds internally and also pocket-like folds externally; central hand-suckers of tentacles equipped with a large tooth in each of the four corners.....Subfam. *Stenoteuthinae.*

(b) Funnel cartilages not jointed with manle cartilages.

(α) Large roundish photophores regularly distributed on belly .....Genus *Hyaloteuthis.*

(β) No photophores on belly .....Genus *Stenoteuthis.*

(c) Funnel cartilages connected with mantle cartilages.....Genus *Symplectoteuthis.*

Sabfamily **Ommastrephinae** Carus, 1890.

Subfam. *Ommestrephidae* (pars), Gill 1871 p. 1.—Hoyle 1886b, p. 32.
Ommastrephinae, Carus 1890, p. 445 (pars).—Jatta 1896, p. 62 (pars).—Pfeffer 1912, p. 433.

Body without keel-like ridge on the posterior part of belly. Foveola formed in funnel groove, often showing longitudinal folds internally but invariably devoid of pocket-like folds externally. Funnel cartilage with a ⊥-shaped groove, the vertical part of which is nearly straight or slightly curves ventrad; antero-dorsal margin flat. Interspace between buccal membrane and arm-bases forms a circular groove hung over by connectives. Tentacular suckers quadriserial except on the carpus where they may be bi- or triserial; no distinct fixing tubercles on the carpus. Hectocotylization in the ventral arm of the right side or of the left side as well.

Genus **Ommastrephes** d'Orbigny, 1835.

Ommastrephes, d'Orb. 1835, p. 45 (pars); in Fér. et d'Orb. 1839, p. 341 (pars); 1845, p. 412 (pars).—Gray 1849, p. 57 (pars).—Verany 1851, p. 88 (pars).—Adams, H. & A. p. 34 (pars).—Tryon 1879, p. 175 (pars).—Verrill 1882, p. 291 (pars).—Carus 1890, p. 445 (pars).—Hoyle 1902a, p. 198; 1904b, p, 15; 1910a, p. 411.—Berry 1912a, p. 297; 1914a, p. 338.
Todarodes, Steenstrup 1880a, p. 83.—Hoyle 1886b, p. 34.—Jatta 1896, p. 80.
Ommatostrephes, Pfeffer 1900, pp. 178, 179; 1908a, pp. 89, 92; 1912, p. 438.
Ornithoteuthis, Okada 1927, p. 13.

Horny ring of larger arm-suckers equipped with 7–21 triangular teeth on the distal margin. Sucker-bearing part of tentacles extensive, often occupying more than half their total length. Their suckers quadriserial except on the carpus where they may be bi- or triserial; those on hand, equipped with numerous sharp conical teeth which ordinarily alternate with small, plate-like supplementary teeth. No distinct fixing pads present on carpus. Lanceola of gladius narrow and short, comprising only 1/6–1/4 of the entire length. Hectocotylization in right ventral arm. An oval organ probably of photogenic nature may occur in mantle cavity.

In the Japanese waters this genus has been represented by two species: *O. sloani pacificus*, and *O. volatilis*. The latter is easily distinguished from the former by the slender body, by the stronger carinations of arms and by the smooth foveola of the funnel groove.

Type.—Loligo sagittata Lamarck, 1799.

Ommastrephes sloani pacificus (Steenstrup, 1880).

Japanese name: Surume-ika (Tokyo; Sagami Prov.; Settsu Prov.; Hokkaido); Maika (Kaga Prov.; Etchu Prov.; Hokkaido).

(Pl. XXIII, figs. 1–6; textfigs. 133, 134.)

Todarodes pacificus, Steenstrup 1880a, pp. 83, 90, etc. 1 fig.—Hoyle 1886b, pp. 34, 163, pl. xxviii, figs. 1–5.—Joubin 1897b, p. 103.
Ommastrephes pacificus, Appellöf 1886, p. 35, pl. iii, figs. 8–10.
Ommatostrephes sagittatus var. *sloani?*, Wülker 1910, p. 21.

Ommastrephes sloani, Berry 1912b, p. 433, pl. vi, fig. 4.
Ommatostrephes sloani pacificus, Pfeffer 1912, p. 456, pl. xxxiv, figs. 3–6.
Ommastrephes sloani pacificus, Ishikawa 1913, p. 585; 4 figs.—Sasaki 1916, p. 103; 1920, p. 199.

A large number of specimens of graduated sizes are found in the collections at my disposal. Their mantle-length ranges up to about 30 cm., that of the mature specimens measuring over about 24 cm.

Adult.—Consistency firm and muscular. Mantle slenderly subfusiform, usually slightly narrowed behind its free margin, broadest near the middle, then tapering off caudad. The taper is at first gradual, becoming rapid near the anterior origin of fins, but as it proceeds further backwards it restores to the former gradual condition. Dorsal part of mantle margin pointed in the middle but without forming any lobe projecting forwards; the ventral part widely and shallowly excavated, showing distinct angular projections on sides of the excavation. Fins taken together broadly sagittate, with rounded lateral angles and distinct anterior auriculations; antero-lateral edges convex; postero-lateral edges also convex in the anterior parts, but distinctly concave in the posterior. Length of fins decidedly less than their combined maximum breadth, which exists far in front of the centre, equaling three-sevenths of the entire length of mantle.

Head as wide as mantle opening, its length measuring 1/8–1/6 that of body. Eyeball of moderate size. Eye-opening with a deep sinus in the anterior margin a little below the middle. Funnel groove deep, distinctly marked off by a horseshoe-shaped ridge, the anterior part engraved to a foveola which has 7–9 longitudinal folds internally but shows no pocket-like folds externally.

Neck distinctly separated from head by a sharp edge, forming an angle of about 120° at nape. Olfactory crest on either side, composed of three longitudinal folds extending from the anterior boundary edge of the neck to its posterior transverse fold. Of the three folds, the dorsalmost is the broadest, the middle the shortest, and the ventralmost the longest. The former two folds are semilunar in shape, running right backwards, while the last is more or less ridge-like, traversing dorsad and caudad. Nuchal cartilage spatulate, the anterior two-fifths expanded into a rounded rhombus, breadth of which is about twice that of the stalk-like portion (Pl. XXIII, fig. 1). The posterior quarter of the cartilage extends beyond the posterior margin of collar-like portion of funnel.

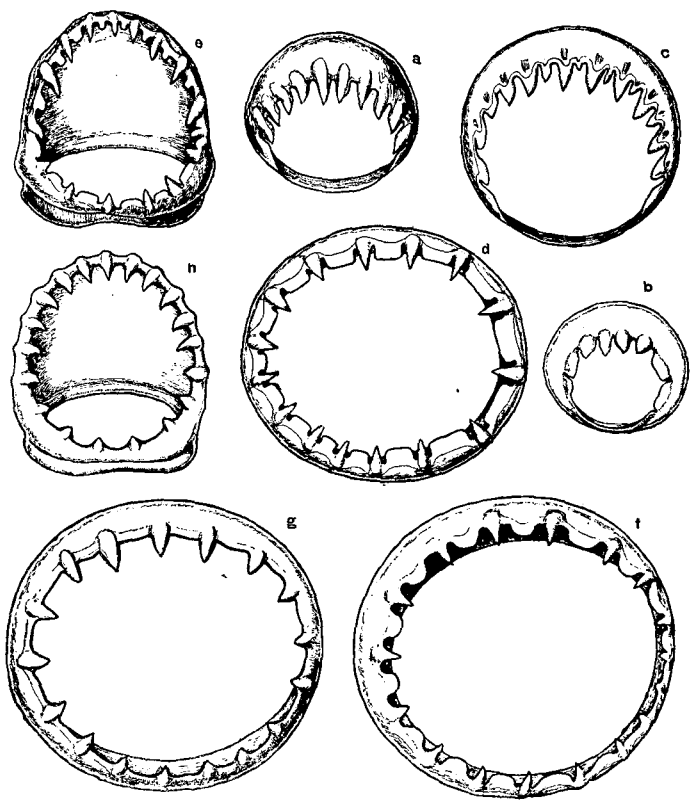
Funnel conical, broad but short, extending at most half way to the ventral interbrachial space. Funnel adductors distinctly bipaired, one pair being on its back and the other pair on its sides. Funnel cartilage triangular, its maximum breadth a little more than a half of the length, which is in turn less than half the length of funnel. Locking groove of the cartilage ⊥-shaped, the anterior end curving slightly ventrad. Mantle cartilage composed of a ⊥-shaped ridge; the vertical rhamus being club-shaped; with the expanded part posteriorly and not bifid in the anterior end.

Arms subequal, the formula of lengthe being $3 \fallingdotseq 2 > 1 > 4$, or $3 \fallingdotseq 2 > 1 \fallingdotseq 4$; the longest about half as long as mantle. All keeled or webbed on back, the carination is especially marked in the third arms, so that these are considerably flattened from side to side, while the remaining arms are quadrangular and prismatic. Protective membranes of arms, of uniform breadth, being as broad as the suckers are long.

Arm-suckers biserial throughout; their size somewhat variable in the different arms, being largest on the lateral arms. Horny rings dentate on the distal as well as on the lateral margins; the teeth being strong, sharply pointed, numbering 6–14. On the whole the teeth of the distal suckers are more slender than those of the proximal suckers; in each horny ring those of the lateral margin are much broader than those of the distal margin (textfig. 133a, b). In larger suckers sometimes there may occur several minute plate-like supplementary teeth alternating with the ordinary ones (textfig. 133c). Papillate area of the rings extendively occupied by numerous radiating ridges.

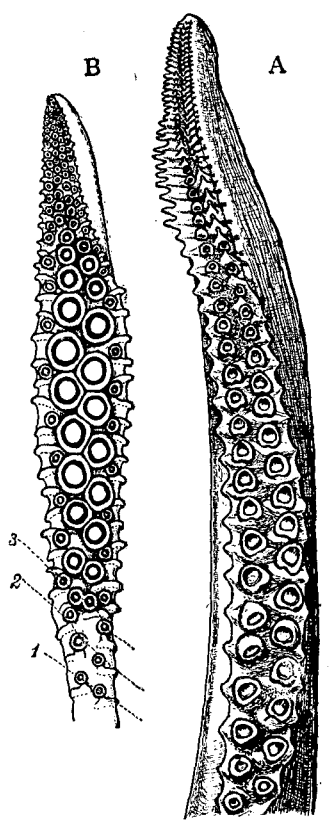
Right ventral arm hectocotylized in the distal one-third, a little shorter than left ventral arm. The dorsal side of the aboral surface protrudes into a marked web, which is broad even at the extremity so that the latter is flattened into the shape of a spatula. The dorsal side of the oral surface has about fourteen normal suckers in a series at the proximal two-thirds, succeeded by five or six

small suckers; then follow about 32 conical paillae, which are on the hectocotylized part. The bases of the papillae are transversely elongated, regularly arranging themselves in a series like the teeth of a comb. The protective membrane of this side shows a parallel development with the suckers: it is of normal breadth up to the fourteenth sucker, and then becomes narrower, disappearing at the place where the papillae begin to occur, On the ventral side of the same surface, the proximal fourteen suckers are normal as on the dorsal side, but the smaller suckers adjacent to these are more numerous, numbering about twelve and diminishing in size distad. These smaller suckers are succeeded by twelve or thirteen conical paillae smaller than those of the dorsal side; the distalmost of the papillae situated far proximally to the extreme tip of the arm. The protective membrane of this side is of normal breadth up to the vicinity of the twentieth sucker, whence it becomes very broad, the margin forming a rough serration. But on the extremity the breadth is again somewhat reduced though the serration of the margin is still conspicuous (textfig. 134A).



Textfig. 133.

Ommastrephes sloani pacificus. Horny rings showing individual variation. a. Horny ring from largest sucker of third arm of male specimen with mantle 17 cm. long.; ×10. b. From basalmost sucker of same specimen; ×15. c. From sucker of seventh row of third arm of male specimen with mantle 22 cm. long; ×10. d. From largest tentacular sucker of specimen of 20 cm. mantle length; ×6. e. From largest marginal sucker of tentacle of same specimen; ×21, f. From largest tentacular sucker of specimen of 25.5 cm. mantle length; ×4. g. From largest tentacular sucker of specimen of 28 cm. mantle length; ×4. h. From largest marginal sucker of same specimen; ×10.



Textfig. 134.

Ommastrephes sloani pacificus. A. Hectocotylized arm of specimen of 255 mm. mantle length; ×4/3. B. Right tentacular club of same specimen; ×4/3.

Tentacles of good preservation about one and a half times the length of arms. Stem as thick as arms, four-sided, flattened laterally; oral surface flat or even slightly concave, marked off by narrow membranes on sides. Club lanceolate in contour, triangular in section, keeled on back and bordered with costate protective membranes on sides (textfig. 134B). On the carpus occur 8–11, small nearly uniform suckers arranged in three or four rows of 1, 3, 4 or 2, 3, 4 or 3, 4, 4 or 1, 2, 3, 4 in each. On the hand, the suckers number about 40 forming four series, those of the inner two series are much larger than those of the outer two series, especially large

are the central ten, which are about three times the diameter of the marginal suckers. On the distal portion the suckers number about 70 and are also quadriserial, gradually diminishing in size distad. Horny ring of the hand suckers equipped with two kinds of teeth i. e. ordinary and supplementary, arranged alternately. The ordinary teeth strong, conical, numbering 15–20; of uniform length in the suckers of the two central series, and of unequal length in those of the marginal series. The supplementary teeth small, plate-like, quadrangular or semilunar, frequently much shorter than wide; occasionally exceedingly shortened so as to reveal themselves as feebly arcuate interspaces between ordinary teeth (textfig. 133d-h). Horny rings of the distal suckers dentate almost as in the marginal hand suckers, but the supplementary teeth are less developed and the ordinary teeth much stronger. Papillate area of all the rings constructed almost as in arm-suckers.

Buccal membrane provided with seven ribs projecting beyond the margin. Counectives also seven, but the dorsalmost deeply bifurcate; fastened to the dorsal side of arms save for that the third arm are connected on the ventral side. The membrane has 12–15 pairs of pinnate seminal receptacles which are arranged in a ring at regular intervals.

Gladius very slender, conisting of little but rhachis, which regularly and gradually tapers caudad; narrow vanes exist posteriorly, forming a small lanceola with an end-cone. The vanes comprises 1/6–1/5 of the entire length of the gladius.

Color in life, reddish brown, deeper above than below. Mantle of preserved specimens tinged with a deep purple along the mid-dorsal region.

Measurements.

Sex	♀	♂
Dorsal length of mantle	280 mm.	255 mm.
Breadth of body	70 ,,	45 ,,
Length of head	42 ,,	32 ,,
Breadth of head	60 ,,	43 ,,
Length of fins	120 ,,	107 ,,
Total breadth of fins	175 ,,	128 ,,
Length of first arms	Left 138 mm. Right 138 mm.	Left 97 mm. Right 97 mm.
,, ,, second arms	150 ,, 150 ,,	125 ,, 120 ,,
,, ,, third arms	144 ,, 144 ,,	118 ,, 115 ,,
,, ,, fourth arms	135 ,, 135 ,,	97 ,, 95 ,,
,, ,, tentacles	200 ,, 200 ,,	135 ,, 140 ,,
,, ,, clubs	135 ,, 135 ,,	85 ,, 90 ,,
Diameter of largest sucker of arms	4.2 mm.	4.0 mm.
,, ,, ,, ,, tentancles	8.0 ,,	7.3 ,,

Larval stage.—Body very short, compared with that of adult, the breadth going only about 2 in the length in specimens of about 9 mm. mantle-length and about 3 in those of about 25 mm. mantle length; the posterior part regularly tapering caudad, without forming attenuated extremity. Fins very small as is usual in the case of so immature individuals, and their combined outline in younger larvae is a Cassinian oval forming a notch in front and also behind (Pl. XXIII, fig. 2). A cuspidation appears in the middle of the posterior notch when the larva becomes large enough as to have a mantle-length of about 11 mm. (Pl. XXIII, fig. 3), and then the Cassinean oval undergoes a gradual change into a broadly cordate contour; at the same time the size becomes proportionately larger as shown in the following table (Pl. XXIII, fig. 5).—

No. of larva	i	ii	iii	iv	v	vi
Length of mantle	9.2 mm.	10.3 mm.	11.5 mm.	15 mm.	18.2 mm.	22 mm.
Proportion of total breadth of fins to their length	2.83 ,,	2.22 ,,	2.21 ,,	—	1.80 ,,	1.57 ,,
Proportion of mantle-length to fin-breadth	7.875 ,,	5.72 ,,	6.05 ,,	5.32 ,,	4.43 ,,	4.68 ,,

Head comparatively large, distinctly constricted in front as well as behind. In larvae with the mantle-length less than about 9 mm. the eye-balls are naked for the greater part. The eye-lid developes when the larva attains a mantle-length of 10 mm. or more and then a pear-shaped eye-opening is formed, bearing the pointed end in front. The latter is narrowed into a sinus some while later when the opening becomes narrower in respect to the size of head. No olfactory crest developed. Funnel groove and its foveola become distinct when the larva attains a mantle-length of 20 mm.

Arms much shorter than in adult, especially short are the ventral pair; the longest is the lateral pair; in larvae with mantle-length less than 10 mm., it measures less than one-fifth the length of body.

In younger larvae the tentacles are shorter than the first three pairs of arms, bearing quadriserial suckers on the distal part; on the remaining proximal part are found soft papillae closely set in two series, which will develop into suckers later (Pl. XXIII, fig. 4). The fully-formed tentacles are found in larvae with mantle-length more than 20 mm. when the suckers have complete horny rings (Pl. XXIII, fig. 6). These horny rings are equipped with a small number of conical ordinary teeth on the distal margin, but the supplementary teeth are not yet discernible in any rings. Papillate area of the rings differs from that of the adult in that the radiated ridges are far shorter while the papillate facetts are comparatively more numerous.

Chromatophores relatively large, their number and distribution being constant in each respective stage of development.

Remarks.—This species is the commonest oegopsid cuttle fish in Japan and has a wide distribution extending from Kiushiu to Hokkaido on both the Japan Sea and the Pacific Ocean sides. It is especially abundant in the districts washed by the Tsugaru Current, where the fishing season continues from summer to the early part of winter. The swimming layer of the squid in the daytime ranges 50–100 fms. below the sea surface, and the water temperature best suited to the squid is 15°C, which temperature is also suitable for rearing the eggs. The hectocotylization becomes first distinct in the individual with about 10 cm. mantle-length and is fully formed when it attains a mantle-length of about 23 cm.

To this species is commonly referrable the common dried cuttlefish known under the name of "Nibanzurume" in commerce, but the same-named one from Okinawa consists of *Symplectoteuthis oualaniensis*.

Locality.—Atkeshi, Hokkaido (Sasaki); Sapporo market, Hok. (!); Takashima, Hok. (Sasaki); Oshoro, Hok. (Sasaki); off Shakotan, Hok. (Sasaki); off Ohama-misaki, Hok. (Sasaki); Obuyu-saki, Hok. (Sasaki); Todohokke, Hok. (Wülker); Tomakomai, Iburi Prov. (Berry); Hakodate market (Sasaki); Hakodate (Steenstrup; Berry); Azamushi, Aomori Pref. (!); Niigata (Ishikawa); Ebisu, Sado Is. (Albotross!); Etchu Prov. (Ishikawa, Sasaki); Usetsu, Noto Peninsula (Sasaki); near Oki Is. (Albatross!); Cape Clonard, Korea, 70 fms. (Albatross!); Iwami Prov. (Ishikawa); Misaki (Sasaki; Wülker; Berry; Ishikawa); Tôkyo (Berry); Tôkyo market (!); Miye (Ishikawa); Inland Sea (Hoyle); Tosa Prov. (!); Nagasaki (Appellöf); Japan (Pfeffer); Vladivostok (Joubin).

Ommastrephes volatilis Sasaki, 1915.

(Pl. XXIII, figs. 7–11; textfigs. 135, 136.)

Ommastrephes volatilis, Sasaki 1915a, p. 138, pl. iv, figs. 1–6; textfig. 3; 1916, p. 105.
Ornithoteuthis luminosa, Okada 1927, pp. 13–15.

Five specimens of this species are found in the collections at my disposal. Their mantle-length ranges 148–113 mm., the largest being a male.

Body elongate-conical, broadest anteriorly, then regularly tapering to a slender end-part; length about six-times the maximum breadth (Pl. XXIII, fig. 7). Mantle margin even, forming neither projection nor emargination. Fins nearly terminal; the combined outline sagittate, showing distinct auriculation anteriorly, and slenderly projecting posteriad in an acuminate extremity; lateral angles pointed; antero-lateral edges convex; postero-lateral edges markedly concave. Length of fins far longer than their combined breadth and about the length of mantle.

Head as broad as mantle-opening. Eye-opening distinctly sinuated in the anterior margin a little below its middle; the dorsal margin of the sinuation markedly thickened. Funnel groove fairly deep, clearly marked off by a sharp fold, which line is a pointed arch; postero-lateral portions of the fold projecting in such a manner as to keep the funnel laterally. Anterior portion of the groove engraved into a distinct foveola delimited posteriorly by a conspicuous crescent-shaped fold. No longitudinal folds discernible inside the foveola nor any pocket-like ones outside it.

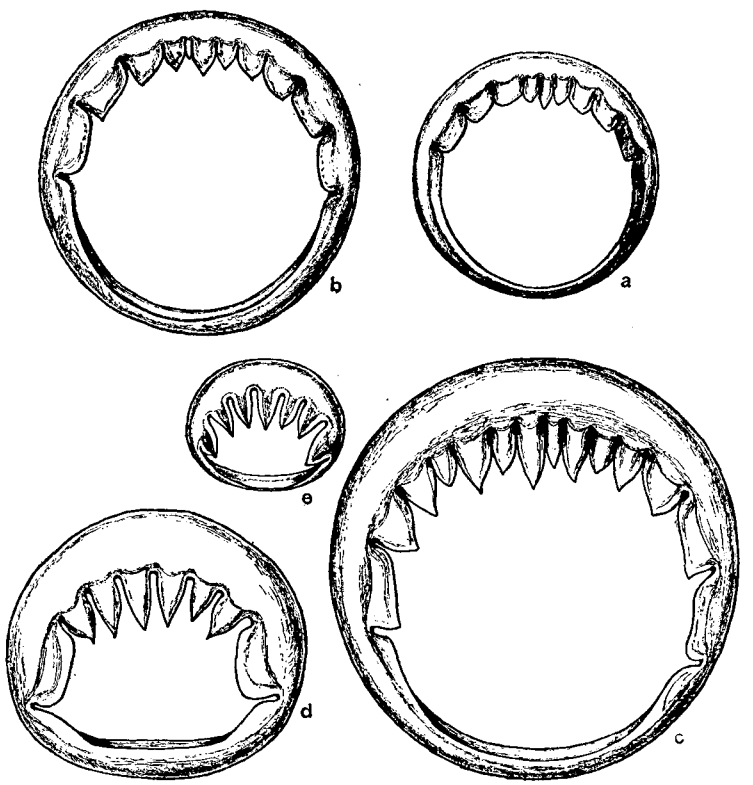
Neck marked off from head by a sharp edge, which line forms a prominent angle at the nape. Nuchal cartilage spatulate, the posterior two-thirds being stalk-like; the remaining anterior part expanded into an oval blade about twice as broad as the stalk-like portion (Pl. XXIII, fig. 8). Olfactory crest on either side composed of three longitudinal folds extending from the anterior boundary edge of neck to its posterior transverse fold. Of the three longitudinal folds, the ventralmost is the longest and more or less ridge-like; while the dorsalmost is the broadest and semilunar in shape.

Funnel short, somewhat narrowing forwards and extending to the centre of head (Pl. XXIII, fig. 9). Adductors bipaired; one pair attached on sides of the funnel, and the other pair, on its dorsal side. From between the latter pair invariably projects a round-headed muscular protuberance of unknown function. Internal valve broad, quadrangular. Funnel organ conspicuous, consisting of a slender $\wedge$-shaped dorsal pad and two elliptical ventral pads; the latter measure about two-thirds the length of the former (Pl. XXIII, fig. 10). Funnel cartilage triangular, measuring 9 mm. by 15 mm. in a female of 208 mm. mantle-length. Locking groove of the cartilage $\perp$-shaped, the vertical part slightly curving ventrad at the anterior end. Mantle cartilage almost as in *O. sloani pacificus*.

Arms long, stout, subequal in length, the formula being $3 \fallingdotseq 2 > 4 > 1$, or $3 \fallingdotseq 2 > 1 > 4$; the longest pair a little longer than half the length of mantle. First pair thinnest; four-sided at the proximal half, whence it becomes nearly circular in section but provided with a faint keel on back. Second pair four-sided throughout, provided along the ventral outer edge with a web as broad as its own protective membranes. Third pair compressed from side to side, markedly keeled on back along its whole length, the keel attaining a maximum breadth much greater than thickness of the arms. Fourth pair four-sided throughout, the aboral surface marked off by sharp edges on sides, the dorsal edge developed into a broad web widening proximad. Protective membranes of all arms broad and distinctly trabeculate, as broad as, or even broader than, the suckers are long. They are equal in breadth on the ventral arms while on the remaining arms the ventral one is somewhat broader than the dorsal.

Arm-suckers globular in shape, with a notch at the distal margin of the opeing; biserial throughout. In a male of 213 mm. mantle-length, 75 are counted on the ventral arm, 50 or more on each of the remaining arms. They are not sexually dimorphic, but vary in size in the different arms, those of the lateral arms being much larger than those of the remaining arms. Horny ring dentate on the distal margin, the proximal margin projecting a little into a narrow crescentic border with smooth edge. The dentation differs in different suckers. In the proximal suckers of each arm, there are several close-set teeth, of which the central 1–3 are much more slender and more sharply pointed than the rest (textfig. 135a, b). In the largest suckers, which are usually in the seventh or eighth transverse row of the lateral arms, the teeth number 10–14, all are sharply pointed, closely set, long and short alternately, and 2 or 3 outermost on either side are by far the broadest and obliquely pointed (textfig. 135c). In the suckers more distal than the tenth transverse row on each arm, the teeth are separated, numbering less than seven, slenderly triangular, sharply pointed except the outermost on either, this being very broad and more or less quadrangular (textfig. 135d, e).

Hectocotylization in right ventral arms (Pl. XXIII, fig. 11). On the proximal two-thirds of this arm, there occur seventeen pairs of suckers biserial as usual. Of these suckers, the first seven pairs are quite normal, while the remaining are reduced in size. Of these small suckers, those of the ventral series are again far more reduced in size than of the dorsal series, especially reduced are the three from the second to the fourth in the series, these being papilliform and not of sucker-like appearance. On the remaining distal one-third of the arm the suckers are represented by 25 pairs of their peduncular bases swollen into transverse, membranes papillae. These papillae are closely set in two series almost in the shape of a comb but those of the ventral series are much smaller than those of the dorsal, bearing a minute rudimentary suckers on their tip. The two series of the papillae are separated by a longitudinal membranous ridge running along the median line of this part. The dorsal protective membrane is of normal development up to where the most distal two or three suckers are situated; hereafter it becomes suddenly narrower and then finally disappears. The ventral protective membrane is of normal breadth for the proximal one-third. In the remaining parts the membrane is broad, very thick, and of fleshy consistency. These characteristics are especially marked on the proximal half of this part. The outer surface of the latter region of the arm has a complex sculpture consisting of fourteen pits and numerous grooves and ridges. The pits are arranged in a longitudinal series and each sends out two transverse grooves towards the margin of the protective membrane. The ridges lie on the side opposite to the groove, and anastomose with one another, bordering numerous small, roundish or ovalish depressions.



Textfig. 135.

Ommastrephes volatilis. Horny rings from suckers of third arm of male specimen with mantle 213 mm. long. a. From one of suckers of second row; ×ca. 13. b. From one of suckers of fifth row ×ca. 13. c. From one of suckers of ninth row; ×ca. 13. d. From one of suckers of twelfth row; ×ca. 13. e. From one of suckers of eighteenth row; ×20.

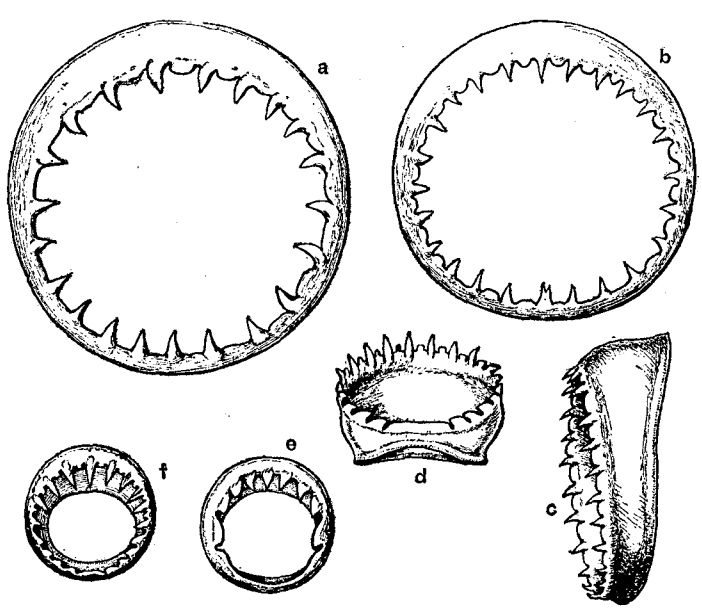
Tentacles about equal to mantle in length. Stem as thick as ventral arm, compressed laterally, four-sided, with a flat oral surface. Club expanded, lanceolate in contour; triangular in section, occupying about one-third of the entire length of tentacles; protective membranes distinctly trabeculate, as broad as the length of suckers. Dorsal web fairly well developed; it is broadest at the distal part of club and narrowed at its middle, but beyond this point it becomes again wider, continuing in this condition towards the base of the stem along its aboral surface.

Tentacular suckers divisible into those of the carpus, hand, and distal portion though all standing in serial continuations. Carpal suckers small, numbering about twelve, sparsely arranged in two or or three series, the proximalmost situated about in the middle of the whole length of tentacles. Hand-suckers in four series of 7–9 each; unequal, those of the central two series being far larger than those of the marginal series; especially large are four or five in the middle of each of the central series, these being about three times the diameter of the marginal suckers. Suckers of distal portion, in four series

of 27 each, smaller than marginal hand-suckers; a little unequal, being larger in the more ventral series than in the more dorsal series. Larger hand-suckers shaped nearly like a pail, wide and deep. Distal and marginal suckers basin shaped, decidedly shallower than broad, with expanded aperture, and with the bottom raised up to the level of the aperture. Horny ring of the central hand-suckers dentate on the whole margin, the teeth consisting of ordinary and accessory teeth in alternate arrangement; the former teeth long, sharply pointed, slightly curved; the latter teeth small, plate-like, semilunar or subquadrangular, less numerous in the larger suckers and quite obliterated in the largest sucker (textfig. 136a-c). The following gives the number of these teeth in the hand-suckers in respect to four of the specimens examined, the diameters of the suckers and the mantle-lengths of the specimens being also appended:—

No. of specimen	i			ii			iii			iv		
Mantle-length	148 mm.			152 mm.			208 mm.			313 mm.		
Teeth of largest sucker of tentacles	Ordinary teeth	Accessory teeth	Diameter of sucker	Ordinary teeth	Accessory teeth	Diameter	Ordinary teeth	Accessory teeth	Diameter	Ordinary teeth	Accessory teeth	Diameter
Suckers of I row	—	—	—	14	11	1.5 mm.	13	10	1.8 mm.	17	16	2.2 mm.
,, ,, II ,,	20	18	3.5 mm.	17	17	2.3 ,,	21	20	3.2 ,,	21	15	3.8 ,,
,, ,, III ,,	21	12	4 ,,	18	Ca. 15	3 ,,	21	13	4 5 ,,	19	10	5.2 ,,
,, ,, IV ,,	20	a few	5 ,,	19	Ca. 7	4 ,,	21	0	5.5 ,,	21	Ca. 6	5.5 ,,
,, ,, V ,,	22	a few	5.2 ,,	19	a few	4 ,,	22	0	5.5 ,,	21	0	6 ,,
,, ,, VI ,,	22	a few	5 ,,	—	—	—	29	Ca. 5	5 ,,	23	0	5.6 ,,
,, ,, VII ,,	25	a few	4 ,,	—	—	—	24	20	3.5 ,,	23	0	5 ,,
,, ,, VIII ,,	23	Ca. 7	2.8 ,,							22	Ca. 7	3.2 ,,

The horny ring in the marginal hand-suckers as well as in the suckers of the distal portion of the club has two kinds of teeth as in the preceding suckers (textfig. 136, d, f). The ordinary teeth number 18–21, and the accessory teeth less than ten, which are found only on the distal margin of the ring although the former teeth are set on the whole margin. The ordinary teeth in each ring are unequal; those of the proximal margin are broad, oblique, triangular and closely set, while those of the distal margin are slender, conical and separated. In the carpal suckers the ring has, on the distal ½–⅔ of the circumference, 8–12 conical teeth of one-kind; but those of the more proximal part are broader, triangular, oblique, and more closely set (textfig. 136e).



Textfig. 136.

Ommastrephes volatilis. Horny rings from tentacular suckers of male specimen of 213 mm. mantle length a. From largest hand-sucker; ×ca. 3. b. From distalmost hand-sucker, ×10. c. From one of hand-suckers of third transverse row; ×ca. 3. d. From mid-marginal hand-sucker (ventral view); ×ca. 3. e. From one of carpal suckers; ×ca. 13. f. From one of suckers of fourth row on distal portion of club; ×ca. 13.

Buccal membrane with seven ribs markedly projecting beyond the margin. Connectives also seven, fastened to the third arm on its ventral side, and to the remaining arms on their dorsal side. Dorsalmost pair of aquiferous porse opposite to dorsol arms, continuous with each other, overhung by the dorsalmost of the connectives.

Radula composed of seven series of somewhat short teeth. Median teeth tricuspid; inner lateral teeth bicuspid; both outer lateral and marginal teeth unicuspid. The inner lateral teeth about as long as the median; the marginal a little longer than the combined length of the two succeeding median.

Gladius shorter than mantle; its greater parts consisting of little but rhachis, which very gradually and regularly tapers posteriad. Vanes developed in the posterior parts as a small lanceola which is one-fifth as long as the whole gladius, terminating in a short hollow end-cone.

On the ventral surface of the rectum occurs a longitudinal elliptical photophorescent organ*). The organ has a silverish lustre, bordered with a shining pink margin. It measures in the male of 213 mm. mantle length, 7 mm. in length, 4 mm., in breadth and 1.5 mm. in depth. It gives out a canal, which runs posteriad along the median line of the ventral integument of visceral mass, nearly reaching its posterior end. The canal is a little dilated midway along its length, forming a space for passing the ventral mantle artery.

The principal measurements are given in one of my previous paper (1915, p. 148).

Remarks.—Though Okada establishes the genus *Ornithoteuthis* for this species I like to retain it still in the genus *Ommastrephes*. My explanation follows: (1) the luminous organ appears very frequently not to be connected with the generic relationship, and (2) other chracteristics given by him do not seem to be weighty enough to separate the species from other Ommastrephes, in comparison with generic differences hitherto.

The species is very rare in occurrance and has no economic value. It is known among fishermen by the name of "Tobi-ika", so called on account of its flying above the sea at times.

Type locality.—Off Atami, Sagami Bay (Sasaki).

Type.—In Tôkyo Imp. Univ.

Subfamily **Stenoteuthinae** Pfeffer, 1912.

Stenoteuthinae Pfeffer 1912, p. 441.—Massy 1925, p. 206.

Connections between buccal membrane and arm-bases as in the Ommastrephinae. Funnel groove shows a distinct foveola bearing longitudinal folds inside and pocket-like folds outside. Funnel cartilages with a ridge-like eminence in the anterodorsal margin so that the vertical part of the ⊥-shaped groove markedly curves ventrad in the anterior parts. Mantle cartilages with a distinct supplementary ridge on one or either side of the anterior end. Larger arm-suckers with unequal conical teeth on the whole edge of the horny ring. One to four fixing tubercles present on carpus. Photophores may occur on belly.

Genus **Hyaloteuthis** Gray, 1849.

Subgen. *Hyaloteuthis*, Gray 1849 p. 63.—Tryon 1879, p. 181.

Hyaloteuthis, Pfeffer 1900, p. 178; 1912, p. 461.—Hoyle 1904b, p. 16 (pars); 1910a, p. 410.

Nineteen round photophores regularly scattered on belly; two indistinct ones on the ventral surface of head near the bases of ventral arms. Funnel cartilages not joined with mantle cartilages. Ventral protective membranes of third arms about as broad as their thickness. Second arms furnished with one or two specially enlarged suckers a little below the middle. Horny ring of arm-suckers equipped on the distal margin, with conical teeth long and short alternately. The ring of largest tentacular suckers, smooth; some of smaller ones equipped with unequal conical teeth. Carpus with a single distinct fixing tubercle. Right ventral arm hectocotylized.

Type.—*Sepia pelagica* Bosc 1802.

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*) According to Okada (1927), besides the intrapallial organ stated above, there is found a linear luminous tissue which extends from the base of the tentacle to its tip along the central tentacular nerve, and which he names "*Bandes photogènes intra-tentaculaires*".

Hyaloteuthis pelagicus (Bosc, 1802).

(Pl. XXXIII, figs. 12–18; textfigs. 137, 138.)

Sepia pelagicus, Bosc 1802, p. 46; pl. i, figs. 1, 2 (fide d'Orb.)

Ommastrephes pelagicus, a'Orb. et Fér, 1839, p. 348; Calmar pl. xviii, figs. 1, 2; Ommastrephes pl. i, figs. 17, 18.—Steenstrup 1880a, pp. 76, 80, 84, 39; 1 fig.—Posselt 1890, pp. 338, 342, 344.

Ommastrephes (*Hyaloteuthis*) *pelagicus*, Gray 1849, p. 63.—Tryon 1879, p. 181; pl. lxxxii, fig. 374.

Hyaloteuthis pelagicus, Pfeffer 1900, p. 180; 1912, p. 462, pl. xlii, figs. 5–8.

Two specimens of this rare cuttlefish have been available to my examination. The larger of these is very well preserved presenting numerous characters hitherto not made out, and far larger than any individual so far measured.

Texture muscular; surface smooth, firm to the touch. Mantle slender, subfusiform, gently narrowed just behind the free margin, a little expanded, near the middle, then tapering to a slender end-part (Pl. XXIII, fig. 12). Maximum breadth of mantle about one-fifth its length. Anterior margin truncate but with faint mid-dorsal projection and also faint ventral emargination. Fins terminal both together widely sagittate, lateral angles pointed, anteaior ends auriculate, antero-lateral edges slightly convex, postero-lateral edges nearly straight. Length of fins equal to $^3/_5$ or $^2/_3$ of their total breadth and 30% or 37% of the mantle-length.

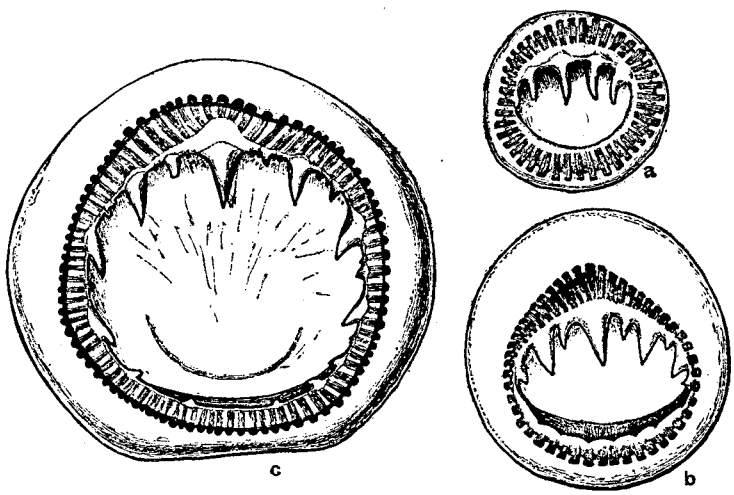
Head as broad as mantle margin, squarish in section. Eye-opening pentagonal, their diameter a little greater than one-third the depth of head; their anterior margin distinctly sinuated a little below the middle, the sinus directed towards between the third and fourth arms, but curving ventrad at the end. Funnel groove deep, distinctly marked off by a sharp horseshoe-shaped ridge, of which the posterior ends project into conspicuous folds, holding the funnel laterally. Foveola formed in the funnel groove, delimited posteriorly by a very narrow delicate membrane, provided with seven distinct longitudinal folds internally, and two or three delicate pocket-like folds externally on either side. Olfactory crest composed of three longitudinal folds, which are connected with a transverse fold behind (Pl. XXIII, fig. 13). Of the three folds, the dorsal two are broad, semicular, running right posteriad, and the other, slender, traversing dorsad and posteriad. None of these folds with distinct tuberculus olfactorius. Neck marked off from head by a sharp edge, which line forms an angle of 150° at the nape, and a low arch between every two succeeding crest-folds as well as between the nape and the dorsalmost crest-fold. No nuchal folds present. Nuchal cartilage spalutate, in outline, traversed by a strong median ridge with a marked groove along its crest (Pl. XXIII, fig. 14). Stalk-like portion of the cartilage composed of little but the said median ridge, extending posteriorly far beyond the collar-like portion of funnel. Blade-like portion roughly rhomboidal, but narrowly extending posteriad along both sides of the median ridge, half down the entire length of gladius; its maximum breadth a little greater than twice that of the stalk-like portion; this measure in turn equaling one-eighth the entire length of gladius.

Funnel short, extending to the centre of head. Adductors bipaired, one pair being submedian, and the other, lateral in position. Internal valve large, appearing from the anterior opening of funnel. Funnel organ conspicuous, consisting of a $\wedge$-shaped dorsal and two elliptical ventral pads. There is a white elliptical body of unknown function on each of the posterior ends of the dorsal pad and also on the corresponding end of the left ventral pad (Pl. XXIII, fig. 15). Funnel cartilage triangular, about half as long as funnel; angles all round; base-line convex; sides slightly concave (Pl. XXIII, figs. 16, 17). Locking groove of the cartilage $\perp$-shaped; the vertical part becoming narrower and shallower anteriad, and markedly curving ventrad at the end. Antero-dorsal margin of the cartilage a little depressed, separated by a longitudinal ridge from the vertical part of the groove. Mantle cartilage $\perp$-shaped as the groove of the preceding cartilage; the vertical part clavate as usual, but its anterior end being a little flattened, with a distinct supplementary ridge on its dorsal side (Pl. XXIII, fig. 18).

Buccal membrane with seven ribs and processes; connectives also seven, fastened to arms on

their dorsal side, except to the third arms, which are joined on the ventral side. A pore present opposite to each of the dorsal arms, continuous with its fellow of the opposite side below the overhanging dorsal counective.

Arms subequal, the formula of length being $4>2>3>1$; the longest slightly longer than one-third the length of mantle. All regularly tapering towards the extremities; four-sided except third arms, which are compressed from side to side, and keeled on back. Web developed on the ventral side of second arms, and also on the dorsal side of fourth arms. Protective membranes on first and fourth arms, similarly narrow, but unequally broad on lateral arms, especially on the the ventral lateral pair, where the ventral membrane is about three times the breadth of the dorsal.



Textfig. 137.

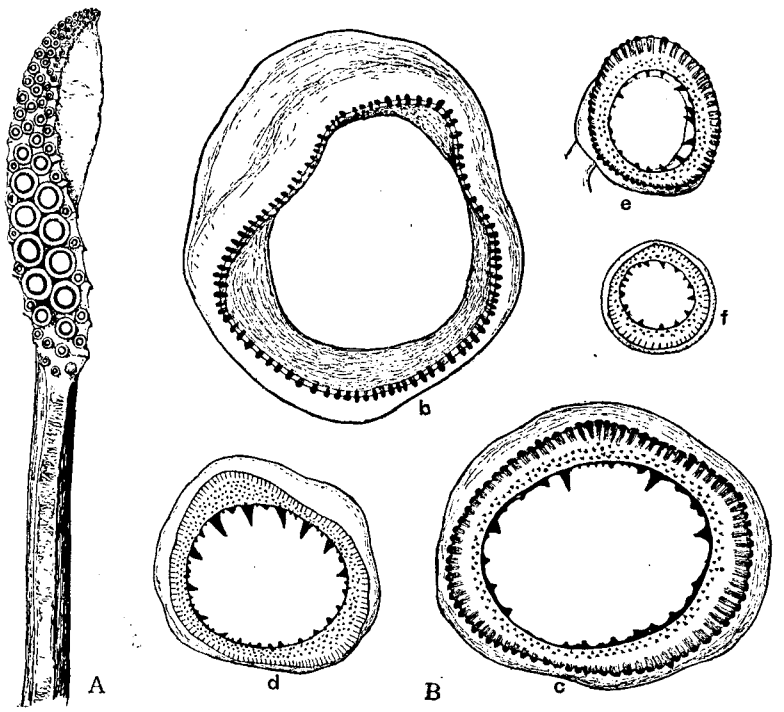
Hyaloteuthis pelagicus. a. One of distal suckers of third arm; ×36.
b. One of proximal suckers of same arm; ×36.
c. Largest sucker of second arm; ×36.

Arm-suckers biserial, numbering about eighteen pairs on each arm; somewhat unequal in size, those of third to seventh pair being much larger than the others. The unequalness of suckers specially marked in the ventral series of the second arms, where the fourth sucker is about twice as large in diameter as the corespondding sucker of the dorsal series. Individual suckers hemispherical; aperture broad, with a notch at the distal margin. Horny ring of middle and distal suckers equipped with 5–7, long, acute, separate teeth on the distal margin, the proximal margin being entire (textflg. 137a). But in proximal suckers the ring is dentate on the whole margin though the teeth of the proximal half are very short and number only 3–5; the teeth of the distal half resemble those of the preceding suckers except that they are unequal in length (textfig. 137b). In the largest suckers of the second arms the ring is dentate in a manner a little different from that mentioned above: the distalmost teeth is by far the strongest, and there are in each interdental space 1–4 minute unequal supplementary teeth (textfig. 137c). Papillate area broad, with innumerable horny radiating ridges instead of the usual papillae; the ridges somewhat projecting beyond the margin so that this shows a denticulation all around.

Tentacles one and half times of arms in length. Stem a little thinner than arms, compressed laterally, four-sided; the oral surface of the distal half a little concave, bordered with distinct ridges, which are continuous with the protective membranes of club. Dorsal margin of the aboral surface of stem projects into a low keel which is joined on to the dorsal web of the club distally. Club slightly expanded, half as long as stem, bordered with broad trabeculate protective membranes on sides; dorsal web well developed in the distal two-thirds (textfig. 138A).

Tentacular suckers (textfig. 138B) roughly divisible into those of carpus, hand, and distal part. carpal suckers minute, in two transverse rows, the formula of arrangement being 1, 3 or 2, 3 or 2, 4; a round distinct fixing tubercle present among them, situated on the dorsal side of carpus. Hand suckers in four series of six each, those of the median two series being far larger than thosc of the marginal two series; especially large are the middle four pairs, which are about five times as large in diameter as the suckers of the marginal series. Suckers of the distal part in four series of 12–14 each; small, subequal, but those of the more ventral series always a little larger than those of the more dorsal. Horny ring of smaller suckers dentate on the whole margin, the teeth being numerous, conical, separate, far longer on the distal margin than on the proximal. The ring of medium-sized suckers dentate almost as in the preceding ring but provided with 2–4 small, unequal, conical, acces-

sory teeth in each interdental space of the distal margin. The ring of still larger suckers irregularly and weakly dentate; some of largest suckers, smooth, without teeth. In these largest suckers the papillate area of the ring is quite smooth, without papillae or radiating ridges except on the margin, where short ridges are found, projecting beyond the extreme edge so that this shows a denticulation as in the arm-suckers. In the smaller suckers the papillate area consists of numerous papillate facetts in 2–4 series, bordered with a comparatively narrow, radiated margin. In the medium-sized suckers, the papillate facetts and the radiated margin both are well developed, dividing the area equally between themselves.



Textfig. 135.

Hyaloteuthis pelagicus. A. Tentacle; ×4. B. Tentacular suckers; their positions are referred to in A.; ×36.

Coloration as in *Ommastrephes*, countless reddish brown chromatophores thickly crowded along the mid-dorsal region of mantle. Belly decorated with nineteen, relatively large, roundish, pearly photophores regularly distributed as depicted in Pl. XXIII, fig. 12. The photophores in the larger specimen referred to measure about 2.3 mm. in diameter. On the head there is found near the base of each ventral arm a round pale patch, which seems to be of the same nature as the photophores of the mantle.

Measurements of specimens examined.

	Specimen from off Satsuma	Specimen from Bonin Is.
Dorsal length of mantle	71 mm.	50 mm.
Ventral length of mantle	69 ,,	47 ,,
Breadth of mantle	14.5 ,,	18 ,,
,, ,, head	13 ,,	14 ,,
Length of fins	26 ,,	15 ,,
Total bseadth of fins	39 ,,	25 ,,
Length of first arms	Left 22 mm. Right 22 mm.	—
,, ,, second arms	25 ,, 24.5 ,,	—
,, ,, third arms	23 ,, 23 ,,	—
,, ,, fourth arms	26 ,, 26 ,,	23 ,,
,, ,, tentacles	38 ,, 35 ,,	—
,, ,, clubs	13 ,, 12 ,,	—

Remarks.—The two specimens referred to are the first representatives of the species in the North Pacific. They agree so well in every particular with d'Orbigny's and Pfeffer's descriptions that there can be no doubt that they belong to the same species.

Localiiy.—Atlantic (d'Orb.; Steenstrup); St. Lucia (Gray); South Pacific (Pfeffer); off Satsuma Prov. (!); Bonin Is. (!).

Genus **Stenoteuthis** Verrill, 1880.

Ommastrephes, d'Orb. in d'Orb. et Fér. 1839, p. 341 (pars).—Adams, H. & A. 1858, p. 30 (pars). —Tryon 1879, p. 175 (pars).—Jatta 1896, p. 63.

Ommatostrephes, Steenstrup 1880a, p. 89.

Stenoteuthis, Verrill 1880a, p. 289; 1882, p. 309.—Steenstrup 1881a, p. 3.—Pfeffer 1900, pp. 179, 180; 1908a, p. 89; 1912, p. 464.—Hoyle 1904b, p. 16; 1910a, p. 413.

Fins taken together, transversally rhomboidal, but arriculate at the anterior end. Funnel cartilage not fastened to mantle cartilage; the former with intrabasal protuberance and anterior marginal ridge. Each arm with a normal extremity and 50–60 suckers. Ventral protective membrane very broad, especially on lateral arms, where the membrane is about four times the thickness of the arms. Large hand-suckers of tentacles with four conspicuous teeth in the four corners of the horny ring, and far smaller teeth between every two of the former teeth. No photophores present on belly. Hectocotylization in right ventral arm.

Type.—*Architeuthis megaptera* Verrill 1878.

Stenoteuthis bartrami (Lesueur, 1821).

Japanese name: Baka-ika (Tokyo; Sagami Prov.); Aka-ika (Sagami Prov.); Medama (Tokyo market).

(Pl. I, fig. 8; Pl. XXIV, figs. 1–3; textfig. 139.)

Loligo bartrami, Lesueur 1821, p. 90; pl. ii, figs. 1a-f (fide Pfeffer).

