

On Two New Eledonid Octopods from The Antarctic Sea

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(Pls. 1—3; Text-figs. 1—16; Tables 1—3)

During her observatory cruise of the research vessel "Umitaka-maru" attached to the Tokyo University of Fisheries to the Antarctic Sea in 1957, three specimens of Eledonid octopods were obtained, together with some benthic invertebrates, with the beam-trawl by Prof. Jirô SENÔ, of the same University, somewhere near the "Shôwa Base" of the Antarctic Observatory Party of Japan. They were handed over to me for specific identification in 1960. It was revealed that the largest specimen out of these three represents a new subfamily, new genus and species, namely, Megaleledoninae, *Megaleledone senoi*, and two smaller specimens, a new species, *Pareledone umitakae*. The descriptions of these two species, accompanied by some morphological and zoogeographical considerations, are embodied in the present report.

I wish to express my cordial thanks to Prof. SENÔ by whose kindness I could have an opportunity of observing so rare specimens, hitherto inaccessible in Japan. Dr. Shirô MURAKAMI, Saikai Regional Fisheries Research Station, Nagasaki, kindly tried to identify the broken pieces of Ophiuroid animals contained in the stomach of *Megaleledone senoi*, to whom I am much obliged. My thanks are also due to Dr. Katura OYAMA, of the Geological Survey of Japan, Tokyo, who was kind enough to lend me some important literatures. In both 1960 and 1961 my study on these specimens has been assisted by a grant of Scientific Testing Research from the Ministry of Education, for which I am very grateful.

DESCRIPTION OF THE SPECIES

Family Octopodidae

Subfamily Megaleledoninae, new subfamily

Genus *Megaleledone* TAKI, new genus

An eledonid of a great size; mantle wider than long, ink-sac small, crop absent; rhachidian tooth of radula symmetrical, unicuspid. Ovarian eggs large.

Type-species: *Megaleledone senoi*, TAKI, new species. (*megalē*, Gr. large, great, big.)

*Megaleledone senoi*¹⁾ TAKI, new species

(Pls. 1—2; Text-figs. 1—8, 16)

General appearance: Body generally plump, rather soft, surface smooth without

1) It is my pleasure that I name this species in honour of Prof. SENÔ who collected this valuable specimen.

any dermal sculpture, though irregularly wrinkled due to the action of the preservative. Integument is thick and flabby, quite loose and easily dislocated here and there to form wrinkles, though muscular tissue rather firm. Light purplish brown (light 'Hydrangea red') in colour, paler on the ventral side of body.

One specimen, female.

Locality: 67° 51.5' S., 33° 13.5' E. Depth: 630–680 m.

Date: 7. Feb., 1957. 16.01–17.50 (Hour).

Gear: Beam-trawl. R.V. "Umitaka-maru."

Measurements: (cf. ROBSON 1929; PICKFORD 1945)

Total length: 460 mm.

Weight: 2860 g (measured just after capture)

Mantle length, dorsal 135 mm., ventral 102 mm.;

Mantle width 143 mm, index 106;

width of head 89 mm, index 66; sucker index 11; funnel length 25 mm., width of aperture 10 mm.

Arm:

No.	Left			Right		
	length mm.	diam. largest sucker mm.	no. sucker	length mm.	diam. largest sucker mm.	no. sucker
1	281	14	62	278	14	61
2	255+a	14	35+a	292	14	63
3	285	14	61	280	15	62
4	280	14	61	295	15	63

Web-depth:

		Left mm.	Right mm.
Sector	A	108	
	B	130	120
	C	125	120
	D	116	102
	E	90	

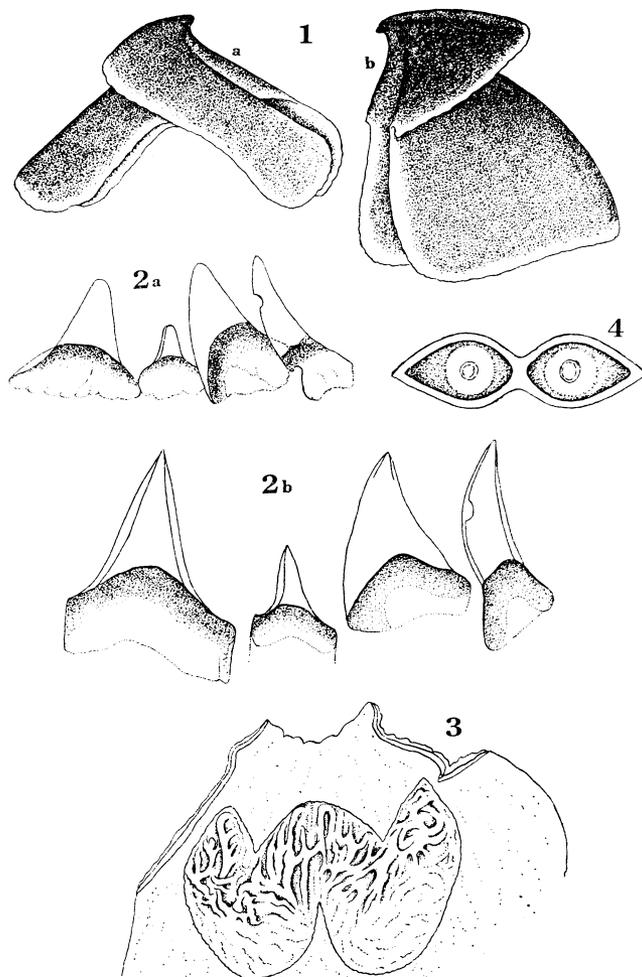
Gill: No. primary leaflet

Left		Right	
inner	outer	inner	outer
11	11	12	11

Mantle and head: Mantle is transversely ellipsoid in outline (width index 106). This is not due to the post-mortem deformation of the specimen in the preservative, as actually witnessed by Prof. SENÔ who collected it. The mantle opening is very wide. Head is narrower than mantle; no ocular cirrus observed.

Arm: Generally squat and big, their length subequal, namely, 4. 2. 3. 1, the longest arm is 64% in the total length and mantle-length is 46% in the length of longest arm. Web is well developed, its order is B. C. D. A. E., and the depth of the deepest sector is 44% of the longest arm.

Sucker: Uniserial, relatively large, its greatest diameter is 11% in the mantle-length, and its number is fairly numerous.

Text-figs. 1-4. *Megaleledone senoi* TAKI, n. g. et sp.1 a, lower mandible; b upper mandible, \times ca. 1;2. Radula; 2a, 4th row; 2b, 29th row. \times ca. 50.3. Funnel-organ, cut open. \times ca. $\frac{3}{4}$.4. Statocyst, cut open, ventral view. \times ca. 1.1.

