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A NEW GENUS OF SCHILBEID CATFISHES FROM THE DECCAN (INDIA).[1]

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Introduction.

During one of the fish collecting expeditions to locate sources of fry and fingerlings suitable for pond culture, a peculiar catfish, with prominent teeth on the undersurface of its tapering snout, was discovered in the Krishna river in the Satara District. Occurrence of such external teeth in catfishes appeared rather unusual. Superficially, the fish resembled *Pseudeutropius acutirotris* (Day) of the Irrawaddy river, but closer examination of the vomero-palatine teeth and its air-bladder revealed that it belonged to a new genus in the Schilbeid group. Hora's (1941) exhaustive treatment of this group of fishes confirmed my results.

The new genus is designated as *Neotropius* and the species as *Khavalchor*, the specific name having been derived from its local name in the type locality. The genus and species are described in detail in the following notes.

Genus Neotropius nov.

Diagnostic features.—Fishes of the Schilbeid type with eight barbels and a tapering snout having teeth on its under surface. Head moderately small and depressed. Branchiostegals nine. Mouth inferior, jaws being comparatively wide like Euselachian jaws. Cleft of the mouth hardly reaching below the anterior orbital margin. Eyes large and without adipose lids. They are situated behind and above the angle of the jaw and are partly on the inferior surface of the head. Nostrils patent; the posterior ones more or less logitudinally disposed and considerably apart. The anterior ones tubular and situated near the edge of the snout. Vomero-palatine teeth in separate patches. Vomerine teeth in a continuous crescentic band covering a wide area on the palate. Palatine teeth in two small patches on either side, widely separated from the vomerine. Barbels eight in number; two nasals, two maxillary and four mandibular. Mandibular barbels arise close to the margin of the lower jaw and their basis are almost in a transverse line. Nasal barbels arise at the base of the posterior nostrils. A comparatively small dorsal fin with a short serrated spine and five or six rays. A small adipose fin also present. Pectoral spine truncate, ending abruptly into a curved denticulation and serrated internally.

Air-bladder large, abovate in shape and somewhat flattened dorso-ventrally. It is moderately thickwalled and divided internally into three incomplete chambers. It comes in contact with the abdominal parieties above the pectoral fin and gives rise to blister-like areas when seen from outside.

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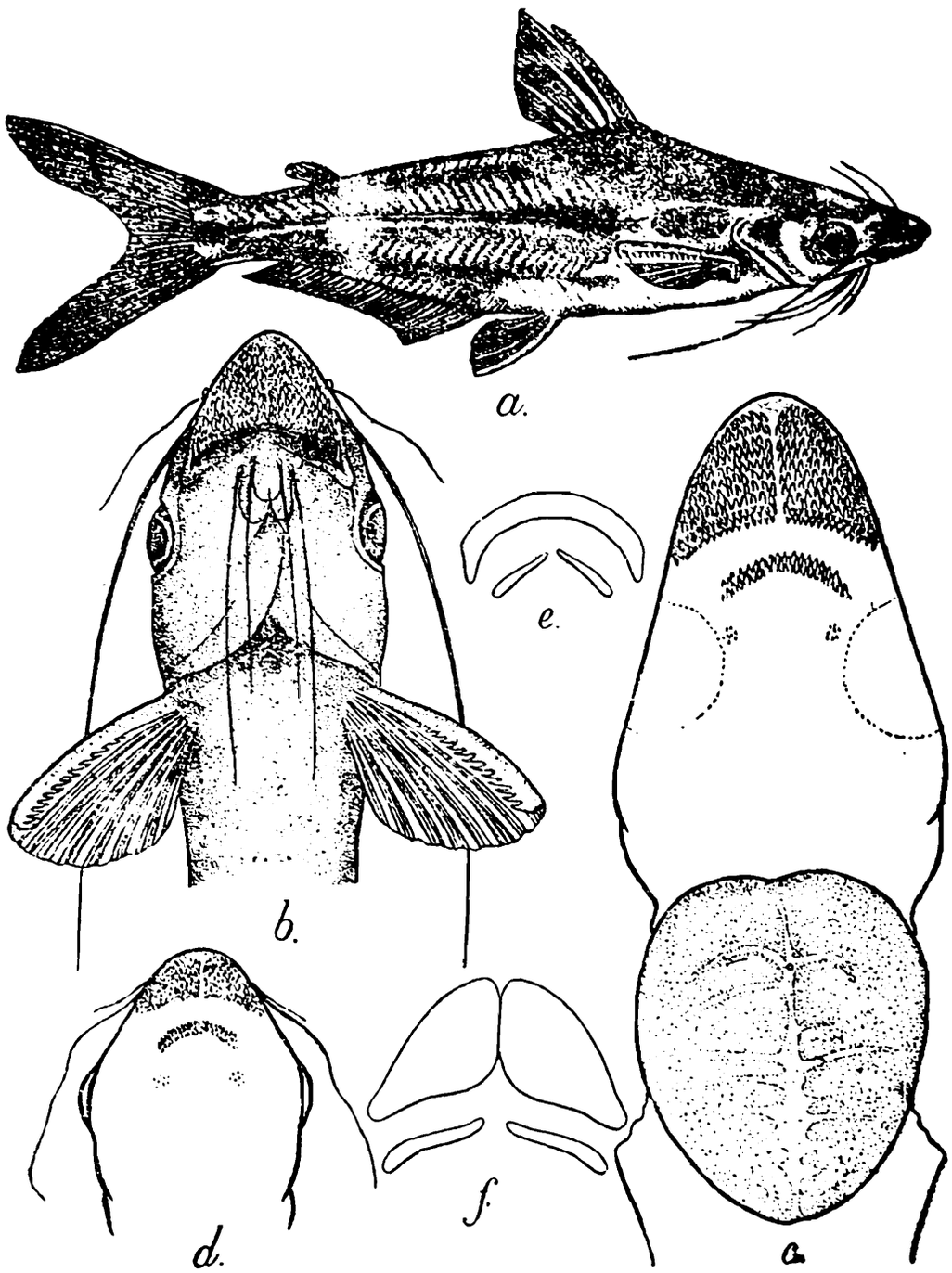
NEOTROPIUS KHAVALCHOR, gen. *et* sp. nov.

B. IX ; D.1/6-7 ; A. 2-3/22-33 ; P. 1/7 ; V. 1/5 ; C. 17.

N. khavalchor has a graceful form with a small depressed head and a high back, on the summit of which is the dorsal fin (text-fig. 1*a*). The body is moderately compressed and rather deep in the anterior half. The dorsal profile is almost a straight line ascending from the tip of the snout to the insertion of the dorsal fin from whence it descends abruptly and proceeds posteriorly in a slight curve up to the base of the caudal fin.



EXPLANATION OF TEXT-FIGURES.

TEXT-FIG. 1.—*a*. Lateral view of *Neotropius khavalchor* sp. nov. : X 1⅓ ; *b*. Ventral aspect of head of same : X 1⅓ ; *c*. Upper dentition and air-bladder of same : X 1⅓ *d*. Upper dentition of juvenile specimen (60 mm.) of same ; *e*. Upper dentition of *Pseudeutropius atherinoides* (Bl.) (57 mm.) X2; *f*. Upper dentition of same (100 mm.) : X 1⅓ (after Hora,)

The ventral profile is uniformally arched but it is slightly straightened below the dorsal fin.

The head is short and somewhat tapering; length of the head being contained $4\frac{1}{2}$ times in the length of the fish. Width of the head is contained from 1·5 to 1·6 times and height at the occiput 1·4 to 1·7 times in length of the head. The inter-orbital space is slightly convex, smooth and covered with subcutaneous layer. Above this space, there is a shallow, median, longitudinal groove which ends at the base of the occipital process. The occipital process is long and slender. Its width at the base is contained 5 times in its length and it reaches the basal bone of the dorsal fin.

The mouth is wide and situated on the ventral side. It is almost devoid of lips except at the angle of the jaws (text-fig. 1*b*). The cleft of the mouth does not extend beyond the anterior margin of the eyes. The denticulated part of the upper jaw extends over the entire undersurface of the snout excepting the tip. Teeth within the gape of the jaw are depressible and villiform with thin apices slightly curved inside, while the teeth on the undersurface of the snout are cuneiform in shape. The latter occupy two extensive sub-triangular patches which form prominent convex dentigerous pads, on the snout. Apices of most of these teeth are slightly bent, those on the sides pointing outwards and the rest pointing forwards. On the lower jaw, teeth are found on the internal as well as external aspect of the mandibles. Those on the inner aspect are slender and villiform like the teeth within the gape of the upper jaw, while those on the outer margin are thicker and stronger somewhat like the teeth on the snout. The outer teeth, however, form a very narrow band as compared to the extensive patches on the undersurface of the snout.

The teeth on the palate are in three separate patches (text-fig. 1*c*). The vomerine teeth are in a continuous crescentic band running almost parallel to the rounded margin of the upper jaw. The palatine teeth form two very small irregular patches, one on either side of the mouth. They are minute and widely separated from the vomerine teeth.

The eyes are prominent and without adipose lids. They are situated just on the lateral margin of the head, so that half of their diameter can be seen in the dorsal aspect and the other half in the ventral aspect. They are almost in the middle of the length of the head. Their diameter is contained 4·5 to 4·6 times in the length of the head, 1·6 times in the length of the snout and about 2 times in the width of the inter-orbital space. The inter-orbital space is convex and is covered with subcutaneous layer.

The nostrils are wide apart; the anterior nostrils are situated near the antero-lateral margin of the head. They are raised and tubular, but their openings, instead of being vertically upwards like a tube, face forwards like a cowl of ventilators in ships. The posterior nostrils are more or less longitudinally disposed and have an oblong opening with thin margins around them. They are widely separated, space between them being twice the distance between anterior and posterior nostrils on each side. There are eight barbels, one nasal pair, one maxillary and two mandibulary pairs. The nasal barbels extend beyond the posterior

margin of the eye. The maxillary barbels extend slightly beyond the posterior extremity of the pectoral fin. The outer mandibular pair extends slightly beyond the base of the pectoral fin and the internal pair reaches the base of the pectoral spine. Maxillary barbels for a short distance from their base, pass through grooves or folds in the skin which extend up to the posterior edge of the eyes. The gill openings are wide, the gill membranes overlapping each other at the isthmus. In front of and above the isthmus the upper chin folds form a small pouch. In the ventral region of the pectoral girdle, there is a small median depression with slightly rugose surface, which may be helpful to the fish in steadying itself on the body of its victim.

The pectoral fin is moderately developed and hardly reaches below the insertion of the dorsal fin. In younger specimens, however, it is slightly longer. The pectoral spine of the fin is strong, short and peculiarly developed. It is not pointed, as in most other fishes, but terminates bluntly into a truncated extremity. On the posterior face, it has strong denticulations about 8 to 13 in number. Proximal dents are slender and smaller but distal ones stronger and larger, the last dent being curved inwards like a hook and its extremity being rather truncated. A thin membrane from the truncated end of the spine grows out for a short distance and terminates along with other fin rays. The truncated end is so irregular that it sometimes appears like the broken end of a spine with a membrane regenerated on it.

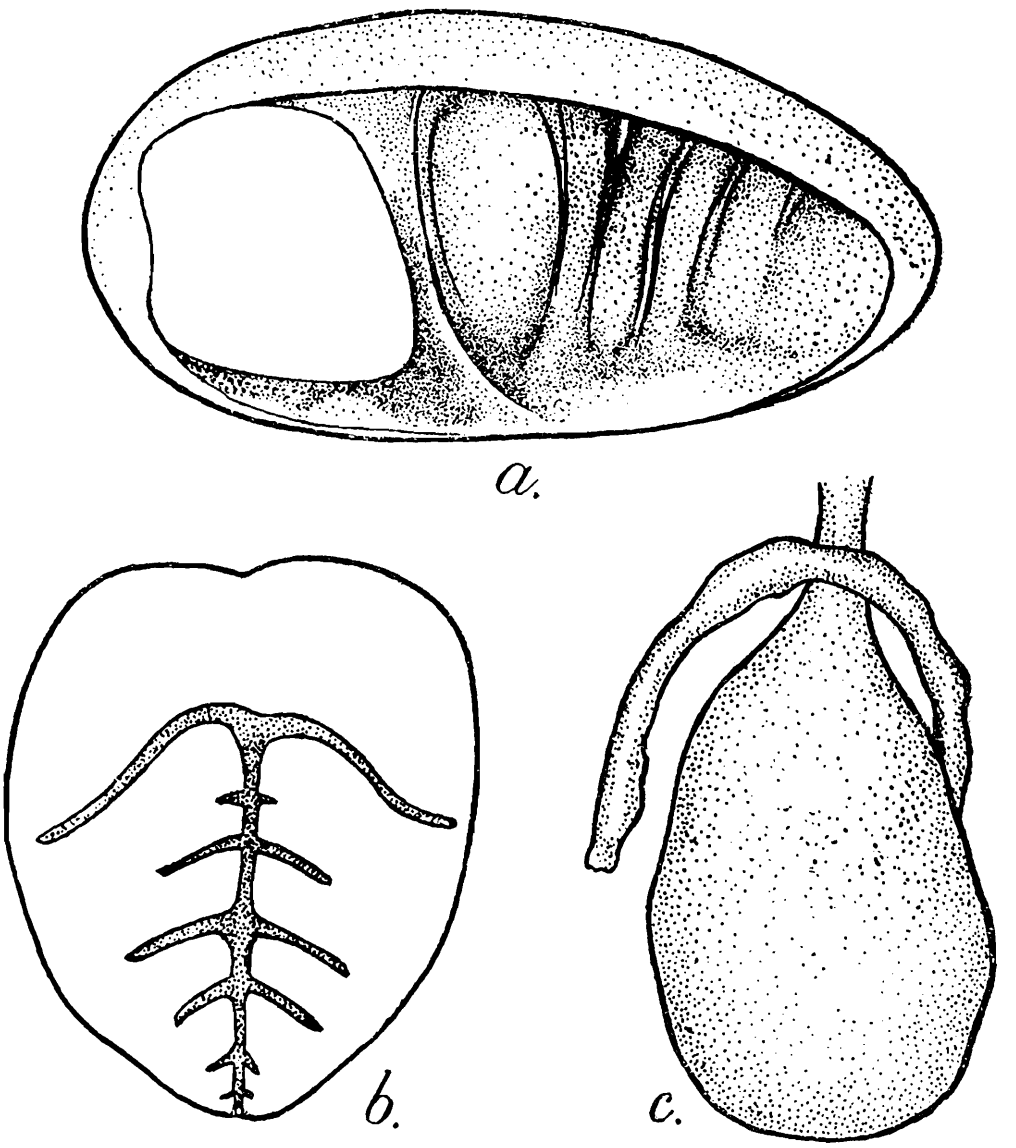
The dorsal fin is situated between the pectoral and pelvic fins but nearer the latter. It has a strong but slender spine which is serrated internally. It is shorter than the two or three rays that follow it. Its outer surface is almost smooth except at its distal end where there are 3 or 4 barb like serrations which, with the internal serrations, make it a formidable structure like a spear with basally directed barbs on either side. The adipose fin is small but well-marked. It is situated on the last quarter of the base of the anal fin. The pelvics are rather well-grown as compared to the pectoral and dorsal fins. They reach the anal fin. The anal is moderately long, its length being contained 4·5 times in the total length of the fish. The caudal is forked and well-developed in structure.