Ommastrephes bartrami, d'Orb. in d'Orb. et Fér. 1839, p. 347; Loligo pl. ii; pl. xxi, fig. 5; Ommastrephes pl. ii, figs. 11, 12.—Gray 1849, p. 62.—Tryon 1879, p. 180, pl. lxxx, figs. 361, 362.—Steenstrup 1880a, pp. 78, 80, etc. 2 figs.—Hoyle 1886b, p. 32.—Carus 1899, p. 446.—Jatta 1896, p. 64, pl. x, figs. 1–16; textfigs. 8 (p. 10), 12 (p. 11), 19 (p. 36).

Stenoteuthis bartrami, Verrill 1880b, p. 223; 1882, p. 322.—Pfeffer 1900, p. 180; 1908a, p. 97, figs. 109–114; 1912, p. 465, pls. xxxv, xxxvi; pl. xxxix, figs. 1, 2.—Massy 1925, p. 206 —Grimpe 1925, p. 85, figs. 30, 32, 33.—Okada 1927, p. 96.

Stenoteuthis pteropus, Verrill 1880b, p. 228, pl. xxvii, figs. 7, 7a; pl. xxxvi, figs. 5–9.—Verrill 1882, p. 317; pl. vii, fig. 2; pl. xvii, figs. 3–9.—Hoyle 1908, p. 132.

? Ommastrephes sagittatus, McIntosh 1907, p. 172, pl. vii.

Several specimens of this species have come under my observation, measuring up to 415 mm. The largest of these was caught by myself at Sagami Bay when it was still active.

Texture fleshy; surface smooth and firm to the touch. Mantle subfusiform, very gradually widening from the anterior margin to the middle where it is broadest, and then it tapers caudad (Pl. I, fig. 8). The taper is at first gradual and becomes rapid from the vicinity of the anterior origin of fins but soon restored into the former gradual condition, forming a slender end-part, which is keeled on the ventral surfece. Maximum breadth of body 25–28% of its length. Anterior margin of mantle with an emargination in the ventral parts and a projection in the dorsal both being faint and grddually fading off laterad. Fins terminal, both together of a transverse lozenge, but their anterior ends auriculate; antero-lateral edges thin, convex; postero-lateral edges thick, straight; lateral angles somewhat acute; posterior angle 100°–115°. Combined breadth of fins equal to about one and two-thirds of their length which is in turn less than half the length of mantle.

Head a little narrower than mantle, and ¼–⅕ as long as the latter. Eye large. Eye-opening wide, distinct; sinuated at the anterior margin slightly below the middle, the sinus directed towards between the third and fourth arms. Funnel groove fairly deep, very well defined by a sharply edged horseshoe-

shaped border, the posterior parts of which are thrown into marked folds holding the funnel laterally. A distinct foveola is formed in the groove, marked off posteriorly by a crescentic fold, and bears 7–9, deep conspicuous longitudinal folds internally. About five thin pocket-like folds are seen in the groove on either side of the foveola.

Neck separated from head by a sharp edge, forming an angle of 60°–70° at the nape. Nuchal cartilage spatulate, traversed longitudinally by a strong ridge with a marked groove along its crest; the blade-like portion situated anteriorly, of roughly pyriform contour, occupying about a quarter of the entire length but extending more posteriorly for a distance as a narrow continuation (Pl. XXIV, fig. 1). Olfactory crest composed of three longitudinal folds, extending from the anterior boundary edge of neck to its posterior transverse fold, which is very long, often extending nearly to the nuchal cartilage. Of the three longitudinal folds, the dorsal two are short but broad and semilunar, running right posteriad, while the ventralmost is narrow and more or less ridge-like, running obliquely dorsad and posteriad.

Funnel comparatively broad, slightly narrowed at the distal end, fully extending to the centre of head. Funnel organ conspicuous; its dorsal pad nicely $\wedge$-shaped, beginning from about halfway along the distance from anus to the distal end of funnel, and extending caudad to the level of the posterior ends of funnel cartilages. Ventral pads of the organ slenderly ovate, blunter anteriorly than posteriorly, broader than the rhami of the preceding pad. Funnel cartilages large, triangular, slightly longer than two-thirds of their own breadth, and about half as long as funnel; antero-dorsal margin markedly thickened into a prominent ridge. Locking groove of the cartilage $\perp$-shaped; its vertical part is narrowed anteriorly, strongly curves ventrad at the same time, and has a small minute intrabasal protuberance near the posterior end. Mantle cartilage clearly marked, consisting of a conspicuous clavate ridge and a sharply edged horizontal ridge. The former expanded posteriorly, and strongly curving ventral anteriorly, where is found a distinct supplemenlary ridge on the dorsal side.

Arms nearly subequal, but the dorsal pair a little shorter than others, which are of equal length and about half as long as mantle. Thid pair compressed from side to side, strongly carinated on back, while the remaining arms are more or less quadrangular in section, one or both sides of their aboral surface developed into webs. Such a web is very broad on the ventral side of second arms and on the dorsal side of fourth arms. Protective membranes of fourth arms alike narrower than the length of suckers. In the remaining arms, the membrane of the dorsal sides as narrow as that of the fourth arms, but that of the ventral side is very broad; especially broad is that of the third arms. The latter membrane is about four times the length of suckers and its ribs do not extend to the free margin but a few at base.

Arm-suckers biserial, of zigzag arrangement; nearly uniform in size in the different arms, but those of lateral arms being a little larger than those of the rest. In a male of 240 mm. mantle length, they number about 24 pairs on each dorsal arm, about 27 pairs on each lateral arm and about 32 pairs on each ventral arm. The largest suckers on each arm form about pairs from the fourth to the seventh, situated a little proximad compared with Pfeffer's description (1912).

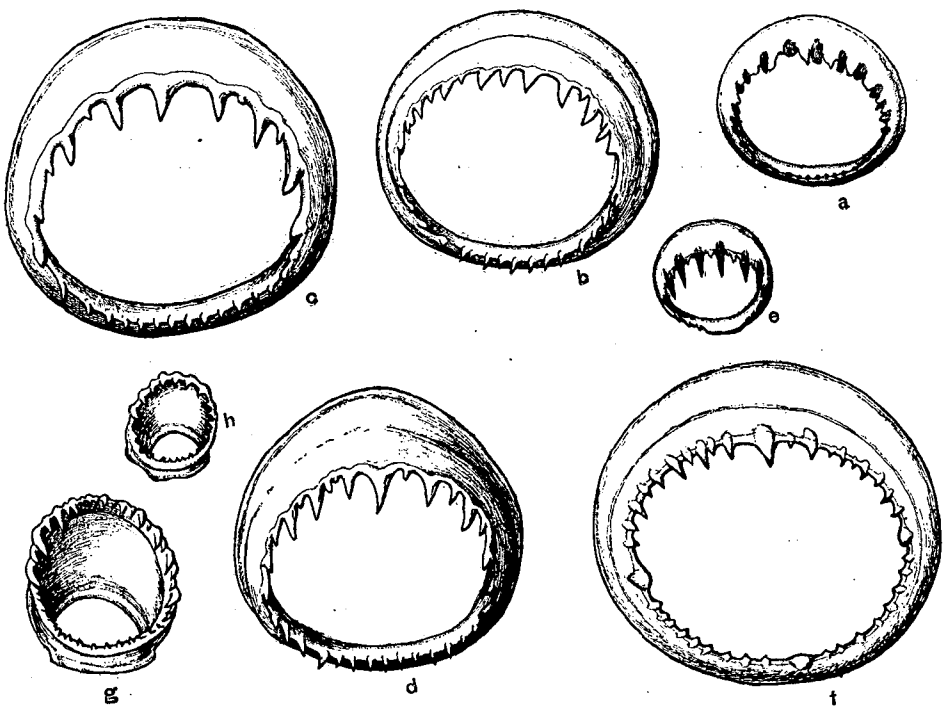
Horny ring of suckers more proximal than about the tenth row, dentate on the whole margin, though the teeth of the distal margin are far longer than those of the proximal. The teeth in the basal suckers are relatively broad, mostly triangular, numbering about 20; there are usually short plate-like supplementary teeth (textfig. 139a). In the suckers from third to tenth row, the teeth number 24–28, bent crescentwise, sharply pointed, markedly unequal, and may be classified roughly into three or four orders according to their length, these roughly alternating with one another (textfig. 139, b-d). In the distal suckers, the horny ring dentates only at the distal two-thirds, the teeth numbering 9–12, and slenderly conical, nearly uniform but sometimes minute supplementary teeth may occur in the interdental spaces (textfig. 139e).

Hectocotylization at the extremity of right ventral arm (Pl. XXIV, fig. 2). In the male of 240 mm. mantle length, the arm has about twenty pairs of suckers at the proximal part; the distalmost pair reaching the point $^{6}/_{7}$–$^{5}/_{6}$ up the length. Beyond this point, the oral surface of the arm is quite naked and smooth, marked off laterally by ridge-like continuations of the protective membranes. The

suckers of this arm are of normal size up to the eighth pair and then become abnormally reduced in size distally.

Tentacles variable in length; but in good preservation being ⅓–½ as long as mantle. Stems about as thick as arms, four-sided, compressed a little laterally; oral surface flat, sharply marked off on sides by continuations of the protective membranes. Clubs lanceolate, as long as stem (Pl. XXIV, fig. 3). Dorsal web broad in the distal half of clubs, coninued as a narrow aboral fold towards the base of stems. Protective membranes of clubs well developed; especially so is that of the dorsal side, which extends on to the stem about three-fourth down its length, even where it is as broad as, or even broader than on the club, and trabeculate as well.

Tentacular suckers may be distinguished into those of carpus, hand, and distal portion although all are in serial continuations. Carpal suckers about eight in number, small, sparsely set in three transverse rows, accompanied by two (rarely three) nipple-like fixing protuberances on the ventral part. Hand-suckers in four series of about ten each; those of the central two series are far larger than those of the marginal two series. Distal suckers in 20–29 transverse rows, quadriserial; those



Textfig. 139.

Stenoteuthis bartrami. Horny rings of arm-suckers (a-e), and tentacular suckers (f-h). a. From sucker of first row of second arm; ×17. b. From sucker of third row of same arm; ×17, c. From sucker of sixth row of sam arm, ×17. d. From sucker of tenth row of same arm; ×17. e. From sucker of twentieth row of same arm; ×17. f. From largest hand sucker of tentacle; ×12. g. From marginal hand-suckes of same; ×17. h. From distal tentacular sucker; ×17.

of the more dorsal series are smaller than those of the more ventral. Horny ring in central hand-suckers, with four specially strong conical teeth regularly distributed in the four quadrants and 7–10 smaller and slenderer ones between every two of the former (textfig. 139f). The smaller teeth on the distal edge of the ring are supplemented in their interspaces by some still shorter, mostly blunt, and thin teeth. Horny ring, in the marginal hand-suckers as well as in the distal suckers, with 21–24 recurved teeth on the whole edge, the teeth of the distal edge being far longer than those of the proximal, and regularly alternating with minute accessory teeth, which are nearly caniniform, being slenderer and sharper than the corresponding teeth of the larger hand-suckers (textfig. 139g,h). Horny ring in smaller carpal suckers with 20–30 conical teeth regularly distributed on the whole

edge; the teeth bordered on sides with thin blade-like margins, which are frequently separated from the main part of the teeth into independent thin short accessory teeth.

Buccal membrane broad, thick, with seven ribs projecting beyond the margin; connectives also seven, fastened to arms on the dorsal side except to the third arms, which are connected on the ventral side. A pore present opposite each dorsal arm. Spermatophores fixed around mouth as in *Ommastrephes*.

Anal valve large, slender, triangular. Nidamental glands in the largest female examined measures 180 mm. in length and 60 mm. in maximum breadth.

Gradius very slender, its greater part consisting of rhachis, which gradually and regularly tapers caudad. Vanes developed in the posterior part of the gladius as a lanceola, the length of which is about five times the combined breadth, and a little greater than one-sixth the entire length of gladius. Posteriorly the margins of the lanceola curve ventrad, forming a hollow end-cone.

Color in life vivid malon; deeper in the dorsal surface which is tinged with a violet.

Measurements of largest Specimen Examined.

Dorsal length of mantle	415 mm.	
Ventral length of mantle	400 „	
Maximum breadth of mantle	104 „	
Length of head	75 „	
Breadth of head	89 „	
Length of fins	183 „	
Total breadth of fins	300 „	
	Left	Right
Length of first arms	180 mm.	180 mm.
„ „ second arms	200 „	200 „
„ „ third arms	190 „	190 „
„ „ fourth arms	195 „	190 „
„ „ tentacles	260 „	260 „
„ „ clubs	140 „	135 „
Diameter of largest sucker of first arm	6 mm.	
„ „ „ „ „ second arm	7 „	
„ „ „ „ „ third arm	7 „	
„ „ „ „ „ fourth arm	6 „	
„ „ „ „ „ tentacles	9 „	

Remarks.—The principal differences of the specimens referred to from Pfeffer's description (1912) are that the accessory teeth in the distal and marginal suckers of tentacles are almost sharply pointed, caniniform, instead of being crenelated, and that the axial part of the gladius gradually and uniformly tapers caudad, without forming any sudden narrowing, as described and figured by Pfeffer.

The species is not rare in Sagami Bay, and we often see the fish-nets fixed along that coast. It is also brought into the fish markets of Tôkyo, but is by no means of such economic value as *O. sloani pacificus*.

Distribution.—Very wide, and of nearly cosmopolitan as listed by Pfeffer (1912) and others. Localities known in Japan: Sagami Bay (Pfeffer; Sasaki); Tsugaru Strait (!); north of the Bonin Is. (!), Formosa (!).

Genus **Symplectoteuthis** Pfeffer, 1900.

Symplectoteuthis, Pfeffer 1900, pp. 178, 180; 1912, p. 501.—Hoyle 1904b, pp. 16, 20; 1910, p. 411.—Berry 1914a, p. 341.

Eucleoteuthis, Berry 1916, p. 60.—Okada 1927, p. 96.

Funnel cartilage shaped as in *Stenoteuthis*, but undetachably fastened to mantle cartilages, which

have a supplementary ridge on either side of the anterior end. Extremities of arms normally constructed. Ventral protective membrane of third arms as broad as their thickness. Two pores present opposite to dorsal arms, continuous with each other below the overhanging dorsal connective of buccal membrane. Left ventral arm hectocotylized. Two to four distinct fixing tubercles present on the carpus of tentacles. A pair of streak-like luminous organs may be found on belly and a pair of oval ones on the corresponding surface of head.

Type.—Loligo oualaniensis Lesson, 1830.

Key to the species of *Symplectoteuthis.*

Well-defined streak-like Luminous organs present on ventral surface .....*S. luminosa.*
No streak-like luminous organs present..... *S. oualaniensis.*

Symplectoteuthis luminosa*) Sasaki 1915.

Japanese name: Suji-ika (Sagami Prov.; Tôkyo)

(Pl. XXIV, figs. 4, 5; textfig. 140.)

Symplectoteuthis oualaniensis, Watasé 1906, p. 195 (nom. nud.).

Symplectoteuthis luminosa, Sasaki 1915a, p. 144, pl. iv, figs. 7-13; textfig. 4.—Sasaki 1916, p. 106.

Eucleoteuthis luminosa, Berry 1916, p. 60.—Okada 1927, p. 4.

I have examined numerous specimens of this species, which I obtained from Sagami and Tosa Provinces. I have also been enabled to examine through the courtesy of Professor Watasé, numerous excellent specimens caught by himself off Misaki. The mantle length of all these examples ranges from 102 mm. to 195 mm. Larger males of these possess a number of spermatophores in Needham's sac, but no females have mature eggs in the ovary.

Texture fleshy; skin smooth, firm to the touch. Body nicely conical, broadest in the anterior end, then tapering to a slender end-part, which comprises one-third of the entire length; breadth 20–23% of length (Pl. XXIV, fig. 4). Anterior margin of mantle even, the ventral emargination and dorsal projection both being very slight. Fins taken together broadly sagittate, with bluntly pointed lateral angles; antero-lateral edges nearly straight; postero-lateral edges slightly concave, scarcely extending to the extreme end of mantle. Length of fins a little less than their total breadth and 43–50% of mantle-length.

Head as broad as mantle. Eye-openings distinctly sinuated at the anterior margin a little below the middle, the sinus curving downwards at the anterior end. Funnel grove fairly deep, marked off by sharp horseshoe-shaped edge, of which the posterior parts project into conspicuous folds holding the funnel laterally. At the apex of the groove is a small rhomboidal foveola, which has about eight faint longitudinal folds internally, and two or three small pocket-like folds externally on either side. Neck separated from head by a sharp edge, which line forms a blunt angle at the nape. Olfactory crest on either side, composed of one transverse and three longitudinal folds, the latter extending between the former and the anterior boundary edge of neck. Nuchal cartilage spatulate, consisting of an axial and wing-like parts; the former is composed of two conspicuous parallel ridges; the latter set out at a point two-fifths up the axial part, then widening gradually cephalad, and thus form a roundish dilatation at the extremity (Pl. XXIV, fig. 5). In a male of 170 mm. mantle-length the cartilage, measures 16 mm. in length and 6 mm. in maximum breadth.

Funnel comparatively small, somewhat narrowed distad, its blunt extremity reaching the centre of head. Funnel cartilages triangular, twice as long as broad, with a spindleshaped elevation at the antero-dorsal margin; locking groove ⊥-shaped, the longitudinal part curving ventrad anteriorly.

*) The Mr. K. Aoki who was an assistant in the Misaki Marine Laboratory, kindly informed me that he actually observed repeatedly the luminosity of this squid; hence I applied to it the specific name "*luminosa*".

Posterior half of the longitudinal part undetachably fastened to mantle-cartilage; the horizontal part also connected at the middle with the same. Funnel organ composed of a single ∧-shaped dorsal, and two elliptical ventral pads; both conspicuous and of the same length.

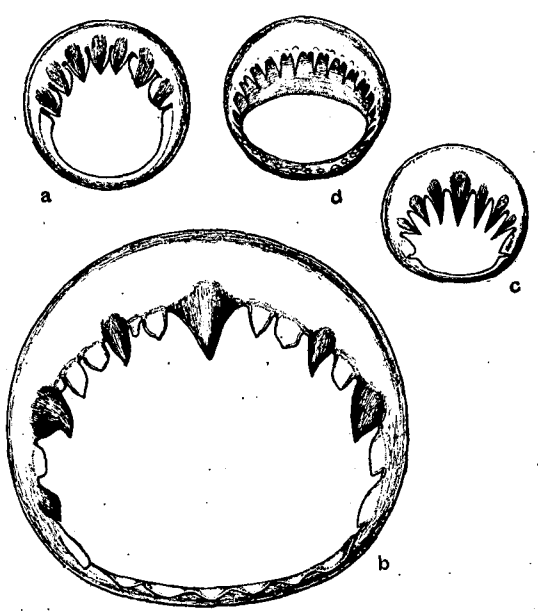
Arms subequal, the formula of length variable, being $2>3>4>1$, or $2>4>3>1$, or $2\fallingdotseq3>4>1$, or $2\fallingdotseq4>3>1$, or $2\fallingdotseq4\fallingdotseq3>1$; the longest about one-third the length of mantle, or even a little longer. First and second pairs nearly quadrangular in section; the former pair furnished with a narrow web on either side of the aboral surface; but the latter pair has only on the ventral side a web which is broader than those of the former pair. Protective membranes of both these pairs strongly trabeculate, a little narrower than the length of suckers, but that of the ventral side of the second arm is about equal to their length.

Third arm compressed from side to side, provided along the whole length with a strong keel, the broadest part of which is situated one-third up the arm, the breadth measuring twice the thickness of the arm. Dorsal protective membrane of this arm narrower than the length of suckers, while the ventral membrane is about three times as wide as the suckers are long.

Fourth arm nearly quadrangnlar, with a narrow web along the ventral side of the aboral surface, and a broad one along the dorsal side; the breadth of the latter equaling the thickness of the arm. Protective membranes of this arm both alike about half as broad as the suckers are long.

Arm-suckers hemispherical or subglobular biserial throughout, numbering 24–30 pairs on each arm. Size of suckers is subject to some variations in the different arms especially in males: largest suckers sitting on second arm, the next largest on third arm, and the smallest on fourth arm.

Horny rings of arm-suckers all dentate, the dentation being somewhat variable. In proximal suckers the ring has 6–8, relatively broad, pointed, nearly uniform teeth closely set on the distal half, the proximal half forming a smooth border projection forwards. In terminal suckers more distal than the tenth row are found nine or less numerous, slenderly conical, somewhat separate teeth on the distal two-thirds of the whole ring-margin, the proximal one-third forming a smooth border as in the former.



Textfig. 140.

Symplectoteuthis luminosa. Horny rings from suckers of male specimen of 170 mm. mantle length. a. From sucker of first row of second arm; ×ca. 13. b. From sucker of fourth row of same; ×ca. 13. c. From sucker of twelfth row of same; ×20. d. From one of marginal hand-suckers of tentacle; ×20.

In largest suckers, which are situated towards the middle of each arm, the dentation of the ring varies with age and also in the different arms of each individual. In the second arm of full-grown specimens the ring of these suckers has on the distal two-thirds, 17–20. greatly unequal teeth, strong and weak roughly alternately, the distalmost of which and the two on the lateral margins are far stronger then the rest, being conical in shape, and with a broad expanded base and acute tip each. The remaining proximal one-third of this ring is not smooth as in the preceding, but uneven or obtusely crenated. In largest suckers of the ventral arm the ring is equipped on the distal margin, with 7–9, rather uniform, slenderly conical teeth, of which the distalmost and the lateral two are but little stronger than the others; the proximal margin forms a smooth border. The dentation of largest suckers of the first and third arms stands between those two extremes mentioned above, but the dentation of the first arm is nearer to that of the fourth, while that of the third nearer to that of the second. Papillate area of horny rings with numerous radiating ridges instead of the papillae.

Left ventral arm about as long as right ventral arm, hectocotylized in the distal one-third. On

the proximal two-thirds are found about eleven pairs of normal suckers; then follow sixteen pairs of minute pavillae, which are situated on the hectocotylized part.

Tentacles variable in length but usually ½–¾ the length of mantle; stem somwhat compressed laterally, four-sided. Club lanceolate in outline, occupying the distal ⅓–½ of the tentacle. Dorsal web of club broad at its distal part, continued downwards as a narrow fold to the base of stem along its aboral surface.

Tentacular suckers quadriserial except on carpus, where are 11–13 minute suckers forming about four transverse rows of 2, 3, 4, 4 or 1, 3, 4, 4 or 1, 2, 4, 4 in each. On the carpus, in addition to these suckers, two (rarely three) minute fiving tubercles are found along the dorsal margin. Suckers of hand in seven or eight transverse rows, unequal, those of the median two series being far larger than those of the marginal two series. Suckers of distal portion in about 23 transverse rows; very small, and somewhat unequal, being minute in the more dorsal longitudinal series than in the more ventral. Horny ring of larger hand-suckers with only a single triangular tooth at the distalmost edge, otherwise being quite smooth. The ring of marginal hand-suckers equipped along the whole margin with 30 or more conical, separate teeth large and small alternately, but those of the proximal margin are very short, nearly uniform, and closely set. The ring of larger distal suckers resembles that of the marginal hund-suckers, but the teeth are comyaratively uniform; the same of smaller suckers has only several uniform conical teeth on the distal margin, the proximal margin being quite smooth. Papillate area of the rings with numerous radiating ridges as in arm-suckers.

Buccal membrane furnished with seven ribs markedly projecting beyond the margin. Connectives also seven, the dorsalmost shallowly bifulcate; attached to the dorsal side of arms but the third arm is fastened on its ventral side. Two aquiferous pores opposite to first arms, connected together below the overhanging dorsalmost connective; another pore found opposite to each tentacular base; thus the pores number four, all told.

Radula composed of seven series of teeth. Median teeth tricuspid; inner lateral, bicuspid; outer lateral and marginal, both unicuspid.

Gladius very slender, its anterior four-fifths consisting of little but the rhachis, which regularly and gradually tapers caudad. Vanes developed in the posterior one-fifth of gladius as a lanceola about one-fifth as long. Their margins curve ventrad in the posterior parts, forming a hollow endcone.

Color in preserved state, reddish brown, deeper above. Two longitudinal paler stripes found on belly two oval paler patches on the corresponding surface of head and an oblong patch on the ventral surface of the fourth arms; all are regarded as luminous organs. The stripes of the belly are situated so as to divide the ventral half of the whole mantle surface into three nearly equal longitudinal areas; their anterior ends expanded and bent outwards. When the belly is flayed, the stripes reveal themselves as long, narrow but distinct, white zones with a brown streak along their whole length. The zone is not continuos throughout but cut at three points into four quite separate parts. Of these the two anteriormost are quite short, patch-like and arranged nearly transversely along the mantle margin. The adjasent part i. e. the third from the anterior is by far the longest, its posterior end reaching about the level of fin entre. The hindmost part is a little shorter than half the length of the preceding part, disappearing at a distance from the posterior end of mautle. Under the paler patches but ther outline is not zonary but transverse-oblong.

According to Okada (1927) the subcutis has microscopic masses of luminous tissues scattered throughout the ventral surface of the squid, which he describes under the name of "*Organs photogènes invisibles.*"

Measurements of largest Male and Female Examined.

Sex	♂		♀	
Dorsal length of mantle	195 mm.		175 mm.	
Ventral length of mantle	185 ,,		170 ,,	
Maximum breadth of mantle	41 ,,		38 ,,	
Length of head	40 ,,		39 ,,	
Breadth of head	38 ,,		36 ,,	
Length of fins	92 ,,		80 ,,	
Total breadth of fins	113 ,,		95 ,,	
Length of first arms	Left 80 mm.	Right 80 mm.	Left 69 mm.	Right 65 mm.
,, ,, second arms	90 ,,	90 ,,	74 ,,	74 ,,
,, ,, third arms	85 ,,	85 ,,	74 ,,	74 ,,
,, ,, fourth arms	80 ,,	83 ,,	76 ,,	76 ,,
,, ,, tentacles	130 ,,	130 ,,	120 ,,	125 ,,
,, ,, clubs	45 ,,	45 ,,	40 ,,	40 ,,
Diameter of largest sucker of first arms	3.0 mm.		3.0 mm.	
,, ,, ,, ,, ,, second arms	5.0 ,,		3.6 ,,	
,, ,, ,, ,, ,, third arms	3.2 ,,		3.0 ,,	
,, ,, ,, ,, ,, fourth arms	2.5 ,,		2.4 ,,	
,, ,, ,, ,, ,, tentacles	4.0 ,,		4.0 ,,	

Remarks.—Professor Watasé had actually observed the phosphorescence of this species off Misaki, where it abounds in summer, long before I suggested the fact by the nomination of the species. He made it public in a meeting of the Tôkyo Zoological Society, in 1906, referring the species to *Symplectoteuthis oualaniensis.*

Berry (1916) established the genus *Euclesteuthis* for this species separating it from *Symplectoteuthis*, chiefly owing to its bearing the characteristic luminous organs. But here the species is retained in the genus *Symplectoteuthis* for the following reasons: (1) luminous organs may appear guite independent of the generic relationship, and (2) even if luminous organs have great weight in this case in determining the generic retationship, the present species may be taken congeneric with *Symplectoteuthis ouslaniensis*, for this latter species itself has a great possibility to have the Okada's *Organes photogense invisibles* as found in *S. luminosa.*

Locality.—Off Misaki (Sasaki); Tôkyo market (!); Tosa Prov. (!).

Type locality.—Off Misaki.

Type.—In Tôkyo Imp. Univ.

Symplectoteuthis oualaniensis (Lesson, 1830).

Japanese name: Tobi-ika (Liukiu); Hoyenjoo 花斫柔 (Formosa).

(Pl. XXX, fig. 8; textfigs. 176–178.)

Loligo oualaniensis, Lesson in Lesson et Garnot 1826–'30, p. 240, pl. i, fig. 2 (fide d'Orb.).

Ommastrephes oualaniensis, d'Orbigny, in d'Orb. et Fér. 1835, p. 351, Calmars pl. iii, pl. xxi, figs. 1, 2; Ommastrephes pl. i, figs. 14, 15.—Gray 1849, p. 63.—Tryon 1879, p. 180, pl. lxxxi, fig. 368.—Hoyle 1886b, p. 162.

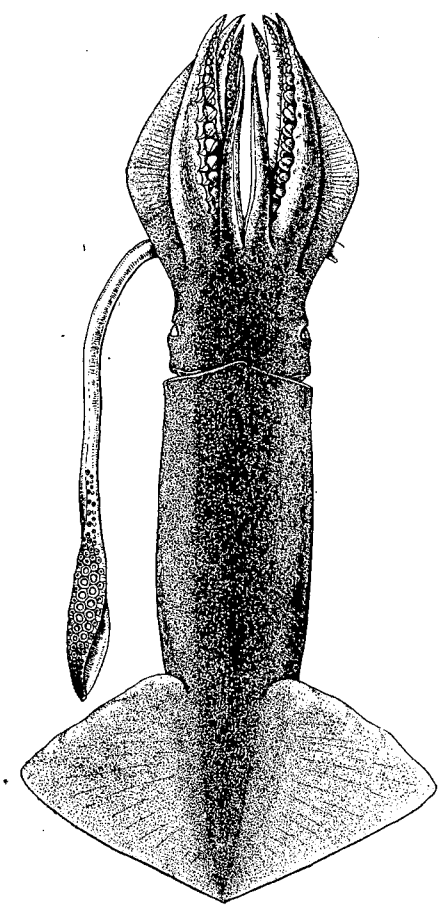
Ommatostrephes oualaniensis, Steenstrup 1880a, pp. 76, 78, 80, etc.; 1 fig.

Symplectoteuthis oualaniensis, Pfeffer 1900, p. 180.—Hoyle 1904, p. 32, textfig. F.—Hoyle 1905a, p. 982.—Wülker 1910, p. 21.—Pfeffer 1912, p. 502, pls. xl, xli; pl. xlii, figs. 1–4.—Berry 1912b, p. 419.—Berry 1914a, p. 341.—Sasaki 1916, p. 106.

List of specimens examined.

No.	Specimens	Mantle-length	Locality	Collector	Where preserved
i	5♂, 7♀,	125–223 mm.	Okinawa	K. Makino	Hok. Imp. Univ.
ii	20, dried	—	do.	M. Sasaki	do.
iii	1♂, 1♀,	125 mm. 134 mm.	Shuri, Okinawa	S. Sakaguchi	do.
iV	1♀	215 mm.	Tainan, Formosa	M. Oshima	Formosan Mus.

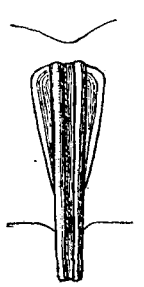
Body more slender in male than in female; in the specimens examined its breadth 23%–25% of the length in the full-grown male, and 27%–30% in a full-grown female. It is roughly cylindrical at the anterior half and is tapered in the remaining parts, terminating posteriorly in a slender end-part which may have a keel-like streak along the middle-ventral line (textfig. 176). Anterior margin of mantle a little protruded dorsally over the head in a very low triangle; ventrally it is quite slightly emarginated.



Textfig. 176.
Symplectoleuthis ouolaniensis (Lesson). Dorsal view of a female, ×½.

Fins transverse-rhomboidal, the total breadth being about twice the length which is in turn about 39% of the body length; anterior end a little auriculate; lateral angles rather acuminated, lying on the line crossing the middle of the length; posterior end very blunt, forming an angle of about 125°; all sides only slightly convex.

Head a little narrower than mantle, and about one-fourth as long as the latter; marked off from neck by a distinct ridge, the mid-dorsal part of which forms an angle of 140°. Eye-opening wide, its anterior free margin deeply sinuated far below the middle and a little above the level of angle between third and fourth arms; dorsal margin of the sinuation is a little thickened but not so greatly as occurs in some oegopsids. Funnel excavation of moderate depth, well marked off from the general surface of head by a horseshoe-shaped ridge, the posterior part of which is developed into folds holding the funnel; foveola with seven longitudinal folds within and four or five crsentic folds externally on either side. Nuchal cartilage as in the accompanying illustration (Fig. 177).



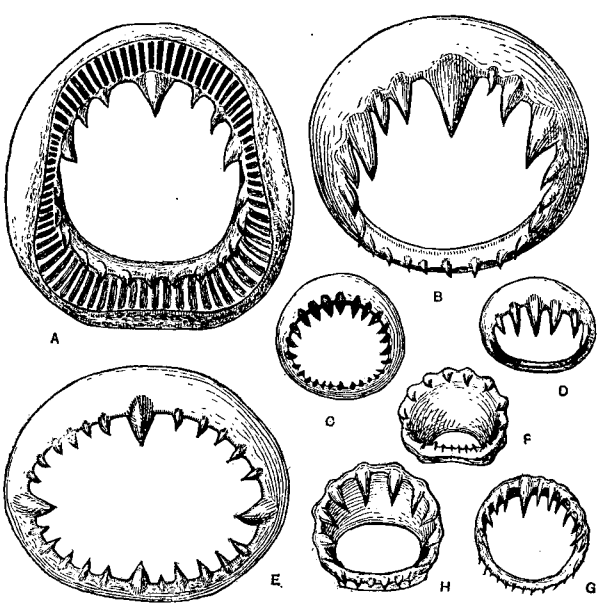
Textfig. 177.
Symplectoteuthis ouolaniensis (Lesson). Nuchal Cartilage, ×1.

Funnel rather large with wide opening. Funnel cartilage triangular with ⊥-shaped lock-groove, of which the anterior end is a little bent internally and is defined externally by a marked cartilaginous callosity, and internally by a narrow ridge. The cartilage is undetachably fused with the mantle cartilage only in the posterior one-third of the longitudinal part of the groove and the fusion does not extend into the horizontal part of the groove as in *S. luminosa.* Longitudinal ridge of the mantle cartilage branches out a short distinct ridge from its anterior origin on each side and there is a wide depression between the main ridge and the ventral branch ridge.

Arms subequal, the formula of length 4>3>2>1 or 4=3>2>1 or 3>4>2>1, where the

longest is about half as long as the mantle. First pair four sided, its aboral surface much nore sharply edged internally than externally. Second pair also four sided and the inner edge of the aboral surface is more or less rounded while the outer edge projects into a fold. Third pair flattened dorso-ventrally, and more or less triangular in profile, producing a marked keel on the back. Fourth pair resembles the second, but the folded edge exists externally and not internally, and the fold widens proximally. Protective membranes strongly costate, of unequal breadth, the ventral one of lateral arms being very broad; and the broadest is that of the ventral lateral arm, of which the breadth equals about double the thickness of the arm. Remaining membranes are all narrow, not reaching the top of suckers at any part of the arm.

Arm-suckers obliquely biserial, those of the second arm being much larger than those of the other arms, which are in turn about equal in size. The largest suckers of the second arms are from the fifth to the tenth, attaining double the diameter of the largest one of the other arms. In the first arm the largest suckers are from the fifth to the eleventh; in the third arm, from seventh to twelfth, and in the fourth, from fifteenth to twenty-third. All with strongly dentated horny ring. The dentation somewhat varies in the different suckers. In the largest suckers of second arms the distal margin of the ring has seven triangular teeth, of which the middle and both the outermost are far larger than the remainings; the lateral margin of each side has about three oblique conical teeth of moderate size which are succeeded by several smaller pointed teeth of the proximal-margin (textfig. 178). In proximal suckers of the same arm the ring has about 25 teeth which are relatively small and similarly conical but become gradually shorter as they come to the proximal margin. In distal suckers the ring is dentate only in the distal half, and the teeth numbering most frequently seven, are strong, sharply pointed, and the higher in position, the larger. The dentation of the suckers standing between any two of the three suckers above mentioned, shows graduated intermediations linking those of the two suckers.



Textfig. 178.

Symplectoteuthis ouolaniensis (Lesson). A-D. Sucker and horny rings of the second arm, ×7: A. Sucker of fourth row from the base of the arm; B. Horny ring from a sucker of the fifth row; C. From the most proximal sucker; D. From a distal sucker. E H. Horny rings of tentacular suckers; E. From largest hand sucker, ×7; F. From marginal hand sucker, ×7; G. From a carpal suckers, ×7; H. From a distal sucker, ×20.

The dentation of the suckers of the first, third and fourth arms agree in the essential characters with that mentioned above except that the distal teeth of the largest dorsal-arm suckers are relatively smaller than those of the largest ventral-arm suckers and that the ring of largest ventral-arm suckers has a smooth proximal margin.

Papillate area of the ring has no ordinary papillae, but horny bars are closely and radially arranged in a row. The bars number about 90 in a largest suckers of the second arm and are constructed nearly as in *Stenoteuthis bartrami* but have no spine at their base. In good preservation there are no space left between the bars, but in bad preservation the bars may be separated by necked spaces especially at the peripheral part of the papillate area.

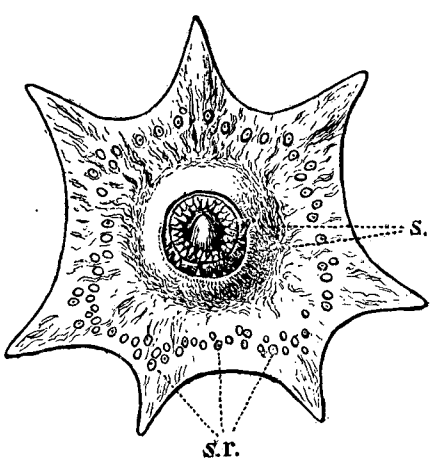
In the male, the left ventral arm is hectocotylized, being far longer and thicker than the corresponding arm of the opposite side. The following measurements of those arms are referred to the males which I have examined.

No. of specimen	i	ii	iii	iv	v	vi
Length of mantle	126 mm.	125 mm.	129 mm.	129 mm.	133 mm.	134 mm.
,, ,, left ventral arm	73 ,,	77 ,,	78 ,,	82 ,,	76 ,,	80 ,,
,, ,, right ventral arm ...	68 ,,	68 ,,	60 ,,	70 ,,	63 ,,	71 ,,

In the left ventral arm, the hectocotylized part includes its distal ½–⅗, having no sucker nor protuberance. The proximal half of the arm has 14 or 15 suckers arranged in two longitudinal rows. Other details as to the structure tally well with Pfeffer's description (1912).

Tentacles about as long as the body and head taken together, with stem a little thinner than the thinnest arm. Dorsal web and protective membranes, both well developed. Club a little expanded, occupying distal one-third of the tentacle, but the sucker-bearing part extends on to the stem, including the distal two-fifths of the tentacle. Suckers quadriserial, except on carpus; unequal, especially those of the hand portion which are far larger in the two rachial rows than in the marginal rows; the largest ones of the rachial rows which number about ten, are about three times the diameter of the marginal suckers. The suckers of the distal portion of the club are closely quadriserial, becoming regularly smaller distad, and in each transverse row the more ventral is the larger. The suckers of the carpal portion numbering about ten, are of sparsely biserial or triserial arrangement, and there are four spherical fixing pads arranged in a row at regular intervals among the suckers.

Horny ring of largest hand suckers provided with four, large, sharply pointed teeth in the four corners, i. e. distal proximal and laterals; between every two of these there are five or six smaller teeth (textfig. 178). The ring of the marginal suckers has about fifteen pointed teeth on the whole margin. Of these teeth about eight on the distal margin are curved crescentwise inwards and much stronger than the others. Distal suckers resemble in dentation the marginal suckers, but the teeth are much stronger and not curved. Teeth of the carpal suckers are numerous, fine, slender, and unequal as compared with those of the marginal as well as distal suckers. Papillate area of largest suckers quite like that of largest arm suckers.



Textfig. 179.

Symplectoteuthis ouolaniensis (Lesson). Buccal membrane and lips, showing seminal receptacles (s.r.) spermatophores fixed by males (s.), ×⅘.

Buccal membrane with seven strong ribs projecting beyond the margin in sharp points; its connectives are also seven, but the dorsal one is deeply bifurcate; they are fixed to the dorsal side of the arms except in the third arms to which their attachment is in the ventral side. Pore developed opposit to the first arm and also between the third and fourth arms; the former is continuous with that of the other side below the connective.

In the membrane of mature females, there are developed 60–70 small ovoid seminal receptacles, irregularly arranged in a circular zone surrounding the mouth; the thickest distribution is in the ventral parts of the membrane (textfig. 179). They have each a minute pore externally.

In the preserved specimen the dorsal lateral surfaces are purplish in color and the shade is deepened along the median zone of the dorsal surfaces of the head and body, Ventral surface is light buff and dotted with reddish brown chromatophores. As compared with *Stenoteuthis bartrami* the color is much reddish, and compared with *Symplectoteuthis luminosa* it is very light.

According to fishermen of Loochoo, the belly discharges light, but I have not yet met with an opportunity to actually observe it. In sections the integument of the belly and its underlying tissue

differ in structure from those of the back, and a diffused glandular tissue resembling the Okada's "*Organes photogènes invisibles*" of *S. luminosa*, is developed there very extensively so that it may be connected with luminosity, if ever this actually occurs.

Gladius very slender, consisting of little but the rachis except in the posterior one-seventh where the vane is developed to form a distinct endo-cone. Rachis beginning anteriorly with a caspidate extremity, uniformly tapers caudad; marginal rib on either side much thicker than mid-rib and strengthened by the external adjoining of another rib except for some distance from the anterior extremity where the margin is single-ribbed.

The inner reproductive organs closely resemble those of *Ommastrephes* in structure. The nidamental glands are quite separated from each other and their length is 100 mm. in the largest female examined. The fully grown oviduct of each side takes a zigzag course, the loops counting more than 10, are folded side by side in a plane, and is full of ripen oval eggs, which range in longest diameter from 0.7 mm. to 1.0 mm. The spermatophore which is 14 mm. or 15 mm. long, and is of quite ordinary structure, is fixed on the lips of grown females.

Measurements.

Locality	Loochoo (=Okinawa)		Formosa
Sex	♂	♀	♀
Dorsal length of body	125 mm.	134 mm.	215 mm.
Ventral length of body	120 ,,	130 ,,	205 ,,
Breadth of body	33 ,,	40 ,,	60 ,,
Length of head	32 ,,	33 ,,	50 ,,
Breadth of head	32 ,,	33 ,,	45 ,,
Length of fins	56 ,,	58 ,,	85 ,,
Total breadth of fins	106 ,,	115 ,,	165 ,,
Length of first arms	Left 58 mm. Right 58 mm.	Left 68 mm. Right 68 mm.	Left 80 mm. Right 85 mm.
,, ,, second arms	64 ,, 64 ,,	76 ,, 78 ,,	102 ,, 101 ,,
,, ,, third arms	70 ,, 70 ,,	82 ,, 82 ,,	108 ,, 106 ,,
,, ,, fourth arms	73 ,, 68 ,,	73 ,, 73 ,,	105 ,, 105 ,,
,, ,, tentacles	170 ,, 170 ,,	200 ,, 215 ,,	270 ,, 275 ,,
,, ,, tentacular clubs	40 ,, 40 ,,	50 ,, 50 ,,	90 ,, 90 ,,
Diameter of largest sucker of first arm	1.5 mm.	1.5 mm.	3.5 mm.
,, ,, ,, ,, ,, second arm	3.0 ,,	3.5 ,,	6.5 ,,
,, ,, ,, ,, ,, third arm	2.5 ,,	2.5 ,,	3.8 ,,
,, ,, ,, ,, ,, fourth arm	1.5 ,,	1.5 ,,	3.8 ,,
,, ,, ,, ,, ,, tentacle	3.5 ,,	3.5 ,,	6.5 ,,

Remarks.—Lesson's original description has not yet appealed to me in comparison with that of the specimens examined. But they well agree with those made by d'Orbigny and Pfeffer. The only few discernible differences are that: d'Orbigny illustrates the horny rings of both arm- and tentacular suckers as having rather uniform teeth regularly decreasing in size toward the distal margin, which is not the case with the Japanese specimens examined. The disagreement from that of Pfeffer's consists in (1) that a keel-like streak is very frequent occurrence on the posterior part of the belly, (2) that the funnel excavation is not always rounded at the anterior end but sometimes is more or less cuspidate, and (3) that the larger arm-suckers have on the distal margin of the horny ring two or three more larger teeth than given by Pfeffer.

The species is very common in Loochoo, where it is caught in plenty for the market. The fish-

ing season continues during summer, the cured marchandise is classified together with *Ommastrephes sloani pacificus*, going under the name "Nibanzurume".

Locality.—Misaki, Sagami Prov. (Wülker); Okinawa (Pfeffer); do. (!); Formosa (!). Laysan (Pfeffer); Pacific Oc. (d'Orb.); Oualan (Lesson); Vanicoro (Quoy & Gaimard); between Api, New Hebrides & Cape York (Hoyle); north of Admiralty I. (Hoyle); Cocos I. (Hoyle); South Nilandu Atoll (Hoyle); Südsee (Pfeffer), Indian Oc. (Tryon; Pfeffer); Cape of Good Hope (Tryon).

Family **Thysanoteuthidae** Keferstein, 1866.

Thysanoteuthidae, Keferstein 1866, p. 1445.—Tryon 1879, pp. 106, 167.—Pfeffer 1900, p. 181; 1912 p. 519—Hoyle 1904b, p. 15.

Thysanoteuthinae, Carus 1890, p. 445.

Body fleshy, conico-cylindrical, bluntly pointed posteriorly. Fins enormous, marginal, extending the whole length of mantle; both together rhomboidal. Eye-openings wide, sinuated anteriorly. Neck with two broad longitudinal olfectory folds on either side, without nuchal folds. Nuchal cartilage flabellate, engraved into a complicated sculpture. Funnel groove feebly marked off anteriorly without a foveola or folds. Funnel cartilage large, fusiform in outline, with a —|-shaped groove. Arms furnished with biserial suckers. Ventral protective membranes of lateral arms very broad, strongly trabeculate. Tentacles with biserial connective group consisting of suckers and fixing pads. Suckers on club quadriserial, their size graduated distally, showing no distinct gap between on the hand and on the distal portion, but on the former portion those of the two central series decidedly larger than those of the two marginal. Buccal membrane, with seven ribs projecting beyond the margin; connectives also seven, fastened to the dorsal surfaces of first and second arms, and also to the ventral surfaces of third and fourth arms. Gladius slenderly sagittate, vanes broad; their anterior ends forming prominent quadrangular lobes. No luminous organ present.

Genus **Thysanoteuthis** Troschel, 1857.

Thysanoteuthis, Troschel 1857, p. 69.—Tryon 1879, pp. 106, 167.—Carus 1890, p. 445—Jatta 1896, p. 56.—Pfeffer 1900, p. 182; 1912, p. 522.—Hoyle 1904b, p. 15; 1910a, p. 413.

Type.—T. rhombus Troschel, 1857.

Thysanoteuthis rhombus Troschel, 1857.

(Pl. XXIV, figs. 6–8; textg. 141.)

Sepioteuthis major, Gray 1828, p. 3, pl. iv, fig. 1 (fide d'Orb. et Fér.).—d'Orb, et Fér. 1835, p. 305, Sepioteuthis pl. vii, fig. 12.—Gray 1849, p. 83.—Tryon 1879, p. 154, pl. lxiv, fig. 222.

Thysanoteuthis rhombus, Troschel 1857, p. 70, pl. iv, fig. 12; pl. v, figs. 1–4.—Tryon 1879, p. 167, pl. lxxii, figs. 285–287.—Weiss 1889, p. 91.—Carus 1890, p. 445.—Jatta 1896, p, 56, pl. ix, figs. 1–13, textfig. 54—Pfeffer 1900, p. 182; 1912, p. 523, pl. xxvii, figs. 24–37.—Berry 1912b, p. 438.—Issel 1920, p. 4, figs. 1–7; 1920a, p. 13.

Thysanoteuthis elegans, Troschel 1857, p. 74; pl. iv, figs. 10 11.—Tryon 1879, p. 167, pl. lxxii, figs. 288, 289.

? Thysanoteuthis nuchalis, Pfeffer 1912, p. 531.

Seven specimens of this striking species from various localities are found in the collections at my disposal. Their mantle ranges from 180 mm. to 685 mm. in length.

Body conico-cylindridal, though slightly compressed dorso-ventrally; the cylindrical part comprises the anterior one-third of the length, the remaining part tapering caudad. The taper is gradual at first but becomes somewhat rapid afterwards so that the posterior end is rather bluntly pointed. Maximum breadth of body in medium- to full-sized specimens, 30%–35% of its length. Anterior

margin of mantle nearly even, the dorsal projection and ventral emargination both being faint. Fins broad, lateral, extending nearly the whole length of mantle, the broadest part lying one-third the length from the anterior. Their combined outline rhomboidal, with nearly straight edges and pointed angles, not auriculate anteriorly; the total breadth equal to, or a little greater than, the length.

Head in full-sized specimens, decidedly narrower than body and about one-eighth as long as the latter. On the dorsal surface the roots of the dorsal arms mark themselves out as two distinct longitudinal ridges running two-thirds down the surface. Eyes large; their opening broad, with a comparative short sinus in the middle of the anterior margin. Funnel groove well-marked; but its anterior part is shallow and shows neither foveola nor folds. The posterior part is deep, its lateral borders developed into conspicuous folds holding the funnel laterally.

Neck marked off from head by a distinct edge, forming an angle of about 140° at the nape. Olfactory crest on either side, composed of two conspicuous longitudinal folds, the dorsal one of which is nearly semicircular, but continued on as a distinct ridge to the posterior boundary groove of neck. The ventral fold of the crest is narrow and runs obliquely to meet with the preceding fold at the point where its ridge-like continuation sets out. Posterior transverse fold of neck present, extending from the dorsal side of the dorsal fold up to the vicinity of nuchal cartilage. This cartilage and the corresponding cartilage of mantle are both much complicated as shown in Pl. XXIV, figs. 7, 8.

Funel large. slightly narrowed at the anterior end, fully extending to the centre of head; its internal valve broad, semicircular. Funnel organ conspicuous, consisting of a $\wedge$-shaped dorsal and two elliptical ventral pads; the latter only slightly shorter than the former. Funnel cartilage roughly fusiform in outline, but the ventral side more convex than the dorsal; maximum breadth equaling about one-third of the length, which measures in turn about the half the length of funnel. Locking groove of the cartilage $\dashv$-shaped. Its vertical part narrow, extending the whole length of the cartilage along its dorsal margin while the horizontal part is broad, dividing the cartilage into equal halves, distal and proximal. The proximal half is flat, while the distal half is greatly thickend, the postero-dorsal part markedly projecting. Mantle cartilage composed of a $\dashv$-shaped ridge having a deep depression in front of the horizontal part; the vertical part as long as the corresponding groove of funnel cartilage.

Arms unequal, the formula of length being $3>2>4>1$; the longest in medium-sized specimens measuring about two-thirds, and in full-sized specimens about two-fifths, the length of mantle. First pair about half as long as third pair; four sided, but the dorsal edge of the aboral surface is rounded off while the ventral edge is developed into conspicuously, low triangular keel extending for the distal three-fourths of the arm. Second pair almost as in the preceding pair, but the keel extends the whole length of the arms, and widens proximal. Third pair by far the longest, compressed from side to side, with a conspicuous keel on the proximal half. Fourth pair quadrangular in section, the aboral surface marked off by sharp edges on sides, the edge of the dorsal side developed into a web about twice as broad as the thickness of arms. Protective membranes with marked trabeculae extending a little beyond their margin; the membrane of the dorsal side on each arm about as broad as the length of suckers; same of the ventral side on first arms two and a half times, on second arms four times, on third arms five times, and an fourth arms one and a half times, as broad as the length of suckers.

