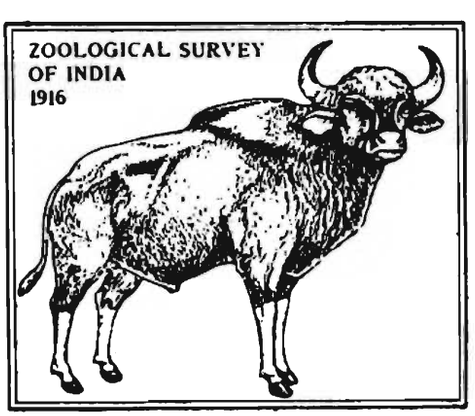
TECHNICAL MONOGRAPH No. 15

CEPHALOPODA OF THE MADRAS COAST

J. T. JOTHINAYAGAM



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CEPHALOPODA OF THE MADRAS COAST

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INTRODUCTION

Cephalopods are bilaterally symmetrical marine molluscs with well-developed head and a crown of tentacles. The terminology of this group is based on the presence of foot attached to the head (Greek "Kephale"= head, "podus"=foot). Our knowledge on the cephalopods dates back to the days of Aristotle. During the 19th century Orbigny (1834-1848), Gray (1849), Steenstrup (1856, 1857, 1875, 1880, 1881), Verrill (1880, 1881 1882), and Hoyle (1885a, 1885b, 1886) made valuable contributions to the study of cephalopod taxonomy. At the dawn of the present century, contributions of Pfeffer (1900, 1908, 1912), Chun (1910), Neaf (1912, 1916, 1921, 1923), Thiele (1921 1935), Grimpe (1916, 1925) and Joubin (1920, 1924, 1931, 1933) gave satisfactory outline to the classification of this group.

During recent years the study of cephalopods taxonomy has received added impetus with increased attention being paid for the exploitation of cephalopods for human consumption. Sasaki (1929), Robson (1929, 1932), Adam (1938a, 1938b, 1939, 1942, 1952, 1954, 1959, 1960, 1973). Voss (1956, 1963, 1977), Fillippova (1968), Roper and Young (1968), Young and Roper (1969, 1969a), Young (1972) and Roper *et al.* (1969, 1984) have brought out important publications paving way for a fuller understanding of cephalopod taxonomy.

A perusal of literature reveals the fact that proper attention has not been paid to the study of the cephalopod fauna of the Indian seas and there are only a few reports on the subject. Important works are by Goodrich (1896), Massy (1916), Robson (1926, 1929, 1932), Winckworth (1936), Adam (1939), Gravely (1941), Rao (1954) and Adam and Rees (1966). Silas (1968) gave a catalogue of the known species of cephalopods from the Indian Ocean. Oommen (1966, 1976 1977) studied some cephalopods from the west coast of India and Silas *et al.* (1982) reported the squid and cuttlefish resources of the Indian seas.

Although Madras is one among the areas in the eastern Indian Ocean where a large number of cephalopod species are landed, very little information is available in literature, on their species composition, seasonal abundance and other aspects of their biology. The present investigations on the cephalopoda of the Madras coast incorporate the following aspects

(i) Description of the cephalopod species collected from the Madras coast,

(ii) Illustrations for all the species together with characters of taxonomic significance in each species,

(iii) Dichotomous key for identification of the species studied and

(iv) Check-list of the species known from the Madras coast.

This work is intended to alleviate the confusion bewildering the workers in this group in the Indian region, serve as a guide to the new entrants in the study of the cephalopod fauna of the area and provide substantial foothold for the fishery scientists interested in the exploitation of this group of animals.

Acknowledgements are due to Dr. B. K. Tikader, Director, Zoological Survey of India, Calcutta, for encouragement and permission to undertake the present work. The author is greatly indebted to Dr. A. Daniel, Joint Director and Officer-in-charge, Marine Biological Station, Zoological Survey of India, Madras for suggesting the problem and valuable guidance. Thanks are due to Dr N. V. Subba Rao, Head of the Mollusca Division, Zoological Survey of India, Calcutta, for suggestions and help rendered for examining the cephalopod holdings of the Zoological Survey of India, Calcutta. The author is thankful to his colleagues at the Marine Biological Station, Zoological Survey of India, Madras, for help and support in various ways for the completion of the present work and to Mrs. Mridhula Jothinayagam, wife of the author, for the typing of the manuscript.

Material and Methods

Material for the study were collected during the period 1975-1982 from the fish-landing centres along the Madras coast between Pulicat in the north and Kalpakkam in the south and from the trawling operations during the fortnightly cruises of 32 feet Research Boat "Chota Investigator" (Pl. 1) of the Marine Biological Station, Zoological Survey of India, Madras, upto a depth of about 50 metres between Ennur in the north and Tiruvanmiyur in the south in which the author participated regularly (Fig. 1). The material from the shore-seines operated along the Madras coast were also collected and utilised for the study. The cephalopod holdings of the Zoological Survey of India, Calcutta and the reserve collections available at the Marine Biological Station, Zoological Survey of India, Madras were also examined for comparative study. A total number of 1858 examples of cephalopods were examined during the course of the present study.

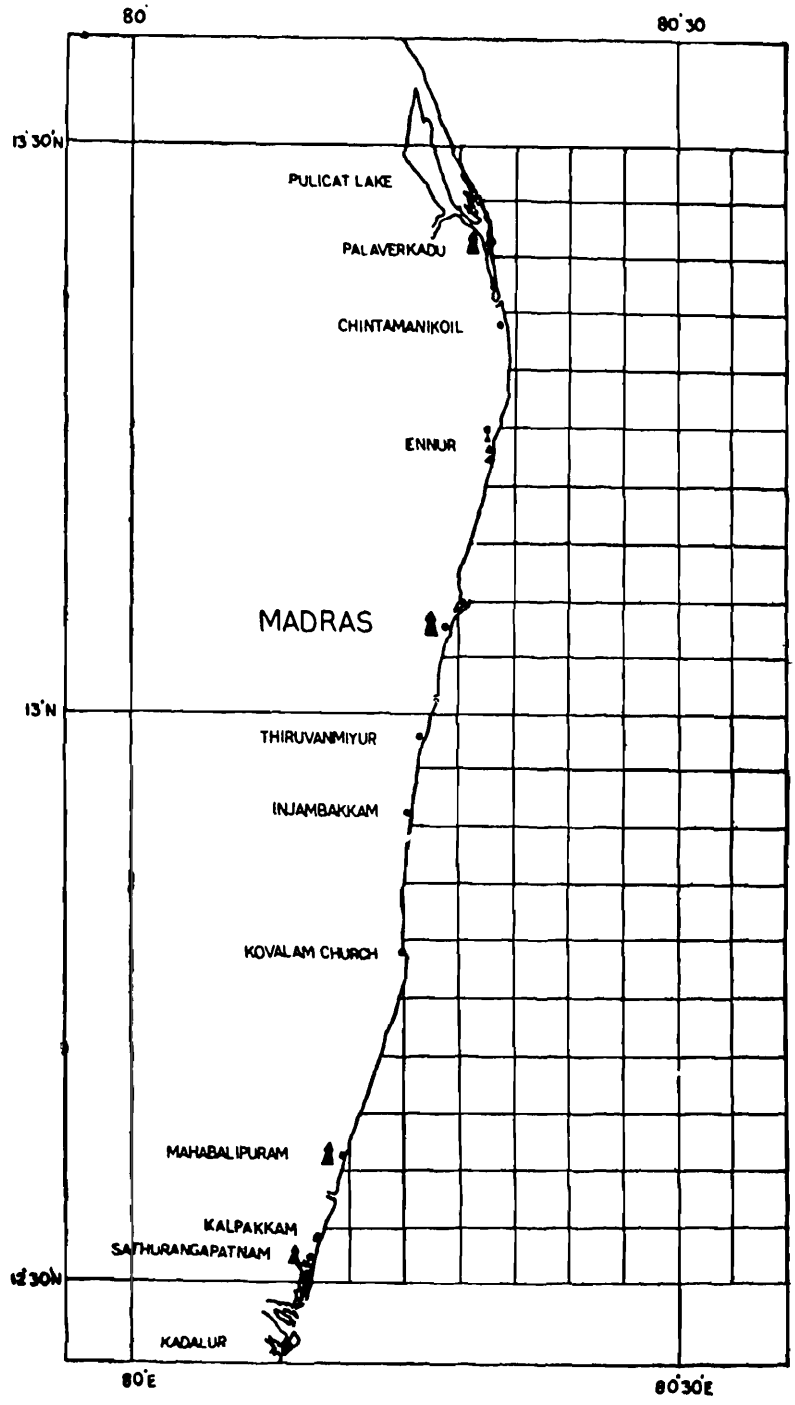


Fig. 1. Map of Madras coast.

For preservation of the specimens, 4% formaldehyde solution was used. To avoid corossion of the cuttlebone in the species of family Sepiidae, this solution was neutralised by adding 10 grams of Sodium Carbonate to 1000 ccs. of the solution. The preservation solution was

injected into the tissues of the bigger specimens to prevent putrification before the preservative penetrates through the skin. After good fixation the specimens were washed in fresh water and kept in 70% alcohol, as otherwise the specimens become rigid.

All the species studied have been illustrated based on material collected during the course of the present study. A dichotomous key is given for identifcation of the species. The identification of the species were confirmed by examining the reference collections identified by Massy (1916) and Adam (1939), available in the cephalopod holdings of the Zoological Survey of India, Calcutta.

In the present work the normal method of orientation of cephalopod body (*i.e.* the head considered anterior and the pallial cavity ventral) has been followed. Measurements were taken using divider, ruler and vernier calipers and were recorded to the nearest mm. The classification followed in the present work is that given by Voss (1977).

The abbreviations used in the present work are as follows

A. = Arm
A.O. = Arm order
A.S. = Arm sucker
B.L. = Buccal lappets
B.M. = Buccal membrane
C.W. = Width of cuttlebone
Cl.L. = Length of club
D.E. = Diameter of eye ball
F.A. = Fin angle
F.L. = Length of fin
F.W. = Width of fin
Fun.L. = Funnel length
Fun.L.C. = Funnel locking cartilage
Fun.O. = Funnel organ
Fun.V. = Funnel valve
G.L. = Length of gill
Gl. W. = Width of gladius

H.L. = Length of head
H.W. = Width of head
Hc.A. = Hectocotylised arm
I. C. = Inner cone
L.A. = Length of arm
L.A.I. = Length of arm I
L.A,II. = Length of arm II
L.A,III. = Length of arm III
L.A.IV. = Length of arm IV
L.F.R. = Length of free rachis
L.L. = Last loculus
L.N.C. = Length of Nuchal cartilage
M.L. = Mantle length
M.W. = Width of mantle
O.C. = Outer cone
P.L. = Length of penis
P.M. = Protective membrane
S. = Spine
S.M. = Swimming membrane
T.A. = Tentacular arm
T.S. = Tentacular sucker
T.L. = Total length
W.O = Web order
V.P. = Velar pouch

CHARACTERS OF TAXONOMIC SIGNIFICANCE

Referring to the taxonomic characters of cephalopods, Massy (1916) aptly stated "any one who has made a study of these creatures is aware of the difficulties lying in the path to correct identification" Hence a careful study was made, of the taxonomic criteria used by earlier cephalopod workers, and those characters considered by the author, appropriate for the identification of the species in the collection were considered in the present work. The material collected for the present study, from the

Madras coast, belonged to three orders, Sepioidea, Teuthoidea and Octopoda.

For the study of Order Sepioidea, the following taxonomic criteria were used (Fig. 2)

Mantle : Description, M.L. measured from the posterior end to anterior end of mantle, M. W. in % of M. L. *

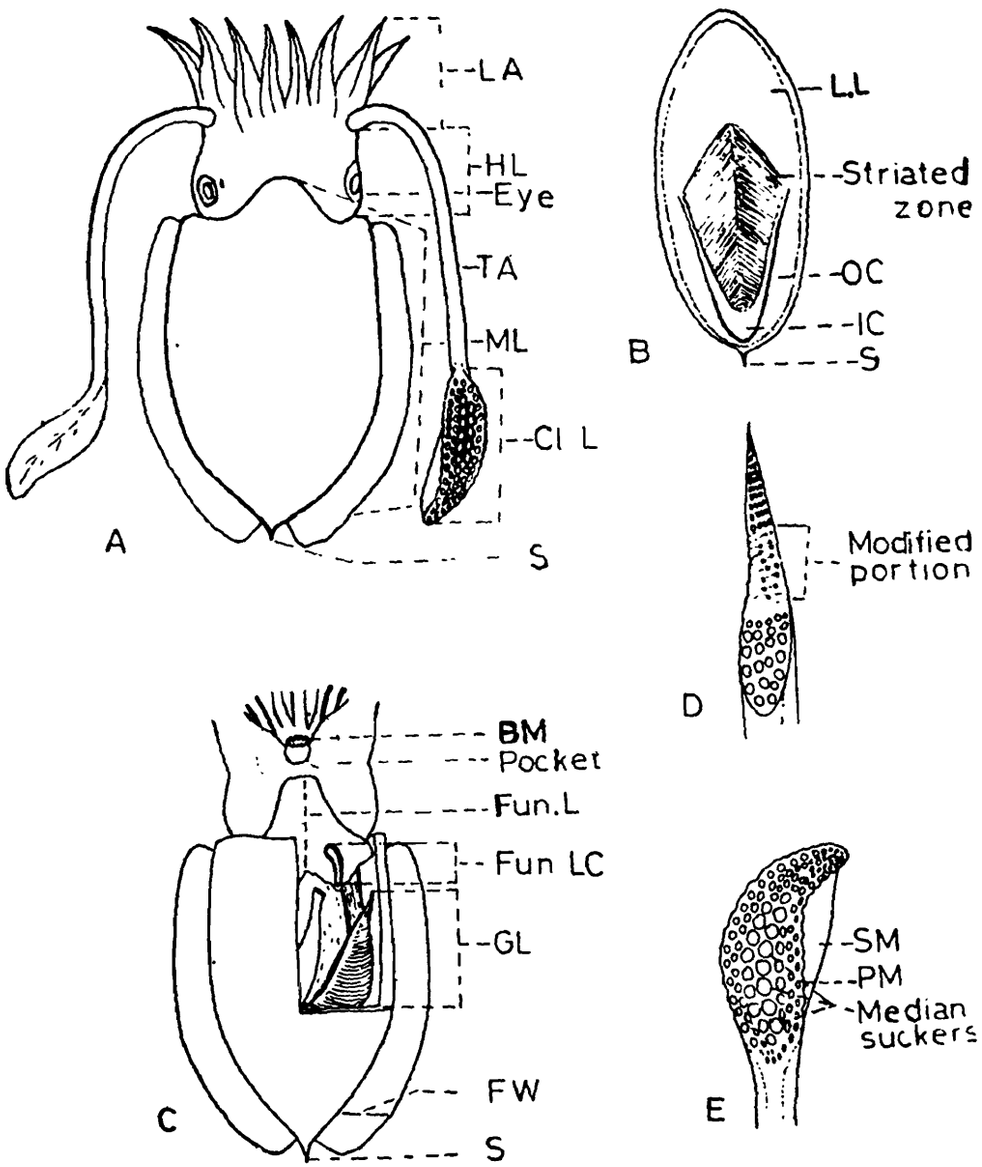


Fig. 2. Characters of taxonomic significance in Order Sepioidea. *eg. Sepia* (a) Dorsal view (b) Cuttlebone-ventral view (c) Ventral view of mantle (d) Hectocotylised arm enlarged (e) Tentacular club enlarged.

*In orders Sepioidea and Teuthoidea the mean of the various measurements in percentage of the mantle length, in the total number of examples studied in each species, are given.

Fin : Distance between the mantle opening and the start of the fin, maximum F.W. in % of M.L.

Head Description, H.L. in % of M.L., H.W. in % of M.L., D.E. in % of M.L.

Arms A.O., extent of P.M. and S.M., L.A.I, L.A.II, L.A.III and L.A.IV in % of M.L. arrangement of suckers in arms.

Hectocotylus : Structure and arrangement of suckers in Hc.A.

Tentacles Shape of tentacular stem, Cl.L. in % of M.L., extent of P.M. and S.M. and arrangement of suckers of club.

Buccal membrane : Description, presence / absence of suckers in the buccal membrane.

Cuttlebone Description, C. W. in % of M.L.

Gill G.L. in % of M.L.

In the order Teuthoidea, the taxonomic characters considered are as follows (Fig. 3).

Mantle : Description, M. L., M.W. in % of M.L.

Fin Shape, F.L. and F.W. in % of M.L., F.A.

Funnel : Description, structure of Fun.V., Fun.L. and length of Fun. L.C. in % of M.L.

Head : Description, H.L., H.W., L.N.C. and D.E. in % of M.L.

Arms : Description, A.O., L.A.I, L. A.II, L.A.III and L.A.IV in % of M.L., arrangement of teeth in A.S., extent of P.M. and S.M.

Hectocotylus : Description of Hc.A.

Tentacles : Shape of stem, Cl.L. in % of M.L., extent of P.M. and SM. arrangement of T.S. number of teeth in chitinous rings of T.S.

Buccal lappets : Description presence / absence of suckers at their tips.

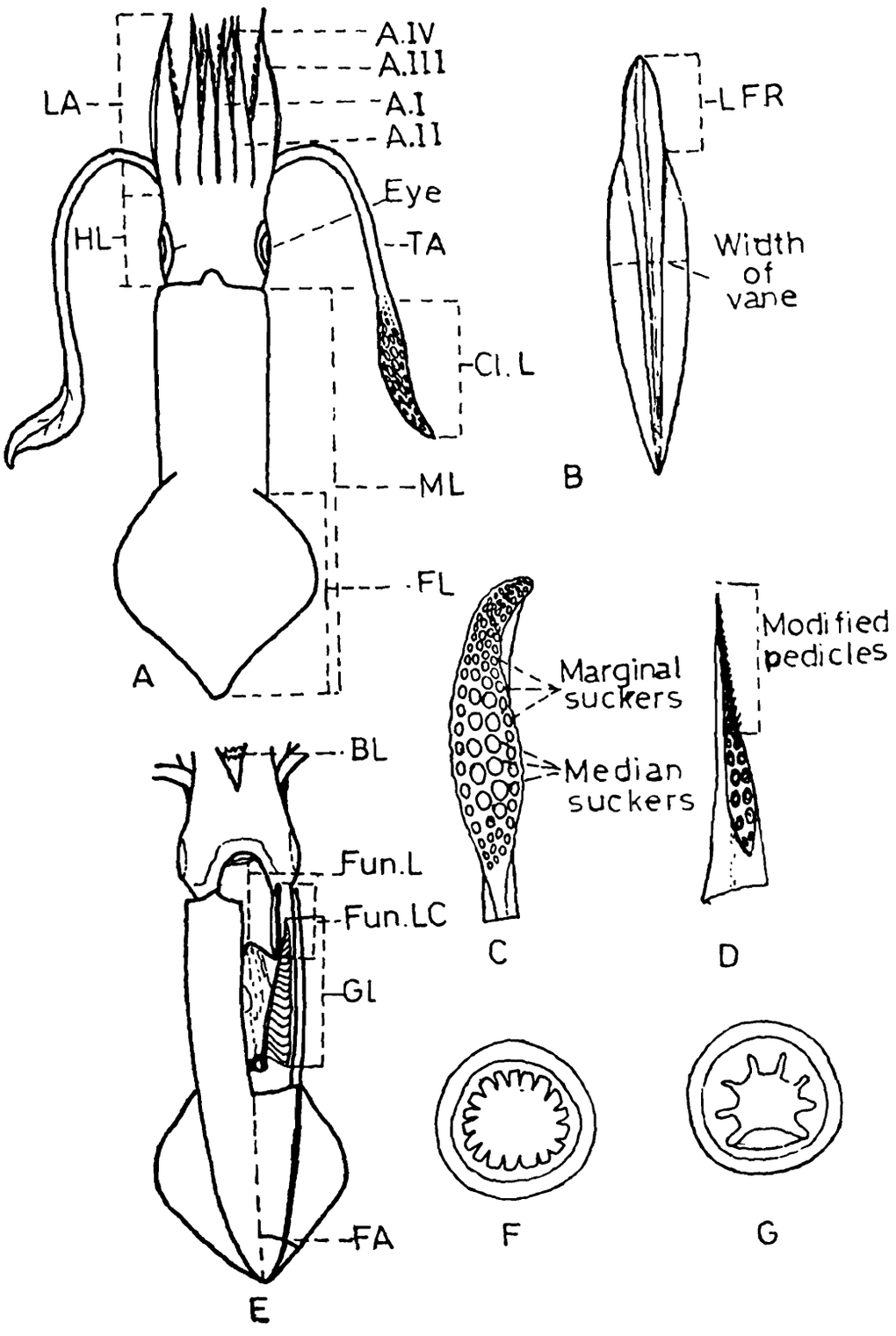


Fig. 3. Characters of taxonomic significance in Order Teuthoidea *eg. Loligo* (a) Dorsal view (b) Gladius (c) Tentacular club enlarged (d) Hectocotylised arm enlarged (e) Ventral view of mantle (f) Tentacular sucker-ring enlarged (g) Arm sucker ring enlarged.

Gladius Description, Gl.W. and L.F.R. in % of M.L.

Gill G.L. in % of M.L.

Taxonomic characters considered for the study of Order Octopoda are as follows (Fig. 4).

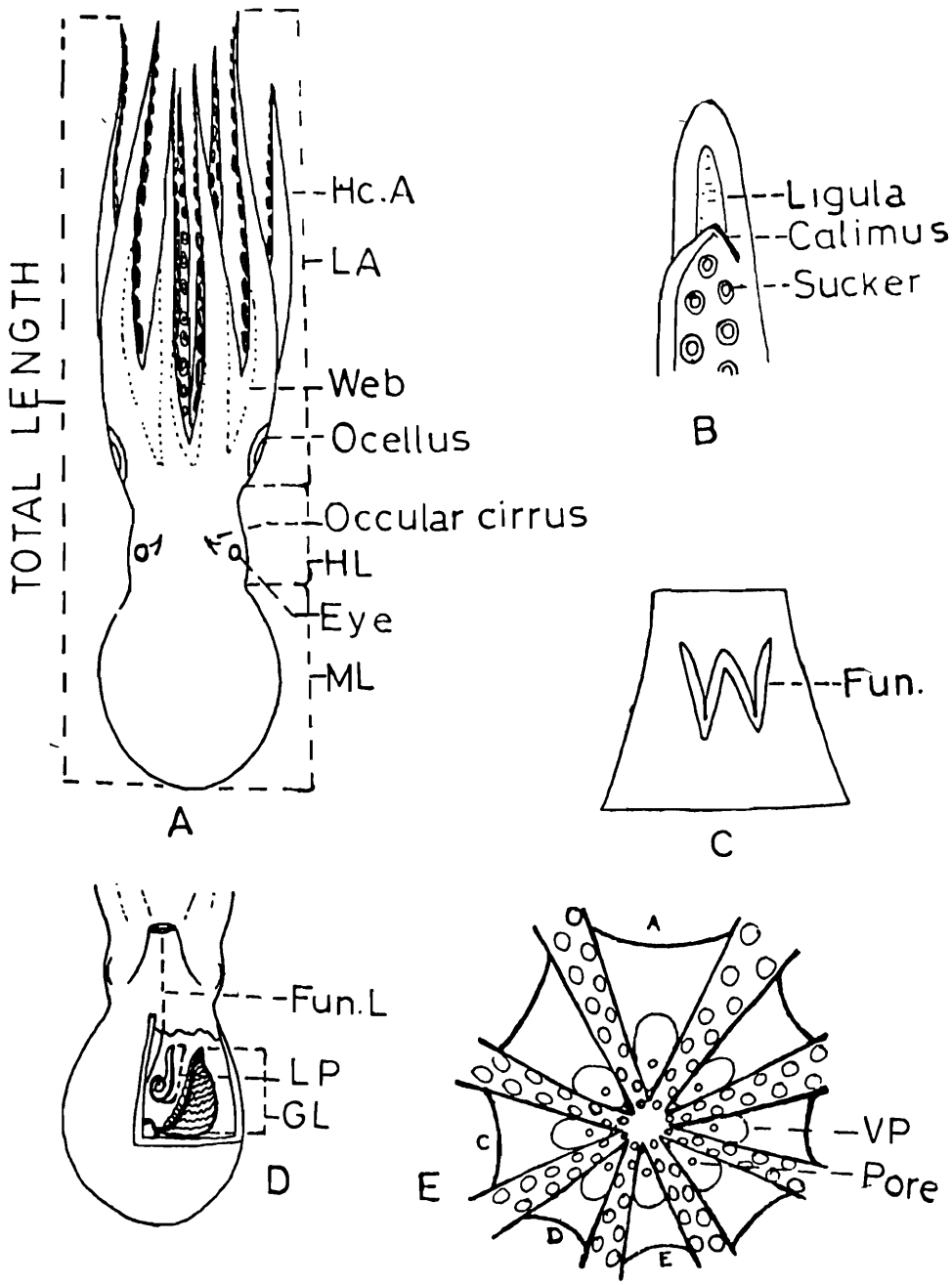


Fig. 4. Characters of toxonomic significance in Order Octopoda *eg. Octopus* (a) Dorsal view of animal (b) Hectocotylus enlarged (c) Funnel organ enlarged (d) Ventral view of mantle (e) Velar pouches and web order A-E.

Mantle Description, M.L. and M.W. in % of T.L. **

Funnel Description, Fun.L. in % of T.L., shape of Fun.O.

Head Description, H.L. and H.W. % of T.L., presence / absence of cirrus above eye.

Arms Description, A.O., L.A.I, L.A.II, L.A.III and L.A.IV in % of T.L., W.O.

Hectocotylus Description, length of ligula in % of L.A.

Penis P.L. in % of T.L., description.

Gill G.L. in % of T.L. number of lamellae on the outer demibranch.

Ocellus : Presence / absence of occellus description, if present.

Few characters like shape of radula and beak and some organs in the pallial cavity, were not considered here as these characters were not very useful in distinguishing the species and the taxonomic characters used in the present report proved sufficient for the study of the present collection.

Key to the species described in the present work

1.	Cephalopoda with ten arms (eight oral and two tentacular) ; suckers stalked and have horny rings	2
—	Cephalopoda with eight arms ; suckers sessile, no horny rings	17
2.	Tentacles retractile into pockets	3
—	Tentacles not retractile into pockets ...	12
3.	Shell internal, calcified	4
—	Internal shell chitinous or lacking ...	10
4.	Cuttlebone with spine at the posterior end ...	5
—	Cuttlebone without spine at the posterior end ...	9
5.	Conspicuous stripes on dorsal mantle, head and arms	*Sepia pharaonis*
—	No conspicuous stripes on dorsal mantle head and arms	6
6.	Dorsal surface of the cuttlebone rose-coloured ...	*Sepia prashadi*
—	Dorsal surface of the cuttlebone white in colour ..	7
7.	Innercone of the cuttlebone rose-coloured ...	*Sepia brevimana*
—	Innercone of the cuttlebone white in colour ...	8

**In order Octopoda the mean of different measurements in percentage of total length, in the total number of specimens examined in each species, are given.