The depth of the body is contained 4 to 4·4 times in the length of the fish without caudal and the least height of the caudal peduncle is about 1·4 to 1·6 times in its length.

In the living condition, the fish is almost silver grey in coloration. In formalin, however, the specimens appear bleached, the grey or brown grey colour being confined only on to the back. A pair of triangular dark areas are seen in the occipital region and an indistinct dark blotch at the base of the caudal fin. The caudal blotch is not present in some forms.

The air-bladder is obovate in form with its narrow end pointing posteriorly (text-fig. 1*c*). It is somewhat thick-walled and flattened dorso-ventrally. It is divided internally into three chambers, one anterior and two posterior, by a T-shaped vertical partition (text-fig. 2*b*), the transverse partition being slightly incomplete. The anterior chamber represents almost $\frac{1}{3}$ of the bladder and is disposed transversely. The posterior chambers are formed by the longitudinal division of the remaining

part of the bladder. The T-shaped partition is supported by several fibrous columner strands extending up and down which strengthen the dorsal and ventral walls of the bladder (text-fig. 2*a*). The dorsal surface of the anterior chamber is closely applied to the bony elements of the vertebral column and on this account appears to be divided into two longitudinal halves in the dorsal aspect. Its ventral surface is



TEXT-FIG. 2.—*Neotropius khavalchor* sp. nov. *a*. Vertical section of air-bladder showing vertical partitions and supporting columner strands : X 2 ; *b*. Horizontal section of air-bladder : X 1½ ; *c*. Stomach and intestines : X 1½.

smooth but slightly undulated ; the bladder is comparatively large and covers the entire width of the fish at its base. It is attached to the abdominal parieties above the pectoral fin, the area of contact manifesting a blister-like appearance from outside. The stomach has no intestinal caeca (text-fig. 2*c*).

Type-localities.—Krishna river near Islampur, District Satara, and Panchaganga river near Kolhapur, Bombay State.

Holotype.—(F . . . .). Zoological Survey of India, Indian Museum, Calcutta.

Relationship of Neotropius.

Neotropius, is closely related to *Pseudeutropius* Bleekar. It differs from the latter mainly in the form of dentition on the palate and the nature of the air-bladder. The difference, though not very outstanding otherwise, is of a generic importance in Schilbeidae to which *Neotropius* belongs. The genus *Pseudeutropius* was proposed by Bleekar to accommodate *Eutropius branchypopterus* in which the teeth on the palate, as quoted by Hora (1937), were described as " Dentis vomerini in vitam tranversam dispositi, palatini distincti nulli " A year later, however, Bleekar revised this definition and stated " Dentis vomero-palatini in vitam transversam indivism dispositi "

Gunther (1864) who examined a typical specimen of Bleekar's *P. branchypopterus* stated that its vomerine teeth " form a very narrow band which is angularly bent and continuous with the palatine teeth ". Weber and de Beaufort (1913), who described the same species, state that its dentition consists of " minute teeth in narrow bands on the jaws ; on the vomer in two small patches connected by an angular line of teeth". In another species from Sumatra—*P. moolenburghae*—the authors (*op. cit.*) record that the teeth on the palate are " in two widely separate elliptic patches "

Day (1878) describes the dentition of *P. acutirostris* as consisting of " two minute patches on the vomer, and of the same character on the palatines which are not continuous with those on the vomer " Description of dentition of *P. atherinoides* furnished by Day is not accurate according to Hora (1941). Revised and carefully checked account of vomerine dentition of *P. atherinoides* and *P. mitchelli* as illustrated by Hora (*loc. cit.*) indicates that it is composed of two separate patches on the vomer, varying in size according to the age of the specimens. Despite these details, Smith (1945) states that in *Pseudeutropius*, vomeropalatine teeth are in a single continuous band, but, in his earlier writings on the subject (1934 p. 297) he has described vomerine and palatine teeth in four distinct patches.

It will thus be clear from the aforesaid account that the dentition occurring in *Neotropius*, *viz.*, of a single continuous crescentic band on vomer with two minute patches of palatine teeth is entirely of a different type unrecorded hitherto.

Detailed description of the air-bladder of *Pseudeutropius* is not available, but Hora (1937, p. 43) states that " in *Pseudeutropius* the air-bladder is large and thin-walled " Smith (1945, p. 355) also records that it is thin-walled. The three chambers and somewhat thick-walled air-bladder of *Neotropius* described above is thus different from the thin-walled air-bladder of *Pseudeutropius*.

It is considered (Hora, 1941, p. 102) that dentition coupled with the nature of the air-bladder should be able to differentiate and define precisely *Pseudeutropius* and other allied Schelbeid genera occurring in India. Genus *Platytropius* (Hora, 1937) is also differentiated on the basis of these characters and in creating the present genus *Neotropius* the same factors are taken into consideration.

Further, comparison of dentition of young specimens of *Neotropius* about 60 mm. in standard length (text-fig. 1*d*) with that of 57 mm. specimen of *P. atherinoides*, (text fig. 1*e* & *f*) as illustrated by Hora (*op. cit.*), indicates that they differ radically in the disposition of their dental patches even in early stages. Another feature observed is that, unlike in *Pseudeutropius*, the dentition (text fig. 1*d*) of the juvenile form of *Neotropius* (60 mm.) is found to be almost identical with that of the adult specimen (text-fig. 1*c*).

Superficially, *N khavalchor* appears to be similar to *P. acutirostris* (Day) in several respects, including the presence of external teeth on the snout. The chief differences relate to the vomero-palatine teeth, the nature of the air-bladder, comparative lengths of barbels, inter-orbital space, anal fin rays, etc. The close resemblance between the two forms indicates that *N khavalchor* occurring in the rivers of Kolhapur of the Western Ghats might have evolved from *P. acutirostris* occurring in the distant waters of Irrawaddy. This probably serves as one of the many examples in Zoogeography of India suggesting Malayan affinities of fresh water fish fauna of Peninsular India and its dispersal along the Satpura trend of mountains as suggested by Hora (1944).

BIONOMICS.

The fish is very remarkable for its lepidophagous habit of feeding on the scales of other fish. Its specific name ' Khavalchor ' derived from its common name in Marathi signifies this habit, the literal meaning being a ' scale-stealing fish ' The report of this unusual habit was corroborated by actual observations when a seine net was being dragged ashore. A specimen of *Neotropius* was seen moving excitedly attacking other fish of its own size and rasping off their scales. Examination of stomach contents of some of the specimens of *Neotropius* showed that their stomachs were gorged with fish scales which were arranged like a pack of cards. The scales were covered with mucous and appeared to be in half digested condition. They had become thin and brittle, the markings (circuli and radii) having almost disappeared in some cases. Those which could be identified belonged to *Garra* and *Labeo* sp. One of the specimens had a water insect, along with a few scales in the stomach, while a couple of them had their stomachs completely empty. This unusual habit of the fish coincides with its peculiar adaptations, namely the wide ventrally situated mouth, the specialised teeth on the outer aspect of the jaws and snout and strong, hooked pectoral spines. Appropriately situated prominent eyes and numerous long barbles may also serve as additional adjuncts to suit the pirate activities of the fish. Trewavas (1947) has also recorded a similar lepidophagous habit in two species of *Corematodus* a genus of Cichlid fishes common to Lake Nyasa in Africa. On examination of the gut contents of these species, *C. taeniatus* Trewavas and *C. shiranus* Blgr., she records that " In each case stomach and intestine contained nothing but hundreds of minute scales exactly like those which cover the caudal fins of so many Cichlid fishes. It seems that *Corematodus* specializes in this curious diet. " These fishes do not seem to have the external teeth on the under surface of the snout, as found in

Neotropius, but their dentition consists, in each jaw, of a broad file-like band of small pointed teeth which are capable of rasping the scales on the tails of other fishes. The teeth of *Neotropius* are of similar structure though disposed in a different manner. This indicates that although the aforesid habit is unusual, it is by no means unique in the Piscine world.

ACKNOWLEDGMENT.

I am deeply indebted to Dr. S. B. Setna, Director of Fisheries, Bombay, for affording all facilities for the completion of this paper. My sincere thanks are also due to Dr. S. L. Hora, Director, Zoological Survey of India, who very kindly furnished me with specimens of *P. atherinoides* for examination from the collection of the Indian Museum and also checked by observations.

REFERENCES.

DAY, F., 1878.—*Fish. India*, pp. 470—478.

GUNTHER, A., 1864.—*Cat. Fish. Brit. Mus.* V, p. 65.

HORA, S. L., 1937.—A new genus of Siamese catfishes. *Journ. Siam. Soc. Nat. Hist. Suppl.* XI, pp. 39—46.

HORA, S. L., 1941.—Siluroid fishes of India, Burma and Ceylone. XI Fishes of Schilbeid genera *Silanopangasius* Hora, *Pseudeutropius* Blke, *Proeutropiichthys* Hora and *Ailia* Gray. *Rec. Ind. Mus.* XLIII, pp. 97—115.

HORA, S. L., 1944.—On the Malayan Affinities of the Fresh Water fish fauna of Peninsular India, etc. *Proc. Natl. Inst. Sci. India*, X, pp. 423—439.

SMITH, H.M., 1934.—Contributions to the ichthyology of Siam : Siamese catfishes of the genus *Pseudeutropius*. *Journ. Siam. Soc. Nat. Hist. Suppl.* IX, p. 297.

SMITH, H. M., 1945.—Fresh water fishes of Siam or Thialand. *U. S. Nat. Mus. Bull.* 188.

TREWAVAS, E., 1947.—An example of Mimicry in Fishes. *Nature*, CLX., p. 120.

WEBER, M. & BEAUFORT, L.F. de, 1913.—*Fish. Indo-Austral Archipel* II, p. 249.

AN ACCOUNT OF THE STOMATOPOD LARVAE OF THE MADRAS PLANKTON.*

By K. H. ALIKUNHI.

CONTENTS.

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INTRODUCTION.

It is well known that early authors, from Fabricius to Dana, including Leach, Latreille and Milne-Edwards, regarded the stomatopod larvae as adult animals and described them under generic names like *Alima*, *Erichthus*, etc. Different stages of the larvae of one and the same species were often described as distinct species and larvae of different species as stages of some one particular species, naturally resulting in much confusion and repetition. Even when the larval nature of these pelagic creatures was recognized, the authors, working mostly on preserved material, were not in a position to identify the larvae with their adults with any certainty, except on circumstantial evidence such as the comparative abundance or otherwise of the adult stomatopods occurring in the particular locality from which the larvae were collected. The limitations of this method are obvious; living usually in burrows and crevices at the bottom it is generally very difficult to make an exhaustive collection of the different species of stomatopods occurring in any particular locality, and larvae from neighbouring localities might get mingled by wind and wave action, with the result that even in relatively recent publications there are instances where larvae have been erroneously referred to the wrong species or even genus. It has been suggested (Brooks, 1886; Lebour, 1934, Foxon, 1939) that the only way out of this difficulty is, wherever possible, to rear the late planktonic larvae into post-larval forms which show a closer approximation to the adult features and are therefore easier to be properly identified than the pelagic larvae.

The decapod larvae from the Madras plankton have been exhaustively dealt with by Menon (1933, '37, '40) in a series of noteworthy contributions. In the present paper an attempt is made to deal with the stomatopod larvae also in a similar manner but with particular reference to establishing their specific identity. Successful endeavour has been made to rear the advanced larvae through metamorphosis and grow the post-larvae under laboratory conditions, so that, it has now been possible to refer almost all the common species of larvae occurring in the Madras plankton to their respective adults, on the best direct evidence. With proper attention, it has also been possible to rear the early post-larvae to the adult stage, in the laboratory aquaria. The habits of the larvae and post-larvae have already been detailed elsewhere (Alikunhi, 1950); while, the descriptive account of the early post-larvae, their growth and attainment of maturity will form the subject matter for a separate communication.

Specific identification in the majority of cases has been checked and confirmed after rearing the post-larvae to the adult stage. Since the identity of the larvae reared has now been positively established with their adults, it is not considered necessary to retain their larval names and I have accordingly used the adult names only. For the same reason, the final pelagic stage of each species is described in some detail and on a common plan to facilitate comparison between species. An attempt

has also been made to give the synonymy of the larvae described in this paper, but I do not claim that this attempt has been sufficiently exhaustive.

HISTORICAL RESUME.

The publication of Claus' classical account of the stomatopod larvae, in 1871, is rightly acknowledged as an important landmark in the study of the larval history of the group. Their larval nature and the lengthy metamorphosis they undergo before assuming the adult characters were first made known by this author. Since then important contributions on the subject have been made by various authors and numerous larval species described, with the result that at present the latter probably exceed the number of known adult species of stomatopods. The contributions of Faxon (1882), Brooks (1886, 1892), Bigelow (1894), Hansen (1895, 1926), Jurich (1904), Tattersall (1906), Lanchester (1903,1906), Borradaile (1907), Giesbrecht (1910), Komai and Tung (1929), Foxon (1932, 1939) and Gurney (1937, 1946), amongst others, have added much useful descriptive material of the larval forms. In a recent contribution Gurney (1946), besides attempting to classify the larvae, has compiled a very useful list of the larval species so far known, as also an exhaustive annotated bibliography. However, the important aspect of correctly referring the numerous larval species to their respective adults still remains practically untouched. Foxon (1939) has remarked that description of unidentified *Alima* larvae is an unprofitable business and it is surprising to see that out of nearly 200 species and varieties of adult stomatopods and a similar or even larger number of larval species known at the present day, only ten species have been positively correlated with their larval forms, as follows :

By hatching from egg.	*By moulting to post-larvae.*
1. *Squilla mantis* (P. Mayer, 1877 ; Giesbrecht, 1910).	1. *Squilla empusa* (Faxon, 1882).
2. *S. oratoria* (Komai, 1924 ; Komai & Tung, 1929).	2. *S. quadridens.* (Bigelow, 1894).
3. *Gonodactylus oerstedi.* (Brooks, 1892).	3. *S. desmaresti.* (Giesbrecht, 1910).
4. *G. glabrous.* (Gurney, 1937).	4. *S. tricarinata.* (Gurney, 1946).
	5. *Lysiosquilla excavatrix* ; (Brooks, 1886).
	6. *L. eusebia.* (Giesbrecht, 1910).