Arm-suckers relatively small, nearly uniform, but those of ventral arms are a little smaller than of the remaining arms; biserial but in a zigzag arrangement. They number in a specimen of 180 mm. mantle length, about 30 pairs on each first arm, about 40 pairs on each second arm and also on each fourth arm, and 45 pairs on each third arm. Horny ring dentate on the whole edge; the teeth conical, sharply pointed far longer on the distal edge than on the proximal; their breadth at base being a little narrower than interdental spaces. The teeth number 20–23 in proximal suckers, 22–26 in largest suckers, and 12–20 in subterminal suckers.

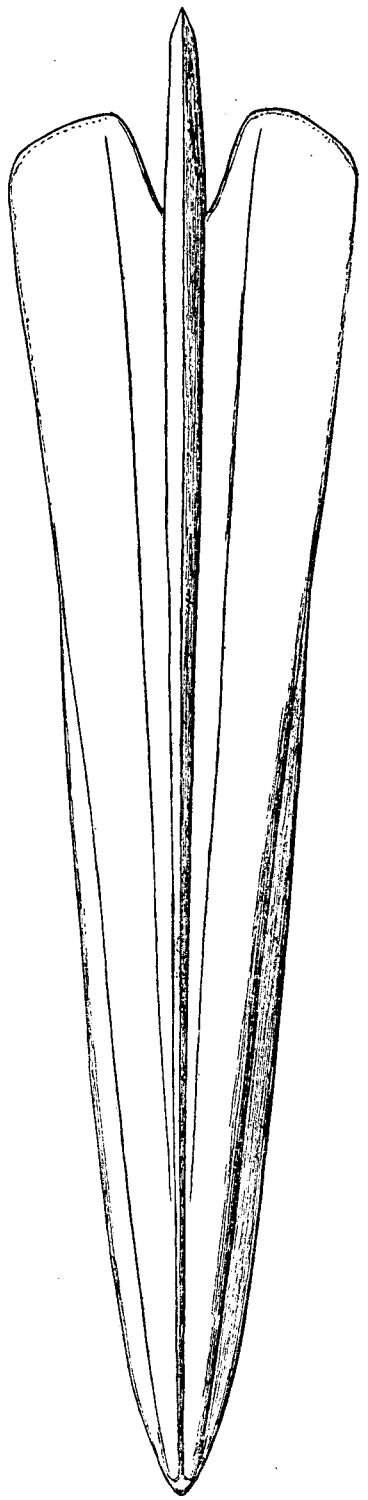
Tentacles a little shorter than mantle, their stem as thick as first arms, three-sided, keeled on the aboral surface. The keel extends from near the base of stem to the middle of club. Oral surface of stem marked off by sharp edges on sides, its distal half furnished with sparsely biserial connective

group, consisting of about fourteen minute suckers alternating with so many minute adhesive pads. Club lanceolate, expanded a little, comprising the distal ⅓–¼ of the tentacle; its protective membranes distinctly trabeculate, extending down to the base of stem as narrow, segmentally nodose membranes. Club-suckers quadriserial throughout, numbering about ten transverse rows on the hand portion, and about twenty rows on the distal portion, although there is no distinct gup in size between these two kinds of suckers. Central suckers of the hand portion about half as large in diameter as its marginal ones. Horny ring of club-suckers equipped with 15–20, sharply pointed caniniform teeth along the whole margin; the breadth of teeth at their base decidedly narrower than their interdental spaces. In the dislal and marginal suckers, the teeth of the distal ring-margin are bent a little inwards and far longer than those of the proximal margin.

Buccal membrane with seven ribs projecting beyond the margin. Connectives also seven in number, fastened to the dorsal surfaces of first and second arms as well as to the ventral surfaces of third and fourth arms. So-called aquiferous pores shaped like a crescentic cleft, numbering two, one of which is oppsite to the four dorsal arms while the other is opposite to the right ventral arm and also to the right tentacle; hence the connectives of first and second arms hang over the dorsal pore and that of the right ventral arm, over the ventral pore.

Gladius slenderly sagittate, its maximum breadth being about 24% of the length. Rhachis broadest one-seventh of the way back, then very gradually tapering posteriorly. Anteriorly it also tapers gradually from the broadest part, terminating in an extremity which forms an angle of about 50°. Vanes begin on the rhachis at the point about one-seventh down its length, regularly and gradually narrowing caudad, but their posterior two-thirds are bordered with narrow thin margins; so that their total outline forms a hypabolic curve. Anterior end of vanes markedly auriculate in a quadrangular lobe (textfig. 141).

Color in alcohol grayish brown, deeper above; no special markings discernible.



Textfig. 141.
Thysanoteuthis rhombus.
Cladius; ×⅔.

Measurement of largest Specimen Examined.

Dorsal lengest of mantle	685 mm.
Ventral length of mantle	670 ,,
Breadth of mantle	240 ,,
Dorsal length of head	156 ,,
Breadth of head	185 ,,
Length of fins	674 ,,
Total breadth of fins...	637 ,,
Length of right first arm	150 ,,
,, ,, ,, second arms	160 ,,
,, ,, ,, third arms	240 ,,
,, ,, ,, fourth arms	170 ,,
,, ,, ,, tentacle	500 ,,
Diameter of largest arm-sucker	7 ,,

Remarks.—The specimens referred to agree in essential characters with Jatta's illustrated description of the species (1896). Pfeffer distinguishes this species from his *T. nuchalis* principally by

by the characters around the mouth and also by the absence of the semilunar transverse fold between the two longitudinal crest folds on either side of the neck. As far as I have examined, however, these characters are subject to individual variations in the species under consideration, so that I am rather inclined to consider *T. nuchalis* synonymous with the former species.

The species is found in Japan on both sides of the Main Island, and is said to frequent Noto Province, Tushima, and Ogasawarajima; also, there is a real evidence its having come to the fish markets of Tôkyo, even though I did not come across any purchased there. According to fishermen the cuttlefish may spring high up obove the sea surface; in fact a specimen examined has a label noting that it flew up from sea and came on board, colliding against the sail.

Locality.—Etchû Prov. (Sasaki); Noto Prov. (Sasaki); Tango Prov. (!); Tsushima (!); Sagami (Sasaki); Bonin Is. (!). ?Ningpo, China (Pfeffer); Mediterranean (Troschel; Jatta; Weiss; Pfeffer), Messina (Issel).

Family **Chiroteuthidae** Gray, 1849.

Loligopsidae, Gray 1849, p. 39 (pars).
Chiroteuthidae, Gray 1849, p. 42 (pars).—Tryon 1879, p. 106 (pars).—Adams, H. & A. 1858, p. 28 (pars).—Pfeffer 1900, pp. 153, 183; 1912, p. 539.—Hoyle 1904b, pp. 3, 13—Chun 1910, p. 216 (pars).
Cranchidae, Tryon 1879, p. 106 (pars).
Taonoteuthis Carus 1890, p. 450 (pars).

Body slenderly conical or hemi-fusiform, ordinarily terminating in a more or less elongated end-part, which sometimes largely extends beyond the fins. Fins more or less fleshy, of moderate to enormous size, terminal or subtarminal or lateral in position, sometimes supplemented by other soft fins behind. Neck constricted or not, bearing neither olfactory crest nor nuchal folds; but tuberclus olfactorius invariably occurs on either side. Funnel groove shallow or even obliterated. Funnel cartilages more or less auri-form, furnished in the middle with a deep-short groove, the margin of which often forms a ventral (tragus) and a posterior projection (antitragus). Mantle cartilage of more or less nose-like ridge. Arms markedly unequal; fourth pair always by far the longest and thickest, and sometimes with uniserial photophores sunk deep below the surface; suckers biserial; no hooks. Tentacles long, often whip-like, sometimes decorated with one conspicuous photophore at the tip and a series of large photophores on the stem; suckers in 4–24 series.

Key to the subfamilies, genera and subgenera of the Chiroteuthidae represented in the Japanese waters.

(A) Fins comparatively small, $\frac{1}{5}$–$\frac{2}{3}$ as long as mantle, tentacular suckers in 4–8 series (subfam. *Chiroteuthinae*).....Gen. *Chiroteuthis*.
  (a) Animal small, markedly elongated, the head being as long as mantle, of which the end-part is long and filiform; arm-formula 4>2>1>3; tentacles with octoserial suckers, without photophores .....Subgen. *Tankaia* nov.
  (b) Animal rather large; the end-part of mantle a little swollen, extending beyond fins; arm-formula 4>3>2>1; tentacles with quadriserial suckers, and uniserial photophores ....Subgen *Chirothauma*.
(B) Fins ordinarily large, $\frac{1}{3}$–$\frac{9}{10}$ as long as mantle; tentcles devoid of photophores, their suckers in ten or more numerous series (Subfam. *Mastigoteuthinae*) .....Gen *Mastigoteuthis*.

Sabfamily **Chiroteuthinae** Chun, 1910.

Chiroteuthinae, Chun 1910, pp. 219, 238.—Pfeffer 1912, p. 541.

Mantle with filiform or subfusiform end-part. Fins subterminal or lateral in position; comparatively small; shorter than two-thirds the length of body; both circular, or cardiform, or reniform;

often soft small supplementary fins present behind. Neck long, slightly constricted or quite cylindrical. Tuberculus olfactorius long peduncled. Club suckers of tentacles in 4–8 series. Conspicuous photophores may be present on tentacles, ventral arms, and the ventral periphery of eye-balls, as well as in mantle-cavity.

Genus **Chiroteuthis** d'Orbigny, 1839.

Chiroteuthis, d'Orb. in d'Orb. et Fér. 1839, p. 324.—Gray 1849, p. 43,—Adams, H. & A. 1858, p. 29.—Tryon 1879, pp. 106, 165.—Pfeffer 1900, p. 184; 1912, p. 541.—Hoyle 1904b, p. 16.—Chun 1910, p. 238.

Loligopsis (pars), Gray 1849, p. 39.—Verany 1851, p. 120.—Tryon 1879, pp. 106, 162.

Doratopsis, Rochebrune 1884, p. 18.—Hoyle 1904b, p. 16.

Chirothauma, Chun 1910, p. 241.

Consistency quite choroidal, nearly transparent. Mantle markedly elongated, tapering caudad into a filiform or fusiform end-part, which extends beyond fins. Fins taken together lunar or cardiform or reniform; sometimes supplemented behind by small soft fins. No funnel-groove present. Funnel adductors ordinarily embedded below the surfaces. Peduncled tuberculus olfactorius present behind each eye. Buccal membrane broad, with seven ribs and connectives, the latter fastened to the dorsal surfaces of first and second arms as well as to the ventral surfaces of third and fourth arms. Arms markedly unequal; fourth pair invariably by far the longest and thickest, usually with a series of photophores; protective membranes feebly developed; suckers biserial. Tentacles sometimes of moderate length, but more often exceedingly elongated and whip-like; a conspicuous photophore may occur at their extreme tip and numerous ones in a series on their stem; club-suckers in 4–8 series.

Type.—Loligopsis veranyi Férussac.

Subgenus **Chirothauma** Chun, 1910.

Chirothauma Chun 1910, p. 241.—Pfefter 1912, pp. 554, 581.

Body tapered posteriorly but terminating in a somewhat swollen subfusiform part which extends largely beyond the ordinary fins and is bordered with a soft narrow supplementary fin on either side. Ordinary fins thick, fleshy; both together nicely lunar in contour. Arm-formula invariably $4>3>2>1$; fourth pair with uniserial photophores sunk below the surface. Tentacles elongated, whip-like with a conspicuous photophore at the extreme tip and numerous prominent ones in a series on the stem. Tentacular suckers quadriserial; their peduncles rather simple in structure but may be provided with a membranous appendage on one side. Their horny ring equipped with 7–9 acute teeth on the distal edge, the central one being by far the strongest.

Chiroteuthis (Chirothauma) imperator Chun, 1910.

Japanese name: Yurei-ika (Sagami Prov.); Mizu-ika (Sagami Prov.)

(Pl. XXIV, figs. 9, 10; textfig. 142.)

? Chiroteuthis macrosoma, Goodrich 1896, p. 12, pl. iii, figs. 51–57.—Pfefter 1909, pp. 185, 186.

? Chiroteuthis (*Chirothauma*) *macrosoma* Chun 1910, p. 240.—Pfeffer 1912, p. 589.

Chciroteuthis macrosoma, Nishikawa 1906, p. 109, pl. iii.—Berry 1912b, p. 438.

Chiroteuthis (*Chirothauma*) *imperator*, Chun 1910, pp. 240, 241, 281, pl. xxxviii; pl. xxxix, figs. 1–10; pl. xl, figs. 2–5, 7; pl. xli; pl. xlii, figs. 1–4; pl. xliii, pl. xliv, figs. 3, 6–16.—Berry 1912b, p. 438.—Pfeffer 1912, p. 581.—Sasaki 1916, p. 108; 1920, p. 200.—Massy 1916a, p. 243.

This species is represented by numerous specimens in the collections I have had access to. They are mostly collected in Sagami Bay, their mantle measuring up to about 30 cm. in length.

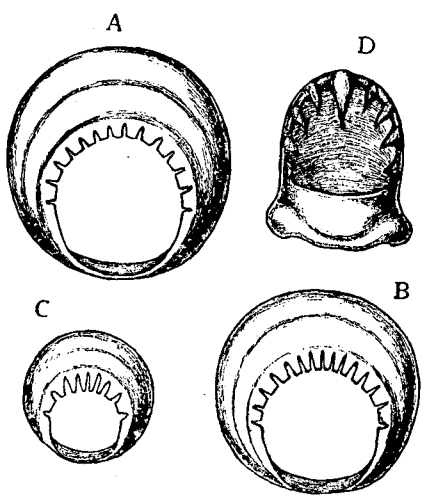
Consistincy choroidal, translucent. Surface smooth and soft to the touch. Body thick-walled, slender, being cylindrical in the anterior one-fourth and then tapering caudad. But the taper fades out soon afterwards and thus a slender parallel-sided part is formed for the central two quarters of the fin-bearing region. Beyond this part the body becomes again somewhat thicker, forming a spindle-shaped end-part, which extends beyond the fins as far as 1/5–1/4 the length of the whole body, and is bordered with a narrow soft supplementary fin on either side. Maximum breadth of the spindle-shaped end-part 1/3–1/2 that of the whole body. Anterior margin of mantle slightly emarginated in the ventral parts, and markedly projecting in the dorsal, where it forms an angle of about 100° in the middle. Fins thick, fleshy and joined together along the mid-dorsal line of mantle, thus forming a nearly lunar contour, the diameter of which is about half the length of mantle.

Head about one-third as long as body, and a little narrower; nearly cylindrical but the ventral surface markedly convex, so that the maximum depth exceeds the breadth. Eye-opening comparatively narrow, pyriform in outline, with the sharper end dorsally, the long-axis being only one-fourth the maximum depth of head. No funnel-groove present.

Neck smooth, with neither ridge separable from head, nor constriction; but in ill-preserved specimens the latter is marked, due to the contraction of the softer tissue there. No olfactory folds developed; but a stalked, acorn-shaped tuberculus olfactorius exists on either side of the ventral surface of head halfway between eye and funnel. Nuchal cartilage oblong, about three times as long as wide; its sides nearly parallel, and its ends similarly rounded.

Funnel ill-defined except at the extremity, which projects anteriad and ventrad. Funnel cartilages nearly auriform, oval in contour, about twice as long as wide, provided with small triangular tragus and conspicuous round-headed conical antitragus. These processes define together with the outer margin of the cartilage a deep ⊣-shaped locking groove. Mantle cartilage shaped like a human nose.

Arms exceedingly unequal, the formula of length being 4>3>2>1, and the thickness varying with the length in direct proportion. Fourth pair by far the longest and thickest, being twice as long as first pair and longer than mantle. All more or less four-sided; oral surface concave, bordered with very narrow feebly trabeculate protective membranes. Aboral surface convex; more sharply edged on the ventral side than on the dorsal in dorsal arms; still more so in lateral arms, where the ventral edge projects like a keel. In ventral arms, the surface is more clearly marked off on the dorsal side, where the edge is developed into a broad, thick, soft web for the entire length.



Textfig. 142.

Chiroteuthis (Chirothauma) imperator. Horny rings from sucker of female specimen of 18 cm. mantle length. A. From sucker of fifth row of third arm; ×20. B. From sucker of twenty-second row of the same; ×20. C. From sucker of seventieth row of the same; ×20. D. From proximal sucker of tentacle; ×23.

Arm-suckers biserial, small, subglobular, with a small round aperture on the lateral aspect, uniform but becoming very gradually smaller distad on each arm and those of ventral arms somewhat smaller than those of the remaining arms. In a specimen of 220 mm. mantle length, they number about 90 pairs on first arm as well as on the second, about 105 pairs on the third, and about 57 pairs on the fourth. Arrangement of suckers becomes closer distally on the dorsal three pairs of arms, while on the ventral pair it is very sparse even at the extremity. Horny ring very oblique, dentates on the distal half, the proximal half being quite smooth, and projecting so that its edge comes to the same level with the points of the teeth (textfig. 142A-C). Teeth in basal suckers, 10–12 in number, uniform, squarish, separated from one another by cleft-like spaces; same in largest suckers, 12–16 in number, shaped and arranged nearly as in the preceding suckers but quite uniform, the outer ones being broader than the inner; same in subterminal suckers, more separated than in all the preceding suckers numbering 7–10, the central three or four of which are far slenderer than the others.

Tentacles in good specimens, about twice as long as mantle, and half as thick as first arms, with cylindrical stem elongated almost like a whip, while in bad specimens they are often far longer than three times the length of body, and their stem is quite thin and filiform. Club lanceolate, occupying less than one-third of the tentacle, expanded a little, bordered with broad protective membranes suspended by numerous strong ribs; its aboral subrface rounded, without dorsal web.

Tentacular suckers crowded in about 85 transverse rows of four each, becoming gradually and regularly smaller towards the tip of club, helmet-shaped, each with a broad opening, markedly obliquely peduncled (Pl. XXIV, fig. 9). Peduncles of marginal suckers very long, stout, two or three times as thick as the diameter of suckers; hemmed along its proximal $^3/_4$–$^4/_5$ with a narrow membrane. The latter of equal breadth throughout, or slightly widening distad, where it is square cut. Peduncles of the suckers of the central two series as thick as the preceding ones but decidedly shorter, provided with a minute papillary appendage midway along their length or a little more distally (Pl. XXIV, fig. 10). Beyond the aforesaid membrane or appendage, the peduncle becomes a little thinner and tapers distad; otherwise no distinct demarkation is discernible between the proximal and distal portions disagreeing with Chun's description. Horny ring very oblique, dentate on the distal three-fourths; the teeth numbering nine or ten, sharply pointed, bent proximad and the central one by far the longest and strongest (textfig. 142D).

Buccal membrane wide, with seven strong ribs which projects beyond the margin in so many sharp processes. Connectives also seven, fastened to the dorsal surfaces of first and second arms as well as to the ventral surfaces of third and fourth arms. Inner surface of the membrane finely wrinkled, violet in color. Six so-called aquiferous pores between the membrane and arms.

Gladius very slender, nearly filiform, its anterior half consisting little but rhachis. The remaining posterior half forms a slender tubular end-cone, which tapers very gradually posteriad and is compressed laterally, the depth equaling about twice the breadth. The following are the measurements of the gladii examined.

No. of specimen	i	ii	iii
Entire length of gladius	250 mm.	220 mm.	130 mm.
Length of end-cone...	120 ,,	125 ,,	80 ,,
Maximum breadth of end-cone	3 ,,	3 ,,	1.2 ,,
Maximum depth of end-cone	6 ,,	6 ,,	3.5 ,,

Uniserial immersed photophores decorate the oral surface of ventral arms running along the dorsal protective membrane so far as this extends, and regularly alternate with the suckers. They number 55–60 and measure about 1.5 mm. in diameter in full-sized specimens.

Uniserial photophores also found on the aboral surface of the tentacular stem, numbering 38–45, ovate, with the long-axis lengthwise, elevated above the general surface; the upper surface concave, with a minute slit-like pore in the middle. They measure about × 2.5 mm. in full grown specimens.

Ventral periphery of eye-balls decorated with numerous, nearly uniform photophores in three connective series. Of the three the outermost is on the outer surface of eye-balls, consisting of seven or eight organs; the middle series, along the exact periphery, of nine or ten organs; the innermost series, on the inner surface, of about six organs.

Measurements of two full-grown Females Examined.

No. of specimen	i	ii
Dorsal length of mantle	250 mm.	220 mm.
Ventral length of mantle	228 ,,	210 ,,
Maximum breadth of mantle	45 ,,	38 ,,
Length of head	75 ,,	70 ,,
Maximum breadth of head	32 ,,	28 ,,
Maximum depth of head	—	31 ,,
Length of fins	110 ,,	103 ,,
Total breadth of fins	110 ,,	100 ,,
Mantle extending behind fins	40 ,,	30 ,,
Length of first arms	Left 130 mm. Right 130 mm.	Left 125 mm. Right 125 mm.
,, ,, second arms	150 ,, 150 ,,	155 ,, 155 ,,
,, ,, third arms	190 ,, ?80 ,,	180 ,, 180 ,,
,, ,, fourth arms	275 ,, —	260 ,, 260 ,,
,, ,, tentacles	380 ,, 350 ,,	430 ,, 450 ,,
,, ,, clubs	170 ,, 127 ,,	160 ,, 170 ,,
Diameter of largest sucker of first arms	—	2.3 mm.
,, ,, ,, ,, ,, second arms	—	2.5 ,,
,, ,, ,, ,, ,, third arms	—	2.5 ,,
,, ,, ,, ,, ,, fourth arms	—	2.5 ,,
,, ,, ,, ,, ,, tentacles	—	1.5 ,,
Length of nidamental gland	26 mm.	15 ,,
Breadth of nidamental gland	11 ,,	6 ,,

Remarks.—The specimens examined agree well with Chun's description, the only discrepancies being that the gladius has a longer end-cone, and that the peduncle of marginal tentacular suckers has a rectangular membrane and the same of the central suckers, a papilliform appendage, instead of both having triangular membranes.

The species is rather common on the coast of Sagami Bay, where the phosphorescence of the above-mentioned photophores has been proved in living animals by Professor Watasé, though this has not yet come into print.

Locality.—Sagami Bay (Chun); Misaki, Sagami Prov. (Sasaki); off Misaki, 350 fm. (Sasaki); Odawara, Sagami (Sasaki); Sembombama, Sagami (Sasaki); Shimo-osa Prov. (Nishikawa); near Koshiki Is. 369 fm. (Albatross!); off Osumi Prov. 703 fm. (Albatross!), Sumatra (Chun); Bay of Bengal (Massy); Gulf of Oman (Massy); Arabian Sea (Massy).

Subgenus **Tankaia** Subgen. nov.

Body hemi-fusiform tapering posteriorly into a filiform end-part of equal thickness. Fins subterminal; both together reniform, with the concavity posteriorly. Head prismatic, as long as mantle, furnished with tuberculus olfactorius on the ventral surface directly behind each eye. Eye-ball roundish, compressed a little, without ventral process. Funnel cartilage ovate, with the blunter end behind, bearing neither distinct tragus nor antitragus. Arms short, the formula being clearly $4>2>1>3$. Tentacles with no dorsal web nor distinct protective membranes; two suckers present toward the base, three on the carpus, 150 or more in several longitudinal series on the club. This part occupies the distal three-sevenths of the tentacle, but not distinguishable from stem except by the location of the crowded suckers. No photophores present.

Typ.—*Chiroteuthis* (*Tankaia*) *borealis* n. sp.

Chiroteuthis (Tankaia) borealis sp. nov.

(Pl. XXIV, figs. 11–14.)

Animal minute, markedly elongated, transparent even in preserved state. Mantle widest anterriorly, tapering caudad; but from near the origin of the fins it becomes filiform, and similar in thickness, containing little but gladius so that the end-part is not flexible but sturdy (Pl XXIV, fig. 11). The extreme tip of the body is not examined as it was broken off. Fins broad, subterminal, attached to the anterior part of the filiform end-part; both together reniform with the concavity behind; the length being three-fourths the total breadth and about half the mantle-length exclusive of the filiform end-part. Anterior margin of mantle entire, but its dorsal part slightly projecting in an angle of 130° in the middle (Pl. XXIV, fig. 12).

Head narrower than body, slightly furrowed beneath, rounded above; Eyes somewhat ventral in position, rather small, the diameter being about half the depth of head. Preocular portion of head conical, tapering anteriad. A pair of tuberculus olfactorius present on the ventral surface of head a little behind the eyes.

Neck markedly elongated, only a little shorter than body; prismatic but slightly norrowing cephalad where it is joined on to head without demarkation or constriction.

Funnel short deeply contracted into mantle cavity, well defined even at the basal part; the proximal half very wide, while the distal half is vely narrow. Funnel cartilage very thin, ovate, with the blunter extremity posteriorly; locking groove short and rather shallow, bearing neither distinct tragus nor antitragus (Pl. XXIV, fig. 13). Mantle cartilage short, faint, more or less ridge-like.

Arms short, unequal, the formula of length being $4>2>1>3$ (Pl. XXIV, fig. 14). Fourth pair of about equal to the head-length exclusive of neck; second pair about half as long as the preceding; third pair very short and rather rudimentary. All without carination on back. Protective membranes poorly developed. Suckers in two alternate series, numbering three on first arm, four or five on the second; one on the third, fifteen or more on the left fourth. The right fourth arm has only six suckers along the proximal half, the distal half being quite smooth and faintly furrowed. Suckers on each arm diminish in size distally, the proximalmost being characteristically large.

Tentacles about half as long as mantle; oral surface nearly flattened; aboral surface rounded, without web. Club not expanded, somewhat tapering distad, occupying about the distal half of the tentacle, being no more otherwise defined than by the crowded suckers; no protective membranes discernible. Club suckers numerous, minute, apparently hexaserial but numbering eight in an oblique-transverse row; those of the more dorsal series a little smaller than those of the more ventral series. Carpus furnished with three suckers which are a little larger than those of club and form a separate group. Stem provided with two suckers towards the base. Horny ring of all suckers apparently smooth.

Chromatophores comparatively large, brownish violet in formalin; very rare, numbering about six on the dorsal side of head, and also on its ventral side, five in a series along the median line of nape, and another five beneath fins. On the mantle three are found on its ventral surface, six or seven on either side, and five or six in a series along its mid-dorsal line.

Liver grayish, ellipsoidal but a little flattened, with the long-axis at right angles to that of body. Ink-bag small, ovoidal, situated at the ventral extremity of liver. No photophores discernible.

Measurements.

Length of body inclusive of its end-part	12 mm.
Breadth of body	3 ,,
Length of fins	4.5 ,,
Total breadth of fins	6 ,,
Length of head inclusive of neck	10 ,,
,, ,, ventral arms	2.3 ,,
,, ,, tentacles	5.5 ,,

Remarks.—This species stands in nearest relationship to *Chiroteuthis* (*Doratopsis*) *vermicularis* (Rüppel), but differs from this in having neither tragus nor antitragus on the funnel cartilages and in lacking of the dorsal web on the tentacular club. Moreover, these two species show a marked difference in the arrangement of the tentacular suckers.

The species more or less approaches *Chiroteuthis* (*Planctoteuthis*) *planctonica* Pfeffer in having hexaserial suckers on the tentacles, but widely different from it in the shape of neck and eye-balls.

The type specimen was collected by the Hokkaido Fishery Institute Steamer "Tankaimaru" 20 miles off Kushiro Prov. on July 20, 1915.

Type.—In Fish. Institute Takashima, Hokkaido.

Subfamily **Mastigoteuthinae** Chun, 1910.

Mastigoteuthidae, Verrill 1881b, p. 100; 1882, p. 430.—Hoyle 1886b, p. 36.
Mastigoteuthinae, Chun 1910, p. 219.—Pfeffer 1912, p. 608.
Iridioteuthinae, Sasaki 1916, p. 108.

Consistency choroidal, semitransparent. Mantle subfusiform sometimes markedly narrowed posteriorly but forming neither filiform nor fusiform end-part. Fins rather terminal often very large, their length being $^1/_3$–$^9/_{10}$ that of body; both together usually more or less cardiform. No supplementary fins present behind. Neck short, usually constricted. Tuberculus olfactorius shortly peduncled. Shallow funnel groove present. Ribs and connectives of buccal membrane as in the Chiroteuthinae. Arms unequal or subequal; the longest being fourth pair; protective membranes rudimentary but may be fairly-broad; suckers biserial. Tentacles long, with numerous suckers crowded in ten or more numerous series. No marked photophores on tentacles nor any on ventral arms. Also none on eye-balls.

Genus **Mastigoteuthis** Verrill, 1881.

Mastigoteuthis, Verrill 1881b, p. 100; 1882, p. 325.—Pfeffer 1900, p. 184; 1912, p. 609.—Hoyle 1904b, p. 16.—Chun 1910, p. 220.
Chiroteuthopsis, Pfeffer 1900, p. 184.
Iridioteuthis, Sasaki 1916, p. 108.

Body conical or subfusiform, bluntly pointed behind, but sometimes forming a slender, acutely pointed end-part. Fins rather terminal, often very large; their combined outline circular, or transverse-elliptical or rhomboidal, but always with a cuspidation behind. Head large, often wider than mantle. Eyes large, their opening sinuated in front. Funnel groove ill defined. Neck short, more or less constricted, with short-peduncled tuberculus olfactorius on either side of funnel. Funnel cartilage always with tragus but may be devoid of antitragus. Tentacular suckers numerous, minute, in 10–30 series. No marked photophores present on tentacles nor any on ventral arms; also none eye-balls; but they may occur as mere chromatic spots either extensively distributed on entire body or localized at certain parts of the mantle or head or fins or arm-bases.

Key to the species of *Mastigoteuthis* found in Japan.

(A) Fins shorter than $^4/_5$ body-length, arm-sucker with dentate horny rings; horny rings of tentacular suckers strongly dentate ..... *M. cordiformis.*
(B) Fins $^5/_6$ as long as body, arm-suckers with smooth horny ring; horny rings of tentacular suckers weakly dentate ..... *M. latipinna.*

Mastigoteuthis cordiformis Chun, 1908.

(Pl. XXIV, figs. 15–20.)

Mastigoteuthis cordiformis, Chun 1908, p. 88.—Ghun 1910, p. 222, pl. xxxiv; pl. xxxv, figs. 1, 5, 10–14; pl. xxxvi, figs. 3–5; pl. xxxvii, fig. 5.—Pfeffer 1912, p. 613.—Sasaki 1920, p. 200.

This species is represented by a single specimen in the collections at my disposal. The specimen is a little larger than that described by Chun, and shows many characters not made out by him.

Consistency subchoroidal. Surface smooth and soft to the touch. Mantle roughly subfusiform, broadest at a distance from the anterior margin, then tapering gradually to the central region of the fins. From this region, the sides proceed caudad nearly parallel with each other but at a distance they again converge so as to form a conical, sharply pointed end-part. As compared with Chun's illustrations, the posterior part of mantle is ill marked off from the fins (Pl. XXIV, fig. 15). Maximum breadth of body equal to 32% of its length. Anterior margin of mantle convex in the dorsal parts and concave in the ventral.

Fins very thick, somewhat stiffer than mantle in consistency; their combined outline nearly cardiform but the anterior auriculation weaker than described by Chun. The posterior cuspidation about one-fifth as long as the entire length extending posteriad as a narrow ridge along either side of the end-part of body. Total breadth of fins only slightly less than their length, which is in turn about 78% of the body-length.

Head large, a little wider than, and one-fourth as long as, mantle. Slightly disagreeing with Chun's description it widens posterad and is flattened above as well as on sides. The ventral surface a little excavated into a funnel groove, which is, though ill-defined anteriorly, well marked off by prominent ridges on sides. Eyes enormous, full; their opening triangular, with two rounded angles behind and a pointed one in front; the latter representing the sinus. Tuberculus olfactorius situated on the posterior part of each eye-prominence, papilliform, shortly stalked.

Neck deeply constricted, marked off from head at nape by a faint ridge and on sides by conspicuous posterior angles of eye-prominences. Nuchal cartilage panduriform, slightly narrowed in the middle, traversed by a longitudinal ridge with a groove along its crest. It measures 9.5 mm. in length and 4 mm. in maximum breadth.

Funnel nearly conical, well-defined even at base, thickwalled; its extremity blunt, bent below; even stretched, does not reach the centre of head. Funnel cartilage roughly auriform, of an ovate contour, blunter posteriorly than anteriorly, bordered around with a thin flat margin. Locking groove of the cartilage rather deep, ⌊-shaped, the tragus being well developed, while the antitragus is almost obliterated, being decidedly fainter than illustrated by Chun. The cartilage measures 7 mm. in length and 4.5 mm. in maximum breadth. The corresponding cartilage of mantle resembles a human nose.

Arms unequal; the formula of length being $4>2>3>1$; the longest about two-thirds as long as body. First and second pairs somewhat compressed laterally, with a weak carination on back. Third pair also compressed from side to side, the aboral surface keeled along the whole length. Fourth pair more or less cylindrical, but with a narrow web on the dorsal side. Narrow but clearly trabeculate protective membranes developed on both sides of arms.

Arm-suckers subglobular and not ovoid as illustrated by Chun; their peduncles rather short and their apertures circular or oval, with a notch at the distal margin (Pl. XXIV, fig. 19). All distinctly biserial, attached to the margin of the oral surface of arms; their number about 52 pairs on first arm and also on the third, about 60 pairs on the second, and 64 pairs on the fourth. Smooth horny ring in the basal three or four pairs of suckers (Pl. XXIV, fig. 16). The ring of the remaining suckers, equipped on the distal margin with some quadrangular close-set teeth, which number 4–6 in largest suckers and 8–11 in subterminal ones (Pl. XXIV, fig. 17). Papillate area of the ring widened distally, consisting of seven or eight series of non-papillate facetts, and bordered externally with a narrow radiated margin (Pl. XXIV, fig. 18).

Tentacles as long as mantle, elongated like a whip, their stem being cylindrical and decidedly thinner than arms. Club a little expanded, occupying the distal ⅔–¾ of the tentacle; thickest at the part one-third up the length, then tapering off distally. Aboral surface of club rounded with neither web nor keel; its oral surface also convex, bordered with narrow and finely trabeculate protective membranes.

Tentacular suckers numerous, small, crowded in numerous series; those of each transverse row

number about eight at the basal part of clubs, increasing into twelve at a short distance up and attain a maximum number of 24 at the part from middle to subterminal. Their size decreases towards the distal end of clubs and also towards their margins, the largest ones situated at the middle region of the proximol part. Individual suckers hemispherical, each with circular opening, which is notched at the distal margin (Pl. XXIV, fig. 20). Horny ring dentate in all suckers, the teeth being blunt, separate, but not so long nor so markedly recurved as illustrated by Chun. The teeth of larger proximal suckers number 20 or more, distributed on the whole edge, and are longer on the distal margin than on the proximal. In smaller distal suckers, they are found only on the distal margin, numbering 7–10. Papillate area very broad especially in smaller suckers; composed of four or five series of facetts which have a conspicuous papilla at the centre.

Cladius not examined.

Extetnal surface thickly beset with fine warts in all parts, and thickly crowded with deep brownish chromatophores which are more numerous and minute than depicted by Chun.

Measurements.

Dorsal length of mantle	90 mm.	
Ventral length of mantle	79 „	
Maximum breadth of mantle	27 „	
„ „ „ head	28 „	
Length of fins	70 „	
Total breadth of fins	67 „	
	Left	Right
Length of first arms	38 mm.	41 mm.
„ „ second arms	52 „	52 „
„ „ third arms	42 „	42 „
„ „ fourth arms	60 „	60 „
„ „ tentacles	90 „	100 „
„ „ clubs	60 „	60 „

Remarks.—The specimen referred to differs from Chun's description, as mentioned above, by the head, by the funnel cartilage, by the shape of arm-suckers, by the horny rings of tentacular suckers, and by the chromatophores. Further, it has more numerous teeth in the arm-suckers, more numerous series of facetts in their papillate area, than given by Chun, and the eye-openings have a sinus in the anterior margin which is said to be smooth in his case.

Locality.—Suruga Bay; 197 fms. (Albatross!); South of Pulo Nias, Sumatra (Chun).

Mastigoteuthis latipinna (Sasaki, 1916).

(textfig. 143.)

Idioteuthis latipinna, Sasaki 1916, p. 108; pl. iii.

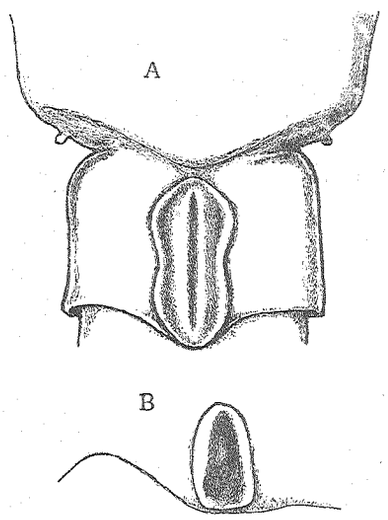
Only a single specimen has come under my observation, caught in the Sagami Sea, outside the Okinose bank. It is quite as large as its mantle measures 238 mm. in length, and is far larger than any species of *Mastigoteuthis* hitherto known.

Consistency nearly choroidal. Surface nearly smooth in all parts and soft to the touch. Body elongate-conical, being broadest anteriorly and somewhat tapering caudad, but the posterior half is not well marked off from the fins. Mantle very thick, its opening wide and free along the whole margin, of which the mid-dorsal part protrudes a little forwards, forming a short but broad triangular projection; lateral margin concave; ventral margin projecting beneath head, but its middle part slightly curving backwards. Fins very thick, large, stiffer than other parts in consisting, and about five-sixths as long as mantle; their combined outline nearly circular but acuminated posteriorly and slightly indented at the anterior attachment.

Head very large, being broader than body, and about one-fourth as long as the latter. Eyes unequal in size and shape; right eye of the usual shape, its opening provided with a shallow sinus in front; left eye of a peculiar shape, with large eye-ball and wide eye-opening twice as broad in diameter as that of the right side. Funnel groove rather shallow, smooth, its boundary edge quite rounded off at the anterior part but a little prominent at the posterior.

Neck strongly constricted, separated from head by a blunt edge. No olfactory crest developed, but there is on either side of neck a tuberculus olfactorius, which is nearly membranous and semilunar. Nuchal cartilage panduriform, narrowed in the middle, and traversed by a longitudinal median ridge with a groove along the crest (textfig. 143A).

Funnel nearly conical, short, reaching about the middle of head. Two pairs of funnel-adductors present, entirely embedded in the integument of funnel groove. Dorsal pad of funnel organ horseshoe-shaped, consisting of a very broad band, with a distinct cuspidation at the anterior end; ventral pads ovate with the blunter end behind, slightly shorter than the former. Funnel cartilage twice as long as broad, nearly auriform, ovate in contour, becoming a little wider posteriad, with a deep central groove, which also becomes wider and deeper posteriad; tragus and entitragus both faint and the latter being by far the fainter (textfig. 143B). Mantle cartilage about as long as funnel cartilage, and of a crest-like shape, as high as long, the higher and wider the more anterior, somewhat resembling a human nose, but the resembrance is less than in *Mastigoteuthis cordiformis*.



Textfig. 143.

Mastigoteuthis latipinna. A. Nuchal cartilage; ×⅔. B. Funnel cartilage; ×⅔.

Arms unequally long, the formula being 4>2>3>1; the longest a little shorter than mantle. First and second pairs a little flattened from side to side, keeled on back. Second and fourth pairs four-sided, with a web along the ventral outer edge. Protective membranes as broad as the length of suckers on all arms.

Arm-suckers of moderate size nearly hemispherical or subglobular, but by no means ellipsoidal nor ovoidal as written by Chun in *M. cordiformis;* very obliquely attached to their respective peduncles. Aperture narrow but wider than in *M. cordiformis*, notched at the distal margin, and surrounded by thick, glandular radial muscles. Arrangement of suckers distinctly biserial, each series comprising about 70 ones on dorsal and also on lateral arms, and about 65 ones on ventral arms. Horny ring thin, smooth but sometimes forming irregular horny lumps on the margin; papillate area rather narrow, thin, consisting of five or six series of facetts, which have distinct papilla at the centre.

Tentacles slender, more or less whip-like, half as thick as first arms, and as long again as mantle; stem cylindrical, being rounded in section. Club comprises the distal half of the tentacle, very gradually tapering towards the tip; a little flattened in the proximal parts but becoming cylindrical distally. Broad protective membranes border both sides of club, supported by numerous well-defined trabeculae.

Tentacular suckers helmet-shaped, oval in contour, very obliquely attached to their respective peduncles, which are as long as the depth of suckers and taper distad; aperture very wide, oval, the distal margin distinctly notched. At the base of the club they number about four in each oblique transverse row, but as proceeded distally their number in each transverse row gradually increases, thus attaining a maximum of about twenty-four in the subterminal parts. At the same time, they grow smaller: while the proximal suckers are about as long as the largest arm-suckers, those at the tip of club are very minute, so that they are scarcely visible to the nacked eye. Horny ring except in distal suckers, equipped with about ten, blunt, minute teeth set on the distal edge; often showing horny lumps of various number. The lumps are well developed in proximal suckers, usually covering up the whole edge as well as all the teeth; especially so in largest suckers, in which the lumps fuse

together into an irregular tubercled thick mass along the whole margin of the ring. The ring of distal suckers dentates on the distal four-fifths of the margin; the teeth numbering about 25, somewhat conical but bluntly pointed, and the more distal always the longer; all are quite minute as compared with those of *M. cordiformis*.

Buccal membrane broad, very thick, fleshy, soft, with seven ill-defined ribs and projections. Connectives also seven, attached to the dorsal surfaces of first and second arms, as well as to the ventral surfaces of third and fourth arms. So-called aquiferous pores present in all interspaces between connectives, hence numbering also seven.

A pair of elongate-elliptical glandular organs of unknown function is found on the inner surfaces of the ventral part of the mantle.

Color in alcohol purplish brown all over, the chromatophores being very minute and thickly crowded. No photophores discernible.

Radula and gladius not examined. For measurements, see: Sasaki 1916. p. 110.

Remarks.—The specimen referred to seems to stand very near *M. cordiformis*, but is distinguished from Chun's description by having (1) a smooth skin, (2) sinuated eye-openings, (3) far lager and more roundish fins, (4) a weaker tragus and antitragus in the funnel cartilage, (5) thicker buccal membrane and its much more feeble ribs, (6) broader protective membranes of arms, (7) far numerous and much shallower arm-suckers; (8) smooth horny ring in the same, and (9) very weakly dentate suckers on the tentacles.

Type locality.—Sagami Sea.

Type.—In Tôkyo Imp. Univ.

Subdivision 2. **Consuta** (Chun, 1910).

Oegopsida consuta Chun 1910, p. 299.

Mantle margin fused with head at the nape, and also with funnel-base on either side. Musculus depressor infundibuli membranous, expanded, serving as a horizontal septum separating the dorso-lateral part of pallial cavity from its remaining ventral part. Median vertical septum of pallial cavity rudimentary, having a very narrow extention from the blind end of mantle. Funnel-valve often absent.

Family **Cranchiidae** Prosch, 1847.

Loligopsiidae d'Orb. in d'Orb. et Fér. 1839, p. 320, (pars).
Cranchidae, Prosch 1847, p. 71 (fide Chun).
Cranchiadae, Gray 1849, p. 37.—Adams, H. & A. 1858, p. 26.
Loligopsidae, Gray 1849, p. 39.—DE Rochebrune 1884, p. 10.
Cranchiaeformes, Steenstrup 1861a, p. 70 (fide Chun).
Taonidae (*Desmoteuthidae*), Verril 1881c, pp. 300, 431.
Desmoteuthidae, Verrill 1882, p. 334.
Cranchiidae, Fischer p. 1882a, p. 340.—Pfeffer 1900 pp. 154, 188; 1908a, pp. 63, 101; 1912, p. 636.—Chun 1906a, p. 82; 1910, p. 299.—Berry 1914a, p. 345.

Oegopsid cephalopods of moderate to minute dimension; pelagic, or abyssal. Mantle membranous, transparent or semi-transparent even in the preserved state, more or less leather-like in consistency. Surface sparsely covered with somewhat large chromatophores. Mantle margin fused with head at the nape and also with funnel-base on either side. Gladius slender, forming posteriorly a rhombic or lanceolate expansion (Lanceola) terminating in a hollow end-cone, which sometimes may be greatly elongated. Eye usually large, yet small one is not rare; in this case it is peduncled and the head proper is elongated and prismatic. A minute tuberclus olfactorius present behind or below each eye though sometimes may be undiscernible. Funnel-valve often absent. Funnel-organ composed of one dorsal and two ventral pads, the latter rarely united together. Often one to three stiff or valvate

processes grow on the dorsal pad. Arms usually short, with biserial suckers only. Tentacles long; club with quadriserial suckers, of which those of the rhachial part may be transformed into uni- or bicuspid hooks; stem with uni- to quadriserial connective suckers, which sometimes alternate with fixing pads. Musculus depressor infundibuli thin, membranous, serving as a septum separating the dorso-lateral part of pallual cavity from its remaining ventral part, so that it forms in company with the dorsal pallial wall and inhalent passage for the inspirational water. Luminous organs often present on eye-balls, sometimes also within pallial cavity. One of ventral arms hectocotylized.

Key to the subfamilies of the Cranchiidae.

Mantle smooth, without even tubercled hyaline streak ..... *Taoniinae.*

Mantle evenly beset with crystalline tubercles all over or at least with tubercled hyaline streaks on the ventral surface..... *Cranchiinae.*

Subfamily **Taoniinae** Pfeffer 1912.

Taoniinae, Pfeffer 1812, p. 695.

Mantle quite smooth, without even tubercled hyaline streaks, but sometimes a few crystalline tubercles may occur at the point where the mantle margin is fastened to the funnel base or to the nape. Eye-ball usually decorated with one or two large lunar or semilunar photophores on the ventral aspect. Stomach invariably larger than caecum.

Key to the genera found in Japan.

(I) Lanceola slender, tapering gladually caudad, sometimes terminating in a long attenuate end-cone (Taonius-artige Taoniinae Pfeffer 1912).

(A) Eye large, non-pedunculate; fins large, longitudinally elongated.

(a) With filiform end-cone; rachial suckers of clubs transformed into hooks at least at maturity.

(1) Very long peculiar trabeculae supporting protective membranes; rachial suckers of clubs entirely modified into conspicuous unicuspid hooks; well-defined fixing apparatus present on carpus ..... *Galiteuthis.*

(2) Trabeculae of ordinary shape supporting protective membranes; rachial suckers of clubs transformed into bicuspid hooks at maturity; no well-defined fixing apparatus on carpus; filiform end-cone greatly extending beyond fins (Desmoteuthidae Verrill 1881)..... ..... *Taodius.*

(b) Without filiform end-cone, tentacles with suckers only..... *Megalocranchia.*

(B) Eye small, peduncled; fins rather small, the total breadth about equal to the length; a few minute crystalline tubercles present on mantle margin, no filiform end-cone.... *Crystalloteuthis.*

(II) Mantle quite smooth all over; lanceola short small, rhomboidal; fins minute (Teuthowenia-artige Taoniinae Pfeffer 1912)

(C) Eye pedunculate; eye-ball ellipsoidal, the ventral part often forming a strong rostrum .... *Teuthowenia.*

Genus **Galiteuthis** Joubin, 1898.

Galiteuthis, Joubin 1898c, p. 279.—Chun 1910, p. 382.—Pfeffer 1912, p. 731.
Taonidium, Pfeffer 1900, p. 192.—Chun 1909a, p. 86.

Mantle quite smooth throughout, slenderly fusiform, truncated anteriorly, tapering caudad to a fine attenuate extremity. Lanceola of gladius exceedingly slender, terminating posteriorly in a filiform and tubular end-cone. Fins in adult, large, much longer than broad, both together being lanceolate, not auriculate either in front or behind; attached terminally to body. Head in young, of quite primitive, structure, shaped as in most other cranchiids, but at maturity it attains a development into shape found in the higher oegopsids, the eye-balls undergoing a change from the exposed and pedunculate condition to the immersed and non-pedunculate. Arms comparatively long; suckers biserial

throughout. Protective membranes united together at the proximal part into an internal umbrella. Trabeculae of the membranes well developed, extending beyond their margins; at maturity those of the distal part of arms become separate cirriform appendages, the membrane between these being almost obliterated. Tentacles with well-defined clubs, which are bordered with broad trabeculate protective membranes; biserial connective suckers on the stem; compact fixing apparatus on the carpus, consisting of several minute suckers and pads. Tentacular club armed with quadrial suckers, of which those of the hand margins disappear at maturity while about twelve at the middle are transformed into conspicuous unicuspid hooks. Pancreas compact, in contact with liver.

Type.—Galiteuthis armata Joubin 1898.

Galiteuthis armata Joubin, 1898.

(Pl. XXV, figs 1–6; textfig. 144.)

Galiteuthis armata, Joubin 1898c, pp. 279, 292, figs. 1–9.—Pfeffer 1912, pp. 731–735—Sasaki 1920, p. 200.—Issel, 1920, p. 12, figs. 13–21.—Robson 1926a, p. 8.

Galiteuthis (*Taonidium*) *suhmi*, Chun 1910, p. 382, pl. lix, figs. 1–11.

Galiteuthis phyllura, Berry 1911, p. 592.—Berry 1912a, pp. 315–317. pl. xlvi, figs. 1–3; pl. liv, figs. 5, 6; pl. lvi; textfigs. 17, 18.

Two excellent specimens of this rare striking species caught by the "Albatross" have been at my disposal for examination (Pl. XXV, figs. 1, 5). The larger of the two specimens is far larger than any so far measured and shows many notewhorthy characters not made out.

Animal exceedingly delicate, nearly translucent, with a thin, smooth, membranous mantle. Body in adult, markedly elongated, about one-tenth as broad, cylindrical in the anterior one-fourth, then tapering posteriad to the origin of fins, where the body-breadth is about one-fourth that at the anterior part. The remaining part of body is attenuated, almost inperceptively narrowing posteriad, thus forming a very slender needle-shaped end-part containing little but the gladius. Anterior margin of mantle rather even, without marked dorsal projection or ventral emargination, fused with head at the nape and also with funnel base on sides as is usual in cranchiids.

Fins large, rather terminal; their combined outline lanceolate, 1/5–1/4 as broad as long, narrowing more gradually posteriad than anteriad. They extend posteriad as very narrow continuations along both sides of the needle-shaped end-part to its extreme end. Their total breadth about equal to the maximum body-breadth and their length slightly less than half the body-length.