8.	Shell small, attenuate behind	*Sepia kobiensis*
—	Shell large, less attenuate behind	*Sepia aculeata*
9.	Cuttlebone rod-shaped ; distinct ear-shaped fold above eye; no glandular pore at the posterior end of mantle	*Aurosepina arabica*
—	Cuttlebone flat with broad chitinous margins ; no ear-shaped fold above eye ; glandular pore at the posterior end of mantle	*Sepiella inermis*
10.	Normal suckers present on the proximal half of the hectocotylised left arm I	*Euprymna berryi*
—	No normal suckers, but large fleshy protrusion at the base of the hectocotylised left arm I ...	11
11.	Mantle short, fins broad	*Inioteuthis japonica*
—	Mantle long, fins short	*Inioteuthis maculosa*
12.	Hectocotylisation by modification of a portion of the left ventral arm IV	13
—	Entire left ventral arm IV hectocotylised ...	*Loliolus Investigatoris*
13.	Fins broad, extending to over 90% of the mantle length from the posterior end	*Sepioteuthis lessoniana*
—	Fins triangular or rhomboidal in shape, less than 90% of the mantle length from the posterior end	14
14.	Vane of gladius broad, with thin edges ...	15
—	Vane of gladius narrow, with thickened edges ...	*Doryteuthis singhalensis*
15.	Enlarged suckers on the two median manal rows have smooth rings ; the ventral row of suckerless papillae in the hectocotylised of the left ventral arm IV greatly swollen and connected into a ridge	*Loligo uyii*
—	Tentacular suckers all have teeth around rings ; papillae on the hectocotylised portion of left arm IV free	16
16.	More than 50% of the distal portion of the hectocotylised arm has transformed suckers (papillae) ; posterior tip of the mantle ends bluntly ...	*Loligo duvaceli*
—	Only 33% of the distal portion of the hectocotylised left arm IV with modified suckers (papillae) ; posterior end of mantle ends into a point ...	*Loligo bengalensis* sp. nov.
17.	Streaks and rings blackish with pale blue centre, present all over the mantle and arms ; five to six basal suckers placed in one row, followed by two rows of suckers in the arms	*Hanlochlaena fasciata*
—	No streaks and rings on the mantle and arms : suckers in two rows from the beginning of the arms	18

18.	Body soft, and gelatinous; funnel completely fused to the head	*Berrya hoylei*
—	Body not soft and gelatinous; funnel free at the anterior end	19
19.	Velar pouch present on each segment of web between the bases of the arm	*Cistopus indicus*
—	No velar pouch between the bases of arms ...	20
20.	Funnel organ VV shaped	*Octopus prashadi*
—	Funnel organ 'W' shaped ...	21
21.	Web shallow between arms I	22
—	Web highest between arms I	24
22.	Ocellus present on web at base of arm II anter-oventral to the eyes	*Octopus areolatus*
—	No ocellus present	23
23.	Long posterior loop present in the penis ...	*Octopus aegina*
—	No posterior loop present in the penis ...	*Octopus rugosus*
24.	Suckers on the arms sunken; arms tapering to very fine points at their tips	*Octopus fusiformis*
—	Suckers on arms raised; arms not tapering to very fine points at their tips	*Octopus macropus*

CHECK-LIST OF CEPHALOPODS OF THE MADRAS COAST***

Class CEPHALOPODA Cuvier, 1798

Sub-class COLEOIDEA Bather, 1888

Order SEPIOIDEA Neaf, 1916

Family SEPIIDAE Keferstein, 1866

Genus **Sepia** Linnaeus, 1758

1 *Sepia aculeata* Orbigny, 1848
2. *Sepia pharaonis* Ehrenberg, 1831
3. *Sepia kobiensis* Hoyle, 1885
4. *Sepia brevimana* Steenstrup, 1875
5. *Sepia prashadi* Winckworth, 1936

Genus **Sepiella** Grey, 1849

6. *Sepiella inermis* Orbigny, 1848

Genus **Aurosepina** gen. nov.

7. *Aurosepina arabica* (Massy, 1916)

***This list comprises of species recorded so far from the area of present study *i.e.*, Madras coast from Pulicat in the north to Kalpakkam in the south.

Family SEPIOLIDAE Leach, 1817
Sub-family SEPIOLINAE Appellof, 1898
Genus **Euprymna** Steenstrup, 1887

8. *Euprymna berryi* Sasaki, 1929

Genus **Inioteuthis** Verrill, 1881

9. *Inioteuthis japonica* Verrill, 1881
10. *Inioteuthis maculosa* Goodrich, 1896

Order TEUTHOIDEA Neaf, 1916
Sub-order MYOPSIDA Orbigny, 1845
Family LOLIGINIDAE Steenstrup, 1856
Genus **Loligo** Schneider, 1784

11. *Loligo duvauceli* Orbigny, 1848
12. *Loligo uyii* Wakiya & Ishikawa, 1921
13. *Loligo bengalensis* sp. nov.

Genus **Doryteuthis** Neaf, 1912

14. *Doryteuthis singhalensis* Ortmann, 1891

Genus **Sepioteuthis** Blainville, 1824

15. *Sepioteuthis lessoniana* Lesson, 1830

Genus **Loliolus** Steenstrup, 1856

16. *Loliolus investagatoris* Goodrich, 1896

Order OCTOPODA Leach, 1818
Sub order INCRIRATA Grimpe, 1916
Family OCTOPODIDAE Orbigny, 1845
Sub family OCTOPODINAE Grimpe, 1921
Genus **Octopus** Lamarck, 1798

17. *Octopus aegina* Gray, 1849
18. *Octopus rugosus* Bose, 1792
19. *Octopus macropus* Risso, 1826
20. *Octopus fusiformis* Brock, 1887
21 *Octopus areolatus* Orbigny, 1840
22. *Octopus globosus* Appellof, 1886****
23. *Octopus cyaneus* Gray, 1849****
24. *Octopus prashadi* Adam, 1939

****Species not represented in the present collection.

Genus **Cistopus** Gray, 1849

25. *Cistopus indicus* Orbigny, 1840

Genus **Haplochlaena** Robson, 1929

26. *Haplochlaena fasciata* Hoyle, 1886

Genus **Berrya** Adam, 1939

27. *Berrya hoylei* (Berry, 1909)

SYSTEMATICS

Class CEPHALOPODA Cuvier, 1798

The class comprises of marine molluscs with bilaterally symmetrical body and a crown of mobile appendages attached to the head, around the mouth. The mouth of the animal has beak-like jaws and radula. The shell of the animal may be internal external or lacking.

Sub-class COLEOIDEA Bather, 1888

Cephalopoda with internal shell and a pair of gills. They have tube-like funnel and have 8 or 10 appendages.

Order SEPIOIDEA Neaf, 1916

The shell of the animal calcareous or chitinous 10 appendages around the mouth (8 oral and 2 tentacular) the 2 tentacular arms are retractile into pockets fin lobes not connected at the posterior end of mantle.

Family SEPIIDAE Keferstein, 1866

Internal shell calcareous body oval fins narrow lateral, extending almost to the full length of the mantle and free at the posterior end arms with 2 to 4 and tentacles with 4 to 8 suckers in longitudinal rows.

Genus **Sepia** Linnaeus, 1758

Cuttlebone flat, laminate and with a prominent spine at posterior end no glandular pore at the posterior end of mantle no ear-shaped lobe behind each eye left ventral arm hectocotylised.

Sepia aculeata Orbigny, 1848

(Fig. 5)

Sepia aculeata

Orbigny, 1848 (in 1834 1848) Cephalopodes acetabuliferes vivants et fossils. In Historie naturelle generale et particuliers : edited by A. Ferussac and A. d'Orbigny, Paris, p. 287.

Goodrich, 1896. *Trans. Linn. Soc. London, Zool.* VII, p. 3
Massy, 1916. *Rec. Ind. Mus.*, XII, p. 223
Adam, 1939. *Ibid.*, XLI, p. 64
Adam & Rees 1966. *John Murray Exped. Sci. Rept.* 11 (1) pp. 12-14 pl. 4, figs. 20 & 21, pl. 42 fig. 251.

Sepia indica
Ferussac & d'Orbigny in 1834-1848. *Hist. nat. Ceph. acetab.* p. 281 pl. 21

Acanthosepion hasselti
Rochebrune, 1884. *Bull. Soc. Philom. Paris.*, B (7) p. 101

Sepia smithi
Hoyle, 1885. *Ann. Mag. Nat, Hist.*, (5) XV p. 190

Material examined 23 ♂ 26 ♂

Diagnosis : Tentacular suckers small, subequal and arranged in 12 longitudinal rows. The proximal part of the left ventral arm hectocotylised with about three series of normal suckers followed by 5-6 series of minute suckers with hollowed-out portion in the middle and the rest of the arm possessing normal suckers. The cuttlebone long and broad with long striated zone in the ventral surface, the last loculus being very short and slightly concave in the middle.

Description :

Mantle : Mantle broadest at the anterior end, the maximum M.W. about 50% of M.L., the M.W. decreasing gradually towards the posterior end. Distinct mid-dorsal projection with excavated sides present.

Fins : Fins start from 3-4 mm. bellow the mantle opening, broadening steadily and reaching a maximum F.W. of about 15% of M.L. at the posterior end.

Funnel : Funnel does not reach the base of the ventral arms F.L. about 31.3% of M.L., Fun.V. bluntly rounded ; length of Fun.L.C. about 12.3% of M.L.

Head : Head narrower than the mantle opening. H.L. about 32.5% of M.L., H.W. about 40.3% of M.L., D.E. about 16.8% of M.L.

Arms A.O. usually 4 3 2 1 ; L.A.I. about 45.9% of M.L., L.A.II about 47% of M.L., L.A.III about 50% of M.L. and L.A.IV about 50.4% of M.L. Dorsal arms rounded and ventral ones with strong S.M. Arm suckers arranged in four rows.

Hectotylus Hectocotylus present in the left ventral arm. The arm has three series of normal suckers followed by 5-6 series of minute suckers with a hollowed-out portion in the middle and the rest of the arm in the distal side has normal suckers.

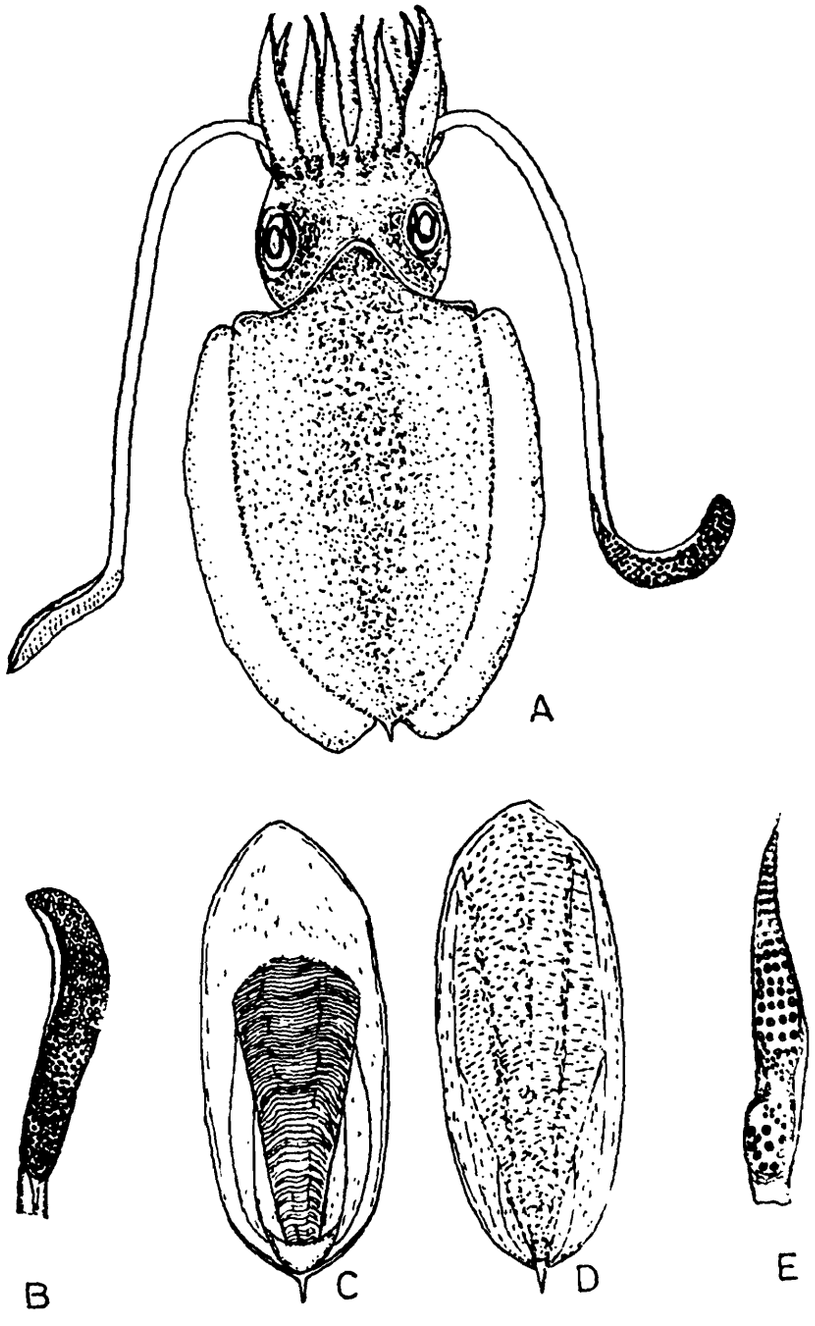


Fig. 5. *Sedia aculeata* Orbigny, 1848 (a) Dorsal view (b) Tentacular club enlarged (c) Cuttlebone-ventral view (d) Cuttlebone-dorsal view (e) Hectocotylised arm enlarged.

Tentacles Tentacles long and the stem is triangular in cross section. The P.M. runs as ridged on the stem. The length of the club about 31.3% of M.L. The S.M. shorter than the sucker-bearing surface. Suckers small, sub-equal, arranged in 12 longitudinal rows.

Cuttlebone : Cuttlebone long, broadest where the striated zone ends maximum width about 35% of M.L. The dorsal surface of the shell rugose and has three distinct low ribs. The striated zone on the ventral surface long the striae are concave ; the last loculus short and slightly concave in the middle. The outercone forms a narrow chitinous ledge between the innercone and the spine the spine is slightly turned upwards.

Buccal membrane Minute suckers present in the membrane.

Gill G.L. about 36.9% of M.L.

Colour : Colour slate with closely set chromatophores on the dorsal surface, except for the fins where it is pale the ventral surface buff with fewer chromatopores.

Type locality Java.

Geographic distribution Indo-pacific, from Arabian sea to south China sea and northwards upto Japan sea.

Affinities The structure of the tentacular club with 12 rows of small, semiequal suckers and the structure of the hectocotylus, separate this species from the other cuttlefishes of the area. In body proportions this species is next only to *Sepia pharaonis* which is the largest specis reported from the area.

Sepia pharaonis Ehrenberg, 1831
(Fig. 6)

Sepia pharaonis

Ehrenberg, 1831. Symbolae physical, animalia evertebrata exclusis insects, Mollusca Berlin, Vol. IV unpag.

Adam & Rees. 1966. *John Murray Exped. Sci. Rept.* 11 (1) pp. 22-26, pl. 8, figs. 38-43 ; pl. 41, fig. 240.

Acanthosepion rouxi

Rochebrune, 1884. *Etude monographique de la famille des Sepiadae Bull. Soc. Philom. Paris* 8 (7) p. 108.

Sepia singalensis
Goodrich, 1896. *Trans, Linn. Soc. London, Zool.* VII, p. 3, pl. 1, fig. 4-8.
Massy, 1916. *Rec. Ind. Mus.*, XII, p. 227

Sepia tigris
Sasaki, 1929. *J. Coll. Agric. Hokkaido Imp. Univ.*, 20 (Suppl.) p. 168 fig. 167 pl. 28 figs. 13-16.

Sepia hulliana
Adam, 1939. *Siboga Exped. Monographie*, 55 b. p. 55.

Sepia ursulae
Adam, 1939. *Ibid.*, 55b, p. 66.

Material examined 14♂ 17♀

Diagnosis Conspicuous transverse stripes on the dorsal side of the mantle head and arms tentacular club has 8 suckers in transverse rows with the medium ones enlarged in size the hectocotylised left arm IV has 12 rows of normal suckers, the next 10 rows with minute suckers in dorsal two rows and normal suckers in the two ventral rows, the dorsal and ventral rows seperated by a fleshy transverse ridge. The inner cone of the cuttlebone is wide and flattened with an oval prominence in the centre.

Description :

Mantle Mantle broadest in the upper half maximum M.W. about 55% M.L. The mid-dorsal mantle is produced into a triangular lobe.

Fins Fins originate a few millimetres behind the mantle opening fins are fleshy and widest in the posterior half with a maximum F.W. about 14.5% of M.L.

Funnel Funnel thick-walled, reaching almost the base of the ventral arms Fun.L. about 30% of M.L. Fun.V. triangular in shape length of Fun.L.C. about 19% of M.L.

Head Head prominent H.A. about 29% of M L., H.W. about 30% of M.L. D.E. about 16% of M.L.

Arms A.O. usually 3 4 2 1 L.A.I about 42% of M.L L.A.II about 43% of M.L.III about 51% of M.L., L.A.IV about 45.5 of M.L., arms posses, strong S.M. and P.M., arm suckers four in transverse rows.

Hectocotylus The left ventral arm hectocotylised it has 12 rows of normal suckers followed by about 10 rows in which the ventral suckers

are normal and the dorsal once are minute and separated by a fleshy transverse ridge. The distal portion of the arm has normal suckers.

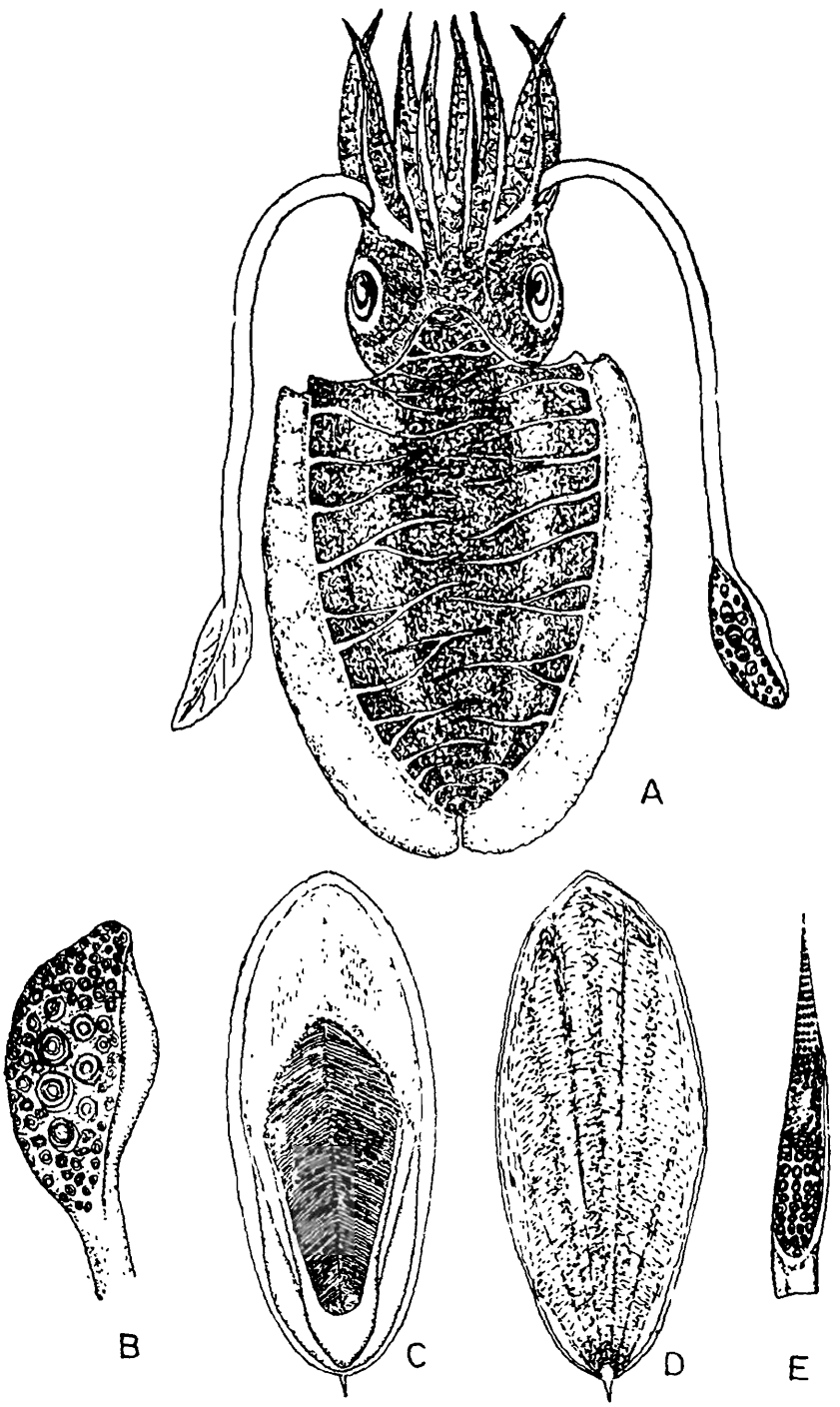


Fig. 6. *Sepia pharaonis* Ehrenberg, 1831 (a) Dorsal view (b) Tentacular club enlarged (c) Cuttlebone-ventral view (d) Cuttlebone-dorsal view (e) Hectocotylised arm enlarged.

Tentacles Tentacles long tentacular stem triangular in cross section Cl.L about 28% of M.L club broad with strong S.M., suckers arranged in 5-7 rows enlarged suckers presnt in two rows in the middle of the club the 7th and 8th suckers are exceptionally large.

Cuttlebone Cuttlebone elongate with broad chitinous margins widest in the middle the maxinum width is about 38% of M.L. The dorsal surface has three longitudinal ribs the ventral surface has a shallow median groove, along the entire length of the striated area the innercone forms a characteristic callosity at the posterior end, the spine is devoid of keels and possesses two lateral expansions.

Buccal membrane Edges of buccal membrane beset with minute suckers.

Gill G.L. about 32% of M.L.

Colour Dorsal surface of the mantle, head and arms are ornamented with conspicuous transverse stripes the fins are paler the ventral surface has fewer chromatophores.

Type locality Tor, Sinai, Massaouah

Geographic distribution Indo-Pacific, Red Sea, Arabian Sea, Bay of Bengal, South China and northern Australia.

Affinities The characteristic stripes on the dorsal mantle, head and arms and the large size of the animal distinguish this species from other species of the area. *Sepia prashadi*, another species found in the area has got enlarged suckers in the tentacular club as in *Sepia pharaonis*. but the former species differs from the latter in having a shorter tentacular club, smaller mantle and distinctly different cuttlebone.

Sepia kobiensis Hoyle, 1885
(Fig. 7)

Sepia kobiensis

Hoyle, 1685. Diagnoses of new species of cephalopoda collected during the cruise of H. M. S. Challenger 2. the Decopoda. *Ann. Mag. Nat. Hist.*, (5) 16 : 195

Adam & Rees, 1966. *John Murray Exped. Sci. Rept.*, pp. 71-78, pl. 19, figs 116-120 : pl. 43 fig. 255, pl. 44, fig. 264.

Sepia (Doratosepion) andreanoides

Massy, 1916. *Rec. Indi. Mus.*, XII p. 229.

Sepia (*Doratosepion*) *kobiensis*
Massy, 1916. *Ibid.*, XII p. 230

Sepia kobiensis var. *albatrossi*
Sasaki, 1920. *Proc. U. S. Nat. Mus.* 57 : 195 pl. 26 figs. 2 and 3.

Sepia kobiensis var. *typica*
Sasaki, 1929. *J. Coll. Agric. Hokkaido imp. Univ.* 20 Suppl : p. 206, fig. 111 pl. 19, figs. 1-4.

Sepia kobiensis var. *andreanoides*
Sasaki, 1929. *Ibid.*, p. 206, figs. 112-114, pl. 1, fig 7 pl. 19 figs. 5-7.

Sepia kobiensis var. *beppuna*
Sasaki, 1929. *Ibid.*, p. 211, fig. 115, pl. 19, figs. 13-15.

Sepia kobiensis var. *toyamensis*
Sasaki, 1929. *Ibid* p. 209, fig. 115, pl. 19, figs. 8-12.

Sepia kobiensis var. *crassa*
Sasaki, 1929. *Ibid.*, p. 213, pl. 19, figs. 16-18.

Sepia andreanoides
Hoyle, 1885. *Ann. Mag. Nat. Hist.*, (5) 16 : 193.
Gravely, 1941. *Bull. Madras Govt. Mus.*, N. H. 5.1. pp. 67-68.

Material examined 14 ♀

Diagnosis Mantle slender head narrower arms tapering to fine points, tentacular club small and narrow with small suckers cuttlebone small, narrow and attenuate behind, with narrow chitinous margin.

Description :

Mantle : Mantle slender, M.W. about 50% of M.L. The mid-dorsal projection is only slightly pronounced ending acutely.

Fins Fins narrow, starting a few mm. below the mantle opening. Maximum F.W. about 9.3% of M.L.

Funnel Funnel almost reaching the base of the ventral arms ; Fun.L. about 30.2% of M.L. ; Fun.V. short and conical ; Fun.L.C. about 16.3% of M.L.

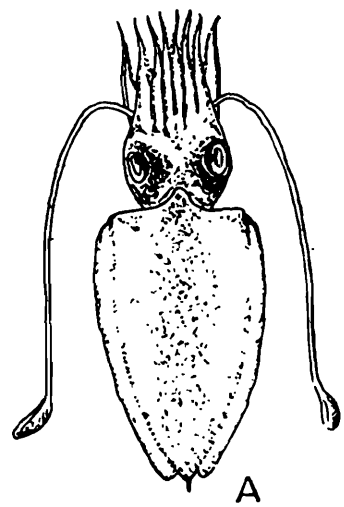
Head : H.W. about 37.3% of M.L., H.L. about 28% of M.L. D.E. about 16.3% of M.L.

Arms : Arms tapering to fine points ; A.O. 4 3 2 1 L.A.I about 42% of M.L., L.A.II about 44% of M.L. L.A.III about 44.3% of M.L. L.A. IV about 46.6% of M.L. S.M. poorly developed in the ventral arms.

