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On Four Newly Known Species of Octopoda from Japan*

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(Plates 1-5; Text-figures 1-28)

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In recent years in my taxonomic study of the Japanese Cephalopoda, I could get a number of Octopod specimens in which two new species, including a new family and a new genus, and two newly recorded species, were found. A brief paper was read in October 1962 at the general meeting of the Zoological Society of Japan held at Okayama (abstract, TAKI 1962), and in the present paper these species are reported in detail with illustration.

I wish to express my gratitude to Messrs. Shinma NAKAYAMA (Kôchi City) and Satoshi HIRANO (Chôshi City) who kindly placed valuable specimens at my disposal, and to Prof. Dr. Huzio UTINOMI and Assist. Prof. Dr. Takashi TOKIOKA (Seto Marine Biological Laboratory of the Kyoto University, at Shirahama, Wakayama Prefecture) for the loan of specimens preserved in the Laboratory, and also to Dr. S. Stillman BERRY, Redlands, California, and Dr. W. ADAM, Bruxelles, both of whom kindly assisted me by sending their papers on Cephalopods.

I DESCRIPTION OF *IDIOCTOPUS GRACILIPES* TAKI

Family Idioctopodidae TAKI, 1962

Diagnosis: Tissue gelatinous and semitransparent; arms long and compressed; suckers uniserial; mantle-aperture divided into two parts by the fusion of base of funnel to mantle margin; radula with multicuspidate rhachidian, first and second lateral teeth; posterior salivary gland larger than the anterior one; crop and liver large; ink-sac rudimentary; funnel-organ V-shaped (?): ligula of hectocotylus slender and long, and seminal channel confined to distal portion of hectocotylized arm.

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* Contributions from the Seto Marine Biological Laboratory, No. 386

Genus *Idioctopus*[1] TAKI, 1962

Diagnosis: Characters of the family.
Type-species: *Idioctopus gracilipes* TAKI, 1962

Idioctopus gracilipes[2] TAKI, 1962

Idioctopus gracilipes TAKI, 1962, Zool. Mag. Tokyo, **71**: 397.

General appearance (Pl. 1; Text-fig. 1): Two specimens (type and paratype) at hand, both of them partly injured and insufficiently preserved, though examination of specimens in detail possible.

Body rather soft and semitransparent; no intact integument is preserved, but the surface seems to be entirely smooth without any sculpture; chromatophores subcutaneously preserved, light reddish purple in colour, minute, ca. 0.1–0.5 mm in diameter, scattered rather sparsely all over the surface; arms partly elongated and partly shrunken, so that suckers are arranged at rather irregular intervals and original length of each arm can not be measured duly.

Measurements: Type-specimen (paratype-specimen, smaller and imperfect)
Total length: ca. 200 *mm*
Width of head: 20 *mm*
Width of mantle: 28 *mm*
Length of mantle: ca. 50 *mm*

	No.	L	R
Arm length	1	(mutilated)	130 *mm*
	2	120 *mm*	(mutilated)
	3	130 *mm*	130 (hectocotylized)
	4	130 *mm*	140 *mm*

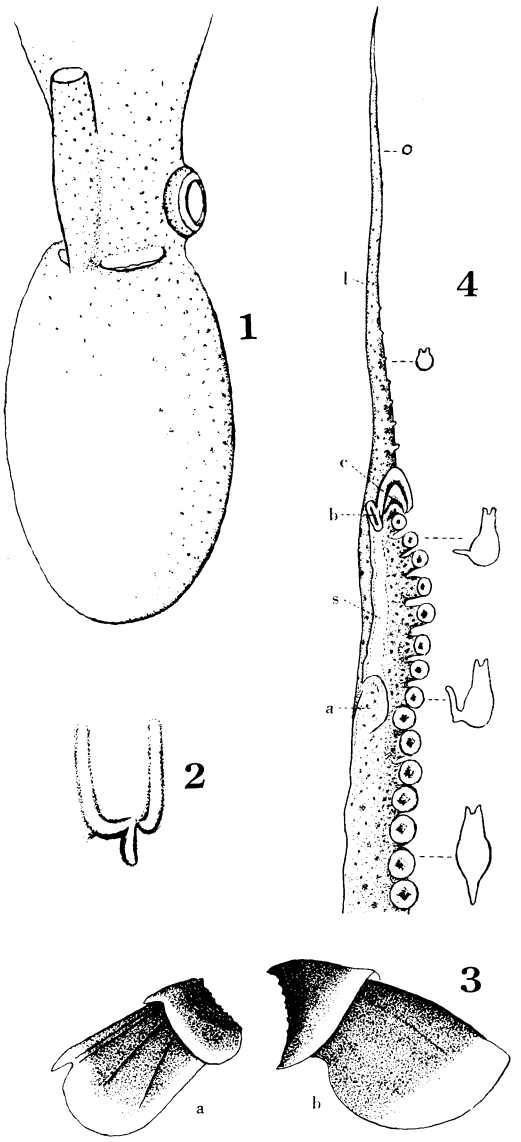
Locality: Off Chôshi City, Chiba Prefecture, 530–560 *m* in depth. Collected by Mr. Satoshi HIRANO, May 1962.

Head rather firm to the touch, surface between both eyes flat, diameter of lens ca. 5.5 *mm*, base of eye dark bluish grey, neck conspicuously constricted; mantle ellipsoidal in outline, widest at about the middle, rounded behind.

Arms very long, the order of length undeterminable due to unfavourable state of preservation, but their length roughly subequal; keeled on the dorsal side, so that their cross-section wedge-shaped, suckers very prominent for the soft arms, arranged uniserially, there are no particularly enlarged suckers, in many large suckers their base ca. 4.5 *mm* wide; 4 *mm* high and sucking surface 3 *mm* wide.

Third right arm hectocotylized (Text-fig. 4); 23 suckers are arranged in 77%

1) *idios*, Gr. distinct, peculiar.
2) *gracili-pes*, L. a slender foot.



Text-fig. 1. *Idioctopus gracilipes* TAKI, left side view of paratype-specimen to show funnel and mantle-aperture, reconstructed. × ca. 1. 2. Funnel-organ of type-specimen, × 2. 3. Mandibles. a, lower mandible; b, upper mandible. × ca. 4. 4. Distal portion of hectocotylized arm, × ca. 2. a, b, wing-like processes at both ends of seminal channel; c. calamus; l, ligula; s, seminal channel.

(ca. 100 mm in length) of proximal part, seminal channel (s) is a narrow, chromatophore-free groove, ca. 15 *mm* in length, is found at the distal part of this region; 11 suckers are arranged corresponding to this region; a wing-like process (a) and a small leaflet (b) are found on both ends of the seminal channel; calamus (c) consists of three thin leaflets of different lengths put together; ligula ca. 30 *mm* in length,

elongate conical in shape, round in section, ca. 5 pairs of minute papilla are arranged on its proximal part.

Web too thin and almost broken to be measured decisively.

Mandibles (Text-fig. 3, a, b): Rather thin and light brown in colour; lower mandible (a) — total length 5.5 *mm*, length of rostral lamella 2.8 *mm*, rostrum scarcely protruded, front margin of rostral lamella thickened and faintly denticulated; three weak ridges radiate in the gular lamella. Upper mandible (b) — total length 7.2 *mm*, length of rostral lamella 4.5 *mm*, rostrum obtusely pointed, front margin of rostral lamella thickened and uneven.

Radula (Text-fig. 5) (as examined in type-specimen); Rhachidian (r), first (l_1) and second (l_2) lateral teeth all multicuspidate with very wide bases, these three showing A_3-seriation, of which rhachidian 9-cusped, its mesocone quite elongated; first lateral 6-cusped, its innermost cusp longest and length of cusp gradually reduces toward outer cusp; second lateral largest of all teeth with very wide and long base, 7-cusped, the cusps gradually diminishes its length outward as in first lateral; third lateral (l_3) saber-shaped, gently curved and acutely pointed, cusp about as long as the mesocone of the rhachidian; marginal plate (m) rather small and roughly quadrangular.

Funnel (seen in paratype-specimen) (Text-fig. 1): Soft in consistency, cylindrical, length ca. 20 *mm*, diameter of aperture ca. 5 *mm*, but narrowed at base where it is completely fused with the middle part of ventral margin of mantle, its inner lumen proximally communicating with the mantle cavity; also the dorsal side of the funnel is fused with the ventral surface of the neck up to the anterior fifth of its length.

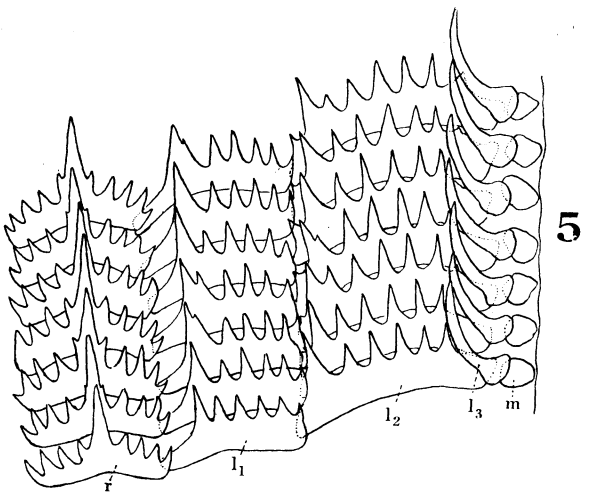
Funnel-organ (seen in type-specimen) (Text-fig. 2) is insufficiently preserved, but it is simply V-shaped, conspicuously raised from its floor and somewhat vertical plate-like in the hinder part, gradually diminishes its height forward; transparent mucus is abundantly seen on its whole surface. In paratype-specimen the spot is represented by a mucous area without any ordinary shape of the funnel-organ.

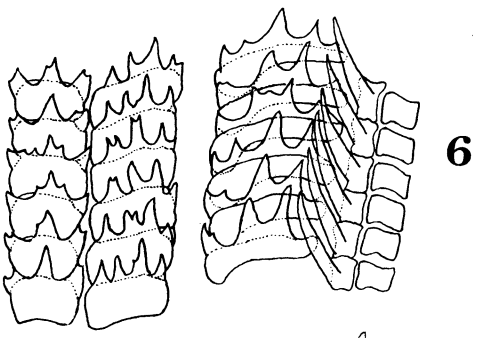
Gill (Text-fig. 11, gl): In type-specimen the gill is ca. 20 *mm* long, 3–4 *mm* wide, outer gill-leaflets ca. 8, inner gill-leaflets ca. 6, the ramification of leaflet is so scarce that the leaflet does not touch with each other, leaving moderate slits between.

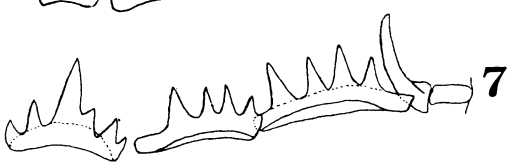
Branchial gland (Text-fig. 11, bg): slender, ca. 20 *mm* in length and 1.8 *mm* in width, attaining the whole length of the gill, attenuated toward both ends; it is nearly rounded-ellipsoid in cross section, opaque, milky white with a slight carneous tint, a number of small chromatophores are scattered on the dorsal part of its capsule.

