



STATE OF ISRAEL
MINISTRY OF AGRICULTURE
DIVISION OF FISHERIES
THE SEA FISHERIES RESEARCH STATION



BULLETIN No. 26

CONTRIBUTIONS TO THE KNOWLEDGE
OF THE RED SEA

No. 16

CEPHALOPODA FROM THE GULF OF AQABA

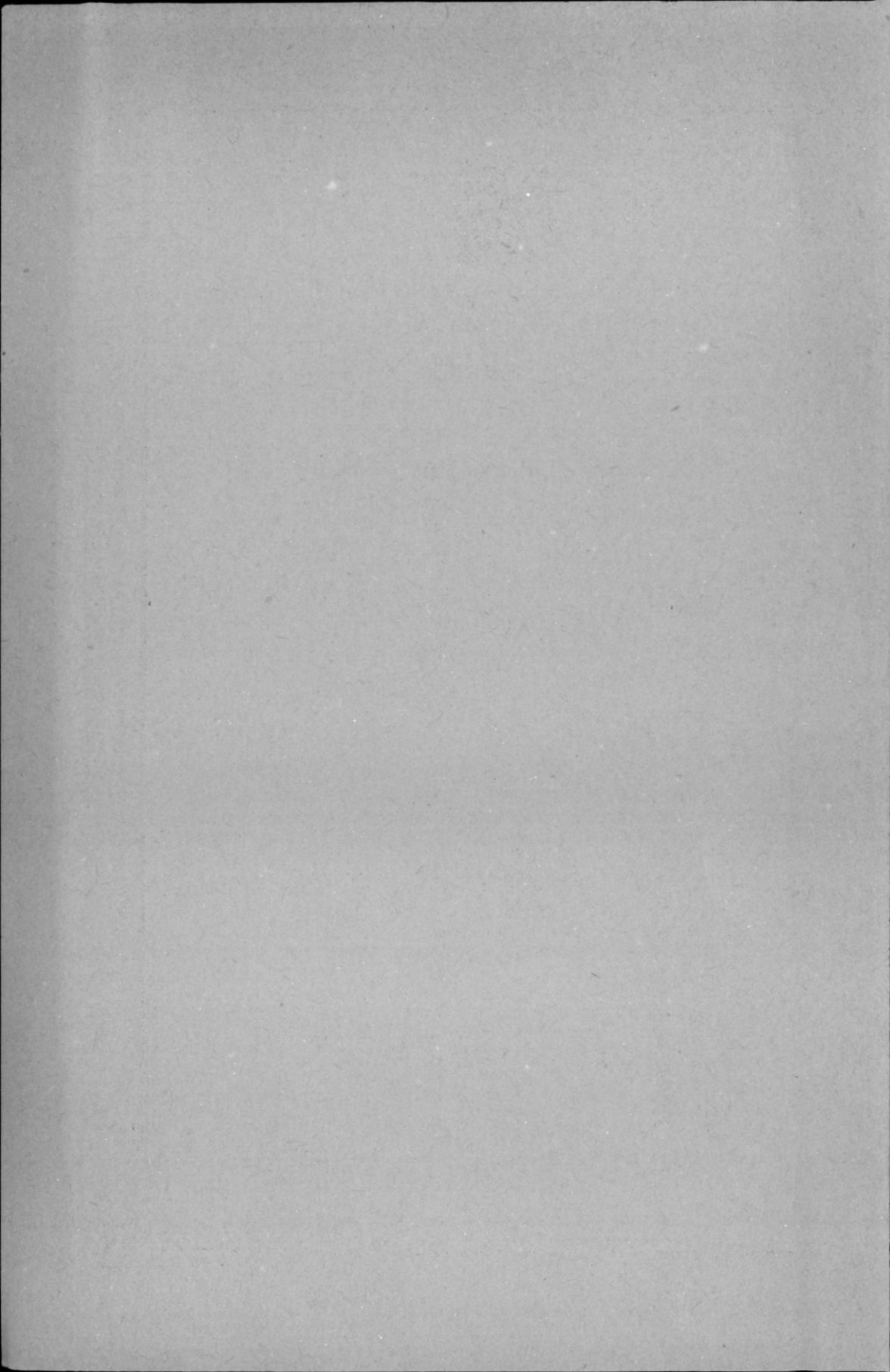
by

WILLIAM ADAM

Instituut Royal des Sciences Naturelles de Belgique, Brussels.

HAIFA, ISRAEL

JANUARY 1960





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CEPHALOPODA FROM THE GULF OF AQABA*

by

William ADAM

Institut Royal des Sciences Naturelles de Belgique, Brussels.

The small lot of Cephalopoda dealt with in this paper has been entrusted to me for study by Dr. H. STEINITZ, Department of Zoology, The Hebrew University of Jerusalem. The specimens have been collected in the Gulf of Aqaba (Red Sea), except one which comes from the Gulf of Suez.

The Cephalopods of the Red Sea have briefly been reviewed by the author in 1942. A detailed paper dealing with the Red Sea Cephalopoda, including illustrations has been published by the "Centre National de la Recherche Scientifique (Paris)". For a historical review of the subject, the reader should be referred to this paper (W. ADAM, 1959).

About 27 species of Cephalopoda have so far been reported from the Red Sea, but some of them are questionable or insufficiently described. About half of the species on record, are endemic. This highly interesting zoogeographical region must, however, be explored much more thoroughly before a reliable account of its Cephalopod fauna can be given.

The present collection of Cephalopods from the Gulf of Aqaba comprises 7 species, among them a new species of Enoploteuthidae (?), and eggs and very young larvae of *Sepioteuthis*. The presence of a few specimens of *Octopus aegina* GRAY offers the opportunity to throw some light on the confusing problem of this, and some other rugose species of *Octopus*.

SEPIIDAE

Sepia pharaonis EHRENBURG, 1831

(pl. I; fig. 1—3)

Sepia pharaonis EHRENBURG, C.G., 1831, p. (?). — ADAM, W., 1941, p. 5, pl. II, fig. 1; 1959, p. 130, fig. 2, pls. I—III, IV, fig. 3.

Sepia rouxii FERUSSAC, A. DE ET ORBIGNY, A.D', 1835—1848, p. 271, pl. 19.—HOYLE, W. E., 1907, p. 42.—WEINDL, TH., 1912, p. 270.

Acanthosepion rouxi, ROCHEBRUNE, A. T. DE, 1884, p. 108.

Sepia singalensis GOODRICH, E., 1896, p. 3, pl. I fig. 4—8.—HOYLE, W. E., 1907, p. 42.—WÜLKER, G., 1920, p. 54.

Ascarosepion singhalensis var. *foxi* ROBSON, G. C., 1927, p. 325.

* Received for publication November 1, 1958.

Geographic distribution:

Central and Western Pacific, Indian Ocean. Previously recorded from the Red Sea by C. G. EHRENBURG (1831), A. de FERUSSAC et A. d'ORBIGNY (1835—1848), p. 271), A. T. de ROCHEBRUNE (1884, p. 108), W. E. HOYLE (1907, p. 42), TH. WEINDL (1912, p. 270), G. WÜLKER (1920, p. 54), G. C. ROBSON (1927, p. 325) and W. ADAM (1941, p. 5 ; 1959, p. 131).

Localities:

- a) Eylath, IX—1949 (coll. G. HAAS : E 49/67) : 3 eggs;
- b) Eylath, IX—1949 (coll. G. HAAS : E 49/68) : 1 young specimen;
- c) Eylath, IX—1949 (coll. G. HAAS : E 49/69) : 4 eggs;
- d) Eylath, 1951 (coll. E. THEODOR : E 51/192) : 1 ♀ ;
- e) Eylath, 6—V—1955 (coll. H. STEINITZ : E 55/262a) : 1 young specimen ;
- f) Eylath, 14—VII—1955 (coll. H. STEINITZ : E 55/348) : eggs and young specimens;
- g) Eylath, 9—VI—1956 (coll. H. STEINITZ : E 56/161) : 1 young specimen;
- h) Red Sea, details unknown (coll. Hebrew University : E ?/201) : 1 ♀.

Measurements in mm:

Locality		<i>d</i>		<i>e</i>	<i>g</i>	<i>h</i>	
<i>Sex</i>		♀		<i>juv</i>	<i>juv</i>	♀	
Mantle :	dorsal length	125		25	21	240	
	ventral length	107		24	20	205	
	width	±60		16	13	110	
Head :	length	25		±9	4,5	57	
	width	43		±15	12	70	
Fins :	width	±78		25	19	±150	
Arms :		left	right			left	right
	I	43	42	11	6	75	75
	II	43	43	10	5,5	95	90
	III	47	46	10	6	—	100
	IV	45	50	12	9	90	105
Tentacles :	total length	150	160	38	—	260	270
	length of club	35	35	7,5	—	65	65
Suckers :	sessile arms	2		0,4	0,4	3,5	
	tentacles	3,3		0,5	—	6	
Sepion :	length	120			21	235	
	width	40,5			10	78	
	thickness	12,5			2,8	26	
	last loculus	43			7	63	
	striate zone	73			12	167	

Description:

The eggs which probably belong to this species are transparent, without any black pigment and with a very thin outer membrane. They are globulous or broadly oval with their two poles faintly pointed, and measure up to 18 x 15 mm.