Hectocotylus : No male specimen in the collection, hence not studied.

Tentacles Tentacles long and thin club short and narrow suckers small and arranged in transverse rows of eight suckers in the central area of the club slightly larger than others S.M. poorly developed.

Cuttlebone Cuttlebone small, elongate, widest in the area where the striated zone ends maximum width of cuttlebone about 10.3% of M.L. The shell is accumunate at the anterior end and regularly tapering towards the posterior end the dorsal surface has a faint median rib, the ventral surface has a median groove forming a broader depression in the anterior part of the last loculus. The inner cone has narrow lateral limbs and the elongated posterior portion the outercone forms a cup-like



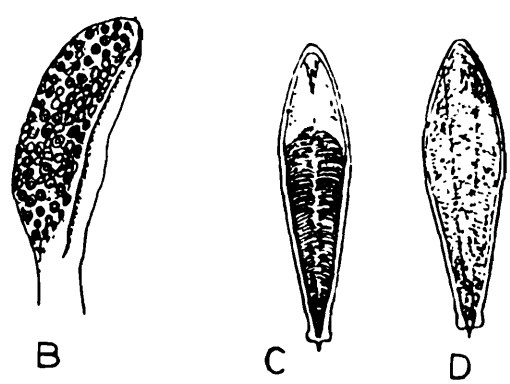


Fig. 7. *Sepia kobiensis* Hoyle, 1885 (a) Dorsal view (b) Tentacular club enlarged (c) Cuttlebone-ventral view (d) Cuttebone-dorsal view.

widening surrounding the innercone. The shell has very narrow chitinous margin the spine is directed upwards.

Buccal membrane : No sucker present on the buccal membrane.

Gill : G.L. about 36.3% of M.L.

Colour The dorsal mantle is dark brown in colour, except in the periphery and the fins, where the chromatophores are very minute and distantly placed. The ventral mantle is pale with lesser number of chromatophores.

Type locality Bay of Kobe, Japan.

Geographic distribution : Indo-Pacific, Arabian sea, Bay of Bengal, China Sea and Japan. This species is reported for the first time from the study-area.

Affinities This species is easily distinguished by the small size, narrow head and arms tapering to fine points and the narrow shell attunuate behind. In the present material, the suckers in the central zone of the tentacular club are only slightly larger than others. It is significant to note that all the 14 specimens present in the collection are only females.

Sepia brevimana Steenstrup, 1875
(Fig. 8)

Sepia brevimana
Steenstrup, 1875. *Hemisepius* en ny slaegt af *Sepia*-Blacksprutternes familie. *K. danske. Selsk. Skr. Nat. Afd., Ser.* 5, 10 (7) : p. 475.
Adam & Rees, 1966. *John Murray Exped. Sci. Rept.* 11 (1) pp. 5-7 pl. 2 figs. 5-8.

Sepia rostrata
Ferussac and d'Orbigny, 1848 (1834-1848). *Hist. Nat. Ceph. acetab.*, p. 284.

Acanthosepion rostratum
Rochebrune, 1884. *Bull. Soc. Philom. Paris.* 8 (7) : p. 102 pl. 6, fig. 1.

Sepia winckworthi
Adam, 1939. *Bull. Mus. r. Hist. nat. Belg.* 15 (32) p. 1 pl. 1 fig. 1.

Matarial examined ; 30 ♂ 27 ♀

Diagnosis Broad mantle with well-marked mid dorsal projection short tentacular club with well-developed S.M. and P.M. and small,

subequal suckers arranged in 6-8 transverse rows spine at the posterior end of cuttlebone, long.

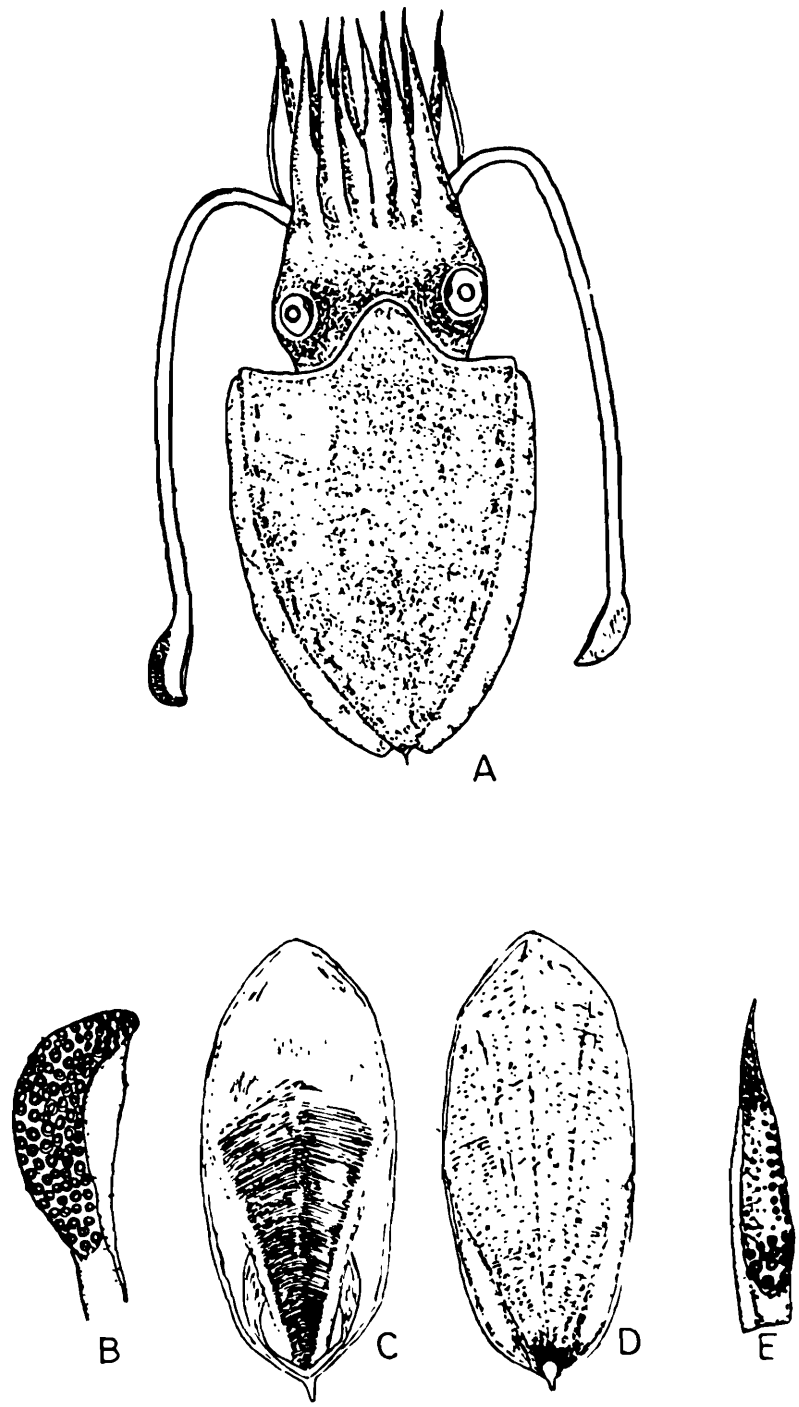


Fig. 8. *Sepia brevimana* Steenstrup, 1875 (a) Dorsal view (b) Tentacular club enlarged (c) Cuttlebone-ventral view (d) Cuttlebone-dorsal view (e) Hectocotylised arm enlarged.

Description

Mantle Mantle short and broad the maximum M.W. about 60% of M.L., the mid-dorsal projection is strongly developed and is accumunate.

Fins Fins start very near to the mantle opening and gradually widen posteriorly maxinum F.W. about 11.3% of M.L.

Funnel Funnel long and reaching the base of the ventral arms Fun.L. about 42.3% of M.L., Fun.V. rounded at the anterior end length of Fun.L.C. about 13.1% of M.L.

Head Head broad, H.W. about 47% of M.L. and H.L. about 43.2% of M.L. D.E. about 24.4% of M.L.

Arms A.O. usually 4 3 2 1 A.L.A.I about 39% of M.L. L.A.II about 44% of M.L. L.A.III about 45.1% of M.L. L.A.IV about 52.6% of M.L. dorsal arms round, swimming membrane slightly developed in the ventral arms.

Hectocotylus Left arm IV hectocotylised the arm has 3 rows of normal suckers in the proximal end followed by 10 rows with minute suckers in the lower region and the corresponding upper region beset with ridges the distal end of the arm has got normal suckers.

Tentacles Tentacular club short ; Cl.L about 15% of M.L. S.M. and P.M. well-developed suckers small, subequal and arranged in oblique transverse rows of 6-8.

Cuttlebone Cuttlebone broad, maximum width about 45.1% of M.L., the dorsal surface is tuberculate and presents three series of stronger tubercles. The anterior portion is accumunate and triangular. The ventral side has a central rib in the middle. The innercone is rose-coloured and has broad lateral limbs ; the outercone is interrupted between the innercone and the spine. The spine is long and slightly curved upwards. In the female the cuttlebone is more wide at the posterior part.

Buccal membrane : No suckers seen in the buccal membrane surrounding the mouth.

Gill G.L. about 43.2% of M.L.

Colour The mid-dorsal mantle is dark slate in colour with concentration of chromatophores while the peripheral zone and the fins are pale. The ventral surface is also pale with fewer chromatophores.

Type locality Indian Ocean.

Geographic distribution Indian Ocean Arabian sea, Bay of Bengal and down to Singapore.

Affinities This species resembles *Sepia aculeata* in having small subequal suckers in the tentacular club but easily distinguished from the latter in having a short broad mantle and short tentacular club. The rose-coloured inner cone of the cuttlebone distinctly separates this species from other cuttlefishes of the area.

Sepia prashadi Winckworth, 1936
(Fig. 9)

Sepia prashadi
Winckworth, 1936. Marine mollusca from South India and Ceylon. A new Indian *Sepia*. *Proc. Malac. Soc. Lond.* 22 (1) : 16.

Marerial examined 8♂ 10♀

Diagnosis Mantle widest at the anterior end fins narrow tentacular club short and broad, 2-3 enormously developed suckers in the middle of the club. The hectocotylised arm has 2 rows of normal suckers at the base followed by 12-14 transverse rows of minute suckers with transverse folds and the distral tip of the arm with normal suckers. The dorsal surface of the cuttlebone rose-coloured.

Description

Mantle Widest at the anterior end and steadily tapering towards the posterior end. Maximum M.W. about 52% of M.L. the mid-dorsal mantle is produced into a conical shape.

Fins Fins begin from about 4mm. distance from the mantle margin fins uniformly narrow, the maximum F.W. about 10.8% of M.L. at the posterior end fins are distinctly separated.

Funnel Funnel large, reaching almost the base of the ventral arms. Fun.L. about 33.7% of M.L. Fun.V. broad and semilunar in shape length of Fun.L.C. about 12% of M.L.

Head Head distinctly narrower than the mantle opening H.W. about 40% of M.L. H.L. about 33.7% of M.L. D.E. about 16.2% of M.L.

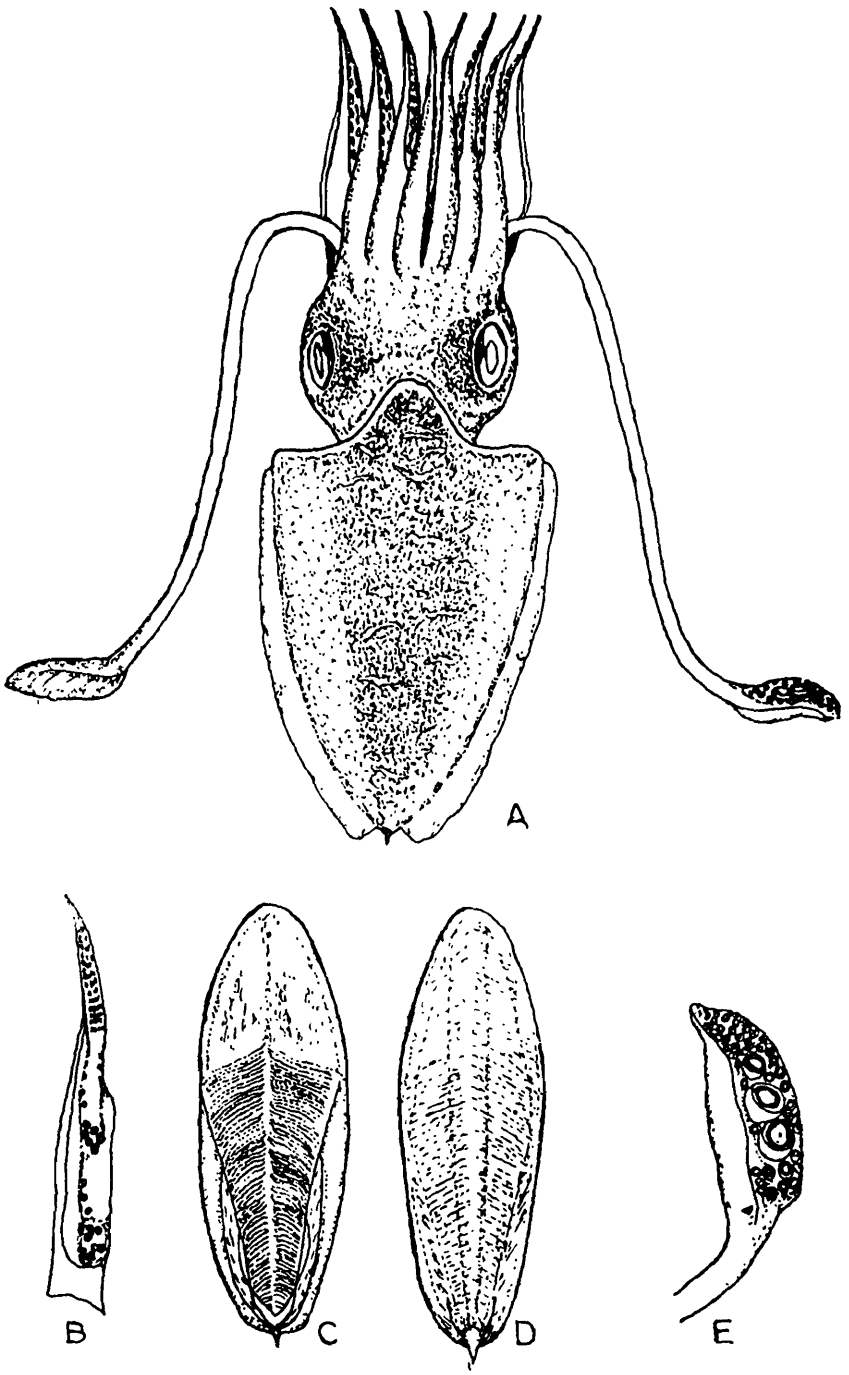


Fig. 9. *Sepia prashadi* Winckworth, 1936, (a) Dorsal view (b) Hectocotylised arm enlarged (c) Cuttlebone-ventral view (d) Cuttlebone-dorsal view (e) Tentacular club enlarged.

Arms Arms distinctly long and drawn into very fine points at their distal end. A.O. usually 1 3 4 2 L.A.I about 60.7% of M.L. L.A.II about 56.7% of M.L., L.A.III about 58.5% of M.L. and L.A.IV about 57% of M.L. S.M. poorly developed in the ventral arms, dorsal arms rounded.

Hectocotylus The hectocotylised left ventral arm IV has 2 rows of normal suckers at its base, followed by the transformed portion with 12-14 transverse rows of minute suckers the transformed portion occupies the greater part of arm-length and has transverse folds the distal tip of the arm has got minute normal suckers.

Tentacles The tentacular stem is round, the club is short and broad with well-developed S.M. and P.M. The tentacular suckers arranged in oblique transverse rows of eight, but due to the enormous development of the 3rd sucker from 2nd to 4th series, the other suckers are pushed aside.

Cuttlebone Cuttlebone elongate three distinct ridge, present on the dorsal side the dorsal surface rugose and rose in colour. On the ventral surface, there is a narrow median furrow, over its whole length. The striated zone is very long the cuttlebone is widest at the end of the striated zone, the maximum width about 32.3% of M.L. The outercone is narrow and surrounds the innercone the chitinous margin is narrow and the spine directed upwards.

Buccal membrane Mouth surrounded by buccal membrane devoid of suckers.

Gill G.L. about 37.8% of M.L.

Colour Dark-brown closely-set chromatophores found on dorsal mantle, head and arms on the peripheral zone of the dorsal mentle and the fins, chromatophores are very much reduced. The ventral mantle is beset with minute pinkish chromatophores.

Type locality Madras, Bay of Bengal.

Geographic distribution Indian Ocean Southern Mosambique, Gulf of Aden, Red Sea. Arabian Sea, Bay of Bengal and Sri Lanka.

Affinities This species resembles *Sepia pharaonis* in having enlarged suckers on the tentacular club, but the latter differs from the former in

having a large tentacular club and very large mantle. The rose-coloured dorsal surface of the cuttlebone distinctly separates this species from other species of cuttlefishes of the study area.

Genus **Sepiella** Gray, 1849

Species of this genus have cuttlebone devoid of spine at the posterior end and they possess a distinct glandular pore at the posterior and of mantle. The mantle locking cartilage is semi-circular with cone-shaped tubercle.

Sepiella inermis Orbigny, 1848
(Fig. 10)

Sepiella inermis

Orbigny, 1848 (in 1834-1848) Cephalopodes acetabuliferes vivants et fossils. *In* Histoire naturelle generale et particuliere. Edited by A. Ferussac and A d'Orbigny, Paris p. 286, pl. 20 fig. 1-9.

Rochebrune 1884. *Bull. Soc. Philom. Paris.* 8 (7) p. 88.

Adam and Rees, 1966. *John Murray Exped Sci. Rept.* 11 (1) : p. 128 pl. 37, figs. 216-219.

Sepia tourannensis

Eydoux and Souleyet 1852 *Voyage autaur du monde execute pendant les annees 1836 et 1837 sur la corvette la Bonite. Commandee par M. Valliant. Zoologie, Paris.* 2 : p. 33 pl. 3 figs. 6-12.

Sepia affinis

Eydoux and Souleyet 1852, *Ibid.*, p. 35, pl. 3 figs. 13 & 14.

Sepia (Sepiella) inermis

Tryon, 1879. *Manual of Conchology.* 1. *Cephalopoda, Philadelphia.* p. 196 pl 91, fig. 423, pl. 192 figs. 424-429.

Diptherosepion martini

Rochebrune, 1884. *Bull. Soc. Philom. Paris.* p. 81.

Rhombosepion touranense

Rochebrune, 1884. *Ibid.*, p. 84.

Sepiella maindroni

Rochebrune, 1884. *Ibid.*, p. 89.

Sepiella curta

Pfeffer, 1884. *Abh. naturw. ver. Hamburg.* 17, p. 13 figs. 16, 16a.

Sepiella microcheirus

Adam, 1939. *Siboga Exped. Monographie.* 55b : p. 107.

Sepiella affinis

Adam, 1939. *Ibid.*, 55b : p. 107.

Material examined : 292 ♂ 326 ♀

Diagnosis Distinct glandular pore at the posterior end of the mantle cuttlebone flat, laminate and devoid of spine at the posterior end tentacular suckers minute and in no particular order.

Description

Mantle Mantle broad, widest anteriorly maximum M.W. about 55.4% of M.L., mid-dorsal projection is broad and ends bluntly distinct

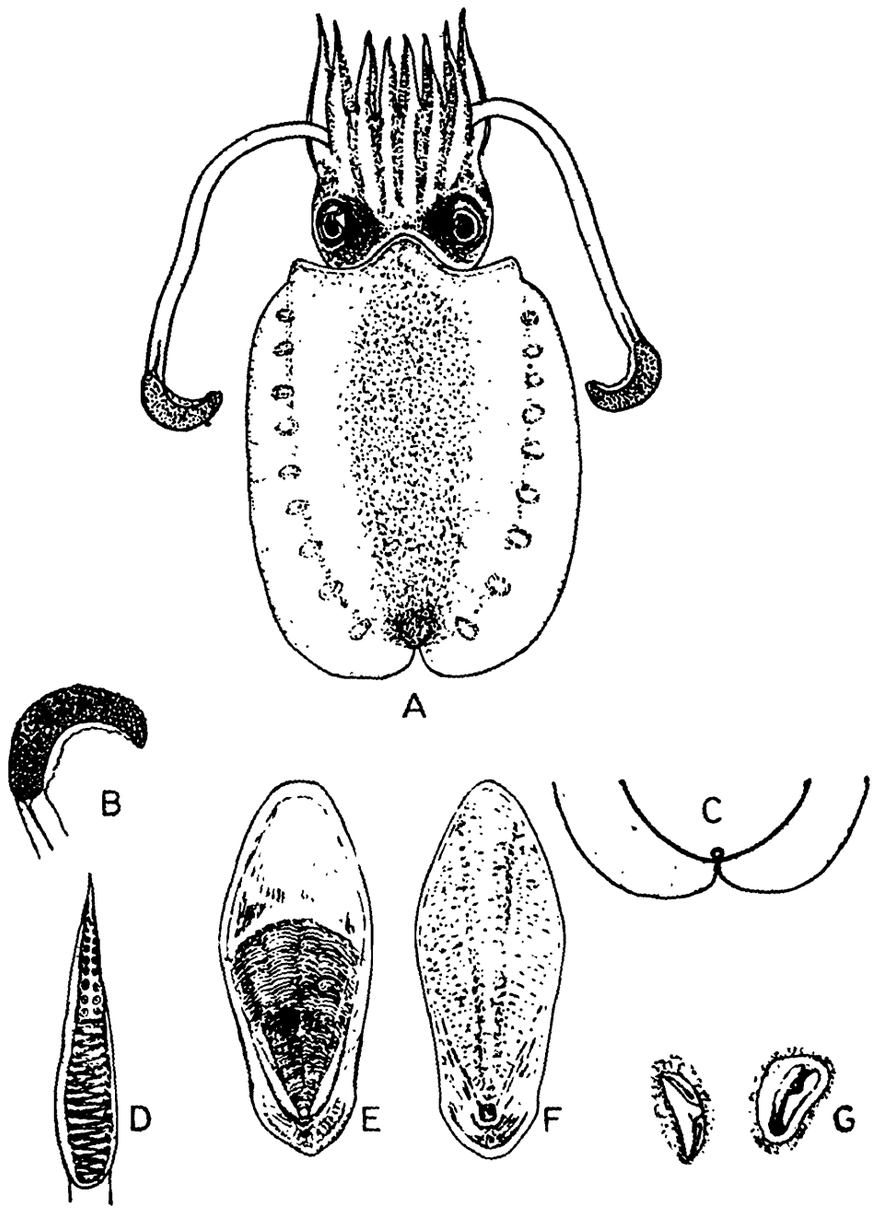


Fig. 10. *Sepiella inermis* Orbigny, 1848 (a) Dorsal view (b) Tentacular club enlarged (c) Pore at the posterior end of mantle (d) Hectocotylised arm enlarged (e) Cuttlebone-ventral view (f) Cuttlebone-dorsal view (g) Locking ridge of mantle.

glandular pore present at the posterior end of the mantle. Locking ridge of mantle with cone shaped tubercle.

Fins Fins originate very close to the mantle opening. become wider posteriorly the maximum F.W. about 19.8% of M.L.

Funnel Fun.L. about 29.7% of M.L., funnel reaching the base of the ventral arms ; Fun.V. bluntly rounded length of Fun.L.C. about 14.8% of M.L.

Head Head broad H.W. about 46.2% of M.L. H.L. about 34.6% of M.L. D.E. about 18.1% of M.L.

Arms A.O. usually 4 3 2 1 L.A.I about 26.4% of M.L. L.A.II about 29.7% of M.L. L.A.III about 39.6% of M.L. L.A.IV about 42.9% of M.L. ; S.M. strongly developed in the ventral arms.

Hectocotylus The proximal half of the Hectocotylised left ventral arm IV modified the modified area characterised by transverse folds and minute suckers the distal half of the arm bears normal suckers.

Tentacles ; Tentacular stem triangular in cross-section Cl.L. about 29.7% of M.L. moderate S.M. and P.M. present club suckers minute, in no particular order.

Cuttlebone Cuttlebone widest in about two thirds of its length from the posterior end, maximum width about 36.3% of M.L. the dorsal surface presents an elevated ridge with shallow grooves on either side. On the ventral side the striae are convex with wavy central portion the last loculus is elevated in front and gradually becomming thinner peripherally ; the limbs of the innercone merges with the outercone the chitinous margins are broad and expanded posteriorly no spine at the posterior end of the cuttlebone.

Buccal membrane No suckers seen on the buccal membrane surrounding the mouth.

Gill G.L. about 36.3% of M.L.

Colour The dorsal surface of the mantle set with close dark chromatophores, the fins are pale faint white patch present as elongation of the arms backward up to the eyes. The ventral surface of the mantle pale-white with distantly placed chromatophores.

Type localities Batavia, Bombay, Pondichery, Coromandel coast.

Geographic distribution Indo-Pacific, Red sea, Arabian sea, Bay of Bengal and up to China sea.

Affinities This species can be easily differentiated from the species of the *Sepia* occuring in the area by the absence of spine at the posterior end of the cuttlebone and the presence of glandular pore at the posterior end of the mantle. This species resembles *Aurosepina arabica* in having spineless cuttlebone, but the latter is easily distinguished by the characteristic rod-shape of the the cuttlebone and the presence of ear-shaped fold behind each eye.

Genus AUROSEPINA gen. nov.

The new genus *Aurosepina* is proposed to accommodate a male specimen of cuttlefish which clearly falls under Family Sepiidae with internal calcareous shell, with lateral fins free at the posterior end, arms with four suckers in a row and tentacular club with 5-6 suckers in a row. The present specimen differs from the already known genera *Sepia* and *Sepiella* in the following characters.

(1) Well-developed ear-shaped fold on the head above the posterior end of each eye.

(2) The cuttlebone unusually narrow to the width of the body, rounded anteriorly and attenuate behind and devoid of chitinous margin, the striae in the ventral surface 'V' shaped (and not $\wedge$ shaped as in genera *Sepia* and *Sepiella*) no spine present at the poterior end, instead, the posterior part of the inner cone radiate a number of keeled ridges, calcareous in the central part and chitinous towards the margin of the outercone that form two narrow wings, united posteriorly.

(3) The hectocotylisation of the left ventral arm, well-marked in genera *Sepia* and *Sepiella*, is not distinguished. In the present specimen both the right and left ventral arms are similar in having the sucker-bearing surface almost completely covered by the protective membrane.

(4) Series of triangular brown patches along the base of fin present ; the second pair of arms have on their dorsal surface near the base a well marked distinct tubercle two barbs each on the outer margin of arms II arms III with barbs along the entire length of outer margin rectangular brown patches pres nt on the dorsal side of arm III.