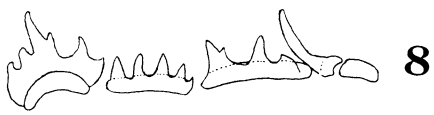
Branchial heart (Text-fig. 11, bh): Nearly spherical, ca. 4 *mm* in diameter, rather soft, thin ashy in colour, covered with chromatophores.

Alimentary canal (Text-figs. 11, 12). Crop (c): In type-specimen the crop is in a state of a narrow tube, which may be due to the contracted condition without diet, but in paratype-specimen it is about as large as the stomach, its wall is so thin



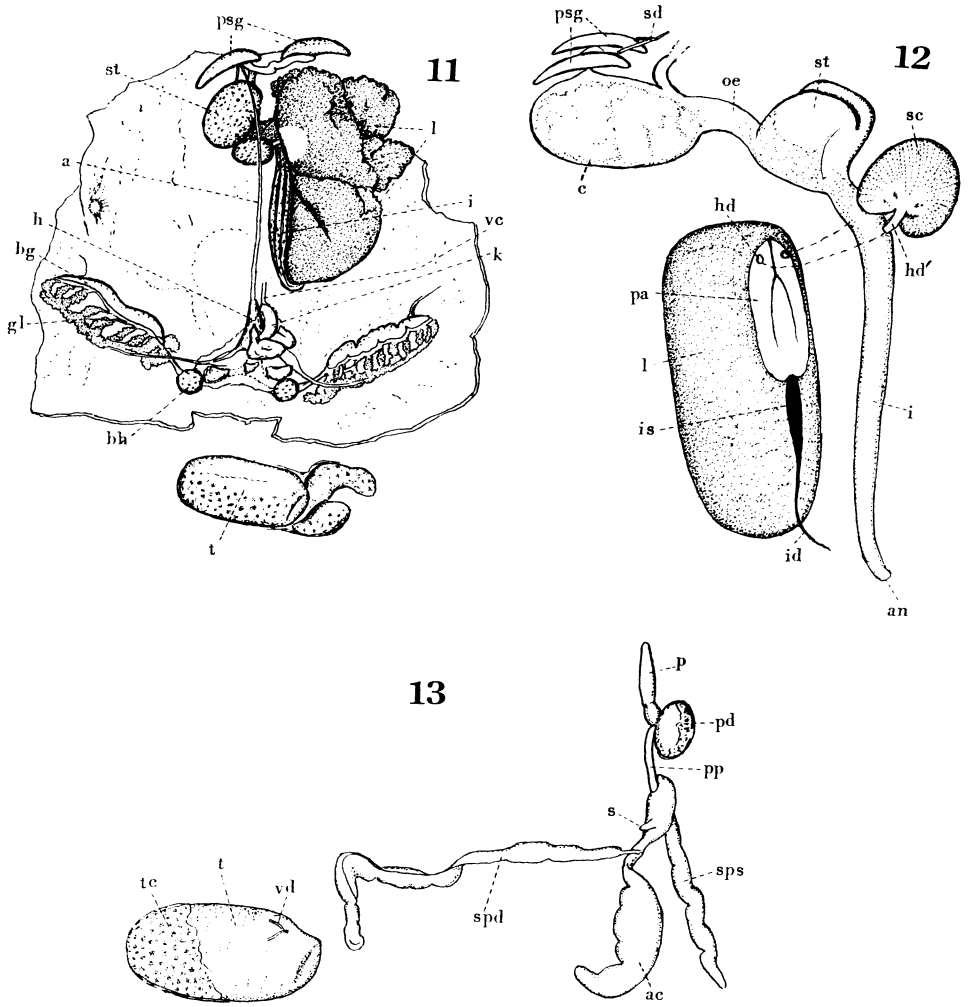






Text-figs. 5–10. Radulae of Bolitaenacea. 5. *Idioctopus gracilipes* TAKI, × ca. 33. r, rhachidian tooth, l_1, l_2, l_3 first, second and third lateral teeth. m, marginal plate. 6. *Eledonella pygmaea* VERRILL (after THORE, 1949). 7. The same (after THIELE, 1915). 8. *Dorsopsis taningi* THORE (after THORE, 1949). 9. *Amphitretus pelagicus* HOYLE (after THORE, 1949). 10. *Amphitretus thielei* ROBSON (after ROBSON, 1930; THORE synonymized this species with the preceding one).

and transparent that the contents within are fully visible from outside; the contents fulfilled in the lumen are homogeneous and amorphous, light ashy purple in colour, apparently a coagulated colloid substance, no animal form of the diet can be detected. Posterior salivary gland (psg) elongated, roughly fusiform, nearly crescentic in cross section, 9 *mm* long and 3 *mm* wide, greyish white in colour, its surface ru-



Text-fig. 11. Internal organs seen when mantle cut open from the ventral side, of type-specimen. × ca. 1.3. 12. The same of paratype-specimen. × ca. 1.7. 13. Male genital organs of type-specimen, its gonoduct system unbound. × ca. 1.7.

a, anterior aorta; ac, accessory spermatophoric gland; an, anus; bg, branchial gland; bh, branchial heart; c, crop; gl, gill lamella; h, systematic heart; hd, origin of hepatic duct; hd′, right hepatic duct; i, intestine; id, ink-duct; is, ink-sac; k, kidney; l, liver; oe, oesophagus; p, penis; pa, pancreas; pd, penis diverticle; pp, proximal part of penis; psg, posterior salivary gland; s, shunting duct; sc, spiral caecum; sd, salivary duct; spd, spermatophoric gland; sps, spermatophoric sac; st, stomach; t, testis; tc, capsule of testis; vc, vena cava; vd, vas deferens.

gose, its duct is extremely slender; larger than the anterior salivary gland which is ca. 3 *mm* by 2 *mm*, and 1 *mm* thick.

Oesophagus (oe) is very short in comparison with other parts of the alimentary canal, and stomach and spiral caecum are covered with a thin film stained with numerous chromatophores.

Stomach (st) is solid, nearly spherical, ca. 10 *mm* in diameter, the musculature of its wall is exceedingly developed; in paratype-specimen a thin outgrowth is seen on its anterior side; spiral caecum (sc) discoidal in shape, without helicoid coiling of outgrowths, the semitransparent wall showing numerous internal septa which are radially arranged; two short hepatic ducts (hd) enter the spiral caecum; liver (l) in type-specimen seriously broken but in paratype-specimen it is preserved intact; it is oblong, light greyish brown in colour; pancreas (pa) occupies an area of anterior half of the ventral side of the liver, light grey in colour; ink-sac (is) very slender, almost buried in the bulk of the liver, with a slender duct at its hind end. Intestine (in) quite short and nearly straight; in type-specimen the earlier part is somewhat dilated and gradually narrowed in width toward rectal part; several longitudinal muscular bands are seen on the wall of the intestine; it bends itself at about the posterior fifth of its length; anus surrounded with small papillae.

Male genital organ (Text-figs. 11, 13): In type-specimen it is located in the dorsal part of the visceral sac; the organ seems to be in nearly the mature state, though no spermatophore is found in spermatophoric sac or penis; in paratype-specimen the organ is apparently undeveloped, the testis only can be discriminated. The whole organ is covered with a thin film stained with numerous chromatophores; testis oblong, ca. 16 *mm* in length; vas deferens is represented by two short, very slender, tubules, which are united at their distal end; spermatophoric gland (spd) can be roughly divided into three regions by the position of turning, of nearly uniform width; spermatophoric duct short and transparent; accessory spermatophoric gland (ac) rather short and big, thickened, gently curved; shunting duct (s) big and short; spermatophoric sac (sps) slender and ca. 13 *mm* long, without longitudinal fibrous structure, no spermatophore within; proximal part of penis (pp) rather long; penis diverticle (pd) is rather large, muscular in structure, ca. 5.5 *mm* in diameter, slightly depressed spherical in shape; penis (p) very soft, a fusiform thin-walled tube.

These structures are noticed by the facts that, (1) vas deferens is short, without characteristic complicated windings, (2) penis diverticle is quite large. The animal might have been just prior to complete maturity, but the regional differentiation of the structure is fairly insufficient and suggests a degenerated condition.

REMARKS ON THE MORPHOLOGICAL CHARACTERS OF *IDIOCTOPUS GRACILIPES*

Habitat: Some of the anatomical characters described above show that this species is an inhabitant of 500–600 *m* depth, which is called archibenthal in habitat;

we can fairly legitimately assume that the animal may be rather weak in strength judged from the extraordinary degeneration of the musculature of mantle and arms, also the arms are equipped with small suckers and devoid of any enlarged ones.

Size of animal: In the Tribe Bolitaenacea, the size of *Idioctopus* is comparatively large, coming next to *Amphitretus*; for comparison in Table 1 the maximum values of each species are given.

Relative length of mantle and arm: It is noted from this Table that in *Idioctopus* the mantle is smaller and the arms are remarkably longer than its relatives. A fundamental difference is seen in the construction of the body between *Idioctopus* and other genera, which may be due to the difference of their ecology. It is well-known or fairly probable that animals of these groups lead a pelagic life, with a gelatinous and voluminous body and rather short arms connected with broad webs, while *Idioctopus* has a rather small body and particularly elongated arms, which are not connected with webs, so that it may be a benthic crawler.

Table 1. Showing the total length, mantle and arm length and arm index in species of Bolitaenacea. Except *Idioctopus*, data taken from THORE (1949).

Genera and species	Maximum total length *mm*	Maximum dorsal mantle length *mm*	Maximum arm length *mm*	Arm index *%*
Bolitaena microcotyla	40+	20	19+	48%
Eledonella pygmaea	135	77	60	45.8%
Japetella diaphana	155	74	72	43%
Dorsopsis taningi	27	15	11	42%
Idioctopus gracilipes	200	50	140	70%
Amphitretus pelagicus	352	87	250	71%

Habit: The animal may not be probably quite active in activity, by the fact that the mantle aperture is narrowed by the median fusion with base of funnel, and also the degeneration of branchial leaflets which inevitably results the low level of the function of gas exchange. Of course, the gas exchange can be performed through the whole surface of the integument which is quite soft and accordingly permeable to gases. The undevelopment of the web between arms may be related to the weakness of the swimming power. The shortness of the intestine and especially the fact that the anus does not attain the mantle margin, may be explained by that the food is restricted to very digestible substance and it is pulverized by the well-developed multicuspidate teeth of radula, as is seen in the contents of crop in paratype-specimen, aided by the function of stomach-liver-pancreas, thus it is so completely digested that the faeces are only quite scarce in quantity, or even nearly nil. But the development of jaw and radula with abundant muscles shows that it has a strong masticative power of food, which may not be fluid or planktonic animals. A somewhat similar state of alimentary canal can also be seen in other members of Bolitaenacea (THORE 1949) or in *Opisthoteuthis* (MEYER 1906). The reduction in size

of the ink-sac is assigned to the archibenthal life.