The larvae just about to hatch have a dorsal mantle-length of 6,5 mm, a mantle-width of 5 mm and an overall width (including fins) of about 6 mm. The fins extend along nearly the whole mantle-length (pl. I, fig. 3).

The dorsal surface of mantle, head and arms is crowded with very small chromatophores; on the ventral surface these are less numerous and widely spaced.

At the posterior end of the mantle, the embryonic "Hoyle's organ" is well developed, with its lateral branches at the base of the fins.

The dorsal surface of mantle and head shows some widely spaced papillae; below each eye there is a big wart. The flattened ventral surface of the mantle bears on each side, near the base of the fins, two longitudinal ridges; that more lateral is made up of a series of papillae, while the medial one is represented by a thin membrane.

The arms are well developed, especially the ventral ones, which possess a large swimming-membrane. Their ventral surface is covered with small papillae.

Several of the newly hatched larvae have their tentacles protruded. These are very slender, with a short club. Their suckers show the same disposition as in the adult *Sepia pharaonis*, with little difference in diameter between the median and the lateral suckers. In these larvae the club is not well differentiated against the tentacular stem and small, widely spaced suckers seem to continue on the stem for a distance of about the same length as the club.

Of the two young specimens (e and g) the last one is very well preserved (pl. I, fig. 1). The dorsal surface of mantle and head shows some lighter patches with a papilla in their center. Other papillae extend even on the fins. Under each eye there is a big multifid wart. The ventral surface of the mantle shows the same membranous ridges as described for the larvae. On the ventral arms the swimming-membranes are well developed; on the other arms they are less conspicuous, possibly owing to the influence of the fixative.

In this specimen the tentacles are retracted, but in the other one they are protruded and show the characteristic disposition of the suckers. The club is well differentiated and there are no suckers on the stem.

The shell (pl. I, fig. 2) is flat, its dorsal surface covered with small granules, the lateral chitinous margins being narrow. On the ventral side the last loculus is weakly concave, the striate zone neatly excavated at its posterior end and limited by the interior cone, which is a narrow rounded ridge, without the plate-like formation which characterizes the adult shell. Its lateral branches are flattened and completely fused with the outer cone. The posterior spine is well developed, without keels. The relative width of the shell exceeds somewhat that of a young *Sepia pharaonis* (= *S. rouxii*) from Banka (ADAM 1939^a, pl. II, fig. 7); the posterior part of the inner cone does not yet show the beginning of the plate-like formation, but these two differences may be due to the fact that the animal is smaller, and probably at an earlier stage of development.

The two adult females (d and h) show the characteristic strongly salient dorsal mantle margin, forming a nearly right angle; the ventral margin is very slightly concave. The dorsal arms have their exterior surface more or less rounded with a weak swimming-membrane in their distal part. On the dorso-lateral and ventro-lateral arms the swimming-membranes extend along the whole arm length. On the ventral arms these membranes are strongly developed, especially at the base. All the arms have the protective membranes well developed.

There seems to be a double spermatheca on the ventral side of the buccal membrane.

The tentacular club shows the characteristic disposition of the suckers. On first sight there seem to exist five longitudinal rows of suckers, but in fact the suckers are placed in their oblique transverse rows of eight, as in *Sepia officinalis*. But contrary

to the latter species, the size of the median suckers differs only slightly from that of the lateral ones. The swimming-membrane of the tentacular club is well developed but does not extend on to the stem. The protective membranes are also well developed, the dorsal one extending slightly on to the inner side of the tentacular stem.

In the smaller of the two female specimens the large tentacular suckers have their chitinous ring irregularly incised; the small tentacular suckers and the arm suckers are more distinctly denticulate, with numerous teeth. In the larger female most of the tentacular and the arm suckers have a smooth chitinous ring.

The dorsal surface of the shell is strongly rugose with a median rounded rib and broad chitinous margins.

On the ventral surface the last loculus shows a weak depression in the middle; the striate zone has a median furrow; its posterior part is covered by the characteristic plate-like formation of the inner cone, which is swollen in its posterior part and flattened or even concave anteriorly. In the median line this plate attains a length of 9 mm in the smaller specimen, and of 20 mm in the larger one. The lateral branches are fused with the outer cone. The posterior spine has no keels. Its base possesses two thick lateral expansions.

LOLIGINIDAE

Sepioteuthis lessoniana LESSON, 1830

(pl. I; fig. 4—8)

Sepioteuthis lessoniana, WEINDL, Th., 1912, p. 270.— ADAM, W., 1939, p. 2, figs. 1—3; pl. 1, fig. 1—2; 1942, p. 2; 1959, p. 155, fig. 11—12. — REES, W. J. and STUCKEY, A., 1952, p. 185; pl. 28, fig. 1—2; pl. 29, fig. 5—6.

Sepioteuthis hemprichii EHRENBURG, C. G., 1831, p. (?).— ADAM, W., 1941, p. 2; pl. I, fig. 1.

Sepioteuthis sp. REES, W. J. and STUCKEY, A., 1952, p. 187.

Geographic distribution:

Central and Western Pacific, Indian Ocean. Previously recorded from the Red Sea by C. G. EHRENBURG (1831), Th. WEINDL (1912, p. 270), W. ADAM (1942, p. 2; 1959, p. 155) and W. J. REES and A. STUCKEY (1952, p. 185).

Localities:

- a) Eylath, 10/12—V—1949 (coll. G. HAAS: E 49/65): numerous young specimens;
- b) Eylath, 10—XII—1949 (coll. G. HAAS: E 49/88): 1 young specimen;
- c) Eylath, 10—XII—1949 (coll. G. HAAS: E 49/89): some eggs;
- d) Eylath, 15—XII—1949 (coll. A. BEN-TUVIA: E 49/2): 1 young specimen;
- e) Eylath, X—1951 (coll. E. THEODOR: E 51/182): numerous eggs;
- f) Eylath, IX—1952 (coll. Ch. LEWINSOHN: N. S. 182): 1 ♂;
- g) Eylath, 15—VII—1955 (coll. H. STEINITZ: E 55/403): eggs;
- h) Eylath, 30—XI—1955 (coll. H. STEINITZ: E 55/717a): 10 young specimens;
- i) Eylath, 30—XI—1955 (coll. H. STEINITZ: E 55/719a): eggs;
- j) Eylath, 8—VI—1956 (coll. H. STEINITZ: E 56/137): 1 young specimen;

- k) Eylath, 9—VI—1956 (coll. H. STEINITZ : E 56/158) : 3 young specimens ;
 l) Tor, 4—I—1957 (coll. H. STEINITZ : E 57/233) : 1 ♀ ;
 m) Sharam a Sheikh, 7—I—1957 (coll. H. STEINITZ : E 57/289) : 1 young specimen ;
 n) Northern Gulf of Aqaba (date and collector unknown : E ?/202) : 1 ♂.

Measurements in mm :

Locality		<i>d</i>		<i>f</i>		<i>l</i>		<i>m</i>		<i>n</i>	
<i>Sex</i>		<i>juv</i>		♂		♀		<i>juv</i>		♂	
Mantle :	dorsal length	25		210		152		17		143	
	ventral length	20,5		190		128		12		130	
	width	9		55		42		7		48	
Head :	length	±10		38		25		5		30	
	width	9		49		40		6,5		33	
Fins :	length	20		195		138		10		130	
	width	17		125		90		11		95	
	maximum width at	18/25		122/210		92/152		12/17		94/143	
Arms :			left	right	left	right			left	right	
	I	5,5	50	45	36	36	2,5		37	37	
	II	7,5	62	68	50	50	4		55	54	
	III	11	85	80	63	58	6		60	61	
	IV	10	75	75	58	60	5		53	55	
Tentacles :	total length	20	125	120	110	110	9		115	110	
	length of club	10	72	72	55	55	±5		46	48	
Suckers :	sessile arms	0,4		4		2,7		0,2		2,4	
	tentacles	0,5		6		3,5		0,3		3,8	
Hectocotylus : modified part				13						14,5	

Description :

Probably all the above-mentioned eggs and larval specimens belong to this species, although in certain cases it is difficult to take a decision.

The egg-capsules mentioned under g) are cylindrical, measuring 35—40 x 6—7 mm, and contain three or four eggs each. As these eggs are not yet developed, I am not quite certain about their identity.

All the other egg-capsules consist of two, three or four eggs, separated by a more or less pronounced constriction, rendering each egg globular. They are more or less transparent and attain a diameter of about 15 mm. These eggs have developed to the stage of typical Loliginid larvae which most probably belong to *Sepioteuthis lessoniana*. The newly hatched larvae (pl. I, fig. 4—7) have a mantle-length of about 5 mm; the head is very large; the arms differ considerably in length, the dorsal ones being very short, the dorso-lateral and the ventral ones about twice as long, and the ventro-lateral ones nearly twice as long as the latter. The tentacles are 1½ times the length of the ventro-lateral arms. The fins are semi-circular, widely separated at the posterior end of the body. At their anterior point of insertion on the mantle there is in most specimens a low membraneous ridge running forward and indicating the future extension of the fins. Hoyle's organ is well developed, attaining the posterior end of the body, with its lateral branches extended on to the fins.