Of the two direct methods for identifying the larvae, that by hatching the eggs is comparatively more difficult than that by moulting, since it is often very difficult to secure the eggs. Gurney (1937) referring to *Gonodactylus* remarks about the extreme difficulty in getting the eggs ' since the animals live in burrows, commonly below the low tide marks, and the eggs are laid in burrows and not attached to the body' In the case of *Squilla* since the egg mass is usually carried by the female, it is easier to obtain the eggs but once in captivity the female casts away the egg mass which is soon attacked by ciliates, impeding further development (Nair, 1942). Also the early larvae are very fragile and only rarely undergo a moult in captivity (Brooks, 1886, Alikunhi, 1950). The late

pelagic larvae are generally common in tow-net catches and, being hardier than the early *Alima*, could be successfully reared in the laboratory aquaria. Identification of the numerous larvae is therefore more easily tackled by rearing the late pelagic larvae till they metamorphose into post-larvae in the laboratory. By carefully following the above method the writer has been able to identify 17 species of stomatopod larvae that generally occur off the Madras coast.

Material and Methods.

Material for the present paper consists of thousands of larvae collected from the Bay of Bengal, off the Madras coast, during the years 1936 to 1943. Collections were invariably made during the morning hours, using an ordinary catamaran and a bolting silk tow-net; the duration of the daily haul being about half an hour. The collections were generally brought to the laboratory by about 9 a.m. For purposes of rearing, the active larvae were immediately picked out and placed in dishes of fresh sea water. They were then sorted into different types by examination of individual specimens under the binoculars and each type was then kept in separate aquaria. Occasionally the larvae were fed on live plankton and at times they also readily took to minced meat of the mole crab, *Emerita asiatica*. Late larvae metamorphosed into post-larvae overnight, while slightly earlier stages remained in the aquaria for a few more days before undergoing metamorphosis. Smaller larvae ranging from minute pseudozoea and antizoea to early synzoea stages, though remained active in the aquaria for several days, could not be reared to the final pelagic stage. Even when constant circulation of water was maintained in the aquarium by a simple siphon arrangement and with live plankton introduced as food, the smaller larvae moulted but once and died within a day or two.

All the figures are camera lucida sketches, except fig. 8 which is a reconstruction from descriptions and dimensions of parts of the final pelagic larva that moulted in the laboratory into the post-larva. In making the diagrams the author has left out certain characters which are of dubious taxonomic significance.

Occurrence.

Stomatopod larvae form an important constituent of the macroplankton of the Madras coast. They do not exhibit any marked seasonal abundance and early as well as advanced larvae are caught almost throughout the year. Dakin and Colefax (1940) also observed the same phenomenon in the Australian waters. While no observations were made either on the vertical distribution of the larvae or on their diurnal migrations, if any, in the surface waters, examination of the horizontal surface hauls, usually made in the morning, indicates only irregular fluctuations in their occurrence. Sometimes they were absent in the tow-net collections for a few days, only to appear soon in considerable numbers; they were, however, never absent continuously for long periods.

Table I.—Stomatopod Larvae of the Madras Plankton : Analysis of tow-net catches made during 1936 to 1943.

Year.	No. of collections examined.	No. of collections with larvae.	Total number of larvae.	Maximum No. per collection.	Month.
1936	34	14	166	66	Sep.
1937	33	16	278	162	Dec.
1938	34	26	772	118	Aug.
1939	51	35	1,219	195	Mar.
1940	43	33	1,729	270	Mar.
1941	71	52	3,383	432	Aug.
1942	90	74	4,117	354	Oct.
1943*	57	48	2,533	302	Jul.
7½ Years	413	298	14,197		

*Till end of July.

As detailed in Table I a total number of 413 tow-net collections were examined. Out of these only 298 collections contained stomatopod larvae (early *Alima* and *Erichthoidina* larvae were not fully enumerated) which totalled 14,197. The maximum number of larvae per collection did not generally exceed 500 and during the period, 1936 to 1943, they were not observed to occur in any enormous swarms. The majority of larvae caught in the tow-net were of an advanced stage (Synzoea) of development. Earlier stages were remarkably few.

The relative abundance of the common species of larvae was also analysed from the collections, as indicated in Table II.

Table II.—Stomatopod larvae of the Madras Plankton : Analysis of species in the tow-net catches made during 1936 to 1943.

Species.	1936.	1937.	1938.	1939.	1940.	1941.	1942.	1943.	Total.
Squilla nepa	130	289	417	652	827	1,815	3,036	1,231	8,495
S. holoschista	3	7	202	274	585	1,233	368	767	3,409
S. wood-masoni	23	3	15	144	145	120	205	204	852
S. interrupta	..	2	6	11	4	20	32	39	114
S. quinquedentata.	3	3	52	45	79	27	129	143	431
S. gonypetes	..	..	29	20	6	25	1	27	98
S. raphidea	..	2	3	8	1	2	24	8	48
S. latreillei	5	4	15	5	20	26	42	20	137
S. boops	..	..	3	13	8	2	16	8	50
S. fasciata	..	..	..	..	..	1	1	2	4
S. scorpio	..	..	..	..	2	..	..	1	3
S. hieroglyphica	..	..	..	..	..	..	..	1	1
Squilla lata	1	1	1	..	..	1	1	2	7
Lysiosquilla maculata	1	1	8	8	6	18	11	12	63
L. multifasciata	..	..	..	4	2	3	1	1	11
L. acanthocarpus	..	..	..	2	..	2	1	1	6
L. tigrina	..	..	..	1	..	..	..	1	2

Squilla nepa is, by far, the commonest species in the Madras plankton, representing more than half the total catches. *S. holoschista* accounts for a little less than one-fourth the total catch and is followed by *S. wood-masoni*, *S. quinquedentata*, *S. latreillei*, *S. interrupta*, *S. gonypetes*, *Lysiosquilla maculata* and *S. raphidea* in the order of abundance. Other species occur only in random catches; *S. hieroglyphica* being represented by a single pecimen and *S. fasciata*, *S. scorpio* and *L. tigrina*, each by 2 to 4 specimens only, during the entire period of seven and a half years. It is interesting to note that the common species of adult stomatopods caught along the Madras coast are *S. nepa*, *S. holoschista*, *S. wood-masoni* and *S. raphidea*, in the order of abundance.

The occurrence of stomatopod larvae in relation to other plankton organisms is also very fluctuating. Generally, when swarms of such diverse forms like *Loimia medusa*, *Thalia democratica*, *Doliolum* sp. *Creseis acicula*, *Eirene malayensis*, *Noctiluca*, *Rhizosolenia*, etc. occur in the plankton the stomatopod larvae are either absent or rare. However, on certain occasions appreciable numbers of stomatopod larvae have been caught along with swarms of *Rhizosolenia* and *Thalia democratica*. Usually when stomatopod larvae abound in the tow-net catches, other plankton organisms have been observed to be poor, both in quality and quantity. Here again, exceptions are met with and appreciable numbers of stomatopod larvae have been caught when there were swarms of *Pleurobrachia globosa*, *Acetes erythraeus*, leptocephalus and post-larval fish, *Hybacodon* sp., etc. Unless more systematic collections are made no definite statements could be made regarding the ecological associations of these larvae. It may be mentioned in this connection that there is a common belief among fishermen that when stomatopod larvae occur in considerable numbers in any particular locality, fishing there will be generally poor.

DESCRIPTIVE ACCOUNT.

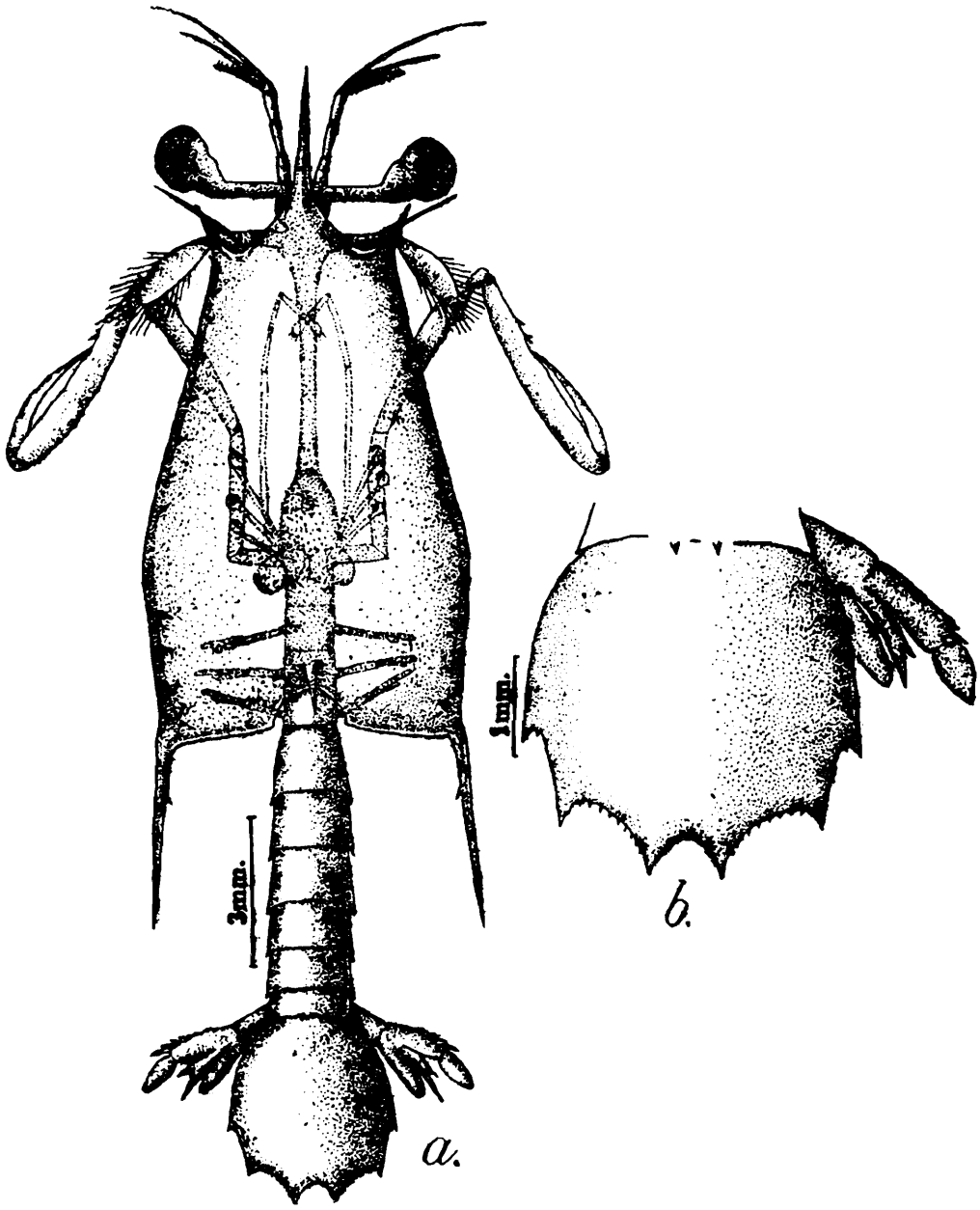
An intensive study of the stomatopod larvae of the Madras plankton was carried out from December, 1941 to August, 1943, when the numerous larvae collected were, as a routine, segregated into types and separately reared in the laboratory aquaria. The final pelagic larvae of the following seventeen species were successfully metamorphosed and the post-larvae of twelve of them reared to the adult stage :—

1. *Squilla nepa* Latreille (Bigelow).
2. *Squilla holoschista* Wood-Mason.
3. *Squilla wood-masoni* Kemp.
4. *Squilla interrupta* Wood-Mason.
5. *Squilla boops* Kemp.
6. *Squilla quinquedentata* Brooks.
7. *Squilla gonypetes* Wood-Mason.
8. *Squilla raphidea* Fabricius.
9. *Squilla latreillei* (Eydoux & Souleyet).
10. *Squilla fasciata* de Haan.
11. *Squilla hieroglyphica* Kemp.
12. *Squilla lata* Brooks.
13. *Lysiosquilla maculata* (Fabricius).
14. *Lysiosquilla sulcirostris* (Kemp).
15. *Lysiosquilla multifasciata* Wood-Mason.
16. *Lysiosquilla tigrina* Nobili.
17. *Lysiosquilla acanthocarpus* Miers.

In the succeeding pages detailed descriptions of the final pelagic larvae of these species are given. Descriptions of the larvae of *S. scorpio* Latreille which could not, unfortunately, be reared to metamorphosis, and notes on the early larvae of the different species picked out from the plankton are also included.

SQUILLA NEPA LATREILLE (Bigelow).

Final Pelagic Stage. (Text-fig. 1).—It is represented in almost every collection in which stomatopod larvae are present. It is easily distinguished from the other species by its comparatively small size and



TEXT-FIG. 1.—*Squilla nepa* Latreille (Bigelow).

a. Final pelagic larva, 22·8 mm. long, dorsal view; *b.* Telson and right uropod of the same, magnified.

large carapace. The size at which it metamorphoses into the post-larva varies slightly, specimens 22 to 25 mm. long having been observed to moult into post-larvae.

Total length	22·8 mm.
Length of rostrum	2·8 mm.
Median length of carapace	10·0 mm.
Anterior breadth of carapace	3·2 mm.
Posterior breadth of carapace	6·1 mm.
Length of antero-lateral spine	0·9 mm.
Length of postero-lateral spine	3·5 mm.
Length of eye-stalk	1·1 mm.
Length of corneal portion of eye*	1·1 mm.
Length of telson	3·0 mm.
Breadth of telson	3·2 mm.

The carapace is comparatively large and extends over the anterior half of the last thoracic somite. The rostrum is slender and devoid of ventral spinules. The maximum breadth of carapace is almost double its anterior breadth. Its lateral margin is provided with 8+4 spinules, the first near the base of the antero-lateral spine, eighth at the level of the labrum and the last four nearer the postero-lateral corner. Each postero-lateral spine has a ventral spinule at one-third its length from base and is directed almost parallel to the margin of the abdominal segments, but usually tending to diverge slightly near the tip, which often reaches the level of the fourth abdominal segment, or rarely up to the fifth. The dorsal spine is shorter than the antero-lateral and is situated on an elevated prominence, a little in front of the posterior margin of carapace.

In the antennular peduncle the basal segment is longer than the other two which are equal in length. The second antennular flagellum carries 12 groups of sensory hairs. In the raptorial limb the peduncular segment is provided with a ventral spine, distally. The propodus has three stout spines at base and a series of pectinations on the margin. The dactylus does not have any free spine other than the terminal. The thoracic segments become gradually longer towards the last. Abdominal segments are broader than the thoracic and have their postero-lateral corners produced into acute spines. The sixth segment is broader than long and has a pair of sub-median dorsal spines. The marginal spines of telson are prominent (Text-fig. 1*b*.). There are 1 lateral, 9 intermediate and 14-15 sub-median denticles on each side. Uropods when directed backwards reach almost half way between the lateral and intermediate spines of telson. There may be 3 or 4 free spines on the outer aspect of the basal segment of the exopod. The ventral prolongation ends in two distal spines, of which, the tip of the inner, larger one reaches beyond the distal extremity of the endopodite.