The characters 1-4 stated above clearly separate the present specimen of cuttlefish from the existing genera *Sepia* and *Sepiella* and necessiate its allocation under a new genus *Aurosepina.*

Study of the type specimens of Massy's (1916) species *Sepia arabica*, available in the Mollusca Division of the Zoological Survey of India, Calcutta, revealed that it possessed the major characters of the present specimen. Massy recorded in specimen $\frac{MB113}{1}$ the ear-shaped folds on the head behind each eye and stated "these appear to accidental" A comparative study of the present material which has got distinct ear-shaped folds, proves that they are not accidental, but regular, permanent structure of the animal. The cuttlebone described by Massy is incomplete due to loss of the posterior end and hence Massy could not bring out the significance of the cuttlebone completely yet the narrow rounded shape, the distinct 'V' shaped striae and the absence of chitinous margin are clearly indicated since the type was a female the hectocotylisation is not shown. Due to small size and long period of preservation, the colouration and connected morphological characters could not be clearly made out.

In the light of characters given above, Massy's species *Sepia arabica* along with present specimen should be placed under the new genus *Aurosepina* as *Aurosepina arabica* (Massy, 1916). The genus is named after the distinct ear-shaped fold on the head above the posterior end of each eye.

The present material is at present in the collections of the Marine Biological Station, Zoological Survey of India, Madras, and in the due course will be deposited with the Zoological Survey of India, Calcutta.

Aurosepina arabica (Massy, 1916)
(Fig. 11 pl. 2)

Sepia arabica
Massy, 1916. The Cephalopoda of the Indian Museum. *Rec. Ind. Mus.*, XII p. 228-230 pl. XXIII.

Material examined 1 ♂

Diagnosis Distinct ear-shaped fold on the head above the posterior end of each eye present cuttlebone unusually narrow to the width of the mantle, rounded anteriorly and attenuate behind, striae on the ventral surface 'V' shaped and no spine at the posterior end.

Description

Mantle Mantle oval, maximum M.W. about 51.1% of M.L., the mid dorsal projection is triangular and accumunate at the end between the eyes.

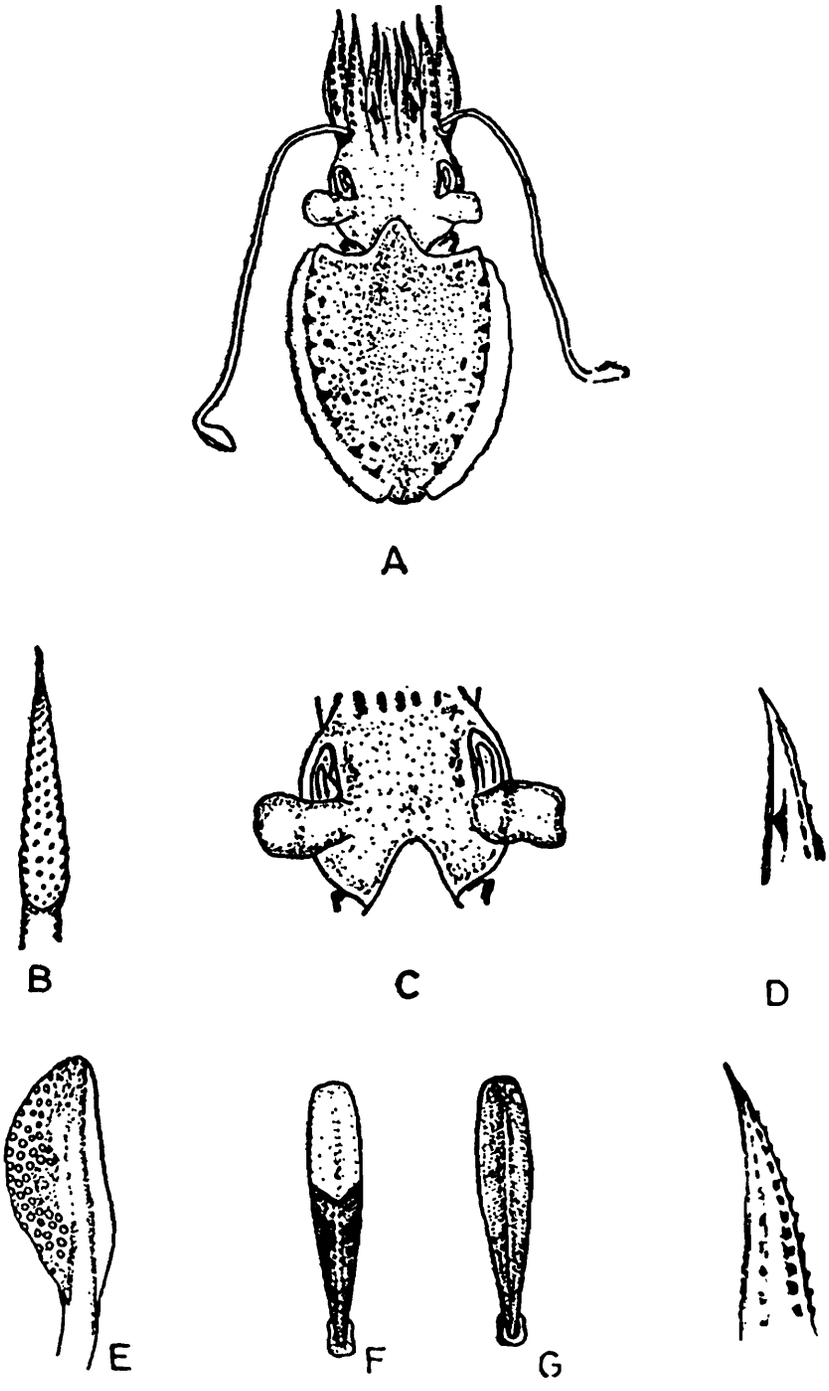


Fig. 11. *Aurosepina arabica* (Massy. 1916) (a) Dorsal view (b) Structure of arm IV enlarged (c) Ear shaped fold on the head enlarged (d) Tubercle at the base of arm II (e) Tentacular club enlarged (f) Cuttlebone-ventral view (g) Cuttlebone-dorsal view (h) Barbs at the outer margin of arm III.

Fins : Fins start from about 4mm. distance from the mantle margin fins narrow, maximum F.W. about 8.5% of M.L.

Funnel Funnel broad and almost reaching the base of the ventral arms ; Fun.L. about 29.8% of M.L. Fun.V. short and bluntly rounded.

Head Head narrower than the mantle opening. H.W. about 42% of M.L. H.L. about 34.1% of M.L. D.E. about 19.1% of M.L. dtstinct muscular ear-shaped fold present above the posterior end of each eye, length of the fold about 16% of M.L. width about 12.1% of M.L.

Arms A.O. usually 4 3 2 1 L.A.I about 31.9% of M.L. L.A.II about 34.1% of M.L. L.A.III about 38.3% of M.L. L.A.IV about 42.7% of M.L. arms compressed, distinct tubercle present at the base on the dorsal side of arm II, and the same arm has two barbs on the outer margin the outer margin of arms III with barbs along the entire length suckers small widely spaced, arranged in slanding series of four in a row.

Hectocotylus There is no distinct hectocotylisation seen in the species both the right and left ventral arms are similar in having sucker braring surface completely covered by the protective membrane.

Tentacles Tentacles slender and the stem triangular in cross section ; club small, Cl.L. about 10.6% of M.L. the club has well developed S.M. on its dorsal side the P.M. continuing as low ridges suckers small, subequal arranged in 5-6 longitudinal series.

Cuttlebone Cuttlebone usually narrow to the width of the mantle, rounded anteriorly and attenuate behind on the dorsal surface, a median rib present, the surface on either side of the rib chitinised and faintly striated the ventral surface has a shallow median groove for the whole of shell length the striae are 'V' shaped the thickness of the shell is at its maximum in the posterior part of the last loculus. The outercone is narrow, the shell has no chitinous margin. The posterior part of the inner-cone radiate a number of sharp keeled ridges, calcarious in the central part and chitinous towards the margin and form two narrow wings united posteriorly no spine present.

Buccal membrane No suckers seen in the buccal membrane surrounding the mouth.

Gill Gl.L. about 38.3% of M.L.

Colour Colour pinkish grey on the dorsal surface of the mantle at the base of the fins a row of triangular patch present along the entire length of mantle row of rectangular brown patch present on the dorsal side of arms III.

Type locality Laccadive sea, Arabian sea Madras, Bay of Bengal.

Geographic distribution Indian Ocean Arabian Sea. This species is reported for the first time from the Madras coast.

Affinities In the absence of spine at the posterior end of the cuttlebone, this species resembles *Sepiella inermis* but it is easily separated from the latter by the absence of glandular pore at the posterior end of the mantle. The presence of distinct ear-shaped fold on the head above the posterior end of each eye distinguishes this species from all other species of cuttlefishes of the area. Although Adam and Rees (1966) recorded *Sepia arabica* from the Red Sea, no mention is made about the ear-shaped fold and hence its systematic position is not discussed here.

Family SEPIOLIDAE Leach, 1817

Only one or both dorsal arms hectocotylised.

Sub-family SEPIOLINAE Apellof, 1898

Dorsal border of mantle fused with head.

Genus **Euprymna** Steenstrup, 1887

Mantle sacular, gladius absent, tentacular club with numerous minute suckers, left arm I hectocotylised with normal suckers on the proximal half and closely packed modified papillae on the distal half.

Euprymna berryi Sasaki, 1929
(Fig. 12)

Euprymna berryi
Sasaki, 1929. A monograph of the dibranchiate cephalopods of the Japanese and adjacent waters. *J. Coll. Agri. Hokk.*, 20 ; pp. 143-146 ; pl. 15, figs. 12 and 13.

Inioteuthis morsei
Verrill, 1881. *Rep. U.S. Fish. Comm.*, p. 417.

Sepiola bursa
Pfeffer, 1884. *Abh. Naturw. Ver. hambura.* VII p. 6. fig. 6.

Inioteuthis morsei
Goodrich, 1896. *Trans. Linn. Soc. London.*, 7 : p. 3.

Euprymna morsei
Hoyle, 1904. *Bull. Mus. Comp. Zool.* XLIII. p. 26.
Massy, 1916. *Rec. Ind. Mus.*, 12 : p. 216.
Sanjeeva Raj & Kalyani, 1971. *J. Mar. Biol. Ass. India.*, 13 (1) p. 135-137.

Material examined : 10♂ 13♀

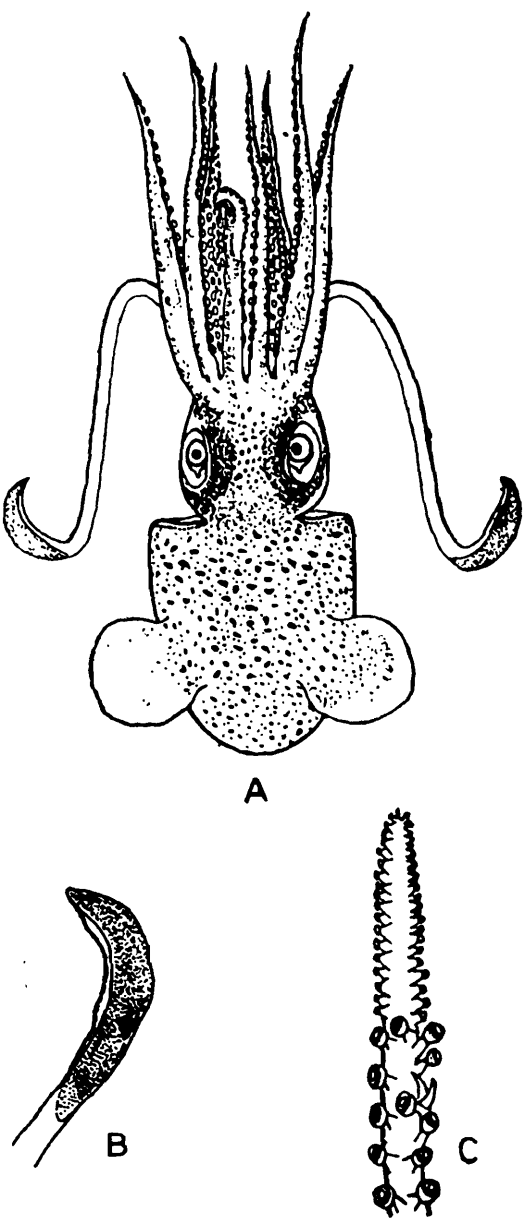


Fig. 12. *Euprymna berryi* Sasaki, 1929. (a) Dorsal view (b) Tentacular club enlarged (c) Hectocotylised left arm I enlarged.

Diagnosis Mental short and sacular head connected with the mantle at the dorsal side arm length about 1.5 times the mental length lateral rows of suckers of arms II and IV enlarged in size left arm I hecto-cotylised having normal suckers in the proximal half with 2 suckerless nipple-like papillae in the ventral row at 0.25 arm length and the distal half has closely set palisaded papillae with rudimentary suckers.

Description

Mantle Mantle short and stout, maximum M.W. about 83.3% of M.L. the dorsal mantle is connected with the head.

Fins Fins large rounded and inserted at mid length of the mantle maximum F.W. about 59.9% of M.L. Fin length at the point of insertion about 33.3% of M.L. and maximum F.L. about 49.9% of M.L.

Funnel Funnel long, free and reaching the base of the ventral arms Fun.L. about 63.2% of M.L. ; Fun.V. small and tringular in shape length of Fun.L.C. 26.6% of M.L.

Head H.W. about 66.6% of M.L. H.L. about 59.9% of M.L. D.E. about 23.3% of M.L. head connected with the mantle on the dorsal side.

Arms A.O. usually 2 3 4 1 maximum length of arm about 1.5 times the mantle length L.A.I about 119.8% of M.L. L.A.II about 143.2% of M.L. L.A.III about 133.2% of M.L. L.A.IV about 133.2% of M.L. arm suckers arranged in four longitudinal rows, the suckers on the lateral rows of arms II and IV enlarged no protective membrane on arms web present between arms III and IV.

Hectocotylus Left arm I hectocotylised, the arm shorter and thicker normal suckers on the proximal half, two prominent suckerless nipple-like papillae in the ventral row at 0.25 arm length on the distal half closely packed modified papillae with rudimentary suckers present.

Tentacles Tentacles stout, stem rounded Cl L. about 40% of M.L. suckers numerous, minute and sub-equal.

Gladius Absent.

Buccal membrane : No suckers present in buccal membrane.

Gill : G.L. about 53.3% of M.L.

Colour Colour pinkish to maroon, darkest dorsally.

Type locality : Not indicated, but Sasaki states that this species is the "commonest sepiolid occurring in Japan"

Geographic distribution ; Indo-Pacific ; Sri Lanka, Bay of Bengal, Andaman Sea, Hong Kong and Japan.

Affinities This species has close affinities with *Euprymna morsei* (Verrill, 1881), but differs from the latter in the arrangement of enlarged suckers in the arms. In *Euprymna berry*, suckers on lateral rows of arms II and IV enlarged in size but in *Euprymna morsei* suckers uniformly small in females and enlerged in the ventral row of arms II, III and IV in males. Sanjeeva Raj and Kalyani (1971) reported this species as *Euprymna morsei* with rare occurance in the Madras coast. The present study reveals that this species occurs in good numbers in commercial catches.

Inioteuthis maculosa Goodrich, 1896

Fig. 13

Inioteuthis maculosa
Goodrich, 1896. Report on a collection of Cephalopoda from the Calcutta Museum. *Trans. Linn. Soc.*, 7 : pp. 2-3 pl. I. figs. 1-3.
Massy, 1916. *Rec. Ind. Mus.*, 12 : p. 216.
Voss, 1963. *Bull. U.S. Nat. Mus.*, 234 : pp. 59-62, fig. 9.

Material examined : 1 ♂

Diagnosis Mantle small and uniformly narrow ; fins short and round; funnel long with broad funnel opening nuchal commissure equal to length of fin at insertion.

Description

Mantle Mantle uniformly narrow and long maximum M.W. about 62.5% of M.L. ; dorsal mantle jointed with the head by nuchal commissure.

Fins Fins short and round F.W. about 37.5% of M.L. F.L. about 37.5% of M.L. ; F.L. at point of insertion about 25% of M.L.

Funnel : Funnel large ; funnel opening broad Fun.L. about 62.5% of M.L. length of Fun.L.C. about 25% of M.L.

Head Head narrower than the mantle opening ; H.W. about 56.2% of M.L. H.L. about 52% of M.L. ; D.E. about 31.2% of M.L.

Arms A.O. usually 3 2 4 1 ; L.A. I about 75% of M.L. L.A.II about 81.2% of M.L. L.A.III about 93.9% of M.L. ; L.A. IV about 75% of M.L. no S.M. on arms present ; suckers stalked and arranged in two rows.

Hectocotylus Left dorsal arm I hectocotylised with a large fleshy protrusion at the base, the distal end of the arm normal.

Tentacles Tentacles slender Cl.L. about 43.7% of M.L. suckers small, 8-9 suckers in a row S.M. poorly developed.

Gladius No gladius observed.

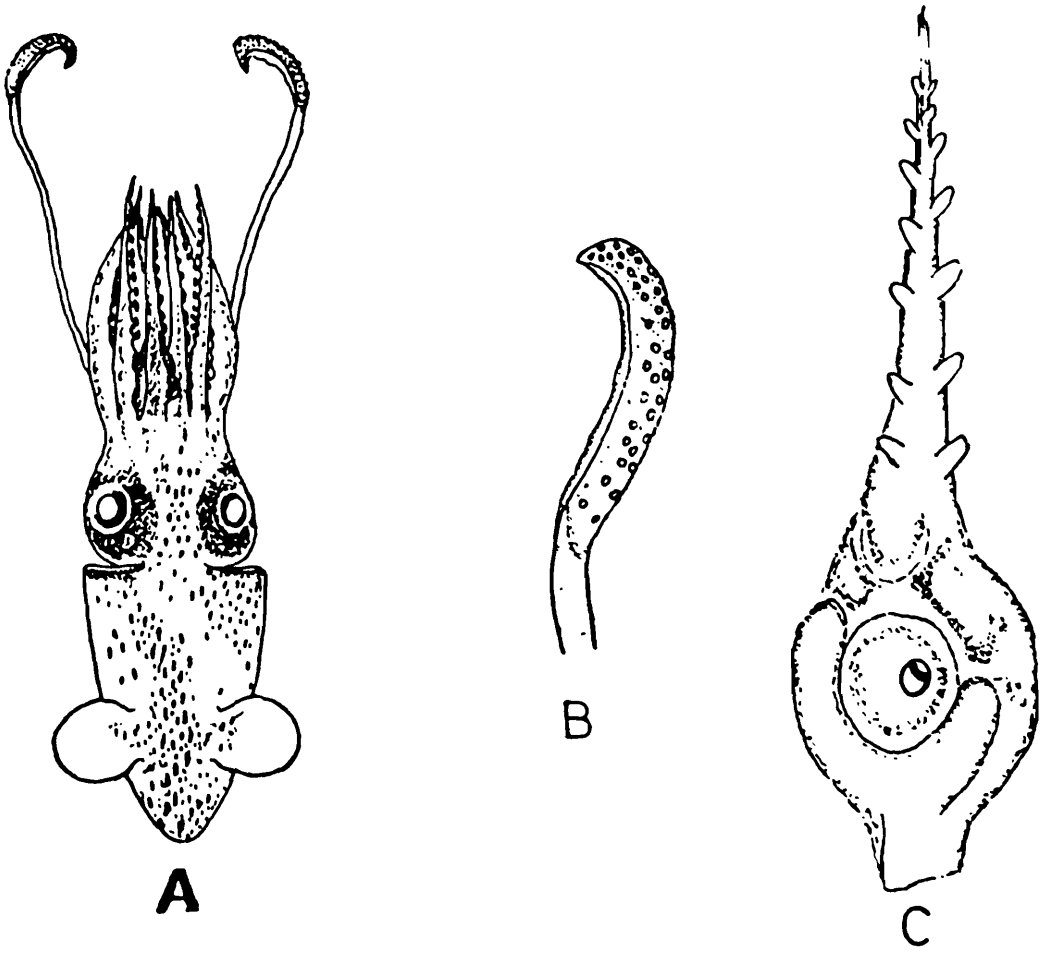


Fig. 13. *Inioteuthis maculosa* Goodrich, 1896 (a) Dorsal view enlarged (b) Tentacular club enlarged (c) Hectocotylised left arm I enlarged.

Buccal membrane No suckers present in the buccal membrane.

Gill G.L. about 43.7% of M.L.

Colour Chromatophores form dark brown spots and bloches all over the body and arms except on the lower surface of the fins.

Type locality Andaman Islands.

Geographic distribution Indo-Pacific Persian gulf. Arabian sea,

Bay of Bengal, Indonesia and upto Philippines. This species is reported for the first time from the Madras coast.

Affinities : This species differs from *Inieuthis japonica* by the uniformly narrower body, shorter rounder fins and larger funnel.

Order TEUTHOIDEA Neaf, 1916.

The Order Teuthoidea consists of cephalopods possessing a streamlined soft body with a pair of fins, varying in shape and disposition the internal shell is a feather shaped gladius, varying in shape and the tentacles are not retractile into pockets. This order consists of two suborders, Myopsida and Oegopsida.

Suborder MYOPSIDA Orbigny, 1845.

The eye of the animal covered with a transparent membrane, with a minute pore. The suborder comprises only two families, Pickfordiateuthidae and Loliginidae.

Genus **Inioteuthis** Verrill, 1881

Mantle small, bell-shaped, fins placed at midway along the mantle length dorsal mantle jointed with the head by nuchal commissure ; left dorsal arm I hectocotylised with fleshy protrusion at the base.

Inioteuthis japonica Verrill, 1881
(Fig. 14)

Inioteuthis japonica
Verrill, 1881. *Rep. U.S. Fish. comm.*, p. 417.
Joubin, 1897. *Bull Soc. Zool. France.* XXII, p. 101.
Berry, 1912. *Proc. Acad. Nat. Sci. Phil.*, pp. 405-408 pl. 5. fig. 5.
Massy, 1916. *Rec. Ind. Mus.*, 12 : p. 215.

Material examined 1 ♂ 1 ♀

Diagnosis Small, short, bell-shaped mantle ; fin large and rounded.

Description

Mantle : Mantle small, bell-shaped, maximum M.W. about 84.6% of M.L. Dorsal mantle jointed with the head by muchal commissure

Fin : Fin large and rounded and placed at midway along the mantle length ; F.W. about 46.1% of M.L. ; maximum length of fin about 53.8% of M.L. ; length of fin at insertion about 38.4% of M.L.

Funnel Funnel broad at the base and the mantle opening very narrow funnel reaching almost the base of the ventral arms Fun.L. about 53.8% of M·L. no funnel valve present length of Fun.L.C. about 23.1% M.L.

Head Head broad, maximum H.W. about 76.9% of M.L H.L. about 46.1% of M.L. D.E. about 46.1% of M.L.

Arms A.O. usually 3 4 1 2 L.A.I about 92.3% of M.L. L.A.II

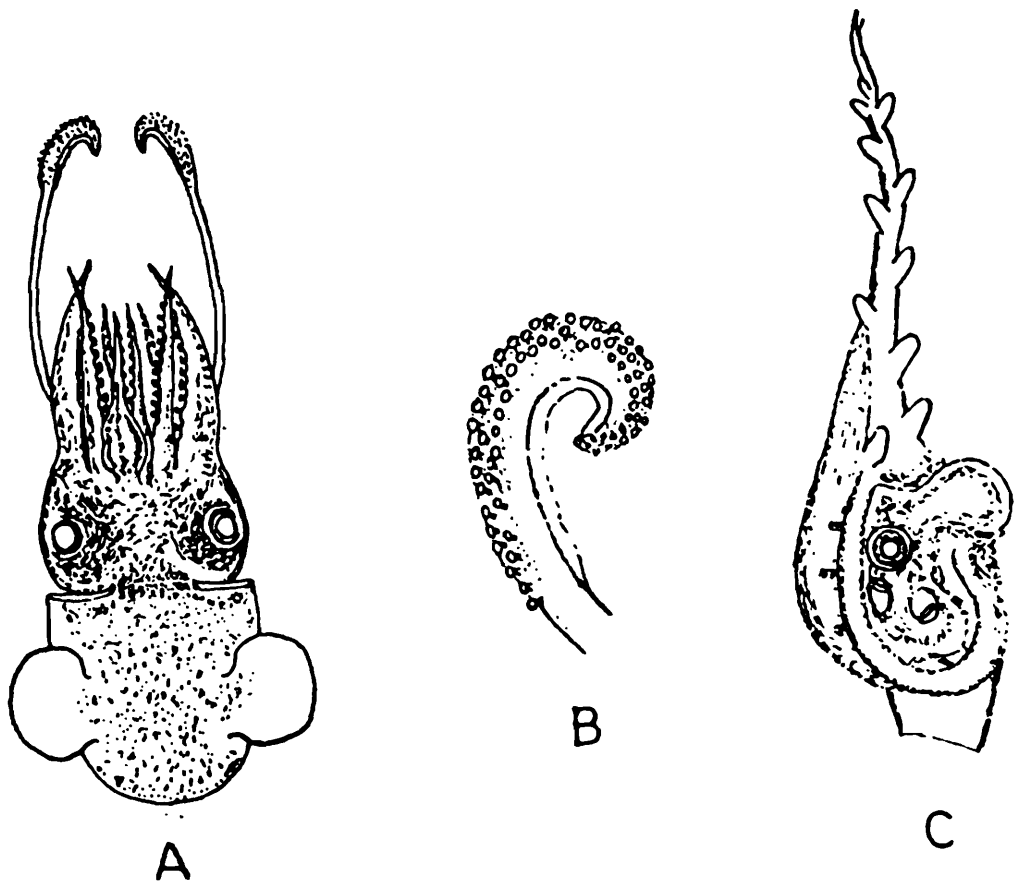


Fig. 14. *Inioteuthis japonica* Verrill, 1881 (a) Dorsal view enlarged (b) Tentacular club enlarged (c) Hectocotylised left arm I enlarged.

about 92.3% of M.L. L.A.III about 100% of M.L. L.A.IV about 92.3% of M L. no S.M. or P.M. present in the arms.

Hectocotylus Left dorsal arm I hectocotylised with a large fleshy protrusion at the base the distal portion of the arm normal.

Tentacles: Tentacles short and club narrow Cl.L. about 46.1% of M.L. suckers small club has narrow S.M.

Gladius No gladius present.

Buccal membrane No suckers present in the buccal membrane.

Gill G.L. about 46.1% of M.L.

Colour Colour bluish red chromatophores on dorsal mantles and head fewer chromatophores on the ventral mantle and funnel.

Type locality Tokyo Bay, Japan.