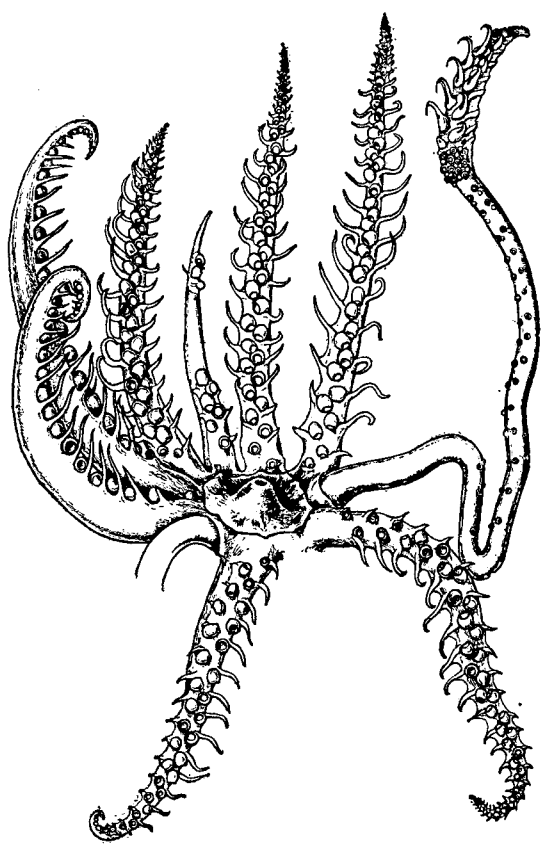
Head in adult, small, being far narrower than body, of roughly three-sided prism, one side represented by the dorsal surface, and the other two, by the lateral surfaces (Pl. XXV, fig. 2). The dorsal surface is not evenly flat but depressed in the middle, the depression defined behind by a prominent nape. The ventral surface is represented merely by an edge of the said prism although it is not shaply angled. It has a groove along its crest bordered with stiff ridges on sides. The groove widens posteriorly where it reveals itself as a funnel groove; but the latter is occupied by a large bundle of funnel-adductors so that it shows no real concavity. Eyes extensively covered with eye-lids as in higher oegopsids. Eye-opening situated near the interspaces between third arm and tentacle; small, triangular, with a pointed angle in front and two rounded ones behind, the former angle representing the sinus of the lid. Distance between the two rounded angles about one-third the maximum depth of head.

The head of the young, differs in many respects from that of the adult. It shows the ordinary structure as found in most crauchiids, agreeing with Joubin's description. Its breadth inclusive of eyes is greater than that of body. The eye-balls are large, naked, projecting, and more or less peduncled (Pl. XXV, fig. 5). When they are not taken into consideration, the head is somewhat prismatic and is marked off from arms by a distinct constriction.

Funnel short, hardly extending to the centre of head; expanded proximally, tubular in the distal parts, which curves ventrad. Funnel organ composed of one dorsal and two ventral pads as usual

(Pl. XXV, fig. 3). The dorsal pad is of inverted sheald-shape, rounded in the anterior end and a little expanded in the posterior, which forms two rounded lobes. There are on the pad three long stiff bluntly-pointed processes, one of which grows from the middle and the other two from the two posterior lobes. The ventral pads are small, being only half as long as the dorsal, and squarish in outline, but slightly elongated transversally and all the angles rounded. In the larger specimen alluded to the dorsal pad measures 7.3 mm. in breadth and also in length; the ventral pads 38 mm. in length (longitudinal) and 4 mm. in breadth (transverse).

Arms slender, unequally long, the formula of length being $4>3>2>1$, the longest about one-fifth the length of body. All roundish in section, uniformly tapering distad. Their protective membranes quite peculiarly constructed, forming an internal umbrella between the bases of arms and suspended by slender trabeculae, which project beyond the margin of the membrane so as to render the latter sharply crenated. At maturity the membranes disappear between these trabeculae except at the arm-bases where the internal umbrella is formed. The trabeculae are thus converted into slender cirriform separate appendages which much recall the cirri of arms in the Cirroteuthidae. They are as long as, or even longer than the thickness of arms, and always somewhat longer on the ventral side than on the dorsal side of each arm. This difference of length is especially marked on the ventral arms, where the trabeculae of the dorsal side are exceptionally short, measuring less than the thickness of the arms (textfig. 144).



Textfig. 144.

Galiteuthis armata. Inner aspect of arms; $\times 5/4$.

Arm-suckers subglobular, as long as deep, equally sized in all arms, arranged in two alternate series. They number in the larger specimen alluded to, 30 pairs on each arm. Their aperture round, rather wide, without notch at the distal margin. On each arm, they commence proximally by a small sucker situated some distance from the base, becoming gradually larger distad and attain their maximum size about half way along the length, the largest measuring 3–4 times the diameter of the proximalmost. Beyond the middle of the arms the suckers become smaller toward the extremity, where are found their five or six pairs as minute as hardly discernible with the naked eye. Horny ring smooth in all suckers.

Tentacles (Pl. XXV; figs. 4, 6) half as mantle, their stem a little thinner than arms, squarish in section, with flat or even slightly concave oral surface, which has a faint streak along the median longitudinal line. Club a little expanded, lanceolate in contour, having neither web nor keel on back, but bordered with fairly broad protective membranes on sides. On the stem, there occur 20 pairs of minute connective suckers sparsely set in a longitudinal series along the distal two-thirds, and are found on the distal part 6–8 pairs of obscure fixing pads alternating with the sucker-pairs. Distally, the connective suckors are joined with the fixing apparatus of carpus. The apparatus consists of a compact group of 10–12 suckers and six or seven pads, not marked off by fold. Hand armatures in the young are composed of about 24 suckers forming four longitudinal rows. At maturity, those of the rachial two series undergo a change into hooks, while those of the marginal two series entirely disappear. In the larger specimen referred to, the hooks appear subequal except the two proximalmost, which are no doubt far smaller than the others, and largest hook measures 2.5 mm. in

length. The distal portion of club is rather short, provided with about 20 minute suckers arranged in four series even at maturity.

Buccal membrane broad, thin, with seven weak ribs slightly projecting beyond the margin. Connectives also seven, thin, fastened to the dorsal surfaces of first and second arms as well as to the ventral suafaces of third and fourth arms. Inner surface of the membrane wrinkled. Buccal mass projects in a cone from the centre of the membrane. Outer lip thin, smooth; in the adult it is evenly tinged with a violet, the curomatophores being joined together at a glance, but in the young they are separate so that the lip is not evenly tinged but dotted comparatively sparsely. Inner lip thick, papillate at margin.

Whole outline of gladius traceable from outside along the mid-dorsal line of mantle, slender, carinated along the whole length; parallel-sided in the anterior one-fifth, then very gradually widening to a little distance in front of the fins. From this point it tapars posteriad, but its sides curve ventrad so as to form a very slender hollow end-cone of a needle-like appearance. The maximum breadth of gladius equals about $^1/_{45}$ of its entire length.

Brownish purple chromatophores are thickly crowded on the dorsal surface of head, inner surface of buccal membrane, and sucker-bearing surface of arms; elsewhere they are sparsely scattered.

Measurements of Specimens Examined.

No.	i		ii	
Dorsal length of mantle	270 mm.		109 mm.	
Breadth of mantle	27 ,,		15 ,,	
Length of fins	140 ,,		50 ,,	
Total breadth of fins	30 ,,		10 ,,	
Length of head	16 ,,		10 ,,	
Breadth of head	18 ,,		15 ,,	
Length of first arms	Left 30 mm.	Right 38 mm.	Left 10 mm.	Right 10 mm.
,, ,, second arms	47 ,,	46 ,,	14 ,,	14 ,,
,, ,, third arms	50 ,,	50 ,,	20 ,,	17 ,,
,, ,, fourth arms	55 ,,	56 ,,	20 ,,	20 ,,
,, ,, tentacles	106 ,,	110 ,,	57 ,,	57 ,,
,, ,, clubs	15 ,,	15 ,,	4 ,,	7 ,,

Locality.—Staritschkof I. near Kamchatka (Albatross!); Bering Sea (Albatross!); Montery Bay, California (Berry); Nizza (Joubin); Guinea Current (Chun); Messina (Issel); South Africa (Robson).

Bathymetric distribution.—764 fms. (Alb.!); 682 fms. (Alb.!), between 1 m. and 2500 m. (Chun); between 780 fms. and fms. (Berry); 900 fms (Robson).

Genus **Taonius** Steenstrup, 1861.

Loligopsis (pars), d'Orb. et Fér. 1839, p. 320.—Gray 1849, p. 39.—Tryon 1879, p. 162.

Taonius, Steenstrup 1861a, pp. 70, 85.—Verrill 1881c, p. 306; 1882. p. 339.—Pfeffer 1900, p. 190; 1908a, p. 102; 1912, p. 702.

Desmoteuthis, Verrill 1881c, p. 300; 1882, p. 335.

Mantle smooth all over, elongated, tapering posteriad to a slender filiform end-part, which extends beyond the fins. Fins rather large, their combined outline lanceolate, attenuated posteriorly. Eyes enormous, projecting; their opening narrow and simple. Tuberculus olfactorius attached to the posterior surface of eye-prominences. Arms somewhat unequal, with biserial suckers, without hooks. Tentacles a little expanded distally, forming lanceolate clubs. Club-armatures when young, composed of four series of suckers, of which those of the rachial two series on the hand are far larger than

others. At maturity the horny rings of these larger suckers undergo a change into peculiar bicuspid hooks. On the extreme tip of the club is formed a triad of minute suckers, separated from others by a nacked space. Paired series of connective suckers present along the stem, alternating with paired fixing pads. Gladius thin, slender, with a conspicuous lanceola terminating in a markedly elongated end-cone which forms the axis of the filiform end-part of body.

Type.—*Loligo pavo* Lesueur, 1821.

Taonius pavo (Lesueur, 1821).

(Textfigs 145–147.)

Loligo pavo, Lesueur 1821, p. 96 (fide Pfeffer).

Loligopsis pavo, d'Orb. et Fér. 1839, p. 321; Calmars pl. vi, figs. 1–3a b; Loligopsis pl. vi, figs. 1–3 (? 5, 5 bis, 6)—Gray 1849, p. 40.—Tryon 1879, p. 163, pl. lxviii, fig. 252; pl. lxix, fig. 253.—Rochebrune 1884, p. 11.—Hoyle 1884, p. 318.

Taonius pavo, Steenstrup 1861a, pp. 70–84 (fide Joubin).—Verrill 1881c, p. 306; 1882, p. 840.—Hoyle 1884, p. 318; 1886b, p. 45.—Joubin 1899, p. 73; 1900, p. 106, pls. viii, ix; pl. x, figs. 7–9; pl. xv, fig. 16.—Pfeffer 1900, p. 191; 1908a, p. 102, figs. 117, 118; 1912, p. 704.—Chun 1910, p. 366.—Sasaki 1920, p. 201.

Desmoteuthis hyperborea, Verrill 1881c, p. 302, pl. xxvii, figs. 1, 2; pl. xxxix, fig. 1; 1882, p. 336, pl. xxiv, figs. 1, 2; pl. xxv.

This rare species is presented by two excellent specimens in the collections which I had access to. The larger of the two specimens is quite as large as the example described by Verrill under the name of *Desmoteuthis hyperborea*, although it is a little smaller than that of Joubin's, which is the largest ever described.

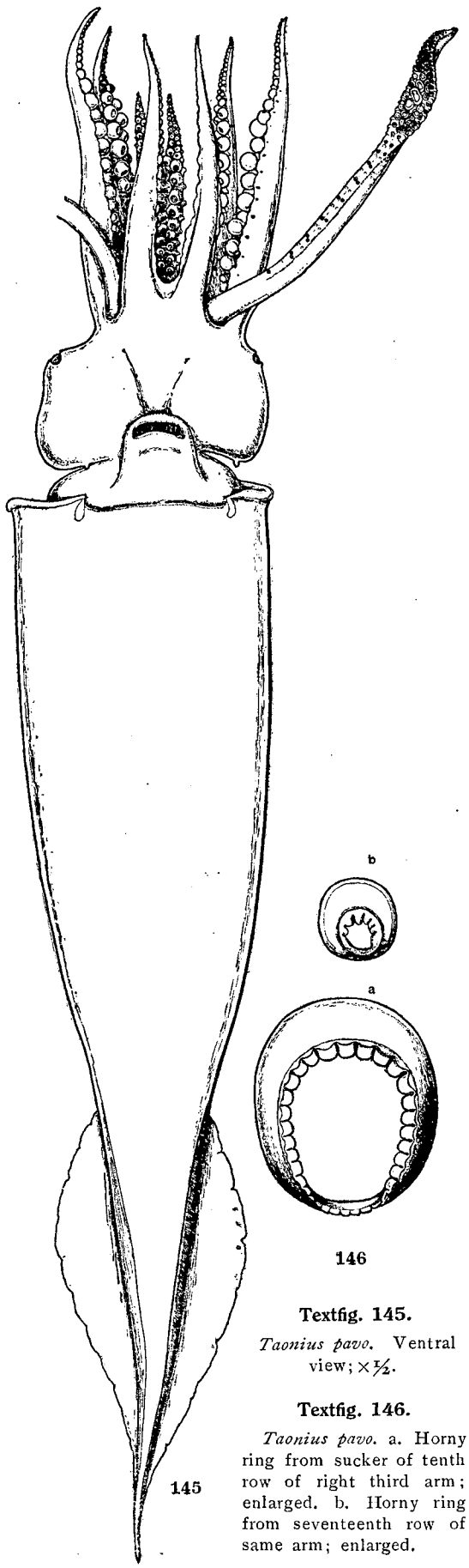
Body elongated, four or five times as large as in breadth, the broadest part being somewhat behind the anterior margin. From this place it gradually tapers caudad to an attenuated filiform end-part extending beyond the fins (textfig. 145). Mantle rather thin, somewhat tough, enclosing a spacious branchial cavity. Anterior margin of mantle slightly projects at the mid-dorsal part, where it is fastened to the nape; ventral part of the margin also fastened to funnel-base on either side, where is found a minute, oblong, naked, hyaline macula. Fins very long, subterminal, their combined outline lanceolate, sharply acuminated posteriorly, with the anterior ends of insertion wide apart from each other. Their length decidedly greater than twice their total breadth and equal to one-third of the mantle-length.

Gradius traceable on the back of mantle, extending its whole length. It is slender, of nearly uniform breadth in the anterior half and then gradually widens to the point a little anterior to the middle of fins. From this point it gradually narrows posteriad, thus a conspicuous lanceola is formed in the fin-bearing region of mantle. The lanceola extends beyond the fins as a slender, very long, hollow end-cone forming the axis of the filiform end-part of body.

Head comparatively short, but very wide if the eyes are taken into consideration. It is concave above, furrowed below, deeply constricted in front as well as behind. Eyes enormous, full, roundish, projecting laterad. Eye-opening narrow, circular, anteriorly situated. A tuberculus olfactorius present on the posterior surface of each eye-prominence. Funnel groove not well-specialized, represented by the longitudinal furrow of the ventral surface of head. Funnel conical, widely expanded at base, extending less than to the middle of head; its distal opening transversally lengthened.

Arms short, rather unequal, the formula of length being $3>2\doteqdot4>1$; longest about one-fourth as long as mantle. All more or less roundish in section. Third pair weakly keeled in the proximal half. Fourth pair with a web on the dorsal outer surface. Protective membranes narrow except their proximal part, which are wide and connected together into an internal umbrella.

Arm-suckers biserial throughout, sparsely set in the proximal parts of arms and crowded in the distal parts, numbering twenty-pairs or more on each arm. Larger suckers nearly hemispherical



145

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Textfig. 145.

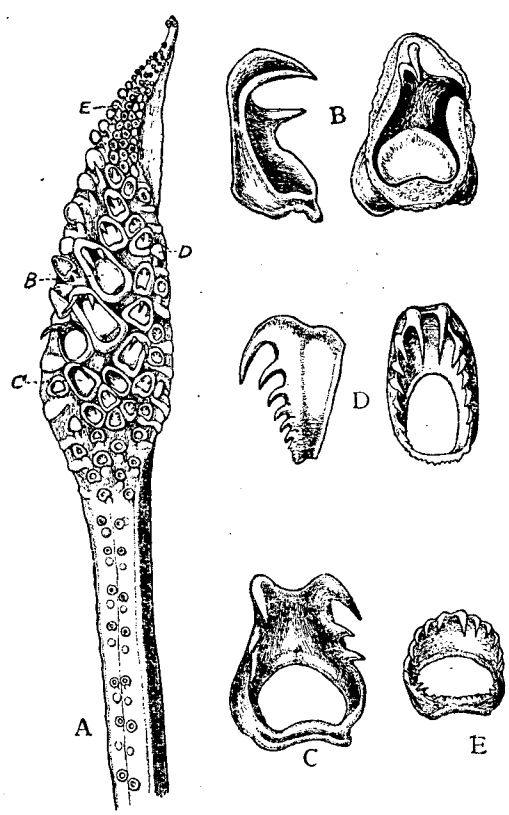
Taonius pavo. Ventral view; ×½.

Textfig. 146.

Taonius pavo. a. Horny ring from sucker of tenth row of right third arm; enlarged. b. Horny ring from seventeenth row of same arm; enlarged.

being half as deep as wide; smaller ones nearly globular, being much deeper than the preceding. On each arm they begin by a minute suckers at base, somewhat rapidly increasing in size to about the eighth pair, beyond which they decrease at first somewhat rapidly but gradually afterwards. Horny ring of larger suckers dentates on the whole margin, the teeth numbering 20–30, broad, and closely set; same of distal suckers dentate at the distal margin, the teeth numbering 6–8 only (textfig. 146). In proximal suckers, all teeth are united together so that the ring appears smooth save for several sinuations of the distal margin.

Tentacles a little shorter than twice the longest pair of arm; their stem about as thick as first arms. Club expanded, lanceolate, tapered at the extremity, bordered with distinct trabeculate protective membranes on sides and furnished with a narrow dorsal web along the distal half.



Textfig. 147.

Taonius pava. A. Tentacular club, ×4/3. B C. Horny rings of its suckers; these positions are referred to in A.

Tentacular sucker (textfig. 147) unequal, arranged in four series but may be crowded into more numerous series owing to their mutual compression. Distal minute suckers subglobular, their horny ring dentate along the distal three-fourths; the teeth

numbering 8–15, sharply pointed, caniniform and becoming longer towards the distalmost margin where the two teeth are by far the longest of all. Marginal hand-suckers constructed nearly as in the preceding suckers, but larger, more flattened, and more elongated. Rachial hand-suckers very large; especially so are the three or four in the ventral rachial series, these being tub-shaped, with wide oblong apertures. The horny ring of rhachial hand-suckers, which is evenly dentate on the whole margin in the young, undergoes a marked metamorphosis during the development, lengthening longitudinally, the distal margin becoming thicker, the two distalmost teeth greatly developing, while the remaining teeth disappear; thus a peculiar bicuspid hook is formed in each sucker at maturity. Carpal suckers sparsely set in four series, each accompanied by a fixing pad proximally. Their horny ring generally smooth, but very rarely dentate. Eight or nine pairs of connective suckers present on stem, extending the whole length and regularly alternating with so many pairs of fixing pads.

Buccal membrane broad, rather thick, suspended by eight ribs, of which the two dorsalmost are united distally into a common tip so that there are only seven processes on the margin. Connectives number eight, continuous with the internal umbrella, fastened to the dorsal surfaces of first and second arms and to the ventral surfaces of third and fourth arms.

Measurements.

No.	i	ii
Dorsal length of mantle	330 mm.	179 mm.
Ventral length of mantle	315 ,,	176 ,,
Maximum breadth of mantle	75 ,,	38 ,,
Length of fins	120 ,,	65 ,,
Total breadth of fins	57 ,,	23 ,,
Length of first arms	Left 75 mm. Right 75 mm.	Left 17.9 mm. Right 21 mm.
,, ,, second arms	91 ,, 90 ,,	40 ,, 33 ,,
,, ,, third arms	93 ,, 93 ,,	38 ,, 40 ,,
,, ,, fourth arms	— 90 ,,	33 ,, 33 ,,
,, ,, tentacles	120 ,, 120 ,,	73 ,, 73 ,,
Diameter of largest sucker of first arms	5.2 mm.	—
,, ,, ,, ,, ,, second arms	6.2 ,,	—
,, ,, ,, ,, ,, third arms	6 ,,	—
,, ,, ,, ,, ,, fourth arms	3.2 ,,	—
,, ,, ,, ,, ,, tentacles	5.2 ,,	—

Locality.—Near Koshiki Is., Kiushiu 369 fms. (Albatross!). Sandy Bay (Lesueur); Gulf stream (Verrill); Madeira (Joubin); from stomach *Diomedea fuliginosa* caught at 58° 52'S., 43°E. (Chun).

Genus **Megalocranchia** Pfeffer, 1884. *s. str.*

Megalocranchia, Pfeffer 1884, p. 24; 1912, pp. 645, 711 (pars).—Berry 1914a, p. 348 (pars).
Desmoteuthis, Pfeffer 1900, p. 191 (pors).

Mantle subfusiform, sharply pointed behind, its surface quite smooth even at the anterior margin. Fins rather large, their combined outline longitudinal-elliptical, extending beyond the posterior end of mantle. Eyes very large, with a tuberculus olfactorius on the ventral surface. Ventral surface of eye-balls with a large semilunar, and a small crescent-shaped photophore. Arms unequal, bordered with broad markedly trabeculate. protective membranes; their suckers biserial. Tentacles a little expanded distally into a lanceolate club; their armatures composed of suckers only even at maturity, those on the club quadriserial, continued to the middle of the stem as connective ones which are bi-

to quadri-serial. No fixing pads present either on the stem or on the carpus. Gladius with rather small, slenderly rhomboidal lanceola sharply pointed posteriorly. Visceral organs aggregated into a compact mass at the centre of pallial cavity; stomach and caecum both small and not extending so far posteriad as usual.

Type.—*Megalocranchia maxima* Pfeffer, 1884.

Megalocranchia maxima Pfeffer, 1884.

(Pl. XXV, figs. 7–9; textfig. 148.)

Megalocranchia maxima, Pfeffer 1884, p. 24, figs. 32, 32a; 1912, p. 712, pl. xlviii, figs. 1–4.—Sasaki 1920, p. 201.

Taonius maximus, Hoyle 1886b, p. 45.

Desmoteuthis maxima, Pfeffer 1900, p. 192.—Chun 1910, p. 356.

A large specimen caught by the "Albatross" has been at my disposal for examination. It is a mature male, far larger than the specimen described by Pfeffer.

Body subfusiform, parallel-sided in the anterior half, then tapering caudad; but the taper becomes very gradual at the end-part, which is slender, and sharply pointed, containing little but gladius (Pl. XXV, fig. 7a). Mantle thin, membranous, tough, and quite smooth even at the anterior margin, which is fastened to head at the nape and to funnel base on either side as is usual in cranchiids. The ventral part of the margin shows a broad distinct emargination, marked off by points on sides.

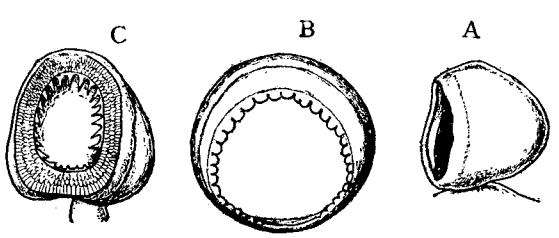
Fins rather large, a little longer than one-third the body-length, far extending beyond the posterior end of mantle. Their combined outline longitudinal-ovate, more acuminate posteriorly than anteriorly (Pl. XXV, fig. 7b). The total breadth about two-thirds the length.

Gladius only partly visible through the integument. Its lanceola slenderly rhomboidal, for more sharply pointed posteriorly than anteriorly, extending for the anterior half of the fins, and continued as a linear streak to their posterior end.

Head proper prismatic, four-sided, breadth of head including eyes about that of body. Eyes enormous, full, globular, constricted at base, but covered with eyelids, which have a small opening at the antero-lateral part. Umbrella obliterated. No funnel groove specialized.

Funnel large, thin-walled, conical, markedly expanded at base, its blunt extremity only a little curving ventrad. No internal valve present. Funnel organ composed of one dorsal and two ventral pads. The dorsal pad two-thirds as broad as long, $\wedge$-shaped but with truncated apical angle; the backwardly directed lobes thumb-shaped with a triangular membranous process along their entire length. The ventral pads ovate in contour, the long-axis transverse, about half as long as the preceding pad (Pl. XXV, fig. 8).

Arms muscular in consistency as usual, rather, unequal, the formula being $3>4>2>1$; the longest about one-third as long as body. All more or less keeled or webbed on back, the keel of third arms being by far the strongest. Their protective mambrane well developed on either side, but that of the dorsal side in ventral arms is rather rudimentary. Trabeculae of the membrane strong, projecting beyond its margin in all arms. As the animal grows older, the membrane in the distal parts of arms disappears between the trabeculae; so that the latter remain in situ as cirriform separate appendages. This fact refers most to the lateral arms where the obliteration of the membrane extends as far as half down the length (Pl. XXV. fig. 9).



Textfig. 148.

Megalocranchia maxima. A. Largest arm-sucker; × 20. B. Horny ring of A; × 35. C. Largest tentacula sucker; × 35.

Arm-suckers hemispherical, obliquely attached to their respective peduncles, rather closely set in two series, numbering about forty in each arm (textfig. 148A). They somewhat rapidly increase

to the fourth or fifth pair, then follow six or seven pairs of equally large suckers; beyond these they gradually decrease in size towards the extremity. Horny ring dentate nearly all round, the teeth being mostly semilunar or quadrangular, closely set, gradually becoming larger towards the distalmost edge (textfig. 148B). In the largest suckers of lateral arms the teeth number more than thirty. Papillate area narrow, but its radiated margin is comparatively broad.

Tentacles about half as long as body, their stem a little thinner than arms, with a flat oral surface. Club a little expanded, lanceolate in outline, comprizing a little less than one-third the length of tentacles; its protective membranes narrow, frill-like. Dorsal web becomes wider distally, running along the whole length of club.

Tentacular suckers quadriserial on the club, where those of the ventralmost series are by far the largest. The suckers of each longitudinal series become rapidly larger one-third up the club, and then decrease in size towards the extremity, the decrease being not regular but rapid at first and very gradual afterwards. Proximally, the suckers are continued as a connective ones to the middle of stem; at first, they are still quadriserial as on the club, but soon undergo a change into a biserial arrangement, and simultaneously their distribution thins off. Horny ring equipped with sharp, slightly curved teeth, which are in larger club-suckers evenly set on the whole margin, numbering about 25, and becomes regularly longer towards the distalmost part of the margin (textfig. 148C).

Viseral organ aggregated into a rounded mass located at the centre of pallial cavity. Stomach and caecum both small, not extending so far as usual. Ink-bag large. Anal valve longly pedunculate, as long as the thickness of rectum. Vena cava greatly winding. 36 branchial leaflets form a gill.

Ocular photophores undiscernible, owing to the unsatisfactory preservation of eye-balls.

Measurements.

Dorsal length of mantle including fins	60 mm.	
Ventrel „ „ „ „ „	63 „	
Breadth of mantle	20 „	
Length of fins	14 „	
Total length of fins	20 „	
Fin extention beyond the posterior end of body	12 „	
Distance between anterior attachments of fins	7 „	
Length of dorsal pad of funnel organ	5 „	
	Left	Right
Length of first arms	12 mm.	12 mm.
„ „ second arms	16 „	16 „
„ „ third arms	21 „	21 „
„ „ fourth aams	17 „	17 „
„ „ tentacles	30 „	30 „
„ „ clubs	10 „	10 „
Diameter of largest arm sucker	0.8 mm.	
„ „ „ tentacular	0.4 „	

Remarks.—The specimen referred to agrees well with Pfeffers description but differs in the fins less auriculated anteriorly, in the eyes more constricted at base and in the obliteration of the protective membrane between its trabeculae at the distal parts of arms.

Locality.—West of Osumi Group, Kiushiu 361 fms. (Albatross!). Cape of Good Hope (Pfeffer).

Genus **Crystalloteuthis** Chun, 1906.

Gen. nov. cranchiidarum, Chun 1903, p. 232.

Crystallotcuthis, Chun 1906, p. 85; 1910, p. 304.—Pfeffer 1912, p. 726.

Mantle subfusiform, sharply pointed posteriorly but not forming attenuated end-part. A crystalline tubercle present on either side of the ventral mantle-margin where the mantle is fastened to the

funnel base; also such another may be found on either side of the nuchal attachment of mantle margin; elsewhere the body is quite smooth. Fins rather small, terminal; their combined outline rhombic or shealed-shaped. Eyes stalked, the peduncle being swollen and not constricted. Eye-ball oval or rhombic in contour, decorated with a large photophore on the ventral surface. Arms very short, subequal, with biserial suckers. Tentacular club well-defined, slightly expanded, its aboral surface rounded, without dorsal web. Tentacular armatures composed of suckers only even at maturity, being quadriserial on the club and biserial on the stem, not forming any special group on the tip. No fixing pads present on the carpus, nor any on the stem. Gladius very slender, but its posterior end expanded into more or less rhomboidal lanceola. Stomach large, with a single constriction near its caecum, which is far smaller than the stomach.

Type.—Crystalloteuthis glacialis Chun 1906.

Crystalloteuthis behringiana Sasaki, 1920.

(Pl. XXV, figs. 10–15; textfig. 149.)

Crystalloteuthis behringiana, Sasaki 1920, p. 202, pl. xxvi, fig. 4.

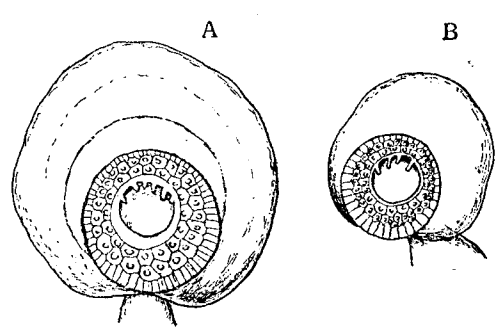
Many specimens are found in the "Albatross" collection at my disposal, their mantle-length ranging from 11 mm. to 27 mm.

Body subfusiform, about one-third as broad as long, the broadest part being a little before the middle, whence it somewhat quickly tapers caudad to an acute end (Pl. XXV, fig. 10). Mantle very thin, membranous, nearly transparent; its anterior margin truncated, forming neither marked projection nor emargination, fastened to head at the nape and to funnel base on either side as is usual in cranchiids. At each junction of mantle margin to the funnel base, there is a small elongated hyaline area, which has a bifid crystalline tubercle at the anterior end. Fins terminal, small; their combined outline being that of a inverted Norman shield; the total breadth slightly greater than the length, which is in turn about one-ninth the length of mantle.

Head proper small, prismatic, four-sided. Eyes nearly mallet-shaped, projecting anteriorly and laterally, and then curving ventrally; their peduncle swollen, not constricted (Pl. XXV, fig. 12). Eyeball very obliquely attached, its contour being of a rounded lozenge, the ventral angle of which is somewhat prominent though not rostrated. A single large semilunar photophore extends over the ventral aspect of eyeballs.

Funnel fairly large, expanded at base, tubular at extremity, which does not quite reach the bases of the ventral arms; aperture ample, transversely elongated. Funnel organ composed of one dorsal and two ventral pads as usual. The dorsal pad quadrilateral, two-thirds as deep as broad, a little expanded proximally, somewhat rounded anteriorly, bearing a long stiff process at the center. The ventral pads of rounded quadrangle, about half as broad as the preceding pad (Pl. XXV, fig. 11).

Arms very short, nearly conical, being rounded on back, without carination. Dorsal pair decidedly shorter than the others, which are of about equal length and a little shorter than one-third the length of body. Umbrella quite rudimentary. Suckers closely set in two series, numbering about ten pairs on dorsal arm, and twelve or thirteen pairs on each of the remaining arms. On each arm they rapidly and regularly decrease in size distad, the basalmost being the largest (Pl. XXV, fig. 13). Horny ring equipped with 5–7, narrow, blunt teeth along the distal margin (textfig. 149A).



Textfig. 149.

Crystalloteuthis behringiana. A. Arm-sucker; ×217. B. Tentacular sucker; ×217.

Tentacles about twice as thick, and four or five times as long, as arms. Stem cylindrical but flattened on the oral side. Club obscurely marked off from stem, only a little expanded, terminating in a blunt

extremity; oral surface flat, nearly lanceolate in outline; aboral surface rounded, without dorsal web. Armatures of club consist of four series of crowded suckers even at maturity. They number about 45, subequal, but the central ten or twelve are somewhat large than the others, and those of the dorsalmost series are smallest of all. About 35, minute, uniform, connective suckers are found on each stem, sparsely set in two series, extending from the near the base to the carpus where they are connected with the suckers of club, the biserial arrangement undergoing a sudden change into the quadriserial of the latter. Horny ring of club-suckers almost as in arm-suckers but the teeth more slender and less numerous (textfig. 149B).

Gladius traceable on the back of mantle, extending its whole length, very narrow, but a little expanded posteriorly into a slender lanceola. In the adult the lanceola as much gradually tapers posteriorly as anteriorly although in the young the posterior taper is much quicker than that of the anterior. The anterior end of gladius is also expanded a little, the outline of the expansion becoming rhombic at maturity.

About 45, branchial leaflets form a gill. Stomach with a single constriction near its caecum which is ovoidal and ¼–⅕ as long as the stomach. Liver ellipsoidal, having the long-axis almost at right angles to that of mantle. Pancreas massive, lying on the ventral aspect of liver, its posterior end far separated from caecum. The two bile-ducts are connected with the pancreas near their exits from the liver and then united together; hence the hepato-pancreatic duct is Y-shaped.

Chromatophores large, maroon in color, numbering two beneath head, three on its back, two on the dorsal surface of eye and also on its ventral surface, one on the dorsal surface of funnel, three on the stem of tentacles and four on their club.

Measurements of largest Specimen Examined.

Length of body	27 mm.
Breadth of body	9.2 ,,
Length of head	3.2 ,,
,, ,, fins	3 ,,
Total breadth of fins	4 ,,
Length of second arms	2.3 ,,
,, ,, tentacles	13 ,,

Remarks.—The species differs from *C. gracilis* Chun at least in having no crystalline tubercles on the mid-dorsal part of the mantle margin, and only one process, instread of three, on the dorsal pad of the funnel organ.

Locality.—Near Near Is. Alleutians (Albatross!), near La Perouse Strait (Albatross!); near Toperkos I. hbr of Nikolski, Bering Is. (Albatross!); off Erimo-zaki, Hokkaido (Albatross!).

Type locality.—Attu I. Aleutian Is.

Type.—In U. S. Nat. Mus.

Genus **Teuthowenia** Chun, 1910, *s. str.*

Teuthowenia, Chun 1910, pp. 304, 376.
Teuthowenia (*Teuthownia*), Pfeffer 1912, p. 742.

Mantle more or less saccular, rather bluntly terminating posteriorly; surface entirely smooth even at the anterior margin. Fins terminal, minute, forming an indentation in the middle of the combined posterior edge. Eyes pedunculate. Eyeball oval or rhombic in contour, the ventral end often projecting into a marked rostrum; ventral surface may be decorated with a large semilunar photophore. Arms very short; the longest shorter than one-seventh the mantle-length; suckers biserial throughout. Tentacles long; club more or less expanded, with a broad dorsal web. Tentacular armatures consist of suckers only, extending nearly the whole length of tentacles, arranged in bi- to quadriserial on the stem and distinctly quadriserial on the club. Gladius streak-like, but forming a minute rhombus in the anterior end and a small rhomboidal lanceola at the posterior.

Type.—*Teuthowenia antaractica* Chun, 1910.

Key to the species found in Japan.

(A) Eyeball with a strong recurved rostrum; tentacular suckers with large broad teeth; dorsal pad of funnel organ quanrilateral ..... *T. tagoi* n. sp.

(B) Eyeball not markedly rostrated; tentacular suckers with minute slender teeth, dorsal pad of funnel organ Λ-shaped ..... *T. elongata* n. sp.

Teuthowenia tagoi sp. nov.

(Pl. XXVI, figs. 1–6; textfig. 150.)

This species is based on a single specimen found in Tago's collection.

Body slenderly barrel-shaped, about three times as long as broad, widening to one-third the length from the anterior end tapering posteriad, where the taper is very rapid, but terminates in a very sharp and cuneiform process (Pl. XXVI, fig. 1). Mantle tough, membranous saccular, quite smooth even at the anterior margin, which is attached to the hend at the nape and also to the funnel-base on either side as is usual in cranchiids. The attachment does not quite extend to the extreme edge of the margin so that the latter remains free all round. Fins small, terminal, orbicular, but their combined outline being a Cassinean oval. Their length about two and a half times their length and about one-twelfth the length of mantle.

Gladius visible from outside as a very thin streak extending the whole dorsol length of mantle. It is of uniform breadth except at both ends, where it is expanded. The expansions of the ends are both rhomboidal, but that of the anterior end is much smaller than that of the posterior. The latter is more sharply pointed posteriorly than anteriorly and wedges in between the fins with the whole length of its posterior triangular part.

Head proper small, very narrow, and of a four-sided prism. Eyes oblique, mallet-shaped, projecting anteriorly and laterally, then turning ventrally; their peduncles prismatic (Pl. XXVI, figs. 2, 3). Eyeball elliptical or rather rounded-rhomboidal in contour, vertically elongated; the ventral end much more sharpened than the dorsal, projecting in a peculiar recurved rostrum. No photophores discernible on the eyeball. Eyelid entirely extends over the eyeball save for a minute slit-like opening. A minute tuberculus olfactorius present on the ventral surface of eye-peduncles. Umbrella quite rudimentary.

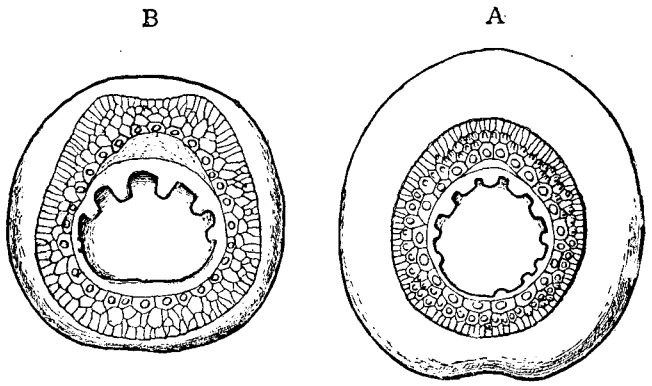
Funnel comparatively large, conical, expanded at base, its distal end more or less tubular, curving ventrad, with a transversely elongated, slit-like aperture. Funnel organ composed of one dorsal, and two ventral pads as usual. The dorsal pad quadrilateral, twice as broad as high, a little expanded anteriorly, shallowly indented posteriorly, bearing no processes on the surface. The ventral pads quadrangular, far smaller than the dorsal pad (Pl. XXVI, fig. 4).

Arms short, unequal, the formula of length being $3 \fallingdotseq 4 > 2 \fallingdotseq 1$; the longest about one-tenth as long as body. Dorsal three pairs more or less flattened from side to side while the ventralmost pair is quadrangular in section. Aboral carination well developed in third pair but rudimentary on the others. Narrow, uniform, protective membranes present on both sides of arms.

Arm suckers small, subglobular, uniform in size, distinctly biserial throughout, numbering about 25 on first arm, and also on the second, and 35–40 on the third as well as on the fourth (Pl. XXVI, fig. 5). Horny ring equipped with several, very broad, crenelated teeth distributed on the distal and lateral margins, bordered with a papillate area as shown in textfig. 150A.

Tentacles about half as long as mantle; their stem much thicker than arms, slightly tapered distad. Club very little expanded, not clearly marked off from the stem, curving a little crescentwise, and provided with a broad dorsal web distally. Suckers numerous, small, nearly uniform, but those of the proximal part of club being larger than the others. They begin on the stem at a short distance from its base, and are arranged in two or three quite sparse up to the middle whence the arrangement undergoes a sudden change into a compact, distinctly quadriserial; in this condition they continue up

to the extreme end of club. Individual suckers nearly hemispherical, their aperture bordered with a wide, but ordinary, papillate area. Horny ring of larger club-suckers equipped with about five, blunt teeth on the distal half (textfig. 150B).



Textfig. 150.

Teuthowenia tagoi. A. Largest arm-suckers; × 218.
B. Largest tentacular sucker; × 217.

Each gill composed of about 30 branchial leaflets. Stomach elongated, extending nearly to the blind end of mantle, distinctly constricted at two points and far larger than caecum. Liver ellipsoidal, with the long-axis at right angles to that of body. Bile-ducts separately extend to the caecum, accompanied by the pancreas throughout. Ink-bag small, conical, situated at the ventral extremity of liver (Pl. XXVI, fig, 6).

Measurements.

Length, total	52 mm.
Length of body	32 ,,
Breadth of body	10.3 ,,
Length of fins	4 ,,
Total breadth of fins	7 ,,
Length of first arms	2 ,,
,, ,, second arms	2.1 ,,
,, ,, third arms	3.2 ,,
,, ,, fourth arms	3.3 ,,
,, ,, tentacles	12 ,,

Remarks.—This species seems to exhibit the closest relationship to *T. megalops* (Prosch), but differs from it in having much more slender body, broader and more rounded fins, which have broader bases of attachment. Moreover, the fourth arms are much longer, and the eyeballs more strongly rostrated than in that species.

The structure of the bile-ducts quite differs from that of *T. antarctica* Chun. According to Chun, in the latter species the two bile-ducts are united together near their exits from the liver, thus forming a long ductus hepato-pancreaticus. The pancreas is connected with the bile-ducts at their origin, extending far less than to the caecum.

Type locality.—Enoura, Suruga Prov.

Type.—In Tôkyo Imp. Univ.

Teuthowenia elongata sp. nov.

(Pl. XXVI, figs. 7–12.)

The species is based upon a single specimen found in the collection of the Science College, Tôkyo Imperial University.

Body fusiform, much elongated, being one-fourth as broad as long, evenly arcuate on sides, the broadest part being one-third the length from the anterior end; the posterior end rather blunt, and not projecting (Pl. XXVI, fig. 7). Mantle membranous, nearly translucent, its surface quite smooth even at the anterior margin, which is nearly trancate, neither emarginated nor projecting, and fastened to the head at the nape also to the funnel-base on either side as is usual in cranchiids. Fins minute and orbicular. Gladius visible through the pallial integument as a very narrow streak extending the

whole length of mantle, and forming a minute pyriform expansion at the anterior end and a small rhombic lanceola at the posterior.

Head proper slender, prismatic, twice as long as broad. Eyes peduncled (Pl. XXVI, fig. 8). Eyeball flattened distally, vertical-ovate in contour, the ventral end a little projecting and more or less acuminated, but not markedly rostrated; no photophores discernible anywhere. Eye-peduncle swollen, as long as the longest diameter of eyeball, provided with a tuberculus olfactorius on the ventral surface.

Funnel conical, rather short, extending but little beyond the centre of head. Funnel organ composed of a dorsal, and two ventral pads as usual. The dorsal pad horseshoe-shaped, the posterior ends cuspidated, projecting sideways. In front of the dorsal pad, there is found a minute process, the base of which is connected with the rounded apex of the pad by means of a faint gladular ridge. Ventral pads roughly as large as the rhami of the former pad, four-sided but curving crescentwise (Pl. XXVI, fig. 9).

Arms are all broken at the extremity except the left third arm which is perfect throughout. This arm is about one-tenth the length of body, flattened from side to side, and provided with a distinct keel on the aboral surface. The suckers of the arm number about 25 and gradually diminish in size towards the extremity, the proximalmost being the largest. Their horny rings have five or six, very broad, semicircular or rectangular, plate-like teeth on the distal margin; their papillate area being broad, but very thin and delicate (Pl. XXVI, fig. 10).

Tentacles half as long as body; their stem much thicker than arms, with flat oral surface, which has a streak along the median line (Pl. XXVI, fig. 11). Club slightly expanded, provided with a distinct dorsal web. Suckers on the club thickly set in four regular series, a little unequal, those of the more dorsal series being the larger, and the largest in each series situated near the middle. Connective suckers on the stem sparsely set in two series extending nearly the whole length. Horny ring of club-suckers, dentate on the whole edge, the teeth numbering 8–10, narrow, and far longer on the distal edge than on the proximal; papillate area well-developed, and broad, consisting of two series of distinctly papillate facetts and a narrow radiate border (Pl. XXVI, fig. 12).

Stomach long, extending nearly to the blind end of mantle, not constricted anywhere, being of uniform diameter throughout; caecum small, ellipsoidal. Hepato-pancreatic duct long, thick, and single throughout, though originating in liver as two separate bile-ducts. Pancreas forms two distinct compact masses composed of several racemose lobes each, coming in contact with the posterior end of liver and connected with the bile-ducts near their exits from liver.

Measurements.

Length of mantle	16 mm.
Breadth of mantle	4 „
Length of left third arm	1.5 „
„ „ tentacles	7 „

Remarks.—This species differs from *T. tagoi* in having (1) much more slender body, (2) no marked recurved rostrum on the eyeball, (3) much narrower teeth in tentacular suckers, (4) funnel-organ of quite different structure, (5) single long hepato-pancreatic duct, and (6) two globular masses of pancreas far separated from the caecum.

Type locality.—Misaki, Sagami Prov.

Type.—In Tôkyo Imp. Univ.

Sbufamily **Cranchiinae** Pfeffer, 1912.

Cranchiinae, Pfeffer 1912, p. 646.

Mantle evenly beset with crystalline tubercles or at least embellished with tubercled hyaline streaks. Eyeball decorated with 4–14 small round photophores. Stomach smaller than caecum.

Key to the genera represented in Japan.

(A) ∧-shaped hyaline streaks on belly; lanceola of gladius quickly narrowing posteriad; fins small, extending beyond body (Cranchia-artige Cranchiinae Pfeffer, 1912).

(a) Body thickly beset with crystalline tubercles ..... *Cranchia.*

(b) Body smooth except for tubercled hyaline streaks on belly and also tubercular series along the mid-dorsal line ..... *Liocranchia.*

(B) | -shaped hyaline streaks on belly; lanceola of gladius slender, gradually narrowing posteriad; fins terminal, of moderate size (Leachia-artige Cranchiinae Pfeffer 1912).

(c) Body smooth except for tubercled hyaline streaks on belly; eyes pedunculate; eyeballs small, almond-shaped..... ..... *Pyrgopsis.*

Genus **Cranchia** Leach, 1817.

Cranchia, Leach 1817, p. 410.—Fér. et d'Orb. 1839, p. 220.—Gray 1847, p. 38 (pars).—Adams, H. & A. 1858, p. 26 (pars).—Tryon 1879, p. 162 (pars).—Pfeffer 1900, p. 795; 1912, p. 678.—Chun 1910, p. 303.

Mantle more or less barrel-shaped, bluntly pointed behind, leather-like in consistency. Ventral part of mantle margin with two small ∧-shaped hyaline streaks. Fins each orbicular, extending a little beyond the posterior end of body. Crystalline tubercles thickly invest the whole surface of body and the dorsal surface of fins. Eyes sessil. Eyeball spherical, embellished with eleven or twelve photophores on the ventral surface and one or two on the dorsal. Arms unequal, third pair being the longest; right ventral arm hectocotylized. All bordered with broad protective membranes; the suckers biserial throughout except on the hectocotylus as well as on the extremities of third arms of the male, where they are quadriserial. Tentacular club expanded well-defined, its protective membranes and dorsal web being both well developed. Suckers on club in four series, those of the proximal portion equally larger than those of the distal. Connective suckers biserial, extending the whole length of stem and regularly alternating with fixing pads. Stomach small, globular, thick-walled; caecum very large, thin-walled. Pancreas compact, situated close to liver. Bile ducts joined together near their exits from liver, forming a long hepato-pancreatic duct.

Type.—*Cranchia scabra* Leach, 1817.

Cranchia scabra Leach, 1817.

(Pl. XXVI, figs. 13–15; textfigs. 151–153.)

Cranchia scabra, Leach 1817, p. 140*)—d'Orb. in Fér. et d'Orb. 1839. p. 222, Cranchies, pl. i, fig. 1.—Gray 1849, p. 38.—Tryon 1879, p. 162, pl. lxviii, figs. 250, 251.—Pfeffer 1900, p. 195.—Hoyle 1904, p. 43, pl. x, fig. 11.—Chun 1910, p. 328, pl. xlviii, figs. 1, 2; pls. xlix, l; pl. lx, figs. 1–6.—Pfeffer 1912, p. 679, pl. xlviii, figs. 22–28.—Sasaki 1916, p. 111.—Robson 1924a, p. 10.

Philonexis eylais, d'Orb. in Fér. et d'Orb. 1839, p. 102; Poulpes pl. xviii, figs. 4, 5.

Cranchia tenuitentaculata, Pfeffer 1884, p. 24, fig. 36.

Cranchia hispida, Pfeffer 1884, p. 27, fig. 37.

Two specimens are found in the collections at my disposal. Of the two the larger specimen, which was collected by Mr. Tago, is very large and excellently preserved (Pl. XXVI, fig. 13).

Body barrel-shaped, widest in the middle, bluntly pointed posteriorly; relative breadth variable but ordinarily about two-thirds the length. Mantle rather membranous and leather-like in consistency, while the head and arms are fleshy.

Mantle-margin fastened to head at the nape and to funnel-base on either side as is usual in cranchiids. The ventral part of the margin a little emarginated between the points where it is fastened

*) Original description of Leach: C. sacco tuberculato scabro; tuberculis duris scabriusculis.

to funnel-base. On the belly, there are two ∧-shaped hyaline streaks extending from the aforesaid points of attachment to one-seventh down the length.

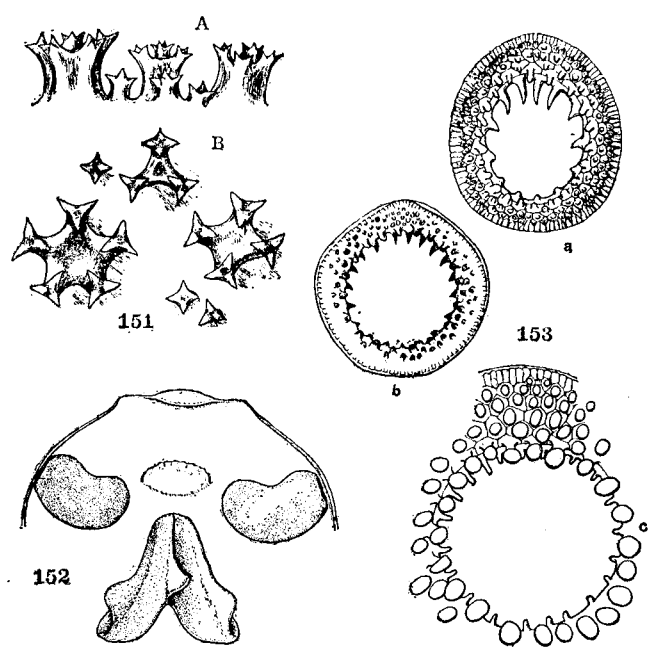
Fins rather small, extending beyond the posterior end of mantle. Their respective outlines orbicular, but when they are taken together, the outline is a Cassinian oval, forming a marked indentation in the middle of the combined posterior edge. Length of fins about one-fifth that of mantle.

Gladius as far as visible through the pallial integument, slender, narrowed in the middle, and expanded posteriorly in a slenderly rhombic lanceola, which is much more sharpened anteriorly than posteriorly. No special expansion formed at the anterior end.

Whole external surface of mantle thickly covered with crystalline tubercles, the distance between which roughly equals their own breadth. The tubercles shortly prismatic, three- to six-sided (but mostly four- or five-sided), expanded into star-shape at their distal end, varying in size but may be classified roughly into two kinds, viz. large and small (textfig. 151). The smaller tubercles have as many points in the distal star-shaped end as their stem has edges. In the larger tubercles the points of the distal end are divided each into 2–4 (mostly 3) conical lobes. Dorsal surface of fins, except their marginal part, is also beset with crystalline tubercles, which are on the whole a little smaller than those of the mantle.

Head short, narrower than the transverse diameter of mantle opening, a little depressed dorso-ventrally, separated from arms by a constriction. Eyes sessil, their opening narrow, circular but with a short sinus in front. Eyeball large, round but somewhat flattened laterally. Umbrella a little developed between second and third arms as well as between the third and fourth. A minute roundish tuberculus olfactorius present behind each eye.