Owing to the varying state of contraction of the chromatophores, we are confronted with a great variety in the appearance of these larvae. Some have the dorsal surface covered with large brown chromatophores, giving a dark shade to the animal. In others the chromatophores are very small, black and widely spaced. On the arms they show a characteristic disposition. On the dorsal, dorso-lateral and ventral arms, there is one row of chromatophores on the outer surface. The ventro-lateral arms have one row of chromatophores on each side of the swimming-membrane and another on each of the protective membranes. The tentacles show one row of chromatophores on the outer ventral side along their whole length, another one along the ventral side of the distal part of the swimming membrane, and two of them on the ventral protective membrane. On the dorso-lateral surface there is one row of chromatophores on the protective membrane, and a few scattered chromatophores on the stem.

G. WÜLKER (1913, p. 453, pl. 22) described and figured the eggs, larvae and young specimens of *Sepioteuthis*. There appear to exist minor differences in the disposition of the chromatophores of these larvae and the ones described above. On the other hand, WÜLKER's figures can not be considered very accurate. In his figures 2^c and 2^d, all the arms of the specimen are of one and the same length whereas those of the younger and of the older stages show the characteristic length-differences.

Of the two post-larval specimens (d and m) only the last one is well preserved (pl. I, fig. 8).

The larger male (f) is of dark reddish-brown colour, with indistinct round patches near the margin of the fins. The transformed portion of the hectocotylized arm is very short, the rest of the arm is covered with 32 pairs of suckers gradually decreasing in size towards the distal end. The large tentacular suckers have their chitinous ring armed with about 20 spaced teeth; that of the arm suckers has about 24 teeth.

The smaller male (n) shows the rounded dark patches of the dorsal fin surface more distinctly. This pattern constitutes a secondary sex-character. The hectocotylized arm bears only 26 pairs of suckers and a relatively longer transformed portion.

The only female specimen (l) is very well preserved.

In the three adult specimens all the lobes of the buccal membrane bear a small number of suckers.

OMMASTREPHIDAE

Symplectoteuthis oualaniensis (LESSON, 1830)

(fig. I)

Symplectoteuthis oualaniensis, PFEFFER, G., 1912, p. 502, pls. 40 ; 41 ; 42, fig. 1—4.—WEINDL, TH., 1912, p. 270.—SASAKI, M., 1929, p. 297, fig. 176—178 ; pl. XXX, fig. 8. — ADAM, W., 1942, p. 11 ; 1954, p. 157 ; 1959, p. 168. — VOSS, G. L., 1954, p. 365.

Geographic distribution :

Central and Western Pacific, Indian Ocean. Previously recorded from the Red Sea by TH. WEINDL (1912, p. 270).

Locality: Eylath, IX—1952 (coll. CH. LEWINSOHN: N. S. 181) : ♀.

Measurements in mm:

Mantle:	dorsal length	184	
	ventral length	170	
	width	42	
Head:	length	40	
	width	40	
Fins:	length	78	
	total width	120	
Arms:		left	right
	I	55	55
	II	55+	65
	III	60+	65
	IV	60+	64
Tentacles:	total length	105	115
	length of club	55	55
Suckers:	I	3	
	II	3,5	
	III	3	
	IV	2,5	
	tentacular club	4	

Description:

The animal is of a brownish-violet colour, the outer membraneous covering of the skin is brown, and where this membrane is detached, the underlying tissues show a bluish-violet tint.

The anterior two thirds of the mantle are cylindrical, the posterior third conical.

The fins are much wider than long, their anterior margin is slightly convex, the posterior one nearly straight.

Dorsally, the anterior mantle-margin forms a slight angle, the ventral margin is somewhat concave.

The head is more or less cylindrical, the eyes are not prominent. The siphonal depression on the ventral side of the head shows a central pouch with six longitudinal plicae. On ventral view, there are at the right side and behind the central pouch three transverse membranes limiting small lateral pouches, and a fourth incomplete membrane without a pouch. At the left side there are the same membranes and pouches, but the third pouch shows two small accessory membranes, limiting secondary pouches.

The adhesive system between the mantle and the funnel shows the characteristic fusion of the tissues, which differentiates the genus *Symplectoteuthis* from the other Ommastrephidae.

The exterior surface of the dorsal arms is flat with a distinct but narrow swimming-membrane on each side, the inner one slightly more developed than the outer one.

The dorso-lateral arms are flattened at the outer side, rounded at the dorsal one, with a distinct swimming-membrane on the ventral side.

The ventro-lateral arms are laterally flattened with a strong swimming-membrane which shows its greatest width at the basal third of the arm-length and gives it a triangular shape.

The ventral arms are flattened at the ventral side with an angular border at the inner margin and a distinct outer swimming-membrane.

All the arms possess protective membranes, which are widest on the ventral side of the ventro-lateral arms.

The tentacles are laterally compressed at their base. A swimming-membrane extends along their whole length. The tentacular club shows two protective membranes which extend as narrow membraneous ridges along the whole flattened inner surface of the tentacular stem.

The connective system (locking-apparatus) of the right tentacular club consists of two small suckers with smooth chitinous rings and two or three tubercles of which the distal one is less distinct. The left tentacular club possesses three small suckers with smooth rings and two tubercles. The tentacular clubs show two or three groups of carpal suckers armed with distal teeth; it is difficult to decide whether the third group belongs to the carpal, or to the main suckers. The main part of each club is covered with a dozen transversal rows of four suckers, of which the median ones are much larger than the lateral ones. Their chitinous rings show the characteristic dentition (fig. 1). The distal part of each club is covered with four longitudinal rows of small suckers; their chitinous rings show the same dentition as the lateral suckers of the main part.

The suckers of the sessile arms are arranged in two longitudinal rows. Their chitinous ring is armed with a small number of big pointed teeth on the distal side. In the proximal suckers the proximal part of the ring is irregularly denticulate, in the distal ones it is smooth.

The largest suckers occupy the mid-portion of the arm. In these suckers very large teeth alternate with slightly smaller ones (fig. 1).

Remarks :

The only specimen previously recorded from the Red Sea (TH. WEINDL, 1912, p. 270) has never been described.

Since the specimen described here is a female it is impossible to demonstrate anything of racial differences between the Red-Sea specimens and those of the Indo-Pacific.

Compared with the description and figures of G. PFEFFER (1912, p. 502, pl. 41) the specimen from Eylath shows two small differences. According to G. PFEFFER there are no secondary pouches in the siphonal groove, and the suckers and tubercles at the base of the tentacular clubs are more widely apart in his figure.

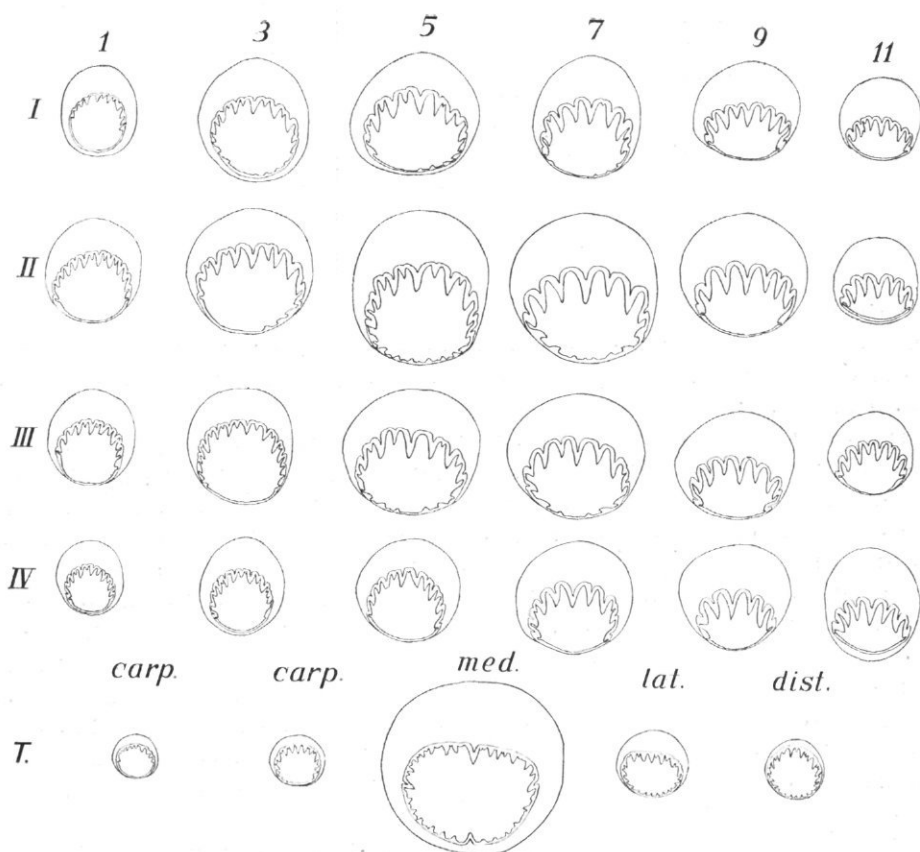


Fig. 1— *Symplectoteuthis oualaniensis* (LESSON), ♀ (dorsal mantle-length: 184 mm); Eylath, IX-1952 (N.S. 181): chitinous rings of the suckers of the dorsal (I), dorso-lateral (II), ventro-lateral (III) and ventral (IV) arms, and of the tentacular clubs (T.); those of the arm-suckers are of the 1st, 3rd, 5th, 7th, 9th and 11th pair of each arm; those of the tentacular clubs are of the carpal, median, lateral and distal suckers. (x 6).