Situs viscerum: The location of stomach and pancreas and also ink-sac in the visceral sac is very characteristic; they are in an inverted position antero-posteriorly of the ordinary state; this fact may be related to the easiness of digestion of diet which enables accordingly the concentration of main digestive organs in the anterior region of the viscera. The direction of ink-duct is also naturally changed to the rectal region. A similar case of situs viscerum is also reported in *Amphitretus pelagicus* and *Vitreledonella richardi*, on both species THORE (1949, pp. 55, 61) discussed, but in *Bolitaena microcotyla* (THIELE, 1915, p. 527, pl. 87) and *Eledonella pygmaea* (THORE, 1949, p. 43, text-fig. 37) it is nearly in ordinary arrangement. There is no confident reason to suppose that *Amphitretus* and *Vitreledonella* are phylogenetically related; this phenomenon should be taken merely as a convergence. I think that *Idioctopus* and *Amphitretus*, two related representatives in the Ctenoglossate group on the one hand, and *Vitreledonella* in the Heteroglossate group on the other hand, pursued a parallel course of adaptive modification into the abyssal life. It is needless to say that almost all morphological characteristics found in animals of these groups should be taken as of secondary origin, quite apart from the primitiveness of the animal.

Chromatophores: It is noticeable that the development of chromatophores in the envelope of organs locating within the mantle; this fact may be due to the transparency of the mantle which is very thin and nearly devoid of muscular coating; in principle chromatophores are developed in animals living in littoral down to several hundred meters' depth, where natural light can penetrate in greater or less degree. The distribution of the chromatophores in this species suggests the depth of its natural habitat, namely the animal must be exposed to light, though perhaps in imperceptible degree, but it does not live in absolute darkness.

Hectocotylized arm: The structure of the hectocotylus of this species is characteristic. In Bolitaenidae the hectocotylus is known only in *Eledonella pygmaea.* In this species it is "found on the third left arm···; consists of a long pointed ligula with a very deep central longitudinal groove, the ligula supported by three thin strands of denser tissue ··· no transverse ridges are found." Besides, "a small but varying number of suckers of the distal half of the third right arm are enormously enlarged" (THORE 1949, p. 42, figs. 31, 32). The status of modification of arm in male in this species is so characteristic that detailled comparison between it and that of *Idioctopus* is nearly impossible, but the modification itself in *Eledonella* is not so much remarkable, since enlargement of suckers and groove-formation in the distal part of the hectocotylized arm is the ordinary mode of modification in the male of Octopodidae. However it is particularly noticeable that in *Eledonella* (1) the hectocotylized arm is the third left arm, and (2) the presence of the enlarged suckers on the third right arm. It is sorry that this status in *Eledonella* was found in one specimen alone, but if the case is substantiated by many specimens, it may be a unique case of bilateral modification of the third arm in male. Formerly APPELLÖF (1893) reported a case of bilateral hectocotylization in *Eledone cirrhosa*

and ROBSON (1929) a similar case in *Octopus rugosus*, in which the second left arm was hectocotylized, though in rather insufficient degree, besides the third right arm, but both of them are teratological and entirely different from that in *Eledonella*, in which the modification itself is not the same bilaterally.

In Amphitretidae (monogeneric and monotypic: *Amphitretus pelagicus*) the hectocotylized arm is reported in detail by SASAKI (1917) and THORE (1949, p. 55, Fig. 49a, 49b). A general resemblance in the structure of hectocotylized arm in *Amphitretus* and *Idioctopus* is found, and in so far as I am aware, no comparable structure is seen elsewhere in Octopoda, yet the difference in structure between two genera is worth noting. Nevertheless, as for the structure of the hectocotylized arm Idioctopodidae is nearest to Amphitretidae among other families.

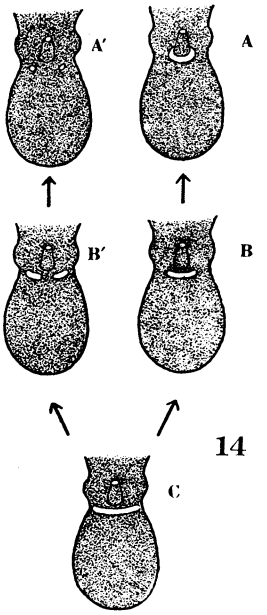
Item		*Amphitretus*	*Idioctopus*
Ligula	Length	shorter	longer
	Form	inner surface flattened	nearly round in cross section
	Papilla	two rows of "minute round protuberances" arranged on each lateral margin	two rows of minute papillae arranged along the median axis of arm
Calamus		"an angular swelling"	a trifoliate outgrowth
Seminal channel		bordered inside by the lateral rim of integument	with two wing-like dermal processes on both ends
Arm		connected side by side with a web along about the proximal 4/5 of the length of arm	not connected side by side with a web

Mantle-aperture: ROBSON (1926, p. 1334, textfig. 1; 1929, p. 110; 1932 b) discussed the various states of the mantle-aperture in the Cephalopoda, and showed three grades (C, B, A) from wide to complete closure in Octopoda, with a tendency that "there is found a progressive bilateral reduction of the aperture··· this progressive reduction is correlated with the abyssal mode of life." For example, in Cirroteuthidae out of 19 cases available, 15 cases represent stage A, and the rest B or C, and all 6 species of Opisthoteuthidae represent stage A, though in Eledonellidae and Vampyroteuthidae only stage C is seen (ROBSON 1926, p. 1335). So that the correlation between the grades of mantle-aperture and the depth of the habitat is not always strictly proportional.

In Idioctopodidae, as described above, mantle-aperture is divided into two parts by the median fusion of the funnel base to the mantle margin; such mode of mantle-aperture has not been known in Octopoda thus far; it may correspond to the stage B, and may be indicated as B′. It is probable that Idioctopodidae shows an intermediate state of mantle-aperture according to the depth of the habitat, softness of body and degenerating tendency seen in the gill structure.

In Amphitretidae "the fusion of the mantle and funnel in the median line restricts the aperture to two small lateral orifices" (IJIMA & IKEDA 1902, p. 97; ROBSON

1926, p. 1335); this state may represent one of the ultimate phase of mantle-closure and be called stage A′. Thus, the progressive closure of mantle-aperture might be pursued in two parallel courses; one, C→B→A, and the other, C→B′→A′.



Text-fig. 14. Diagram showing the progressive reduction of mantle-aperture in the Octopoda. C, aperture wide; B, aperture intermediate; A, aperture nearly closed; B′, aperture bilateral and intermediate; A′, aperture bilateral and nearly closed. Mantle- and funnel-apertures white, the other part stippled.

Radula (Text-figs. 5–10): The radula of *Idioctopus* is characterized by (1) the number of the cusp of this species is the greatest among any other species whose radula is known (in both *Bolitaena* and *Japetella* it is not reported), (2) the cusp is the longest of all, (3) the arrangement of the cusp is quite regular.

Systematic position: The characteristic features of *Idioctopus* deserve the establishment of a particular genus and moreover a family, which should be placed in the Tribe Bolitaenacea[1] (=Ctenoglossa) characterized by the possession of the multicuspidate lateral teeth.

Among systematic features, radular character should be taken as of primary importance; we need not say too much about the Gastropod radular armature which shows a remarkable differentiation according to their mode of life, giving a valuable clue for the solution of the phylogenetic relationship of its possessors. It is evident that the softness of the body and the uniserial sucker of Idioctopodidae are related to the family Vitreledonellidae, but these features should be thought as of secondary

1) In our present knowledge, the features given by ROBSON (1932 p. 325) should be partly revised; nemely in (6) "no sexual dimorphism" should be altered to "third right or left arm in male hectocotylized."

importance.

ROBSON's study (1932 a, p. 291; 1932, p. 16) "supports the view that the Ctenoglossa and Vitreledonellidae should be separated, as their central nervous systems are definitely dissimilar." But JOUBIN (1937) and THIELE (1934) placed Vitreledonellidae in Bolitaenacea; they did not seem to put so much weight on the radular character as I do.

It is probable that Idioctopodidae stands nearer to Amphitretidae than to Bolitaenidae by the facts that (1) all arms subequal in length, (2) and longer than the mantle-length, (3) the form of the characteristic hectocotylized arm, (4) dual nature of the mantle-aperture, (5) the status of visceral organs. Accordingly it is legitimately supposed that both Idioctopodidae and Amphitretidae may have evolved from a common stock, the former advancing to the way of a benthic crawler and the latter to a pelagic swimmer.

Thus, the Tribe Bolitaenacea is systematically tabulated as follows:

BOLITAENACEA
- (A) Arms shorter than mantle — Arms connected with web — (1) Bolitaenidae
  - (a) Optic nerve long
    - (i) *Bolitaena*
    - (ii) *Eledonella*
  - (b) Optic nerve short
    - (iii) *Japetella*
    - (iv) *Dorsopsis*
- (B) Arms longer than mantle
  - Arms not connected with web — (2) Idioctopodidae ..... (v) *Idioctopus*
  - Arms connected with web — (3) Amphitretidae ..... (vi) *Amphitretus*

II REDESCRIPTION OF *BERRYA HOYLEI* (BERRY)

Family Octopodidae Subfamily Octopodinae

Genus *Berrya* ADAM, 1939

Berrya ADAM, 1939, Rec. Ind. Mus., **41**: 101.
Hapaloctopus TAKI, 1962, Zool. Mag., **71**: 397.

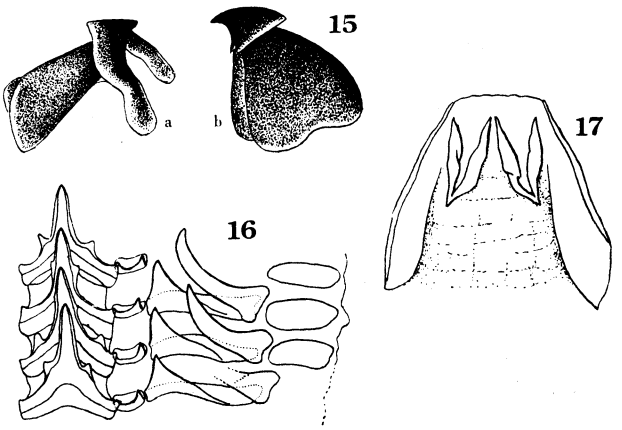
Diagnosis: Body soft and gelatinous; head broad, mantle saccular and squat, arms comparatively short and suckers small, webs deep; mantle-aperture reduced in width; no enlarged suckers in male; funnel-organ double V-shaped; ink-sac present. Inhabitant of hemibathyal to archibenthal sea.