Funnel large, somewhat conical, widely expanded at base, fully extending to the interspace between ventral arms. Funnel organ conspicuous, consisting of one dorsal, and two ventral pads as usual. The dorsal pad consists of a ∧-shaped, broad ridge, furnished with three longitudinal triangular valvate processes, the smallest of which is situated on the anterior lobe; the remaining two are equally larger and lower, growing from the posterior lobes. The ventral pads are as large as the preceding pad, nicely reniform, with concavity anteriorly, situated near together so that they appear to be united together at a glance. In front of the dorsal pad is found a distinct semilunar muscular valve (textfig. 152); this is a fact never mentioned before, but which constitutes a noteworthy character.



Textfig. 151.

Cranchia scabra. Crystalline tubercles of mantle; × 30. A. Lateral view. B. Upper view.

Textfig. 152.

Cranchia scabra. Funnel laid open: enlarged.

Textfig. 153.

Cranchia scabra. Horny rings of tentacular suckers. a. From one of larger hand-suckers; × 48. b. From one of subterminal suckers; × 58. c. Portion of ring of terminal sucker; × 163.

Arms (Pl. XXVI, fig. 15) short, unequal, the formula of length being $3>4\fallingdotseq2>1$ in adult, and $3>2\fallingdotseq4>1$ in the young as far as I have examined; the longest equal to a quarter of mantle in length. All more or less quadrangular in section, but third arm much flattened laterally, provided with a keel extending the whole length of the back. First arm ½–⅓ as long as the third, which

length is in turn one and a half times that of the second or the third. No hectocotylization examined, the specimens in my hand being all female.

Arm-suckers hemispherical, uniform but regularly diminishing in size towards the extremity of arms. In the largest female examined they number about 30 on first arm, about 85 on the third, and about 45 on the second as well as on the fourth, all being biserial throughout. The horny rings of these suckers are equipped with 10–15, very broad, but thin, plate-like teeth closely set on the whole margin, while in smaller specimens the rings show no dentation, agreeing with Pfeffer's description (1912).

Tentacles three times the length of third arms, and longer than half the length of mantle; stem a little tapering distad, with a flat oral surface, which shows a faint longitudinal streak along the median line. Club a little expanded, flattened, somewhat curving crescentwise; well-defined, the dorsal web and protective membranes both being distinct (Pl. XXVI, fig. 14).

Tentacular suckers numerous, extending the whole length of club and also of stem. On the club they are crowded in four distinct series, and those of the hand portion are nearly uniform and larger than those of the distal portion. On the stem they are equally small, arranged in one zigzag series, regularly alternating with fixing pads of similar arrangement, so that one sucker and pad form a transverse row.

Horny ring of club-suckers distinctly dentates on the whole edge, the dentation varying in different suckers. In larger proximal suckers, the ring has 10–14 strong teeth, which are unequal, being much longer, stronger, and more sharply pointed on the distal edge of the ring than on the proximal edge (textfig. 153a). In smaller distal suckers, there are on each ring 20–24, small, conical, rather uniform teeth (textfig. 153b, c). These two kinds of dentations are linked by intermediate forms shown by the middle suckers of the club. The papillate area of the horny ring also varies in the different suckers in respect to the development of the papillae, showing an inverse proportion with the development of the teeth. In the proximal suckers mentioned above, the papillae are far smaller than the teeth and end bluntly, while in the distal suckers the papillae of the innermost row are greater than the teeth, and of funnel-shape, having each an expanded and flattened apex.

Buccal membrane with seven ribs and processes. Connectives also number seven, fastened to the dorsal surfaces of arms, except that the third arms are connected on their ventral surface.

50–60 branchial leaflets form a gill.

Stomach small, globular, thick-walled; caecum thin-walled, very large, being two or three times, as long, and also as broad, as stomach. Liver ellipsoidal, a little flattened laterally, the long-axis being nearly at right angles to that of body; ventral extremity slightly recurved but not acuminated. Pancreas massive, situated close to liver and far remote from caecum so that there exists a single long hepato-pancreatic duct connecting the caecum and digestive glands.

Ocular photophores small, round, numbering about 13, which are mostly situated on the ventral surface of eyeballs, arranged in three concentric series. The outermost of the three series is composed of seven or eight photophores extending half round the eyeball just inside its ventral periphery. The middle series consists of four organs, situated just outside the same periphery. The innermost series is composed of only two (rarely one) minute organs, lying on the upper margin of the pupil.

Measurements of the largest Specimen Examined.

Ventral length of mantle	56 mm.
Breadth of mantle at its anterior margin	17 „
Maximum breadth of mantle	38 „
Length of fins	10 „
Total breadth of fins	20 „
Length of first arms	6 „
„ „ second arms	10 „
„ „ third arms	15 „

Length of fourth arms ... ... 10 mm.
„ „ tentacle ... ... 46 „

Remarks.—The specimens examined have an excellent valve in the funnel, which is a noteworthy difference from Chun's description (1910). In other respects they show no marked discrepancies from it.

Distribution.—Localities extensively scattered from the temperate to the tropical region of the Altantic as well as of the Pacific, and also found in the Indian Ocean, as listed by Pfeffer (1912) and others; those in Japan being: Sagami Bay (Sasaki); Ôsumi Prov. (!).

Genus **Liocranchia** Pfeffer, 1884.

Perotis, Tryon 1879, p. 164 (pars).
Liocranchia, Pfeffer 1884, p. 25; 1912, pp. 644, 665.—Chun 1906a, p. 84; 1910, p. 303, etc.—Hoyle 1910, p. 416.—Berry 1914a, p. 345.

Mantle more or less succular or slenderly goblet-shaped, usually sharply pointed behind, membranous and somewhat leather-like in consistency. Belly embellished with a tuberculate, Λ-shaped streak on either side; back may be tuberculate along the median line; elsewhere the body is quite smooth. Fins of moderate breadth, more or less extending beyond the posterior end of body, their conjoined outline transverse-oval or Cassinian oval. Gladius linear but expanded into a slender lanceola posteriorly; the anterior part also slightly expanded. Eyes sessil and incorporated with head at maturity. Eyeball with small roundish photophores. Arms unequal, the formula being $3>4>2>1$. All bordered with protective membranes. Left ventral arm hectocotylized. Arm-suckers usually biserial throughout. Tentacular club well-defined, provided with protective membranes and dorsal web. Quadriserial suckers on club, of nearly equal size in each transverse row but becoming smaller in the distal parts. Connective suckers on stem in a zigzag series, alternating with fixing pads. Stomach small, muscular, thick-walled; caecum thin-walled, exceedingly larger than stomach. Pancreas situated close to liver. The hepato-pancreatic duct, oesophagus and intestine form together a long twisted cord. Dorsal pad of funnel organ with three processes on the surface.

Type.—Liocranchia reinhardtii (Steenstrup, 1856).

Kye to the species found in Japan.

(A) Mid-dorsal line of mantle embellished with crystalline tubercles .....*L. reinhardtii.*
(B) Dorsal surface of mantle quite smooth throughout .....*L. valdiviae.*

Liocranchia reinhardtii (Steenstrup, 1856).

(Pl. XXVI, fig. 16; Pl. XXVII., figs. 1–4; textfigs. 154–158.)

Leachia reinhardti, Steenstrup 1856, p. 200.
Loligopsis (*Perotis*) *reinhardtii*, Tryon 1879, p. 165.
Cranchia reinhardti, Brock 1882, p. 605, pl. xxxvii, fig. 4.
Perotlis reinhardti, Rochebrune 1884, p. 25.
Liocranchia brockii, Pfeffer 1884, p. 25, figs. 33, 33a.
Liocranchia cf. *reinhardti*, Pfeffer 1884, p. 29, fig. 35.
Cranchia (*Liocranchia*) *reinhardti*, Hoyle 1886b, p. 184, pl. xxxi, figs. 11–14; pl. xxxii, figs. 1–4.
Cranchia reinhardti, Brock 1887a, pp. 317–322.—Girard 1892, p. 217.—Lönnberg 1896, p. 607, figs. 1–4.
Liocranchia reinhardti, Pfeffer 1900, p. 194; 1912, p. 667, pl. xlviii, figs. 1–3.—Chun 1906a, p. 84; 1910, p. 336, pl. li, figs. 5–7.—Issel 1908, p. 218, pl. ix, figs. 24–26; pl. x, fig. 27.—Sasaki 1916, p. 112.—Robson 1924a, p. 6.

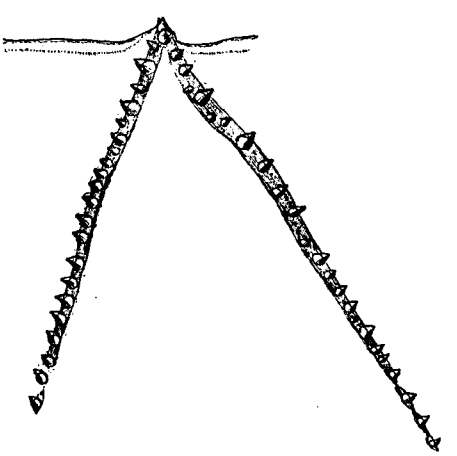
This species is represented by five specimens in the collections I have had access to. The

largest of the five is an excellent male specimen, collected by Mr. Tago in Suruga Bay, and is far larger than any so far measured, attaining a mantle-length of 79 mm. (Pl. XXVI, fig. 16).

Body somewhat barrel-shaped but sharply pointed posteriorly; length a little over twice the maximum breadth. Mantle very thin, membranous, and nearly leather-like in consistency. Anterior margin of mantle fastened to head at the nape and also to funnel base on either side as is usual in cranchiids. The ventral part of the margin shows a distinct emargination between the points where it is attached to the funnel-base. In good specimens these points distinctly project forward to mark out the emarginated part from the remaining.

Gladius visible through pallial integument. In smaller specimens it is quite streak-like, and of equal breadth except at the posterior part where it is a little expanded into a slender lanceola much more quickly narrowing posteriorly than anteriorly, as mentioned by Pfeffer. In larger specimens, however, it is expanded as well in the anterior parts as in the posterior, with the narrowest part a little in advance of the middle; the lanceola is more marked and has the posterior extremity much more sharply pointed than in smaller specimens.

Ventral surface of mantle embellished with two Λ-shaped, tuberculate, hyaline streaks, their apices coinciding with the aforesaid points of attachment. The two rhami of the streak meet together at an angle of about 50°, and the inner rhamus is a little longer than the outer. The crystalline tubercles on the streak are single-headed, conical, of various sizes, and arranged nearly in a single series. In the largest specimen alluded to above, the streak extends one-third down the mantle and the tubercles number about 20 on the outer rhamus and about 25 on the inner. Their disposition and relative size will best be seen from the annexed figure (textfig. 154). In smaller specimens, which measure 20–28 mm. in mantle length, the streak extends only one-fourth down the mantle and the tubercles number only half as many as in the preceding specimen.



Textfig. 154.

Liocranchia reinhardtii Right hyaline streak of belly; ×3.

Dorsal surface of mantle furnished with a series of conical crystalline tubercles along the median line of gladius, and a number of much smaller tubercles scattered on its lanceola. These tubercles also vary in number with age. In the said largest specimen they number about 45 along the median line of gludius and about 30 on its lanceola, while in the smaller specimens, the number along the median line is 20–25 and that on the lanceola only three or four. The distalmost of the tubercles is smaller than that on the ventral hyaline streak, and not so large as twice the size of it as mentioned by Pfeffer.

Fins also vary with age in shape as well as in relative size. In full-grown specimens, they are comparatively large, united together posteriorly into a transverse-oval contour, which shows no indentation either in front or behind. Their length (longitudinal) is three-fourths their total breadth (transverse), and equals about two-thirds of the mantle-length. In younger specimens, however, they are comparatively small, and their combined outline is a Cassinian oval, with a slight indentation in front and also behind. The length in this case is less than one-fourth that of the mantle. The relation of the fins to the mantle agrees well with Pfeffer's statement.

Head in adult short, bull-necked, nearly as wide as mantle-opening, rounded on sides, flattened above, longitudinally furrowed below, and marked off from arms by a strong constriction. Eyes sessil, large, full, entirely incorporated with head. Eyeball enormous, spherical but more or less flattened from outside internally, decorated with fifteen, roundish, photophores or rather irregular arrangement (Pl. XXVI, fig. 1). Eye-opening roundish or pyriform, with a faint sinus in front. Integument of head forms behind each eye-opening a peculiar protuberance, which is the more marked

in the larger specimen. A small semilunar or triangular tuberculus olfactorius exists beneath each eye a little below the aforesaid cutaneous protuberance. Umbrella a little developed, extending $^1/_3$–$^2/_5$ up the arms, but between ventral arms it is obliterated as usual. The head and eyes of the young are almost as mentioned by Pfeffer.

Funnel large, conical, very broad at base, extending nearly to ventral interbranchial space, connected with head by broad ligaments on sides. Funnel organ composed of a single dorsal and two ventral pads as usual. The dorsal pad conspicuous, triangular; all angles rounded, and edges concave, the concavity of the posterior edge being by far the deepest. On the pad, there are found three broad triangular valvate lamellae, of which one is situated along the median line and the other two on both sides. The ventral pads also conspicuous, nearly as large as the dorsal pad, reniform, with the notching in front. A distinct, lunate funnel-valve present on the dorsal wall just in front of the dorsal pad, a fact not ever mentioned but which constitutes a noteworthy character (Pl. XXVII, fig. 2).

Arms short, unequal, the formula of length being $3>4>5>1$; the longest about equal to a quarter of the mantle-length. First and second pairs slenderly conical, without any carination on back. Third pair compressed laterally, carinated on back. Fourth pair somewhat quadrangular in section, with a delicate web along the outer side. Protective membranes somewhat developed, similar in breadth on both sides of arms.

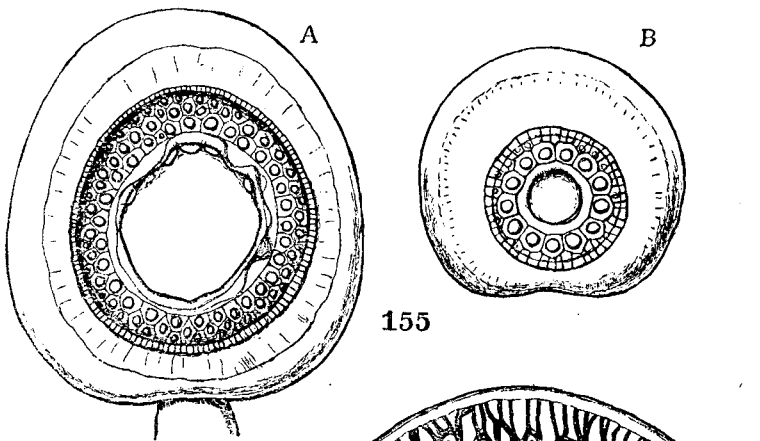
Arm-suckers in female biserial throughout, unequal, those of third arms being by far the largest. On each arm they become larger to the third or fourth pair, then regularly decrease in size towards the extremity. In the male they are biserial on the first, second, and fourth arms. On the third arms the proximal thirty, which occupy the proximal three-fourths of these arms, are biserial and as large as in the female, but the remaining suckers are minute, and thickly crowded in 4–8 series (Pl. XXVII, fig. 3).

The horny ring of arm-suckers varies with age as far as I have examined. In younger specimens, the papillate area of the ring is relatively thick and has distinct papillae on the facetts (textfig. 155). The facetts in smaller suckers are in two concentric series throughout, their papillae being by far larger in the inner series, and the margin of the ring is quite entire. In large suckers there are two series of the facetts on the proximal part of the ring and their three series on the distal part, the papillae of the innermost series of facetts are the largest as usual but not so large as in smaller suckers. The ring-edge of these larger suckers is not quite entire but has several, broad, but thin, plate-like teeth along the distal edge. At maturity the papillate area becomes delicate, and its papillae fade out, while the boundaries of the facetts are thickened into ridges connected together into a network. At the same time, the margin of the ring becomes thinner and smooth even in larger suckers (textfig. 156).

In the largest specimen alluded to, the hectocotylized left ventral arm is perfectly preserved; its length is quite that of the right ventral, and the suckers are regularly biserial throughout as usual. The hectocotylization affects the distal half of the arm, where the protective membranes are quite rudimentary. On this part, there are comprised about 21 pairs of suckers, all much reduced in size through not undergoing any structural modification. The proximal half of the arm shows no peculiarity, being quite same in all respects as the corresponding part of the right ventral arm, and have nine pairs of normal suckers.

Tentacles somewhat variable in thickness and length, but in good specimens they are as thick, and three times as long, as third arms. Stem with flat oral surface, which shows a longitudinal streak along the median line. Club a little expanded, lanceolate, bordered with distinct protective membranes on sides, the dorsal web being also distinct.

Tentacular armatures consist of suckers only. These on club are distinctly quadriserial, and of uniform size in each transverse row, but becoming smaller at the distal portion. About 22 connective suckers present on stem, extending three-fourths down the length, arranged in a zigzag series, regularly alternating with fixing pads, so that one sucker and pad form a transverse row. The horny ring of club-suckers vary with age as in arm-suckers. When young, the papillate area of the ring is



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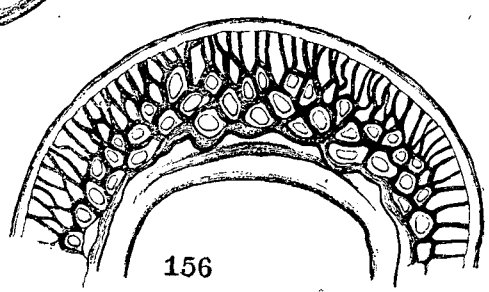

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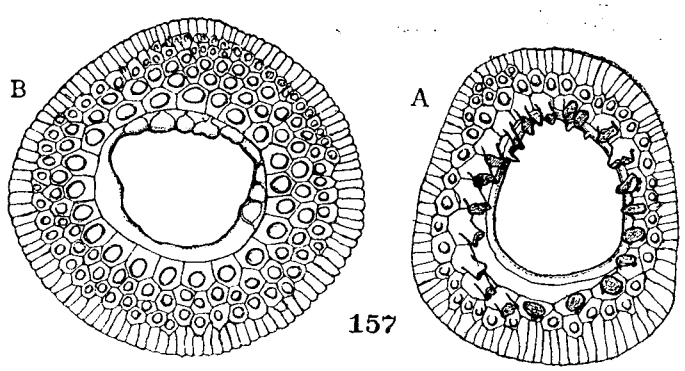

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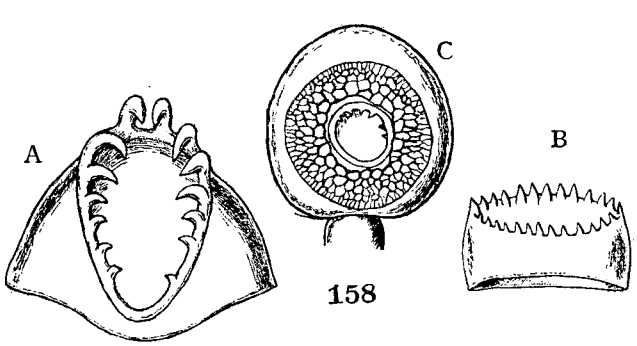

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Textfig. 155.

Liocranchia reinhardtii. Suckers of younger specimen examined; ×217. A. Largest sucker of third arm. B. Distal sucker of same arm.

Textfig. 156.

Liocranchia reinhardtii. Portion of horny ring from the largest sucker of second arm of the largest specimen examined; ×217.

Textfig. 157.

Liocranchia reinhardtii. Horny rings of tentacular suckers of younger specimen; ×217 A. From the largest sucker. B. From a smaller sucker.

Textfig. 158.

Liocranchia reinhardtii. A. Horny ring of larger tentacular sucker of the largest speeimen referred to; ×77. B. Horny ring from one of subterminal tentacular suckers; ×77. C. One of terminal tentacular suckers; ×167.

well developed, armed with strong papillae, and the ring-margin has a few, minute teeth (textfig. 157). At maturity, the teeth become much stronger and more numerous, while the papillate area shows a retrogressive development, the thickness decreasing and the papillae becoming much fainter. At the same time, the boundaries of the facetts are thickened into ridges connected together into a retiform marking as in arm-suckers (textfig. 158). The dentation in full-grown specimens is subject to same variation in different suckers. In larger suckers, which are on the hand portion of the club, the teeth number 19–26, large, conical, and somewhat closely set on the whole margin of the ring, those of the distal edged being two or three times longer than those of the proximal. In smaller suckers, which are on the subterminal part of club, they are more numerous and much smaller than those in the preceding suckers, and are only a little larger on the distal edge than on the proximal. The suckers of the club-base are equipped along the distal three-fourths of the ring, with 12–15 teeth, which are slender, bent inwards, and greatly unequal in length. The minute suckers of the extremities of clubs have a few minute teeth on the distal edge, the remaining part being quite smooth.

Stomach very small, ellipsoidal, acutely pointed behind, having a very thick, muscular wall; caecum exceedingly spacious, being several times longer, and as much broader, than stomach, but its wall being thin as usual. Liver ellipsoidal,

the long-axis being at right angles to that of body; ventral extremity acuminated, curving forwards. Pancreas in contact with the posterior aspect of liver and not extending the whole length of hepato-pancreatic duct. Branchial leaflets number 45–50 in each gill.

Measurements of largest Specimen Examined.

Dorsal length of mantle	79 mm.	
Ventral length of mantle	76.5 „	
Maximum breadth of mantle	34 „	
Breadth of mantle at the anterior margin	23 „	
Length of fins	22 „	
Total breadth of fins	29 „	
	Left	Right
Length of first arms	7 mm.	7 mm.
„ „ second arms	10 „	10 „
„ „ third arms	17 „	17 „
„ „ fourth arms	14 „	14 „
„ „ tentacles	48 „	47 „
„ „ clubs	10 „	11 „

Remarks.—The body of the specimens examined seems to deviate from what is declared by Pfeffer as the typical shape; it is thicker and has the broadest part more posteriorly, so that it is more like a barrel in shape than "*ein schlanker Kelch*". The head of larger specimens also differs from his description, which, however, undoubtedly depends upon the difference of the developmental stage. The hectocotylization which is seen in the largest specimen examined disagrees with Lönnberg's description, so that the identification with his specimen is with a great deal of hesitation.

Distribution.—Localities extensively scattered from the temperate to the tropical region of the Pacific as well as of the Atlantic, and also found in the Indian Ocean, as listed by Pfeffer (1912) and others; those known in Japan: Sagami Bay (Sasaki); Suruga Bay (!).

Liocranchia valdiviae Chun, 1906.

(Pl. XXVI, figs. 17–19; Pl. XXVII, figs. 5, 6.)

Liocranchia valdiviae, Chun 1906a, p. 84.—Chun 1910, p. 337, pl. xlviii, figs. 3, 4; pl. li, figs. 1–4, 8–14; pl. lx, figs. 7–11.—Pfeffer 1912, p. 675.—Sasaki 1920, p. 203.

A single mature female caught by the "Albatross" has been at my disposal for examination. It is far larger than any of those measured by Chun, the mantle-length inclusive of the fins being 63 mm.

Body roughly hemi-fusiform, three times as long as broad, broadest at the part a little before the middle, then slightly narowing forwards to the truncated end. Posteriorly it is tapered from that part, terminating in a sharp point (Pl. XXVI, fig. 17). Mantle thin, membranous, leather-like in consistency. Mantle-margin fastened to head at the nape and to funnel base on either side as usual; its dorsal part slightly projecting in the middle, while the ventral part has a broad distinct emargination marked off by pointed projections on sides. On the ventral surface of the mantle, there are found two tuberculate $\wedge$-shaped streaks, the apices of which coincide with the said boundary projections of emargination. The two rhami of the streak stand 50° apart from each other; the inner rhamus is a quarter longer than the outer, and extends one-third down the mantle, approaching within a few mm. of the corresponding streak of the opposite side. The crystalline tubercles of the streaks are mostly conical, uniserial, numbering about 25 on the inner rhamus and about 20 on the outer. The anterior-most tubercles of both the rhami stand close to each other and are a little larger than the remainder.

Fins semilunar, but their combined outline being a Cassinian oval, with a shallow notch in the middle of the combined posterior edge, and slightly indented in the anterior attachment. Length of fins equal to two-thirds of their total breadth, and a little less than one-fourth the length of mantle.

Gladius visible from outside along the whole mid-dorsal line of mantle, expanded at both ends, the narrowest part being at the point one-third down the length. The expansion at the anterior end clavate, about twice as broad as the narrowest part of the gladius. Lanceola represented by the posterior expansion, far broader than that of the anterior end, gradually and regularly widening to the level of anterior origin of fins, then quickly tapering to a hollow end-cone, the vertex of which forms an angle of about 35°, pointing a little behind the centre of the combined fins.

Head rather small, flattened above, weakly furrowed beneath; the breadth inclusive of eyes decidedly narrower than body. Eyes comparatively large, globular, projecting but not pedunculate; the dorsal aspect distinctly marked off from the head proper by a deep sulcus although the ventral surface joined on to it. Eeyball decorated with a series of four uniform, roundish photophores on the ventral periphery. Umbrella slightly developed between second and third arms, even more slightly between first arms as well as between first and second arms and obliterated in the remaining interbrachial spaces.

Funnel very large, conical, much expanded at base, tubular at extremity, which is bent downwards. Dorsal pad of funnel organ, composed of a $\wedge$-shaped broad ridge, of which the anterior lobe regularly narrows cephalad to a blunt tip, while the posterior lobes are rounded, separated from each other by a semicircular concavity. At the centre of the pad, there stands a slender, laterally compressed process, and also on either side, a longitudinal triangular valvate one, which traverses diagonally the posterior lobe. Ventral pads of the same organ, not clearly discerned but appearing to be united together into a large crescentic cushion with the concavity in front (Pl. XXVII, fig. 5). No internal valve present.

Arms greatly unequal, the formula of length being clearly $3>4>2>1$. Third pair by far the longest and thickest of all, being four times the length of first pair and a little longer than one-third the length of body. Protective membranes distinct but very narrow. Aboral carination distinct on third arm and also on the fourth. Suckers biserial throughout, numbering about 20 on the first, about 30 on the second as well as on the fourth, and 50 on the third.

No hectocotylization observed, the specimen examined being female. According to Chun it affects the left ventral arm. The arm is a little shorter than the corresponding arm of the opposite side and has biserial suckers on the proximal half and uniserial ones on the distal.

Tentacles about as thick, and twice as long, as third arms. Oral surface of their stem flat, with a fine streak along the median line. Club only a little expanded, more or less crescentic, bordered with distinct protective membranes. This membrane of the ventral side rather rapidly widens proximad and its trabeculae become stronger at the same time, while on the dorsal side the membrane and trabeculae are both feebly developed even at the proximal part. Dorsal web broad, extending for the distal four-fifths of the club and regularly narrowing towards both ends.

Tentacular armatures represented by suckers only (Pl. XXVI, fig. 18). These on club crowded in four series, somewhat unequal, becoming larger for about the first quarter, then gradually decreasing in size towards the extremity. At the extremity of club, four suckers form a special group, separated from the remainder, a fact not mentioned by Chun but which constitutes a distinct character. Ten or twelve connective suckers present on stem, extending down to its base, at first arranged in a zigzag row, but becoming straightly uniserial and much sparser afterwards; each accompanied by a fixing pad either on one side or in front. Horny ring of larger club-suckers, with a peculiar margin markedly projecting beyond the aperture (Pl. XXVI, fig. 19). The margin dentate except at a short proximal part, the teeth being slender, sharply pointed and unequally long. Papillate area of the ring attached to the base of the outstanding margin.

Stomach half as large as caecum in both length and breadth. Pancreas situated in contact with liver, which is ellipsoidal, having the long-axis diagonally in the mantle cavity. Oesophagus, intestine, and hepato-pancreatic duct forming together a long, twisted cord. Rectum short, anal valves minute. Vena cava stretched straight. Nidamental gland short, papilliform, bilobed. About 31 branchial leaflets form a gill.

Measurements.

Dorsal length of mantle including fins	63 mm.
Ventral „ „ „ „ „ „	61 „
Maximum breadth of body	21 „
Length of fins	21 „
Total breadth of fins	14 „
Fin extention beyond the posterior end of body	5 „
Breadth of head including eyeballs	14 „
Length of dorsal pad of funnel organ	5 „
Breadth „ „ „ „ „ „	6.3 „

	Left	Right
Length of first arms	5 mm.	5 mm.
„ „ second arms	9 „	9 „
„ „ third arms	18 „	18 „
„ „ fourth arms	10 „	10 „
„ „ tentacles	33 „	32 „

Remarks.—The specimen referred to markedly differs from Chun's description in the head which is much less incorporated with the eyes than in his case; this seems to be attributable to the ill-preservation of the specimen at my disposal. The suckers of arms and tentacular stems number more, and the arms longer, and more unequal in length, than illustrated by Chun. These differences are probably due to that of the developmental stage.

Locality.—Off Kii Prov., 500 fms. (Albatross!). Indian Sea: 10°8′S., 97°14′0; 4°5′S, 73°24′0.; 4°5′S., 70°1′0.; 4°45′S., 48°58′0.; 5°42′S., 43°36′0.; 2°58′N., 46°50′0 (Chun).

Genus **Pyrgopsis** de Rochebrune, 1884.

Loligopsis (pars), Verany 1851, p. 125.
Zygaenopsis, de Rochebrune 1884, p. 19.—Pfeffer 1900, p. 193.—Chun 1906a, p. 84.
Pyrgopsis, de Rochebrune 1884, p. 23.—Pfeffer 1912, p. 656.
Zygocranchia, Hoyle 1909, p. 276, 1910, p. 413.
Euzygaena, Chun 1910, pp. 304, 354.

Body elongated, subfusiform, sharply pointed. Mantle very thin, membranous, with even anterior margin. Belly with two tuberculate longitudinal hyaline streaks; elsewhere the body is quite smooth. Fins terminal, of moderate breadth, their conjoined outline transverse-oval or more or less trapezoidal. Eyes pedunculate. Eyeball small, more or less almond-shaped, decorated with four or five minute photophores on the ventral periphery. Eye-peduncle swollen, ovoidal. Tuberculus olfactorius present beneath each eye. Arms unequal, third pair being by far the longest; all bordered with frilled protective membranes. Right ventral arm hectocotylized in the distal half. Arm-suckers biserial throughout even in the male. Tentacular club well defined, with protective membranes and dorsal web. Quadriserial suckers on the club, unequal in size, proximal eight of the rachial series being much larger than those of the marginal. Stem with ten or more connective suckers, sparsely set in a single zigzag series, without fixing pads. Gladius broad, forming posteriorly a conspicuous lanceola. Stomach twice as long as caecum, not distinctly constricted. Bile-ducts united together near their exits from liver into a common duct which takes a long way to reach the caecum. Pancreas situated far behind liver, and close to caecum; connected with the common bile-duct near its entrance to caecum.

Type.—*Pyrgopsis rhynchophorus* de Rochebrune, 1884.

Pyrgopsis pacificus (Issel, 1908).

(Pl. XXVII, figs. 7–17; textfig. 159.)

Zyaenopsis pacifica, Issel 1908, p. 223, pl. x, figs. 33–44.

Euzygaena pacifica, Chun 1910, p. 354, pl. lii, figs. 1–3.

Pyrgopsis pacificus, Pfeffer 1912, p. 661.—Sasaki 1916, p. 112.—Massy 1916b, p. 168 textfig. 40.—Robson 1924a p. 5.

Numerous specimens of this species have been in my hand. They were all collected at Misaki, Sagami Prov., the mantle-length ranging from 40 mm. to 52 mm.

Body slenderly subfusiform, very gradually widening posteriad for the anterior one-third, then tapering to an attenuated end-part, which contains little but the gladius. Proportional breadth of body variable according to the different conditions of preservation, but usually a little greater than a quarter of its length (Pl. XXVII, fig. 7). Mantle thin, membranous, somewhat leather-like in consistency, its anterior margin even, showing neither marked projection nor emargination, attached to head at the nape and to funnel-base on either side as usual. Belly embellished with two tuberculate longitudinal hyaline streaks, which extend one-fourth down the mantle. The crystalline tubercles on each of these streaks number about fifteen, seven to nine of which are small, unilobed, conical bodies, and the others, large, stellate ones, consisting of five or six conical lobes each; both kinds of tubercles roughly alternate with one another (Pl. XXVII, fig. 8). Fins terminal, attached to both sides of the end-part of body, their combined outline transverse-oval, usually slightly indented at their anterior attachment, their length about one-fourth that of body.

Gladius easily traceable on the back of mantle, extending its whole length, very broad. Lanceola conspicuous, comprising about two-thirds of the entire length of gladius, attaining its maximum breadth far in front of the fins and then tapering caudad to a sharply pointed end-cone.

Head proper slender, prismatic, four-sided. Eyes pedunculate, projecting forwards and sideways. Eyeball ovate in contour, the distal aspect flattened, the ventral margin projecting into a compressed rostrum, which has a transverse series of four or five small photophores on the ventral surface (Pl. XXVII, fig. 9). Peduncles of eyes swollen, ovoidal, decidedly longer than the longest diameter of eye-balls. Tuberculus olfactorius present beneath each eye.

Funnel conical, much expanded at base, extending more than halfway to ventral interbrachial space. Funnel organ composed of one dorsal, and two ventral pads as usual. The dorsal pad conspicuous, like an inverted shield in outline, slightly broader than long, expanded behind; anterior end rounded but with a minute cuspidation in the middle; posterior margin somewhat convex, but sinuated in the middle to let the anterior vena cava pass. On either side of the pad near its base-line, there stands a minute process, which is a slender, isosceles-triangle in shape, and flattened laterally, its apex curving inwards (Pl. XXVII, fig. 10). The ventral pads less conspicuous and far smaller than the dorsal pad; they are triangular, but all the angles are rounded.

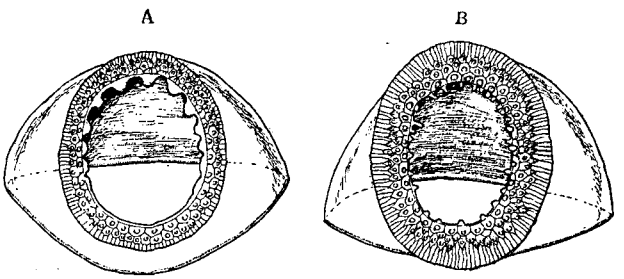
Arms unequal, the formula of length being $3>2\fallingdotseq 4>1$. Third arms by far the longest and stoutest of all though very short as compared with body, attaining only one-fifth as long as it. Three dorsal arm-pairs somewhat compressed from side to side, more or less carinated on back. The carination strongest on third arms where it extends for the distal two-thirds. Fourth arms quadrangular in section, the outer edge of the aboral surface protruding into a web as usual. All arms bordered with thick and frilled protective membranes on both sides.

Arm-suckers subglobular, with a round or ovate aperture, biserial throughout. On each arm they begin some distance from the base and gradually diminish in size distad, the basalmost being the largest except on third arms, where they rapidly increase in size to the middle of the sucker-bearing part and then become smaller towards the extremity. In a specimen of 400 mm. mantle length, which I have subjected to a thorough search, they number about 16 on the first arm, 25 on the second, 40 on the third, and 20 on the fourth (Pl. XXVII, fig. 11). Horny ring equipped with about ten broad, semilunar teeth on the distal margin; papillate area narrow (textfig. 159A).

Right ventral arm a little longer than the left ventral, hectocotylized in about the distal half, which is more or less expanded and bordered with broad protective membranes on sides. The arm has about 35 suckers, of which about half the number are comprised in the hectocotylized part. The suckers of this part are equally small and form two distinct compact rows separated from each other

by a broad, naked, and a little furrowed interspace, while those of the non-hectocotylized part are of moderate size and crowded together into a compact zigzag series (Pl. XXVII, fig. 13).

Tentacles as thick, and one and a half times as long as third arms. Oral surface of stem flattened, marked by a distinct streak along the median line. Club a little expanded, provided with a distinct protective membrane on either side and a broad web along the distal half. Club-suckers thickly set in four series; unequal, those of the inner two series being larger than those of the outer series; especially large are about proximal eight of the inner series. Twelve connective suckers present on the stem, extending for its distal two-thirds, very sparsely set in a single zigzag series without accompanied by fixing pads. Horny ring in larger club-suckers equipped with about twelve blunt teeth, which resemble the papillae around, but compressed and growing from the extreme edge of the ring (textfig. 159B)



Textfig. 159.

Pyrgopsis pacificus. A. Horny ring from one of larger arm-suckers; ×70 B. Horny ring from one of larger tentacular suckers; ×70.

Stomach elongated, slightly narrowed in the middle, lying far behind the liver; caecum somewhat large, but only half as long as stomach, more or less constricted in the middle. Liver ellipsoidal, somewhat compressed laterally, with the long-axis nearly at right angles to that of body. Bile-ducts leave the liver at the point one-fourth from its posterior end, but united at once into a common duct, which takes a long way to reach the caecum (Pl. XXVII, figs. 13, 14). Pancreas massive, rounded, only slightly smaller than liver, connected with the common bile-duct near caecum, with which it comes into close contact; therefore, the hepato-pancreatic part of the duct is very short. Ink-bag small, attached to the posterior end of liver. Nidamental glands small, papilliform, roughly ovoidal but bilobate at the tip. Gill slender, delicate, consisting of about 42 thin leaflets.

Measurements of the largest Male Examined.

Length, total	73 mm.	
Length of body	52 „	
Maximum breadth of body	8.5 „	
Length of head	5 „	
„ „ fins	11.5 „	
Total breadth of fins	14 „	
	Left	Right
Length of first arms	2 mm.	2 mm.
„ „ second arms	3 „	3 „
„ „ third arms	10 „	10 „
„ „ fourth arms	4 „	5 „
„ „ tentacles	16 „	16 „

Remarks.—The specimens examined by me deviate from Issel's description, in its having a broad teeth in the arm-suckers, and more numerous crystalline tubercles on the hyaline streaks of the belly. Chun describes a specimen from Sagami Bay (1910), but seems to have not noticed the ocular photophores (p. 304) or rather even to deem their existence (p. 354). In all the specimens in my hand, however, they distinctly exist, strikingly resembling in structure those mentioned by Pfeffer in *P. schnehagani* (1912).

Locality.—Sagami Bay (Chun); Misaki, Sagami Prov. (Sasaki). Between Tahiti Pango-pango (Issel); off Three Kings Is. (Massy); off North I., New Zealand (Massy); South Africa (Robson).

Abbreviations used in the Explanation of Textfigures and Plates.

a. br.	Arteria branchialis.
a. c.	Aorta cephalica.
a. d.	Adductor infundibuli.
a. l.	Anal ligament.
an.	Anus.
a. p.	Aorta posterior.
ap. br.	Appendage of branchial heart.
a. sg.	Accessory spermatophoric gland.
a. sl. g.	Anterior salivary gland.
a. v.	Anal valve.
b. b.	Buccal bulb.
b. d.	Bile duct.
br. h.	Branchial heart.
c.	Coecum of stomach.
c. br.	Commissura ganglion brachialis.
c. br. b.	Commissura brachio-buccalis.
c. buc.	Commissura buccalis.
cl.	Calamus copulatus.
cm.	Chromatophore.
cp. br.	Capsule of branchial heart.
cr.	Cirrus.
d. a. sp.	Distal portion of accesory spermatophoric gland.
dm.	Diaphragma.
d. p.	Diverticle of penis.
e.	Eye.
f. c.	Funnel cartilage.
f. o.	Funnel organ.
f. s. c.	Folds of spermatic cushion.
f. v.	Funnel valve.
g. br.	Ganglion branchiale.
g. buc. s.	Ganglion buccale superior.
g. cer.	Ganglion cerebrale.
gg. l.	Gastrogenital ligament.
g. op.	Genital opening.
g. opt.	Ganglion opticus.
g. ped.	Ganglion pedunculi.
g. s.	Ganglion stellata.
g. vis.	Ganglion viscerale.
H.	Systematic heart.
hc.	Hectocotylus or Hectocotylized arm.
hp.	Hepatopancreatic duct.
i. b.	Ink bag.
i. d.	Ink duct.
it.	Intestine.
kd.	Kidney.
l.	Liver.

l. c.	Ligula copulata.
li.	Inner lateral teeth.
lm.	Luminous organ.
l. o.	Outer lateral teeth.
ls.	Lens.
m. c.	Mantle cartilage.
md.	Median teeth.
mg.	Marginal teeth.
m. m.	Mantle margin.
N.	Needham's sac.
n.	Nerve.
n. ant.	Nervus anterior.
n. br. 1, 2, 3, 4.	Nervus brachialis I, II, III, IV.
nd.	Nidamental gland.
n. off.	Nervus olfactorius.
n. opt.	Nervus opticus.
n. op. inf.	Nervus ophthalmicus inferior.
n. op. sup.	Nervus ophthalmicus superior.
n. pal.	Nervus pallials.
n. vis.	Nervus visceralis.
o.	Ovum.
o. b.	Oviducal ball.
o. d.	Oviduct.
od. s.	Oviduct sens. str.
oe.	Oesophagus.
o. p.	Olfactory pit.
op. cp.	Opening of capsule of branchial heart.
op. i.	Opening of ink gland.
op. w.	Opening of water vascular canal.
ov.	Ovary.
ov. gl.	Oviducal gland.
p.	Penis.
p. a. sp.	Proximal portion of accessory spermatophoric gland.
pc.	Pancreas.
p. l.	Posterior margin of cephalic cartilage.
p. sl. g.	Posterior salivary gland.
rc.	Rectum.
r. gl.	Receptacular gland.
r. op.	Renal opening.
r. s.	Renal sac.
rt.	Retractor palli medianus.
s.	Spermatophore.
s. c.	Spermatophoric canal.
s. ch.	Spermatic cushion.
sd.	Spermiduct.
sg.	Spermatophoric gland.
sg. I.	First portion of spermatophoric gland.
sg. II.	Second portion of spermatophoric gland.
sg. III.	Third portion of spermatophoric gland.
s. h. a.	Sacculus hepaticus anterius.
sl. d.	Salivary duct.

s. m.	Median pallial septum.
s. od.	Terminal swelling of oviduct.
s. r.	Seminal receptacle.
sp.	Spiraculum.
st.	Stomach.
s. v.	Swelling of vagina.
t.	Testis.
tc.	Tentacle.
t. o.	Tuberculus olfactorius.
u. m.	Umbrella margin.
v. ab.	Vena abdominalis.
v. br.	Vena branchialis.
v. c.	Vena cava.
v. d.	Vas deferens.
vg.	Vagina
v. p.	Vena pallialis.
vs.	Visceral sac.
w.	Water vascular canal.
I.	First arm.
II.	Second arm.
III.	Third arm.
IV.	Fourth arm.

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Papers which have remained inaccessible to me are indicated by affixing asterisks.

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PLATE I.

Page.

Watasella nigra Sasaki, ... 4

Fig. 1. Dorsal view ; × 3.
Fig. 2. Ventral view ; × 3.
Fig. 3. Inner aspect of arms and umbrella ; × 3.
Fig. 4. Sucker ; × 60. A. Upper aspect. B. Under aspect. C. Oblique side view.

Sepia esculenta Hoyle, ... 175

Fig. 5. Dorsal view ; natural size.

Sepia andreana Steenstrup, ... 196

Fig. 6. Dorsal view ; natural size.

Sepia kobiensis var. **andreanoides** Hoyle, ... 206

Fig. 7. Dorsal view ; natural size.

Stenoteuthis bartrami (Lesueur), ... 289

Fig. 8. Dorsal view ; × 2/5.

Polypus variabilis n. sp., ... 90

Fig. 9. Dorsal view ; × 2/3.

Polypus marmoratus (Hoyle), ... 47

Fig. 10. Subterminal part of third arm ; natural size.



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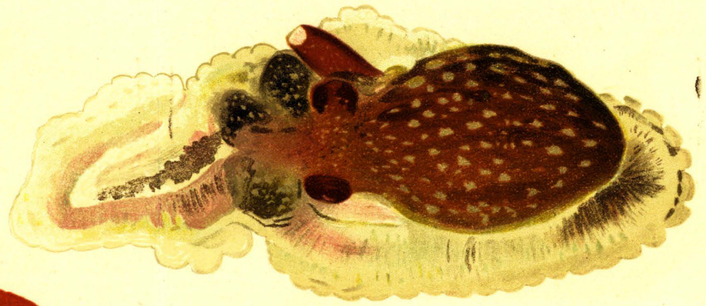

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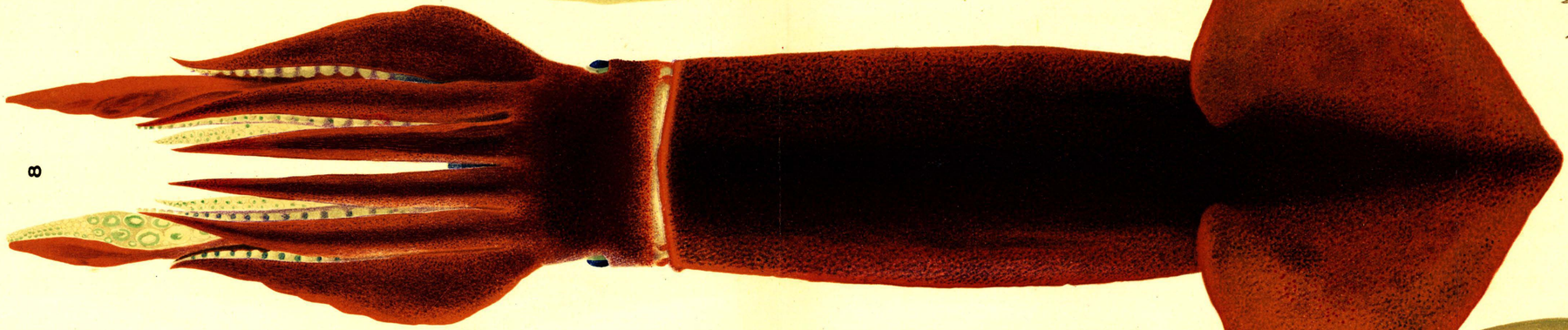

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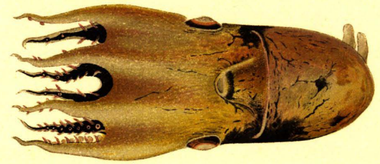

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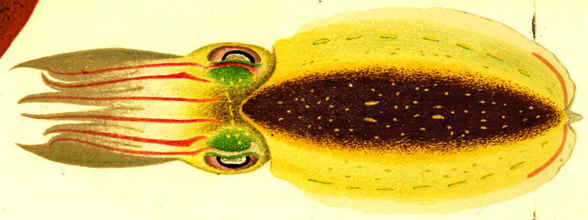

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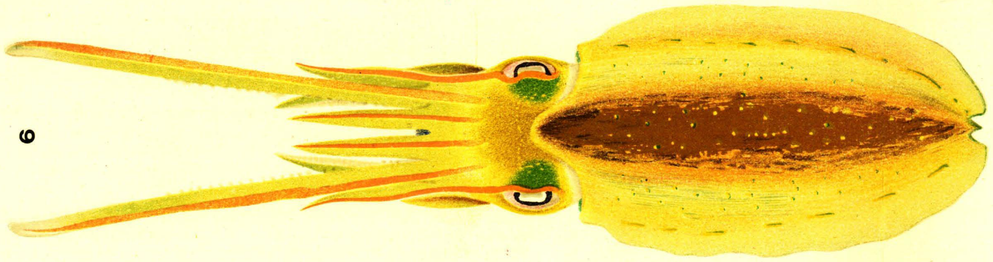

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PLATE II.

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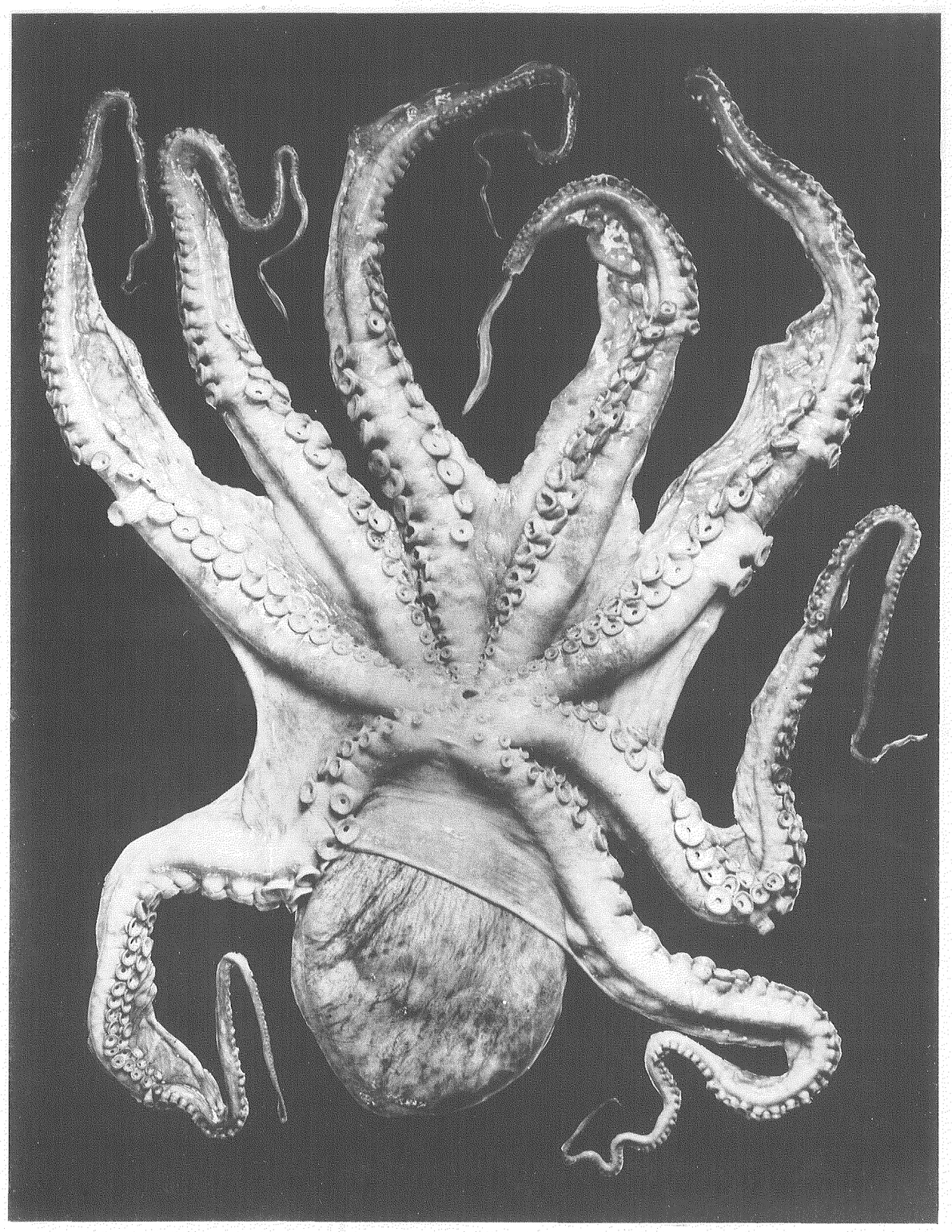
Polypus döfleini Wülker, ... 73

Fig. 1. Fresh mature male from fish market of Sapporo, with suckers of ordinary size at the middle part of arms, × ca. 1/6.