? ENOPLOTEUTHIDAE

? *Enoploteuthis dubia* sp. nov.

(fig. 2)

Locality : Eylath, V—1955 (coll. CH. LEWINSOHN : N. S. 195) : ♂.

Measurements in mm :

Mantle :	dorsal length	36	
	ventral length	33	
	width	±16	
Head :	length	16	
	width	±12,5	
Fins :	length	21	
	total width	36	
	length of attached part	16	
Arms :		left	right
	I	25	39
	II	31	41
	III	34	39
	IV	38	40

Description :

The only specimen of this interesting species has unfortunately lost both its tentacles, but otherwise it is very well preserved. Its tissues are firm and more or less transparent (fig. 2 a—b).

The mantle is broadly cone-shaped, the apex slightly exceeding the fins, the anterior edge nearly straight, very little angular in its medio-dorsal part. The fins are triangular, their anterior edge slightly convex, the posterior nearly straight. Anteriorly, the median area of the pen is faintly visible through the skin of the mantle and causes it to become elevated in a low ridge. From about half-length of the fins the pen is no more discernable from the outside. The head is narrower than the mantle, the eyes not prominent, their opening oval, elongated vertically, with a small sinus in the middle of the anterior edge. The nuchal cartilage is spoon-shaped, widest anteriorly. The funnel-cartilages are oval, twice as long as broad, widest in their posterior half. On either side of the broadly conic funnel there are two semilunar folds of about 1.5 mm length, and above them, two other, continuous folds forming a semicircular crest. These folds show the same disposition as in *Abralia veranyi*.

The arms are nearly equal in length. The dorsal ones are flattened at the outer side of their base, more rounded distally, without a swimming-membrane. The dorso-lateral arms are rounded outside, with a faint indication of a swimming-membrane in their distal half. The ventro-lateral arms show a swimming-membrane nearly along their whole length, widest distally, and reduced to a low crest along the basal half of the arm. The ventral arms are flattened on the outside of their proximal portion, more rounded distally; the median edge of the outer side is rounded, the lateral edges of the proximal portion slightly expanded into a swimming-membrane. In all the arms the protective membranes are well developed ventrally, very little however on the opposite side.

The dorsal arms bear 13 or 14 pairs of rather spaced hooks and, at their distal tip, about ten pairs of very small suckers and an ill-defined number of still smaller

suckers in formation. These suckers have the distal half of their chitinous ring armed with a few blunt teeth.

The dorso-lateral arms show 12 pairs of hooks, and have the suckers in the same formation as the dorsal ones. The ventro-lateral arms are distinguished by 14 pairs of hooks in much closer setting, equally followed by small suckers on the distal tips.

The left ventral arm bears 24 pairs of closely-set hooks and only $4\frac{1}{2}$ pairs of minute suckers. The hooks are largest at the base of the arm (fig. 2 d-e) decreasing gradually in size towards its distal end. The first three or four pairs have the interior hook larger than the exterior one; in the other pairs both hooks are of nearly equal size, or the exterior hook is slightly larger.

The right ventral arm is hectocotylyzed (fig. 2 c). Its proximal two thirds bear 13 pairs of hooks decreasing gradually in size. Up to the 5th pair, the interior hooks are the larger ones; from the 6th pair on, the exterior hooks are much larger than the interior ones. The distal third of the arms is transformed and bears only six small exterior hooks occupying about half of this distal part, while an interior row is lacking. Distad of the last hook the outer protective membrane forms a thick, short lobe, 1,5 mm in length. At the interior margin the protective membrane of the transformed part consists of two thick lobes, the proximal one being longer than the distal one, the two together measuring 8 mm in length. The more distal lobe carries a very minute sucker (0,25 mm in diameter) near its outer edge. The distal portion of the arm extends 5 mm beyond the exterior lobe; it is completely devoid of suckers and membranes. The whole hectocotylyzed portion has a length of 15 mm; the six unpaired hooks occupy about the combined length of the inner lobes.

The outer surface of the buccal membrane is well provided with dark chromatophores. Its eight points are attached by eight connectives to the dorsal side of all the arms, even of the ventro-lateral ones.

In other Enoploteuthidae the ventro-lateral arms have the connectives attached to their ventral side, whereas all the other arms have them on the dorsal side.

The inner surface of the buccal membrane is covered with big papillae.

The small luminous organs (photophores) of the body-surface are of three types; a fourth type is represented by the photophores found on the ventral side of the eye-ball. The largest photophores of the ventral side of mantle, funnel, head and ventral arms, about $\frac{1}{4}$ of a mm in diameter, are whitish, encircled by a few punctiform black chromatophores. These photophores are widely spaced and form a perfectly symmetric pattern. Fig. 2 a, while indicating precisely the position of the photophores, presents them slightly beyond their relative size in order to distinguish them more easily from the other photophores. On the ventral surface of the mantle they are disposed in six longitudinal series, three on either side. On the funnel there are only four of them, arranged in a transverse line. On the hind part of the head, three photophores are placed on either side just anterior to the neck-folds. In the middle of the ventral side between the eyes and the funnel-opening there are six of them arranged in three alternating longitudinal groups of two. In the middle of the posterior rim of the eye-opening there is one white photophore located, and a second one above it (this last one is not visible in the figure). Between the sinus and the middle of the ventral margin of the eye-opening three more white photophores are to be found. At the base of each of the ventral and the ventro-lateral arms one white photophore can be located.

Each of the ventral arms carries one longitudinal series of these widely spaced

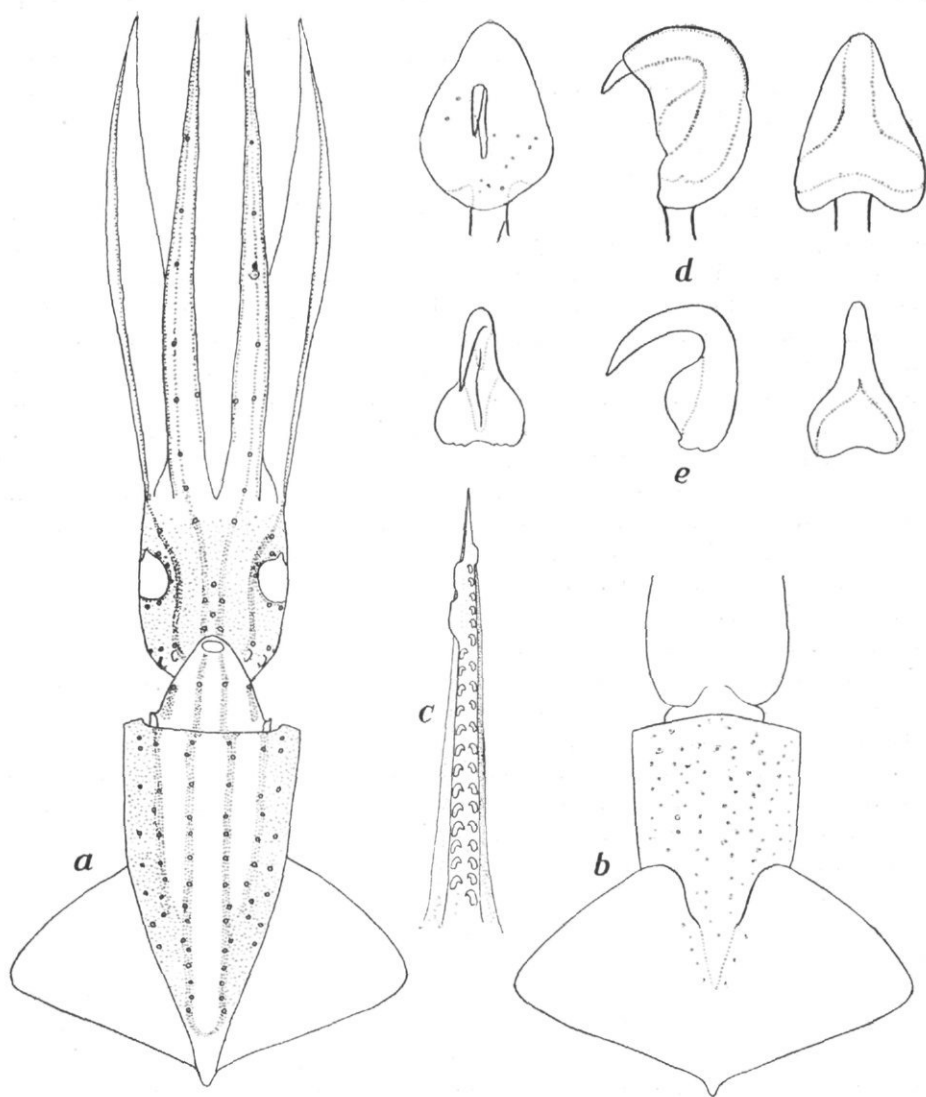


Fig. 2— ? *Enoploteuthis dubia* sp. nov., holotype, ♂ (dorsal mantle-length: 36 mm) ; Eylath, V-1955 (N.S. 195): a-ventral view (x 1.4); b-dorsal view (x 1.4); c-hectocotylus (x 1.4); d-hook of the left ventral arm, with its fleshy hood (x 9.7); e-the same without its fleshy hood (x 9.7).

photophores, lined up in the middle of their ventral side, and besides a single one near the interior edge.