Earlier Stages of Larvae.—The earliest stage obtained, that can be positively referred to this species measures 9·0 mm. in total length (Collection dated 4-2-1937 ; a second specimen 9·2 mm. long is also of

* 'Corneal portion of eye' as used in this paper includes the entire eye proper excluding the stalk.

the same stage). As in the final pelagic stage, the carapace extends posteriorly across the middle of the last thoracic segment. Along the lateral margin of carapace there are 5+4 spinules of which the first, sixth and seventh are long and prominent, while the rest are rudimentary. Rostrum has a slight downward bend at the base. Postero-lateral spine, with a spinule near the base, has its tip reaching the level of the 4th abdominal segment. The antero-lateral and dorsal spines are long and pointed. The tip of antennular peduncle is markedly inferior to tip of rostrum. The second antennular flagellum has four groups of sensory hairs. Antennal endopodite is unsegmented. Thoracic limbs 3 to 5 are mere finger-like outgrowths, while no trace of the last three is visible. Pleura of the abdominal somites end in blunt points posteriorly. The sixth abdominal segment is not yet fully differentiated. The fifth pleopod is smaller than the rest. Telson is broad, with well developed marginal spines. There are 1 lateral, 8-9 intermediate and 13 sub-median denticles on each side. Uropods are only stump-like, bifid processes.

Larva, 13·8 mm. long.—In general appearance it resembles the final pelagic stage. Carapace has 8+4 spinules as in the latter. Antennular peduncle is slightly longer and 7 groups of sensory hairs have appeared on the second antennular flagellum. Antennal endopodite is 3-segmented and reaches just beyond the tip of peduncle. Thoracic limbs 3 to 5 are well developed ; while the last three are still rudimentary though bifid. The sixth abdominal segment has been differentiated and the pleura of the abdominal somites have become pointed posteriorly. In the telson the lateral spines are smaller than the rest ; the denticles number 1 lateral, 10 intermediate and 16 sub-median on each side. Uropod reaches half-way to the base of lateral spine of telson. Ventral prolongation of uropod is not yet clearly bifid. The exopod has one free spine.

Larvae up to 16·5 mm. resemble the above stage in almost all details.

In specimens 17·5 mm. long, the antennular peduncle is only slightly inferior to the tip of rostrum ; while the second antennular flagellum carries 8 groups of sensory hairs. Antennal endopodite is longer, while the last three thoracic limbs are better developed than in the previous stage. Ventral prolongation of the uropod has the tip distinctly bifid, with the inner spine about double the size of the outer. Exopod of uropod has two free spines basally.

In the 18·5 mm. stage an additional group of sensory hairs appears on the antennular flagellum ; antennal endopodite reaches half way to the tip of squame and the uropod is better differentiated than in the previous stage.

When 21·5 mm. long, the larva very much resembles the final pelagic stage, but the antennular flagellum has only 10 groups of sensory hairs ; the peraeopods are shorter than in the final pelagic larva ; the exopod of uropod has still only 2 free spines ; while the inner spine of the ventral prolongation of uropod is thrice as long as the outer and has the tip reaching slightly beyond the tip of endopodite.

With the next moult the larva probably reaches the final pelagic stage.

Remarks.—Except in size, spinulation of carapace, shape of telson and certain other minor details, the larva shows close resemblance to the final pelagic stage of *S. holoschista* (p. 19), particularly in general appearance and to a great extent in the relative proportions of the various parts of the body. *S. nepa* and *S. holoschista* are very closely related and this is probably reflected in the close resemblance between their pelagic larvae.

While it is the commonest larva in the Madras plankton, it does not appear to have been described before. It, however, shows close resemblance to *Alima dilatata* (Hansen, 1895) and *Alima subtruncata* (Jurich, 1904), though on grounds of distribution these cannot be identical with the larva of *S. nepa*, the distribution of which is limited to the Indo-Pacific region. The larva ascribed to *A. subtruncata* by Komai and Tung (1929) from the Japanese seas, however, appears to be very distinct from Jurich's species and is markedly different from the larva of *S. nepa*, particularly in the form and spinulation of carapace. The *Alimerichthus* larva (15·52 mm. long) from the south Atlantic, figured by Brooks (1886) also has the broad, shield-like carapace characteristic of the larvae of *S. nepa* and *S. holoschista*. The size and stage of development of the larva figured by Brooks show that it is probably closely related to *S. nepa*, even though from the spinulation of carapace and on geographical considerations the two appear to be specifically distinct. Brooks has classified the above larva as *Alimerichthus*, but it does not possess features characteristic of that group of larvae. Lanchester's (1903) view that *Alimerichthus* sp. of Claus is identical with *Alimericthus* larva of Brooks also does not appear to be correct.

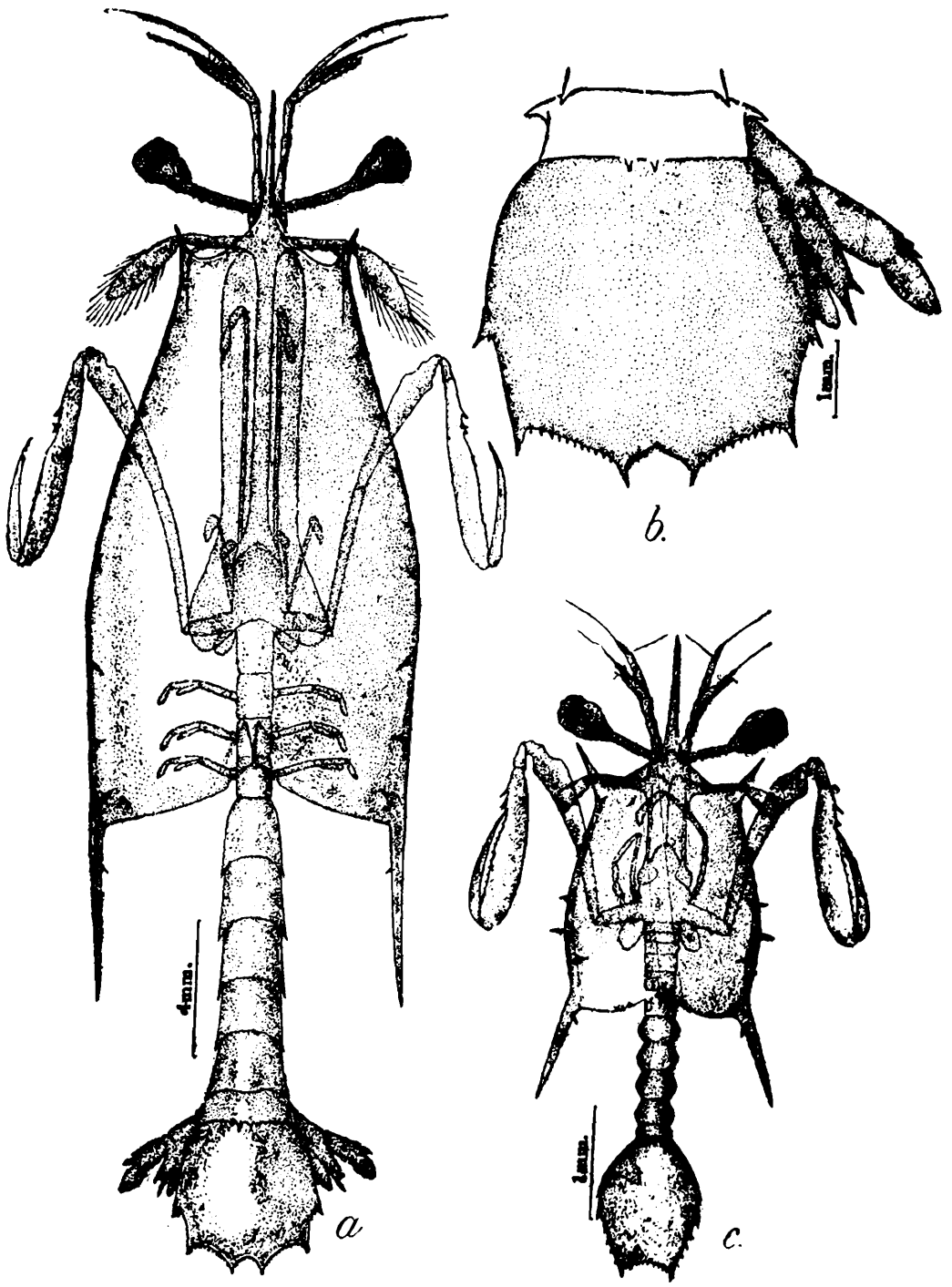
SQUILLA HOLOSCHISTA Wood-Mason.

1837. *Alima laticauda*, Milne-Edwards, *Histoire Naturelle des Crustacea*, Paris, p. 507.
1837. *Alima laticauda*, Milne-Edwards, *Crustacea*, In Cuvier's *Regne Animal*, Paris, Pl. lvii, fig. 2.
1857. *Hyalopelta laticauda*, Guerin-Meneville, *Animaux asticules, Paris*, Crustacea, Stomatopodes, Pl. lix.
1871. *Alima*, Claus, *Abh. Ges. Wiss. Gottingen*, Pl. viii, fig. 31.
1871. *Alima laticauda*, Claus, *ibid.*, Pl. viii, fig. 32.

Final pelagic stage. (Text-fig. 2).—One of the largest and most conspicuous larvae secured in tow-net catches, the final pelagic larva of *S. holoschista* is easily recognized by its large size, very broad carapace and relatively slender abdominal segments.

Total length	34·5 mm.
Length of rostrum ..	4·3 mm.
Median length of carapace	15·3 mm.
Anterior breadth of carapace	4·8 mm.
Posterior breadth of carapace ..	9·0 mm.
Length of antero-lateral spine ..	1·2 mm.
Length of postero-lateral spine ..	5·5 mm.
Length of eye-stalk	2·4 mm.
Length of corneal portion of eye ..	2·0 mm.
Length of telson	4·3 mm.
Breadth of telson	3·8 mm.

The carapace is conspicuously broad and posteriorly covers the anterior half of the last thoracic somite dorsally. The rostrum is comparatively short and slender and is devoid of ventral spinules. The antero-lateral spines are short and almost equal to the dorsal spine which is situated on a prominence at the hind border. The maximum breadth of carapace (9·5 mm.) at about the level of the labrum, is almost twice its anterior breadth. The postero-lateral spines, each with a prominent ventral spinule at about one-fourth its length from the base, are directed almost parallel to the abdominal segments and reach the



TEXT-FIG. 2.—*Squilla holoschista* Wood—Mason.

a. Final pelagic larva, 34·5 mm. long, dorsal view ; (rudimentary post-larval carapace is indicated as a median, long, narrow strip) ; *b*. Telson and right uropod of the same, magnified ; *c*. Larva, 5·6 mm. long.

level of the fourth abdominal somite. There are 8+3 ventrally directed spinules on each lateral margin of carapace; the last three which are larger than the rest, being situated nearer the postero-lateral corner.

The tip of rostrum is superior to the tip of antennular peduncle, but often the two may be at the same level. The second antennular flagellum carries 15 groups of sensory hairs. The eye is comparatively small and slender, with a long stalk. The region between the antenna and the labrum is very much distended. The peduncular segment of the raptorial limb is provided with a stout ventrally directed distal spine. The raptorial propodus carries three stout spines and a series of pectinations. The dactylus is slender, falciform and without any free tooth other than the terminal. The last three thoracic segments are distinctly longer than broad. The abdominal segments are broader than the thoracic and have their pleura produced into acute spines posteriorly. The sixth abdominal segment is very short, about two and a half times as broad as long, with a pair of sub-median spines dorsally and with the lateral margin anteriorly produced into a stout ventrally directed spine. The marginal spines of telson are well developed (Fig. 2 b). The denticles number 1 lateral, 12 intermediate and 15-16 sub-medians on each side. The uropods when directed backwards reach half-way between the lateral and intermediate spines of telson. The basal segment of exopod carries 3 free spines on its outer aspect. The tip of the ventral prolongation reaches just beyond the tip of endopod and has two spines distally, the outer one being about half the length of the inner which has no prominence on its outer aspect.

Earlier stages of Larvae.—They seldom occur in the collections. A single specimen, probably in the second pelagic stage, is referable to this species (Text-fig. 2*c*.).

Total length	5·6 mm.
Length of rostrum	1·2 mm.
Median length of carapace	2·1 mm.
Anterior breadth of carapace	1·2 mm.
Posterior breadth of carapace	1·5 mm.
Length of postero-lateral spine	0·9 mm.
Length of telson	1·0 mm.
Breadth of telson ..	0·85 mm.

Carapace is large and extends posteriorly over the anterior half of the last thoracic segment. Rostrum is long and prominent and has no ventral spinules. Antero-lateral spines are acutely pointed; postero-laterals are shorter than the rostrum, divergent posteriorly and are provided each with a prominent spinule near the base. Tip of each postero-lateral spine reaches the level of the 4th abdominal segment. Lateral margin of carapace has 4 spinules, the first near the base of the antero-lateral spine, the 2nd and 3rd situated mid-way from either end, are long and project outward; while the fourth is directed ventrally. The tip of antennular peduncle reaches only half-way to tip of rostrum; second antennular flagellum has three groups of sensory hairs; the corneal portion of eye is slightly longer than the stalk; there is no trace of the antennal endopodite; raptorial propodus has three basal spines; the 3rd to the 8th thoracic appendages are not developed; sixth abdominal segment is not differentiated; postero-lateral corners of abdominal segments do not end in spines; 5th pleopod is in the form of

a bilobed rudiment; uropod is not indicated; telson is large and conspicuous; sub-median spines are almost double the size of the lateral or intermediate spines and denticles number 1 lateral, 4 intermediate and 5 or 6 sub-median on each side.

Remarks.—It is not certain that the early *Alima* described above, actually belongs to *S. holoschista*; the broad carapace and the relatively large size when compared with the stage of development being the only criteria on which the identification is based. This larva, however, largely resembles the 4·5 mm. long *Alima a* (Tattersall, 1906) from the gulf of manaar, the only difference being the possession of a median carina on the carapace in the latter. *Alima dilatata*, 4·7 mm. long, described by Hansen (1895) also appears to be identical with the Madras and Ceylon larvae. The young *Alima*, 3·3 mm. long, described by Gurney (1946) from Bermuda as *A. dilatata*, differs from the above specimens in the shape of telson and in the possession of an additional spinule on the margin of carapace.