Fig. 2. Mature male from Hidaka, with markedly enlarged suckers at the middle part of arms (formalin specimen), × ca. 1/5.

Journ. Coll. Agr., Hokkaido Imp. Univ., Sapporo. Suppl. to Vol. XX. 1928.



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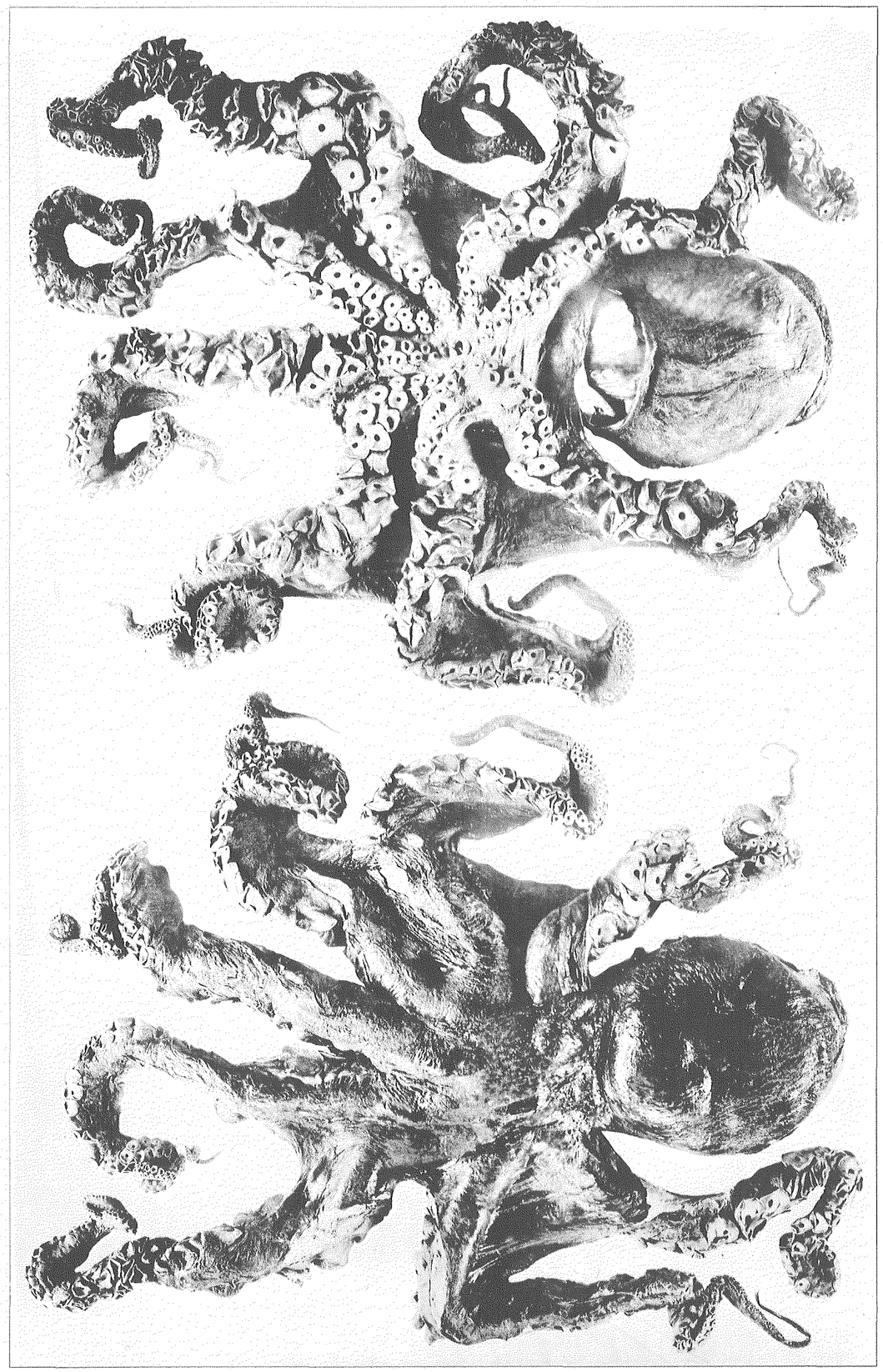

PLATE III.

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Amphitretus pelagicus Hoyle, ... 16

Fig. 1. Obliquely dorsal view; × 7/10.

Fig. 2. Lateral view; × 7/10.

Argonauta hians Solander, ... 20

Fig. 3. Full-grown shell of markedly auriculate form; × 2/3.

Fig. 4. The same of less auriculate form; × 2/3.

Fig. 5. The same of not auriculate form; × 2/3.

Fig. 6. A-D. Lateral view of shells, showing graduated stages of growth; × 2/3.

Argonauta böttgeri Maltzan, ... 22

Fig. 7. A-D. Lateral view of shells, showing graduated stages of growth; × 2/3.

Argonauta argo Linneus, ... 23

Fig. 8. Lateral view of full-grown shell; × 1/2.

Fig. 9. Similar view of smaller shell; × 1/2.

Fig. 10. Similar view of still smaller shell; × 1/2.

Fig. 11. Upper view of full-grown shell; × 1/2.

Fig. 12. Similar view of smaller shell; × 1/2.

Ocythoe tuberculata Rafinesque,... 26

Fig. 13. Male specimen, with hectocotylus inclosed in its sac; slightly reduced.

Fig. 14. Another male specimen, with hectocotylus stretched out of its sac; × 5/9.

Polypus parvus Sasaki, ... 38

Fig. 15. Dorsal view of male specimen; slightly reduced.

Fig. 16. Ventral view of the same; slightly reduced.

Fig. 17. Female specimen from Misaki and its own nest; × 1/2.

Polypus granulatus (Lamarck), ... 40

Fig. 18. Male specimen from Kagoshima referred to (p. 40); approximately natural size.

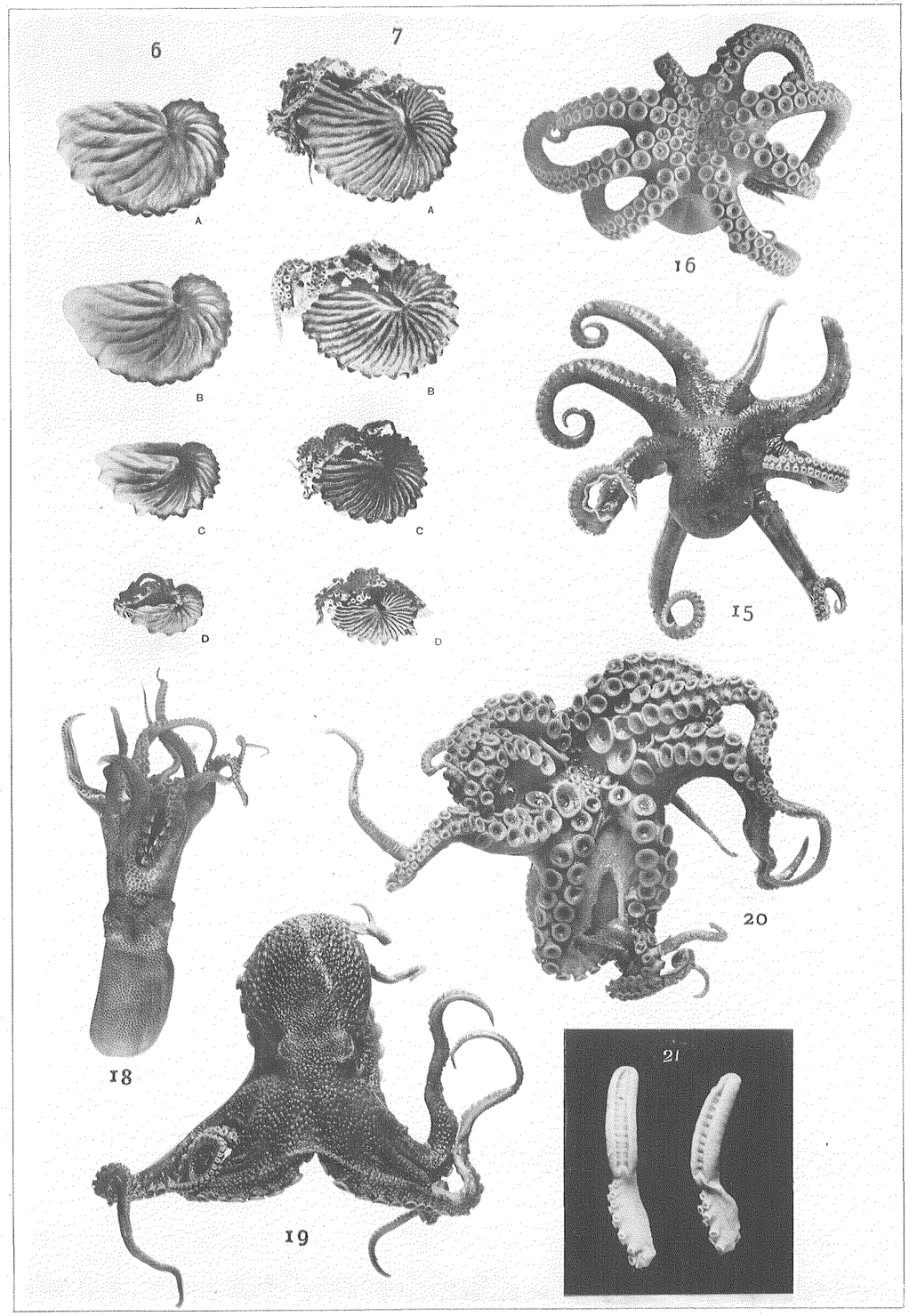
Pelypus fangsiao var. **etchuanus** n. var.... 53

Fig. 19. Dorsal view of a specimen from Nagasaki; a little reduced.

Fig. 20. Inner aspect of the same; a little reduced.

Polypus variabilis n. sp. var. **typicus** mihi 90

Fig. 21. Hectocotylus; a little reduced.



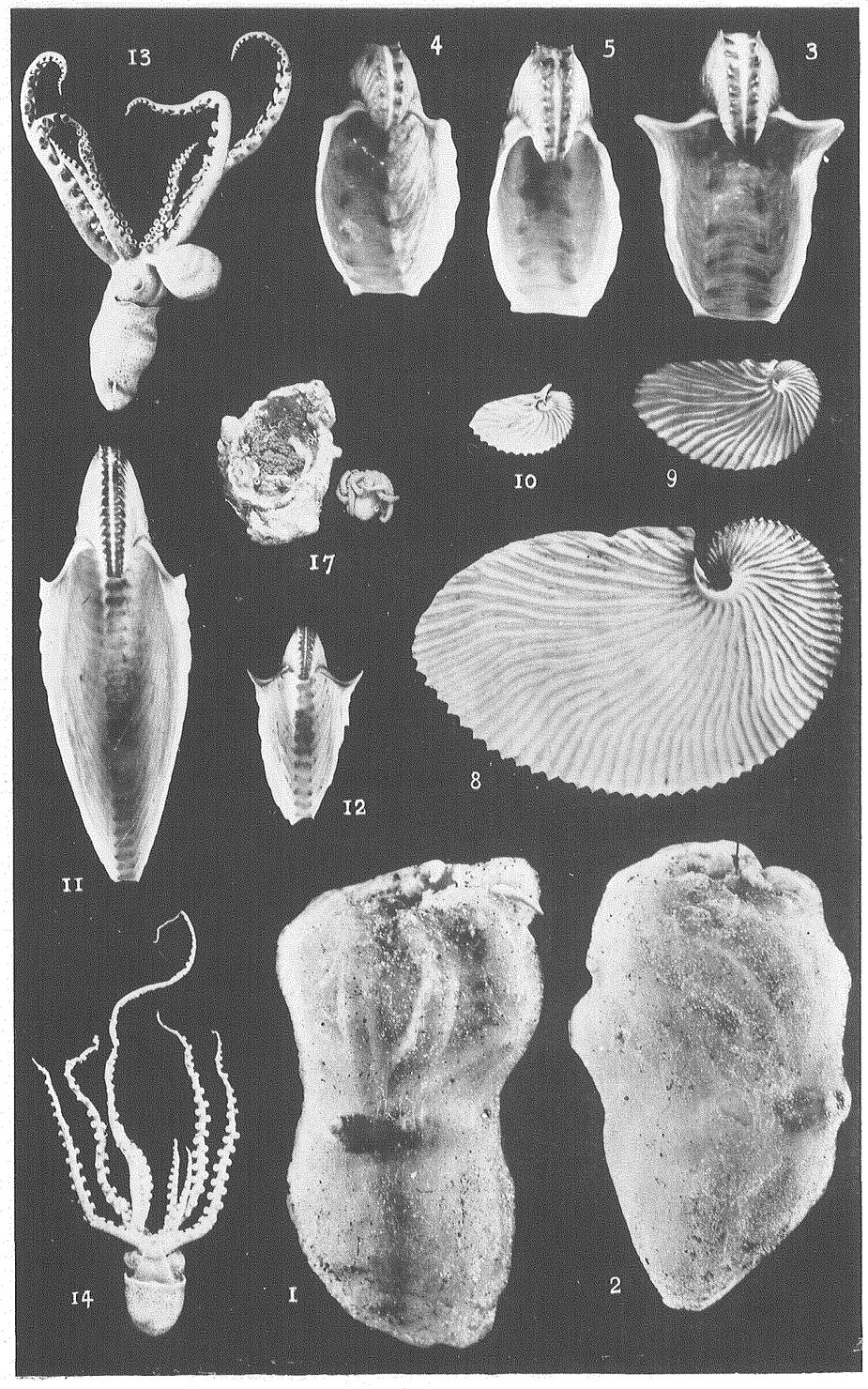


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PLATE IV.

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Polypus vulgaris (Lamarck),... 35

Fig. 1. Example with branching arms; × ca. 1/3.

Polypus oliveri Berry, ... 42

Fig. 2. Obliquely dorsal view; × 1/2.

Polypus januarii (Steenstrup), ... 61

Fig. 3. Ventral view; × ca. 2/3.

Polypus hokkaidensis Berry, ... 63

Fig. 4. Dorsal view; × 5/9.
Fig. 5. Ventral view; × 5/9.

Polypus ochotensis Sasaki, ... 65

Fig. 6. Dorsal view; × 3/4.
Fig. 7. Ventral view; × 3/4.

Polypus tsugarensis Sasaki,... 66

Fig. 8. Dorsal view; × 4/7.
Fig. 9. Ventral view; × 4/7.

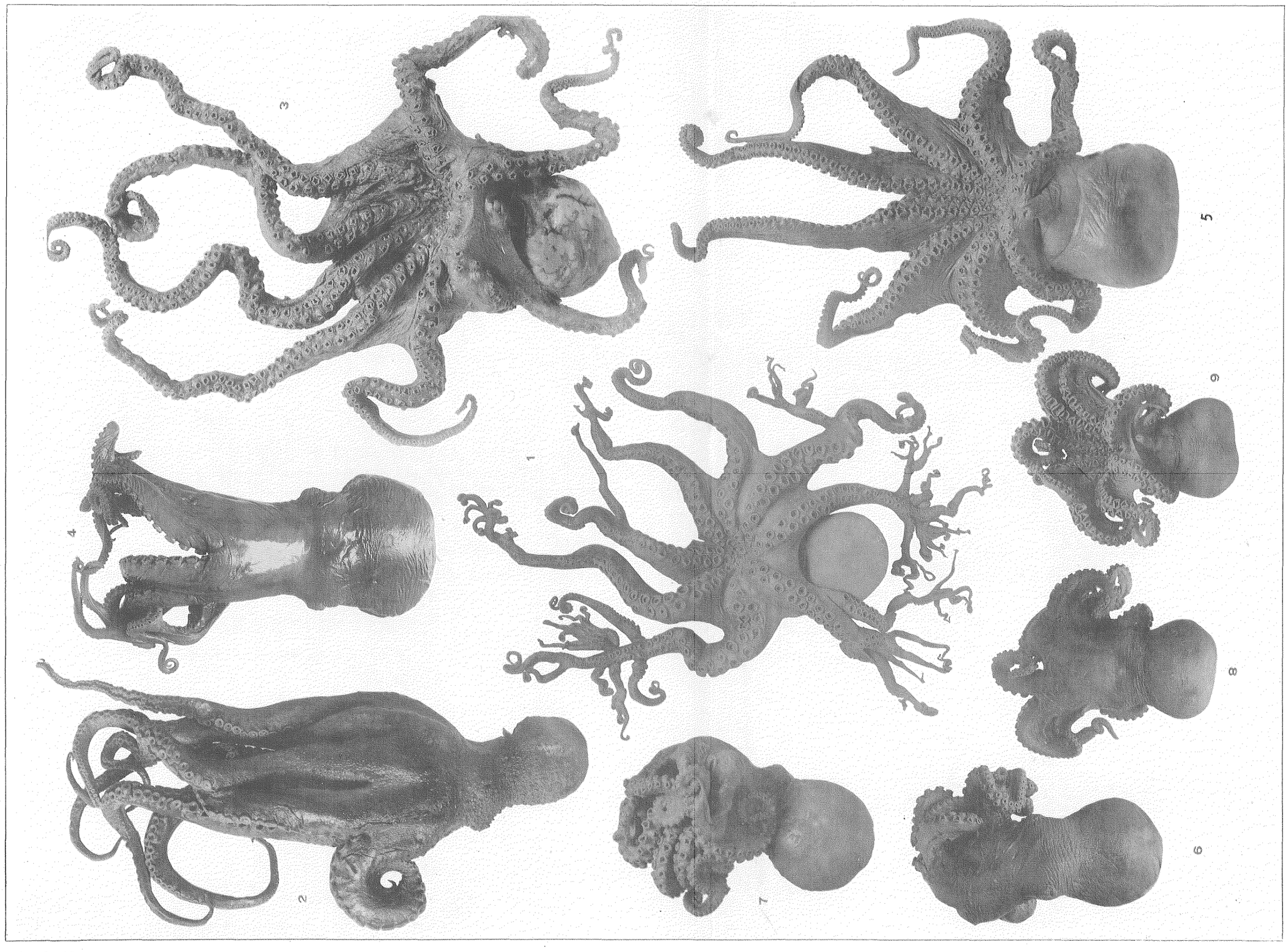

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PLATE V.

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Polypus fujitai n. sp., ... 70

Fig. 1. Dorsal view; × 7/9.

Polypus madokai Berry,... 71

Fig. 2. Dorsal view; × 1/2.
Fig. 3. Ventral view; × 9/15.

Polypus marmoratus (Hoyle), ... 47

Fig. 4. Dorsal view; × 1/3.

Polypus spinosus Sasaki, ... 76

Fig. 5. Obliquely dorsal view; a little reduced.
Fig. 6. Ventral view; nearly natural size.

Polypus yendoi Sasaki, ... 81

Fig. 7. Dorsal view of a male specimen; × 2/3
Fig. 8. Ventral view of the same; × 2/3.

Polypus tenuipulvinus Sasaki, ... 96

Fig. 9. Ventral view; × 3/5.

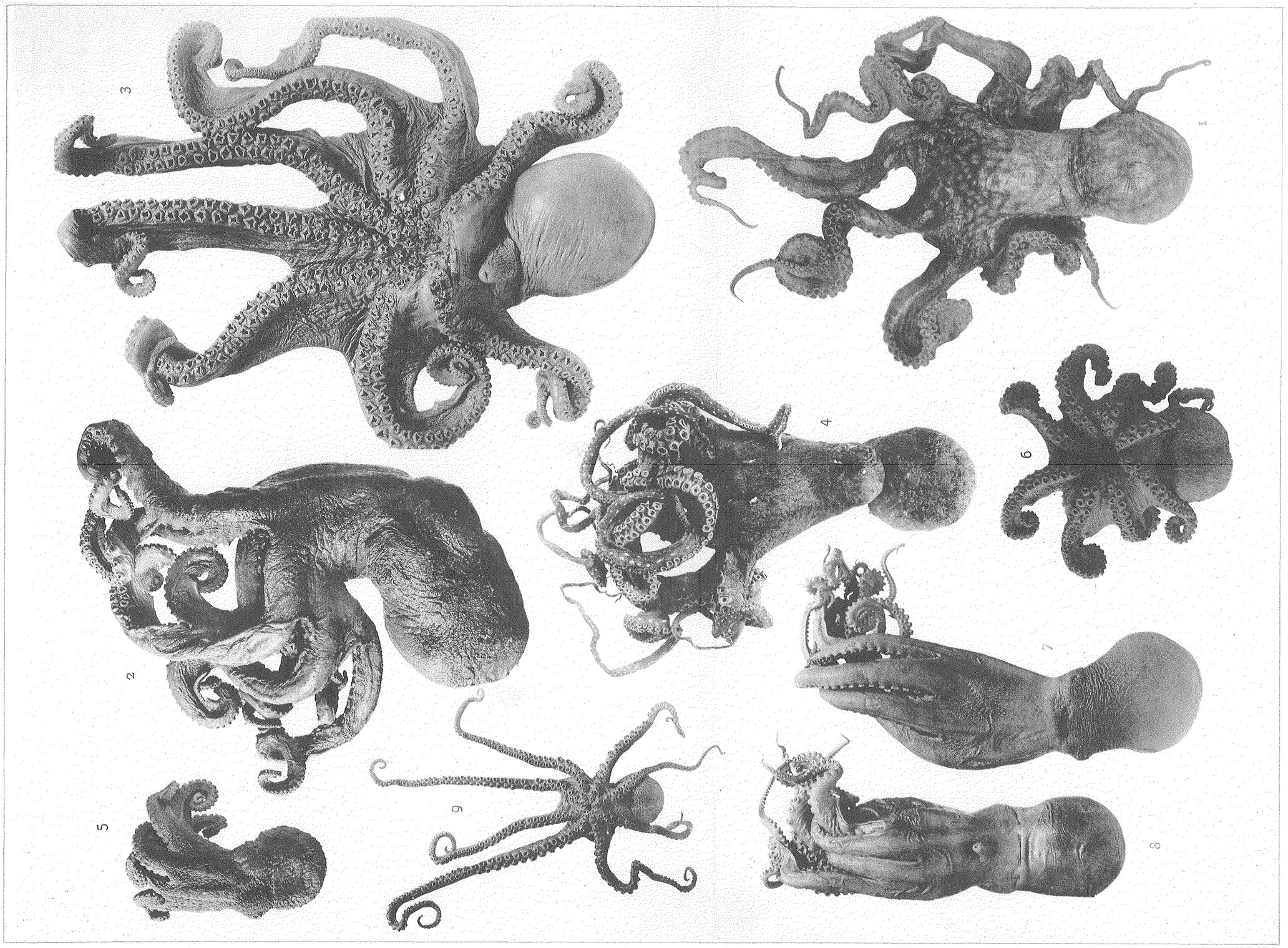

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PLATE VI.

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Polypus abruptus Sasaki, ... 68

Fig. 1. Inner aspect of arm and umbrella; × ca. 1/3.

Polypus conispadiceus Sasaki, ... 84

Fig. 2. Dorsal view of a male specimen; a little more reduced than half the measure.

Fig. 3. Ventral view of same; nearly of the same scale.

Polypus alatus Sasaki, ... 89

Fig. 4. Ventral view of a smaller individual referred to (p. 89); × 2/3.

Polypus salebrosus Sasaki, ... 99

Fig. 5. Obliquely dorsal view; × 1/2.

Fig. 6. Ventral view; approximately natural size.

Polypus validus Sasaki, ... 101

Fig. 7. Dorsal view; × 1/2.

Fig. 8. Ventral view; × 1/2.

Fig. 9. Inner aspect of arms and umbrella; × 1/2.

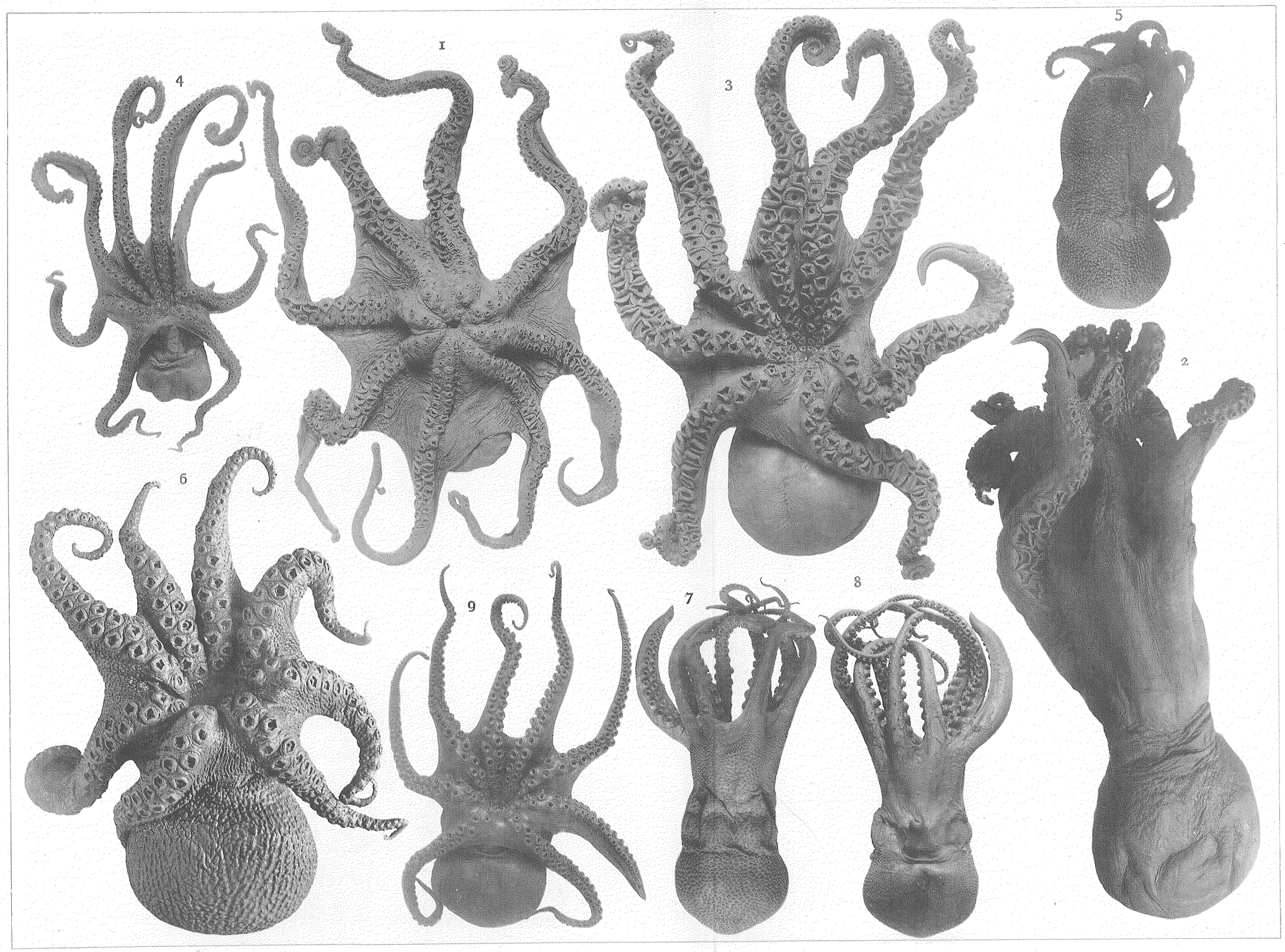

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PLATE VII.

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Watasella nigra Sasaki, ... 4

Fig. 1. Anatomy of body ; × 4.
Fig. 2. Frontal view of visceral organs ; × 4.

Stauroteuthis albatrossi Sasaki, ... 7

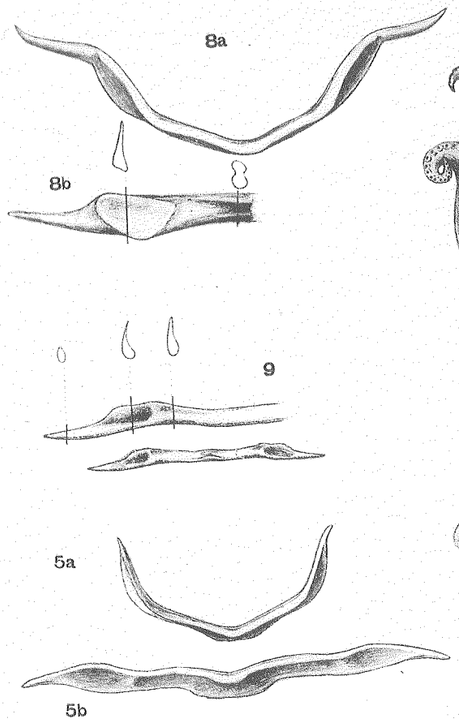
Fig. 3. Ventral view of a male specimen ; × 2/3.
Fig. 4. Young specimen ; × 1/3. a. Dorsal view. b. Lateral view.
Fig. 5. Full-formed dorsal cartilage ; × 2/3. a. Dorsal view. b. Obliquely posterior view.
Fig. 6. Visceral organs of a female specimen ; × 2/3.

Opisthoteuthis depressa Ijima & Ikeda, ... 10

Fig. 7. Dorsal view of a female specimen ; × ca. 2/3.
Fig. 8. Dorsal cartilage of a full-grown male ; × 2. a. Dorsal view. b. Posterior view of left half.
Fig. 9. Dorsal cartilage of a type specimen ; × 2.

Eledonella ijimai n. sp. 13

Fig. 10. Dorsal view ; × 2.
Fig. 11. Ventral view ; × 2.
Fig. 12. Lateral view ; × 2.
Fig. 13. Inner aspect of arms and umbrella ; × 2 2/3.
Fig. 14. Mantle, laid open ; × 1 7/9.
Fig. 15. Nervous system ; × 10.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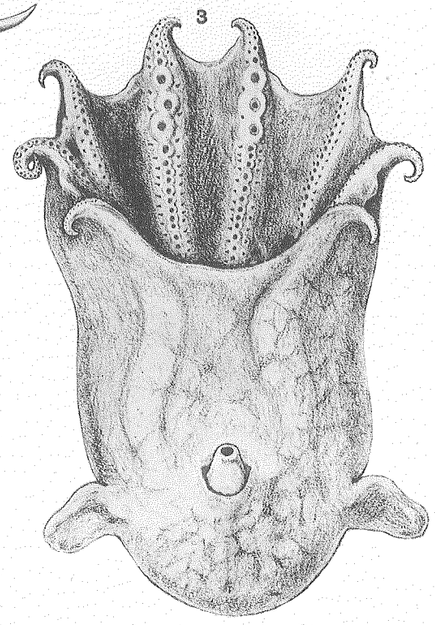
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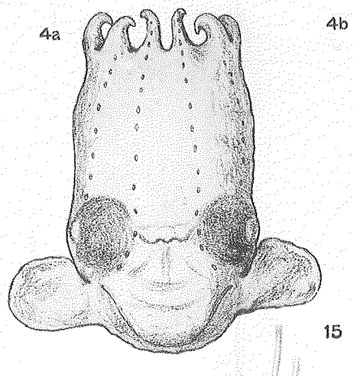
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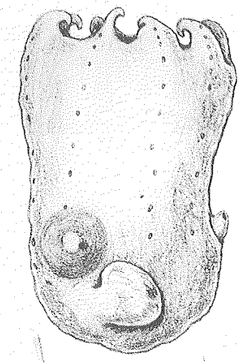
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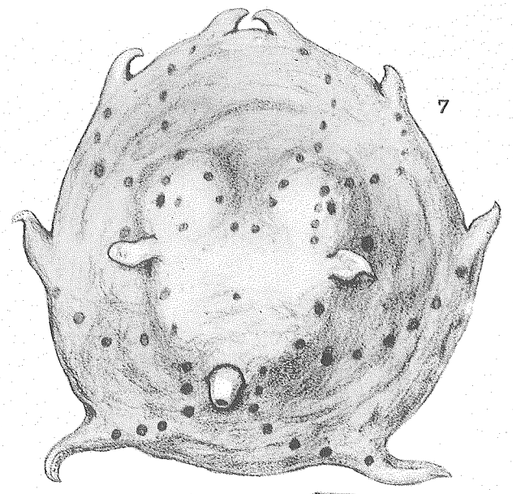
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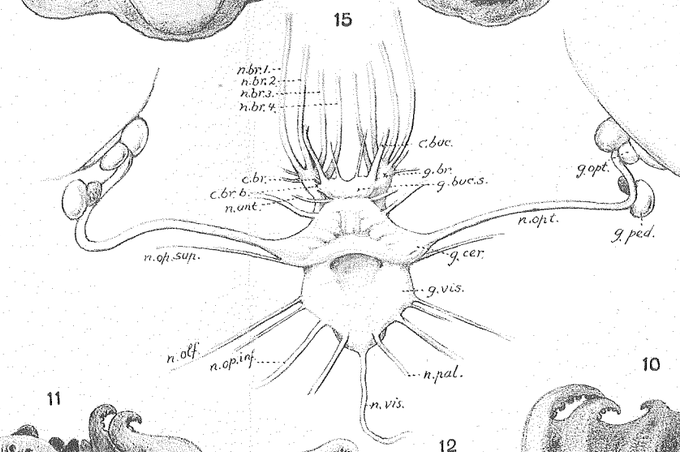
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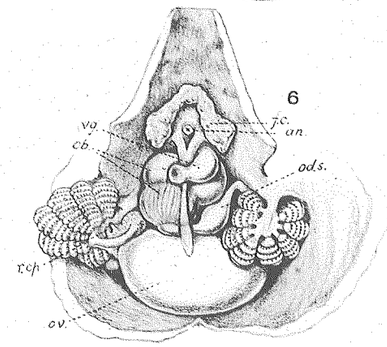
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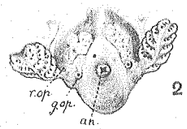
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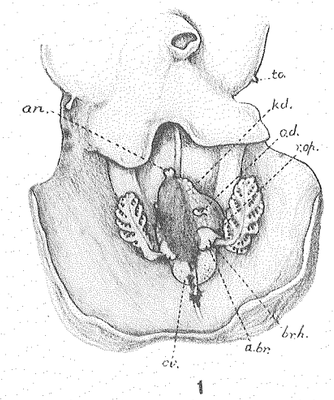
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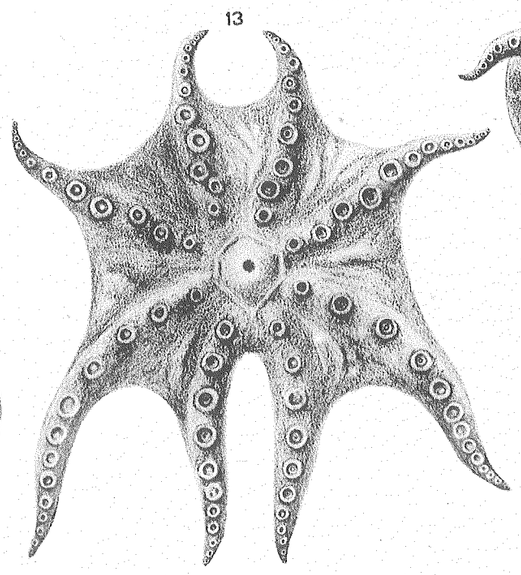
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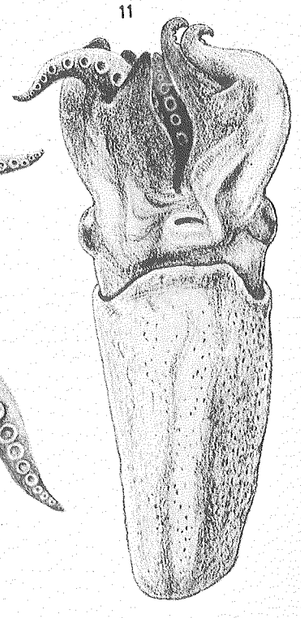
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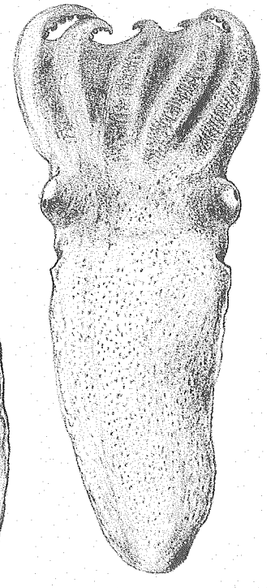
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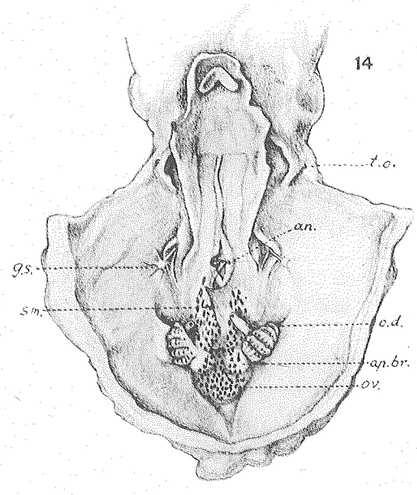
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PLATE VIII.

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Chunella diaphana (Hoyle), ... 14

Fig. 1. Male specimen; × 1 1/3. a. Ventral view. b. Lateral view.
Fig. 2. Mantle, laid open; × 2 2/9.
Fig. 3. Inner aspect of arms and umbrella; × 1 7/9.
Fig. 4. Funnel organ; × 2 2/3.

Amphitretus pelagicus Hoyle, ... 16

Fig. 5. Mantle and funnel of a male specimen, laid open; × 1 1/3.

Alloposus pacificus Ijima, ... 18

Fig. 6. Ventral view of a female specimen; × 1 1/3.
Fig. 7. Inner aspect of arms of the same specimen; × 1 1/3.
Fig. 8. Tuberculus olfactorius of the same specimen; × ca. 2 2/3.

Argonauta hians Solander, ... 20

Fig. 9. Right half of mantle of a female specimen, laid open to show inserted hectocotylus; × 1 1/3.
Fig. 10. The same hectocotylus taken out; × 3 1/3.

Argonauta böttgeri Maltzan, ... 22

Fig. 11. Inner aspect of arms; × 2/3.

Ocythoe tuberculata Rafinesque, ... 26

Fig. 12. Mantle of a female specimen, laid open; × 2/3.
Fig. 13. Ventral view of a male specimen; × 2.
Fig. 14. Oral region with hectocotylus-sac; × 1 1/9.
Fig. 15. Hectocotylus-sac, laid open; × 1 5/9.
Fig. 16. Hectocotylus stretched out from its sac; × ca. 1 1/3.

Tremoctopus violaceus Delle Chiaje, ... 29

Fig. 17. Lateral view of a young female; × 2/3.
Fig. 18. Mantle of the same, laid open; × 2/3.
Fig. 19. Mantle and funnel of the same, dissected to show the renal tract; × 2/3.

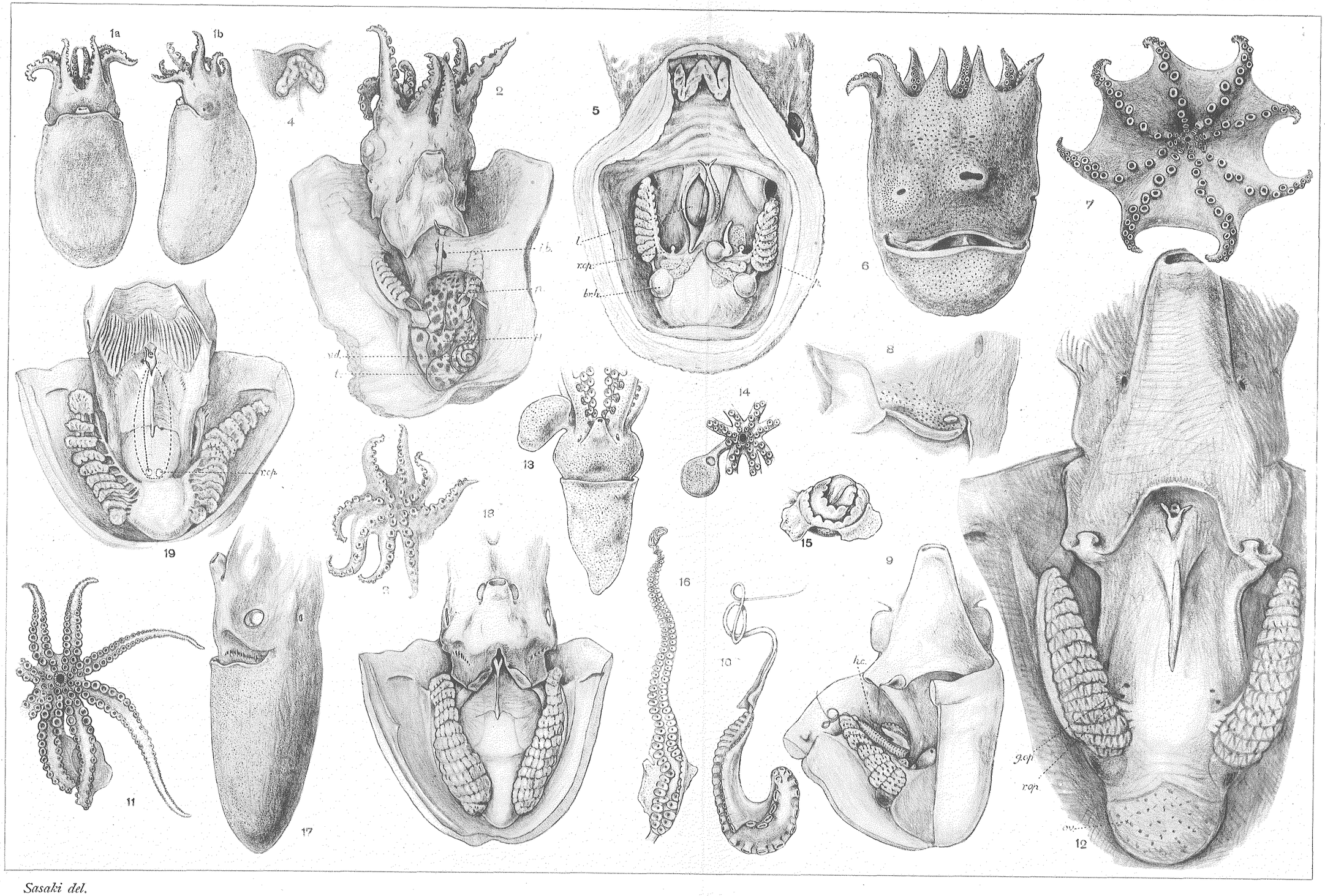

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PLATE IX.

Page.

Polypus vulgaris (Lamarck),... 35

Fig. 1. Full-formed hectocotylus ; × 5 1/3.
Fig. 2. Male internal genital organs ; × 1 1/3. a. External view. b. Internal view.
Fig. 3. Spermatophore ; × 5 1/3.

Polypus parvus Sasaki, ... 38

Fig. 4. Full-formed hectocotylus ; × 10.
Fig. 5. Visceral organs of a female specimen ; × 1 1/3.
Fig. 6. Mantle of a male specimen, laid open ; × 1 1/3.
Fig. 7. Part of digestive system ; × 1 1/3.
Fig. 8. Female internal genital organs ; × 1 1/3.
Fig. 9. Male internal genital organs ; × 2. a. Ventral view. b. Dorsal view.
Fig. 10. Oral part of spermatophore ; × 33.

Polypus granulatus (Lamarck), ... 40

Fig. 11. Mantle and funnel of a male specimen, laid open ; × 2/3.
Fig. 12. Internal genital organs of a full-mature male ; × 1 1/3. a. Ventral view. b. Dorsal view.
Fig. 13. Internal genital organs of a male specimen from Kagoshima referred to (p. 40) ; × 1 1/3.

Polypus oliveri Berry, ... 42

Fig. 14. Mantle and funnel of a female specimen, laid open ; × 2/3.
Fig. 15. Part of digestive organ ; × 2/3.
Fig. 16. Female genital organs ; × 2/3.
Fig. 17. Male genital organs ; × 1 1/3. a. Ventral view. b. Dorsal view.
Fig. 18. Vas deferens, laid loose ; × 1 1/3.

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Fig. 19. Lateral view of head and body ; × 2/3.
Fig. 20. Full-formed hectocotylus ; × 1 1/3.
Fig. 21. Mantle and funnel of a female specimen, laid open ; × 2/3.
Fig. 22. Digestive system ; × 2/3. a. Whole ventral view. b. The same, but the liver taken off.
Fig. 23. Internal genital organs of a full-mature male ; × 2/3. a. Ventral view. b. Dorsal view.
Fig. 24. Female genital organs ; × 2/3.

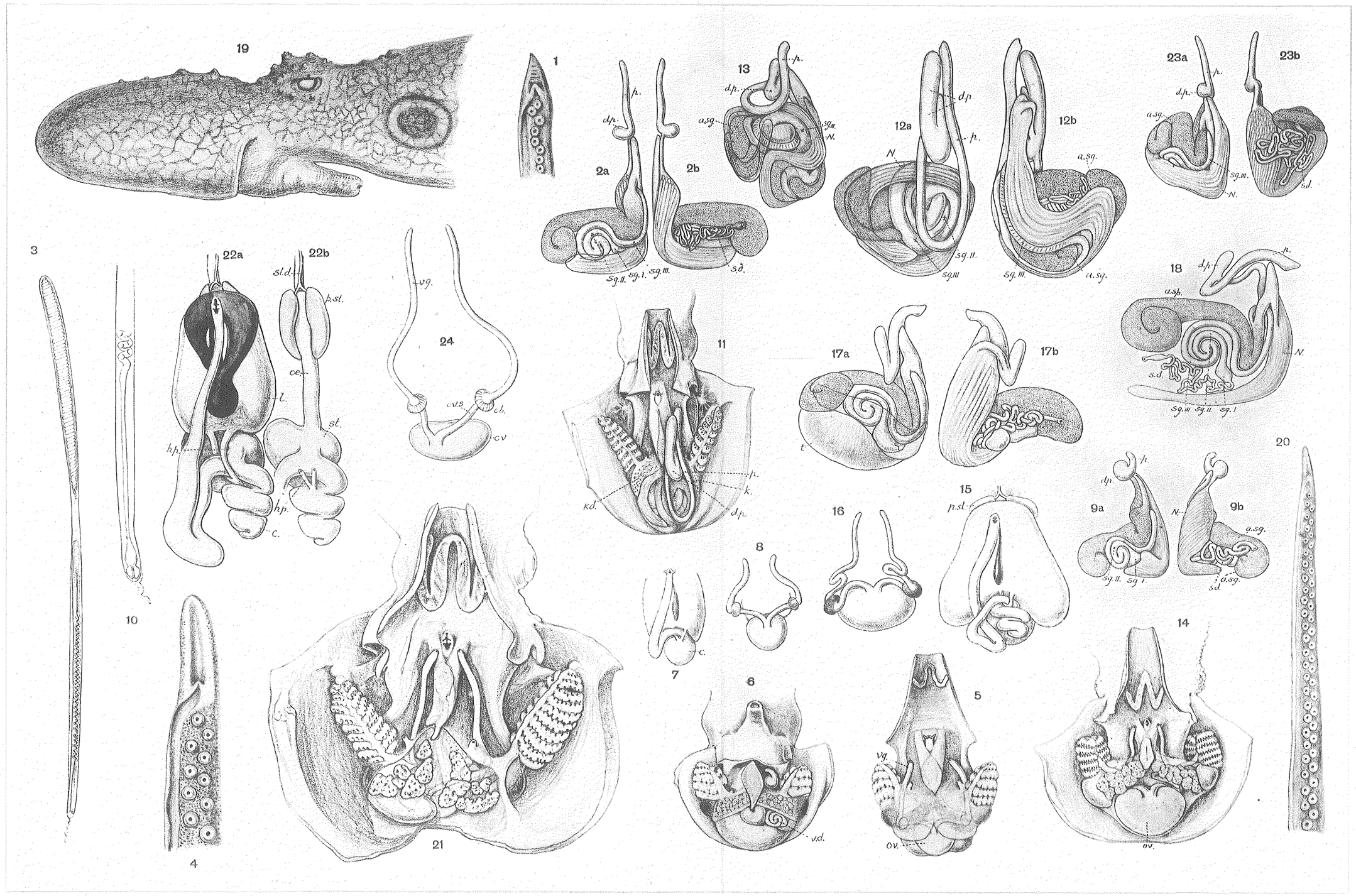
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PLATE X.

Page.

Polypus fangsiao (d'Orb.) var. **typicus** mihi, ... 49

Fig. 1. a. Dorsal view; × 5. b. Lateral view; × 3 1/3.

Fig. 2. Spermatophore. a. Whole view; × 5 1/3. b. Aboral part; × 40. c. Intermediate part; × 33.

Fig. 3. Ovary and oviduct; × 1 1/3. a. Ventral view. b. Dorsal view.

Polypus fangsiao var. **etchuanus** n. var., ... 53

Fig. 4. Mantle of a male specimen, laid open; × 2/3.

Fig. 5. The same of a female specimen, laid open; × 2/3.

Fig. 6. Full-formed ovary and oviduct: × 2/3. a. Dorsal aspect. b. Ventral aspect, drawn together with systematic heart and part of intestine.

Fig. 7. Dorsal aspect of an immature ovary and oviduct; × 2/3.

Fig. 8. Internal genital organs of a full-mature male; × 1 1/3. a. Ventral view. b. Dorsal view.

Fig. 9. Same, laid loose; × 1 1/3.

Fig. 10. Spermatophore. a. Whole view; × 5 1/3. b. Aboral part; × 40. c. Intermediate part; × 40. d. Oral part; × 40.

Polypus ovulum Sasaki, ... 55

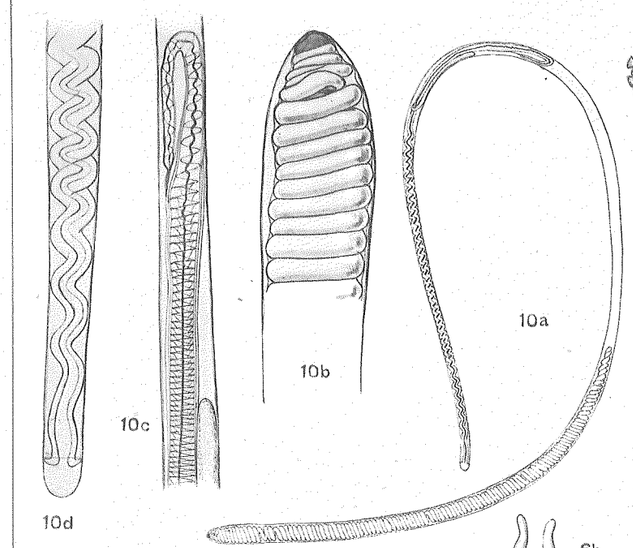
Fig. 11. a. Dorsal view; natural size. b. Ventlal view; same scale.

Fig. 12. Male internal genital organs; × 1 1/3. a. Ventral view. b. Dorsal view. c. Ditto; the testis is omitted.

Fig. 13. The same, laid loose; × 1 1/3.

Fig. 14. Spermatophore. a. Whole view; × 5 1/3. b. Oral part; × 40. c. Swelling of discharging part; × 40. d. Aboral extremity of the same part; × 40.