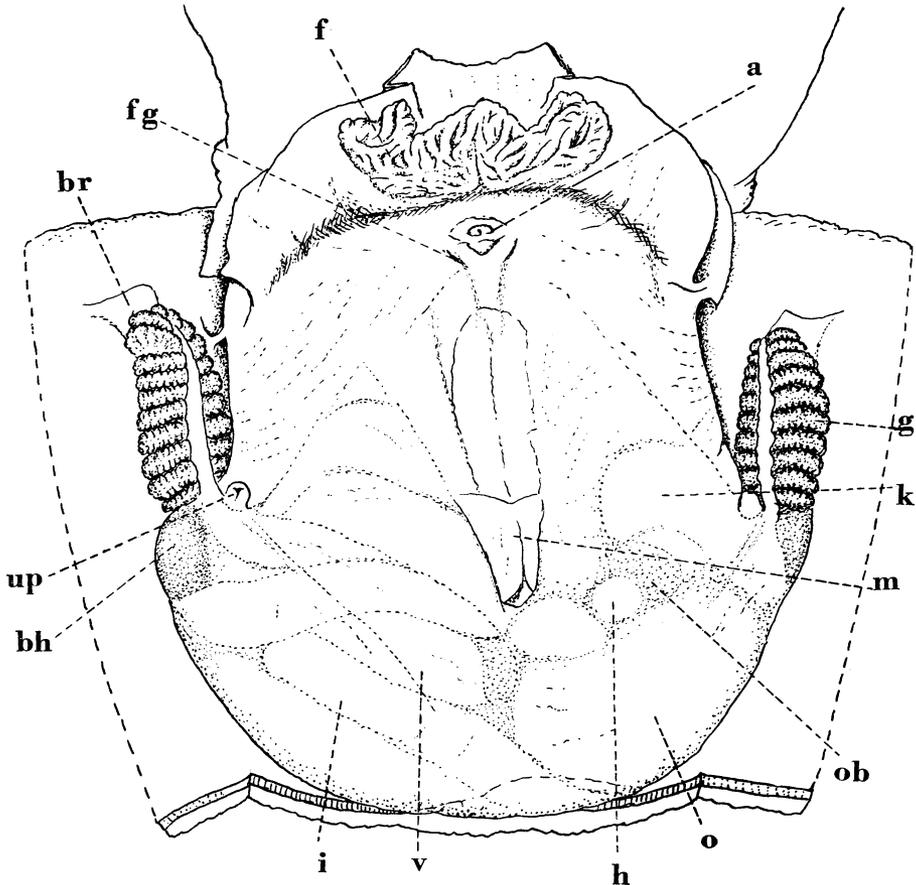
Funnel (Text-fig. 3): Wide and squat; funnel-organ W-shaped, its limb is exceedingly wide, so that the two anterior and posterior sinuations are very shallow. The organ is quite shrunken to produce many deep wrinkles on the anterior half area, but quite low and the boundary between it and the neighbouring integument is rather indistinct.

Buccal bulb: Roughly spherical, though somewhat elongated dorso-ventrally, measuring ca. 40 mm wide, 45 mm high and 40 mm long. Mandibles (Text-fig. 1) are well developed, both rostra quite stout, with a blunt apex and deep black in colour. Ala of lower mandible wide and long, 33×16 mm on each side, jugular

lamina 31 mm long and 12 mm wide. Rostrum of upper mandible incurved and its apex rounded owing to abrasion, frontal lamina 20 mm long and 24 mm wide on each side, palatine lamina 38 mm high and 29 mm long at the base.

Radula (Text-figs. 2a, 2b): Quite large; when extended it measures 9 mm in width. Anterior part of the radula is rather small and tip of each cusp of teeth blunt, probably due to the abrasion by rasping action. Teeth transparent, very faintly brown in colour, the thickened base dark brown.

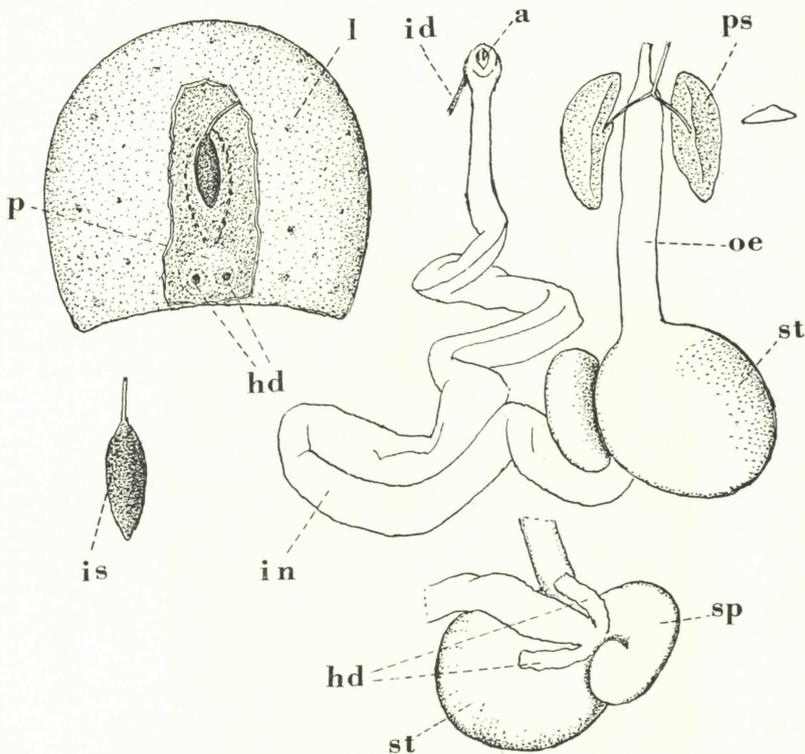
The 4th row (2a): Rhachidian rather low, with a blunt cusp and moderately wide base; cusp of first lateral rather wide and blunt, with a thin and narrow blade on its inner margin; second lateral quite large in comparison with the other teeth, with a blunt cusp, its inner margin faintly arcuated; third lateral rather narrow and long, gently arcuated with a blunt apex, a small elliptical notch at the middle of the inner margin of the cusp as well as at the inside of the base.



Text-fig. 5. *Megaleledone senoi* TAKI, n. g. et sp. Ventral view of the viscera, mantle and funnel cut open, ca. half nat. size.

a, anus; bh, branchial heart; br, branchial gland; f, funnel-organ; fg, female genital opening; g, gill; h, arterial heart; i, intestine; k, kidney; m, mantle septum; o, ovary; ob, left oviducal ball; up, urinary papilla; v, right vagina.

The 29th row (2b): Teeth generally larger than those of the anterior part. Rhachidian thin and long, with a sharply pointed cusp, and a thin blade on both sides, base wide, roughly pentagonal; first lateral long and pointed, a thin blade at its inner margin, base wide, with a small and low process at its inner margin, which does not develop into an ectocone anywhere in the radula; second lateral wide and rather pointed, blade very narrow and short, base wide; third lateral wide and long, a thin blade on both sides, with a small notch at its inner margin (this notch can be observed throughout the right third lateral up to 48th row, though no such peculiar incision exists on the left side.) No marginal plate.