Larvae younger to the final pelagic stage are not represented in the present collection. The final pelagic larva, though slightly smaller than the corresponding stage of *S. wood-masoni* in total length, is by far the most conspicuous stomatopod larva in the Madras plankton, mainly by virtue of its large, shield-like carapace. Claus's *Alima laticauda* from the Indian ocean appears to be identical with the final pelagic stage here described. It is of almost the same size as the latter. While I have not been able to compare the descriptions of *A. laticauda* given by Milne-Edwards (1837) and Guerin Meneville (1857), there seems to be little doubt that the larvae described by them are identical with *S. holoschista*. The 16 mm. long *Alima*, described by Claus (His Fig. 31), is also probably identical with *A. laticauda*, though representing an earlier stage than the final pelagic.

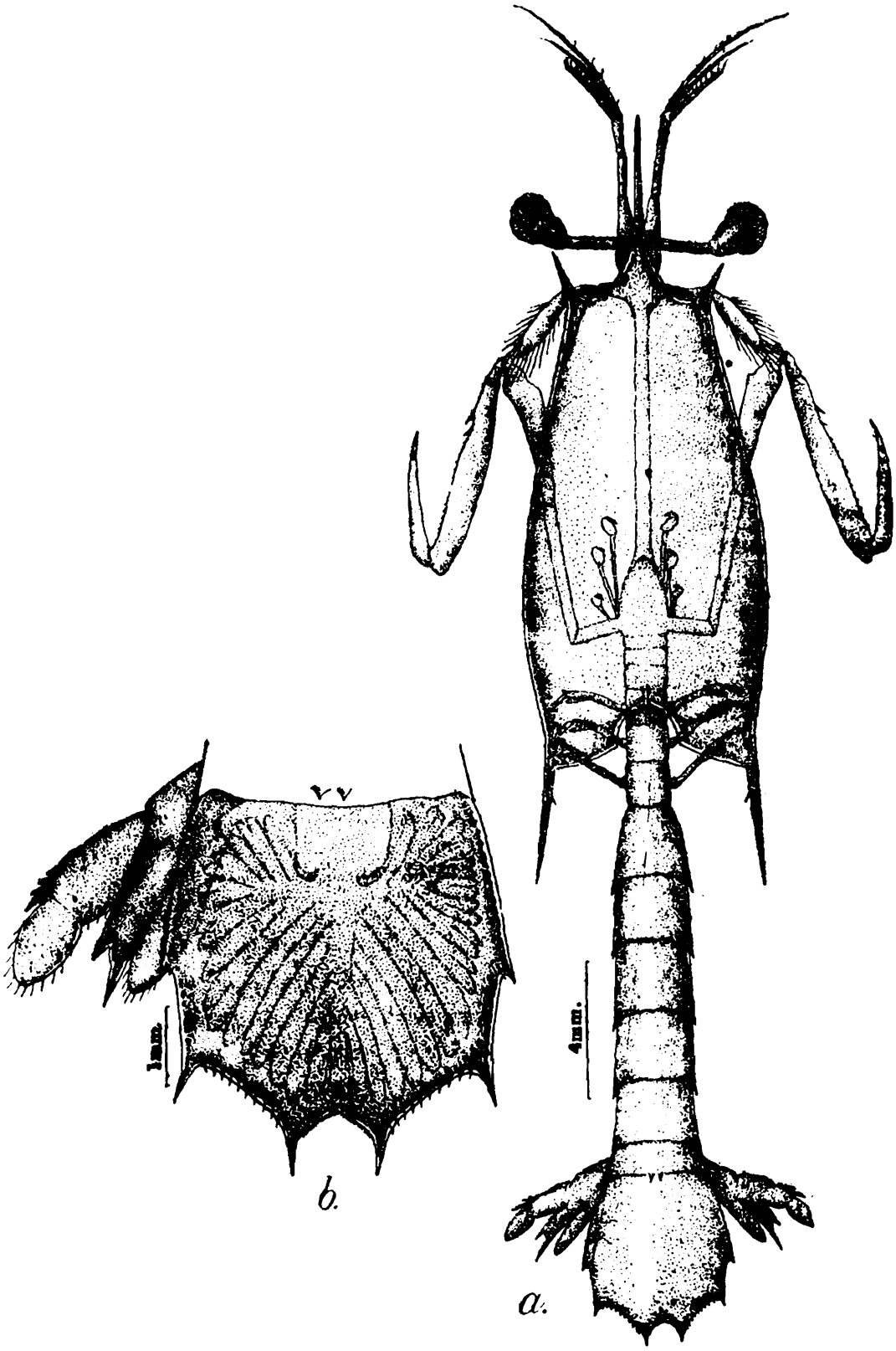
SQUILLA WOOD-MASONI Kemp.

1871. *Alima emarginata*, Claus, *Abh. Ges. Wiss. Gottingen*, Pl. viii, fig. 33 (?)
1895. *Alima trivialis*, Hansen, *Ergeb, Plankt. Exped.*, Pl. viii, fig. 11.
1906. *Alima a*, Tattersall, *Rept. Pearl Oyster Fish. Lond.*, figs. 23, 24, 25.
1929. *Alima emarginata*, Komai & Tung, *Annot. Zool. Jap.*, Pl. v, figs. 16-22; Pl. vi, figs. 1-15; Pl. vii, figs. 1-3.
1932. *Alima emarginata*, Foxon, *Sci. Rept. Great Barrier Reef Exped.*

Final Pelagic Stage (Text-fig. 3).—The longest stomatopod larva in the Madras plankton, it is less frequently caught than the final pelagic larvae of *S. nepa* and *S. holoschista* from which it is easily distinguished by the large size and the relatively narrow carapace.

Total length	35·5 mm.
Length of rostrum	4·5 mm.
Median length of carapace	12·8 mm.
Anterior breadth of carapace	4·3 mm.
Posterior breadth of carapace	6·1 mm.
Length of antero-lateral spine	1·6 mm.
Length of postero-lateral spine	3·6 mm.
Length of eye-stalk	1·7 mm.
Length of corneal portion of eye	1·85 mm.
Length of telson	4·3 mm.
Breadth of telson	4·3 mm.

The carapace extends only upto the anterior portion of the sixth thoracic somite, leaving the last two segments exposed dorsally. The rostrum is prominent and without any ventral spinule. The antero-lateral spine is about twice the size of the dorsal spine which is placed on an elevation near the hind margin. The greatest breadth of carapace (7·0 mm.) at about the level of the labrum, is more than one and a half times its anterior breadth. The postero-lateral spine, not very divergent



Text fig. 3.—*Squilla wood-masoni* Kemp.

a. Final pelagic larva, 35·5 mm. long, dorsal view ; *b*. Telson and left uropod of the same, magnified.

posteriorly, carries a ventral spinule at about one-third its length from base and has the tip reaching the level of the hind border of the first abdominal segment. The lateral margin of carapace is provided with 12+4 spinules, the last 4 being near the postero-lateral angle.

The tip of rostrum and that of the antennular peduncle are usually situated at the same level. The second flagellum of the antennule carries 18 groups of sensory hairs. The eyes are comparatively large, the corneal portion being larger than the stalk, unlike the condition in *S. holoschista.* The peduncular joint of the raptorial limb carries a distal, ventrally directed, stout spine. The raptorial propodus has three stout spines proximally, besides pectinations on the inner margin. The dactylus has only the terminal tooth. The thoracic segments gradually become longer towards the last. The first four abdominal segments are almost as broad as long, while the last two are broader. The sixth segment carries a pair of dorsal sub-median spines and a pair of lateral, ventrally directed spines. The marginal spines of telson, particularly the sub-medians and intermediates, are along. The denticles number 1 lateral, 11 intermediate and 20-21 sub-median on each side. The tip of exopod of uropod, when directed backwards, reaches the base of intermediate spines of telson. It has 5 free spines on the outer aspect. The ventral prolongation of uropod is bifid, with the outer spine less than half the length of the inner which has an inconspicuous bulging on the outer basal aspect.

Earlier stages of Larvae.—Like *S. holoschista,* earlier stages of larvae of the present species also are very seldom caught. An early synzoea stage, 26 to 28·5 mm. long, is represented in the present collections by a few specimens. The carapace, as in the final pelagic larva, leaves the last two thoracic segments exposed. The lateral margin carries 10+4 spinules ; the number in other specimens varying from 8 or 9+4. The second flagellum of antennule carries 14 groups of sensory hairs. Antennal endopodite reaches half-way to tip of squame. The last three thoracic legs are elongate and bifid but are shorter than in the final pelagic stage. The lateral spines of telson are short. Uropods are well differentiated.

Remarks.—The final pelagic larva shows close resemblance to *Alima emarginata* (Claus, 1871), eventhough the latter is about 9 mm. longer. *A. trivialis* (20·6 mm. ; Hansen, 1895) also appears to be identical with *S. wood-masoni,* though it represents an earlier stage to the final pelagic. Komai and Tung (1929) have identified certain larvae from the Japanese seas as *A. emarginata.* The first two larvae of this series measure 52 and 44 mm. respectively in length, excluding rostrum and have the shape of carapace different from that of Claus's *A. emarginata.* These are obviously different from *S. wood-masoni.* Two other specimens ascribed to the same species by Komai and Tung, have a different carapace form ; are smaller than the first two specimens (30 and 31 mm. long, including rostrum) and are probably identical with *S. wood-masoni,* though representing a slightly earlier stage than the final pelagic.

The 27 mm. long *Alima a* described by Tattersall (1906) also appears to belong to *S. wood-masoni.* Representing an earlier stage than the final pelagic, it agrees with the Madras form in the spinulation of carapace

and in the relative size considered with the stage of development attained. The earlier stage, 4·5 mm. long, ascribed to this species by Tattersall, has been shown to be probably the larva of *S. holoschista* (vide p. 21.)

Squilla sp. (*Alima emarginata*, Foxon, 1932) from the Great Barrier Reef is probably identical with *S. wood-masoni*; while the larva described as *A. emarginata* by Lanchester (1906) appears to belong to the closely related *S. interrupta* (vide p. 26).

A. robusta (Jurich, 1904) shows a vague general resemblance to the final pelagic larva of *S. waod-masoni*; but the indication of five teeth beneath the cuticle on the dactylus of the raptorial claw in the 28·7 mm. long specimen, probably shows that it belongs to a different species than *S. wood-masoni.*

SQUILLA INTERRUPTA Wood-Mason.

1906. *Alima emarginata*, Lanchester, *Fascicule Malayensis*, Fig. 4.

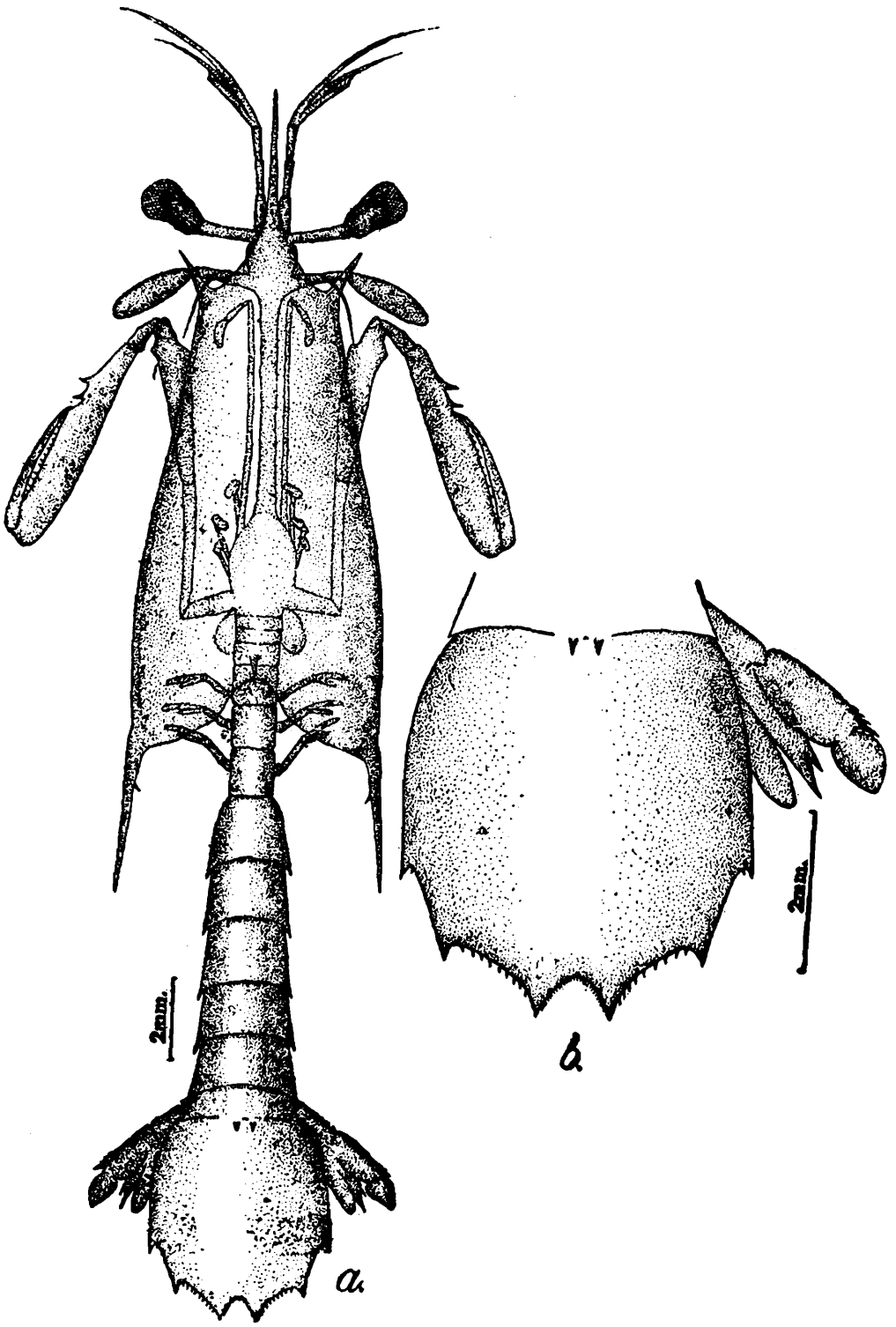
Final Pelagic Stage (*Text-fig. 4*).—The larva is fairly large-sized and robust in appearance. Occasionally, considerable number of them is obtained along with some of the earlier stages also. The fairly large size, the comparatively narrow carapace and the large telson easily mark out this larva from the rest.

Total length	29·5 mm.
Length of rostrum	4·5 mm.
Median length of carapace	10·8 mm.
Anterior breadth of carapace	3·4 mm.
Posterior breadth of carapace	6·0 mm.
Length of antero-lateral spine	1·3 mm.
Length of postero-lateral spine	3·5 mm.
Length of eye-stalk	1·6 mm.
Length of corneal portion of eye	1·6 mm.
Length of telson	4·4 mm.
Breadth of telson	4·2 mm.