Berrya hoylei (BERRY, 1909)
(Pl. 2; Text-figs. 15–19)

Polypus hoylei BERRY, 1909, Proc. U. S. Nat. Mus., **37**: 407–408, fig. 1.
——— ——— BERRY, 1914, Bull. Bur. Fish., **32**: 296–298, pl. 47, fig. 1, pl. 48, figs. 2–4; pl. 55, fig. 2; text-fig. 15.
——— ——— MASSY, 1916, Rec. Ind. Mus., **12**: 207–209.
Octopus hoylei; *hoylei* var. *annae* ROBSON, 1929, Monogr. Rec. Cephal., **1**: 219–221, fig. 89.

Berrya hoylei ADAM, 1939, Rec. Ind. Mus., **41**: 100–103, pl. 1, figs. 2–3, text-figs. 22–23.
Hapaloctopus albidus TAKI, 1962, Zool. Mag. Tokyo, **71**: 397.

General appearance (Pl. 2): The entire animal is covered by a thick (3–5 *mm* in thickness) coating of almost transparent, very soft hypodermic gelatinous tissue except the distal half of all arms. The hypodermic connective tissue is so thin in consistency that in aquatic medium it can be easily moved to and fro like a semi-fluid.



Text-figs. 15–17. *Berrya hoylei* (BERRY).
15. Lower (a) and upper (b) mandibles. ×4
16. Radula. ×50
17. Funnel-organ. ×2.

Body squat, head rather broad, a little narrower than mantle, weakly constricted behind; eye-ball large, ca. 13 *mm* in length, eye-orifice small, 3 *mm* in diameter (Pl. 2, fig. 2), with an ocular cirrus, ca. 2 *mm* long, on the hind corner of each eye-ball.

Mantle nearly as long as broad, widest at about the posterior third and rounded behind.

Mantle-aperture somewhat reduced, belongs to stage B of ROBSON. Surface of body almost smooth, with a fine reticulum, each mesh of uniform size, ca. 0.8 *mm* long; coloured whitish carneous, head, mantle and arms light carneous, eye-ball with a faint tint of light purple.

Funnel short and base very wide, ca. 18 *mm* in width and 15 *mm* in length, roughly depressed conical. Funnel-organ VV-shaped, both outer and inner limbs of moderate width and acutely pointed both in front and behind.

Arms comparatively short and slender, ca. 3–4 *mm* wide, arm formula 3.2.4.1 (left) and 4.2=1.3 (right) in the specimen A, but an exact arm formula can not be made from a single specimen and might be better expressed as subequal in length; suckers relatively small, its diameter 4.2% in longest arm, no enlarged sucker. Web

well developed, roughly E. D. C. B. A. in specimen A, extending to nearly the distal end on both sides of each arm as fin-like outgrowth.

Third right arm in specimen A hectocotylized, which is decidedly shorter than that of the opposite side, 55.2% of total length; ligula, short, 5.8% of longest arm, acutely pointed, the ventral side shallowly concave, calamus small and inconspicuous.

Interior of the mantle (Text-fig. 18): The organs found in the mantle cavity, together with the buccal bulb, are coated with thin, transparent film which correspond to the gelatinous hypodermis of body surface, but the films have the appearance of loose connective tissue and not massively gelatinous seen in the oedematous tissue of a pathological specimen.

Mandibles (Text-fig. 15): Both rostra black and the rest dark reddish brown in colour; lower mandible (a) 6 *mm* long, 6 *mm* wide, rostral lamella 5 *mm* long, rostrum rather bluntly pointed and rostral lamella narrow, gular lamella of moderate width and hind margin deeply sinuated; upper mandible (b) 6 *mm* long and 5 *mm* wide, rostrum short and rostral lamella narrow, palatine lamella broad, shallowly sinuated on both sides.

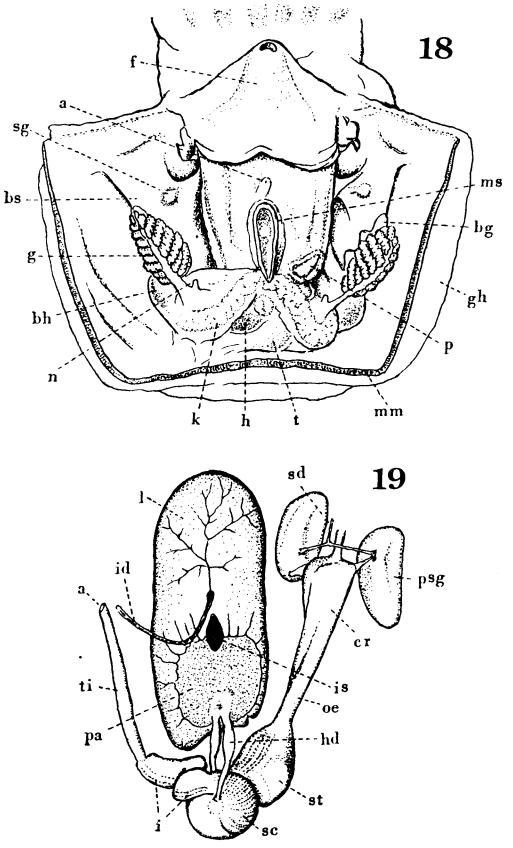
Radula (Text-fig. 16): Rhachidian pentacuspidate; median cusp long and wide, gently pointed, mesocone of moderate size, shows A_3-seriation, ectocone low, not much protruded; base of first lateral comparatively wide, inner cusp low and blunt and outer cusp relatively long and acutely pointed; base of second lateral wider than the rhachidian and its cusp wide and long, acutely pointed; third lateral very wide, its curvature rather gentle; marginal plate oblong.

Gill leaflets numbers 8, 9 or 10 in each demibranch.

Alimentary canal (Text-fig. 19): Posterior salivary gland 8.5 *mm* long and 3.5 *mm* wide, surface smooth, buff in colour; wall of crop thick, no diet found in the specimen A; oesophagus is not strictly demarcated from the crop; stomach (st) 8.5 *mm* long and 4 *mm* wide, somewhat elongated cube in shape, its wall conspicuously muscular, spiral caecum (sc) thick disc-like in shape, numerous septa can be seen from outside; intestine divided into two parts, the earlier part (i) is very wide and its wall is very thin with two slender longitudinal muscular bands, terminal part (ti) nearly straight, its wall is thick; no anal papilla; liver (l) is quite voluminous, 21 *mm* log and 10 *mm* in diameter, roughly cylindrical, asymmetrical in shape, namely the right side somewhat elongated posteriorly than the left side, but in specimen B the liver is symmetrical, greyish buff in colour; pancreas 7 *mm* long, occupying a round area at the posterior third of the liver; ink-sac buried in liver, its surface of about 6 *mm* long appearing; ink-duct starting at about the centre of the liver and attaining the anal part.

It is noticeable that the kidney (k) is well developed, occupying a large area in the ventral view of the viscera, and the branchial heart (bh) is also relatively large.

Male genital organ: In specimen A the whole organ is far from maturity; the testis ca. 4.5 *mm* in diameter, nearly spherical and the regional differentiation in the gonoduct system is scarcely seen, but the penis only is easily recognized, which is



Text-figs. 18–19. *Berrya hoylei* (BERRY).

18. Interior of mantle, cut open from the ventral side. × ca. 1.
19. Alimentary canal seen from the ventral side. × ca. 1.7.

a, anus; bg, branchial gland; bh, branchial heart; bs, branchial suspensorium; cr, crop; g, gill; gh, gelatinous hypodermis; h, systematic heart; hd, hepatic duct; i, intestine; id, ink-duct; is, ink-sac; k, kidney; l, liver; mm, mantle muscle; ms, mantle septum; n, nephrostome; oe, oesophagus; p, penis; pa, pancreas; psg, posterior salivary gland; sc, spiral caecum; sd, salivary duct; sg, stellate ganglion; st, stomach; t, testis; ti, terminal part of intestine.

ca. 5 *mm* long, simply conical in shape.

Specimen B. It is very smaller than specimen A, about half as long as its total length. The hypodermis of the whole surface is rather loose but not swollen as specimen A; this fact can be explained as that it was found from the stomach of a deep-sea fish (*Alepisaurus borealis*), and the hypodermic tissue had been shrunken, due to dehydration of the tissue in the gut of the predator. The internal anatomy showed that it was quite juvenile, but the radular armature well agrees with that of specimen A.

Remarks: In 1909 BERRY described *Polypus hoylei* from the specimens of the "Albatross" collection; the type-specimen was an adult male and accompanied with

Measurements (in *mm*):

Specimen		Specimen A		Specimen B	
Total length		115		65	
Mantle length	dorsal	36		30	
	ventral	30		23	
Head width		30		15	
Mantle width		35		18	
		L	R	L	R
Arm length	1	67	57	30	31
	2	77	57	30	32
	3	78	43 (hect.)	29	31
	4	67	67	30	29
Web depth	A	18		13	
	B	—	21	12.5	13
	C	26	17	11.5	13
	D	23	25	8.5	13
	E	25		12	
Arm length index		67.8%		49.2%	
Mantle-arm index		46.2%		93.7%	
Web-arm index		33.4%		40.6%	
Ligula index		5.8%		—	
Hectocotylized arm index		55.2%		—	
Sucker index		4.2%		3.8%	
Locality		Off Cape Ashizuri, Tosa Bay, 153–227 *m* in depth		Kinan-shō, off Shiono-misaki (136°–136° 30′E., 38° N.; ca. 710 *m*) from the stomach of *Alpisaurus borealis* (Gill)	
Collector		Mr. Shinma Nakayama		Members of Nankai Regional Fisheries Research Laboratory	

3 additional specimens, all of which came from the Hawaiian Islands. This species was described in detail by the same author in 1914 with illustrations. In 1916 MASSY gave a further description based on four specimens in the "Investigator" collection without illustration, and in 1929 ROBSON summarized the descriptions of this species, allocating it in "species of uncertain generic position," with addition of a new variety *annae* which came from the Persian Gulf, Arabian Sea and south of Ceylon, namely the specimens described by MASSY were separated as a variety.

ADAM in 1939, re-examined the specimens formerly described by MASSY, giving further details on this species. He then created a new genus *Berrya* for this species, but he said that "the internal anatomy of *O. hoylei* is still insufficiently known." His figures (pl. 1, figs. 2–3) do not seem satisfactory for general recognition; he did not accept ROBSON's var. *annae* as valid, as the difference is slight. On a peculiar form of an Octopod at hand I read a paper in 1962 and later its abstract was printed in a few lines, naming it *Hapaloctopus albidus*. However it should be identified as

Berrya hoylei. So far as known this genus is quite characteristic and monotypic.

Size. The maximum value of the total length of this species seems to be 233 *mm* which was recorded by BERRY (1914), so that the specimens described above, having a value only about half of its length, is quite immature. The comparative shortness of arms and smallness of suckers, and especially the undifferentiated calamus of hectocotylus of this specimen may be assigned to this immaturity. Also the fact that the surface of body is nearly smooth and thin colouration in general may be due to similar reason.