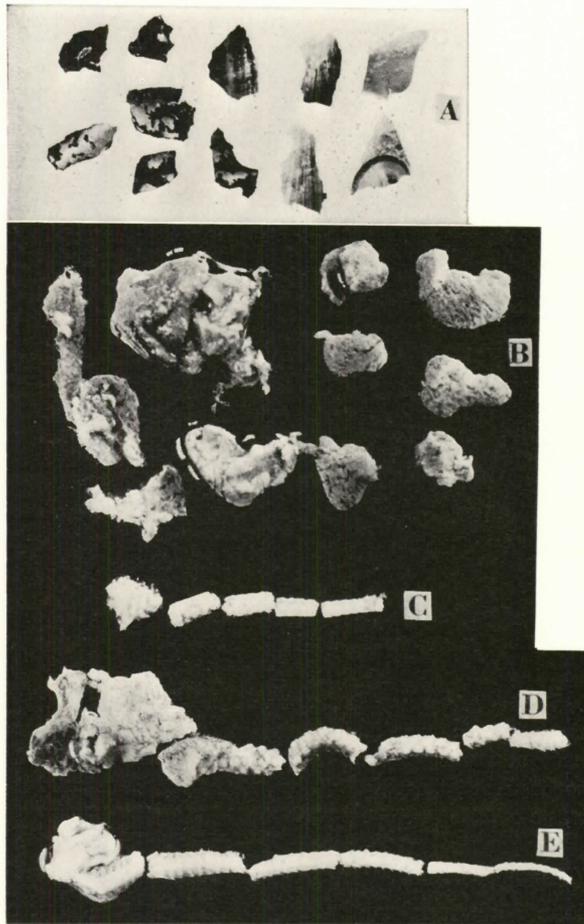
Text-fig. 6. *Megaleledone senoi* TAKI, n. g. et sp. Alimentary canal, \times ca. 3/5.
 a, anus; h, hepatic duct; id, ink-duct; in, intestine; is, ink-sac; l, liver;
 broken line at the centre shows the outline of ink-sac imbedded in the liver;
 oe, oesophagus; p, pancreas; ps, posterior salivary gland, and its cross section;
 st, stomach; sp, spiral caecum.

Oesophagus (Text-fig. 6, oe): anterior part 6 mm wide and 18 mm long, but posterior part widened, 15 mm long, nearly cylindrical, without any particular diverticle which can be discriminated as a crop.

Posterior salivary gland (ps) ellipsoid and flat, 33 mm long, 15 mm wide and 4 mm thick, discoloured in ashy brown, somewhat resembling the colour of the liver, perhaps due to the post-mortem oxidation of the tissue. Such discolouration, though in a weak degree, is usually met with in *Octopus vulgare*.

Liver (1) massive, of an enormous size, 82 mm wide and 70 mm long, roughly transversely oblong, completely covered with a thin muscular envelope, on which dark dots (1–5 mm in diameter) are sparsely scattered all over the surface; ink-sac (is) embedded at about the centre of the ventral side of the liver; pancreas (p) 20 mm wide and 15 mm long, shallowly bilobed at the posterior side, thin ashy buff in colour; through the tissue of pancreas two hepatic ducts (hd) pour into intestine at the junction between it and the spiral caecum (sp).

Ink-sac (is): A part of its surface appears as a fusiform, 7 × 21 mm in size, on the ventral surface of the liver, but its bulk is buried therein, the total sac measuring 13 × 27 mm in size, which is fusiform tapering to both the anterior and posterior ends, connected with a slender stalk (id) to the dorsal side of the anus.



Text-fig. 7. Stomach contents of *Megaleledone senoi* TAKI, n. g. et sp., ca. nat. size.

- A. Thin scaly pieces of unknown origin.
- B. Yellowish brown, amorphous masses of unknown origin.
- C. Broken arms of Ophiuroidea (genus *Stegophiura*?).
- D. The same (subfamily Ophiomastinae).
- E. The same (*Ophiura* sp.).

Stomach (st) roughly spheroidal, 55 mm wide, 42 mm long and 37 mm thick; it was tightly filled with food to form a compact mass which weighed 19 g in all. The solid contents excluding fluid (Text-fig. 7) consist of (1) chalky white calcareous pieces, ca. 5–15 mm long, which are broken arms of the Class Ophiuroidea, together with part of their discs irregularly cut; they were examined by Dr. Shirô MURAKAMI as follows: (Text-fig. 7, C): A species quite akin to *Stegophiura*, judged by the broken pieces of arms whose spines were lost; (D) A species referable to the subfamily Ophiomastinae of the family Ophiolepididae: it is nearly impossible to determine the genus, because the specimens lack the oral parts, though they are represented by the broken pieces of arms equipped with spines and broken aboral parts of discs. (E) A species referable to the genus *Ophiura*, the specimen being provided with imperfectly preserved oral parts.

(2) (B) yellowish brown amorphous, apparently gelatinous masses of unknown origin;

(3) (A) dark brown or light yellowish brown, thin transparent or semitransparent, scaly pieces of irregular sizes, of unknown origin.

It is not possible to know the nature of (2) and (3), but may be of animal matter.

Intestine (in): Wall very thin and soft, with about 4 loops in its entire course, the widest part about 25 mm wide, containing within numerous buff coloured small grains. They are fine, about 1 mm or less in diameter, including white grains and very short tubes. It is sure that the contents of intestine are consistently the same as those of the stomach, though in a much smaller size, before they are digested into a fluid state.

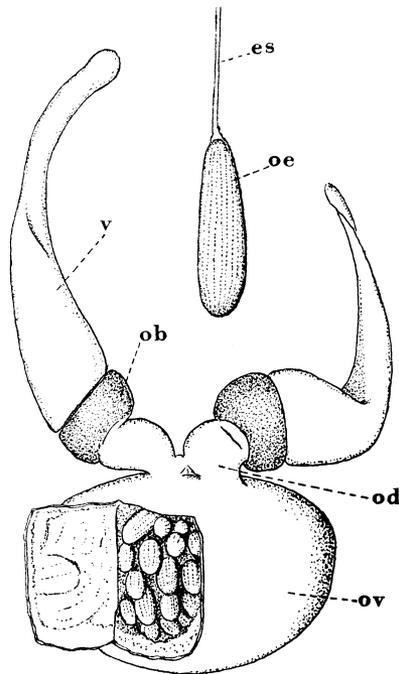
Rectum: About 7 mm wide, its wall is rather thick and firm in consistency, ending at a swollen part, which is ca. 14 mm wide when depressed.

Anus (a): No particular valve is seen on the margin of the anal opening, the margin being minutely incised; but there are three longitudinal short wrinkles on the inside of the dorsal wall.

Female genital organ (Text-fig. 8): Ovary large, depressed spherical in outline as imbedded in the viscera, 56 mm wide and 43 mm long; capsule rather firm, muscular, 0.5 mm thick, the interior of which is wholly invested with soft, loose delicate tissue, which is 1–2 mm thick. Female gonoduct as a whole 88 mm long, oviducal ball 11×17 mm, oviduct is rather short, ca. 8 mm long, vagina 68 mm long, widest at the proximal part (17 mm) and narrowest at the anterior $2/3$ of the vagina; left vagina is shorter than the right one, while the left oviducal ball is larger than the right one.

Ovarian eggs seem to be of a matured size: each egg 5.5×17 mm (13% of the mantle-length), stalk 14 mm long, and ca. 50 eggs contained, but several smaller ones are found among them.

Statocyst (Text-fig. 4): examined by dissecting from the ventral side: each cyst ovoidal, 13 mm wide and 8 mm high, rounded at the inner margin and tapers outwardly; no papillae found in the interior of the cyst; there is a spherical, thin, transparent jelly-like capsule at the centre of the cyst, which contains in turn a smaller



Text-fig. 8. *Megaleledone senoi* TAKI, n. g. et sp. Ventral view of female genital organ. $\times 2/3$.
 es, egg stalk; ob, right oviducal ball; od, left oviduct; oe, ovarian egg;
 ov, ovary, part of its capsule cut open; v, right vagina.

spherical delicate capsule at its centre. No calcareous statolith is found. The animal has been preserved in formalin solution since its capture in 1957, but the contents of both stomach and intestine, which contained Ophiuroid skeletons, were not decalcified. It is surmised that the statolith, if it is actually present, may not have been decalcified in this specimen, as it is protected by a rather thick wall composed of a cartilage. In short, no statolith exists in this species.