The carapace is comparatively long and narrow, and covers the anterior half of the 6th thoracic somite, leaving the last two fully exposed. The lateral margin of carapace bears 7+3 spinules. The rostrum is fairly long and is armed with 7 ventral spinules. The antero-lateral spines are acutely pointed and are longer than the dorsal spine. The postero-laterals do not diverge much posteriorly, each carries a ventral spinule at a point slightly in advance of one-third its length from the base and has the tip reaching the level of the anterior half of the second abdominal segment.

The tip of antennular peduncle is distinctly inferior to the rostral tip. Second antennular flagellum carries 15 groups of sensory hairs. The eye is not very conspicuous and the corneal portion is only equal to the stalk in length. The raptorial limb has a sharp spine on the distal end of the basal segment, ventrally. The propodus has three stout spines and a row of pectinations. The dactylus has no free tooth other than the terminal. The abdominal segments are more than one and a half times as broad as the thoracic and have their postero-lateral corners produced into acute spines. The segments are broader than long and

get gradually shorter towards the last which is about 2½ times as broad as long. It has a pair of sub-median spines and an additional spine at the postero-lateral margin directed ventrad. The telson is comparatively large and is longer than broad (Text-fig. 4*b*). The marginal spines are



TEXT-FIG. 4.—*Squilla interrupta* Wood-Mason.

a. Final pelagic larva, 29·5 mm. long, dorsal view ; *b.* Telson and right uropod the same, magnified.

rather short and stout. The denticles number 1 lateral, 9–10 intermediate and 15–17 sub-median on each side. The uropod when directed backwards, reaches the base of the lateral spine of telson and has 4 free spines on the outer aspect of the basal segment of exopod. The ventral

prolongation is bifid, the inner spine being over double the size of the outer, without any noticeable tubercle on its outer aspect and with the tip just projecting beyond the distal end of the endopod.

Earlier stages of Larvae.—Two stages slightly earlier to the final pelagic are present in the collection. Both these, measuring 23·5 mm. and 26·0 mm. respectively in length, resemble the final pelagic larva with which they agree in almost all details except that the various structures are, as a whole, slightly less developed than in the final pelagic stage.

Remarks.—Lanchester (1906) referred a single *Alima* larva, 20 mm. long, collected off cape Patani, to *Alima emarginata*. The details of the spinulation of carapace and the figures given by Lanchester, however, indicate that the larva is different from Claus's *A. emarginata* which measured 44 mm. in length. Foxon (1932) commenting on Lanchester's larva stated that " Lanchester's figure is hardly typical, especially as regards the telson and the spinulation of the carapace " The conspicuous telson, the shape of carapace, ventrally armed rostrum and the 7+3 spinules on the lateral margin of carapace are all characteristic of the larva of *S. interrupta* and Lanchester's specimen is therefore referable to that species.

Lele (1937) has briefly reported that he has been able to note the successive stages of a pelagic *Alima* larva from the Bombay waters and trace the same to the adult form of *S. interrupta*. However, as no description of this larva has been available to me I am unable to comment further on this record.

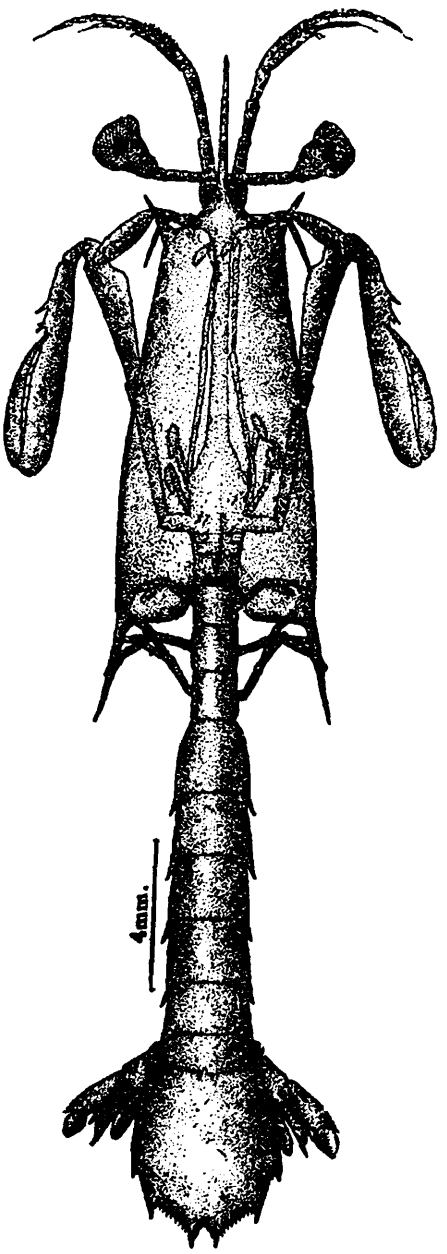
SQUILLA BOOPS Kemp

Final Pelagic Stage (*Text-fig. 5*).—The larva comes up only rarely in the plankton catches. In the shape of carapace and in the number of its spinules it resembles *S. interrupta*, but the comparatively more slender build and the larger size make it easily distinguishable.

Total length	31·0 mm.
Length of rostrum	4·0 mm.
Median length of carapace	9·5 mm.
Anterior breadth of carapace	3·5 mm.
Posterior breadth of carapace	5·0 mm.
Length of antero-lateral spine	1·1 mm.
Length of postero-lateral spine	3·0 mm.
Length of eye-stalk .	2·0 mm.
Length of corneal portion of eye	1·9 mm.
Length of telson	4·4 mm.
Breadth of telson	4·0 mm.

The carapace is long and narrow and leaves the last three thoracic segments fully exposed. Its lateral margin is provided with 7+3 spinules. The rostrum is long and slender and has a row of 6–7 ventral spinules, usually continued forwards as a series of fine tubercles. The antero-lateral spines are long and pointed, while the dorsal spine is short and inconspicuous. The postero-laterals are short and slender,

slightly divergent posteriorly, each with a ventral spinule at about $\frac{1}{4}$ its length from base and have the tips reaching the level of the hind border of the last thoracic segment.



TEXT-FIG. 5.—Final pelagic larva of *Squilla boops* Komp, 31·0 mm. long, dorsal view.

The antennular peduncle is long and slender, with its tip slightly inferior to the rostral tip. The second flagellum of the antennule has 12 groups of sensory hairs. The basal joint of the raptorial limb carries a terminal ventral spine. The propodus has three stout spines and a row of pectinations. The dactylus has no free tooth besides the terminal but internally shows traces of five, including the terminal one. The last three thoracic somites are longer than broad. In the first five abdominal segments the postero-lateral corners are produced into long slender acute spines. In the sixth there is no such spine, but a pair of sub-median dorsal spines and an antero-lateral, ventrally directed spine on either side are present. The telson is longer than broad and has the

marginal spines well developed. The denticles number 1 lateral, 9 intermediate and 15—16 sub-median on each side. The tip of uropod when directed backwards reaches the lateral spine of telson. The exopod carries 3 to 5 free spines externally ; the inner spine of the basal prolongation is more than double the size of the outer, has a prominent swelling or tubercle externally and has its tip projecting distinctly beyond that of the endopod.

Earlier Stages of Larvae.—A few early stages of the larvae are also present in the collection. The smallest of them, measuring 19 mm. in length, has the same general body form as in the final pelagic larva. However, the ventral spinules on the rostrum are rather inconspicuous, the second antennular flagellum carries only 6 groups of sensory hairs ; the antennal flagellum is small and rudimentary, hardly reaching the tip of antennal peduncle ; the last three thoracic limbs are only rudimentary, bifid stumps ; and the uropod is just getting differentiated, with the tip reaching only upto $\frac{1}{4}$ the distance to the base of lateral spine of telson ; the exopod still unsegmented and without any clearly marked spine and the ventral prolongation stump-like with its tip which is not yet bifid, reaching only half way to the tip of endopod.

A specimen 21·0 mm. long, though generally resembling the above stage, has 7 groups of sensory hairs on the second antennular flagellum ; the exopod on the uropod segmented and with one outer spine and the ventral prolongation just bifid at the tip which is still inferior to the tip of endopod.

In the 23 mm. stage the second antennular flagellum has 8 groups of sensory hairs ; tip of antennal flagellum just projects beyond the tip of peduncle ; peraeopods are longer and in the uropod the ventral prolongation has its tip still inferior to the tip of endopod.

When 25 to 27 mm. long, the second antennular flagellum bears 10 groups of sensory hairs ; tip of uropod reaches half way to the lateral spine of telson ; exopod still has only one free spine ; the bifid tip of the ventral prolongation is at the same level as the tip of endopod and its inner, larger spine is devoid of the smooth swelling found in the final pelagic stage.

Apparently between the final pelagic stage and the one described above there is another intervening stage which is not represented in the present collection.

Remarks.—While this larva does not appear to have been described before, it shows some resemblance to the larva of *S. oratoria* (Komai & Tung, 1929) in general appearance ; but the distinctly larger size, the shorter postero-lateral spines and the marginal spinulation of carapace are distinguishing features of the species.

SQUILLA QUINQUEDENTATA Brooks

Final Pelagic Stage (*Text-fig. 6*).—The larvae are only occasionally caught and are not very abundant, though some of the earlier stages

also come up along with the final pelagic larvae. The very slender, frail body, with the short, narrow carapace is characteristic of the final pelagic larva.

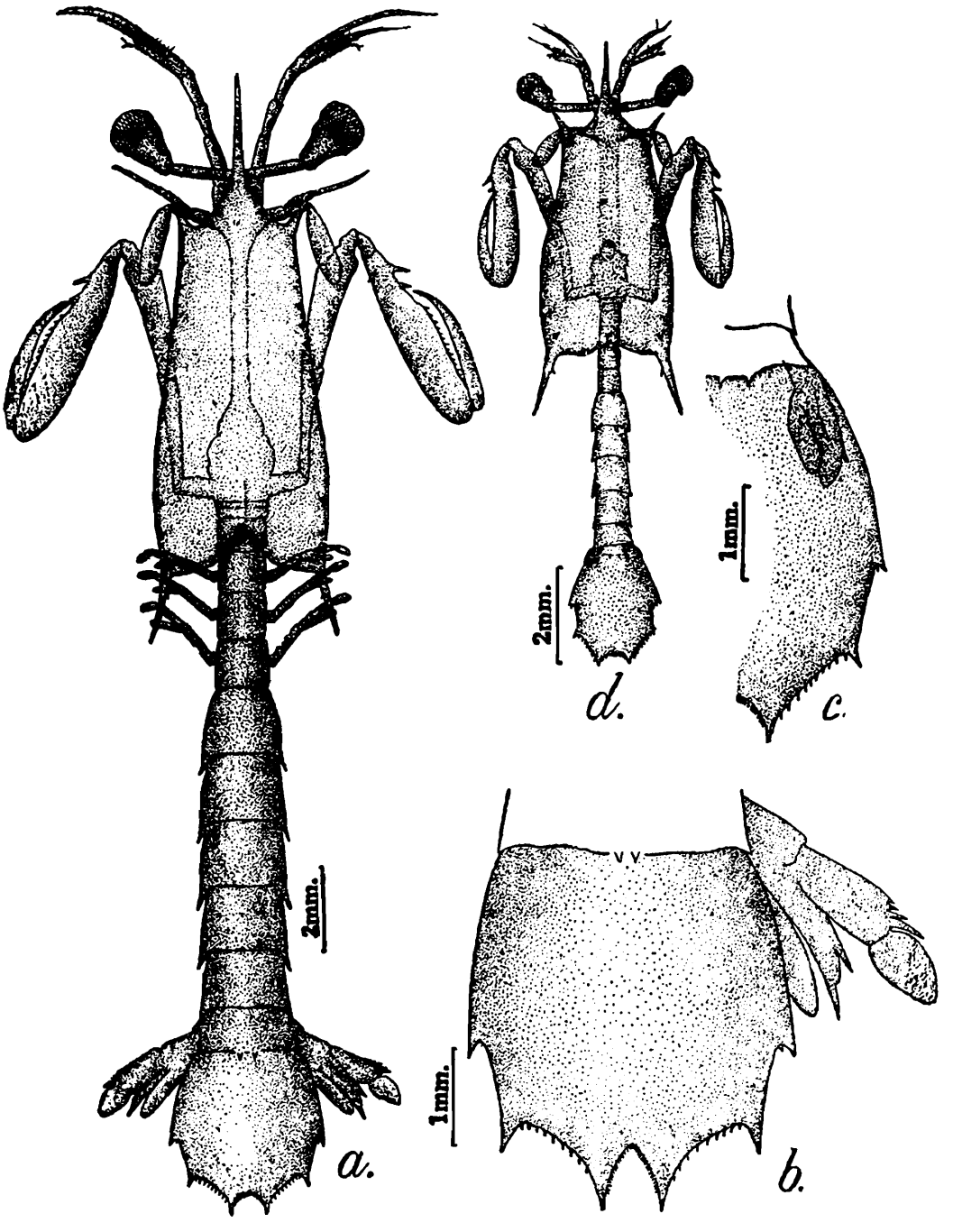
Total length	27·4 mm.
Length of rostrum	3·4 mm.
Median length of carapace	8·4 mm.
Anterior breadth of carapace	2·7 mm.
Posterior breadth of carapace	4·0 mm.
Length of antero-lateral spine	1·0 mm.
Length of postero-lateral spine	2·5 mm.
Length of eye-stalk	1·5 mm.
Length of corneal portion of eye	1·6 mm.
Length of telson	3·4 mm.
Breadth of telson	3·4 mm.

The carapace extends over the posterior half of the fifth thoracic somite, the last three segments of the thorax remaining fully exposed dorsally (fig. 6*a*). The rostrum is long and slender and is armed with 8 ventral spinules, the last four of which being very minute. The antero-lateral spines are acutely pointed. The postero-laterals are short, slightly divergent posteriorly, with the tip of each reaching the level of the hind end of the last thoracic somite and each carrying a ventral spinule at about one-third its length from base. The dorsal spine is small and inconspicuous. The lateral margin of the narrow carapace bears 8+3 spinules, the last three being bigger than the rest and situated at longer intervals near the postero-lateral corner of carapace.

The tip of antennular peduncle is at the same level as, or slightly superior to, the tip of rostrum. The second antennular flagellum carries 11 groups of sensory hairs. The eyes are comparatively large, with the stalk slightly shorter than the corneal portion. Protopodite of the raptorial limb carries a ventrally directed distal spine. Propodus has the usual three spines and the series of pectinations. Dactylus has no free tooth other than the terminal. Third and fourth segments of the thorax are very short and the two together make only half the length of the fifth which is almost as long as broad. The sixth is as long as the precedig one but the last two are longer. Abdominal segments are broader than the thoracic, but get shorter gradually towards the sixth which is about twice as broad as long and has a stout ventro-laterally directed anterior spine on either side, besides a pair of sub-median dorsal spines. Telson is almost as broad as long and has the marginal spines rather elongated (Text-fig. 6*b*). Denticles number 1 lateral, 9–10 intermediate and 14 sub-median on each side. Uropods when directed backwards reach slightly beyond the lateral spines of telson. The basal segment of the exopod has 4–5 free spines. The ventral prolongation, as usual, is bifid at the tip, the outer of the two spines being smaller than half the length of the inner which has a smooth prominence on its outer aspect basally and has the tip just projecting beyond the distal extremity of the endopodite.