It is to be noted that, while the specimen A described above is coated with very soft gelatinous hypodermis all over the surface, which is a quite noticeable feature, no similar hypodermis has been reported by previous authors. It is evident that the specimen A which I examined is well preserved to allow internal dissection, and thick gelatinous coating of the body is never thought to be the artefact of inappropriate state of preservation. On the contrary the specimens examined by ADAM (1939) were reported, "owing to the poor condition of the material the internal anatomy could not be studied" (p. 103). In conclusion, it is clear that this species is characterized by a thick coating of very soft hypodermis, though its relative thickness might be reduced down according to the advance of the age of the animal, or subjected to individual variation to some extent.

BERRY (1914) figured two ocular cirri but I could find only one cirrus in the specimen A, perhaps due to its immaturity. Mandibles have not been reported before, but detailed comparison is nearly impossible as in many species our knowledge is still insufficient. ADAM's (1939) description on the radula well agrees with mine, with minor difference which does not seem important.

The agreement of the funnel-organ between specimens described by BERRY (1914, p. 297, fig. 15; pl. 48, fig. 4) and mine is satisfactory. As regards the inter-

Table 2. Showing the comparison of characters between the genera *Berrya* and *Benthoctopus*.

Characters	*Berrya*	*Benthoctopus*
No. species contained	1	14+a
General appearance	rather squat	rather slender
Surface of body and hypodermis	very soft and gelatinous	rather firm
Muscular tissue	soft	firm
Mantle-aperture	rather narrow (Stage B)	wide or narrow (Stage B or C)
Arm length	short	rather long
Arm length index	70–73%	77% (mean of 13 spp.)[1]
Sucker	small	rather small
Ink-sac	present	absent
Funnel-organ	VV-shaped	W- or VV-shaped
Crop	well developed	not well developed
Web	deep	rather shallow
Web-depth index	33–37%	30% (mean of 12 spp.)[2]

1) 2) Cf. SASAKI 1929; ROBSON 1932; ADAM 1954.

nal organs only little has been known thus far; it is noticeable that, (1) the liver is very large; (2) the pancreas is also large, (3) the intestine is very short, without looping, which is differentiated into two regions, (4) the ink-sac is reduced in size, (5) the kidney is exceptionally well developed. These features may be related to adaptation to an abyssal life in more or less degree.

Distribution-Horizontal: So far as known, this species inhabits the Indo-Pacific Oceans, ranging from the Hawaiian Islands to Persian Gulf and Arabian Sea, the localities in Japan described above coming the intermediate position between two extremities.

Vertical: Bathymetrical records are summarized as follows, the value of fathoms being converted into meters.

816–835; 515–561; 468–567; 46; 236 (2 specimens); 95–124; 153–227; 710 *m*. Thus, its frequency of catch is as follows:

1– 100 *m*	1
100– 200 *m*	1
200– 500 *m*	3
500–1000 *m*	4

It ranges from 46 to 835 *m* in depth, and frequency of catch predominates in 200–1000 *m* depth, which corresponds to "deep sea province" according to OYAMA's (1952) classification of vertical distribution of marine Mollusca; especially this species is found principally in bathyal and 'abyssal zones.'

Systematic position. This genus, by its morphological characteristics and habitat, stands close to the genus *Benthoctopus* in the Subfamily Octopodinae, but it can be easily distinguished from it by the presence of the ink-sac, though it is reduced in size. The points of difference are summarized in Table 2. The soft hypodermic tissue of the whole surface seems a particular character of this genus, and in addition the short arms with small suckers, weak muscle and deep web — all these characters suggest that this genus represents a transient form to change into animals of pelagic life, for example *Amphitretus*, etc. Probably the animal may not be quite active in motion and prefer swimming to crawling.

III DESCRIPTION OF *OPISTHOTEUTHIS JAPONICA* TAKI, 1962

Genus *Opisthoteuthis* VERRILL, 1883

Opisthoteuthis japonica TAKI, 1962

(Pl. 3; Text-figs. 20–22)

Opisthoteuthis (*Teuthidiscus*) *japonica* TAKI, 1962, Zool. Mag. Tokyo, **71**: 794.

General appearance (Pl. 3): Body very flabby, in outline subdiscoidal, both eyes and mantle raised as a plano-convex disc which is very low; surface smooth, though very weakly wrinkled in the preserved state; eye-bulbs extremely large, its axial length attaining about 1/2.5 the length of the mantle; eye-orifice rather small,

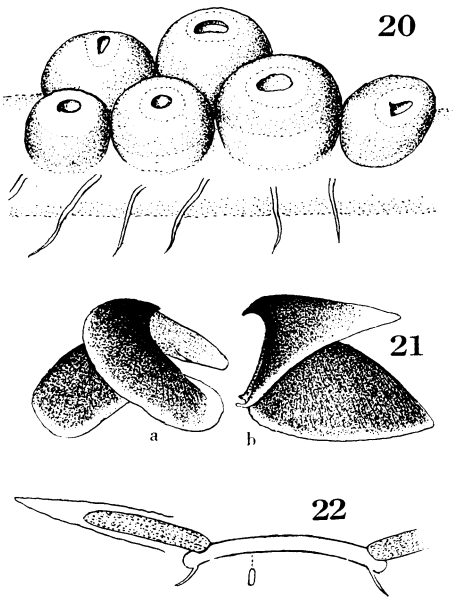
about a quarter of its axial length. Distance between both eyes wider than the mantle, and nearly smooth.

Fins extremely slender and long, its length about five times of its width, oblong in shape and its distal one-fourth tapers to a rather pointed end. Mantle aperture rather wide; funnel shrunken, depressed and rather inconspicuous, about 20 *mm* long; funnel-organ composed of two oblique, slender pads.

Arms subequal in length, the order of length can not be shown exactly since each arm, if strictly expressed, is under somewhat different state of preservation; all arms are connected with very thin, broad web, leaving the distal ca. 1/5 of the arm free. Suckers are uniserially arranged; both type- and paratype-specimens are males and the 5th-14th suckers from the mouth are prominently enlarged, the largest one measuring 6 *mm* in diameter, nearly spherical, its sucking surface about half of its diameter; they are so aggregated to form alternate biserial arrangement; suckers distal from this part gradually diminished in size.

Cirri are arranged on both sides of the space between series of suckers, hairy and flat, ribbon-like, the longest one ca. 0.3 *mm* wide and 6 *mm* long, tapering to a pointed end; they do not seem retractile and no receptible sheath is found.

Dorsal cartilage (Text-fig. 22): For observation of the internal anatomy the paratype-specimen was used. It is a slender, very gently arcuated rod, in the natural state it is a convex arc in the paratype and concave arc in the type-specimen, 23 *mm* long and 2 *mm* wide,; its cross-section ellipsoidal; there is a fine, needle-like extension, 0.8 *mm* wide and 5 *mm* long, on each side; also there is a flat, oblong mus-



Text-figs. 20–22. *Opisthoteuthis japonica* TAKI.

20. A part of the second right arm of type-specimen, with enlarged suckers and cirri. ×ca. 2.5.
21. Lower (a) and upper (b) mandibles. ×ca. 2.5.
22. Dorsal cartilage and outline of fin of paratype-specimen. ×ca. 1.3.

Measurements (in *mm*):

Specimen		Type		Paratype	
Total length (approx.)		170		165	
Total width (approx.)		150		150	
Interorbital distance		45		35	
Dorsal mantle length		45		32	
Height of body		28		25	
		L	R	L	R
Arm length	1	100	100	85	70
	2	90	70	90	72
	3	90	80	90	80
	4	90	85	85	90
Web depth	A	70		40	
	B	50	65	40	35
	C	50	55	55	40
	D	60	65	45	43
	E	65		50	
Sex		♂		♂	

Locality: Off Minabe, near Tanabe Bay, Wakayama Prefecture, depth ca. 152 *m*, by bottom trawler; Dec. 1942.

cle, 17 *mm* long and 4 *mm* wide, on each anterior end of the cartilage which forms the axis of the fin; this muscle may be called "fin muscle."

Mandibles (Text-figs. 21): Black and dark brown in colour; upper mandible (b) 6.2 *mm* high, rostral lamella 6 *mm* long; rostrum well developed, protruded with an acute cusp, rostral lamella relatively large, lower margin shallowly sinuated; lower margin of palatine lamella nearly straight; lower mandible (a) 5 *mm* high and 5.5 *mm* long, rostrum rather weak and its cusp short, rostral lamella rather wide and thin; gular lamella relatively small, without any notch on the middle of the lower margin.

Colour. The aboral surface is coloured light old lilac, eye and viscera light slate purple; in the oral surface the web is Vernonina purple and suckers light Hydrangea red.

Remarks: Fin muscle. As the form of fin and dorsal cartilage are important characters in the classification of *Opisthoteuthis*, they are generally described in detail by previous authors, especially MEYER (1906) on *Opisthoteuthis depressa*. However, perhaps due to the relative smallness of the fin and its muscle in this species, finding the "Gallertkern" in the axis of fin (p. 197, Text-fig. II), his description contained no mention on the muscle attached to the end of dorsal cartilage and enters the central axis of fin, so that a term "fin muscle" is proposed herewith; this muscle may serve to the movement of the fin. This muscle is remarkably developed in *O. californiana* (See later).

Comparison: BERRY (1918) established a subgenus *Teuthidiscus*, distinguish-

ing his new species *pluto* and *persephone* in which the dorsal cartilage is a single rod-like, from the type-species *agassizi* in which it is inferred to be composed of two parts. But at that time its dorsal cartilage was neither actually observed nor figured. This subdivision was followed by ROBSON (1932) with some doubt, until Voss (1956) examined a specimen of *agassizi* collected in the Gulf of Mexico and figured (fig. 14 c), who negated this subdivision. Therefore, *Opisthoteuthis* need not be divided subgenerically.

This species differs from the well-known *O. depressa* IJIMA & IKEDA which represents one of the famous rare animals of Japan in so many points that comparison at species level seems almost unnecessary, but for precision's sake it may be added; in *depressa* the form of fin is oblong, its length is 1.5–2.0 times of its width, and its point is rounded, dorsal cartilage concave, curving "roughly crescentwise, with five weak bendings, which are situated so as to divide the cartilage into six subequal parts" (SASAKI, 1929, p. 11, pl. 7, figs. 8–9). However, it shows some resemblance to *extensa* THIELE, *pluto* BERRY and *persephone* BERRY, but can be distinguished as follows:

Table 3. Comparison of characters of four species of *Opisthoteuthis*.