Geographic distribution Indo-Pacific Andaman sea, Taiwan and Japan. The previous record of this species in the Indian Ocean is from Andaman Islands by Massy (1916). The present report from Madras coast is the first record of this species from the coasts of the Indian mainland.

Affinities This species differs from *Inioteuthis maculosa* in having a shorter and broader mantle, broader head and larger fins.

Family LOLIGINIDAE Steenstrup, 1856.

The mantle of the animal may be long and slender or short and stout ; fins united posteriorly suckers of arms in two rows and tentacular suckers in four rows ; the left arm IV hectocotylised. Eight genera are recognised in the family Loliginidae, of which four are represented in the present collection.

Genus **Loligo** Schneider, 1784.

Species of this genus have lateral fins, rhomboidal in outline and united at the posterior end ; length of fin 50—70% of M.L.

Loligo duvauceli Orbigny, 1848
(Fig. 15)

Loligo duvauceli
Orbigny, 1848 (in 1834-1848). Cephalopodes acetabuliferes vivants et fossils. *In* Histoire naturelle generale et particuliere., Edited by A. Ferussac and A d' Orbigny, Paris, 318. pl. 14, pl. 20 fig. 6-16.
Adam, 1939. *Rec. Ind. Mus.*, 41 : pp. 66-67.
Loligo indica
Pfeffer, 1884. *Abh. naturw. ver. Hamburg.*, 8 : p. 5 figs. 3
Goodrich, 1896. *Trans. Linn. Soc. London. Zool.*, 7 : p. 7, pl. 2 figs. 20-28.
Massy, 1916. *Rec. Ind. Mus.*, 12 : p. 218. pl. 23. fig. 9 pl. 24 fig. 11.

Material examined : 240 ♂ 276 ♀

Diagnosis Mantle long slender and tubular, tapering gradually from the middle to a blunt posterior end fins rhomboidal with F.L. of about 53.4% of M.L. left ventral arm hectocotylised by the modification of the distal half of the arm possessing pedicles flattened into conical papillae present.

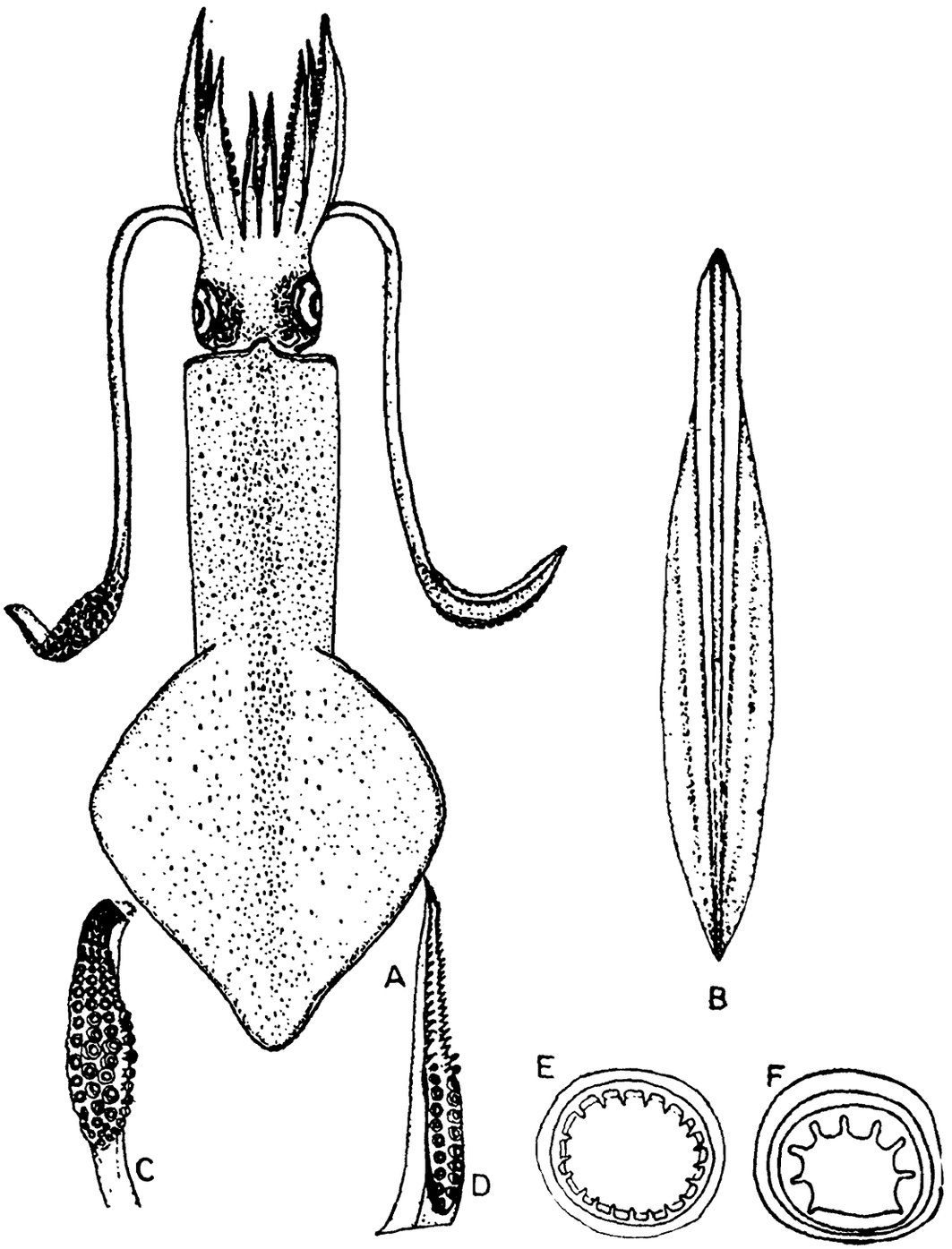


Fig. 15. *Loligo duvaucelii* Orbigny, 1848 (a) Dorsal view (b) Gladius (c) Tentacular club enlarged (d) Hectocotylised arm enlarged (e) Tentacular sucker ring enlarged (f) Arm sucker ring enlarged.

Description

Mantle Mantle long and tubular in outline, tapering gradually from about the middle to a blunt posterior end ; maximum M.W. about 20% of M.L. ; mid-dorsal mantle produced into a rounded point.

Fins Fins rhomboid in shape, widest above the mid-point of F.L. maximum F.W. 47.8% of M.L. maximum F.L. about 55.4% of M.L. F.A. about 42%.

Funnel Funnel well developed, set in deep funnel-grove, funnel opening on level with the eyes Fun. V. broad and blunt, Fun. L. about 14.6% of M.L. length of Fun.L.C. about 12% of M.L.

Head : Head narrower than mantle opening ; H.W. about 14.6% of M.L. ; H.L. about 16.9% of M.L. L.N.C. about 17.7% of M.L. D.E. about 9.2% of M.L.

Arms A O. usually 3 2 4 1 L.A.I about 23.8% of M L. ; L.A.II about 28.9% of M.L. L.A.III about 30.8% of M.L. ; L.A.IV about 27.7% of M.L. ; suckers on arms arranged in two rows. The chitinous rigns of arm suckers posses 6-8 broad teeth S.M. developed maximum in arm III and to lesser extent in other arms ; P.M. well-developed in all arms.

Hectocotylus : Left ventral arm hectocotylised by the modification of the distal half of the arm ; the arm has about 8-9 normal rows of suckers, the next two pairs have pedicles enlarged and the cups reduced in size thereafter upto the tip, only the pedicles flattened into conical papillae present.

Tentacles Tentacles robust Cl.L. about 19.2% of M.L. club suckers arranged in transverse rows of four each ; P.M. of club well-developed about 20 teeth present in the horny rings of the tentecular suckers.

Gladius Gladius long and wide maximum Gl.W. about 13.8% of M.L. ; rachis stiff maximum L.F.R. about 21.5% of M.L. lateral edges of wane thin, vane tapers at both ends and widest in the central area,

Buccal lappets Seven distinct buccal lappets present around the mouth ; small suckers present on the inner surface of the buccal lappets.

Gill : G.L. about 25.2% of M.L.

Colour Reddish brown chromatophores on pale white back-ground, chromatophores are dark and closely set on the head above the eyes.

Type locality Not known.

Geographic distribution Indo-Pacific Mozambique, Red Sea, Arabian Sea, Bay of Bengal, South China Sea, Philippines and northward upto Taiwan,

Affinities This is the most common species of the genus in the study area. This species is easily distinguished from the other species of the genus occurriing in the area by the differences in the structure of the hectocotylised arm, the shape and size of the fins and the arrangement of teeth in the chitinous rings of the suckers in the tentacles and arms,

Loligo uyii Wakiya & Ishikawa, 192
(Fig. 16)

Loligo uyii
Wakiya & Ishikawa, 1921. Review of myopsid cephalopods in Japan. *Zool. Mag. Tokyo.*, 33 : 286

Material examined 12♂ 7♀

Diagnosis Mantle short, M.W about 30% of M.L. and F.L. about 56% of M.L. tentacular club long with 8 suckers in the central area greatly enlarged with smooth rings left arm IV hectoctylised with the distal 2/3 length having sùckerless papillae, and connected into a ridge, on the ventral row.

Description

Mantle Mantle short and moderately broad. blunt posterior end maximum M.W. about 30% of M. L. the anterior mid dorsal area ends in a pronounced rounded point.

Fins Fins rhomboidal in shape F.L. about 56% of M.L. F.W. abhut 60% of M.L. F.A. about 50%.

Funnel Funnel opening on level with the eyes funnel groove moderately deep. Fun.L. about 24.9% of M.L. Fun V. short, broad and bluntly rounded at the anterior end length of Fun.L.C, about 17.8% of M.L.

Head H.W. about 28.4% of M.L. H.L. about 26.7% of M.L. L.N.C. about 21.3% of M.L. D.E. about 17.8% of M.L.

Arms Long A.O. usually 3 4 2 1 L.A. I about 32% of M.L. L.A. II about 46% of M.L. L.A. III about 64% of M.L. L.A. IV about 49.1% of

M.L. P.M. in arms poorly developed ; S.M. developed in arms III and IV ; suckers in the middle region of arm IV larger in size ; arm sucker rings with 4-6 broad teeth in distal half, proximal half smooth.

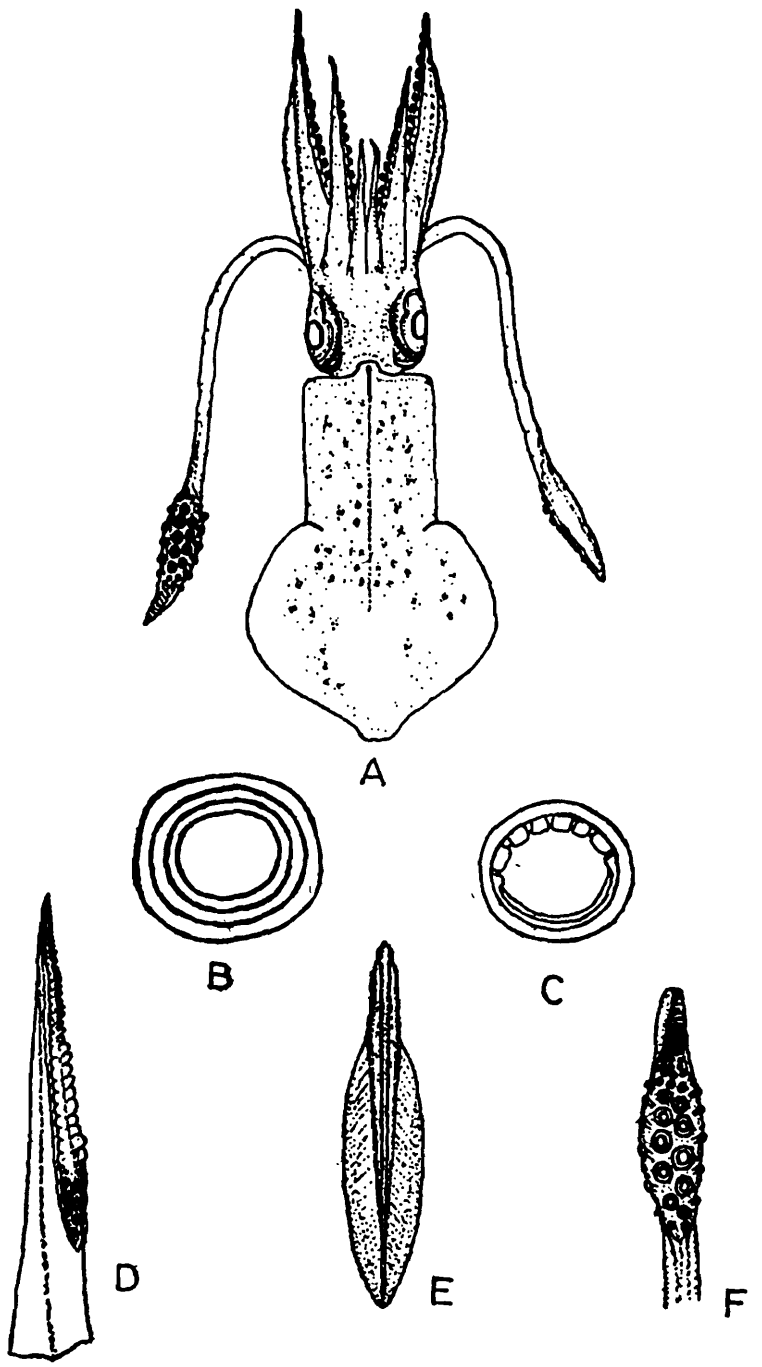


Fig. 16. *Loligo uyii* Wakiya & Ishikawa. 1921 (a) Dorsal view (b) Tentacular median sucker ring enlarged (c) Arm sucker ring enlarged (d) Hectocotylised arm enlarged (e) Gladius (f) Tentacular club enlarged.

Hectocotylus Left arm IV hectocotylised the arm has 4-5 rows of normal suckers, the rest 2/3 length of the arm modified with suckerless papillae, those on the dorsal row small and almost separate, but the ones on the ventral row greatly swollen and connected into a ridge.

Tentacles Tentacles moderately long Cl.L. almost 26.7% of M.L. S.M. and P.M. poorly developed about 8 suckers in the two medium rows greatly enlarged the enlarged suckers possess smooth rings.

Gladius Gladius moderately wide maximum Gl.W. about 21.3% of M.L. rachis stiff L.F.R. about 30% of M.L. lateral edges of vane thin vane tapering at both ends and widest in the central area,

Buccal lappets Buccal lappets well-developed with minute suckers at their extreme ends.

Gill G.L. about 33.8% of M.L.

Colour Colour reddish brown chromatophores on the dorsal mantle and head, on the posterior dorsal mantle reddish yellow chromatophores seen. On the ventral mantle, chromatophores are smaller the ventral surface of fin devoid of chromatophores.

Type locality Japanese waters, Pacific Ocean.

Geographic distribution Indo-Pacific Bay of Bengal, Japan Sea and Hong kong. So far, this species is known the Pacific Ocean only and the present report from the Madras coast is the first record of this species from the Indian Ocean.

Affinities This species is easily distinguished from the other species of this genus occurring in the area by the distinct hectocotylised arm and the smooth rings in the enlarged suckers of the tentacular club.

Loligo bengalensis sp.nov.
(Fig. 17, pl. 3)

Material examined 5 ♂ 11 ♀

Diagnosis The study of a group of 16 examples of genus *Loligo* available in the collection revealed the following characters differing from the species described hitherto

(1) Mantle narrow with pointed posterior end.

(2) Fins narrow widest at the anterior portion and tapering gradually towards the posterior end fin angle very low.

(3) The hectocotylised left ventral arm has about 15-16 rows of normal suckers and the distal 1/3 portion of the arm with pedicles modified into slender papillae.

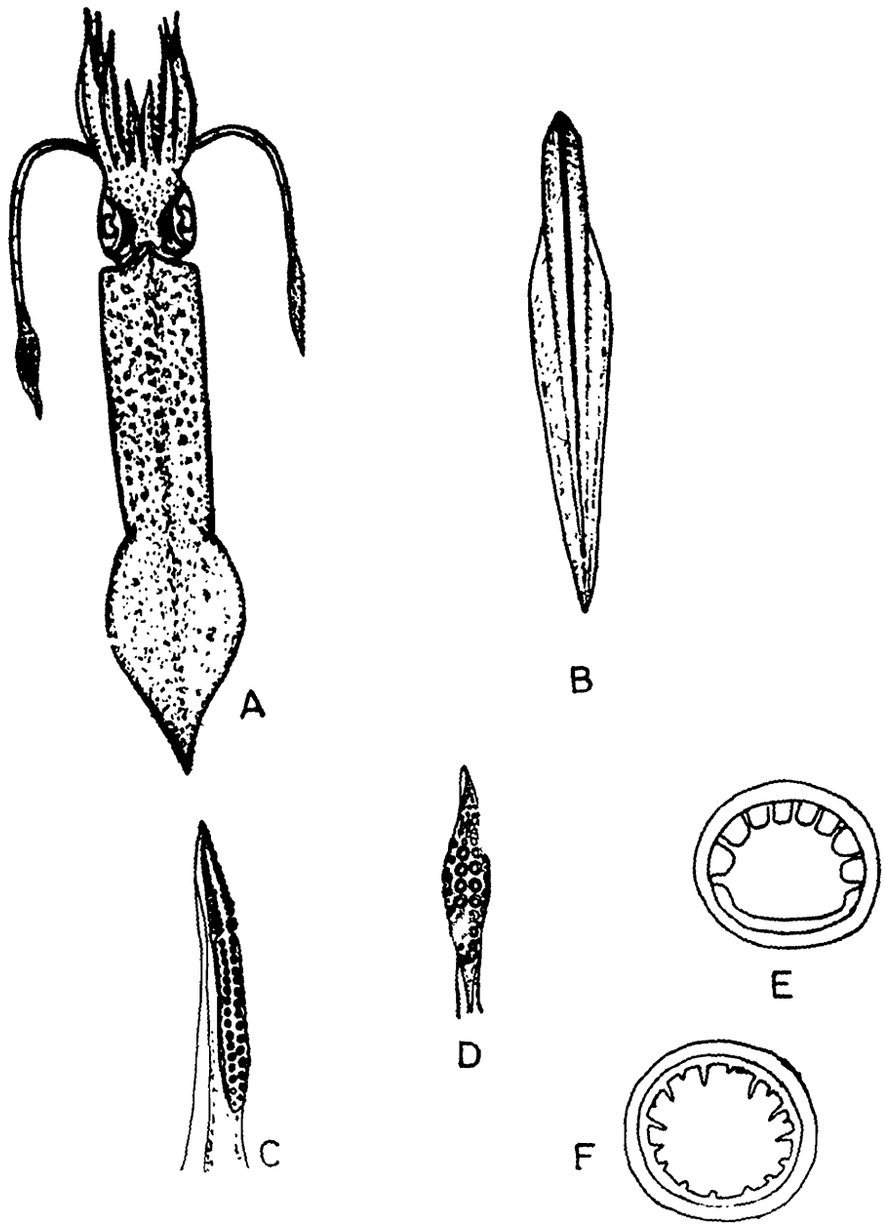


Fig. 17. *Loligo bengalensis* sp. nov. (a) Dorsal view (b) Gladius (c) Hectocotylised arm enlarged (d) Tentacular club enlarged (e) Arm sucker ring enlarged (f) Tentacular sucker ring enlarged.

(4) The vane of gladius broadest at the anterior portion and tapering towards the pointed posterior end.

(5) The tentacular sucker rings have smaller teeth alternating with larger ones on the distal side and almost the same size teeth in the proximal side.

The characters 1-5 stated above, separate these specimens from the already known species of *Loligo* and hence a new species of *Loligo bengalensis* is described, to accommodate these specimens. The new species is named after the locality from where it is obtained. These sppecimens are at present in the collections of the Marine Biological Station, Zoological Survey of India, Madras and in due course will be deposited with the Zoological Survey of India, Calcutta.

Description

Mantle Mantle moderately long, narrow, tubular and tapering to a pointed posterior end M.W. about 23% of M.L. mid-dorsal mantle pointed with excavated sides.

Fins Width at the maximum in the anterior 1/3 of its length ; maximum F.W. about 50.7% of M.L. F.L. about 52.8% of M.L. fins tapering to a point at the posterior end F.A. about 30°

Funnel Funnel opening broad and reaching the upper limit of the eyes Fun. L. about 17.6% of M.L. Fun. V. broad ending with flat margin length of Fun. L.C. about 12.1% of M.L.

Head H.W. about 18.7% of M.L. H.L. about 18.7% of M.L. D.E. about 9.9% of M.L.

Arms A.O. usually 3 4 2 1 ; L.A. I about 19.8% of M.L. L.A. II about 22% of M.L. L.A.III about 28.6% of M.L. L.A.IV about 25.3% of M.L. S.M. poorly developed except on arm III P.M. on arms poorly developed arm suckers have about 8 broad teeth on the distal half and the proximal half is smooth.

Hectocotylus Left arm IV hectocotylised the arm has about 15—16 rows of normal suckers in the 2/3 proximal portion and the 1/3 distal portion with pedicles modified into slender papillae.

Tentacles Tentacles long, club narrow and lanceolate S.M. and P.M. poorly developed suckers in four rows, the suckers of the median rows larger than the marginal ones sucker rings have small teeth alternat-

ing with larger ones in the distal side and almost of the same size in the proximal side ; number of the teeth around 17-20 ; Cl.L about 23.1% of M.L

Cladius : Gladius narrow Gl.W. about 13.2% of M.L. ; rachis stiff ; L.F.R. about 23.1% of M.L. vane broader anteriorly and tapering to a point at the posterior end ; lateral edges of vane thin.

Buccal lappets Buccal lappets well-developed and possess minute suckers at their extreme ends.

Gill Gill long and narrow. G.L. about 24.2% of M.L.

Colour Dark pink large chromatophores on the dorsal mantle head and fins ; ventral mantle paler with lesser number of chromatophores.

Type locality Madras, Bay of Bengal.

Geographic distribution Indian Ocean : Bay of Bengal.

Affinities *Loligo bengalensis* sp. nov. can be easily differentiated from other species of *Loligo*, by the shape and size of the fins, the posterior pointed end of mantle and the characteristic modification of the hectocotylised arm. This species resembles *Doryteuthis singhalensis* in having the pointed posterior end of mantle, but differs from the latter in having shorter fins. long tentacular arms and the vane of gladius devoid of thickened edges.

Genus **Doryteuthis** Neaf, 1912.

Mantle long and narrow with a sharply pointed posterior end ; gladius narrow with thickened edges ; F.L. about 70% of M.L.

Doryteuthis singhalensis Ortmann, 1891
(Fig. 18)

Doryteuthis singhalensis
Ortmann, 1891. Cephalopoden von Ceylon. *Zool. Jb. Syst.* 5 : p. 676, pl. 46 fig. 3.
Neaf, 1912. *Zool Anz.* 39 : p. 742.
Loligo spectrum
Massy, 1916 (non Pfeffer) *Rec. Ind. Mus.*, 12 : 221.
Loligo singhalensis var. *bervllae*
Robson, 1928. *Serv. Ocean. Peches Indochine.*, 10 : p. 15, figs 4-10

Material examined 6 ♂ 2 ♀

Diagnosis : Mantle long and slender, F.L. about 70% of M.L. tentacles short chitinous rings of tentacular club with 20-22 sharp teeth arm

suckers with 7-9 blunt teeth left ventral arm hectocotylised, the distal half with slender papillae having minute suckers gladius narrow with thickened edges.

Description

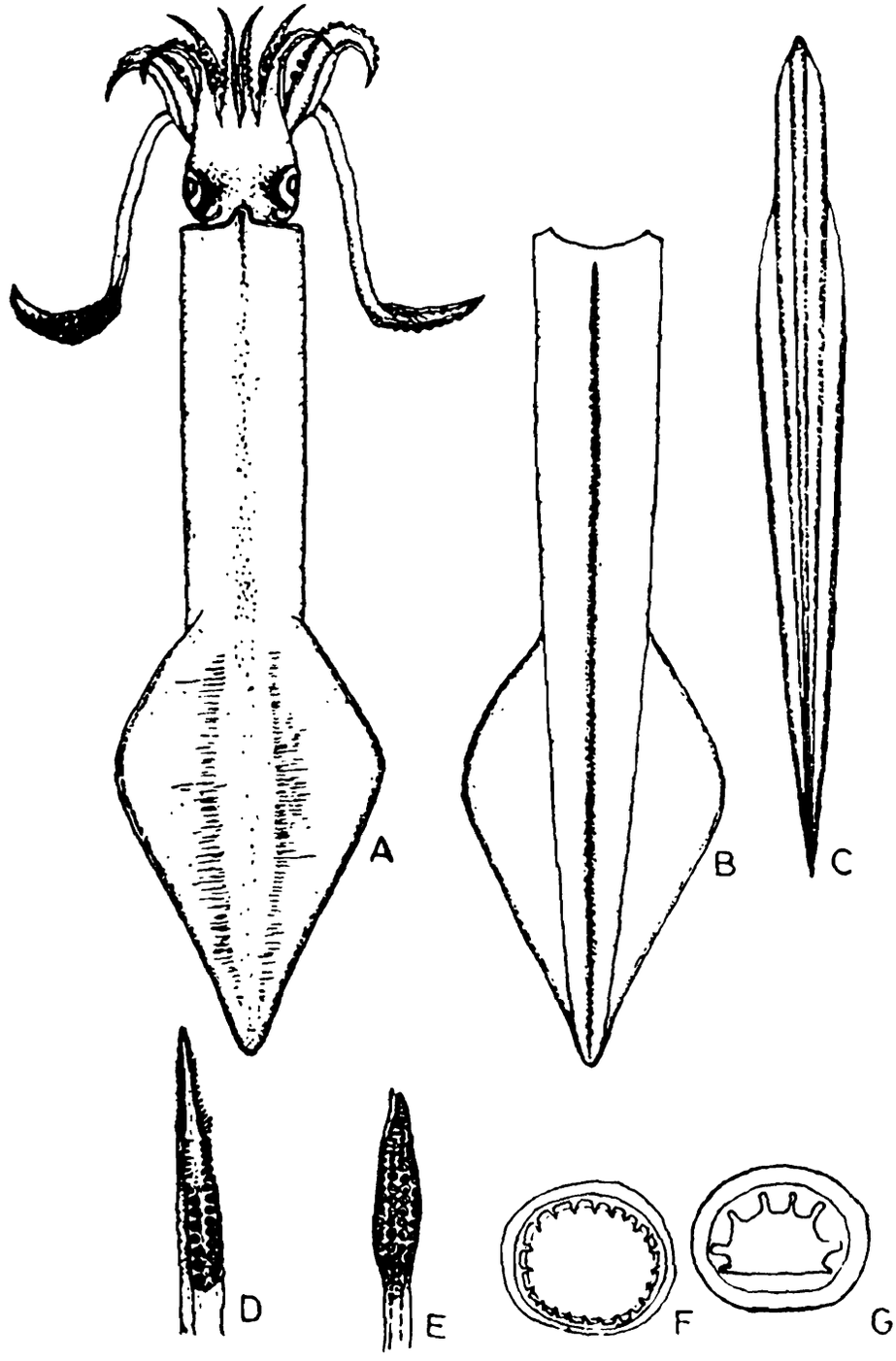


Fig. 18. *Doryteuthis singhalensis* Ortmann, 1891 (a) Dorsal view (b) Ventral mantle (c) Gladius (d) Hectocotylised arm enlarged (e) Tentacular club enlarged (f) Tentacular sucker ring enlarged (g) Arm sucker ring enlarged

Mantle Mantle long and slender, tapering to a narrow pointed end, maximum M.W. about 1 .9% M.L. anterial mid dorsal projection very prominent.