Branchial gland (Text-fig. 5, br): the right glandular tissue, the capsule being peeled off, measures 55 mm long, 16 mm wide and 9 mm thick, weighs 4 g. The ratio to the body weight (2860 g) of the gland on both sides (8 g) is 0.00280.

CONSIDERATIONS ON THE MORPHOLOGICAL CHARACTERS OF *MEGALELEDONE SENOI*

Size of animal: It is worth while to note that *Megaleledone senoi* is very great in size in comparison with the members of allied genera as shown in Table 1. Namely, members of *Eledone* is the largest and *Megaleledone* comes next, the rest is generally rather small. This is, needless to say, a mere comparison of linear measurement, and *Megaleledone* is so squat and big that in this group it may come at a high rank in the weight of animals. I cannot compare the weight as such data

Table 1. Comparison of total length, mantle length and length of longest arm in Eledoninae, Bathypolypodinae and Megaleledoninae; in each item maximum value is adopted.

* Approximate value calculated from the description or estimated from the figure on plate.

Subfamily	Genus	Species	Total length mm	Mantle length mm		Length of longest arm mm	Author
				dors.	vent.		
Megaleledoninae	<i>Megaleledone</i>	<i>senoi</i>	460	135	102	295	TAKI 1961
Eledoninae	<i>Eledone</i>	<i>moschata</i>	170	45	—	135	JATTA 1896
		<i>cirrosa</i>	558 ¹⁾	160	—	360	ISGROVE 1909
	<i>Pareledone</i>	<i>charcoti</i>	96	—	32	60	JOUBIN 1905
		"	—	—	40	131	MASSY 1916
		<i>turqueti</i>	42	—	15	28	"
		<i>polymorpha</i>	(200)*	56	—	(148)*	ROBSON 1930
		<i>harrissoni</i>	336	78	—	248	DELL 1959
		<i>adelieana</i>	110	—	25	76	BERRY 1917
		<i>antarctica</i>	—	—	100	180	THIELE 1921
	<i>umitakae</i>	120	45	36	73	TAKI 1961	
	<i>Velodona</i>	<i>togata</i>	(430)*	111	—	(300)*	CHUN 1915
		<i>togata capensis</i>	—	60	—	78	ROBSON 1932 ROBSON 1932
	<i>Tetracheledone</i>	<i>spenicirrus</i>	—	42	—	81	VOSS 1955
Bathypolypodinae	<i>Bathypolypus</i>	<i>arcticus</i>	215	66	—	78	ROBSON 1932
		<i>lentus</i>	—	60	—	?69	"
		<i>obesus</i>	—	72	—	66	"
		<i>sponsalis</i>	—	39	—	77	"
		<i>salebrosus</i>	153	—	40	100	SASAKI 1929
		<i>valdiviae</i>	—	34	—	71	ROBSON 1932
		<i>grimpei</i>	—	40	—	72	"
	<i>Graneledone</i>	<i>challengeri</i>	—	(93)*	—	(165)*	HOYLE 1886
		<i>verrucosa</i>	—	100	—	85	VERRILL 1881
		<i>verrucosa media</i>	—	ca. 86	—	76	ROBSON 1932
		<i>setebos</i>	—	—	170	220	MASSY 1916
	<i>Thaumeledone</i>	<i>brevis</i>	55	—	15	35	HOYLE 1886
		<i>gunteri</i>	(100)*	36	—	(57)*	ROBSON 1930
	<i>Bentheledone</i>	<i>rotunda</i>	165	—	45	110	HOYLE 1886
		<i>albida</i>	170	35	—	129	BERRY 1917

1) JAECKEL (1958, p. 562) gives the maximum length 105 cm, average 38 cm.

are not available in the literature.

Form of mantle: In members of Eledoninae, it is more or less ovoidal or somewhat spherical, and transversely elongated form is rather rare. This species resembles *Graneledone setebos* ROBSON (ROBSON 1932, p. 313) of the subfamily Bathypolypodinae, in the broadness of mantle, though it is known by only a single, man-

gled specimen (width-index 120: this species 106).

Radula: In *Pareledone*, the rhachidian tooth is pentacuspoid or tricuspoid in *P. turqueti*, *harrissoni* and *polymorpha*, unicuspid in *adelieana* and *charcoti*, but all of them have a second lateral with a wide base and low cusp. *Graneledone setebos* ROBSON (cf. MASSY 1916, p. 160, fig. 33), which has the most similar radula to the present species, differs from the present species by the fact that its third lateral has a rather wider base and lower cusp than this species. ROBSON (1932, p. 134) remarks on the radula of *Graneledone* that "the simplicity and uniformity of the teeth being in my opinion definitely archaic."

In the subfamily Bathypolypodinae, in *Bathypolypus articus* and *B. sponsalis* the rhachidian is unicuspid, but the first and second laterals are very wide, in *Graneledone challengerii* the rhachidian is tricuspoid and the second lateral has a wider base in comparison with *Megaleledone senoi*.

The radula of *Megaleledone senoi* is characterized as follows:

- (1) rhachidian unicuspid;
- (2) first lateral is equipped with a well-developed cusp;
- (3) second lateral has a comparatively narrow base and long cusp;
- (4) third lateral has a narrow base and rather straight cusp;
- (5) marginal plate missing.

In the present species, the mandibles, radula, stomach, liver and intestine are well-developed; especially the presence of as much food matter as the stomach can contain and also the fact that the whole body is muscular with arms having rather large suckers show that the animal is quite active and voracious in habit.

The wideness of mantle opening is related to the littoral habit of the animal (ROBSON 1926).

Food: Though the octopod is predatory and carnivorous in its food habit, the range of food is rather wide (Foraminifera, Polychaeta, Crustacea, Mollusca, and fish, exceptionally sea-weed: MASSY 1916; ROBSON 1929, p. 20; 1932, p. 22). However, so far as I am aware, there has been no record of Ophiuroid animals as food of Eledonid octopods. The present case may be an unusual food for the Octopoda in general, and it is surmised that the scarcity of fleshful animal species of a habit of sluggish movement in the Antarctica may have compelled this species to search animals having scanty flesh.

Alimentary canal: The absence of crop and the smallness of the posterior salivary gland, spiral caecum and ink-sac seem to suggest that the animal in question has a tendency to be of deep-sea form (cf. ROBSON 1926). However, no substantial atrophy is seen in the respiratory as well as circulatory organs. The branchial gland which is an organ of internal secretion (TAKI 1943) is of a normal or rather large size, and its ratio to body weight is a little greater than that of *Octopus vulgare*. I formerly showed that in three species of *Octopus* its ratio is greater in the larger species approximately proportionally to its body weight, and also it is greater in female than in male. Though this is a single case and the range of variation is not known, the fact that a large species and also a female is equipped with a heavy

branchial gland agrees well with the result observed in the genus *Octopus*. A conjecture might be allowed from the comparison of these figures that the branchial gland has an important bearing on the maturation of the ovary.