Earlier Stages of Larvae.—Earlier stages are fairly well represented in the collection and the earliest stage obtained that could be referred to this species measures about 7·5 mm. in total length.

Larva, 7·5 mm. long.—Carapace leaves the last two thoracic segments exposed dorsally. Tip of antennular peduncle is inferior to tip of rostrum. Lateral margin of carapace has only 5 spinules, one near the antero-lateral spine, two near the middle region at each margin and the other



TEXT-FIG. 6.—*Squilla quinquedentata* Brooks.

a. Final pelagic larva, 29·4 mm. long, dorsal view ; *b*. Telson and right uropod of the same, magnified ; *c*. Right half of telson and right uropod of larva, 18·5 mm. long, magnified ; *d*. Larva, 13·0 mm. long, dorsal view.

two near the postero-lateral spine, all directed outwards. Tip of postero-lateral spine projects just beyond the hind border of the second abdominal segment.

Second antennular flagellum carries 4 groups of sensory hairs. Antennal endopodite is bud-like and small ; third and fourth thoracic limbs are rudimentary ; appendages on segments 5 to 8 are absent ; the

fifth pair of pleopods are smaller than the rest ; uropod is only an unsegmented, small rudiment. Telson is large and long, with 1 lateral, 6 intermediate and 6 sub-median denticles on each side. Postero-lateral corners of the abdominal segments are not acutely pointed.

Larva, 10·0 to 10·5 mm. long.—Carapace as in the 7·6 mm. long larva, except that the antero-lateral spines are long and pointed, that the lateral margin of carapace has only 4 spinules and that the rostrum carries 5–6 ventral spinules.

Second antennular flagellum still has only 4 groups of sensory hairs. Antennal endopodite stops short of the tip of antennal peduncle. Thoracic segments 5 to 8 carry minute bud-like limb rudiments. Fifth pleopod is still small. Uropod is a small bifid outgrowth, while the telson is long and conspicuous, with the intermediate spines stouter than the sub-medians which are longer. Denticles number 1 lateral, 9 intermediate and 6 sub-median on each side.

Larva, 13·0 mm. long (*Text-fig. 6d*).—Carapace as in the 10·0 mm. long larva, but with 7+2 marginal spinules, the last 6 of which are extremely minute and with the tip of postero-lateral spines reaching only just beyond the last thoracic segment.

The second antennular flagellum has 5 groups of sensory hairs. Antennal endopodite is segmented, but the tip does not yet reach the peduncular tip. The last three maxillipeds are not fully differentiated, the last being still rudimentary. Rudiments of peraeopods are unsegmented. Fifth pleopod is smaller than the rest. Uropod is bifid but rudimentary. Telson is large, longer than broad and has 1 lateral, 9–10 intermediate and 9–10 sub-median denticles on each side.

Larva, 14·5 to 15·5 mm. long.—Carapace only partially covers the 6th thoracic somite ; 2+3 marginal spinules well developed ; the rest rudimentary ; rostrum with 3 or more ventral spinules.

Second antennular flagellum with 7 or 8 groups of sensory hairs ; antennal endopodite three-jointed, with the tip projecting beyond peduncular tip ; last three maxillipeds fully differentiated and directed forwards ; peraeopods rudimentary but bifid ; fifth pleopod as large as those in front ; tip of uropod when directed backwards reaches $\frac{1}{3}$ the distance to the lateral spine of telson ; exopodite indistinctly segmented and with a rudimentary outer spine ; tip of ventral prolongation just bifid and reaches to $\frac{2}{3}$ the length of endopod. Sub-median spines of telson are the longest and are acutely pointed. Denticles number 1 lateral, 10 intermediate and 12–13 sub-median on each side.

Larva, 16·5 mm. long.—Appendages are slightly better differentiated than in the previous stage.

Larva, 18·5 to 19·0 mm. long (*Text-fig. 6c*).—Carapace as in the 16·5 mm. long larva, but has 4–5 ventral spinules on rostrum and the lateral margin is provided with 8+3 spinules as in the final pelagic stage.

Second antennular flagellum has 8 or 9 groups of sensory hairs. Antennal endopodite is a trifle longer than in the 16·5 mm. long larva and so also are the peraeopods. Tip of uropod reaches to almost half

the distance to the lateral spine of telson. Tip of ventral prolongation is inferior to the tip of endopodite ; denticles as in the 16·5 mm. long larva.

Larva, 21·0 to 22·3 mm. long.—Carapace as in the final pelagic larva, except that the postero-lateral spines are a trifle longer. Second antennular flagellum has 10 groups of sensory hairs. Antennal endopodite reaches half way to tip of squame ; peraeopods are almost fully differentiated ; tip of uropod reaches more than half-way to the base of lateral spine of telson ; exopod has two free spines ; outer spine at the bifid tip of the ventral prolongation is about half the length of the inner, the tip of which reaches the endopod tip. Denticles on telson are as in the 19·0 mm. long larva.

The above larva is almost identical with the final pelagic stage in details, but probably, a further stage intervenes between it and the final pelagic stage.

Remarks.—As already mentioned the distinctly narrow carapace makes the larva appear very slender and frail and by this feature alone it is easily distinguished from the other species. Like *S. boops* this larva also does not appear to have been described before. In general appearance it closely resembles *Alima bigelowi* (Hansen, 1895). Bigelow (1894) observed a similar larva moult into *S. quadridens*. Lebour (1934) has described a similar, though different, larva from Asia Negros. These larvae, measuring only 15 to 16 mm. in length, are very much smaller than the final pelagic stage of *S. quinquedentata* and as such the resemblance between them is perhaps only superficial.

SQUILLA GONYPETES Wood-Mason

1939. *Squilla* (*Alima*) sp. ("*nepa*" group), Foxon, *Sci. Rept. John Murray Exped.*, Fig. 1.

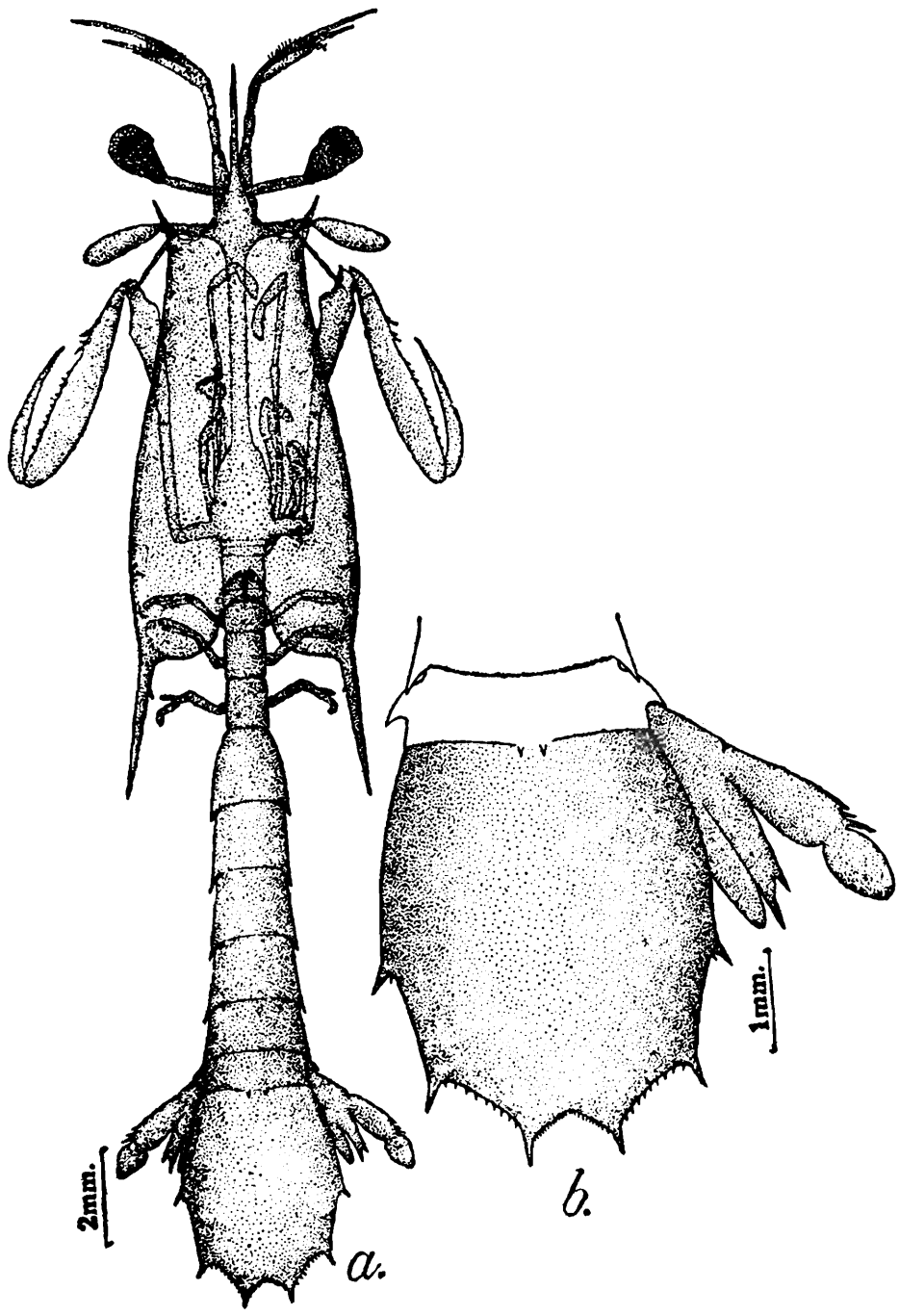
Final Pelagic Stage (*Text-fig. 7*).—Only a few specimens are obtained in the tow-net collections and that too very occasionally. They resemble the larvae of *S. quinquedentata* and are of almost the same size, but can be easily distinguished from them by the distinctly broader carapace and the long telson.

Total length	27·0 mm.
Length of rostrum	3·2 mm.
Median length of carapace	8·5 mm.
Anterior breadth of carapace	2·9 mm.
Posterior breadth of carapace	4·7 mm.
Length of antero-lateral spine ..	1·1 mm.
Length of postero-lateral spine	3·0 mm.
Length of eye-stalk	1·4 mm.
Length of corneal portion of eye	1·4 mm.
Length of telson	4·0 mm.
Breadth of telson	3·3 mm.

Carapace posteriorly extends over the anterior part of the 6th thoracic segment. The greatest breadth of carapace (4·9 mm.) is at about the level of the 5th thoracic segment. The lateral margin is usually provided with 6+2 spinules but often an additional spinule may be present in front of the penultimate one. The rostrum is very slender and is devoid

of ventral spinules. The antero-lateral spines are acutely pointed and are longer than the dorsal spine which is very small and inconspicuous. The postero-lateral spine carries a ventral spinule at about $\frac{1}{4}$ its length from the base, is slightly divergent posteriorly and has the tip reaching the level of the hind border of the first abdominal segment.

Peduncular segments of the antennule are long and slender, the basal one being the longest. Tip of the peduncle is inferior to the rostral tip and its second flagellum carries 12 groups of sensory hairs. Eyes are comparatively small, with the corneal portion being of almost the same length as the stalk. Raptorial limb has a peduncular spine; the propodus has three spines and a series of pectinations; while the



TEXT-FIG. 7.—*Squilla gonypetes* Wood-Mason.

a. Final pelagic larva, 27·0 mm. long dorsal view ; *b.* Telson and right uropod of the same, magnified.

dactylus has no free spine other than the terminal. Thoracic segments gradually become longer towards the last which is longer than broad. Abdominal segments are broader than the thoracic and become gradually shorter towards the last. The postero-lateral corners are produced into long, acute spines. The 6th somite is about $2\frac{1}{2}$ times as broad as long and has a pair of sub-median dorsal spines and an additional pair of antero-lateral spines, directed ventrad. Telson is characteristically longer than broad (*Text-fig. 7b*). The marginal spines are long and slender. The denticles number 1 lateral, 9 intermediate and 13 sub-median on each side. The tip of uropod when directed backward reaches beyond the lateral spine of telson. The exopod has three free spines. The ventral prolongation is bifid, the outer spine being about half the size of the inner which has its tip projecting beyond the distal end of the endopod and has no prominence on its outer basal aspect.

Remarks.—The *Alima* sp. figured by Foxon (1939) from the Red Sea appears to be identical with the final pelagic stage of *S. gonypetes*. Foxon, however, does not give details of the spinulation of carapace; nor are these evident from his figure. The shape and proportion of carapace, structure of telson and uropods and size, however, are features in common with the Madras larva. In attempting to allocate the larva to the adult, Foxon suggested that it might belong to the "*nepa*" group and probably to *S. investigatoris*. The majority of his specimens were of an earlier stage than the final pelagic, unlike " the three rather damaged specimens " caught from the gulf of Oman and which showed indications of 5 spines on the raptorial claw. Foxon, therefore, pointed out that there is a chance that these larvae do not belong to the " *nepa* " group, but considered it most likely that another spine may be added on the dactylus at a subsequent moult. It seems fairly certain, as shown above, that Foxon was actually dealing with larvae of *S. gonypetes* which occurs in the same locality.