Species name		*pluto* BERRY, 1918	*persephone* BERRY, 1918	*extensa* THIELE, 1915	*japonica* TAKI, 1962
Eye size		moderately large	rather small and inconspicuous	small	very large
Fin		situated near the eye; length less than $\frac{1}{5}$ of inter-ocular distance; oblong; twice as long as broad; tip pointed	situated more or less median in position; minute, tenuous; length less than $\frac{1}{3}$ of interocular distance; more than twice as long as broad	situated at halfway between eye and funnel; length less than $\frac{1}{3}$ of inter-ocular distance; tip pointed	situated near the eye; length less than $\frac{1}{3}$ of inter-ocular distance; slender oblong in shape; tip pointed
Areola in dorsal surface		present	present	——	absent
Colour	Aboral surface	chocolate and dark slaty grey	dirty grey	light brown	ligth greyish purple
	Oral surface	chocolate brown and dark slaty purple	dark bluish slate	dark brown	brownish purple
Cirrus sheath in arm		present	present	——	absent
Dorsal cartilage		concave arc	concave arc	——	concave or convex arc with two slender branches
No. demibranch		8 (4 a side?)	6, 6+1	6	4
Locality		Great Australian Bight	Great Australian Bight	Off east coast of Sumatra	Off Minabe, Wakayama Prefecture
Depth of habitat		275–824 *m*	275–549 *m*	769 *m*	152 *m*

IV REDESCRIPTION OF *OPISTHOTEUTHIS CALIFORNIANA* BERRY

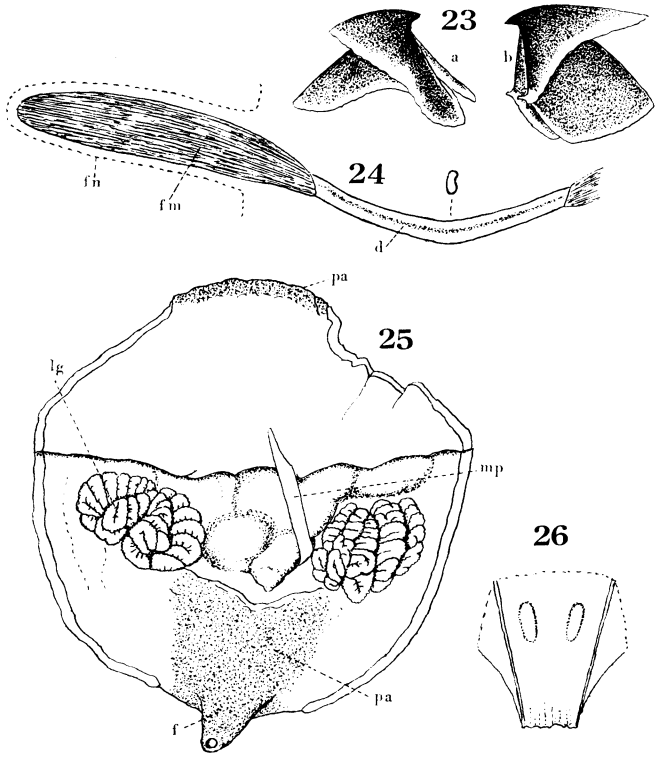
In 1962 and 1963, five specimens of *Opisthoteuthis* obtained in Kashima-Nada were forwarded to me, which are identifiable to *O. californiana* BERRY. Though BERRY's descriptions (1949, 1952, 1955) cover the general features of this species, some internal morphology was not noticed. Thus it seems advisable to redescribe this species based on my material.

Opisthoteuthis californiana BERRY, 1949

(Pls. 4–5; text-figs. 23–26)

Opisthoteuthis (*Teuthidiscus*) *californiana* BERRY, 1949, Leaflets in Malac. **1** (6): 23–26; 1952. California Fish and Game, **38** (2): 183–188, text-figs. 1–5; 1955. Ibid., **41** (3): 219–224, text-figs. 1–4.

General appearance (Pls. 4–5): Animal large for this genus, flabby, subdis-

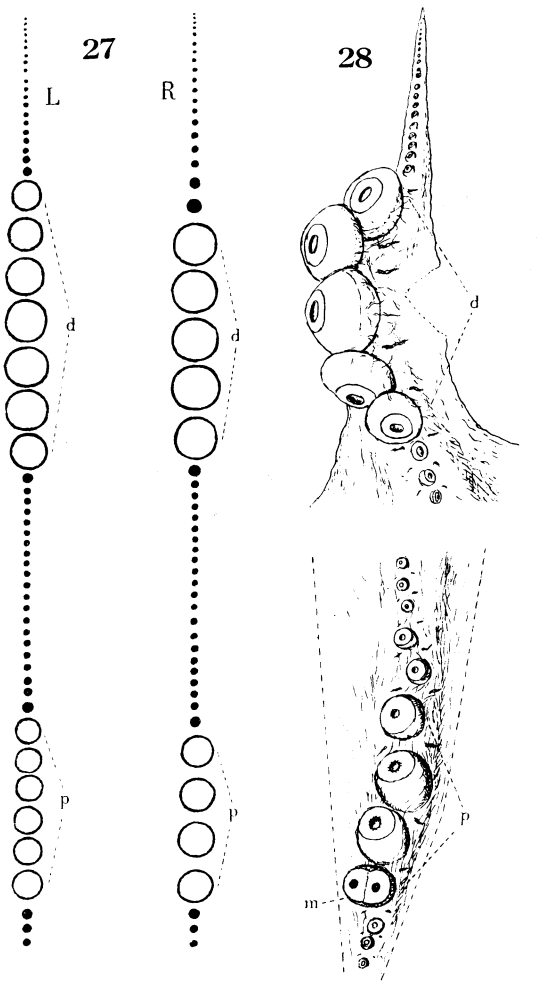


Text-figs. 23–26. *Opisthoteuthis californiana* BERRY.

23. a, lower mandible; b, upper mandible. ×ca. 2.8.
24. Dorsal cartilage (d) of specimen B, seen from above. ×ca. 1.2. fn, outline of fin; fm, fin muscle.
25. Posterior half of mantle cavity, mantle cut open to show the interior. ×ca. 1.1. lg, left gill; f, funnel; mp, median pallial retractor; pa, pigmented area.
26. Funnel organ of specimen C. ×ca. 1.1.

coidal. Head and body faintly raised above the disc; eyes extremely large; interocular distance as wide as the mantle; fins fairly large for the genus, situated at about the anterior third of the distance between the eye and pallial aperture, oblong, its length about 3 times of its width, its end rounded.

Aboral surface smooth, but in large specimens the epidermis is very much eroded, in all three mature specimens it is nearly lost except the distal part of the arms, the epidermis itself seems to have been scraped off to irregular net-works, ex-



Text-figs. 27–28. *Opisthoteuthis californiana* BERRY.

27. Diagram to show the arrangement of enlarged suckers in the first arms of specimen A; compare Pl. 4, fig. 2. L, R, left and right arms; d, enlarged suckers in the distal portion; p, the same in the proximal portion.
28. Distal and proximal portions of the first right arm in specimen A; compare fig. 27, R. m, abnormal sucker ("double monster").[1)]

1) This sucker measures 8.5 mm long and 6.5 mm wide; it is composed of two suckers which are compactly fused side by side; this is a very rare case of abnormality.

posing a broad area of the underlying hypodermis. Such erosion of epidermis might have been caused partly by the trawling net at the catch, but it seems probable that the main cause is the epidermis itself which may become fragile and deciduous with the advance of the age. Such a state of erosion is already illustrated in figs. 1 and 4 of BERRY's paper (1952). Also the oral surface of the web suffers the similar erosion (Pls. 4, fig. 2).

Arms considerably thick and muscular for the genus, measuring about 15 *mm* in diameter and 20 *mm* in height in the mature male, its length subequal, connected with a broad web, leaving the distal tenth of its length free; suckers arranged uniserially; in female they are small and low but in mature male (Text-figs. 27–28) they are particularly enlarged in the 4th–11th suckers from the mouth, their diameter about 5–7 times those of the female of similar size, and especially 4–7 suckers near the distal part of the first arms, namely 24th–32th suckers from the mouth are again enlarged. The mode of enlargement is somewhat different in two portions, namely in the proximal suckers they are shortenend cylindrical or "barrel of beer" in shape, the largest one being 8 *mm* wide and 9 *mm* high, but in distal portion depressed spherical or biconical in shape and larger than the former, the largest one ca. 13 *mm* in diameter and 12 *mm* in height. In both portions of arms, the less the number of enlarged suckers, the larger the diameter of each sucker. Such enlargement is taken as a type of hectocotylization. Cirri delicate, situated alternately on both sides of the series of suckers, the longest one measures ca. 7 *mm* in length and 0.5 *mm* in width at base, gently tapers toward its tip.

Gill leaflets 4 in the outer, 3 in the inner demibranch on each side.

Funnel-organ (Text-fig. 26) is composed of two small, thin transparent longitudinal pads.

Dorsal cartilage (Text-fig. 24) is flat rod-like, gently arcuated, with a very shallow longitudinal groove on the dorsal side of it, 28 *mm* long and 5.0 *mm* wide in large specimen. A flat, long muscle starts from the end of the cartilage and enters the fin, forming the axis of it; in specimen B the muscle measures 35 *mm* long, 8 *mm* wide and 2.5 *mm* thick: the fin muscle (fm).

Mandibles (Text-fig. 23). Black and dark brown in colour; upper mandible (b): rostral lamella comparatively broad, rostrum short and acutely pointed, palatine lamella also broad and the hind margin nearly straight; lower mandible (a): rostrum short and acutely pointed, rostral lamella relatively broad and its inner end somewhat extended inward; gular lamella nearly oblong viewed ventrally.

Colour. Aboral surface generally oxblood red, eye-bulb dull blue violet, exposed hypodermis cameo pink; oral surface oxblood red, which is generally darker than the oral surface, arm and sucker cameo pink.

Remarks: The enlargement of the suckers in mature male is noteworthy. This phenomenon is known in *O. japonica* and especially in *O. depressa*; SASAKI (1929, p. 11, text-fig. 4) says on the latter species, "this enlargement being specially marked in the suckers from fifth to twentieth, which in full-grown specimens attain over 7 *mm* in diameter." In *O. californiana*, however, differentiation in the enlargement

Measurements (in *mm*): (The value is almost approximate)

Specimen A

Total length			280
Total width			280
Mantle length (from middle of eye to funnel base)			70
Interocular distance (measured from both outer margins of eye)			75
		L	R
Arm length	1	140	150
	2	145	150
	3	150	165
	4	150	163
	A	100	
	B	90	100
Web depth	C	95	100
	D	100	100
	E	95	

Fin size (L) 27×13 (R) 27×14

Locality: Kashima-Nada, in 530–560 *m*. Five specimens (2♂ and 3♀).

of suckers is seen, namely the enlargement is affected in all arms in the proximal portion, but the number of affected suckers is confined to 4–7, and moreover it is also seen in distal 4–7 suckers in both first arms. We still know very little about the ecological function of the enlarged suckers; but it might be plausible to surmise that they have some meaning at the time of copulation, and the distal enlarged suckers of both first arms serve to seize the partner.