The second type of photophores is smaller, about 0,15 mm in diameter, with a dark ring and a minute light center. These photophores are very numerous, densely crowded, and partly forming dark bands, every band on the mantle having a width of two to four of them.

On the ventral surface of the mantle, there are four such bands, coinciding with the four innermost series of white photophores. These dark bands continue on to the funnel, the head and the ventral surface of the ventral and the ventro-lateral arms.

The two median dark bands on the mantle extend along the whole mantle-length separated from each other by a space completely devoid of photophores. The space between the medial and the lateral bands (the latter extending only over the anterior half of the mantle length) is equally lacking photophores. What remains of the ventral and of the lateral surface of the mantle, is crowded with dark photophores like those just described, yet more distant than those of the bands, and associated with photophores of a third type, still smaller (about 0,1 mm in diameter) and of a lighter shade. The difference between the two last types of photophores is not always obvious. The smallest whitish photophores extend also over the whole dorsal surface of the mantle and on to the fins, close to their insertion; they are wide apart and less in number.

The four dark bands of the funnel, continuous with those of the mantle, are separated by wide spaces devoid of photophores. Another band of dark photophores (not visible in the figure), can be seen alongside the funnel where the latter unites with the head.

On the ventral surface of the head, the four dark bands continue, but here the space between them is occupied by numerous photophores of the two last types.

The two median dark bands extend as narrow stripes almost in the midline of the ventral surface of the ventral arms. The two lateral dark bands on the ventro-lateral arms are drawn out into a single series of dark photophores at the base of the swimming-membrane. The ventral arms possess a second series of dark photophores, starting a short distance from their base and extending along the interior edge; a third series is noted on the lateral swimming-membrane. Of the three longitudinal series of dark photophores distinguishing the ventral arms of this species, the central one coincides with the row of white photophores.

The dorsal surface of the head and the dorsal and dorso-lateral arms are completely devoid of photophores. The presence of white photophores near the rim of the eye opening has already been noted; they are joined by photophores of the two additional types densely packed on the ventral, but rather wide-spaced on the dorsal circumference.

The ventral surface of the eye-ball is marked by a row of nine circular photophores: the two terminal organs are the largest (0.8 mm in diam.); between them five others are found, about half the size of the former; finally, two photophores of minute size are situated slightly more laterally from the central medium-sized organ with whom they are in contact.

The internal organs appear to be of the same structure and disposition as those of *Abralia*, with a very big penis. As I preferred not to dissect the only specimen I was unable to study them in detail. The spermatophores are distorted by the fixation, but resemble those of *Abralia*.

Remarks:

Our new species is characterized by the peculiar arrangement of photophores, by the right ventral arm being hectocotylized, and by the exceptional position of the connection between the buccal membrane and the ventro-lateral arms. It is very unfortunate that both tentacles are missing; they could have given valuable information as to the generic position of this species.

The species is considered to belong to the *Enoploteuthidae*, although no other species of this family is known to have the ventro-lateral connective attached to the dorsal surface of the ventro-lateral arms.

The photophores of mantle and head, grouped in dark bands, and the hectocotylisation affecting the right ventral arm, correspond with the characters of the genus *Enoploteuthis*. The present species differs from the other species of this genus by the smaller number of dark bands of photophores on the ventral mantle-surface. Unfortunately the type-species, *Enoploteuthis leptura* (LEACH), has never been described in detail.

As long as the tentacles of our species remain unknown it is impossible to establish its generic position with certainty; for the same reason a detailed comparison with other species of the *Enoploteuthidae* is out of question.

OCTOPODIDAE

Octopus macropus RISSO, 1826

Octopus macropus, JOUBIN, L., 1898, p. 22.— ROBSON, G. C., 1929, p. 101.— REES, W. J., and STUCKEY, A., 1952, p. 188. — ADAM, W., 1954, p. 172 ; 1959, p. 174, fig. 20.

Polypus macropus, HOYLE, W. E., 1907, p. 36. — WEINDL, TH., 1912, p. 270. — WÜLKER, G., 1920, p. 50.

Geographic Distribution:

North Atlantic, Mediterranean, Indian Ocean, Central and Western Pacific. Previously recorded from the Red Sea by L. JOUBIN (1898, p. 22)), W.E. HOYLE (1907, p. 36), TH. WEINDL (1912, p. 270), G. WÜLKER (1920, p. 50), G. C. ROBSON (1929, p. 101), W. J. REES and A. STUCKEY (1952, p. 188) and W. ADAM (1959, p. 174).

Localities:

- Eylath, 10/12—V—1949 (Coll. G. HAAS: E 49/66): 1 young specimen;
- Eylath, 6—V—1955 (coll. H. STEINITZ: E 55/262^b): 1 young specimen;
- Eylath, 16—VII—1955 (coll. H. STEINITZ: E 55/489): 1 young specimen;
- Eylath, 8—VI—1956 (col. H. STEINITZ: E 56/133): 1 young specimen.

Measurements in mm:

Locality		a	b	c	d
Mantle:	dorsal length	18	15,5	21	15
	ventral length	14	11,5	17	10,5
	width	8	8,5	10	8
Head:	length	8	13	15,5	8
	width	6,5	9,5	11,5	8,5
Arms:	I	42	±60	±80	50

Description:

These young Octopods represent the typical "alderii" stage of *Octopus macropus*.

Octopus cyaneus GRAY, 1849

Octopus cyanea GRAY, J. E., 1849, p. 15. — ROBSON, G. C., 1929, p. 94, fig. 21 — 23. — REES, W. J., and STUCKEY, A., 1952, p. 190, pl. 30.

Octopus cyaneus, ADAM, W., 1954, p. 171 ; 1955, p. 191 ; 1959, p. 172.

Octopus horsti JOUBIN, L., 1898, p. 23.

Polypus horsti, HOYLE, W. E., 1907, p. 38. — WEINDL, TH., 1912, p. 270. — WÜLKER, G., 1920, p. 51.

Geographic distribution :

Pacific, Indian Ocean. Previously recorded from the Red Sea by L. JOUBIN (1898, p. 23), W. E. HOYLE (1907, p. 38), TH. WEINDL (1912, p. 270), G. WÜLKER (1920, p. 51), W. J. REES and A. STUCKEY (1952, p. 190) and W. ADAM (1955, p. 191).

Localities :

- a) Eylath, IV—1951 (coll. Ch. LEWINSOHN : N. S. 196) : 1 young specimen ;
- b) Eylath, 29—XI—1955 (coll. H. STEINITZ : E 55/760) 1 ♀.

Measurements in mm :

Locality	a	b
Sex	Juv.	♀
Mantle : dorsal length	7,5	74
ventral length	—	53
width	5	49
Head : length	—	52
width	6,5	41
Suckers	—	6

Description :

In both specimens the arms are so tightly coiled that they can not be used for measurements. The younger specimen is nearly blackish but the ocelli are still visible. The female specimen is of a light-greyish colour with the characteristic zebra-like markings on the ventral side of the arms. The colouration of this specimen is rather exceptional, but W. J. REES and A. STUCKEY (1952, p. 190) have also recorded two female specimens from the Red Sea which "are of a buff or pale brownish colour, with an olive-green sheen", instead of the dark purple colour of most specimens of this species.

The ocelli are much nearer to the eyes than to the margin of the web, the left one measuring 8,5 mm (outer ring : 17,5 mm), the right one 8 mm (outer ring : 15 mm).

W. J. REES and A. STUCKEY (1952, p. 190) mention "a double row of slightly raised, buff-coloured, simple papillae" on the dorso-lateral surface of the arms. In a female specimen from the island Abulat (Red Sea) I found these papillae on both lateral sides of all the arms (W. ADAM, 1955, p. 192). In the present specimen these papillae are very inconspicuous, probably owing to the contracted state of the arms which renders their whole surface more or less rugose.

Octopus aegina GRAY, 1849

(fig. 3—10)

Octopus aegina GRAY, J. E., 1849, p. 7. — ROBSON, G. C., 1928, p. 641, fig. 1—4; 1929, p. 113, fig. 31—32; pl. V. fig. 1. — ADAM, W., 1954, p. 166, fig. 30; pl. II, fig. 2—3; 1959, p. 171, fig. 19.

Octopus rugosus ADAM, W. (non BOSC), 1942, p. 15.

Geographic distribution:

Western Pacific, Indian Ocean. Previously recorded from the Red Sea by W. ADAM (1942, p. 15; 1954, p. 166; 1959, p. 171).