Ratio of branchial gland weight to body weight. Female.

<i>Megaleledone senoi</i>	<i>Octopus vulgare</i>	<i>O. minor variabilis</i>	<i>O. ocellatus</i>
0.00280	0.00247	0.00191	0.00156

Female genital organ: The ovary with its matured eggs, oviducal ball and vagina of this species are of a great size not comparable to any of those of hitherto known species of subfamilies Eledoninae and Bathypolypodinae. The greatness of the ovarian egg leads necessarily to the reduction in the number of eggs, and it is

Table 2. Comparison of characters of four subfamilies of Octopodidae.

Characters		Octopodinae	Eledoninae	Bathypolypodinae	Megaleledoninae
Form of mantle		oblong or oval	oval or spherical	oval or transversely oval	transversely oval
Mantle aperture		wide	wide	narrow	wide
Ink-sac		present : well-developed	present : well-developed	absent	present : abortive
Arm-length : index		long or moderately long 63-90%	moderately long 67-81%	short or rather short 63-85%	short 64%
Sucker	arrangement	biserial or triserial	uniserial	biserial or uniserial	uniserial
	size index	large 5-14%	large 8-11%	small 4-10%	large 11%
Web-depth : index		shallow 4-42%	shallow 16-40%	deep 25-68%	deep 44%
Crop		present	present	reduced or absent	absent
Eggs and vaginae		small	small	large	large
Radula	rhachidian	penta-, tri-, or unicuspid	penta-, tri-, or unicuspid	unicuspid	unicuspid
	1st lateral	cuspid low, base wide	cuspid low, base wide	cuspid low, base wide, or cuspid high, base narrow	cuspid high, base narrow
	2nd lateral	cuspid high, base wide	cuspid high, base wide	cuspid high, base wide or narrow	cuspid high, base narrow
	3rd lateral	cuspid long, curved	cuspid long, curved	cuspid long, curved	cuspid long, straight
	marginal	present	present	absent	absent
Depth of habitat		mostly littoral	mostly littoral	abyssal	archibenthal

legitimately expected that an exceedingly large young will hatch out from such an egg.

The large size of the oviducal ball and oviduct may perhaps have a close relation to the production of large eggs.

The oviducal system is of asymmetrical construction in the Cirrata, "the left hand members alone are found (ROBSON 1932, p. 15), while it is symmetrical in Incirrata which includes the majority of Octopod species. In the present species the right oviducal system is longer than the left one. It may, therefore, be able to surmise that the asymmetrical structure found in this species is assigned to the transitory state toward the bilateral differentiation of the oviducal system, though I could find no particular differentiated structure in other organs in this species.

Subfamily relation: Though this animal was caught at a depth of archibenthal fauna, its morphological characters are nearly littoral and only a little modified for the adaptation to the life of deep seas. Characters of *Megaleledone* such as the mantle-aperture, sucker arrangement, gill size and number of filaments, have in common with the subfamily Eledoninae, but differ from it in the ink-sac, arm-length, crop, eggs and vaginae, web-depth, etc. While they are similar to subfamily Bathypolypodinae in the outline of mantle, arm-length, crop, eggs and vaginae and web-depth, but fairly different in the mantle aperture, gill size and number of filaments.

The radular characters of this species somewhat resemble those of *Graneledone setebos*, which fact may show a racial affinity to that species, but it is difficult to place this species in Bathypolypodinae owing to various points of difference as given in Table 2.

In conclusion, it seems appropriate to establish a new subfamily to receive the present species as follows:

Subfamily Megaleledoninae, new.

Characters of the genus *Megaleledone*, n. gen., as given above.

Subfamily Eledoninae

Pareledone umitakae TAKI, new species

(Pl. 3; Text-figs. 9-16)

Two specimens, both males.

Locality, Date and Gear the same as *Megaleledone senoi*.

General appearance: Animal firm in consistency, but integument thin, soft and choroidal, mantle as broad as long; eye-ball extraordinarily voluminous, as seen from the dorsal side it is 15 mm long and 15 mm wide, leaving a narrow (ca. 6 mm) interspace between both eyes; a small ocular cirrus, 2 mm long and 3 mm high, is found at the posterior corner of the right eye-ball, the integument of the left eye being scraped off; arms short and slender as compared with the head and body taken together. Surface of integument apparently smooth, though weak, thin reticular wrinkles are discernible all over the surface under a lens.

Colour greyish reddish brown; a number of reddish brown patches are scattered

over the surface of which a large diamond-shaped (3.5×5 mm) patch is situated at the centre of the dorsal mantle, and a smaller one (2.5×3.5 mm) between both eyes, a smallest one (4.5×1.5 mm) at the middle of the dorsal side of eye-ball, and an irregular-sized one (3×3 mm) between the anterior margin of both eyes; numerous minute patches (ca. 0.5 mm in diameter) are sparsely scattered all over the surface of body and arms. Ventral surface of head, mantle, arms and webs is light greyish purplish red.

Mantle-aperture very wide; no peripheral keel.

Funnel-organ (Text-fig. 13) **W**-shaped; the central part rather wide (2.5 mm), but anterior parts of outer and inner limbs taper up to the extremity.

Gill-leaflet 8 in both the inner and outer demibranchs on each side.

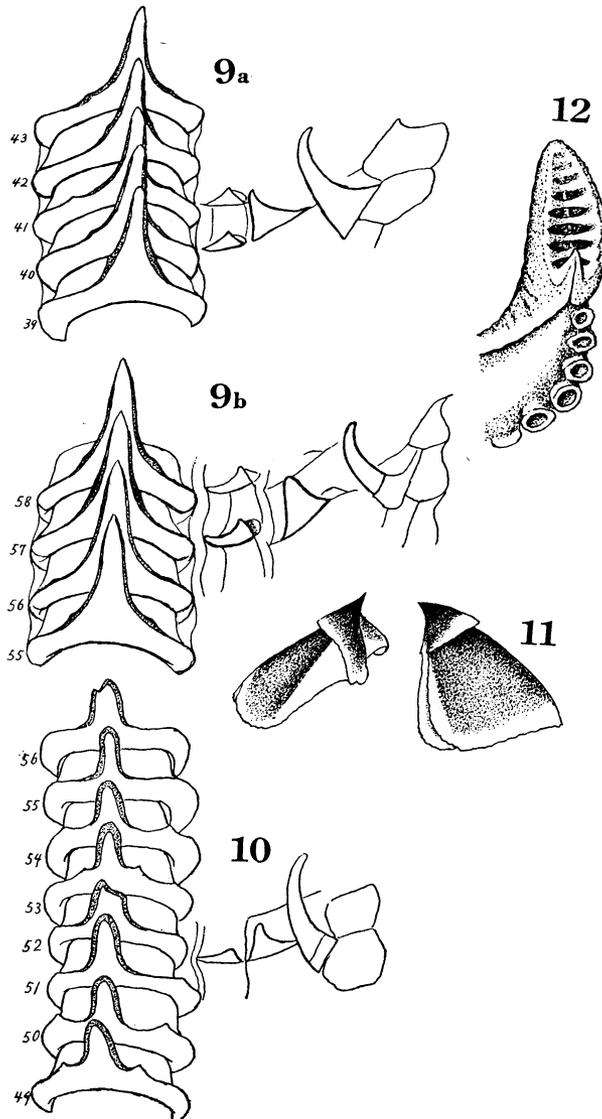
Upper mandible (Text-fig. 11b): Rostrum blackish brown, 1.7 mm long, rather sharply pointed, with a thin margin posteriorly, palatine lamina dark brown, with a thin margin ca. 1 mm in width. Lower mandible (Text-fig. 11a): Rostral wing narrow, ca. 2.2×3.3 mm, protruded straight, not curved, jugular lamina quadrangular, a notch at the posterior centre, with a rather wide thin margin on both sides.