Fins F.L. about 62% of M.L. maximum F.W. about 35% of M.L. fin widest in the anterior half, tapering towards the posterior end ; fin angle 32°

Funnel Funnel opening on level with the eyes Fun. L. about 14.2% of M.L, funnel set in deep funnel grove ; Fun. V broad with blunt margin ; length of Fun. L.C. about 10.6% of M.L.

Head : H.L. about 15.1% of M.L. H.W. about 14.2% of M.L. ; L.N.C. about 13.3% of M.L. ; D.E. about 7.1% of M.L.

Arms A.O. usually 3 4 2 1 L.A.I. about 14.2% of M.L. L.A.II about 19.5% of M.L. L.A.III about 24% of M.L. L.A. IV about 22.2% of M.L. S.M. well developed on arm III P.M. on arms poorly developed ; arm sucker rings with 7-9 bluntly pointed teeth.

Hectocotylus Left arm IV hectocotylised ; the arm has about 8-9 rows of normal suckers followed by slender conical papillae, bearing minute suckers at their tips the papillae in the extreme distal end free.

Tentacles Tentacles short with shorter club Cl.L. about 19.5% of M.L. suckers on the medial rows only slightly larger than the suckers of the lateral rows rings of the tentacular suckers have 20-22 sharp pointed teeth.

Gladius Vane of gladius narrow, with thickened edges ; posterior end sharply pointed rachis stiff L.F.R. about 19.5% of M.L.

Buccal lappets Buccal lappets well developed with minute suckers at their extreme ends.

Gills ; G.L. about 27.5% of M.L.

Colour : Pale white with small chromatophores on dorsal surface of mantle and head chromatophores scarce on the ventral mantle, especially in the lower side of fins.

Type locality : Sri Lanka, Indian Ocean.

Geographic Distribution : Indo-Pacific : Arabian Sea, Bay of Bengal, South China Sea and Philippines.

Affinities This species shows close affinities to the species of the genus *Loligo* occurring in the area, but differs from the latter in possessing a long slender mantle, short arm, narrow gladius with thickened edges and pointed posterior end and the structure of the hectocotylised arm. This species resembles *Loligo bengalensis* sp. nov in having a pointed posterior end of mantle but differs from the latter in having longer fins, shorter tentacular arms and the vane of gladius thickened at the edges.

Genus **Sepioteuthis** Blainville, 1824.

Mantle long, tubular and tapering to a blunt posterior end; fins bordering the entire mantle length, thick and muscular and broadest about the posterior third of the mantle.

Sepioteuthis lesseneana Lesson, 1830
(Fig. 19)

Sepioteuthis lessoniana
Lesson, 1830. Mollusques. In voyage autour de monde execute sur la corvetté de S.M. 'La Coquille' pendant les annles 1822-1825, Paris, 2 (1) : p. 244 pl. 2.

Sepioteuthis hemprichii
Ehrenberg, 1831. *Symbolae phys. Moll., un pag.*

Sepioteuthis quinensis
Quoy and Gaimard, 1932. *Zoologie., Paris.*, Vol. 2Pt. 1 ; p. 72 pl. 3.

Sepioteuthis lunulata
Quoy and Gaimard, 1932. *Ibid.*, p. 74. pl. 3 figs. 8-13.

Sepioteuthis mauritiana
Quoy and Gaimard, 1932. *Ibid.*, p. 76, pl. 4. figs. 2-6.

Sepioteuthis sinensis
Ferussac and d' Orbigny, 1848 (in 1834-1848), *Hist. Nat. Ceph. acetab.*, p. 304

Sepioteuthis arctipinnis
Gould, 1852. *U.S. Exploring Exp.*, 12 : p. 137, pl. 26, fig. 1.

Sepioteuthis neoguinaica
Pfeffer, 1884. *Abh. naturw. ver. Hamburg.*, 8 : p.4.

Sepioteuthis indica
Goodrich, 1896. *Trans. Linn. Soc. London.*, 7 : p. 5 pl. 1, fig. 9-19.

Sepioteuthis seiboldi
Joubin, 1898. *Not. Zool. Mus , Leyden.*, 20 : p. 27.

Sepioteuthis malavana
Wulker, 1913. *Abh. Senckenb. naturforsch. Ges.*, 34 : p. 478 figs. 7a-f.

Sepioteuthis krempfi
Robson, 1928. *Serv. Ocean. Peches. Indochine* 10 : 28, figs. 3-4.

Material examined : 4 ♀

Djagnosis Mantle elongate, conico-cylindrical, tapering to a blunt posterior end fins thick, muscular and bordering almost the entire mantle length : greatest fin width posterior to the mid-point of of the mantle.

Description

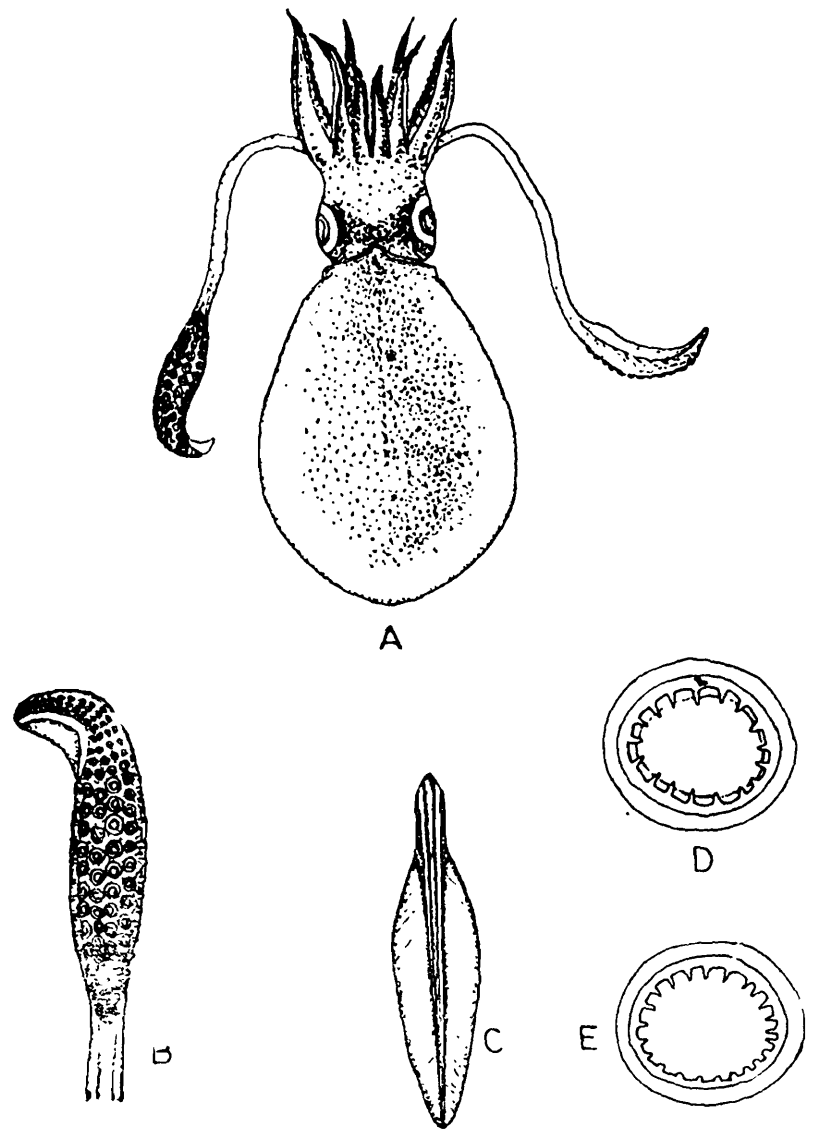


Fig. 19. *Sepioteuthis lessoniana* Lesson, 1830 (a) Dorsal view (b) Tentacular club enlarged (c) Gladius (d) Arm sucker ring enlarged (e) Tentacular sucker ring enlarged.

Mantle Mantle elongate, tubular, widest at the anterior end and tapering to a blunt posterior end. Maximum M.W. about 32.2% of M.L. anterior dorsal mantle extends into a rounded point.

Fins Fins long, broad and fleshy, extending almost along the entire mantle length, broadest posterior to the mid-Point of mantle maximum F.W. about 64.4% of M.L. F.A. about 32°

Funnel Funnel set in deep groove beneath the head ; Fun.L about 19.3% of M.L. ; length of Fun.L.C. about 19.3% of M.L. Fun.V broad and semilunar at the outer margin.

Head H.L. about 22.5% of M.L. H.W. about 27.4% of M.L. D.E. about 16.1% of M.L, L.N.C. about 20.6% of M.L. the skin behind the eyes produced into a crust.

Arms A.O. usually 3 4 2 1 L.A.I about 24.1% of M.L. L.A.II about 28% of M.L. L.A.III about 54.4% of M.L. L.A.IV about 42 6% of M.L. S.M. and P.M. well developed only on arm III in other arms they are poorly developed the horny rings of the arm suckers have about 18—23 teeth.

Hectocotylus No male specimen in the collection hence not given.

Tentacles Tentacles laterally compressed, Cl.L. about 33.8% of M.L. the club has wide P.M. the suckers in the medial rows larger at the centre of the club 16—24 teeth present in the horny rings of the tentacular club suckers.

Gladius Gladius lanceolate rachis strong L.F.R. about 30.5% of M.L. lateral edges of vane thin widest at about 2/3 of its length from the posterior end.

Buccal lappets Seven buccal lappets present around the mouth, with minute suckers at their extreme ends.

Gill G.L. about 32.2% of M.L.

Colour The dorsal mantle has large dark brown chromatophores at the central areas towards the periphery the chromatophores are smaller and very few chromtophores present on the margin of fins dark chromatophores present above the eyes and on the arms on the ventral surface of the mantle, the chromatophores are fewer the lower side of the fins are devoid of chromatophores.

Type locality : 'Dorhry'

Geographic distribution Indo-Pacific Red Sea, Arabian Sea, Bay of Bengal, China Sea, Japan and Australia· This species is common in the Palk Bay and Gulf of Mannar area, but in the Madras coast it occurs very rarely.

Affinities This species is easily distinguished from the other species of Loliginids by the large fins along the entire length of mantle.

Genus **Loliolus** Steenstrup, 1856.

Mantle short, stout and broadly rounded posteriorly ; fins broad and heart-shaped ; length about 70% of M.L. ; the entire left ventral arm hectocolised by the drastic modification of suckers.

Loliolus investigatoris Goodrich, 1896.
(Fig. 20)

Lolious investigatoris
Goodrich, 1896. Report on a collection of Cephalopoda from the Calcutta Museum. *Trans, Linn. Soc. London.*, 7 : pp. 8-9, pl. 2. figs. 29-37.
Massy, 1916. *Rec. Ind. Mus.*, 12 : p. 222
Adam, 1939. *Rec. Ind. Mus.*, 4 : p. 66.

Material examined 180 ♂ 143 ♀

Diagnosis Mantle short and stout, widest at about 2/3 of its length from the posterior end fins broad, fin length about 69.2% of M.L. ; the entire left ventral arm hectocotylised by the drastic modification of suckers.

Description

Mantle : Mantle short and stout maximum M.W. about 41.5% of M.L. posterior end of mantle broadly blunt the middorsal mantle is produced into a point.

Fins Fins broad F.W. about 77.6% of M.L. ; F.L. about 69.2% of M.L. fins tapering from mid-length gradually to the posterior end. F.A. about 60°

Funnel : Funnel thin-walled, wider posteriorly ; Fun.L. about 33.2% af M.L. ; Fun. V. broad and flat at the extreme end ; length of Fun. L.C. about 21.2% of M.L.

Head : H.L. about 30.5% of M.L. ; H.W. about 38.8% of M.L. L.N.C. about 21.2% of M .L. ; D.E. about 16.6% of M.L.

Arms A.O. usually 3 2 4 1 L.A.I about 30.5% of M.L. L.A.II about 44.3% of M.L. L.A.III about 55.4% of M.L. L.AIV about 42.6% of M.L. S.M. and P.M. poorly developed the chitinous rings of the arm suckers have 3-5 broad teeth.

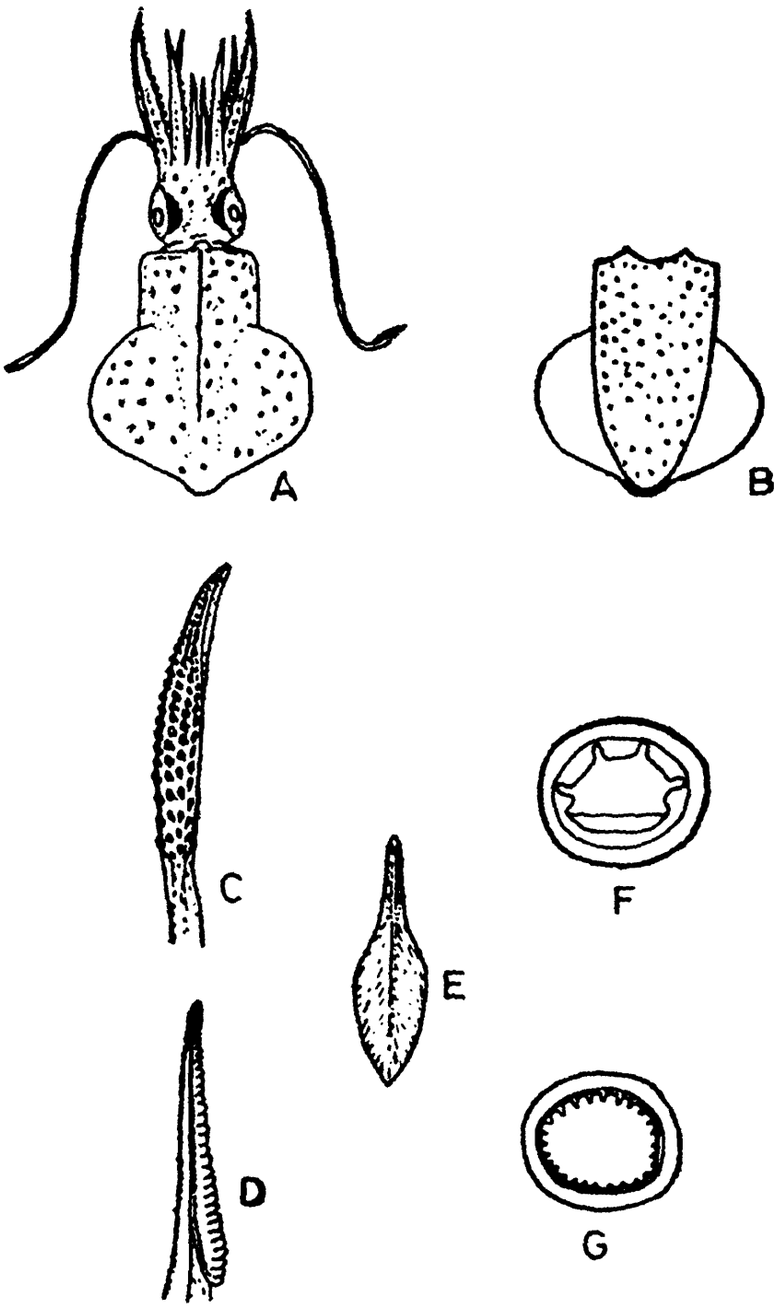


Fig. 20. *Loliolus investigatoris* Goodrich, 1896 (a) Dorsal view (b) Ventral view (c) Tentacular club enlarged (d) Hectocotylised arm enlarged (e) Gladius (f) Arm sucker ring enlarged (g) Tentacular sucker ring enlarged.

Hectocotylus The entire left ventral arm hectocotylised by drastic modification of suckers, membranes and trabeculae.

Tentacles : Tentacles thin club narrow ; S.M. and P.M. poorly developed ; Cl.L. about 19.4% of M.L. : suckers small, arranged in four rows sucker rings have 24-26 acute teeth.

Gladius ; Rachis narrow ; L.F.R. about 24.9% of M.L. vane broadest at about 2/3 of its length from the posterior end lateral edges of vane very thin.

Buccal lappetes Buccal lappets around the mouth well-developed ; minute suckers present at the extreme ends of lappets.

Gill G.L. about 33.3% of M.L.

Colour Mantle pale white with dark brown chromatophores both on the dorsal and ventral surface head and arms chromatophores are minute at the periphery of the fins on the dorsal side the ventral surface of the fins devoid of chromatophores.

Type locality Bay of Bengal.

Geographic distribution Indo-Pacific Arabian Sea. Bay of Bengal, Mergui Archipelago, Sumatra.

Affinities This is a very common species of loliginid commonly found along the east coast of India and is easily distinguished by the distinct morphological features, especially the hectocotylisation of the left ventral arm by the drastic modification of the entire sucker bearing surface.

Order OCTOPODA Leach, 1818.

Cephalopods with eight arms suckers sessile and devoid of chitinous rings shell reduced, vestigial, or absent no buccal membrane present.

Sub order INCIRRATA Grimpe, 1916.

No cirri present on arms no fins present one arm hectocotylised with ligula and calimus.

Family OCTOPODIDAE Orbigny, 1845.

Gills with inner and outer demibranch funnel organ 'W' or 'VV' shaped no detachable hectocotylus.

Subfamily OCTOPODINAE Grimpe, 1921

Suckers on arms biserial ink-sac present.

Genus **Octopus** Lamarck, 1796.

Biserial suckers on arms ink-sac normal third right arm hectocotylised no velar pouches present mantle aperture wide.

Otopus aegina Gray, 1849
(Fig. 21)

Octopus aegina
Gray, 1849. Catalogue of the Mollusca in the collections of the British Museum. 1. Cephalopoda antepidia London. *Cat. Moll. Brit. Mus.*, 1 : p. 7.
Robson, 1928. *Ann. Mag. Nat. Hist.*, (10) 1 : 641. figs. 1-4.
Robson, 1929. *Mono. Rec. Ceph.*, p. 113. figs. 31-32. pl. 5. fig. 1.
Adam, 1954. *Siboga Exped., Leiden* (55c) p. 166. fig. 30.
Adam, 1959. *Res. Sci. Mission R. P. Dollfus on Egypte* (3) 28 : p. 171 fig. 19.
Adam, 1960 a. *Bull. Sea. Fish. Res. Stn. Haifa* 26 : pp. 18-25.
Adam, 1973. *Sea Fish. Res. Stn., Haifa* 60 : p. 38 pl. 1 fig. 4.
Octopus rugosus
Adam (non Bosc) 1942. *Bull. Inst. Oceanogr. Monaco.* 822 : p. 15.

Material examined 3♂ 3♀

Diagnosis This species is characterised by the enormous development of the penis. The skin of the animal is granulous, the dorsal side being covered with small rounded dense tubercles a multifid cirrus present above each eye.

Description

Mantle On the dorsal mantle the skin is brown with dark reticulate pattern, the ventral side paler mantle oval-shaped M.L. about 20.9% of T.L. M.W. about 16.4% of T.L.

Funnel Funnel broad at the base and tapering towards the tip funnel reaching the upper limit of the eyes Fun.L. about 9% of T.L. Fun. O 'W' shaped with broad bands.

Head H.L. about 7.8% of T.L. H.W. about 8.6% of T.L. eyes prominent a multifid cirrus present above each eye.

Arms Arms long, robust at the base and tapering to narrow ends A.O. usually 4 2 3 1 L.A. I about 49.2% of T.L L.A. II about 62.3% of T.L. L.A. III about 52.8% of T.L. L.A. IV about 69.7% of T.L. suckers on the proximal portion of arms II and III enlarged in males ; dark patch of chromatophores present at the base of suckers on the dorsal side W.O. usually D E C B A.

Ocellus : No ocellus present.

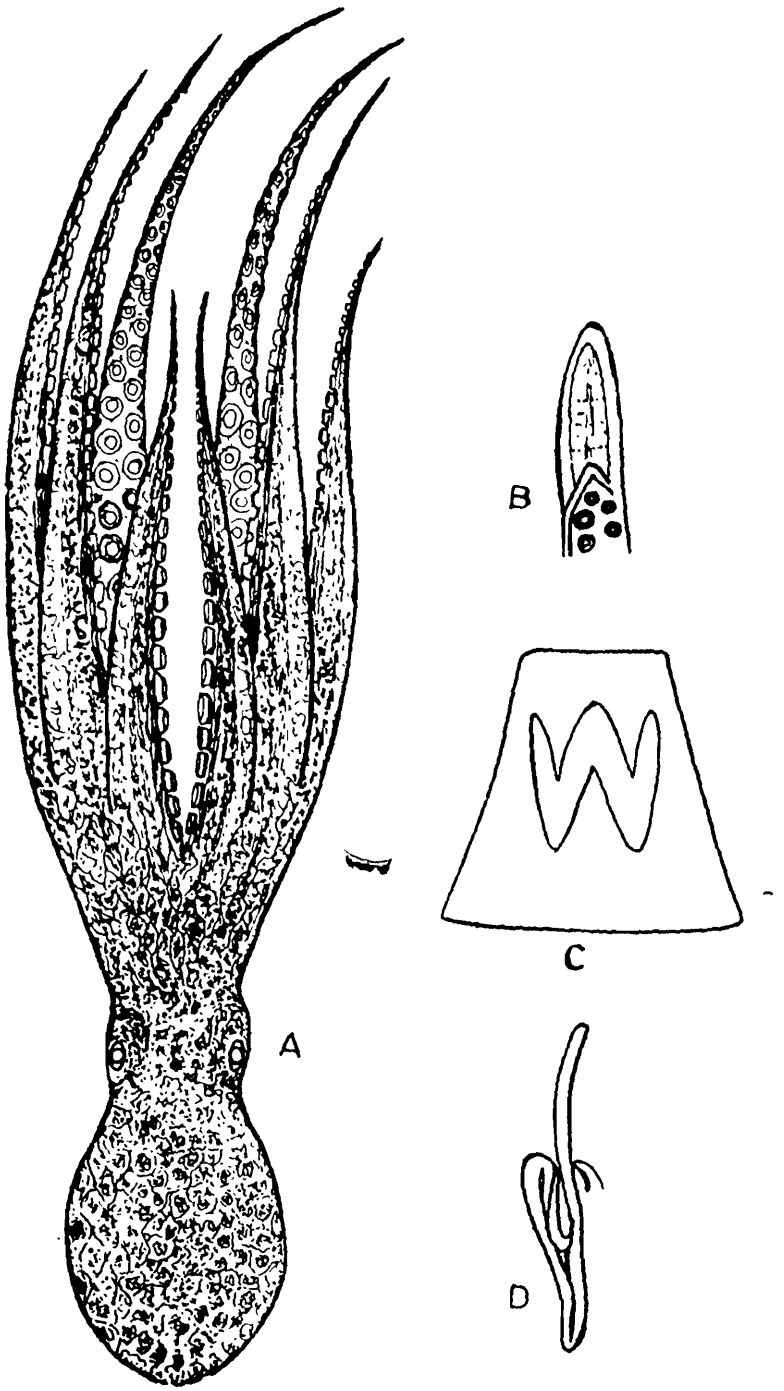


Fig. 21. *Octopus aegina* Gray, 1849 (a) Dorsal view (b) Hectocotylus enlarged (c) Funnel organ enlarged (d) Penis enlarged.

Hectocotylus Third right arm hectocotylised, ligula about 5% of arm length ligula with broad shallow groove calimus ending bluntly.

Penis Enormous development with long posterior loop present. L.P. about 12% of T L.

Gill G.L. about 12% of T.L. nine lamellae present on the outer demibranch of each gill.

Type locality Not known.

Geographic distribution Indo-Pacific Red Sea, Arabian Sea, Bay of Bengal, China Sea and Japan Sea. The present record is the first report of this species from the Madras coast.

Affinities This species shows affinities with *Octopus rugosus* in the shape of the body, the dark-brown reticulate pattern of the skin and the multifid cirrus above each eye but differs from the latter in the enormous development of penis with long posterior loop.

Octopus rugosus (Bosc. 1792)
(Fig. 22)

Sepia rugosa
Bosc, 1792. Observations sur la *Sepia rugosa* (*O.*) *rugosus* Fer.) *Act. Soc. H. N. Paris.*, 1 : p. 24. pl. 5. figs. 1 & 2.
Octopus granulatus
Goodrich, 1896. *Trans. Linn. Soc. London Zool.*, 7 : p. 19
Polypus rugosus
Massy, 1916. *Rec. Ind. Mus.*, 12 p. 189.
Polypus granulatus
Sasaki, 1929. *Journ Coll. Agri. Hokkaido Imp. Univ.* 20 (Suppl) p. 40 pl 3 fig. 18 pl. 9. figs. 11-13 pl. 29. figs. 2-3.
Octopus (Octopus) rugosus
Robson, 1929. *Mono. Rec. Ceph* . p. 63.
Adam, 1939. *Rec. Ind. Mus.*, 41 : p. 71.

Material examined 5♂ 4♀

Diagnosis Prominent multifid cirrus present on head above each eye eyes prominent mantle round with a ventral furrow skin of the mantle grey with tubercles and faint dark, reticulation on the dorsal side and paler on the ventral side arm-length about two and a half to three times the length of the mantle.

Description

Mantle : Mantle round with a distinct ventral furrow skin of the mantle dark grey with tubercles and faint dark reticulation on the dorsal side and paler on the ventral side M.L. about 27.6% of T.L. and maximum M.W. about 19.3% of T.L.

Funnel Funnel broader at the posterior end and reaching above the level of the eyes Fun. L. about 10.5% of T.L. Fun. O. 'W' shaped with narrow bands.