Localities:

- a) Eylath, IV—1951 (coll. H. STEINITZ: E 51/167): 2 ♂;
b) Eylath, I—V—1955 (coll. H. STEINITZ: E 55/959): 1 ♀;

Measurements in mm:

Locality		a		a		b	
Sex		♂		♂		♀	
Mantle:	dorsal length	± 35		34		36	
	ventral length	26		22		28	
	width	—		—		28	
Head:	length	—		—		16	
	width	—		14		18	
Arms:		left	right	left	right	left	right
	I	67	67	66	64	75	75
	II	93	72	77	74	85	—
	III	93	56	75	57	90	95
	IV	93	85	77	76	90	95
Web:	A	12		—		13	
	B	18		—		20	
	C	25		—		25	
	D	25		—		23	
	E	20		—		±22	
Hectocotylus:	ligula	±4		2		—	
	calamus	±2		0,5		—	
Suckers:	diameter	6		±5		3,5	

Description:

The female specimen is well preserved, of a brownish colour with a dark reticulate pattern on the dorsal side, and with a very dark band on the dorsal side of the arms, at the base of the suckers.

The gills have eight filaments in each demibranch. The eggs are numerous, very small, measuring $\pm 2 \times 0,5$ mm.

Both the male specimens are distorted by the fixation. Their skin is more granulous, the dorsal side being covered with small rounded dense tubercles. In both sexes there is a multifid wart above each eye. The dark bands on the arms are less conspicuous. The gills have the same number of filaments.

The rhachidian teeth of the radula show an A₂ seriation (fig. 10a).

One of the most characteristic features of this species is the enormous development of the penis, probably in connection with the great length of the spermatophores.

The other genital organs have the same formation as described by W. MARCHAND (1907, p. 53—61) for *Octopus vulgaris*, *O. defilippii* and *O. macropus*. As in these species the canal leading from Needham's organ, in which the spermatophores are stored, opens in to the diverticulum of the penis. But whereas in most *Octopodidae* this diverticulum is of globular or reniform shape, in *Octopus aegina*, it bears a more or less developed appendix, in which the anterior part of the spermatophore is lodged. In both specimens from Eylath this appendix is turned backward (fig. 3^{a-c}), in those from Amboina (fig. 3^d) and Ennûr (fig. 3^f) (see ADAM, 1954, p. 168) it is more elongated, initially turning backward but with its distal part pointing in the opposite direction. The penis forms a more or less developed posterior loop and then opens anteriorly of the diverticulum. There are only a few spermatophores lodged in Needham's organ and a single one in the penis.

G. C. ROBSON (1929, p. 114, fig. 32) rendered a schematic drawing of the penis and its diverticulum, but his interpretation of the different parts was not correct. It is rather unfortunate that ROBSON failed to indicate in the figure the symbols A, B and C, which were assigned in the text, to certain portions of this organ.

According to his text: "it will be seen that it consists of (A) the penis proper with a short rounded appendix, (B) a second penial appendix, which is twice as long as the penis and is continued into (C) a third appendix, which is long and narrow and nearly five times as long as the penis". In fact, if I compare ROBSON's figure with my drawings (fig. 3) it becomes evident that what ROBSON calls "the penis proper" is the appendix of the diverticulum; what he calls "the second penial appendix" is the diverticulum itself, and what he calls the "third appendix", is the penis proper. ROBSON, found "this remarkable ensemble" in all four adult males in the type series of *kagoshimensis*, a species which he synonymizes with *Octopus aegina*. Independently from G. C. ROBSON, M. SASAKI (1929, p. 40) has synonymized *Octopus kagoshimensis* with *Octopus granulatus* LAMARCK. His figures (pl. IX fig. 11, 12 and 13) of the male genital organs show the same type of penis and diverticulum as the above-mentioned specimens of *Octopus aegina*, but with the diverticulum more elongate. SASAKI indicates the length of the spermatophores as being 160 mm, whereas the largest male has a ventral mantle-length of 65 mm. In the Eylath specimen of 35 mm dorsal mantle-length the spermatophores measure 42 mm (fig. 5). Unfortunately neither G. C. ROBSON (1929) nor M. SASAKI (1929) describe the spermatophores.

In 1954 (p. 166) I mentioned several specimens from the Indian Ocean which had the following characters in common: the granulous skin, the dark reticulate pattern, the very short dorsal sector of the web, the enormous development of the penis, and the extremely long spermatophores attaining up to $1\frac{1}{2}$ times the dorsal mantle-length. But I was able to divide the males of this species in two distinct groups corresponding to two different types of spermatophores, the first type of a length exceeding the dorsal mantle length, being unarmed (specimens from Sabang, fig. 6; Amboina and Suez), the second type of a length less than that of the mantle and having the posterior portion of the sac armed with large spines (specimens from Nias, fig. 7, Amoy, fig. 8, and Ennûr, fig. 9).

It is to be regretted that neither G. C. ROBSON (1929) nor M. SASAKI (1929) described the spermatophores of their respective specimens. I had the opportunity to examine the male specimen from Amoy, mentioned by G. C. ROBSON; it belongs to the second group. In a foot-note, G. C. ROBSON (1929, p. 115) states that

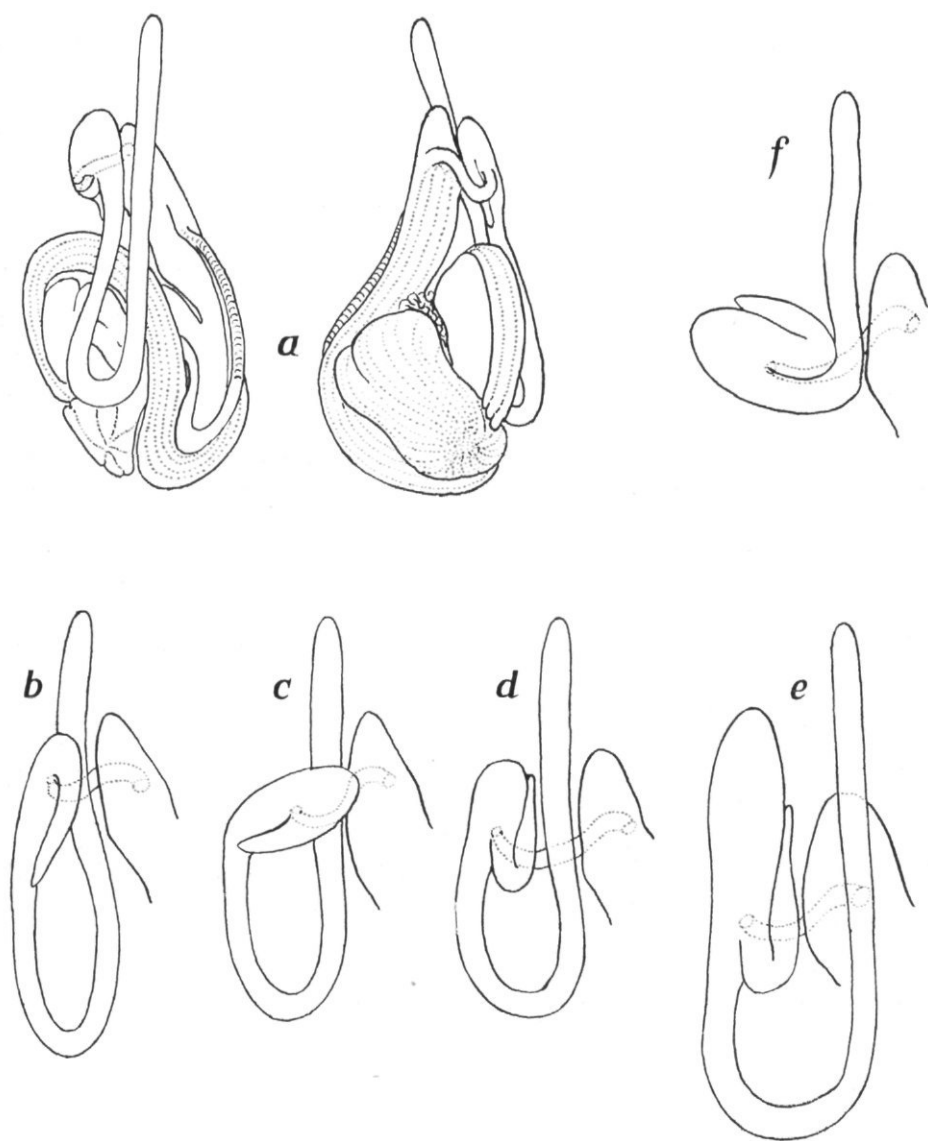


Fig. 3— a-*Octopus aegina* GRAY, ♂ (dorsal mantle-length: ± 35 mm); Eylath, IV-1955 (E51/167): ventral and dorsal view of the genital organs; b-schematic view of the penis of the same specimen; c-schematic view of the penis of the second specimen of the same locality; d-schematic view of the penis of a specimen from Amboina (dorsal mantle-length: 48 mm); e-*Octopus kagoshimensis* ORTMANN, type-specimen (dorsal mantle-length: 40 mm); schematic view of the penis; f-*Octopus aegina* GRAY, ♂ (dorsal mantle-length: 49 mm); Ennûr: schematic view of the penis. ($\times 2.5$).

"*Octopus dollfusi* ROBSON (1928, p. 43) may be related". In the original description of this species, the length of the spermatophore is not mentioned, but the very imperfect figure (27) seems to indicate that it is of the armed type.

Until now I have been unable to distinguish these two types of specimens by characters other than the spermatophore. If the presence or absence of spines in the spermatophore is a specific character, the specimens hitherto regarded as *Octopus aegina* will have to be separated at least in two species. In that case the first question which arises is to know which of them has to be called *Octopus aegina*. Unfortunately the holotype of this species is a female specimen from an unknown locality, and until now I am unable to distinguish the females of these two species which are equally characterized by their granulous skin and the very low dorsal sector of the web.