The localities where BERRY obtained this species are as follows:

Off Eureka Bar, California, 188 *fms*=343 *m*

Off Humboldt County, California, 280 *fms*=512 *m*

It is generally known that in depths about 500–1000 *m* of Kashima-Nada boreal or cold sea animals are found; it is very noticeable that this species inhabits the eastern part of Japan, and may be explained as that localities of both sides in the Pacific Ocean have similar oceanographical conditions. This is the first record in which a species of *Opisthoteuthis*, seemingly a sluggish moving animal, is found in two widely separated localities.

In conclusion, it is noted that as many as three species of *Opisthoteuthis* are found in the Japanese seas, namely *depressa*, *japonica* and *californiana*; the most numerous species of this genus living in rather small area of the sea.

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新たに知られた日本産タコ類4種について

滝　　巌

近年著者の入手したタコ類4種を記載した．これらは昨年（1962）日本動物学会大会（岡山）で発表し要旨は動物学雑誌71巻397～398頁に載っている．

1) テナガヤワラダコ　胴部などの破損した標本2点で，銚子沖産．全長約200 mm，套長約50 mmで体は亜寒天質で半透明，腕は細長く側扁し吸盤は1列に並ぶ．交接腕（右第3腕）の舌状片は糸状に細い．外套開口は2部に分かれ，歯舌の中央歯は9歯尖，第1側歯は6歯尖，第2側歯は7歯尖を有するのでフクロダコ族に所属するが，既知のどの科にも属せしめることができないのでテナガヤワラダコ科とテナガヤワラダコ属を設け，フクロダコ科・クラゲダコ科との関係についても考察した．

2) ヤワハダダコ　土佐足摺岬沖と紀南礁で採れたもので全長約115 mm，套長約36 mm．未成熟個体で皮下に極めて軟かい寒天質層がある．腕は比較的短かく吸盤は小形で傘膜は広い．ハワイ・セイロン島南・アラビア海・ペルシャ湾で採れており日本は新分布地である．

3) センベイダコ　標本2個で和歌山県南部沖産．既知のメンダコと比べると傘膜は狭く背軟骨はゆるい弧状に曲がる点その他多くの点で異るが，*Opisthoteuthis pluto*, *O. persephone*（どちらも大豪洲湾産），*O. extensa*（スマトラ附近産）と比べても背軟骨・鰓葉数・鰭形・触毛鞘・体色などで異る．

4) オオメンダコ　鹿島灘で採れた5個で，北米加州で1949年に知られた種に同定しうる．甚だ大形で成熟雄には腕全長の中央部と左右の第1腕の先端部近くと合計2個所に大形吸盤がある．太平洋の東西2地方に同一種を産することは注目される．

EXPLANATION OF PLATES

Plate 1

Idioctopus gracilipes TAKI, dorsal view. ×ca. 0.9

Two balls seen through the mantle; the upper one, the stomach, the lower one the testis. 1, 2, 3, 4, show number of arms.

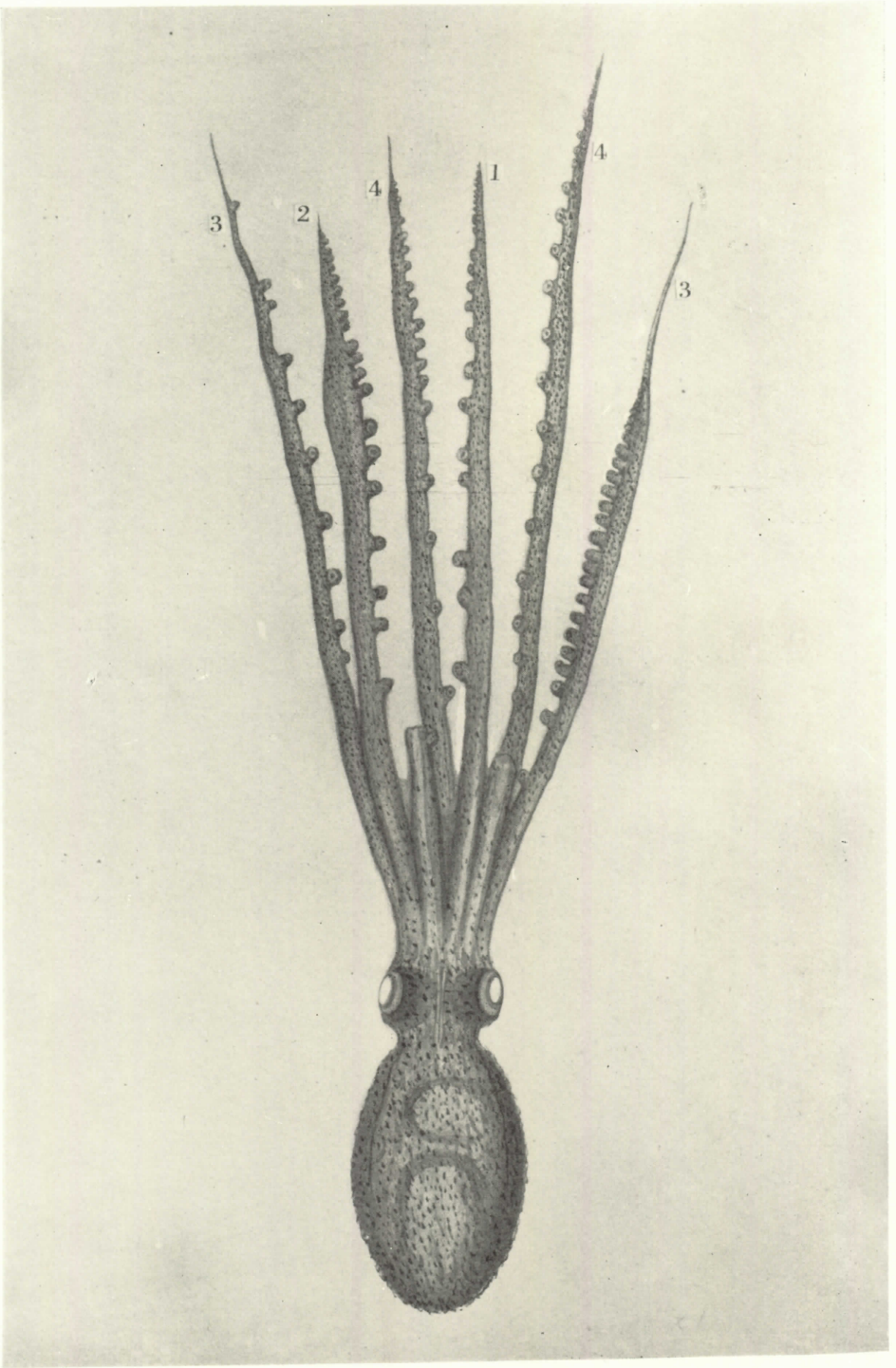

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Plate 2

1, 2, 3. *Berrya hoylei* (BERRY). Ventral, left oblique and dorsal views. In Fig. 2 the eye-orifice is shown. × 1.1