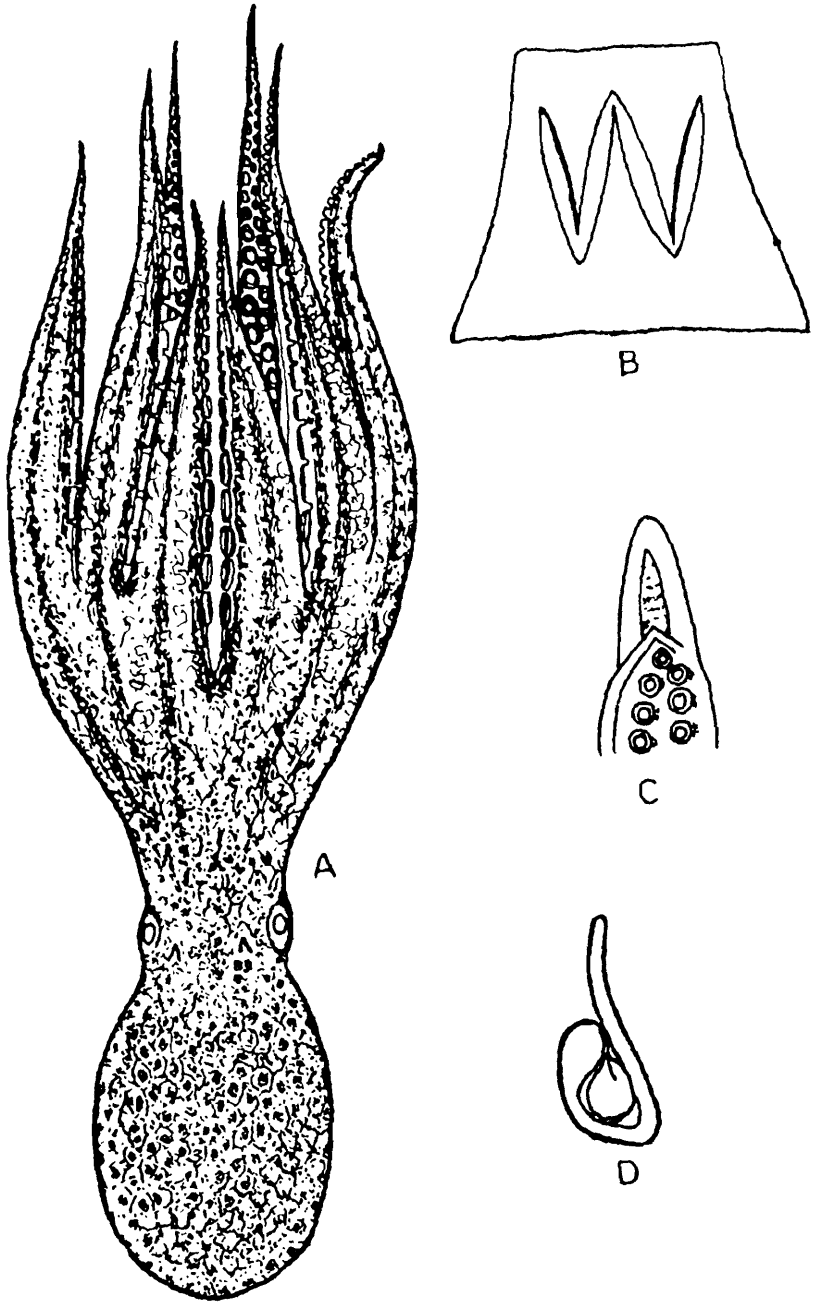


Fig. 22. *Octopus rugosus* Bosc. 1792 (a) Dorsal view (b) Funnel organ enlarged (c) Hectocotylus enlarged (d) Penis enlarged.

Head H.L. about 9.2% of T.L. and H.W. about 10.1% of T.L. eyes prominent a distinct mutifid cirrus present above each eye surface of skin dark grey and granulated.

Arms Arms robust ending into blunt tips maximum length of arm about two and a half to three times the length of the mantle A.O. usually 4 2 3 1 L.A. I about 54.2% of T.L. L.A. II about 57.5% of T.L. L.A. III about 56.1% of T.L. L.A. IV about 74% of T.L. suckers on the proximal portion of arms II and III enlarged in males dark band at the base of suckers on the dorsal surface of arms, the skin of the arms dark grey with faint reticulation web shortest in between the dorsal arms, the W.O. usually C D E B A.

Ocellus : No ocellus present.

Hectocotylus The right arm III hectocotylised, the length of ligula about 9% of A.L., it is narrow with a shallow groove at the centre the tip of calimus broad and blunt.

Penis Penis well-developed, sacular L.P. about 9.2% of T.L.

Gill G.L. about 11.9% of T.L. nine lamellae present on the outer demibranch of each gill.

Type locality Senegal, West Africa.

Geographic distribution Cosmopolitan in tropical to warm temperate waters this species is known from the east and west coasts of India.

Affinities This species shows close affinities with *Octopus aegina* in having the ocular cirrus the shape of the body and the dark grey reticulated skin but differs from the latter by the shorter sacular penis.

Octopus Marcopus Risso, 1826.
(Fig. 23)

Octopus macropus
Risso, 1826. Apercu sur d' historie naturelle des Mollusques. *Hist. nat. Europe. Meridion.*, 4 : p. 3.
Goodrich, 1896. *Trans. Linn. Soc. London Zool.*, 7 : p. 20.
Adam, 1959. *Res. Sci. Mission R. P. Dollfusen Egypte.*, (3) 28 : p. 174 fig. 20.
Voss, 1963. *Bull. U. S. Natl. Mus.*, (234) : p. 164. pl. 3b.
Polypus. macropus
Massy, 1916. *Rec. Ind. Mus.*, 12 : p. 192
Octopus (Octopus) macropus
Robson, 1929. *Mono. Rec. Ceph.*, 1 p. 101

Material examined : 7♂ 6♀

Diagnosis : Dorsal pair of arm long and stout ; the ligula of the hectocotylised right arm III stout and folded inwards ; 12 lamellae present in the outer demibranch of each gill ; colour of body buff with minute chromatophores on the dorsal side and pale on the ventral side.

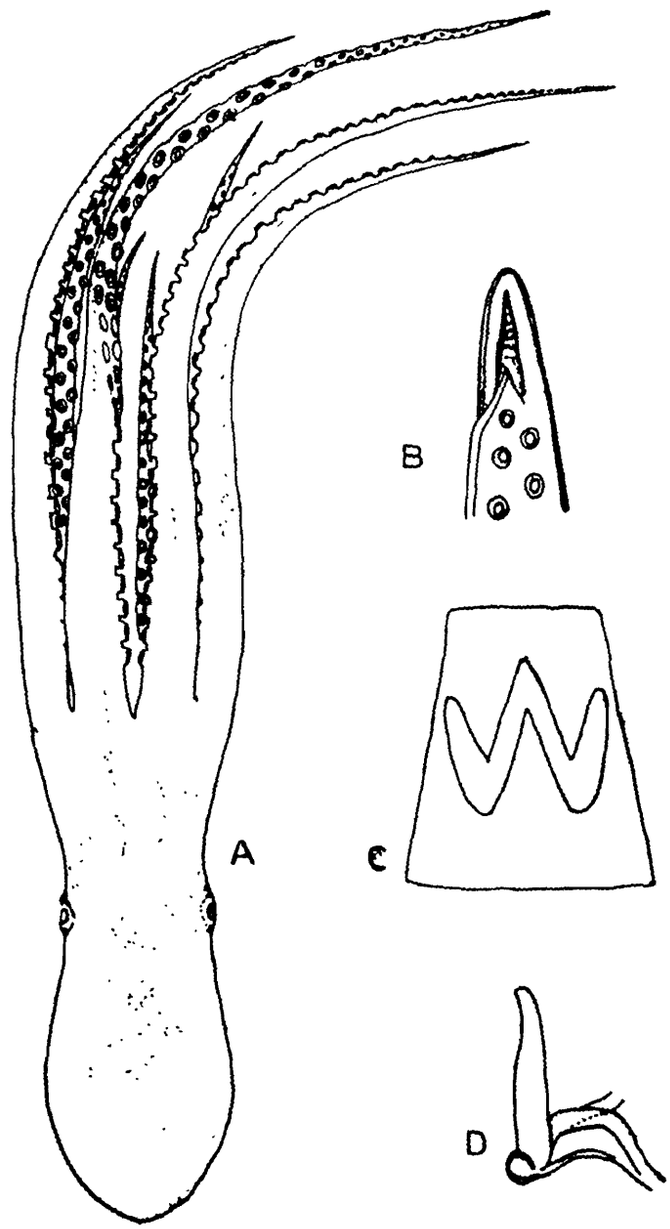


Fig. 23. *Octopus macropus* Risso, 1876 (a) Dorsal view (b) Hectocotylus enlarged (c) Funnel organ enlarged (d) Penis enlarged.

Description

Mantle Mantle short and round colour buff with minute chromatophores on the dorsal side, ventral side pale M.L. about 14% of T.L. M.W. about 11.9% of T.L.

Funnel Funnel long, reaching above the level of the eyes. Fun. L. about 8.4% of T.L. Fun. O. 'W' shaped.

Head Head very short, H.L. about 4.2% of T.L. H.W. about 8.7% of T.L. eyes less prominent no cirrus present above the eye.

Arms Dorsal pair of arms longest A.O. usually 1 2 3 4 L.A.I. about 71.7% of T.L. L.A. II about 55.7% of T.L. L.A. III about 54.2% of T.L. L.A. IV about 47.2% of T.L. suckers on the proximal portion of arm I in males enlarged suckers raised on the arms web longest between the dorsal arms W.O usually A B C D E.

Ocellus . No ocellus present.

Hectocotylus Right arm III hectocotylised ligula short and narrower than the part of the arm immediately proceeding it edges of ligula folded inwards calimus distinct.

Penis Penis small L.P. about 2.4% of T.L.

Gill G.L. about 6.3% of T.L. 12 lamellae present on the outer demibranch of each gill.

Type locality Mediterranean.

Geographic distribution ; Cosmopolitan in the warm and tempeater seas throughout the world. The present record is the first report of this species from the study area.

Affinities This species differs from the other species occurring in the study area by the longest and stoutest dorsal arms and the typical shape of ligula of the hectocotylus inwards.

Octopus fusiformis Broc,1887

(Fig. 24)

Octopus fusiformis

Brock, 1887. In dische Cephaloden. Zool. Jehrb, Syst., 2: p. 601. pl 16 fig. 1 & 2.

Polypus fusisormis

Massy, 1916. *Rec.Ind, Mus.*,12 : p. 203

Octopus (Octopus) fusiformis

Robson, 1929. *Mono. Rec. Ceph.*, 1 : p. 132.

Adam, 1939. *Rec. Ind. Mus.*, 4 : p. 86.

Material examined 3♂ 4♀

Diagnosis Long and narrow mantle, short and narrow head and the arms about 4-5 times the length of the body and tapering to very fine

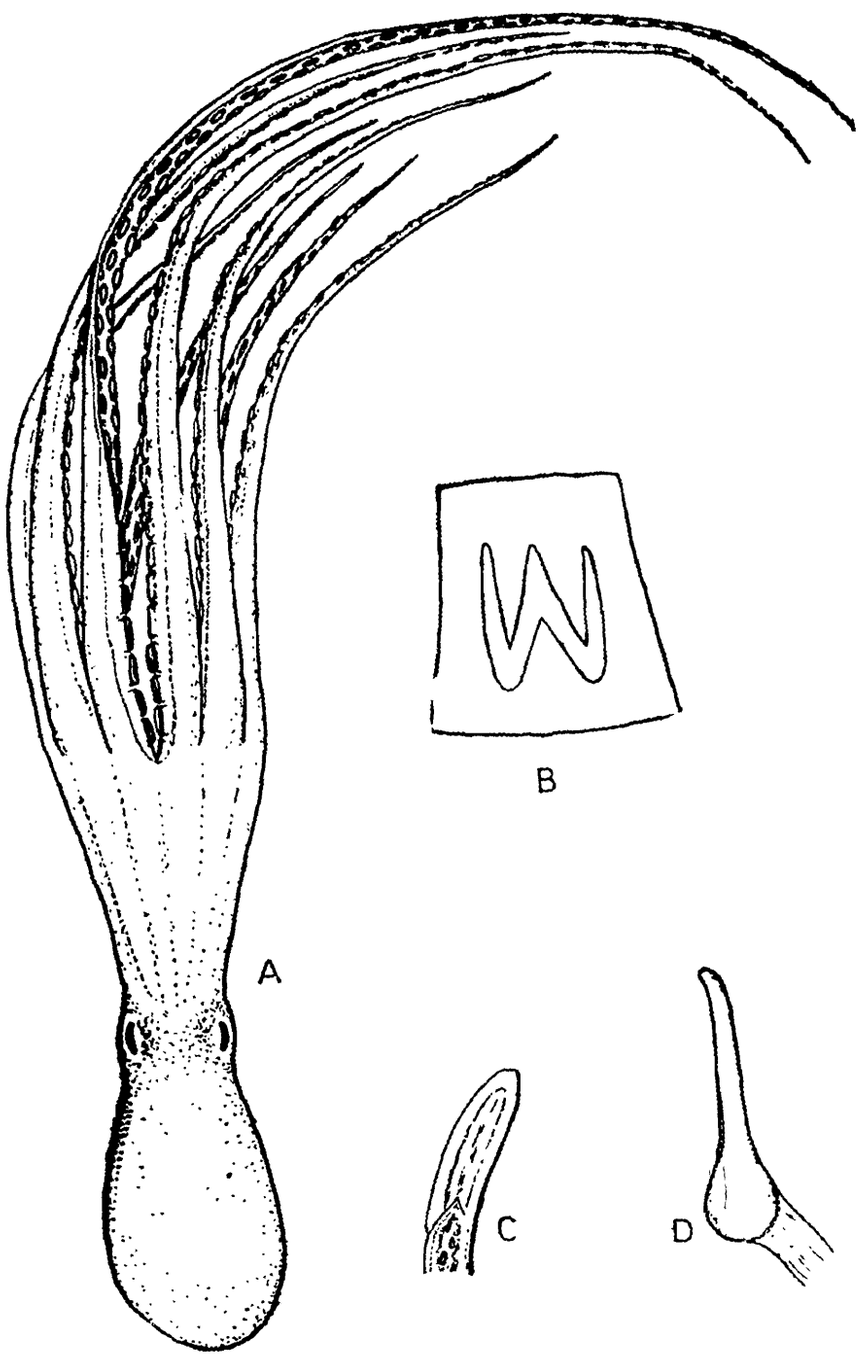


Fig. 24. *Octopus fusiformis* Brock, 1887 (a) Dorsal view (b) Funnel organ enlarged (c) Hectocotylus enlarged (d) Penis enlarged.

points body surface smooth, brownish above and pale below suckers on arms sunken.

Description

Mantle Long, narrow, surface smooth, colour brownish above and pale below M.L. about 16.2% of T.L. M.W. about 6.7% of T.L.

Funnel Funnel long. conical and adherent to 2/3 of its length Fun. L. about 6% of T.L. Fun.O 'W' shaped with narrow bands.

Head Head short and narrow H.L. about 3.5% of T.L. H.W. about 5.2% of T.L. eyes small and less prominent no cirrus present above the eye.

Arms A.O. usually 1 2 3 4 L.A.I about 82% of T.L, L.A.II about 57.5% of T.L. L.A.III about 43.7% of T.L. L.A.IV about 40% of T.L. arms tapering to very fine points no enlarged suckers present on arms suckers short and sunken into the arms W.O usually A B C D E.

Ocellus No ocellus present.

Hectocotylus Ligula broad with a central furrow calimus distinct terminating into a point.

Penis Small L.P. about 2.5% of T.L.

Gill G.L. about 5.2% of T.L. 12 filaments present in the outer demibranch of each gill.

Type locality Amboina.

Geographic distribution Indo-Pacific Bay of Bengal, Indonesia. This species is reported for the first time from the Madras coast.

Affinities The long, narrow body and arms distinguishes this species from other speciess of *Octopus* occurring in the area. Massy (1916) stated that "no species already described resembles it"

Octopus areolatus Orbigny, 1848

(Fig. 25)

Octopus areolatus

Orbigny, 1848 (in 1834-1848). Cephalopodes acetabuliferes vivants et fossils. *In* histoire naturelle generale et particuliere Edited by A. Ferussac and A d Orbigny, Paris. p. 65

Polyous areolatus

Massy, 1916. *Rec. Ind. Mus.*, 12 : p. 193.

Octopus (Octopus) areolatus

Robson, 1929. *Mono. Rec. Ceph.*, 1 : p. 122 pl. 7, Fig. 1.

Material examined : 4♂ 5♀

Diagnosis : Ocellus present between the base of the second and third arm arms about two and a half to three times the length of the mantle ; cirrus present above the eyes mantle widest posteriorly with a ventral furrow web shorter between the dorsal pair of arms.

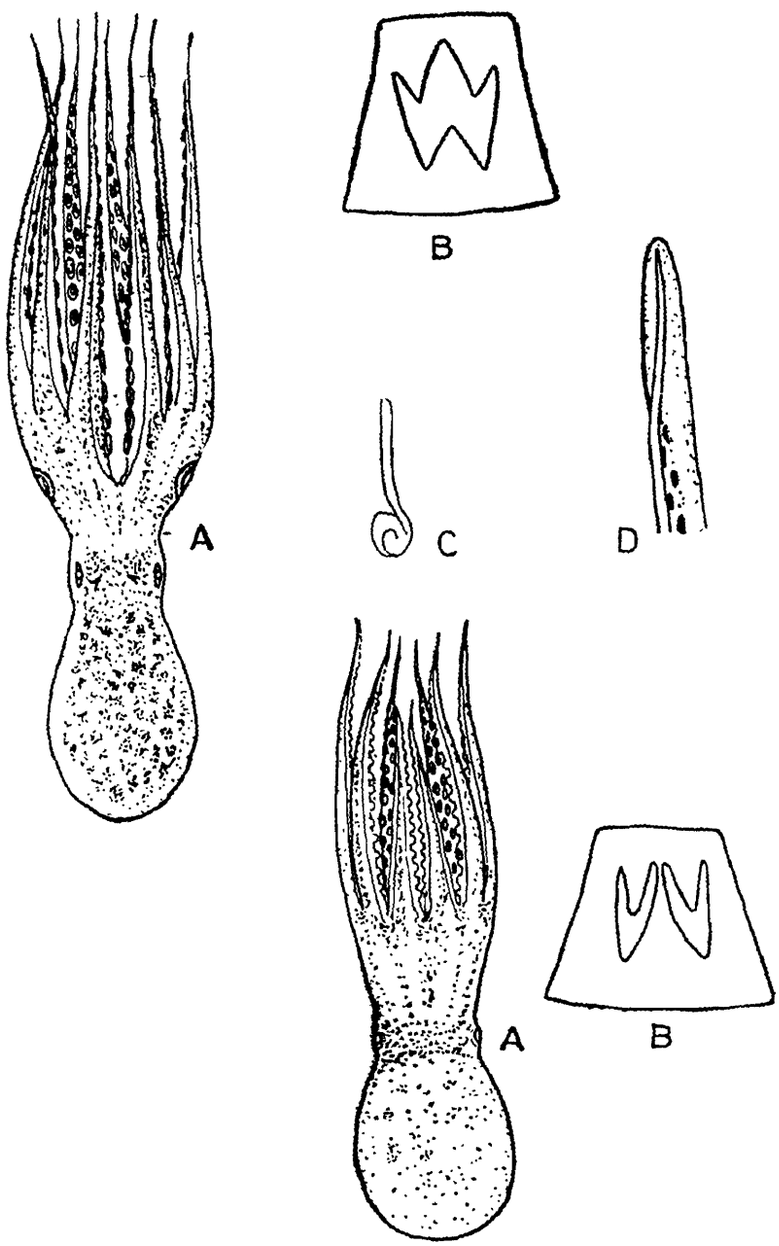


Fig. 25. *Octopus areolatus* Orbigny. 1840 (a) Dorsal view (b) Funnel organ enlarged (c) Penis enlarged (d) Hectocotylus enlarged.

Fig. 26. *Octopus prashadi* Adam. 1939 (a) Dorsal view (b) Funnel organ enlarged

Description

Mantle Mantle sacular, widest posteriorly with conspicuous ventral furrow the dorsal surface of the mantle dark grey, paler ventrally M.L. about 19.2% of T.L. M.W. about 14.5 %of T.L.

Funnel Funnel free for half of its length and reaching above the level of the eyes Fun.L. 8.3% of T.L. Fun.O 'W' shaped with broad bands.

Head H.L. about 6.2% of T.L. H.W. about 7.8% T.L. eyes moderately prominent large cirrus present above each eye.

Arms A.O. usually 4 2 3 1 L.A.I about 46.8% of T.L. L.A.II about 63.4% of T.L. L.A.III about 62.4% of T.L. L.A.IV about 74 8% of T.L. tips of arms tapering to narrow ends suckers of the proximal portion of arms II and III in males enlarged over others dark grey chromatophores on the dorsal surface of arms web shortest between the dorsal pair of arms W.O. usually B C D E A.

Ocellus Ocellus paesent between the base of the second and third arms ocellus consisting of dark core surround by white ring and succeeded by a dark outer ring.

Hectocotylus The ligula narrow long with deep central furrow calimus not well-defind.

Penis Long L.P. about 4.1% of T.L.

Gill G.L. about 8.8% of T.L. eight fillaments in the outer demibranch of each gill.

Type locality Japan.

Geographic distribution Indo-Pacific Bay of Bengal, Japan, Hong-Kong. This species is reported for the first time from the Madras coast.

Affinities The presence of ocellus and cirri above the eyes readily distinguish this species from other species of octopuses of the study area.

Octopus prashadi Adam, 1939
(Fig. 26)

Octopus prashadi
Adam, 1939. The Cephalopoda in the Indian Museum, Calcutta. Rec. Ind. Mus., 41 : pp. 103-105 pl. 2 fig. 1—3.
Polypus levis (nec Hoyle)
Massy, 1916. *Rec. Ind. Mus.*, 12 : pp. 198—199.

Material examined 2 ♀

Diagnosis : Arm length about two times the dorsal mantle length ; web between the arms very deep Fun.O. 'VV' shaped head short and less prominent.

Description :

Mantle Mantle smooth. slate blue and paler beneath mantle broader at the base M.L. about 33.9% of T.L. M.W. about 27.1% of T.L.

Funnel : Funnel free for about 1/3 of its length and opening above the level of the eyes. Fun.L. about 15.5% of T.L. Fun.O. VV' shaped.

Head head very short, H.L. about 9.7% of T.L. H.W. about 16.4% of T.L. eyes small and less prominent no cirrus present above the eye.

Arms : Maximum arm length about two times the length of the mantle. A.O. usually 3 4 2 1 ; L.A.I about 59.1% of T.L. L.A.II about 67.9% of T.L. L.A.III about 68.8% of T.L. L.A.IV about 67.9% of T.L. ; web between arms very deep, W.O usually C D E B A,

Ocellus : No ocellus present.

Hectocotylus No male specimen present in the collection, hence not studied.

Penis No mantle specimen present in the collection and hence not studied.

Gill Short ; G.L. about 12.6% of T.L. nine lamellae present on the outer demibranch of each gill.

Type locality Port Blair, Andamans.

Geographic distribution Indian Ocean, Andaman Islands Bay of Bengal. This species is reported for the first time from the Madras coast.

Affinities : At present this species is known only from the two female specimens designated to this species by Adam (1939). It is interesting to note that the two specimens in the present collection assigned to this species are also females. As already pointed out by Massy (1916) and Adam (1939) this species shows strong resemblences to *Octopus levis* Hoyle.

Genus **Cistopus** Gray,1849.

Distinct velar pouch with small pore present on each segment of web between the base of arms ligula of the hectocotylised arm very short and smooth.

Cistopus indicus (Orbigny, 1840)
(Fig. 27)

Octopus indicus
Orbigny, 1840. (in 1834—1848). Cephalopodes acetabuliferes vivants et ofssils. *In* Histoire naturelle generale et partieuliere edited by A. Ferussac and A d' Orbigny, Paris. p. 24.
Cistopus indicus
Robson, 1929. *Mono. Rec. Ceph.*, 1 : 182
Voss, 1963. *Bull. U.S. Natl. Mus.*, (234) pp. 165—166.
Satyamoorthi, 1956. *Bull. Mad. Govt. Mus., N.H.* 1, 2 pt. 7, p. 185.

Material examined 2 ♂

Diagnosis The velar interapaces on the oral side contains elongately avoid pouches opening on the oral surface of each interspace ligula of the hectocotylised arm very short and smooth, calimus ending bluntly.

Description

Mantle Mantle elongate and sacular surface smooth M.L. about 14.7% of T.L. M.W. about 10% of the T.L.

Funnel Funnel broad and prominent attached to the head more than half of its length Fun.L about 6.7% of T.L. Fun.O 'W' shaped. shaped.

Head H.L. about 3.6% of T.L. eyes less prominent no cirrus above the eye present.

Arms Long with broad suckers on the proximal half A.O. usually 1 2 3 4 L.A.I about 88.5%of T.L. L A.II about 81% of T.L. L.A.III about 69.7% of T.L. L.A.IV about 66 7% of T.L. web between arms well-developed W.O. usually A B C D E.

Ocellus No ocellus present.

Velar pouches The velar interspaces on the oral side contains elongately ovoid pouches, opening on the oral surface of each interspace.

Hectocotylus Right arm III hectocotylised ligula very short and smooth calimus ends bluntly.

Penis Small L.P. about 2.2% of T.L.

Gill G.L. about 5.2% of T.L. eleven lamellae present on the outer demibranch of each gill.

Type locality Celebes.

Geographic distribution Indo-Pacific Arabian Sea, Bay of Bengal, China Sea and upto Philippines.