In his first redescription of *Octopus aegina* GRAY, 1849, G. C. ROBSON (1928, p. 642) mentions a male specimen from China which shows an A₂ seriation in the rhachidian teeth of the radula. Its hectocotylus is undeveloped; the "penis has a well-marked appendix of the *O. rugosus* type, and is very long (33 per cent. of the mantle-length)." If this specimen had the enormous penis with a big posterior loop, characteristic of *O. kagoshimensis* and of the above described specimens from the Red Sea, Sabang and Amboina, all of which have an unarmed spermatophore, G. C. ROBSON would certainly have noted it. Thus, his specimen from China probably belongs to the form with the smaller, armed spermatophore, and with the less developed penis, lacking the posterior loop.

In 1929, G. C. ROBSON (p. 113, fig. 31—32) synonymized *Octopus kagoshimensis* with *O. aegina*. He mentions among the examined specimens one male from Amoy, one from China and the type specimens of *O. kagoshimensis*.

I am very much indebted to Prof. J. H. VIVIEN, Director of the zoological Museum of Strassbourg, who kindly put the type-specimens of *O. kagoshimensis* to my disposal. Although these specimens are in a rather macerated condition and do not permit a detailed description, they do not leave any doubt that they belong to the species which M. SASAKI (1929, p. 40) describes as *O. granulatus* LAMARCK. The males have the typical penis with a large posterior loop (fig. 3^e), an unarmed spermatophore (fig. 4) which measures twice the dorsal mantle-length in a specimen of 40 mm. mantle-length, and the radula with A₂ seriation of the rhachidian teeth (fig. 10^e).

Thus, G. C. ROBSON's description of *Octopus aegina* is based on animals of different forms: the first one represented by the males from Amoy and from China, having a less developed penis and an armed spermatophore (I have examined the spermatophore of the male from Amoy only), and the second, represented by *Octopus kagoshimensis* from Japan, having a penis with a large posterior loop, and a much longer, unarmed spermatophore. In a foot-note, G. C. ROBSON (1929, p. 115) states that *Octopus dollfusi* ROBSON, 1928, may be related. As mentioned above, this species seems to belong to the first form, with armed spermatophore, and with the penis lacking the posterior loop.

From a nomenclatorial point of view I see three possible solutions:

- 1.—to keep the name of *Octopus aegina* GRAY for the form with armed spermatophores, although the justification for this procedure can not be substantiated, the holotype being a female from an unknown locality; to retain at the same

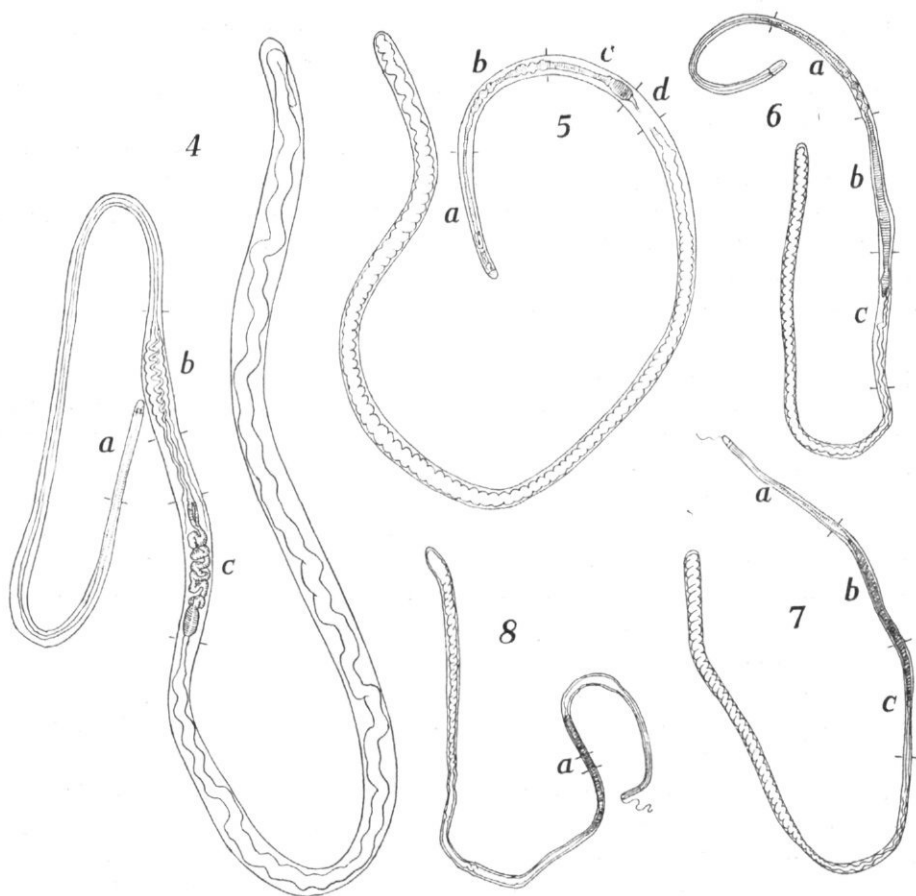
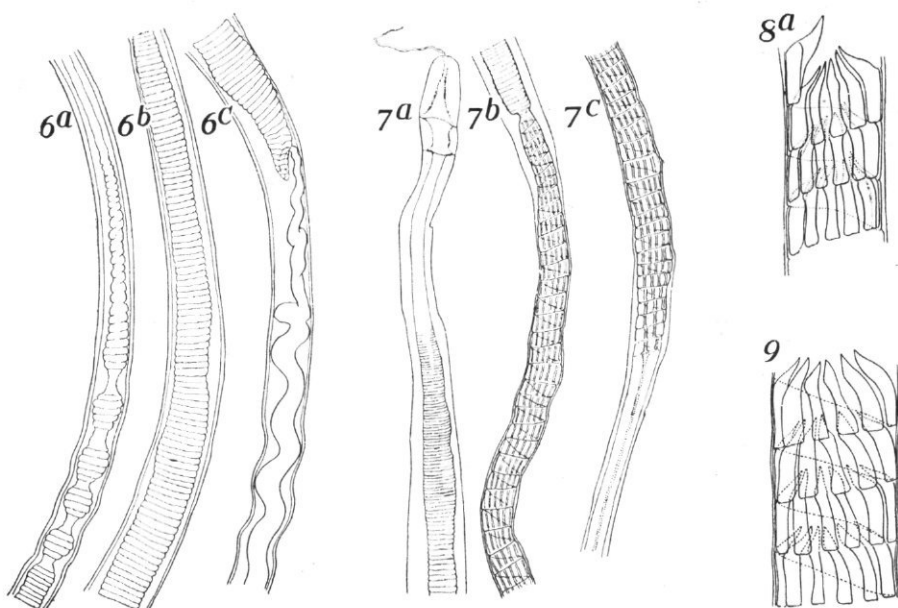
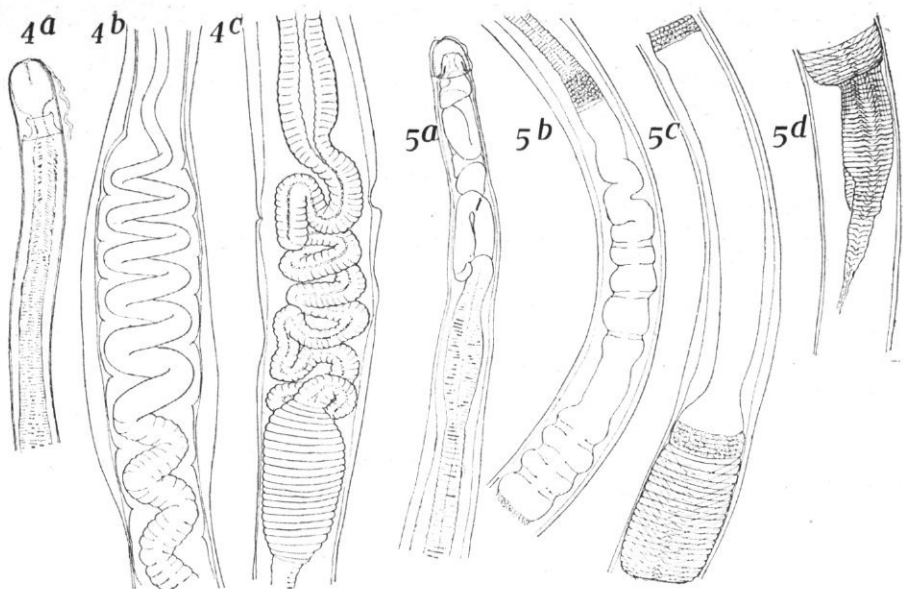


Fig. 4-9— Spermatophores:

- Fig. 4—*Octopus kagoshimensis* ORTMANN, type-specimen (dorsal mantle-length: 40 mm): general view (x 3,9); a-c: details (x 15);
- Fig. 5—*Octopus aegina* GRAY, (dorsal mantle-length: \pm 35 mm); Eylath, IV-1955 (E 51/167): general view (x 3,9); a-d: details (x 15);
- Fig. 6—*Octopus aegina* GRAY, (dorsal mantle-length: 42 mm); Sabang: general view (x 3,9); a-c: details (x 15).
- Fig. 7—*Octopus aegina* GRAY, (dorsal mantle-length: 40 mm); Nias: general view (x 3,9); a-c: details (x 15).
- Fig. 8—*Octopus aegina* GRAY, (dorsal mantle-length: 45 mm); Amoy: general view (x 3,9); a: detail (x 51);
- Fig. 9—*Octopus aegina* GRAY, (dorsal mantle-length: 49 mm); Ennür: detail (x 51).



time the name of *O. kagoshimensis* ORTMANN for the form with unarmed spermatophores.