Fig. 15. Dorsal aspect of a full-formed ovary and oviduct; × 1 1/3.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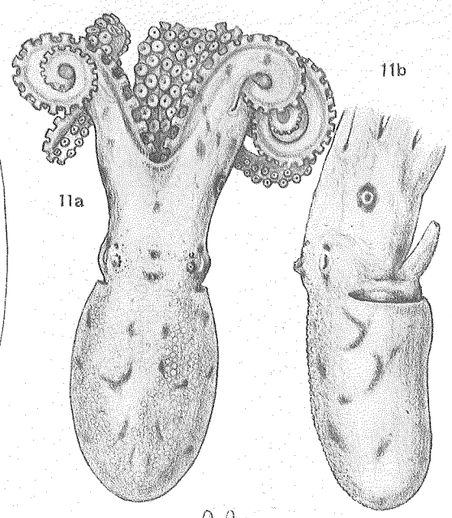
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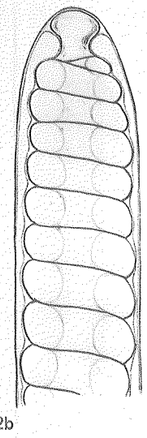
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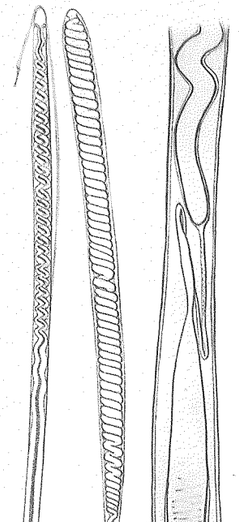
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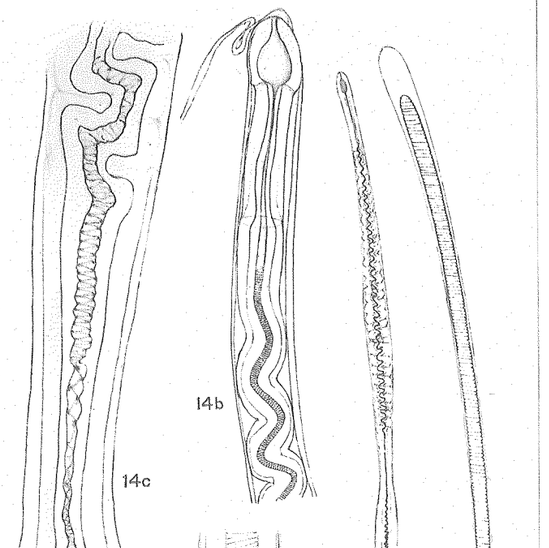
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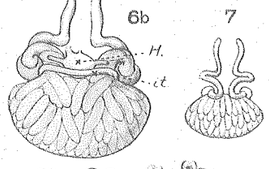
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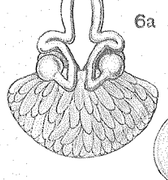
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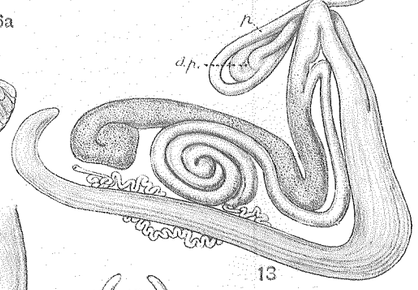
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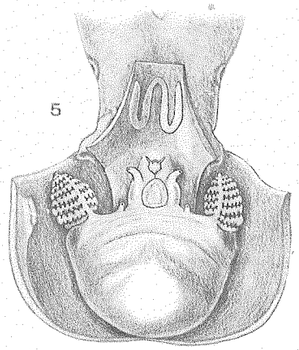
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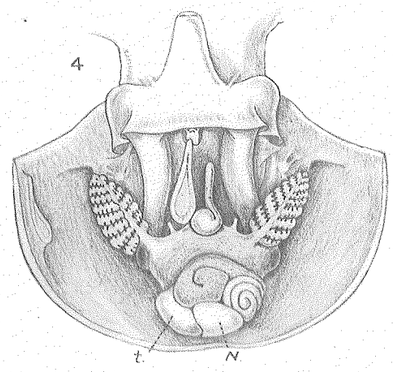
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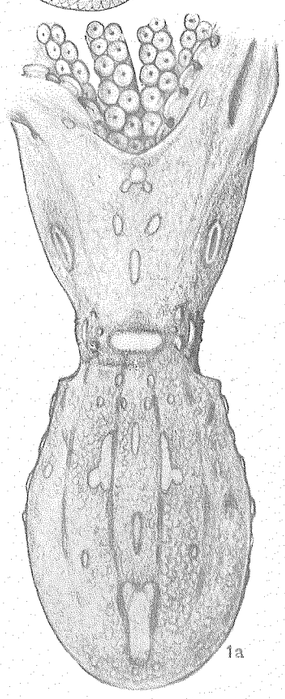
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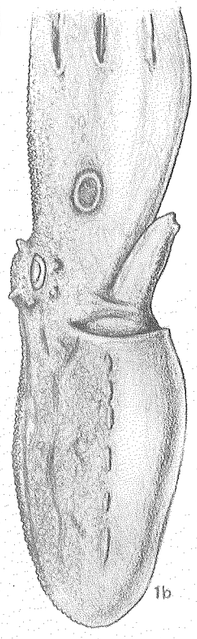
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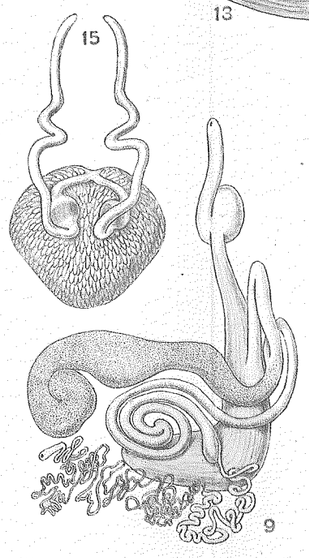
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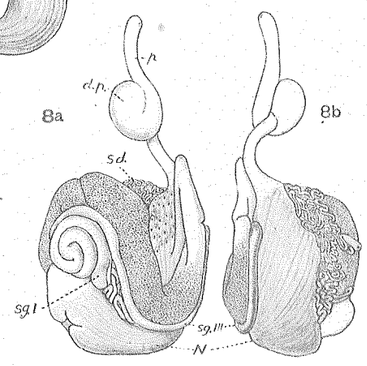
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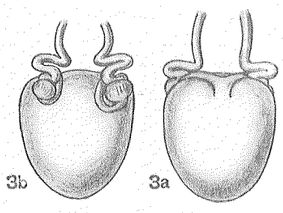
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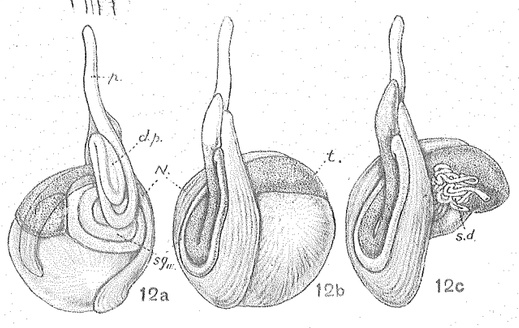
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PLATE XI.

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Polypus fasciatus (Hoyle), ... 58

Fig. 1. Outer aspect of a female ; × 7/9.
Fig. 2. Hectocotylus ; × 5 1/3.
Fig. 3. Dorsal aspect of head and body of a young specimen ; × 1 2/3.

Polypus januarii (Steenstrup), ... 61

Fig. 4. Mantle of a female specimen, laid open ; × 2/3.

Polypus hokkaidensis Berry, ... 63

Fig. 5. Hectocotylus ; × 5 1/3.

Polypus tsugarensis Sasaki,... 66

Fig. 6. Mantle and funnel of a male specimen, laid open ; × 1 1/3.
Fig. 7. Hectocotylus ; × 4.

Polypus fujitai n. sp., ... 70

Fig. 8. Mantle, laid open ; × 2/3.

Polypus madokai Berry,... 71

Fig. 9. Mantle and funnel of a female specimen, laid open ; × 2/3.

Polypus döfleini Wülker, ... 73

Fig. 10. Full-formed hectocotylus ; × 2/3.
Fig. 11. Full-grown mantle, laid open ; × 1/3.

Polypus spinosus Sasaki, ... 76

Fig. 12. Mantle, laid open ; × 1 1/3.
Fig. 13. Part of digestive systems ; × 1 1/3.

Polypus tenuicirrus n. sp., ... 78

Fig. 14. Anatomy of body and funnel ; × 2/3.
Fig. 15. Internal genital organs of a full-mature male, the testis taken out ; × 2/3.
Fig. 16. The same of an immature male ; × 1/13. a. Ventral view. b. Dorsal view ; the testis is omitted.

Polypus longispadiceus Sasaki, ... 79

Fig. 17. Mantle of a male specimen, laid open ; × 2/3.
Fig. 18. Funnel of the same specimen, laid open ; × 2/3.
Fig. 19. Internal genital organs of a full-mature male, the testis taken out ; × 2/3. a. Ventral view. b. Dorsal view.

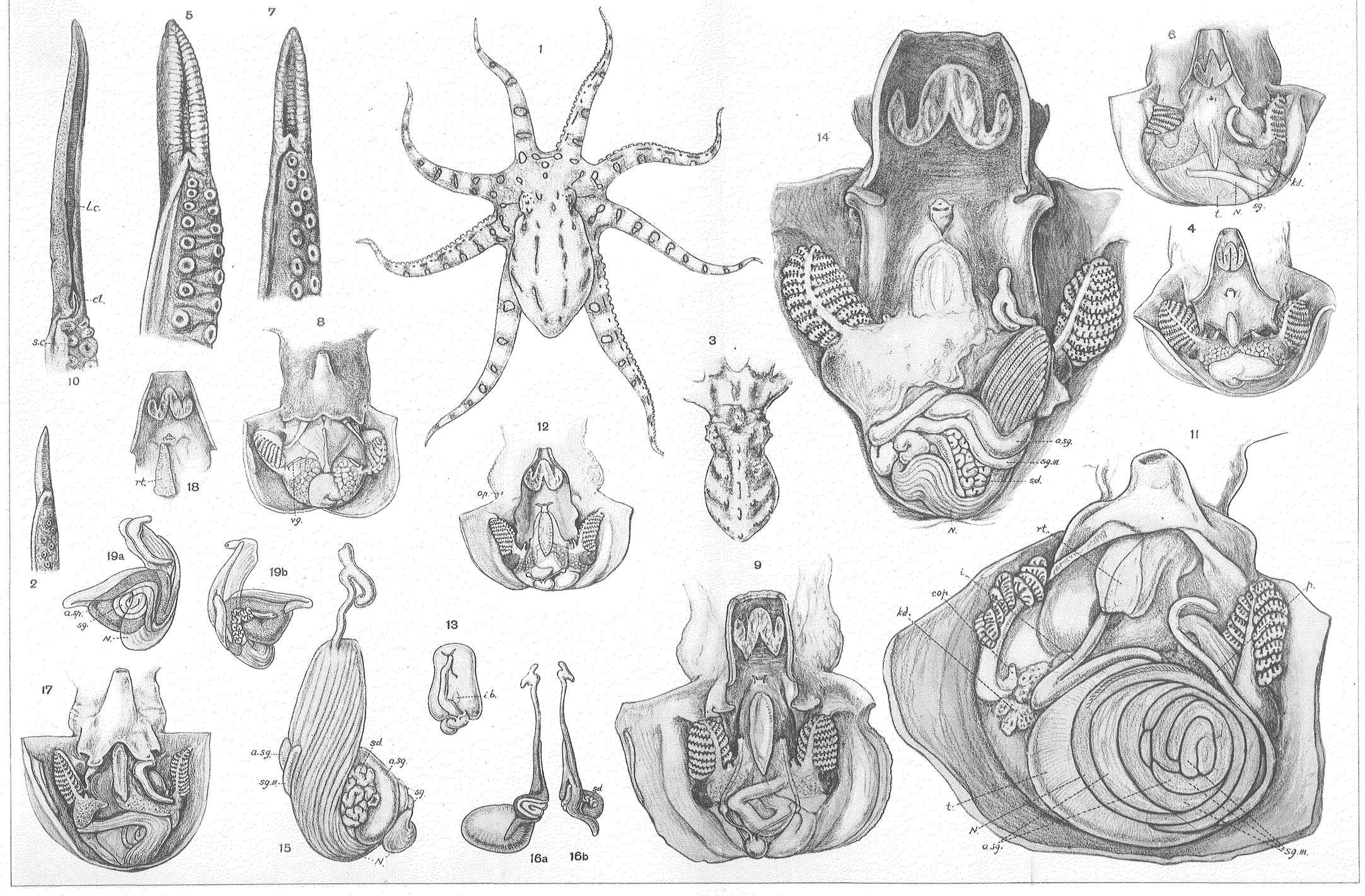
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PLATE XII.

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Polypus yendoi Sasaki, ... 81

Fig. 1 Lateral aspect of body and head ; × 2/3.
Fig. 2. Mantle of a male specimen, laid open ; × 2/3.
Fig. 3. Mantle of a female specimen, laid open ; × 2/3.
Fig. 4. Full-formed hectocotylus ; × 5 1/3.
Fig. 5. Immatur hectocotylus ; × 5 1/3.
Fig. 6. Internal genital organs of a full-grown male ; natural size. a. Ventral view. b. Dorsal view ; the testis taken out

Polypus conispadiceus Sasaki, ... 84

Fig. 7. Mantle of a full-grown female, laid open ; × 1/3.
Fig. 8. Digestive system ; a little reduced.
Fig. 9. Frontal view of a female internal genital organ ; × 1/3.

Polypus hattai n. sp., ... 87

Fig. 10. Anatomy of body and funnel ; × 2/3.

Polypus alatus Sasaki, ... 89

Fig. 11. Anatomy of mantle and funnel of an immature male referred to (p. 89) ; × 1 1/3.
Fig. 12. Hectocotylus of the same specimen ; × 6 2/3.

Polypus variabilis n. sp. var. **typicus** mihi, ... 90

Fig. 13. Mantle and funnel of a full-mature male, laid open ; × 2/3.
Fig. 14. Internal genital organs of a full-grown male ; natural size. a. Ventral view. b. Dorsal view ; the testis taken out.

Polypus variabilis n. sp. **pardalis** n. var., ... 94

Fig. 15. Mantle and funnel, laid open ; 2/3.
Fig. 16. Internal genital organ, the testis taken out ; × 1 2/5.

Polypus variabilis n. sp. **minor** n. var., ... 95

Fig. 17. Dorsal view ; natural size.
Fig. 18. Ventral view ; natural size.
Fig. 19. Mantle and funnel, laid open ; × 1 1/3.

Polypus tenuipulvinus n. sp., ... 96

Fig. 20. Mantle and funnel, laid open ; × 1 1/3.

Polypus globosus (Appellöf)... 97

Fig. 21. Dorsal aspect of body and head ; natural size.
Fig. 22. Full-formed hectocotylus ; × 6 2/3.

Polypus validus Sasaki, ... 101

Fig. 23. Inner aspect of hectocotylized arm ; × 1 1/3.

Scaeurgus patagiatus Berry, ... 102

Fig. 24. Mantle and funnel laid open ; × 2/3.
Fig. 25. Internal genital organs of a male specimen ; the testis taken out ; natural size. a. Ventral view. b. Dorsal view c. Whole loop, laid loose.

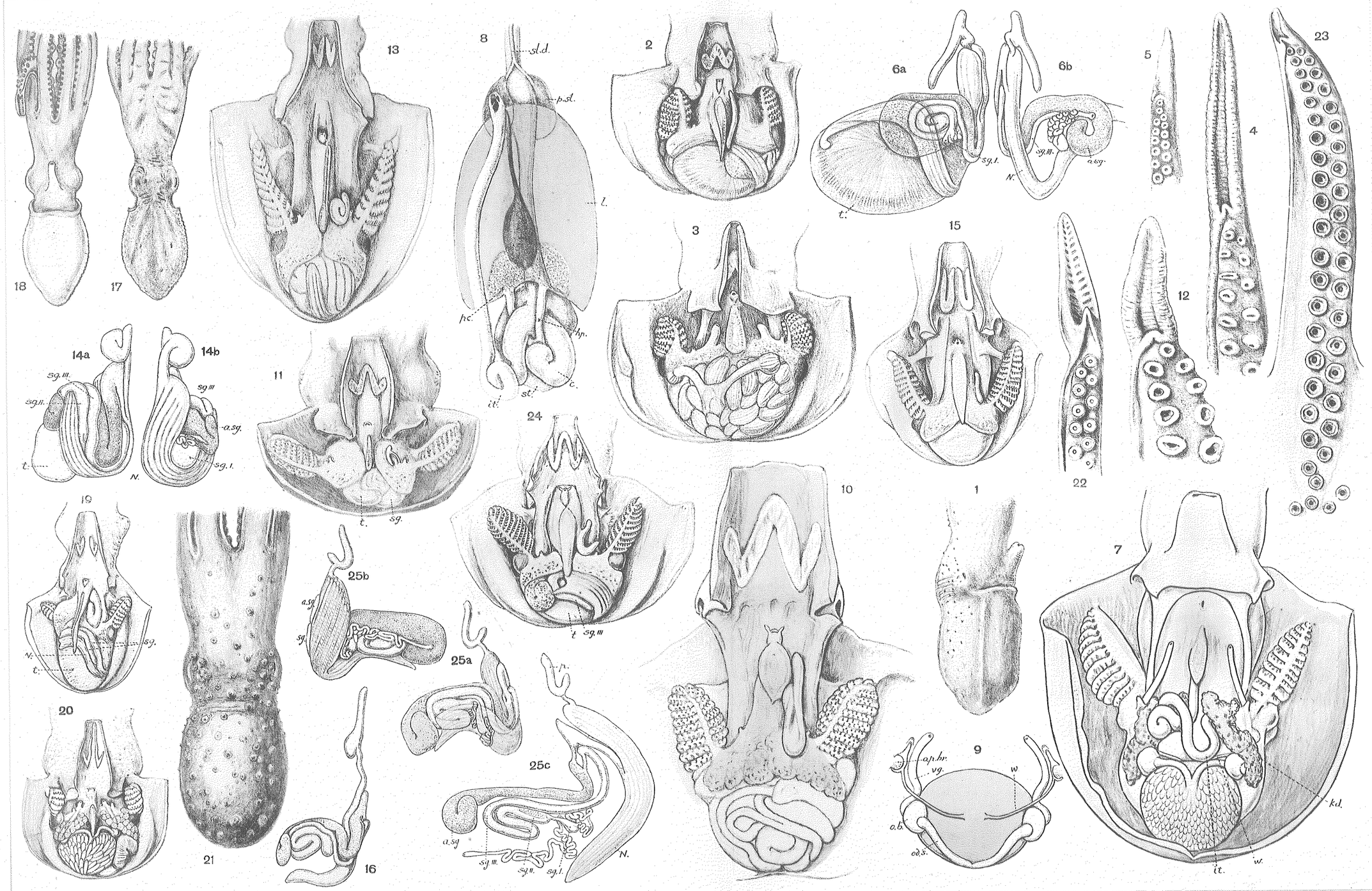
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PLATE XIII.

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Loligo edulis Hoyle, ... 107

Fig. 1. Ventral view of a full-mature male from Etchu Prov. ; × 2/3.
Fig. 2. Part of mantle cavity of a young male from Sagami Bay ; × 1 1/3.,
Fig. 3a. Largest arm-sucker of a male specimen of 192 mm. mantle-leugth ; × 10.
Fig. 3b. Distal sucker of tentacles of the same specimen ; × 10.

Loligo edulis forma **nagasakensis** n. f., ... 109

Fig. 4. Spermatophores ; × 40.

Loligo beca n. sp. 121

Fig. 5a, b. Juvenile specimens from Ariake Bay ; × 1 1/3.

Loligo bleekeri Keferstein, ... 125

Fig. 6. Mature male from Sagami Bay ; × 2/3.
Fig. 7. Hectocotylized arm of the same specimen ; × 2 2/3.
Fig. 8. Tentacle of the same specimen ; × 2 2/3.
Fig. 9a. Largest arm-sucker ; × 20.
Fig. 9b. Larger tentacular sucker ; × 40.
Fig. 10. Gladius of a male specimen ; × 2/3.

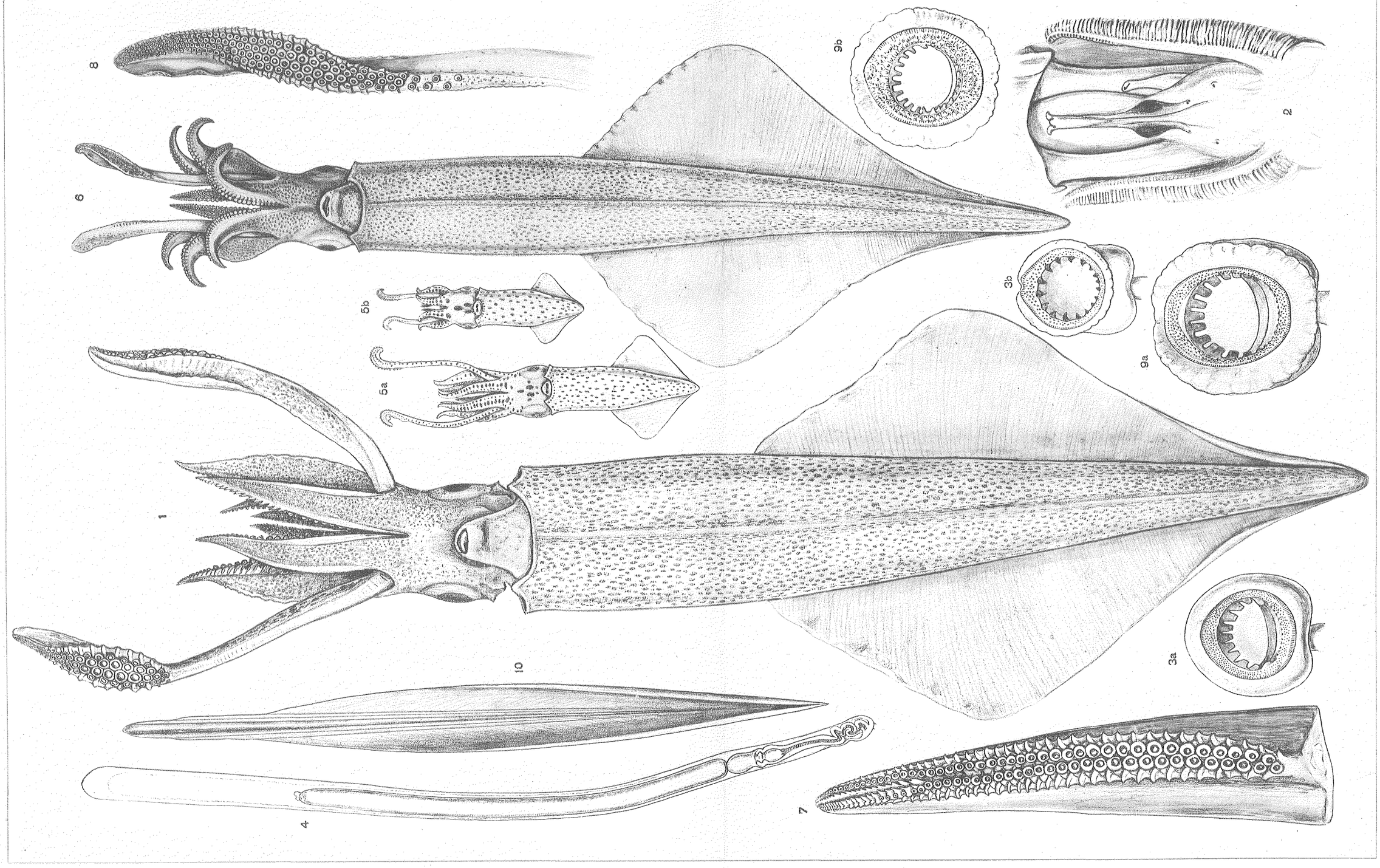

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PLATE XIV.

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Loligo japonica Steenstrup., ... 112

Fig. 1. Ventral view of a female specimen from Etchu Province ; × 2/3.
Fig. 2. Dorsal view of the same specimen ; × 2/3.
Fig. 3. Nuchal cartilage ; × 1 1/3.
Fig. 4. Funnel organ ; × 1 1/3.
Fig. 5. Hectocotylized arm ; × 2 2/3.
Fig. 6. Gladius of a female specimen ; × 2/3.

Loligo kobiensis Hoyle., ... 114

Fig. 7. Ventral view of a female specimen ; × 2/3.
Fig. 8. Left tentacle of a smaller female ; × 2 2/3.
Fig. 9. Buccal membrane ; × 1 1/3.

Loligo gotoi n. sp., ... 116

Fig. 10. Ventral view of the largest female examined ; × 2/3.
Fig. 11. Hectocotylized arm of the largest male examined ; × 2 2/3.
Fig. 12. Left tentacle of the said female ; × 2 2/3.
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Loligo tagoi n. sp., ... 118

Fig. 14. Dorsal view of a type specimen ; × 2/3.

Sepioteuthis lessoniana Férussac., ... 127

Fig. 15. Dorsal view of a full-grown male from Etchu Prov. ; × 1/3.
Fig. 16. Hectocotylized arm of a full-mature male from Hokkaido ; × 1 1/3.
Fig. 17. Spermatophore ; × 10 2/3.

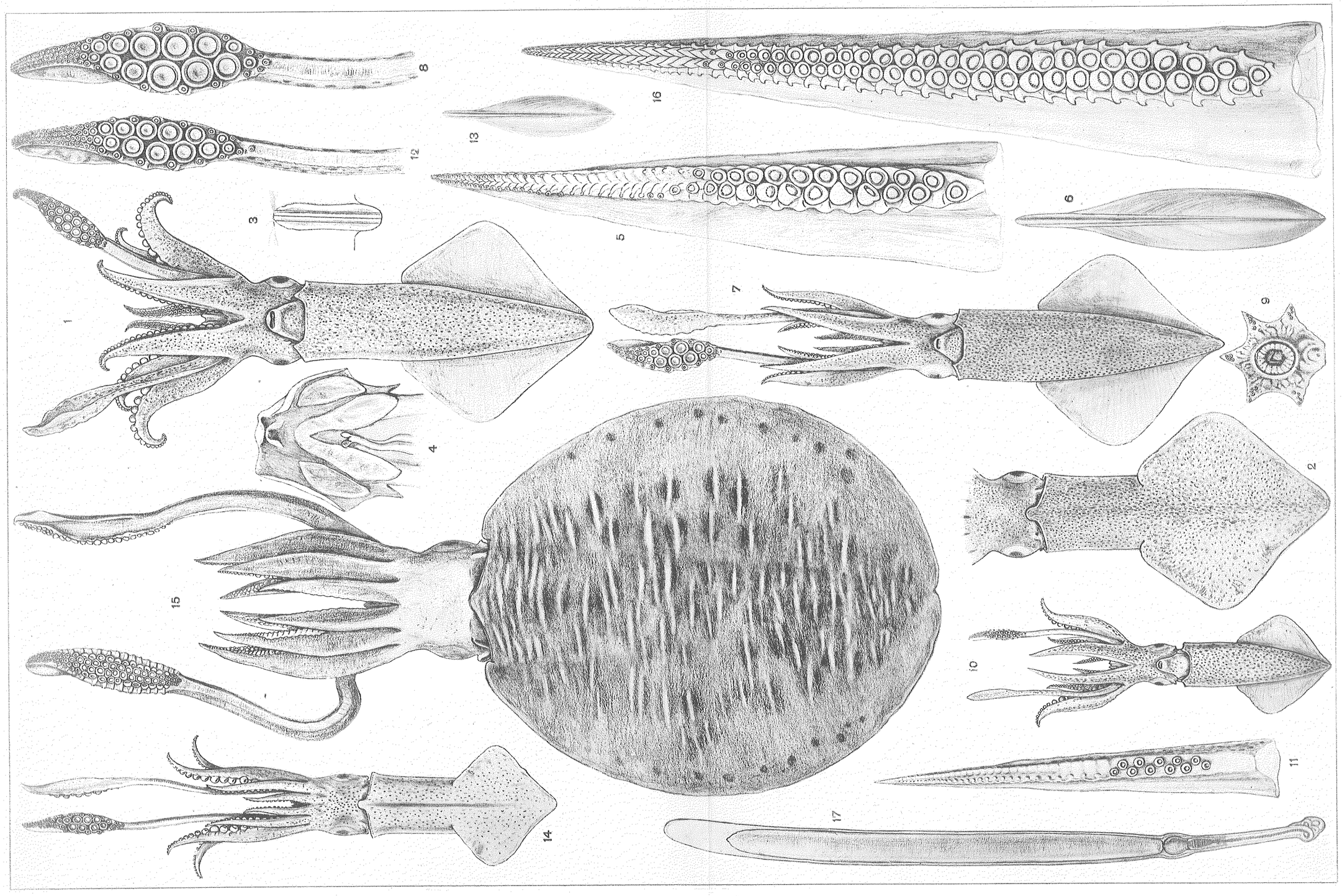

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PLATE XV.

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Idiosepius paradoxa (Ortmann), ... 133

Fig. 1. Dorsal view of a full-mature male ; × 4.
Fig. 2 Mantle of the same specimen, laid open ; × 4.
Fig. 3. Funnel of the same specimen, laid open ; × 4.

Sepiola parva Sasaki 136

Fig. 4. Mantle and funnel of a type specimen, laid open ; × 3 1/3.
Fig. 5. Spermatophore taken from its gland, not from Needham's sac ; × 13.

Sepiola birostrata. Sasaki, ... 137

Fig. 6. Full-mature male ; × 1 1/3. a. Dorsal view. b. Ventral view.
Fig. 7. Funnel of the same specimen, laid open ; × 2.
Fig. 8. Spermatophore. a. Whole view ; × 10. b. Intermediate organ ; × 30.

Inioteuthis japonica Verrill,... 141

Fig. 9. Full-grown male specimen ; × 1 1/3. a. Dorsal view. b. Ventral view.
Fig. 10. Mantle and funnel of the same specimen, laid open ; × 2 2/3.
Fig. 11. Spermatophore ; × 12 2/3.

Euprymna berryi sp. n. 143

Fig. 12. Mantle and funnel of a mature male, laid open ; × 1 1/3.
Fig. 13. Spermatophore. a. Whole view ; × 16. b. Intermediate part ; × 53.

Euprymna morsei (Verrill), ... 146

Fig. 14. Total view of spermatophore ; × 10.

Sepiolina nipponensis (Berry) 149

Fig. 15. Dorsal view of a full-mature male ; × 1 1/3.
Fig. 16. Another male specimen ; × 1 1/3. a. Lateral view. b. Ventral view.
Fig. 17. Funnel of the same specimen, laid open so as to show funnel organ and photophore; × 4.

Sepiadarium kochii Steenstrup, ... 152

Fig. 18. Mantle and funnel of a mature female, laid open ; × 2 2/3.
Fig. 19. Whole view of spermatophore ; × 77.

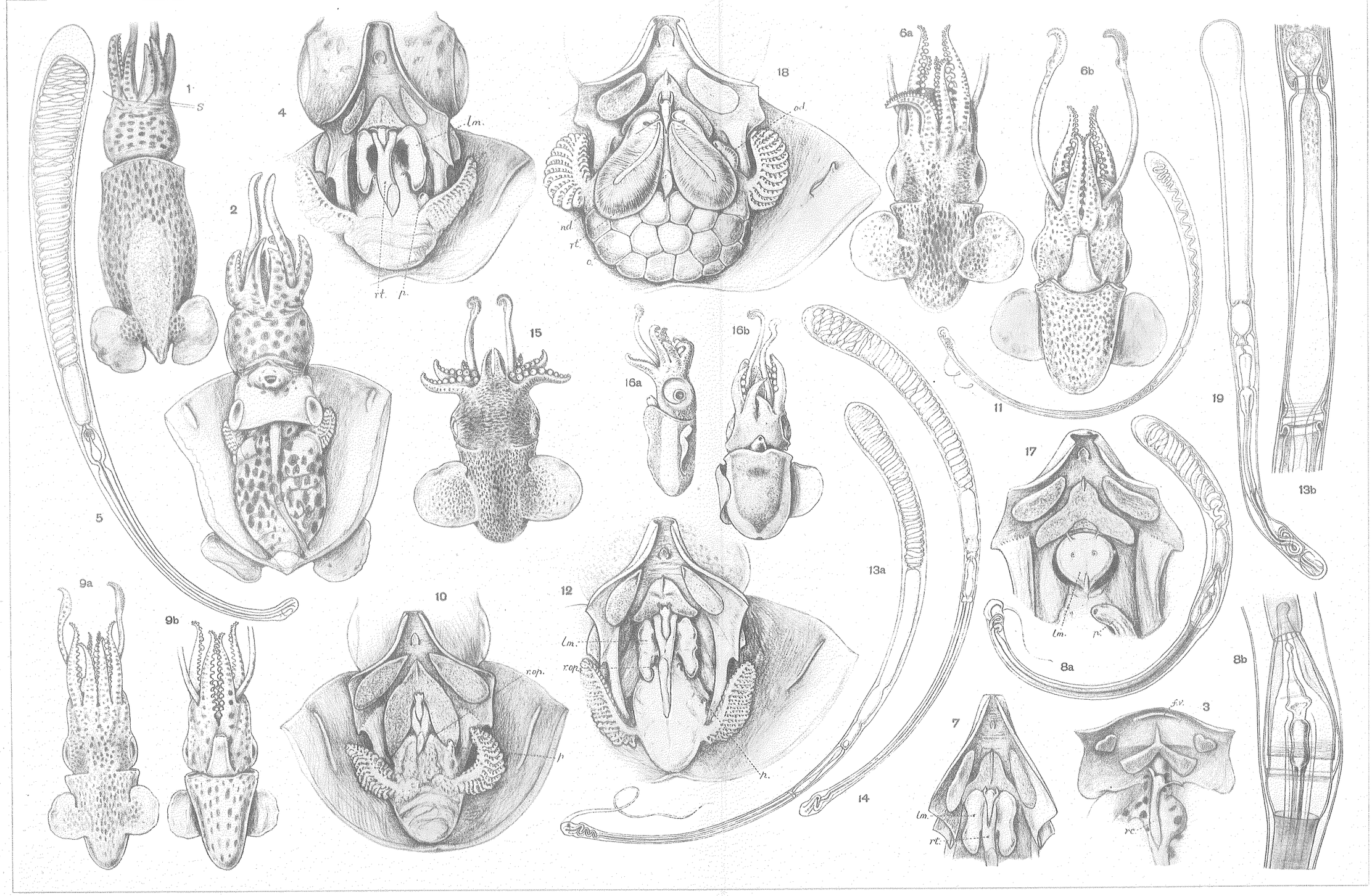
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PLATE XVI.

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Fig. 1. Inner aspect of arms of a mature female, × 2.
Fig. 2. The same of a mature male ; × 2.

Rossia pacifica Berry, ... 154

Fig. 3. Anatomy of a full-mature female ; natural size.
Fig. 4. Nuchal cartilage ; × 1 1/3.
Fig. 5. Tentacular club ; natural size.
Fig. 6a. Gladius of a male specimen of 40 mm. mantle length ; × 4.
Fig. 6b. Same of a female specimen of 75 mm. mantle length ; × 4.
Fig. 6c. Same of a female specimen of 30 mm. mantle length ; × 4.

Rossia mollicella Sasaki, ... 157

Fig. 7. Ventral view of the largest specimen referred to (p. 157) ; natural size.
Fig. 8. Nuchal cartilage of the same specimen ; × 1 1/3.
Fig. 9. Radula of the same specimen ; × 36.
Fig. 10. Gladius of the same specimen ; × 6.

Sepia torosa Ortmann, ... 163

Fig. 11. Full-grown shell ; × 2/3. a. Ventral view. b. Lateral view.

Sepia aculeata Van Hasselt 171

Fig. 12. Shell ; × 2/3. a. Ventral view. b. Dorsal view.

Sepia subaculeata Sasaki, ... 173

Fig. 13. Full-formed hectocotylylized arm ; × 1 1/3.
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Sepia esculenta Hoyle 175

Fig. 15. Full-formed spermatic pad ; × 1/3. a. Upper view. b. Side view.
Fig. 16. Whole view of spermatophore ; × 12.
Fig. 17. Ventral aspect of shell ; × 2/3.

Rossia bipapillata Sasaki, ... 160

Fig. 18. Anatomy of mantle and funnel ; × 3.
Fig. 19. Funnel ; × 3.

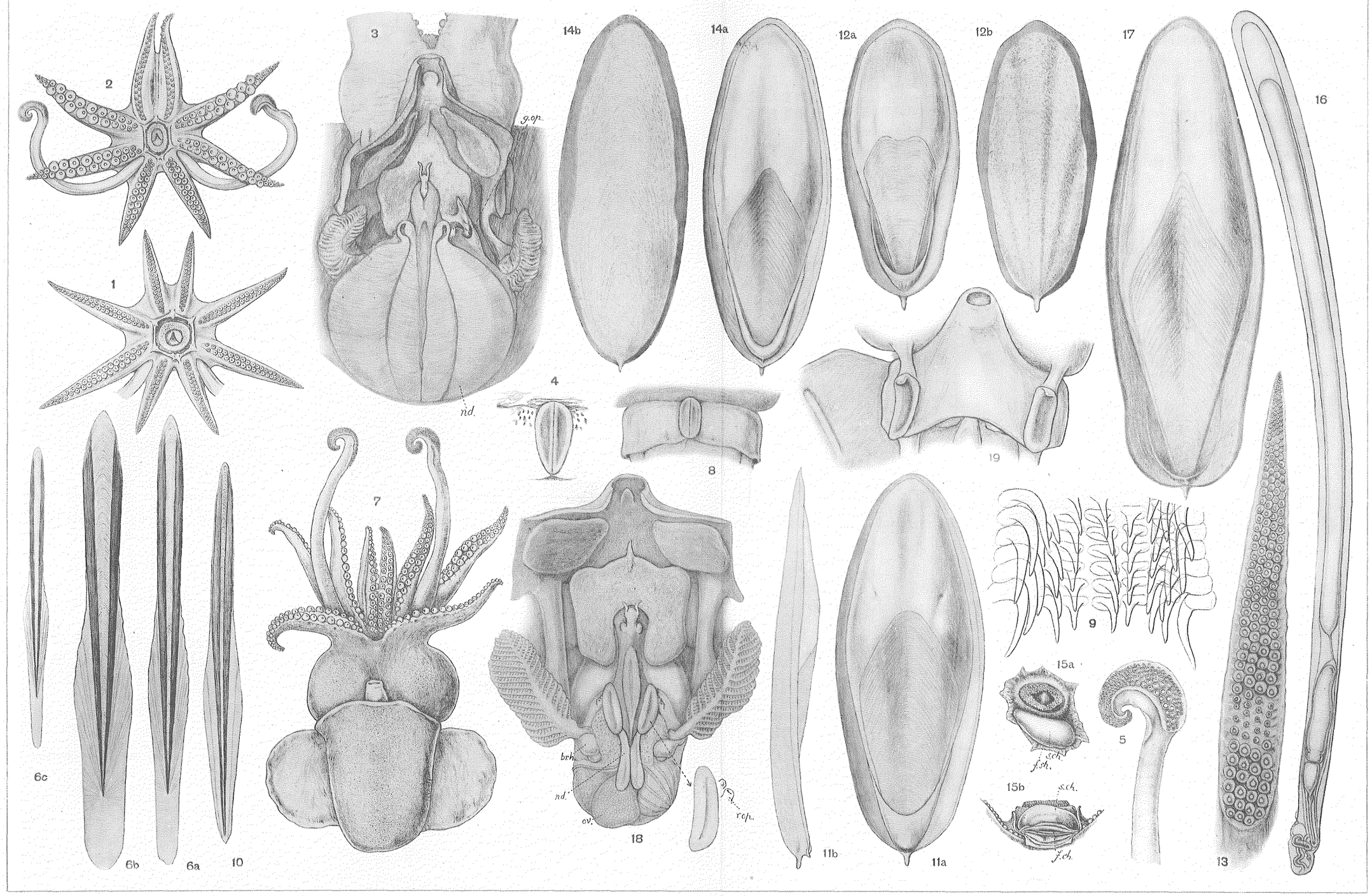
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PLATE XVII.

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Sepia robsoni sp. nov. 179

Fig. 2. Dorsal view of a young specimen caught by the " Albatross " at the station 4938 ; × 1 1/3.

Fig. 3. Full-formed shell ; natural size. a. Ventral aspect. b. Dorsal aspect. c. Lateral view.

Sepia carinata Sasaki, ... 181

Fig. 4. Dorsal view ; × 1 1/3.

Fig. 5. Tentacular club ; × 4.

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Sepia erostrata sp. nov.,... 183

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Fig. 10. Dorsal view of a female specimen caught by the " Albatross " at the station 4884 ; natural size.

Fig. 11. Shell of a mature female purchased at Tôkyo market ; × 2/3. a. Dorsal aspect. b. Ventral aspect.

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Fig. 13. Full-grown shell ; × 2/3. a. Ventral aspect. b. Dorsal aspect.

Sepia lorigera Wülker, ... 189

Fig. 14. Full-grown shell ; × 2/3. a. Ventral aspect. b. Dorsal aspect. c. Lateral view.

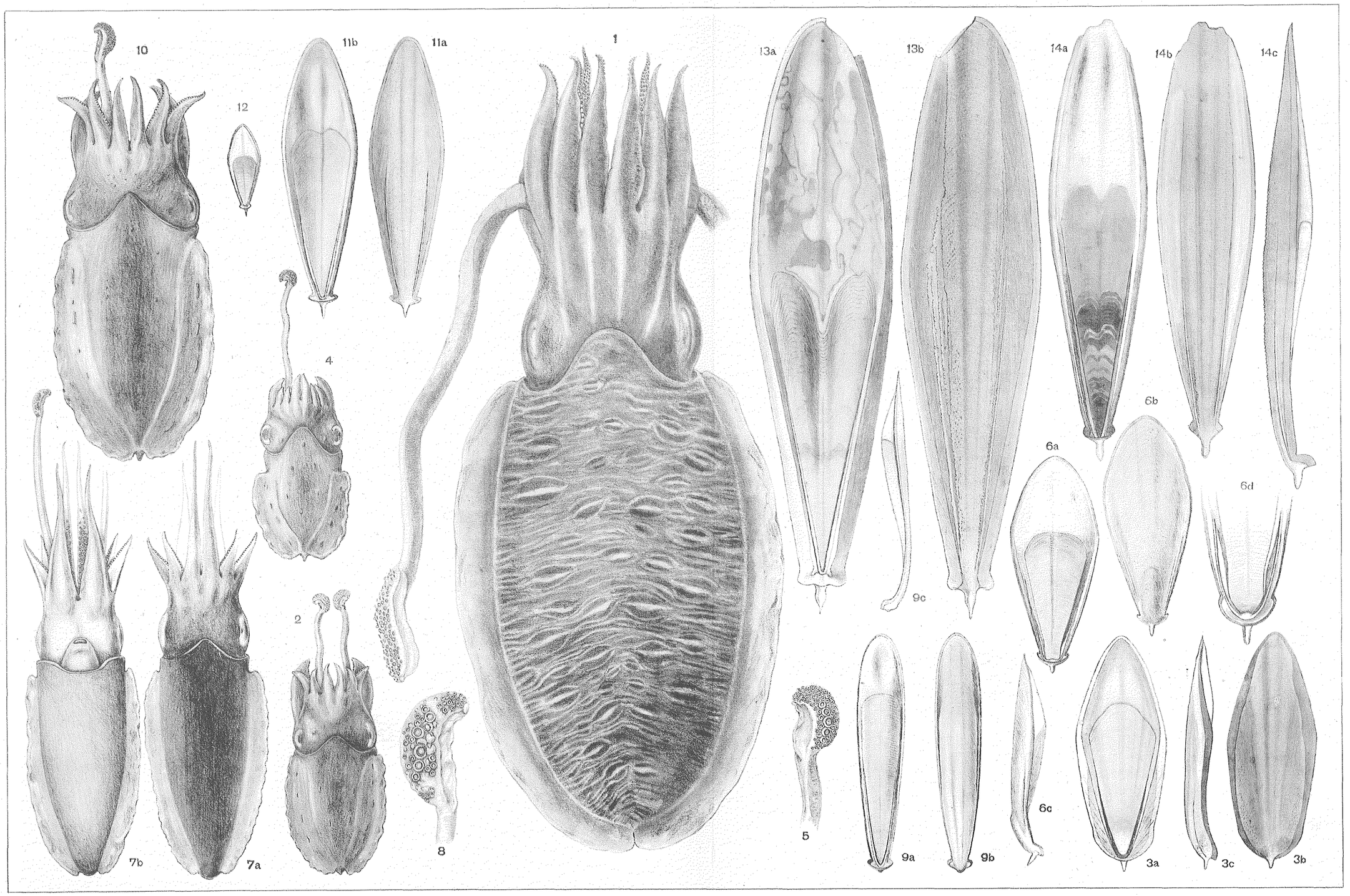
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PLATE XVIII.

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Fig. 1. Mature male ; × 2/3. a. Dorsal view. b. Ventral view.
Fig. 2. Hectocotylized arm of the same specimen ; × 1 2/3.
Fig. 3. Inner aspect of arms of a mature female ; × 2 2/3.
Fig. 4. Largest arm-sucker ; × 17.
Fig. 5. Horny ring of distal arm-sucker ; × 40.
Fig. 6. Tentacular club ; × 2 2/3.
Fig. 7. Horny ring of tentacular sucker ; × 40.
Fig. 8. Spermatophore ; × 40.
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Metasepia tullbergi (Appellöf), ... 217

Fig. 16. Mature female ; natural size. a. Dorsal view. b. Ventral view.
Fig. 17. Tentacular club ; × 4.
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Sepiella japonica sp. nov. 219

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Fig. 21. The same of tentacular sucker ; × 80.
Fig. 22. Spermatophore ; × 20.
Fig. 23. Shell ; × 2/3. a. Ventral view. b. Dorsal view.

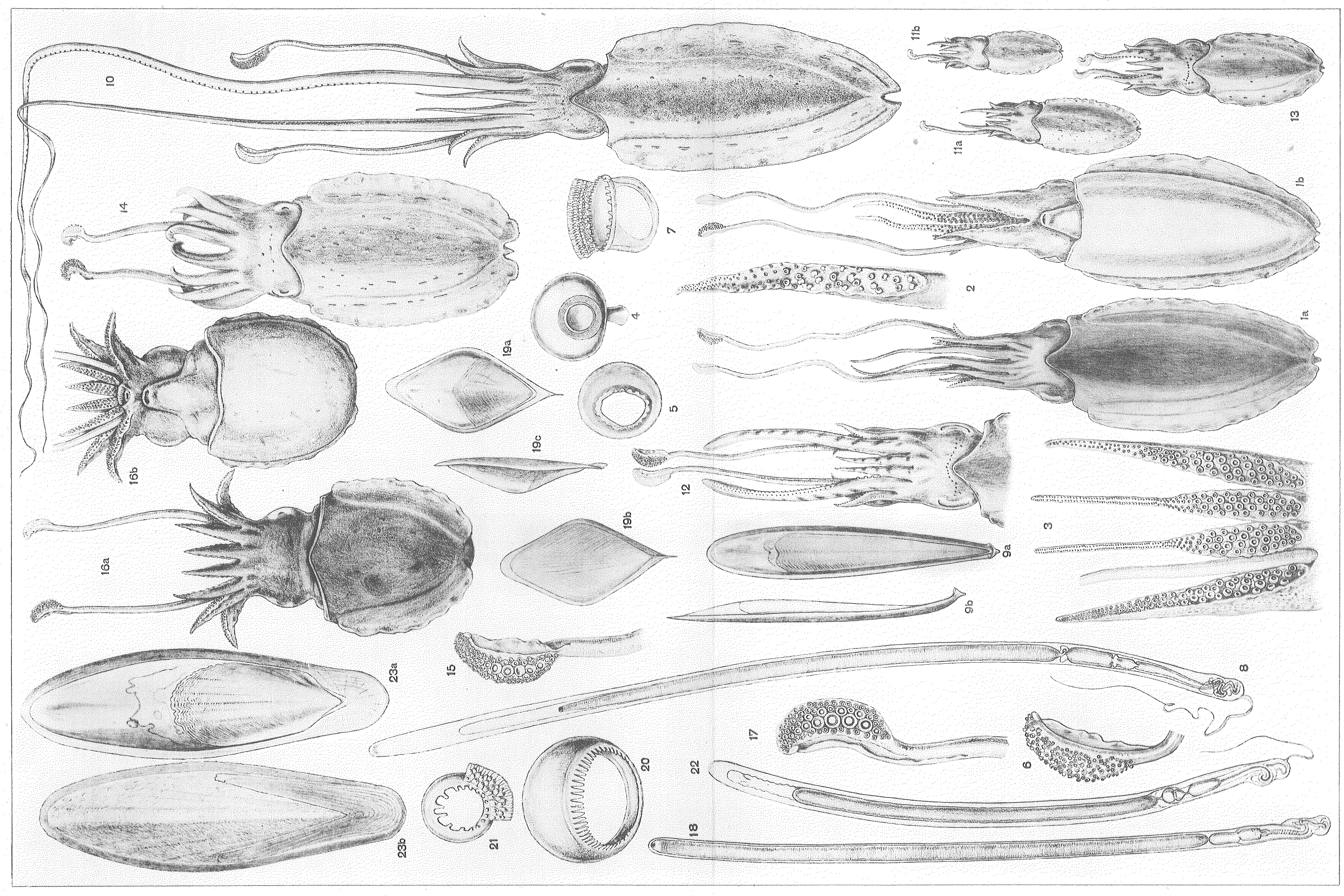
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PLATE XIX.

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Fig. 2. Tentacular club of a same specimen; × 6 2/3.
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Sepia kobiensis var. **andreanoides** Hoyle, ... 206

Fig. 5. Ventral aspect of shell of a full-grown male; × 1 1/3.
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Sepia kobiensis var. **toyamensis** var. nov. 209

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Sepia kobiensis var. **beppuana** var. nov. 211

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Sepia kobiensis var. **crassa** var. nov. 213

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Sepia kobiensis var. **albatrossi** Sasaki, ... 214

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Sepiella japonica sp. n. 219

Fig. 28. Full-formed hectocotylized arm; natural size.