Radula (Text-fig. 9): Nearly symmetrical; rhachidian unicuspid, base very wide,

Specimen		A		B	
Total length		120 mm		37 mm	
Body weight		61 g		2.8 g	
Mantle-length		45(dors.), 36(vent.)mm		15(dors.), 13(vent.)mm	
Mantle-width		35 mm		15 mm	
Head-width		36 mm		14 mm	
Arm length	1	L	R	L	R
	2	65	63	20	21
	3	67	73	22	22
	4	70	63(h)	22	22
Arm formula		4.	3.	2.	1.
	A	18		7	
	B	19	21	7.5	7
	C	20	21	8	8
Web depth	D	21	23	7	7
	E	17		(broken)	
Diameter of largest sucker		4 mm		0.9 mm	
Arm-length index		61%		59%	
Mantle-width index		78%		100%	
Head-width index		80%		93%	
Web-depth index		31%		36%	
Mantle-arm index		62%		68%	
Sucker-index		5.5%		4.1%	
Ligula-index		12.7%		—	

with a rather long and acutely pointed cusp; a nearly inconspicuous swelling at the position of ectocone, which fades away gradually in a manner of A_3 seriation; first lateral very small, with a low triangular cusp at the outer side; second lateral rather low, with a flat, triangular cusp; third lateral small as compared with the rhachidian, base wide, moderately curved distally; marginal plate very thin, roughly hexagonal.

Arm: Length is subequal, especially in specimen B, its order 4.3.2.1 on the left side, and the index 61%. Suckers uniserial.



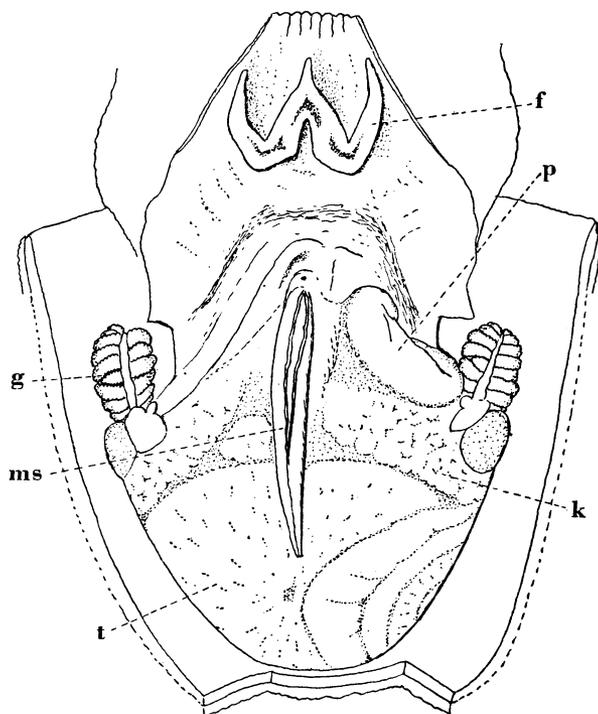
Text-figs. 9-12. *Pareledone umitakae* TAKI, n. sp. 9a, anterior; 9b, middle part of radula, $\times 65$; 10; radula of young specimen, $\times 260$; dotted area shows a thin blade on both sides of the cusp; 11, mandibles, $\times 3.3$; 12, hectocotylus, $\times 2.6$.

Web: Narrow, its index 31%, its order D.C.B.A.E.

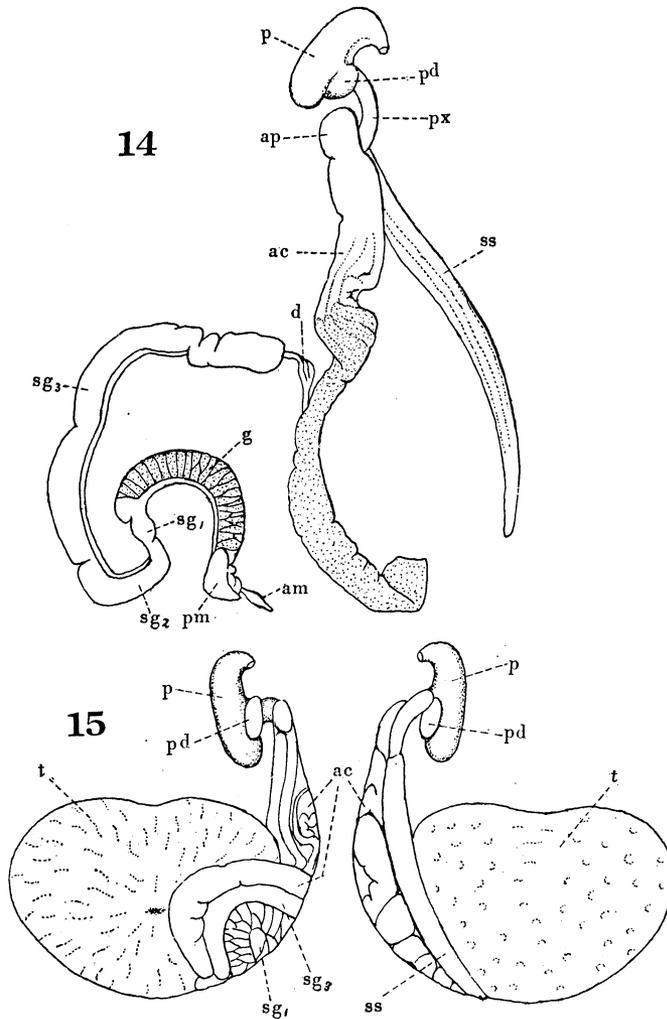
Hectocotylied arm (Text-fig. 12): Shorter than the arm on the opposite side; suckers number 28 in all, ligula 8 mm long and 4 mm wide, 8 very deep transverse grooves separating 7 bars; calamus 2 mm long. Ligula index 12.7%.

Male genital system (Text-figs. 14–15): Testis. When the male gonoduct system is liberated, the testis is roughly trigonal and depressed, the hilus portion being at the centre of the ventral side of it. Gonoduct. Proximal portion of vas deferens is slightly swollen (ampulla); in the succeeding part both the proximal massive region (pm) and the glandular part (g) seem to correspond to the vas deferens plus proximal spermatophoric gland in *Octopus* (cf. TAKI 1944). Next comes a rather smooth-walled spermatophoric gland (sg) of nearly equal caliber, which turns thrice, the distal part being widened in diameter. This part may be divided into three regions, namely the first, second and third (sg₁₋₃) according to the turning points and the internal structure.