- 2.—to retain the name *Octopus aegina* GRAY for the form with unarmed, and *O. dollfusi* ROBSON for that with armed spermatophores.
- 3.—to abandon the name of *Octopus aegina* GRAY and to adopt *O. dollfusi* ROBSON for the form with armed, and *O. kagoshimensis* ORTMANN for the one with unarmed spermatophores.

As long as we can not distinguish the females of these Octopoda, the position of *O. aegina* remains uncertain.

In any case, the specimens from the Red Sea, Amboina and Sabang, so far described represent a form with unarmed spermatophores. But the penis and the spermatophores seem to be developed rather less than in the typical *O. kagoshimensis* from Japan. This may be a sub-specific character, but more material will be needed to arrive at a satisfactory solution. The radula may provide another specific character; the form with armed spermatophores showing A₁ seriation (fig. 10^d), the unarmed one A₂ seriation (fig. 10^a, b, c).

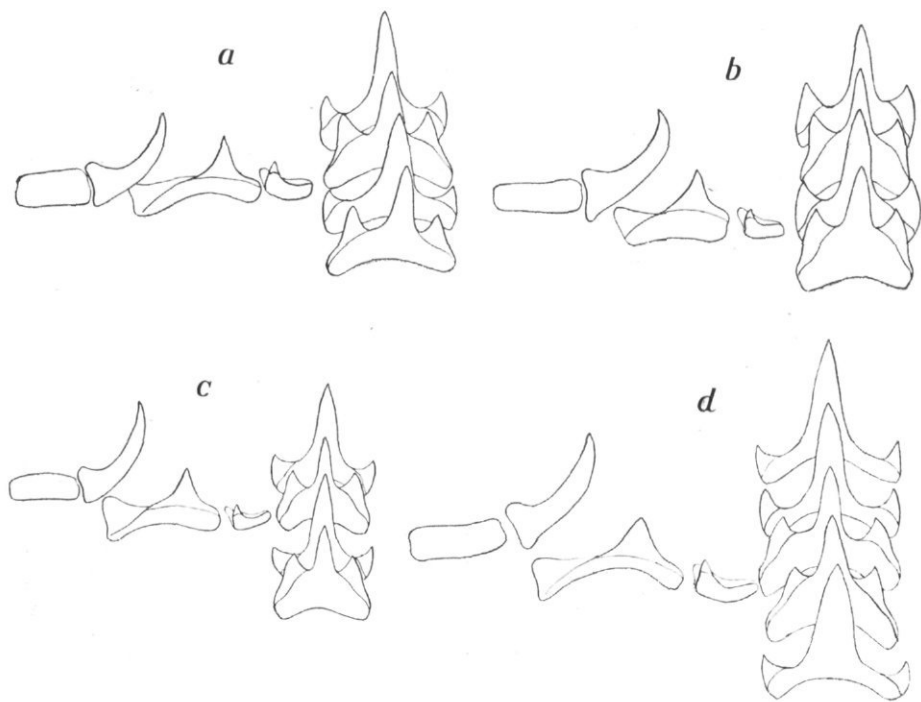


Fig. 10—Radulae (x 76).

a-*Octopus aegina* GRAY, ♂ (dorsal mantle-length: 34 mm); Eylath, IV-1955 (E51/167);

b-*Octopus aegina* GRAY, ♂ (dorsal mantle-length: 25 mm); Golfe de Suez;

c-*Octopus kagoshimensis* ORTMANN, type-specimen, ♂ (dorsal mantle-length: 30 mm);

d-*Octopus aegina* GRAY, ♂ (dorsal mantle-length: 40 mm); Nias.

But here too, the number of examined specimens is too small for a definite statement.

The study of great numbers of well-preserved specimens from different localities will be necessary to solve these and other problems of Octopodan systematics.

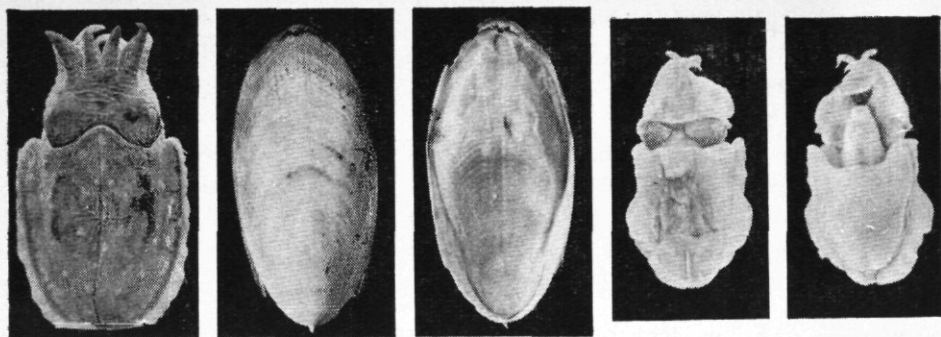
The material at my disposal has enabled me to throw some more light on the confusing position of the "rugose" or "granulose" Octopoda from the Indo-Pacific region. But for the moment I prefer not to take any premature decisions.

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PLATE I

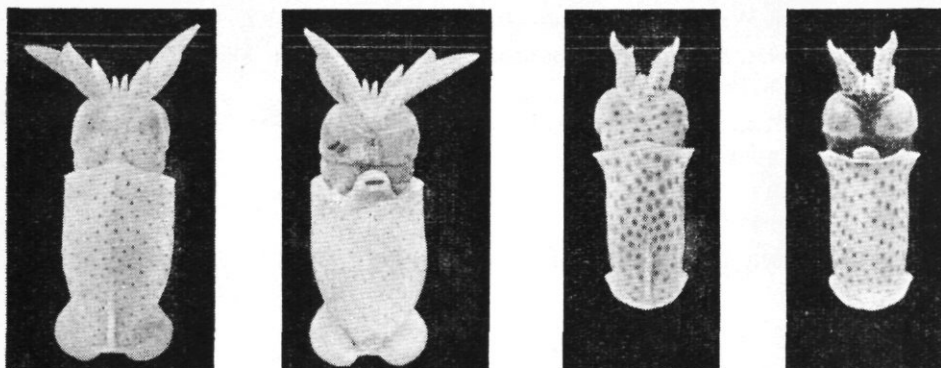


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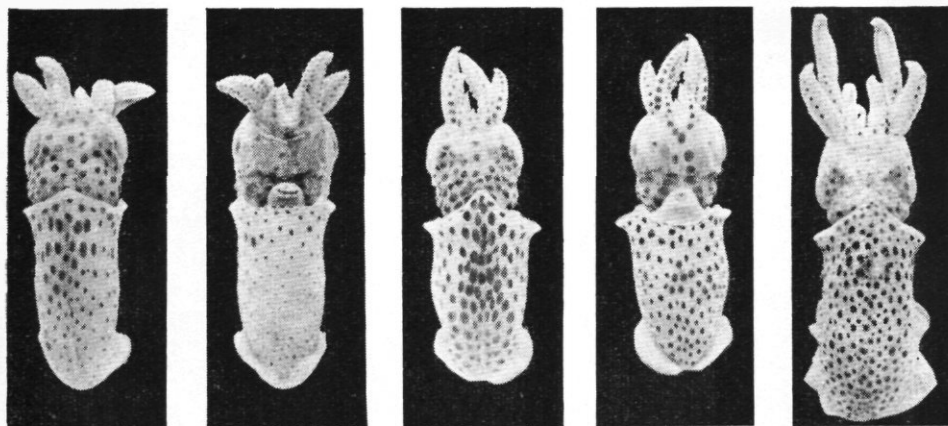
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Sepia pharaonis EHRENBERG



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Sepioteuthis lessoniana LESSON

- Fig. 1— Young specimen (dorsal mantle-length: 21 mm); Eylath, 9-VI-1956 (E 56/161).
 Fig. 2— Siphon of the same specimen.
 Fig. 3— Larval specimen (dorsal mantle-length: 6.5 mm); Eylath, IX-1949 (E 49/67).
 Fig. 4— Larval specimen (dorsal mantle-length: 5.5 mm); Eylath, 10/12-V-1949 (E 49/65).
 Fig. 5— Larval specimen (dorsal mantle-length: 4.5 mm); Eylath, 10/12-V-1949 (E 49/65).
 Fig. 6— Larval specimen (dorsal mantle-length: 5.5 mm); Eylath, 30-XI-1955 (E 55/717a).
 Fig. 7— Larval specimen (dorsal mantle-length: 5.5 mm); Eylath, 8-VI-1956 (E 56/137).
 Fig. 8— Young specimen (dorsal mantle-length: 17 mm); Sharam a Sheikh, 7-I-1957 (E 57/289).

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