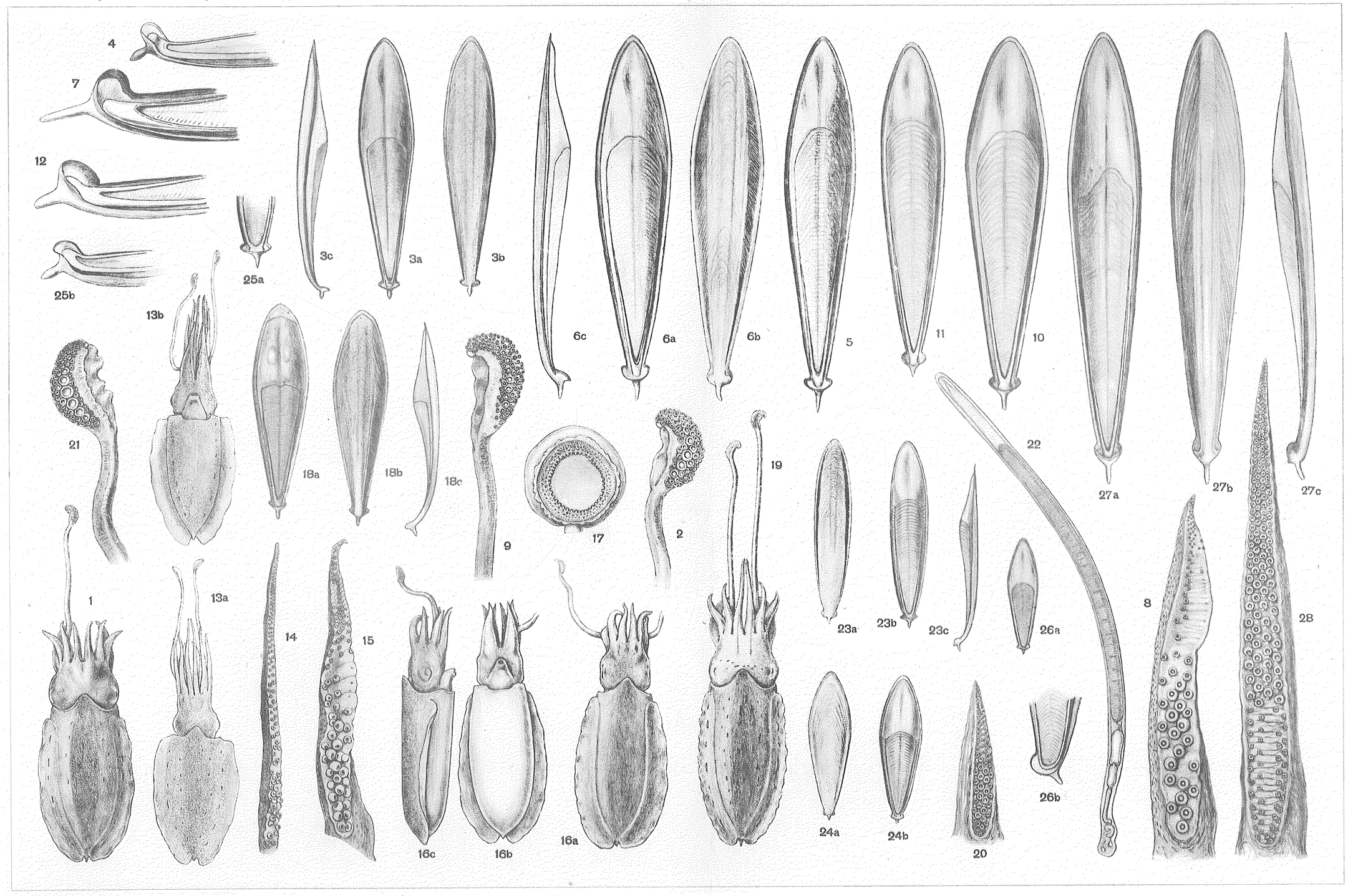
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Fig. 2. Nuchal cartilage ; × 1/3.
Fig. 3. Dorsal mantle cartilage ; × 1/3.
Fig. 4. Funnel, laid open ; × 2/7.
Fig. 5. Funnel cartilage ; × 1/3.
Fig. 6. Ventral mantle cartilage ; × 1/3.
Fig. 7. Horny ring taken out of a sucker of first row (on third arm) ; × 3 1/2.
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Fig. 9. Horny ring taken out of a sucker of twenty-third row ; × 3 1/2.
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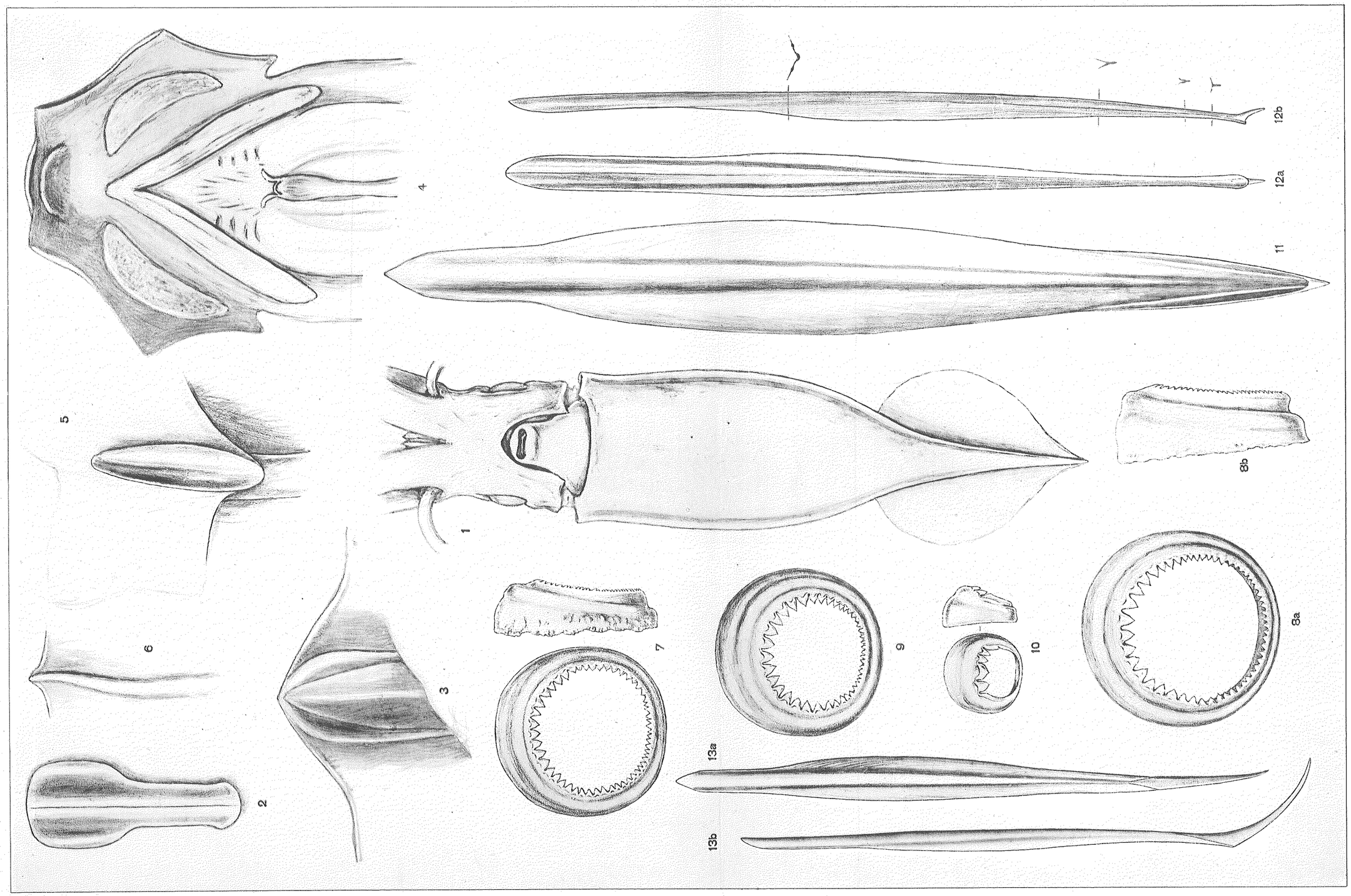
Moroteuthis lönnbergii Ishikawa and Wakiya.... 235

Fig. 13. Gladius ; × 2/3. a. Dorsal view. b. Lateral view.



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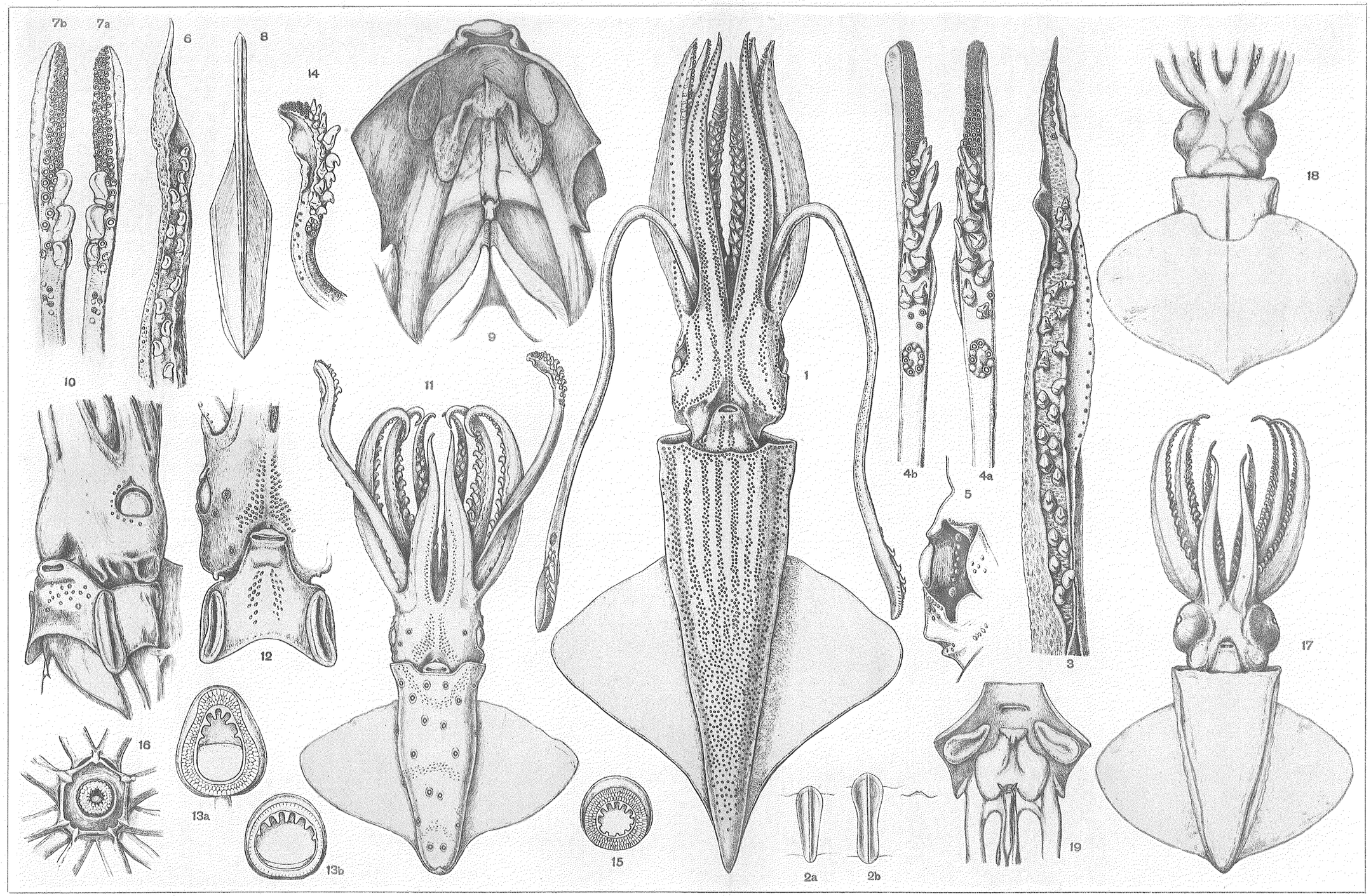
Octopodoteuthis sicula Rüppell,... 256

Fig. 17. Ventral view; × 2.

Fig. 18. Dorsal view; × 2.

Fig. 19. Funnel, laid open; × 4.



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Stigmatoteuthis döfleini Pfeffer,... 258

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Fig. 2. Right tentacular club; × 1 1/3.
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Meleagroteuthis separata Sasaki, ... 262

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Fig. 8. Full-formed nuchal cartilage; natural size.
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Gonatus magister Berry 270

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Fig. 22. Adolescent stage; × 2/3.

Gonatopsis octopedatus Sasaki,... 273

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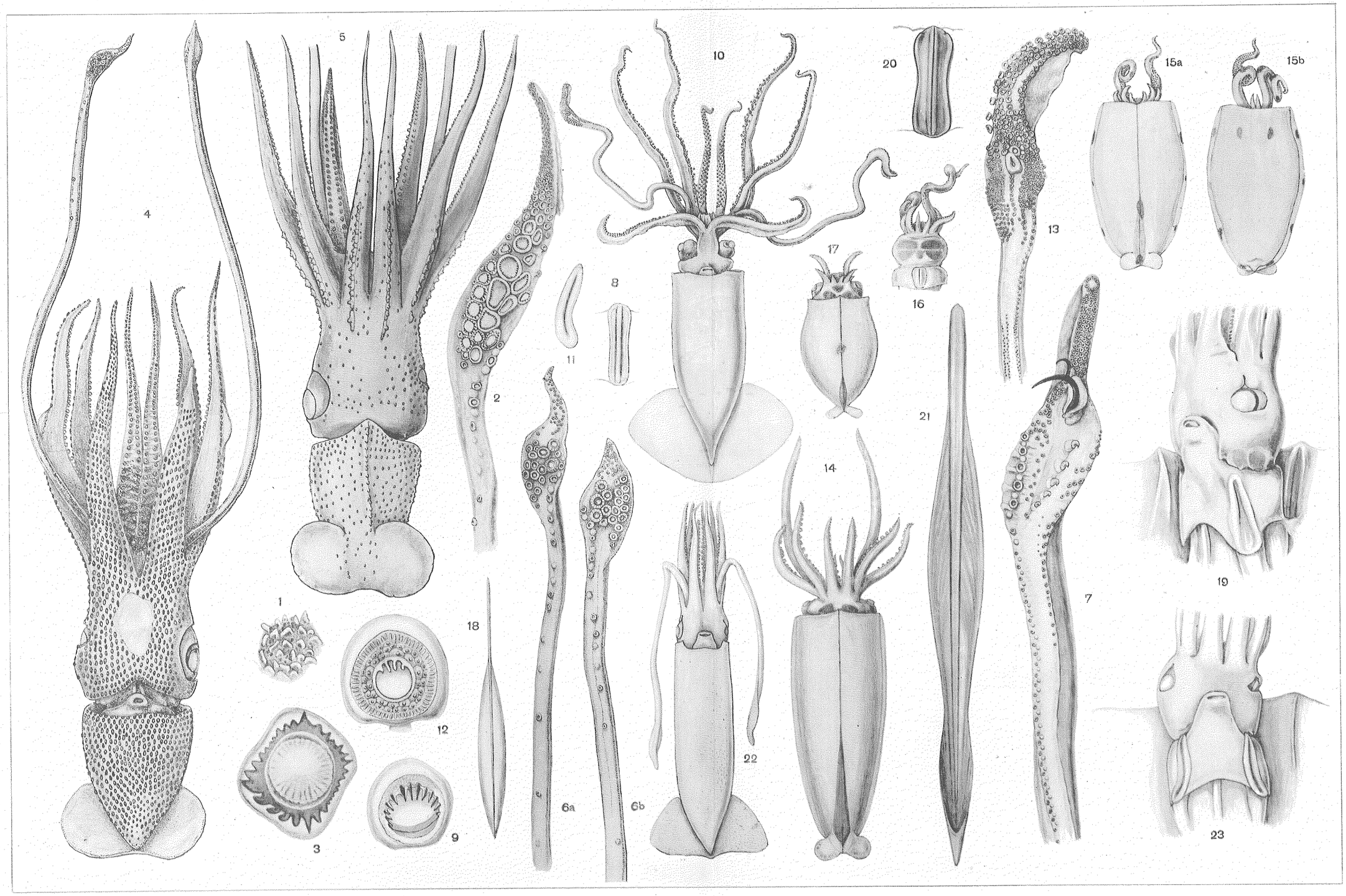

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PLATE XXIII.

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Ommastrephes sloani pacificus (Steenstrup), ... 277

Fig. 1. Nuchal cartilage; × 1 1/3.
Fig. 2. Smallest larva examined; × 3 1/3. a. Dorsal view. b. Ventral view.
Fig. 3. Larger larva; × 3 1/3. a. Dorsal view. b. Ventral view.
Fig. 4. Tentacle and fourth arm of the same larva; × ca. 14.
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Ommastrephes volatilis Sasaki,... 281

Fig. 7. Ventral aspect of a mature male; × 2/3.
Fig. 8. Nuchal cartilage; × 1 1/3.
Fig. 9. Ventral aspect of funnel; × 1 1/3.
Fig. 10. Mantle and funnel, laid open; × 1 1/3.
Fig. 11. Hectocotylized arm; × 1 1/3. a. Inner aspect. b. Lateral aspect.

Hyaloteuthis pelagicus (Bosc), ... 286

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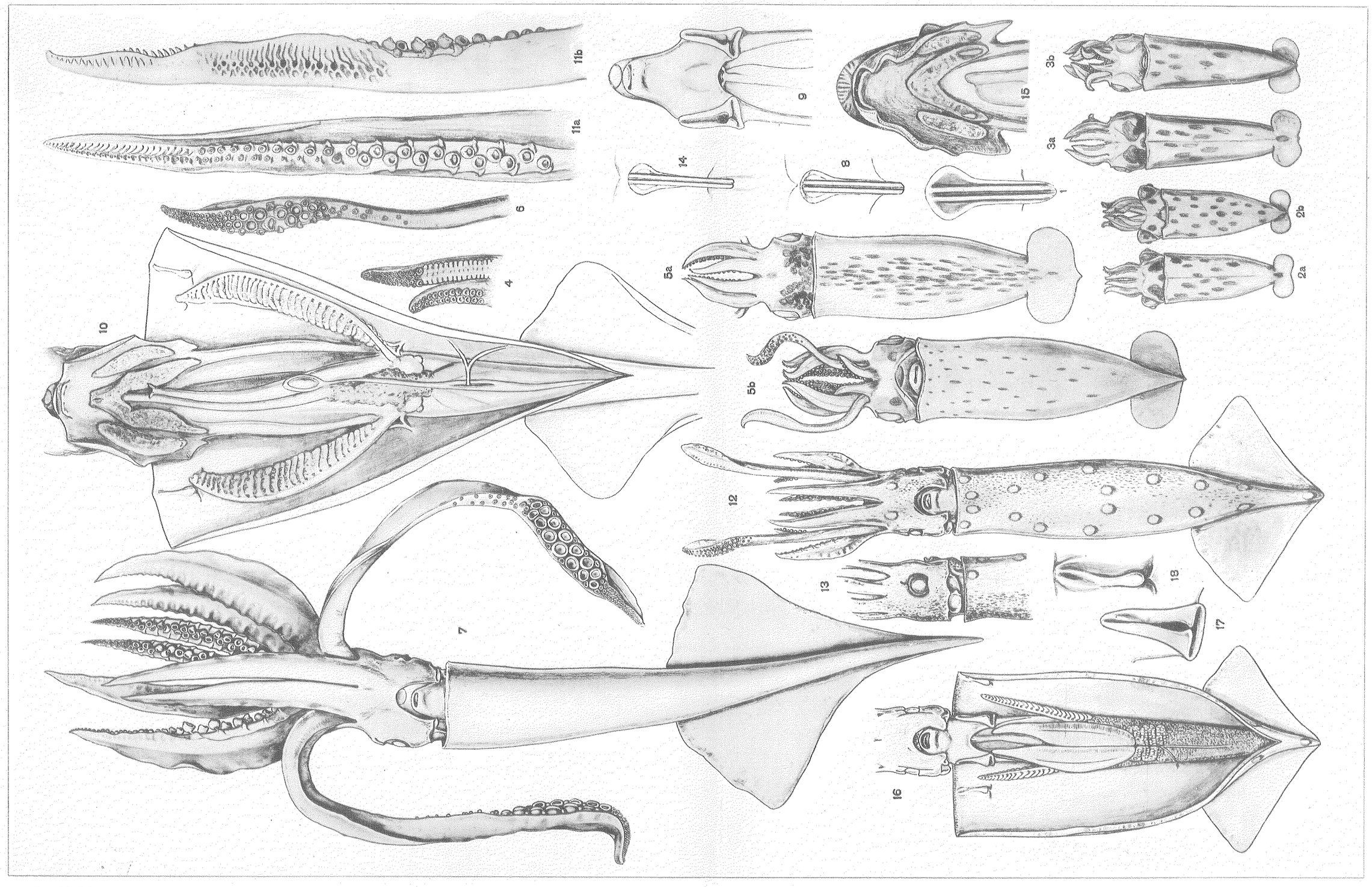
Fig. 16. Mantle, laid open; × 1 1/3.
Fig. 17. Funnel cartilage; × 3 1/3.
Fig. 18. Mantle cartilage; × 3 1/3.



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Stenoteuthis bartrami (Lesueur), ... 289

Fig. 1. Nuchal cartilage; × 2/3.
Fig. 2. Hectocotylized arm; × 2/3.
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Chiroteuthis (Chirothauma) imperator Chun, ... 305

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Fig. 10. Tentacular suckers; × 14. R. Rachial sucker. M. Marginal sucker.

Chiroteuthis (Tankaia n. gen.) **borealis** sp. nov. 309

Fig. 11. Type specimen; × 5 1/3. a. Ventral view. b. Lateral view.
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Fig. 13. Mantle, laid open; × 8.
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Mastigoteuthis cordiformis Chun, ... 310

Fig. 15. Ventral view; natural size.
Fig. 16. Horny ring taken out of sucker of fourth row (on third arm); × 32.
Fig. 17. Horny ring taken out of sucker of seventh row; × 32.
Fig. 18. Papillate area of the same ring; × 143.
Fig. 19. Suckers of the eleventh row of third arm; × 27.
Fig. 20. Proximal sucker of tentacle; × 60.

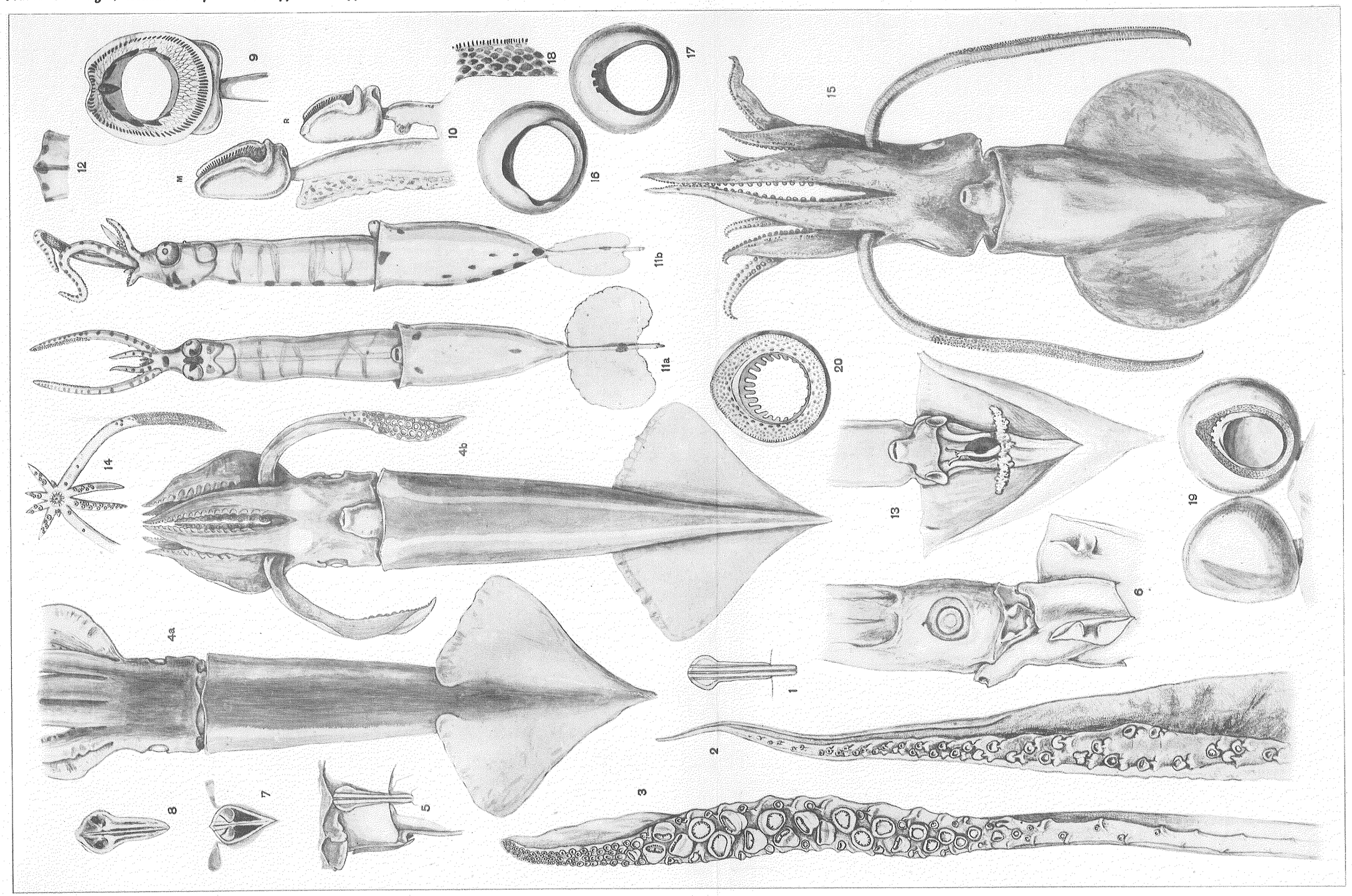

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PLATE XXV.

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Galiteuthis armata Joubin, ... 316

Fig. 1. Dorsal view of a larger specimen referred to (p. 316); × 2/3.
Fig. 2. Ventral view of head of the same specimen; × 1 1/3.
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Fig. 5. Dorsal view of a smaller specimen referred to (p. 316); × 2/3.
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Megalocranchia maxima Pfeffer, ... 322

Fig. 7a. Ventral view of whole body; × 1 1/3.
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Fig. 10. Largest specimen referred to (p. 324); × 4. a. Dorsal view. b. Ventral view. c. Latero-ventral view.
Fig. 11. Mantle and funnel, laid open; × 5 1/3.
Fig. 12. Ventral view of eye; × 10.
Fig. 13. Inner aspect of arms and tentacle; × 6 2/3.
Fig. 14. Ventral view of visceral organs; × 10.
Fig. 15. Dorsal view of a younger specimen; × 3 1/3.

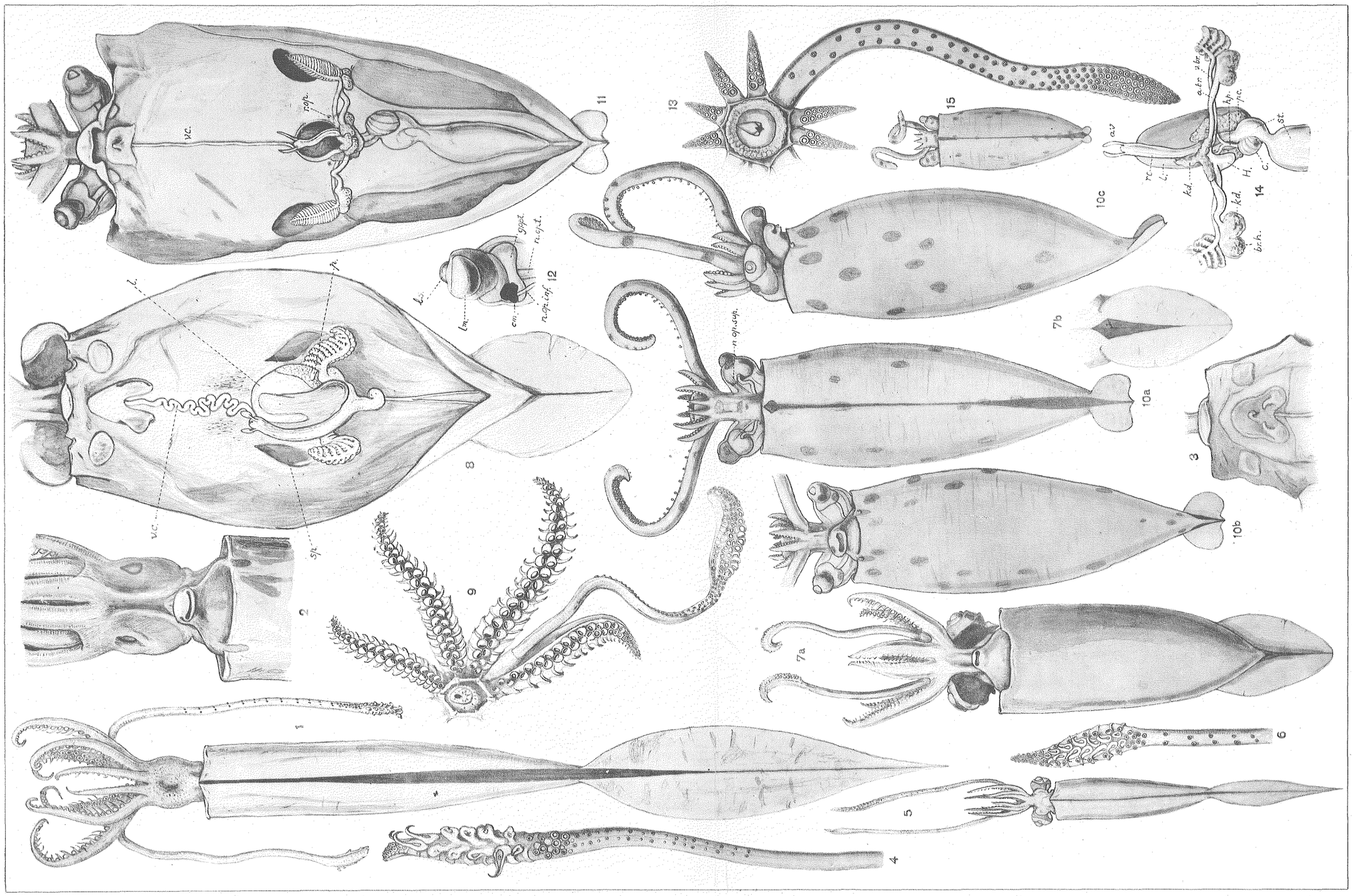
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PLATE XXVI.

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Fig. 1. Type specimen; × 2. a. Dorsal view. b. Ventral view.
Fig. 2. Lateral view of head; × 4.
Fig. 3. Lateral view of eye; × 6.
Fig. 4. Mantle, laid open; × ca. 4.
Fig. 5. Inner aspect of arms and tentacles; × 6 2/3.
Fig. 6. a. Visceral organs seen from right side; × 6 2/3. b. Same seen from left side; same scale.

Teuthowenia elongata sp. n. 327

Fig. 7. Dorsal view of type specimen; × 4.
Fig. 8. Oblique lateral view of eye; × 10 2/3.
Fig. 9. Mantle, laid open; × 6 2/3.
Fig. 10. Largest sucker of third arm; × 217.
Fig. 11. Tentacle; × 14.
Fig. 12. Largest tentacular sucker; × 217.

Cranchia scabra Leach, ... 329

Fig. 13. Largest specimen referred to (p. 329); natural size. a. Dorsal view. b. Ventral view.
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Fig. 15. Inner aspect of arms and tentacle of smaller specimen; × 6 2/3.

Liocranchia reinhardtii (Steenstrup), ... 332

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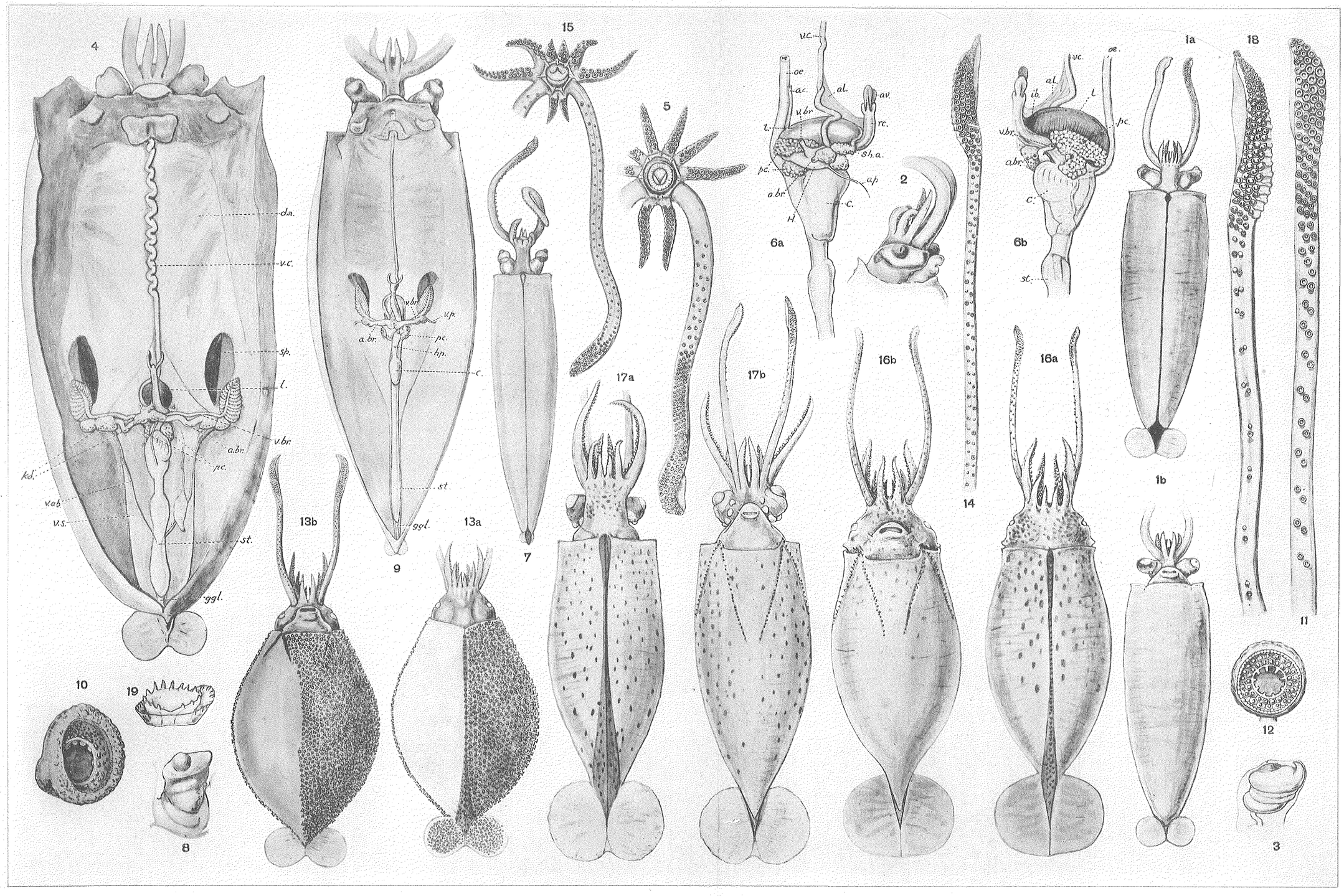
Fig. 17. a. Dorsal view; × 1 1/3. b. Ventral view; on the same scale.
Fig. 18. Inner aspect of tentacle; × 5 1/3.
Fig. 19. Marginal part of horny ring of a larger tentacular sucker; × ca. 200.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Liocranchia reinhardtii (Steenstrup),... 332

Fig. 1. Eyeball showing photophores; × 5 1/3. a. Frontal view. b. Ventral view.
Fig. 2. Mantle and funnel of the largest male alluded to, laid open; × 2.
Fig. 3. Inner aspect of arms and tentacle of the same specimen; × 3 1/3.
Fig. 4. Visceral organs of the same specimen, seen from the right side; × 2 2/3.

Liocranchia valdiviae Chun, ... 336

Fig. 5. Mantle and funnel, laid open; × 2 2/3.
Fig. 6. Visceral organs seen from the left side; × 4.

Pyrgopsis pacificus (Issel), ... 338

Fig. 7. The largest male examined; × 2. a. Dorsal view. b. Ventral view.
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Fig. 10. Mantle and funnel of a female specimen, laid open; × 6.
Fig. 11. Inner aspect of arms and tentacle of the same specimen; × 7.
Fig. 12. Hectocotylized arm; × 7.
Fig. 13. Visceral organs of a female specimen seen from left side; × 14.
Fig. 14. Liver and bile-ducts of the same female; × 14.
Fig. 15. Vas deferens and branchial vessels of the largest male alluded to; × 14.
Fig. 16. Vas deferens; × 20. a. Dorsal view. b. Ventral view.
Fig. 17. The same organ, laid loose; × 14.

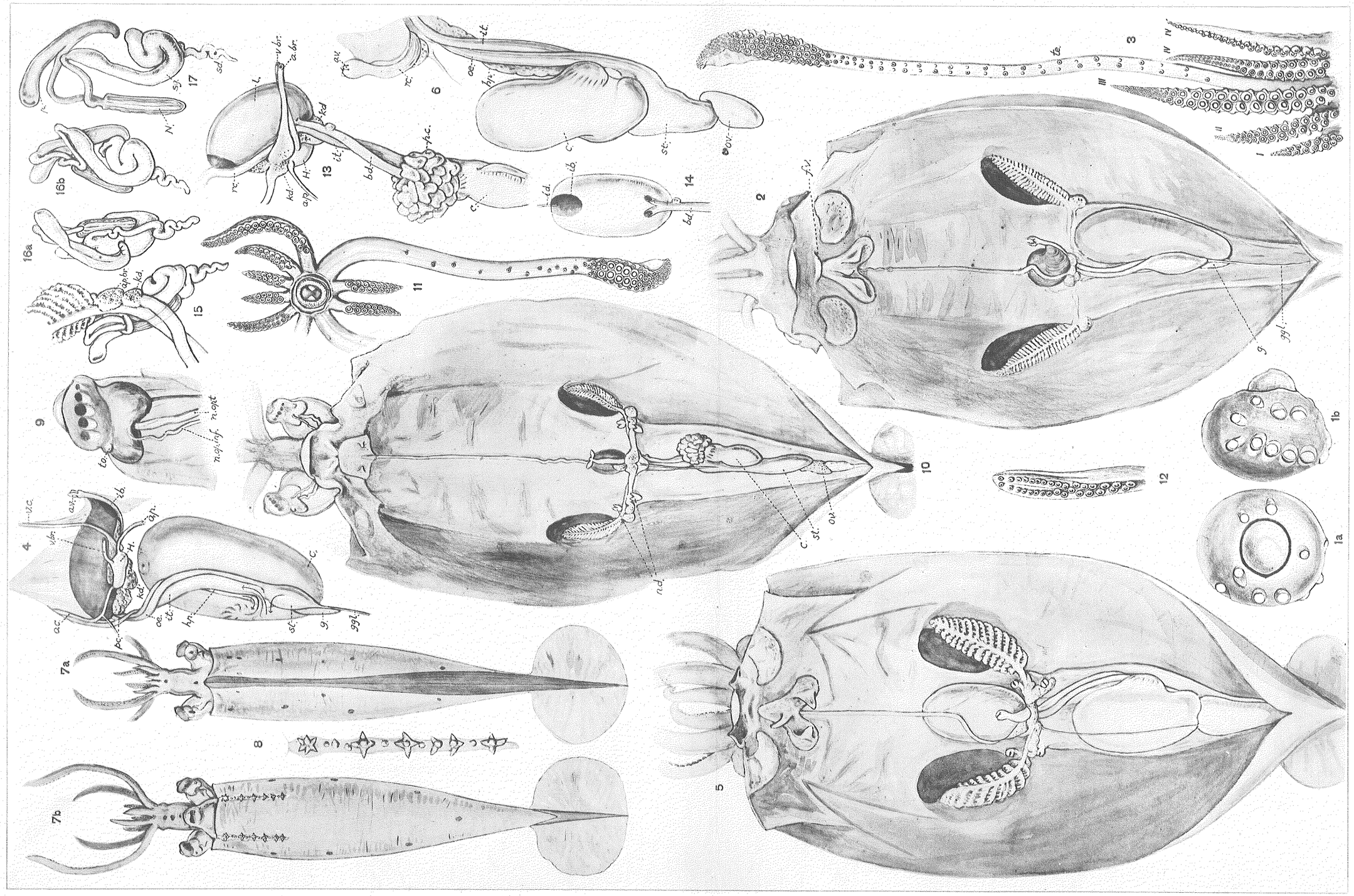

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PLATE XXVIII.

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Polypus oshimai sp nov., ... 44

Fig. 1. Dorsal view of a mature female ; × 2/3.
Fig. 2. Ventral view of head and body of same ; × 2/3.
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Polypus luteus sp. nov., ... 45

Fig. 6. Dorsal view of head and body of a male examined ; × 2/3.
Fig. 7. Hectocotylus ; × 2.
Fig. 8. Mantle of the same male, dissected ; × 2/3.
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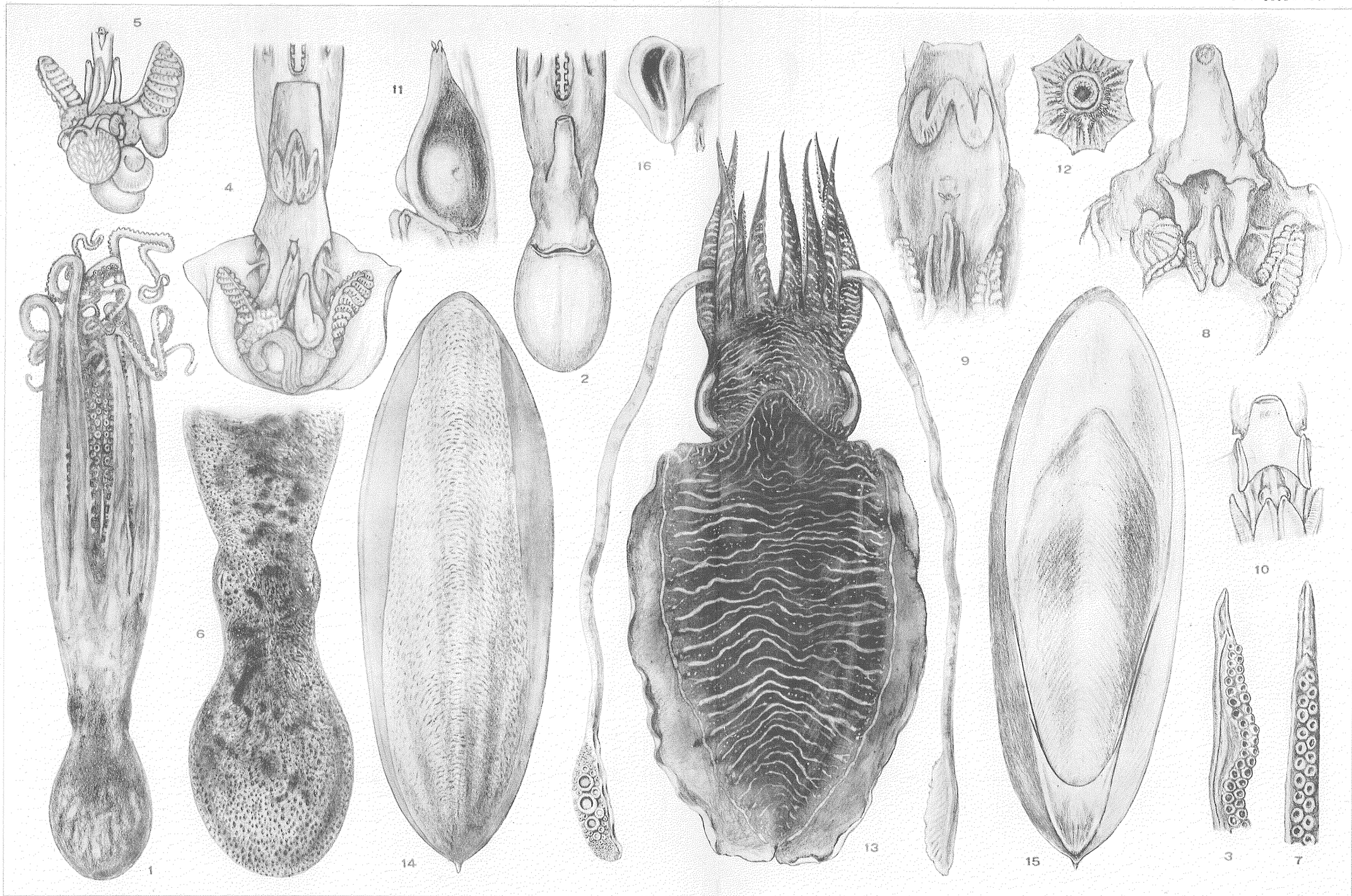

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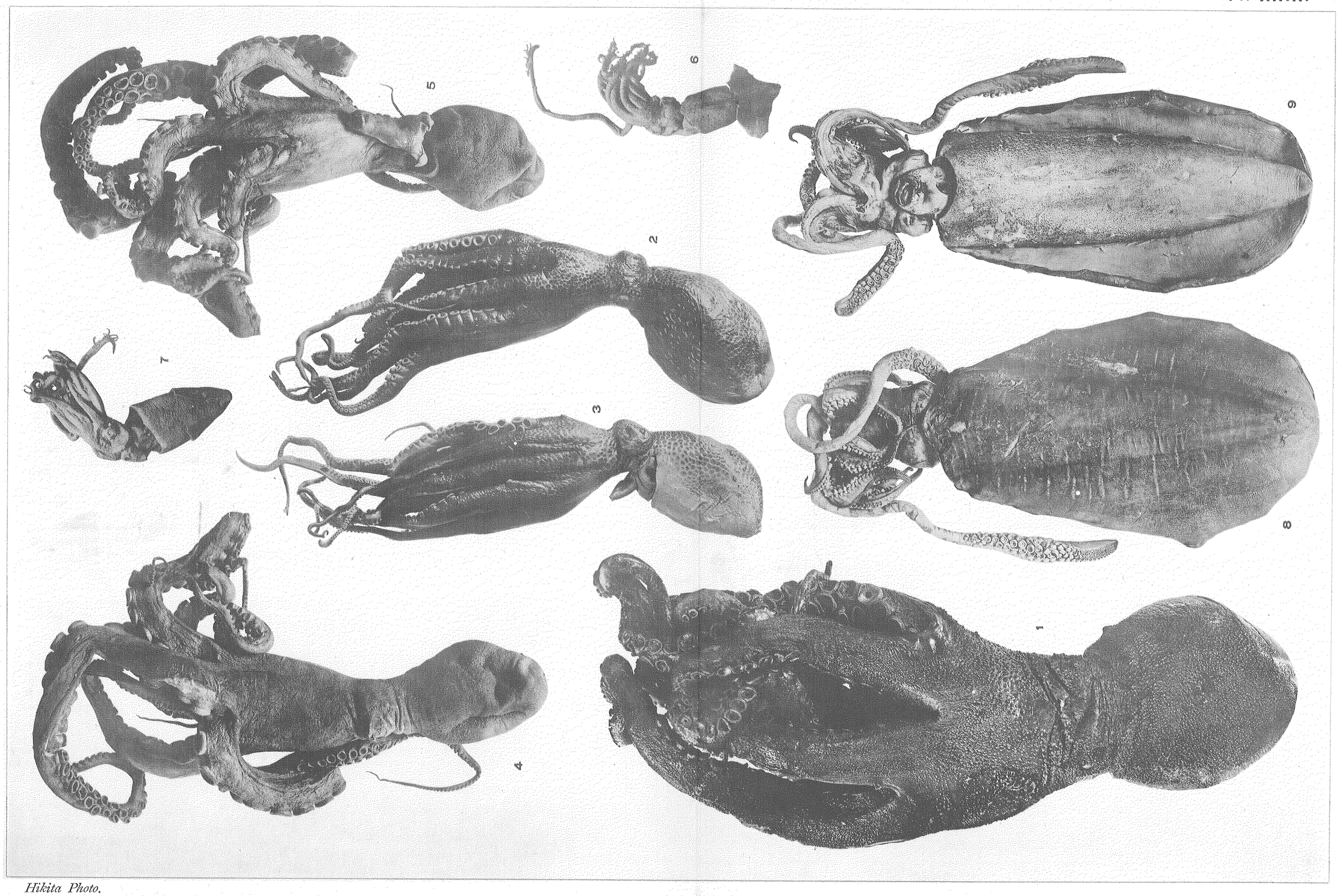

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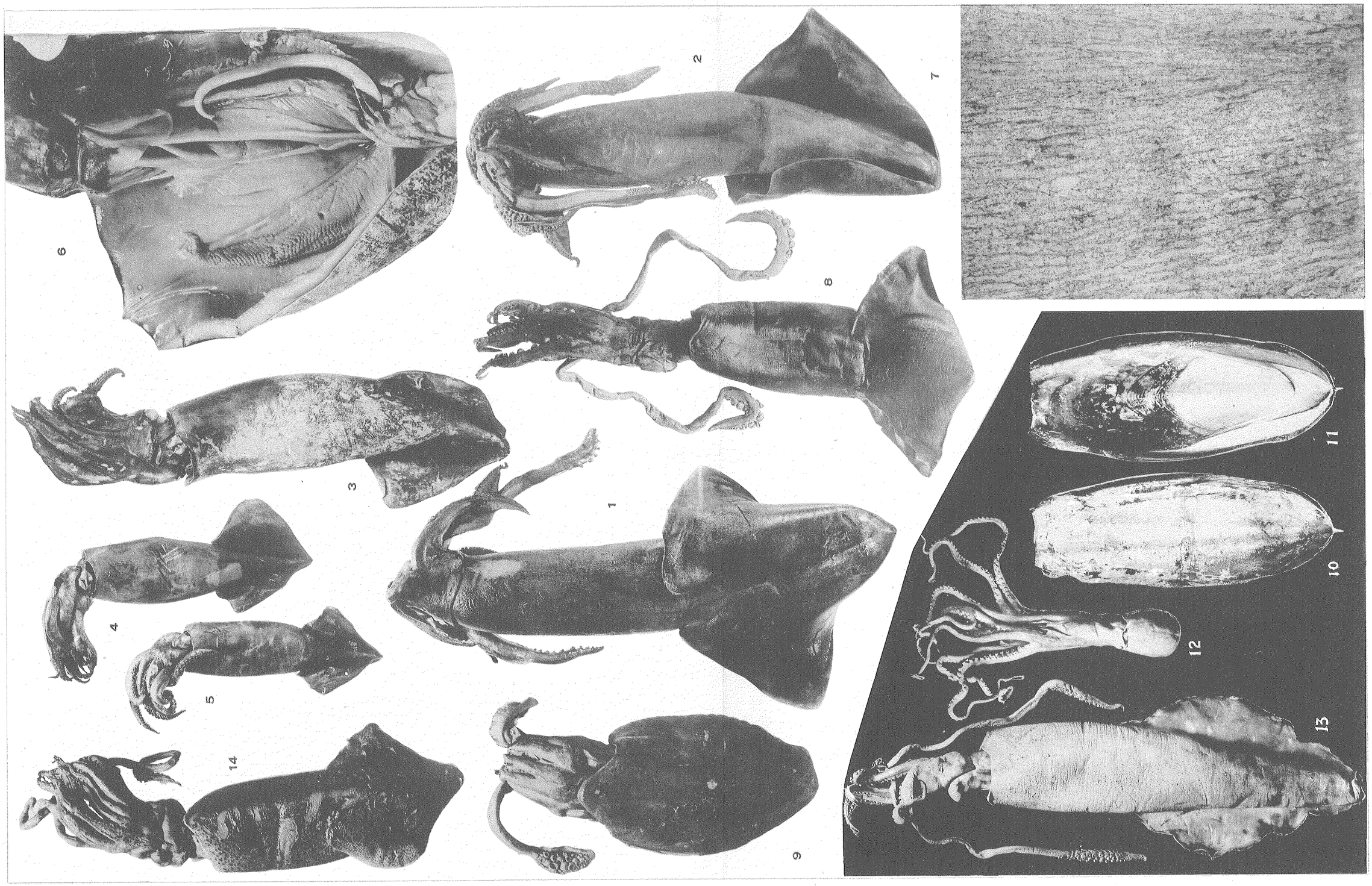

Hikita photo.