The spermatophoric duct (d) is thin-walled and wrinkled. The accessory spermatophoric gland (ac) is glandular except the distal part, which is rather thin-walled and wrinkled longitudinally; the proximal part is rather flattened and abruptly crooked on the left side as in *Octopus*. Next, the "shunting duct" (ap) is nearly spherical, not pointed anteriorly. This is generally termed "spermatophoric duct," but it



Text-fig. 13. *Pareledone umitakae* TAKI, n. sp. Ventral view of viscera in situ, mantle and funnel cut open, $\times 2$; f, funnel-organ; g, gill; k, kidney; ms, mantle septum; t, testis.



Text-figs. 14-15. *Pareledone umitakae* TAKI, n. sp. 14. Male gonoduct system, $\times 2$. 15. Male genital organ, ventral and dorsal views, in situ. $\times 1.7$. ac, accessory spermatophoric gland; am, ampulla; ap, shunting duct; d, spermatophoric duct; g, glandular part of vas deferens; p, penis; pd, penis diverticle; pm, proximal part of vas deferens; px, proximal part of penis; sg₁, sg₂, sg₃, first, second and third regions of spermatophoric gland; ss, spermatophoric sac; t, testis.

is better to call it a shunting duct to avoid confusion with the same term which denotes the duct between spermatophoric gland and accessory spermatophoric gland. The spermatophoric sac is slender and generally tapers behind, no spermatophore is found within.

The proximal part of penis (px) is thick-walled, and penis diverticle (pd) rather small; penis (p) muscular and remarkably thick-walled, the distal part gently curved, with a small aperture at its end.

Table 3. Comparison between *Pareledone polymorpha* and *P. umitakae*.

Characters	<i>polymorpha</i>		<i>umitakae</i>
	<i>forma oblonga</i>	<i>forma affinis</i>	
Peripheral ridge of mantle	present		absent
Radula {second lateral third lateral	large, wide long, wide		small, narrow short, narrow
Web-depth	45-35% A=E	30-27% —	31% A>E
Arm	72-65%	—	61%
Sucker	7-8%	11.6-7%	5.5%
Hectocotylus	15-13.9%	17-9%	12.7%
Mantle	narrow and oblong 75-64%	wide 104-70%	rather narrow 78%
Head-width	69-61%	90-53%	80%
Type of mantle-aperture	B		A

Specimen B. Radula (Text-fig. 10): Rhachidian A₄ seriation, first lateral very low, otherwise similar to the adult specimen. But it is noticeable that the tip of the main cusp of rhachidian is shallowly bifid (Nos. 52 and 56), and each cusp is followed by a low mesocone of the next tooth. In the posterior part of the radula the rhachidian cusp is longer and more pointed.

ROBSON (1929, p. 14) did not "attach very great weight on the seriation in the diagnosis of species..." and says that "the rhachidian tooth of young forms may have different seriation than that found in old ones." Namely, no remarkable difference is found between radulae of specimens A and B.

Mandibles: So thin and weak in consistency that at dissection they were partly broken; lower mandible 2.3 mm long and upper one 2.5 mm long. Form as that of the adult.

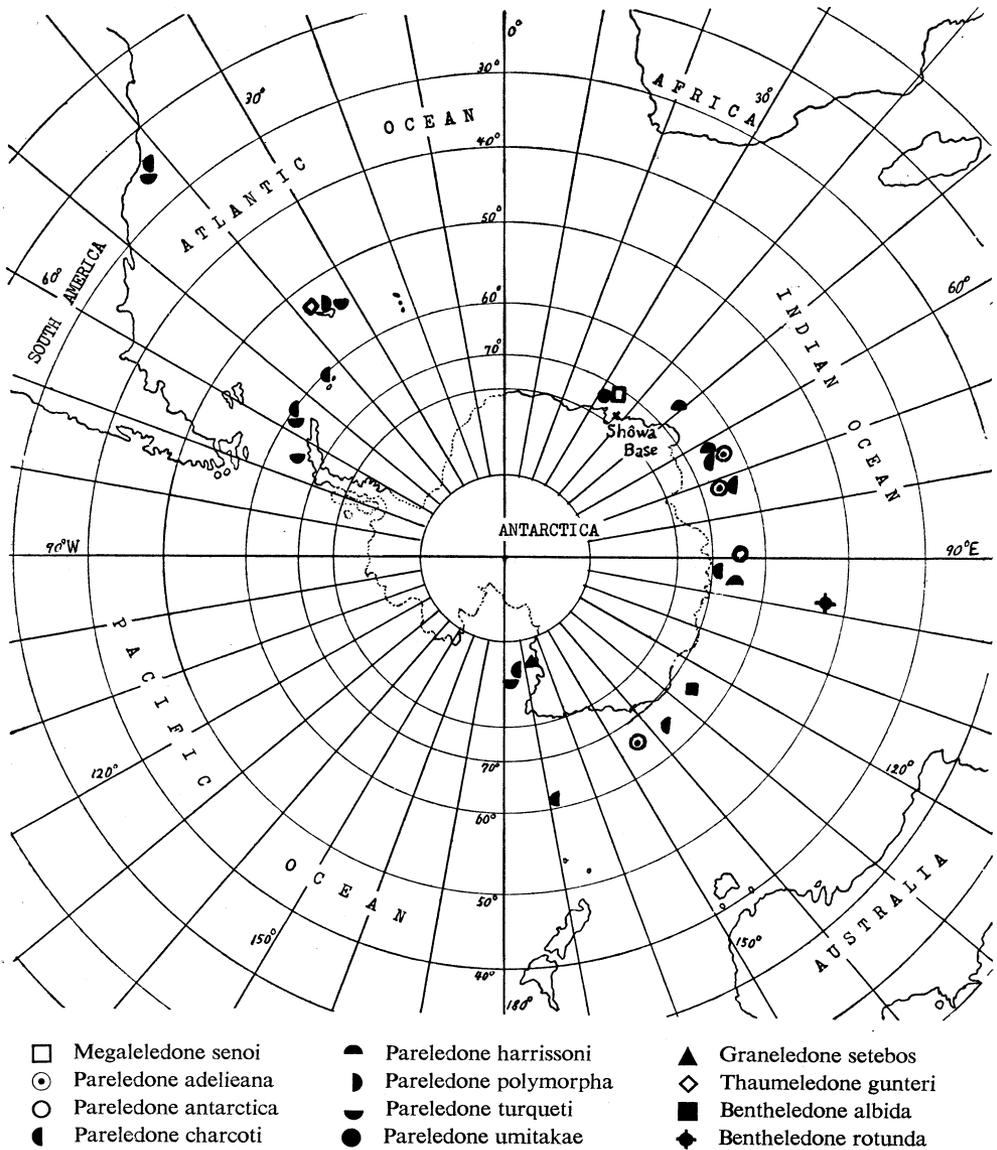
In this specimen the fact that (1) the colour of body is light, (2) body and integument is soft, (3) the arm is disproportionally short, (4) mandibles are soft and not thickened, (5) radula, (6) hectocotylus and (7) genital organs are in an undeveloped state, shows that it is a juvenile specimen. Also by the fact that it was obtained at the same haul as the specimen A, and radula, mandible, six kinds of indices of body proportions agree well with it, it is identified with this species.