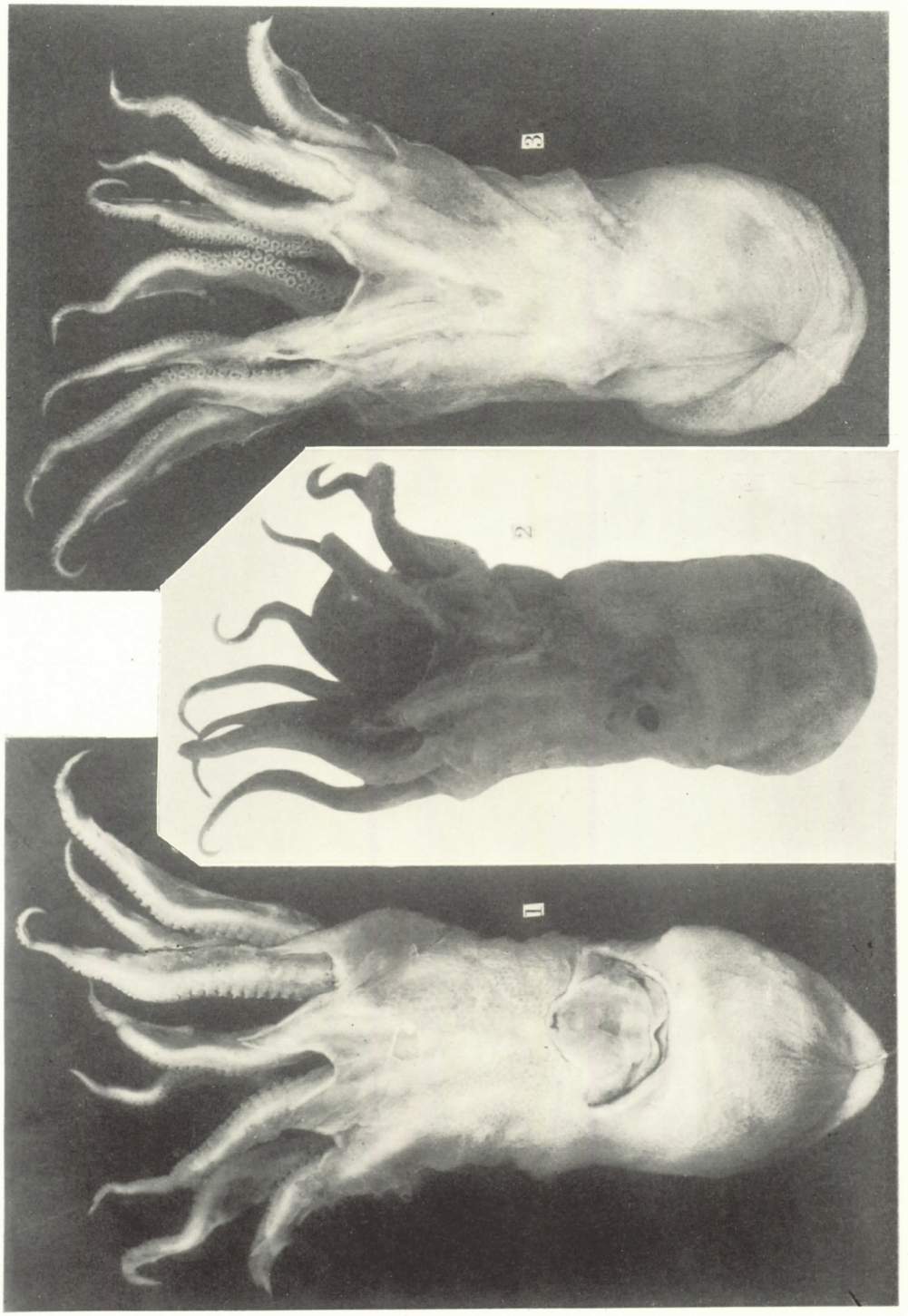

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Plate 3

Opisthoteuthis japonica TAKI 1, aboral; 2, oral surface of type-specimen. ×0.65

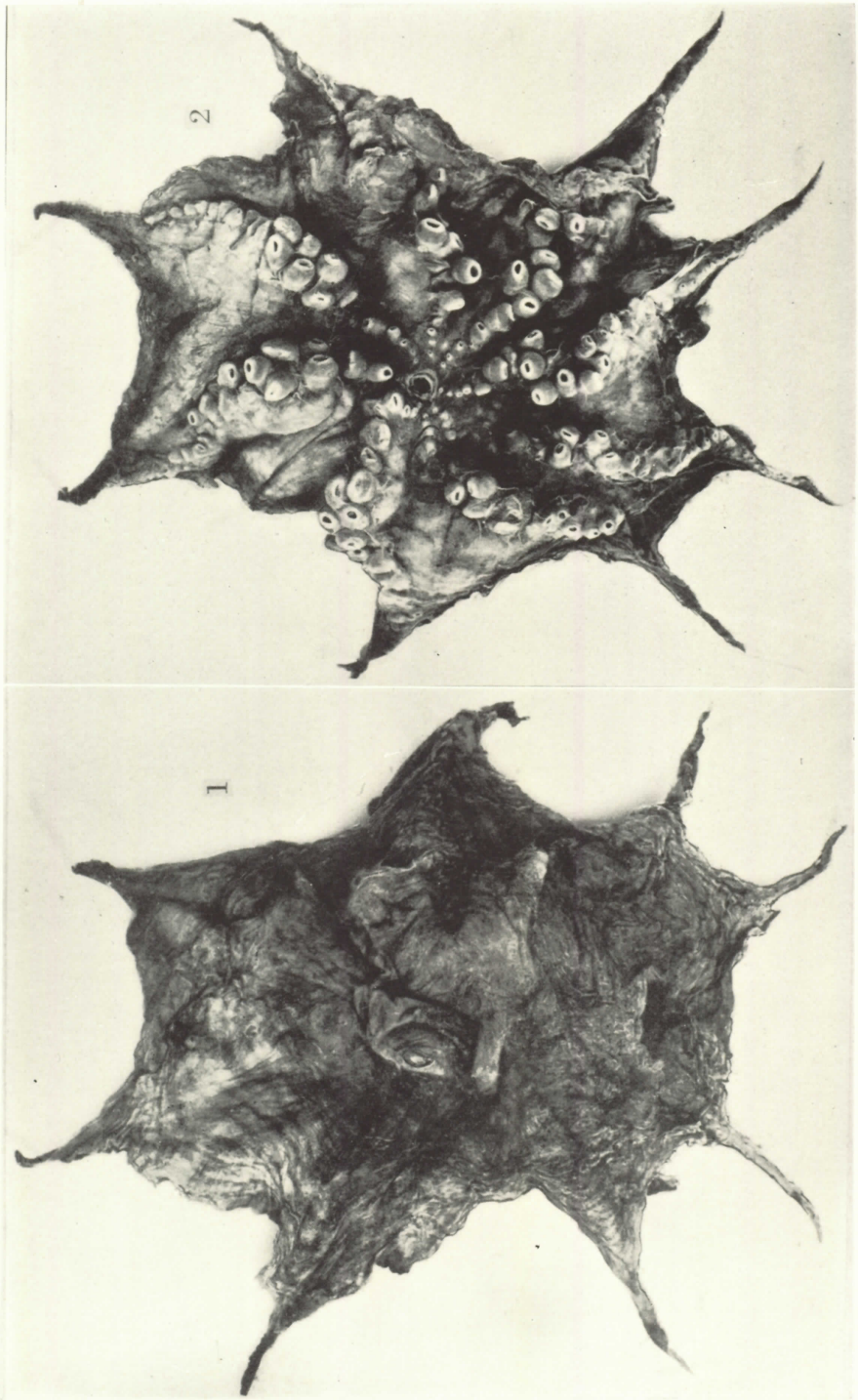

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Plate 4

Opisthoteuthis californiana BERRY

Mature male (specimen A): 1, aboral; 2, oral surface. Scale 20 cm. × ca. 0.36

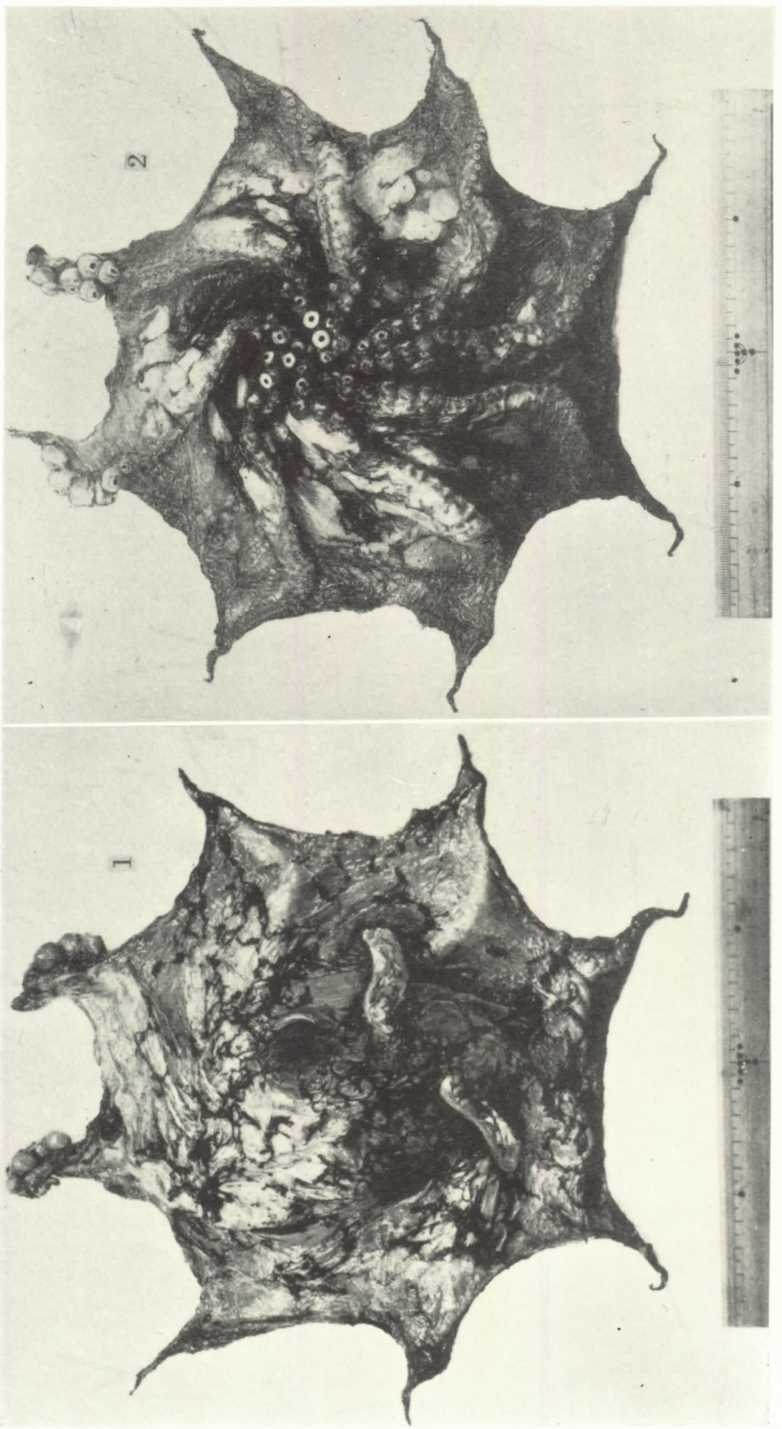

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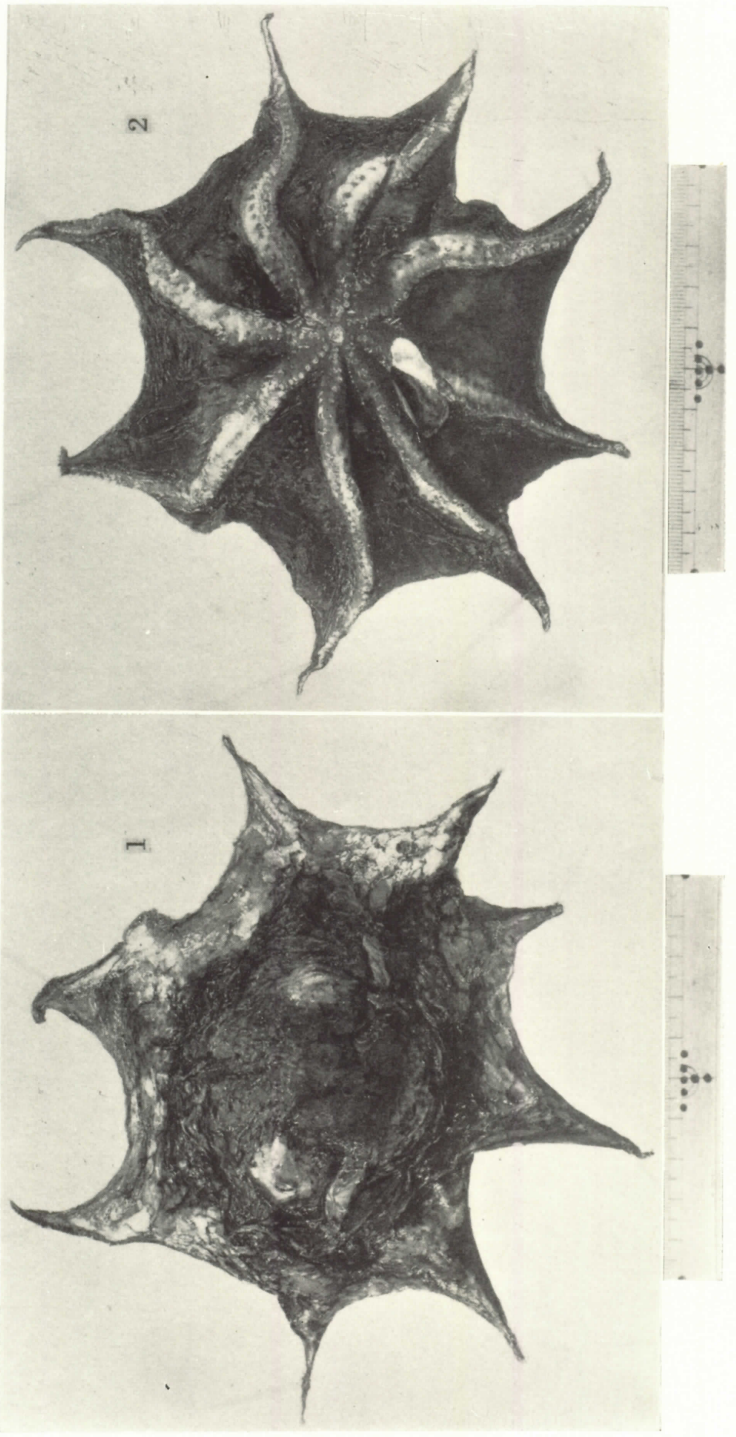
Plate 5

Opisthoteuthis californiana BERRY

Juvenile female (specimen C). Note the epidermis which is preserved almost intact. 1, aboral; 2, oral surface. Scale 10 cm. × ca. 0.54



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