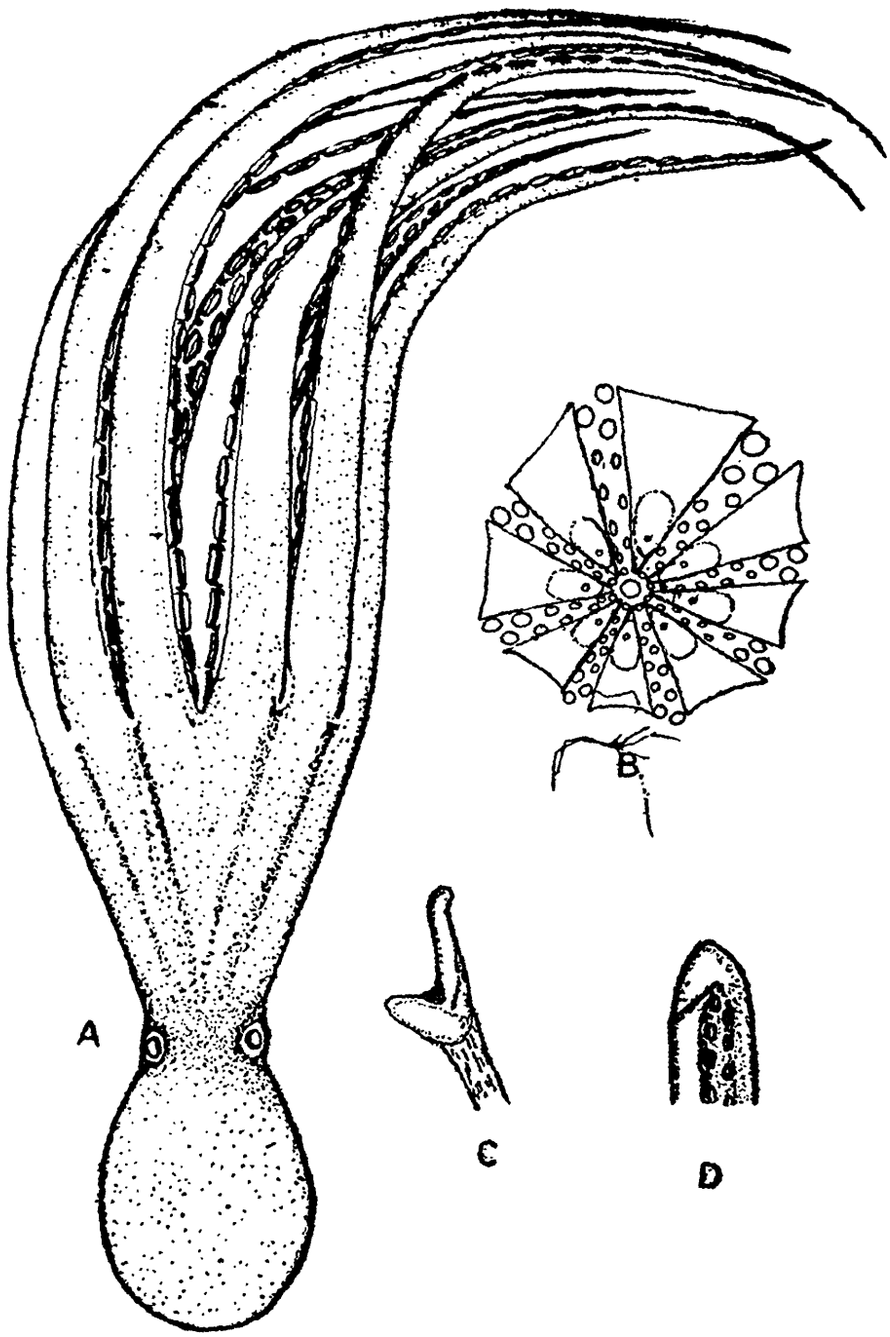


Fig. 27. *Cistopus indicus* Orbigny, 1840 (a) Dorsal view (b) Velar pouches (c) Penis enlarged (d) Hectocotylus enlarged.

Affinities The velar pouches and the distinct type of hectocotylus readily distinguish this species from the other species of octopuses occurring in the Madras coast. The present report is the first record of this species from the study area.

Genus **Hapalochlaena** Robson. 1929.

This genus is characterised by the presence of blackish streaks and rings with pale blue centre on the mantle and arms.

Hapalochlaena fasciata (Hoyle, 1886)
(Fig. 28)

Octopus pictus var. *fasciata*
Hoyle, 1886. Report on the Cephalopoda collected by H. M. S. 'Challengar' during years 1873—1876. *Rep. Sci. Res. Voy. 'Challenger' 1873—76* (*Zool*) 16 (44): p. 94, pl. 8. fig. 3.
Goodrich, 1896. *Trans. Linn. Soc. London.* Zool. 7 : p. 19, pl 5, fig. 82.
Hapalochlaena maculosa
Robson, 1929. *Mono. Rec. Ceph.*, 1 : p. 211.
Hapalochalena fasciata
Adam, 1939. *Rec. Ind. Mus.*, 41 : pp. 98—100.

Material examined 3♂ 5♀

Diagnosis Blackish streaks and rings with pale-blue centre present on the mantle head and arms; 5-6 basal suckers on arms placed in one longitudinal series the ligula of the hectocotylised arm with a rounded median groove, the calimus well-developed.

Description

Mantle Mantle small skin smooth streaks and rings with pale blue centre present on the mantle. M..L. about 37.7% of T.L. M.W. about 20. 1% of T.L.

Funnel Funnel free for half of its length Fun. L. about 13.8% of T.L. about 12.6% of T.L. H.W. about 15.1% of T.L. eyes less prominent no cirrus present above the eye.

Arms Arms short A.O. usually 3 4 2 1 L.A. I about 50.4% of T.L. L.A. II about 60.4% of T.L. L.A. III about 61.7% of T.L. L.A. IV about 61.7% of T.L. 5 – 6 basal suckers on arms placed in one longitudinal row streaks and rings in dark background present on the outer skin of arms no enlarged suckers present. W.O. usually C D E B A.

Ocellus No ocellus present.

Hectocotylus : Right arm III hectocotylised ; ligula rounded and narrower than the portion of the arm proceeding it and with a median groove calimus well-developed, terminating into a point.

Penis Well-marked ; L.P. about 6.3% of T.L.

Gill G.L. about 12.6% of T.L. seven lamellae present in the outer demibranch of each gill.

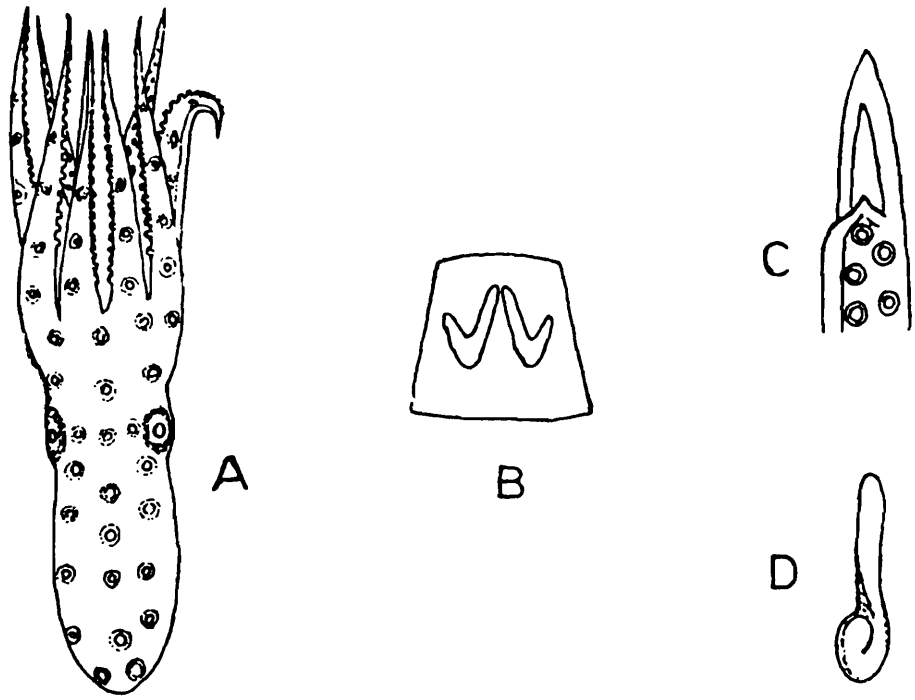


Fig. 28. *Haplochlaena fasciata* Hoyle, 1886 (a) Dorsal view (b) Funnel organ enlarged (c) Hectocotylus enlarged (d) Penis enlarged.

Type locality Not clearly known.

Geographic distribution Indo-Pacific Sri Lanka, Australia and Japan seas. The inclusion of this species in the present work is the first report of this species from the Madras coast.

Affinities This species differs from all other species of octopuses reported from the Madras coast by the typical streaks and rings found on the mantle and arms. The funnel organ present in the present specimens showed very closely set 'VV' shape and not 'W' shape as reported by Adam (1939).

Genus **Berrya** Adam, 1939.

Body of the animal soft mantle opening narrow funnel fused to the head Fun. O. 'VV' shaped.

Berrya hoylei (Berry, 1909)
(Fig. 29)

Polypus hoylei
Berry, 1909. Diagnoses of new Cephalopods from the Hawaiian Islands, *Proc. U. S. Nat. Mus.*, 37 : p. 407. fig. 1
Massy, 1916. *Rec. Ind. Mus.*, 12 : p. 207.
Octopus hoylei var. *annae*
Robson, 1929. *Mono. Rec. Ceph.*, 1 : p. 219. fig. 89.
Berrya hoylei
Adam, 1939. *Rec. Ind. Mus.*, 41 : p. 101—103.

Material examined 1 ♂ 1 ♀

Diagnosis : Skin of the body soft and gelatinous mantle secular arms short, suckers sunken funnel fused to the head ; funnel organ 'VV' shaped hectocotylus well-developed.

Description

Mantle Mantle sacular, skin soft and gelatinous M.L. about 32.5% of T.L. M.W. about 28.6% of T.L.

Funnel : Funnel short and fused to the head Fun. L. about 14.3% of T.L. Fun. O. 'VV' shaped.

Head Head short, H.L. about 11.7% of T.L. H.W. about 20.8% of T.L. eyes less prominent minute warts seen around the eyes.

Arms A.O. usually 3 4 2 1 L.A. I about 58.5% of T.L. L.A. II about 65% of T.L. L.A. III about 78% of T.L. L.A. IV about 72.8% of T.L. suckers small, sunken into the arms and are very closely set. W.O. usually D C E B A.

Ocellus No ocellus present.

Hectocotylus Right arm III hectocotylised ligula well-developed with large central groove and the sides rolled inwards calimus weakly developed and separates the ligula from the rest of the arm.

Penis well-marked L.P. about 6.5% of T.L.

Gill : G.L. about 13% of T.L. ten lamellae present on the outer demibranch of each gill.

Type locality : Hawaii.

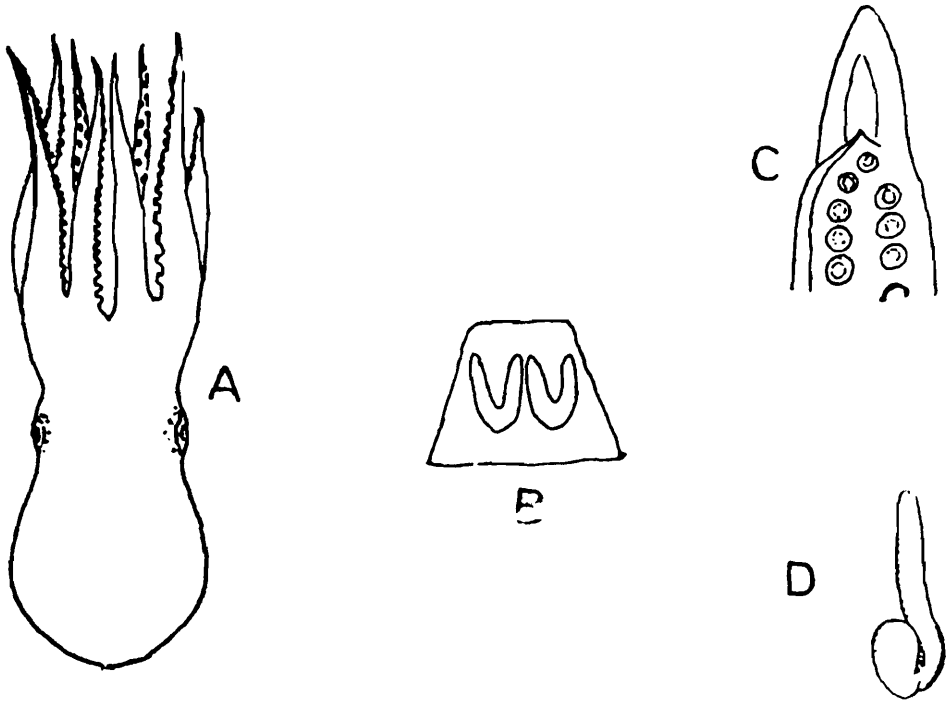


Fig. 29. *Berrya hoylei* (Berry, 1909) (a) Dorsal view (b) Funnel organ enlarged (c) Hectocotylus enlarged (d) Penis enlarged.

Geographic distribution Indo—Pacific Arabian Sea, Bay of Bengal, Andaman Sea and Hawaii. This species is reported for the first time from the Madras coast.

Affinities The soft and gelatinous skin of the body, the typical funnel organ and the hectocotylus distinguish this species from other species of octopuses occurring in the Madras coast.

DISCUSSION

In the present work a total number of 25 species of cephalopods (Sepioidea—10, Teuthoidea—6 and Octopoda-9) have been recorded from the Madras coast. *Sepia kobiensis, Aerosepina arabica, Inioteuthis japonica, I. maculosa, Loligo uyii, Octopus aegina, O. macropus, O. fusiformis, O. prashadi, Cistopus indicus, Haplochlaena fasciata* and *Berrya hoylei* have been recorded for the first time from the study area.

Further, a new species, *Loligo bengalensis* has also been described. Two species, of *Octopus, O. cyaneus* and *O. globosus* already reported from the Madras coast are not represented in the present collection. It is interesting to note that the study of the material collected from lwo water mark to about 50 metres depth along the Madras coast yielded 13 new records and a new species. It is obvious that comprehensive off shore collecting with adequate equipment would probably bring to light many additional species.

The geographic distribution of the species included in the report falls under three catagories namely (1) species endemic to Indian Ocean (2) Indo-Pacific species and (3) Cosmopolitan species.

(1) *Species endemic to Indian Ocean* *Sepia brevimana, S. prashadi, Aurosepina arabica, Loligo bengalensis* sp. nov. and *Octopus prashadi* are endemic to the Indian Ocean.

(2) *Indo-Pacific species* : The Indo-Pacific species are disproportionately high in the samples studied. *Sepia aculeata, S. pharaonis, S. kobiensis, Sepiella inermis, Euprymna berryi, Inoteuthis japonica, I. maculosa, Loligo duvauceli, L. uyii, Doryteuthis singhalensis, Sepioteuthis lessoniana, Loliolus investigatoris, Octopus aegina, O. fusiformis, O. areolatus, Cistopus indicus, Haplochlaena fasciata* and *Berrya hoylei* included in the present report are inhabitants of both Indian and Pacific Oceans. It is a known fact that when the north-west monsoon prevails, the North Equatorial Current is well-developed enabling the water from the Pacific Ocean enter the Indian Ocean. This mixing up of waters of the Indian and Pasific Oceans may be the reason for the occurrence of a large number of Indo-Pacific species reported herein.

(3) *Cosmopolitan species* Two species of Octopus, *O. rugosus* and *O. macropus* reported in this work have world-wide geographic distribution and have been reported from the warm and temperate waters around the world.

It is interesting to note that not even a single species of the Atlantic Ocean is found in the present collection. This may be due to the fact that there is no free mixing of the Atlantic and the Bay of Bengal Sea.

Very little attention has been paid to the study of the planktonic cephalopoda of the Indian Seas, except the work of Silas (1968) on the planktonic cephalopods of the west coast of India.

The biology and life-histories of the Cephalopoda of the Indian Seas are poorly known the only noteworthy work is that of Rao (1954) on *Sepioteuthis arctipinnis* (=*S. lessoniana*). This field of study needs urgent attention. For the study of octopoda Voss (1975) stressed the need to have a complete series of animals or have reared them in the aquarium since in most species life histories have not been worked out (personal communication).

SUMMARY

1. The present study is based on the cephalopod samples collected from the Madras coast between Pulicat in the north to Kalpakkam in the south during the years 1975-1982. A total number of twenty five species under Order Sepioidea, six species under Order Teutho idea and nine species under Order Octopoda are reported from the Madras coast. The important taxonomic characters of the Orders Sepioidea, Teuthoidea and Octopoda are figured. Diagnosis and descriptions are given for each species. Illustrations are provided for all the species together with characters of taxonomic significance. A dichotomous key is provided for the identification of species present in the collection. The Type locality, synonyms, geographic distribution and affinities are discussed for all the species under consideration.

2. Four species under Order Sepioidea, one species under Order Teuthoidea and eight species under Order Octopoda are reported for the first time from the area of study. One species of *Loligo*. *L. uyii* Wakiya & Ishikawa, 1921 is reported for the first time from the Indian Ocean. Two species of *Octopus* already reported from the Madras coast are not present in the present collection.

3. A new genus *Aurosepina* has been proposed to accommodate a male specimen of cuttlefish present in the collection. This specimen differs from the species of already known genera *Sepia* and *Sepiella* in the following characters :

(i) Distinct well-developed ear-shaped fold on the head above the posterior end of each eye.

(ii) The cuttlebone narrow, rounded with 'V' shaped striations and devoid of chitinous margins and spine.

(iii) The hectocotylisation of the left ventral arm is not distinguished.

(iv) A series of triangular brown patches along the base of the fins ; well-marked tubercle on the dorsal side of 2nd pair of arms and barbs on the outer margin of arms II and III.

As the type material of *Sepia arabica* Massy, 1916 examined by the author possessed many of the important characters mentioned above, it is placed under a new genus *Aurosepina* as *A. arabica* (Massy, 1916).

4. A new species of *Loligo, L. bengalensis sp.* nov. is described to include specimens in the coollection with the following characters differing from the specses of *Loligo* described hitherto.

(i) The mantle narrow with pointed posterior end , dark pink large chromatophores on the dorsal surface of the mantle, head and arms.

(ii) Fins short with narrow poterior end fin angle about 30°

(iii) The hectocotylised left ventral arm has normal suckers in the first 2/3 length of the distal 1/3 length has modified papillae.

(iv) The tentacular sucker rings have smaller teeth alernating with larger ones on the distal side and same sized teeth on the proximal side.

5. Among the twenty five species reported, two species are cosmopolitan, eighteen species are Indo-Pacific and five species are endemic to Indian Ocean in geographic distribution. The free-mixing of the Indian and Pacific Oceans may be the reason for the occurrence of large numbers of Indo-Pacific species.

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PLATES

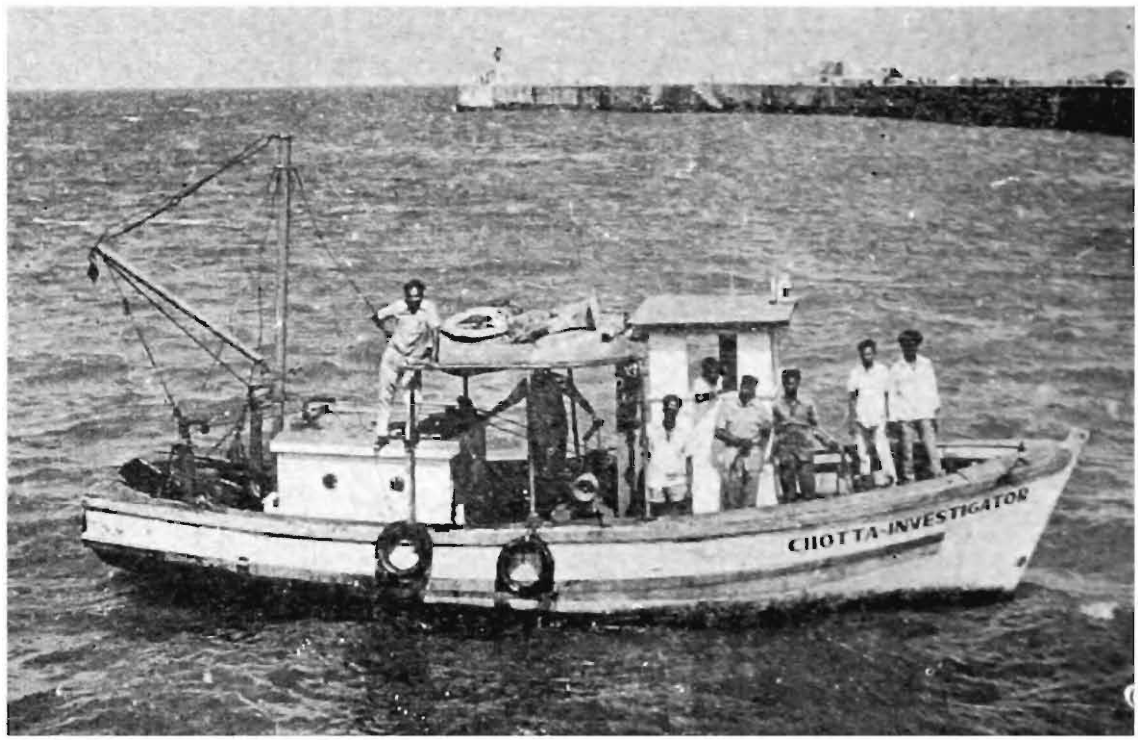

Plate. 1. R.V. "Chota Investigator" 32 feet Research Boat

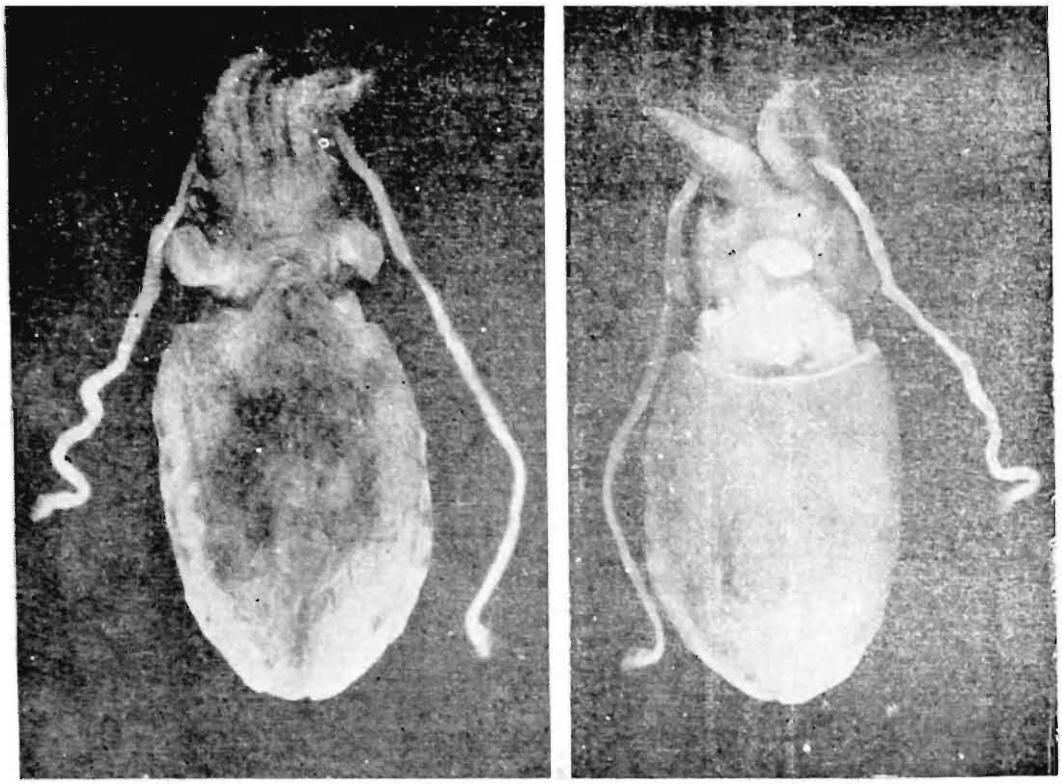

Plate. 2. *Aurosepina arabica* (Massy, 1916) A. Dorsal view B. Ventral view

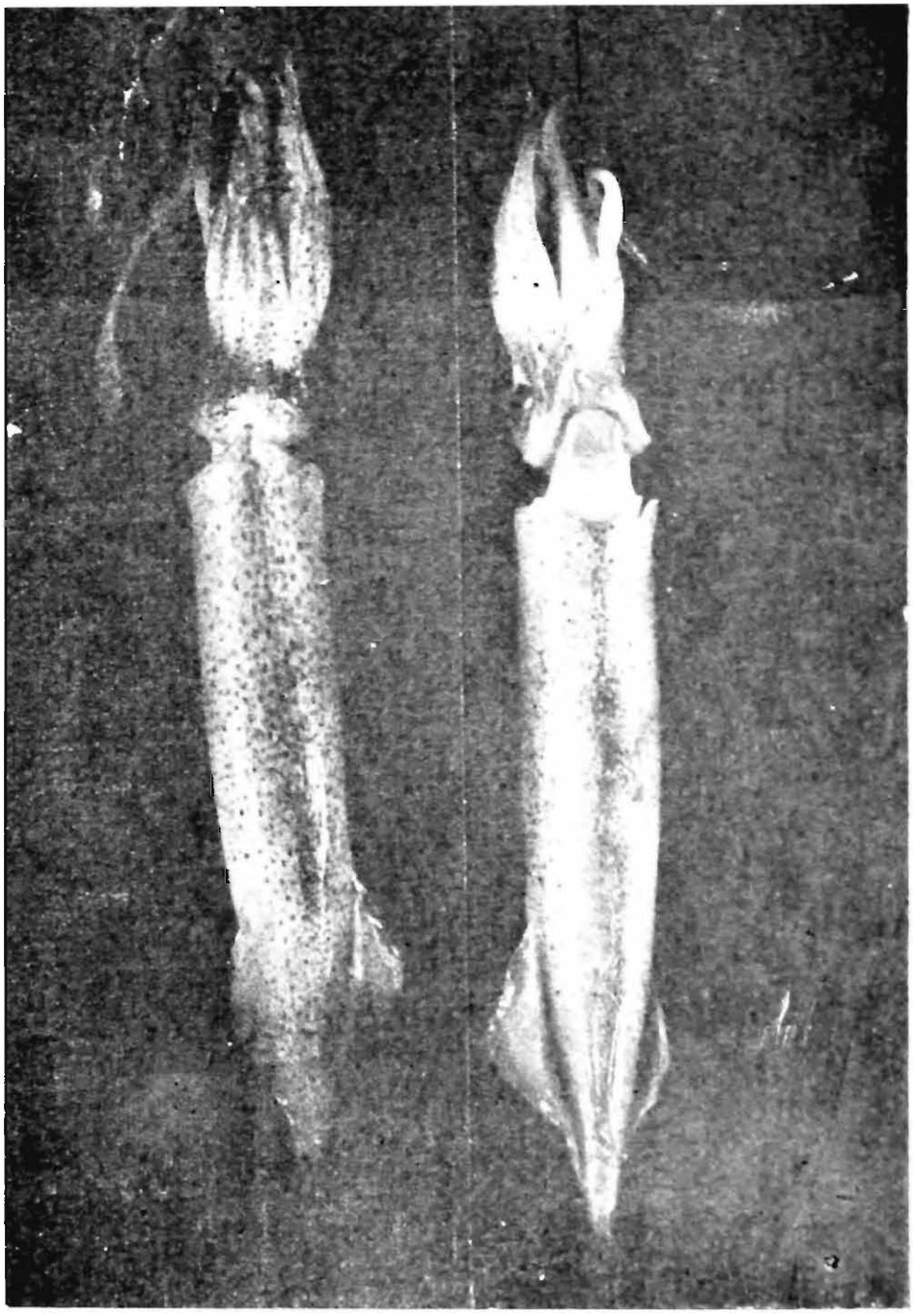

Plate. 3. *Loligo bengalensis* sp. nov. A. Dorsal view B. Ventral view