Remarks: This species is placed in the genus *Pareledone* by the presence of unmistakable ligula and calamus. By the W-shaped funnel-organ this species differs from *P. charcoti* (= ? *aurorae*), *turqueti* and *harrissoni* which have VV-shaped one. *P. nigra* has very long arms (78%) and large (15%) suckers, and coloured nearly black; *P. adeliaeana* has a larger second lateral than the present species. In *P. antarctica* the suckers "have a zigzag arrangement, and are arranged far more like those of an *Octopus*" (ROBSON 1932, p. 280); also the arm is slightly longer (66-62%), hectocotylus is shorter (4.2%) than the present species; the order of web-

depth is $E > A$ in *antarctica* while $A > E$ in the present species.

Though many points of resemblance are found between *P. polymorpha* and this species, the following may be sufficient to distinguish the two, namely,

- (1) surface of body smooth, not tubercular;
- (2) peripheral ridge of mantle is absent;
- (3) mantle aperture is very wide;
- (4) arm is shorter;



Text-fig. 16. Map of the Antarctic and Subantarctic Regions in which localities of species of Eleudoninae, Bathypolypodinae and Megaleledoninae occurring therein are shown.

- (5) sucker is smaller;
 (6) second and third laterals of the radula smaller and narrower,
 as compared with that species.

This species is named in honour of the research vessel "Umitaka-maru" which brought back this specimen.

ZOOGEOGRAPHICAL CONSIDERATIONS

Cephalopod species hitherto known from Antarctic and Subantarctic Seas are recently listed by POWELL (1960), and localities of those belonging to subfamilies Eledoninae, Bathypolypodinae and Megaleledoninae are shown in Text-fig. 16.

The seas where both new species herein described were obtained have long remained unexplored by any expedition owing to their extremely unfavourable meteorological conditions for approaching all the year round. DELL (1959) subdivided the shores of the Antarctic Continent into 5 areas according to the longitude. According to him, two new species described here are included in the '5th area.'

I have already shown that *Graneledone setebos* is somewhat related to *Megeledone senoi* by the radular character which hold an archaic feature, but the locality of the former is situated at nearly the opposite side of the Antarctica to that of the latter. Namely, at present *Megaleledone* stands solitary zoogeographically.

Seven species are known in the genus *Pareledone* (ROBSON 1932), of which six species are confined to the Antarctic and Subantarctic Seas, and one species *P. nigra* occurs in South-west Africa. I have shown that *P. umitakae* is somewhat related to *P. polymorpha*, but the localities of both species are, so far known, very distantly separated, especially *P. umitakae* was obtained at a higher latitude than *P. polymorpha*. However, both *P. charcoti* and *P. turqueti* have a very wide range of distribution, the former covering 1-5 areas and the latter 1-3. In general, members of this genus are widely distributed in the South Atlantic, Subantarctic and Antarctic Seas and occurrence of species of an endemic nature at a particular habitat is rather rare, though our knowledge of the distribution is as yet quite unsatisfactory.

Members of *Pareledone* inhabit the sea of a wide vertical range: both *P. turqueti* and *P. charcoti* ranges from 24 m to ca. 1300 m; *P. nigra* in a shallow sea, *P. polymorpha* 15-270 m, *adelieana* and *harrissoni* ca. 600 m (*antarctica*, depth unknown). Thus, *P. umitakae* belong to a rather deep-sea inhabitant in this genus, which fact agrees with the softness of integument of this animal.

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EXPLANATION OF PLATES 1-3

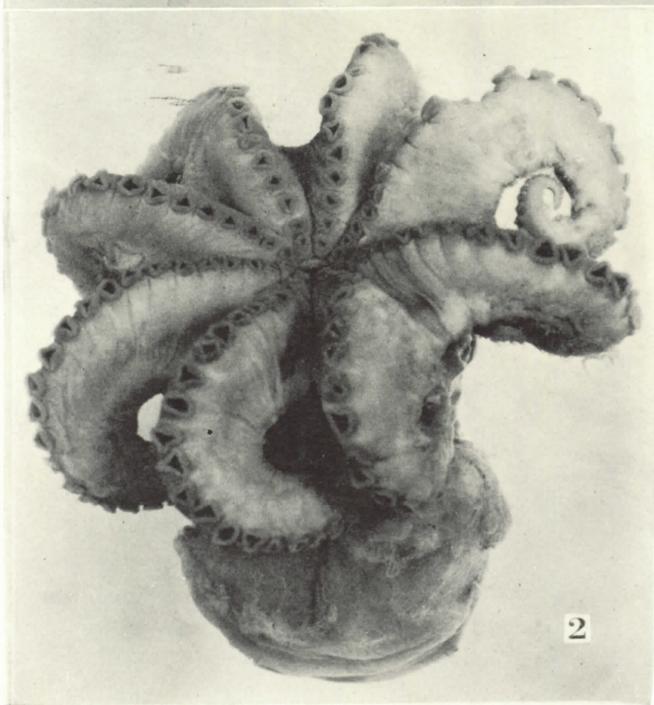
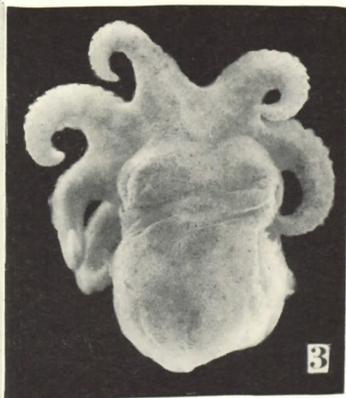
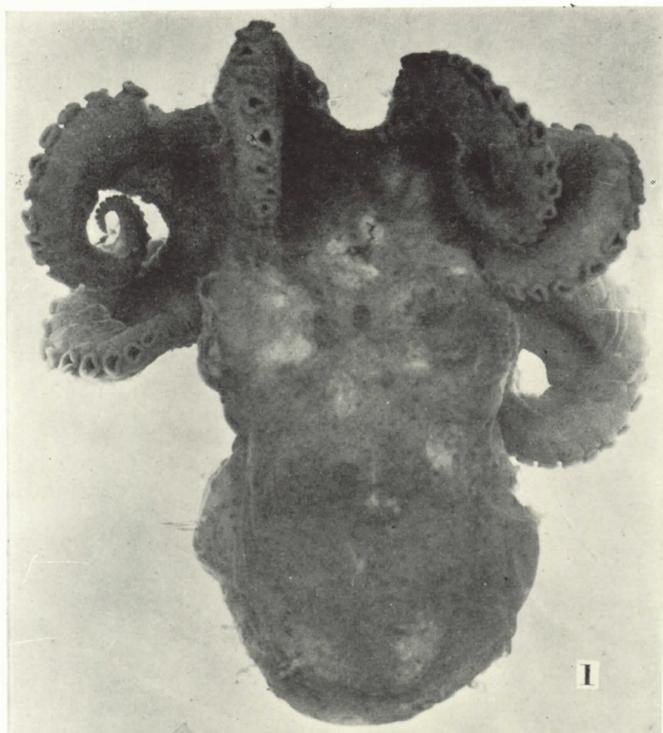
- Pl. 1. *Megaleledone senoi* TAKI, n.g. et sp. Dorsal view, \times ca. $\frac{1}{3}$.
- Pl. 2. The same, ventral view.
- Pl. 3. *Pareledone umitakae* TAKI, n. sp.
Figs. 1, 2. Dorsal and ventral views of adult specimen, ca. nat. size.
Figs. 3, 4. Dorsal and ventral views of young specimen, \times ca. 1.5.



TAKI: Eledonid Octopods from Antarctic Sea



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