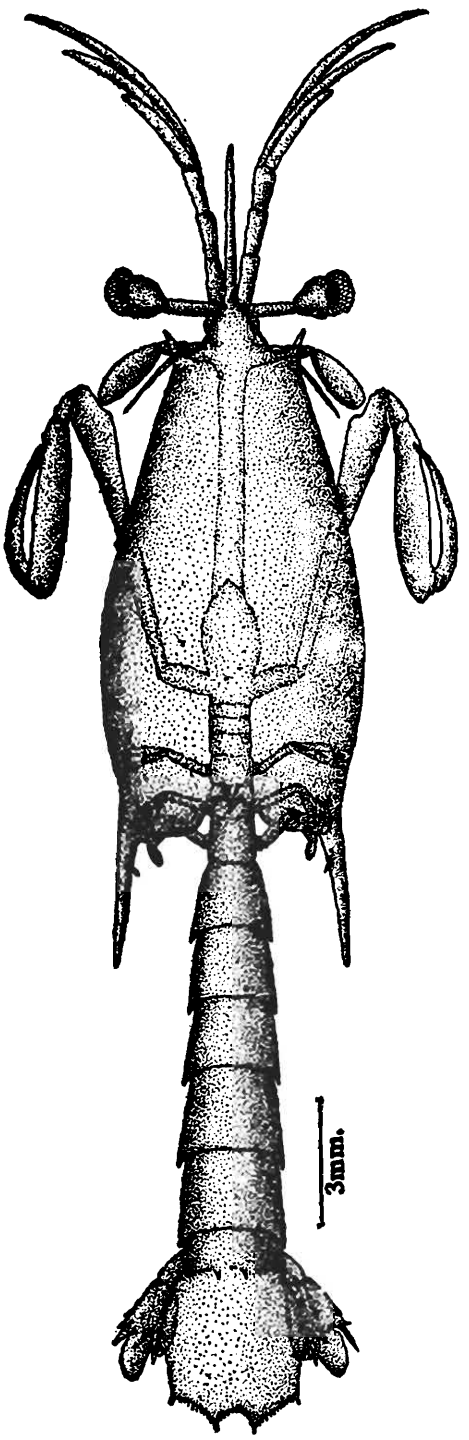
SQUILLA HIEROGLYPHICA Kemp

1944. *Squilla* (*Alima*) *hieroglyphica*, Alikunhi, *Curr. Sci., Bangalore*, fig. *a-d.*

Final Pelagic Stage (*Text-fig. 8*).—A brief description of the final pelagic larva of this rare stomatopod, obtained from the plankton collected on 5-3-1943, has already been published (Alikunhi, 1944). While no other specimen was obtained during the present investigtions, I have included in this report a complete figure of the final pelagic larva for the sake of comparison with those of the other species and easy identification. There is nothing to add to the description already given.

Remarks.—Of the typical, larger *Alima* larvae of the Madras plankton, the final pelagic stage of *S. hieroglyphica* is easily distinguished when alive by the characteristic pigmentation on the ' Hands ' of the 3rd, 4th and 5th thoracic appendages. Unlike other species of the ' Quinquedentata ' group, viz.; *S. boops*, *S. quinquedentata* and *S. gonypetes*, this larva has a broader carapace which has a general resemblance to that of the final pelagic larva of *S. wood-masoni*.

The species appears to be very rare in the Madras waters.



TEXT-FIG. 8.—**Final pelagic larva** of *Squilla hieroglyphica* Kemp, 30·0 mm. long, dosral view.

SQUILLA RAPHIDEA (Fabricius)

1871. *Alimerichthus*, Claus, *Abh. Ges. Wiss. Gottingen*, pl. viii, fig. 30.

1903. *Alimerichthus pyramidalis*, Lanchester, *Fauna Geog. Maldive and Laccadive Archipelagoes.*

1932. *Alima pyramidalis*, Foxon, *Sci. Rept. Great Barrier Reef Exped.*

1939. *Alima multispinus* (Atypical form), Foxon, *Sci. Rept. John Murray Exped.*, Fig. 2*b*.

Final Pelagic Stage (*Text-fig. 9*).—A few specimens are occasionally brought up in the plankton catches. The relatively small size, the short, stout carapace and the broad abdominal segments are characteristic of the final pelagic larva.

Total length ..	18·1 mm.
Length of rostrum	2·2 mm.
Median length of carapace	6·5 mm.
Anterior breadth of carapace ..	3·3 mm.
Posterior breadth of carapace	5·8 mm.
Length of antero-lateral spine ..	1·0 mm.
Length of postero-lateral spine	2·1 mm.
Length of eye-stalk	1·4 mm.
Length of corneal portion of eye	1·8 mm.
Length of telson	2·6 mm.
Breadth of telson ..	3·1 mm.

The carapace is broad and covers all the thoracic somites posteriorly. Its lateral margin is provided with 4+3 spinules of which the first two, near the base of the antero-lateral spines are ventrally directed. The third one, larger than the foregoing two and situated just in front of the middle point of the lateral margin is directed ventro-laterally ; while the fourth, situated a little behind the 3rd is much larger and is directed laterally. The last three spines are smaller, directed ventrad and nearer to the postero-lateral angle of the carapace. The rostrum is slender and carries a weak ventral spinule at about its middle point. The antero-lateral spine is almost equal to the dorsal spine which is acutely pointed. The postero-laterals are short and each has a ventral spinule a little in front of its middle point. They are slightly divergent posteriorly, with the tips reaching the level past the hind border of the second abdominal segment.

The tip of the antennular peduncle is inferior to the rostral tip and the second flagellum of the antennule carries 9 groups of sensory hairs. The eyes are conspicuous and are distinctly larger than the stalk. In the raptorial limb the basal segment does not possess a terminal spine. The propodus has three stout spines at the base, but the pectinations along the margin are few and there are some additional short hairs. The dactylus has no free tooth other than the terminal. Indications of seven to 9 spines are, however, visible through the skin. The third and fourth segments of the thorax are short, while the fifth is about double the size of the 4th. The last three thoracic somites are longer than the preceding ones and each is about three times as broad as long. The abdominal segments are broader than the thoracic, the sixth segment being about 4 times as broad as long. The postero-lateral corners of the abdominal segments, except the last one, end in acute spines. The last has a pair of sub-median spines and an additional stout spine on the lateral margin anteriorly, directed ventro-laterally backwards. The telson is very much broader than long and has the marginal spines fairly elongated. The sub-median space is wide. The denticles number 1 lateral, 13–14 intermediate and 19–20 sub- median on each side. The tip of uropod when directed backwards reaches half-way between the lateral and intermediate spines of telson. The basal segment of the

exopod carries 4 or 5 free spines. The terminal spines of the ventral prolongation of the uropod are unequal, the inner one being longer than double the length of the outer and has a distinct smooth prominence at the outer basal aspect.

Occasionally, besides the typical larva described above, a closely similar one with a larger carapace is also collected. Dimensions of one such specimen are given below :

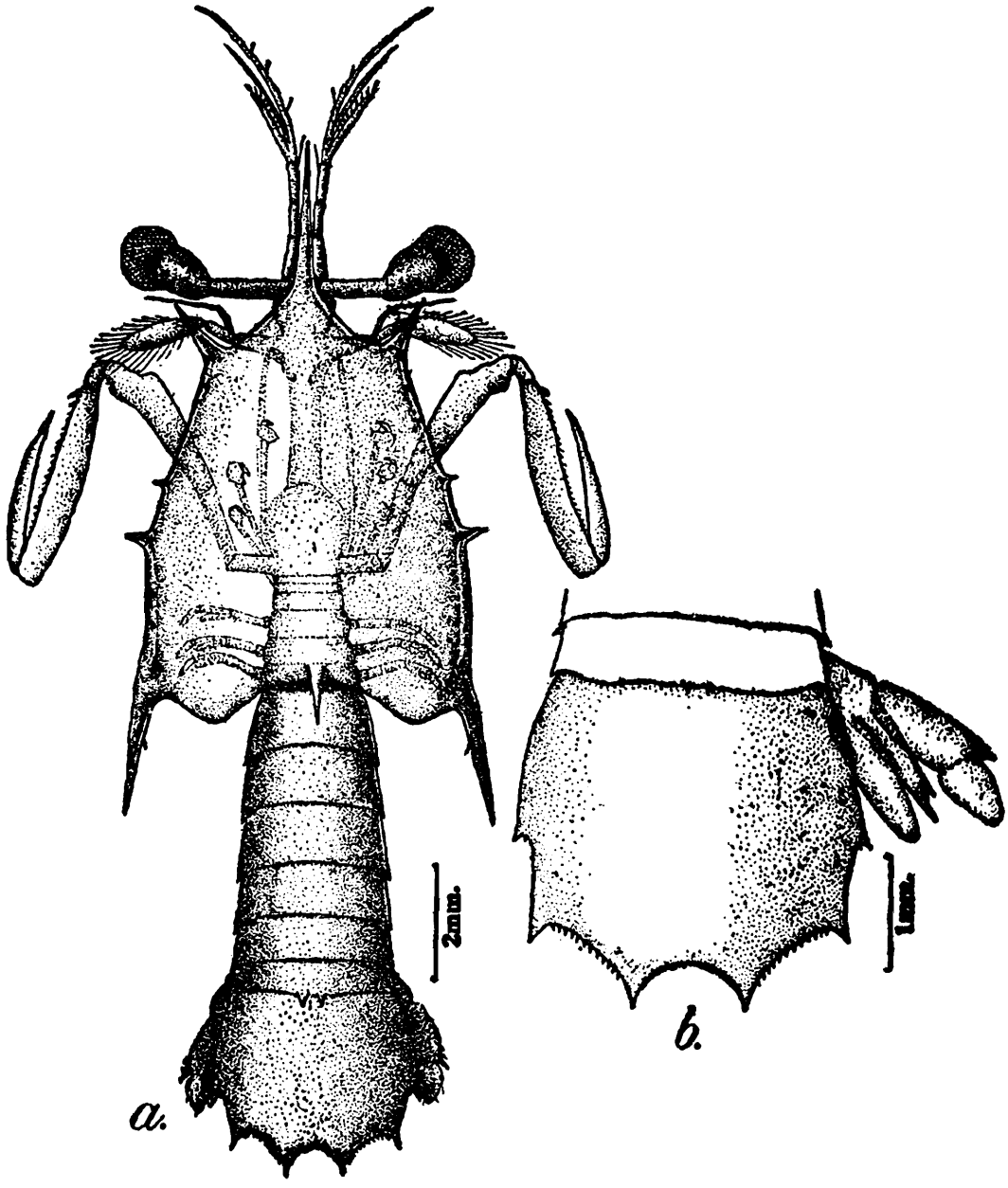
Total length	18·2 mm.
Length of rostrum	2·9 mm.
Median length of carapace	7·5 mm.
Anterior breadth of carapace	4·2 mm.
Posterior breadth of carapace	7·0 mm.
Length of postero-lateral spine	3·0 mm.
Length of antero-lateral spine ..	1·1 mm.
Length of eye-stalk	1·5 mm.
Length of corneal portion of eye ..	2·0 mm.
Length of telson	3·1 mm.
Breadth of telson	3·6 mm.

Though hardly longer than the typical form, the larva appears much stouter and has the different parts also relatively bigger than in the typical form. When placed side by side and examined, the two larvae look very different, eventhough in the details of structure they do not differ so much. The spinulation of carapace is identical with that in the typical form, except that the laterally directed spine is perhaps a little stouter. The postero-lateral spines are long, almost parallel to the body and have their tips reaching the level of the hind border of the 4th abdominal segment. Telson is bigger than in the typical larva and has 1 lateral, 11 intermediate and 21 sub-median denticles on each side. The outer spine of the basal prolongation of the uropod is only about $\frac{1}{2}$ the length of the inner. The second antennular flagellum carries 10 groups of sensory hairs. Eyes are slightly more rounded and large. In all other features the larva is identical with the typical one.

Remarks.—While the typical larva has been definitely correlated with *S. raphidea* by rearing the pelagic larvae into post-larvae, it is not yet certain whether the atypical form with the larger carapace, also belongs to the same species. The post-larva obtained by moult from one such larva more or less agrees with *S. raphidea*. However, since the early post-larvae in most cases do not show the full adult characters and since *S. raphidea* and *S. annendalei* are very closely related, it is a possibility that the atypical larva probably belongs to the latter species. This is, however, just a surmise which is not based on any positive evidence.

The final pelagic larva of *S. raphidea* appears to be identical with Claus's *Alimerichthus* sp. Claus's figure, however, shows only one laterally directed spinule on the margin of carapace ; but size, general appearnce, shape and proportion of carapace and the clear indication of 8 spines on the dactylus of the raptorial claw are in agreement with the present larva.

Lanchester (1903) considers *Alimerichthus* sp. of Claus and Books as synonymous with his *A. pyramidalis*, which measured 17 mm. in length. While no figure is available for comparison and since details of the spinulation of carapace are also wanting it is not possible to state definitely whether this larva is identical with the Madras form; but from the description given the two appear to be identical.



TEXT-FIG. 9.—*Squilla raphidea* (Fabricius).

a. Final pelagic larva, 18·1 mm. long, dorsal view; *b*. Telson and right uropod of the same, magnified.

Foxon (1932) considers *A. pyramidalis* Lanchester, *A. unidens* Lanchester and *Alimerichthus a* Tattersall as belonging to a single species. He observes that the characters used by Lanchester and Tattersall to differentiate their species are subject to much variation. However, *A. unidens* has now been shown to be the final pelagic larva of *S. fasciata* (p. 50) and *Alimerichthus a*, the corresponding stage of *S. latreillei* (p. 47). That Foxon was dealing with a collection of species under the name *A. pyramidalis* is, therefore, obvious. Since larvae measuring 18 mm. in length are reported in this collection, it is likely that *S. raphidea* is also represented in it.

The atypical form of *Alima multispinous* described by Foxon (1939) also shows close similarity to the final pelagic larva of *S. raphidea*. Foxon observed that this atypical larva " appears to be that figured by Claus in his figure 30' But, like Claus's *Alimerichthus*, in this larva also only one laterally directed spinule is seen along the margin of carapace. Full details of the spinulation of carapace are not given by Foxon, nor are these evident from his figures. However, in size, general shape of carapace and indications of seven spines on the dactylus of raptorial claw Foxon's larva (atypical form) agrees with *S. (Alima) raphidea*. The typical specimens of *A. multispinus*, as figured by Foxon, have two lateral spinules on the carapace, but the shape of carapace is different from that in *S. (Alima) raphidea*. Also the raptorial dactylus of the former has 4 free teeth which is never the case in the final pelagic larva of *S. raphidea*.

Foxon, attempting to refer these larvae to their adults, pointed out that if the typical and atypical larvae are specifically distinct, they might belong to *S. raphidea* and *S. annendalei*. As already pointed out, while the atypical form is perhaps identical with *S. (Alima) raphidea*, the typical larva might well belong to the closely related *S. annendalei*.

Claus's *Erichthus multispinus* appears to be a very different species, probably not related to *S. raphidea*, eventhough it also possesses laterally directed spinules on the carapace. Borradaile's specimens are perhaps identical with the specimen figured by Claus. The shape and spinulation of carapace in *E. multispinus* is so characteristic that it is doubtful whether *A. multispinus* of Foxon has been rightly referred to that species.

SQUILLA SCORPIO Latreille

1915. *Squilla (Alima) scorpio*, var. *immaculata*, Kemp, *Mem. Ind. Mus. Calcutta* ; fig. 2g.

1929. *Squilla (Alima) oratoria*, Komai & Tung, *Annot. Zool. Jap.*, Pl. ii, figs. 1-26 ; pl. iii, figs. 7-17.

Final Pelagic Stage (*Text-fig. 10*).—Very rarely caught in the townet, this larva closely resembles the final pelagic stage of *S. fasciata*, but colouration, the characteristically long rostral and postero-lateral spines, the small spinule at the posterior margin of carapace and the absence of laterally directed spines on the margin are features that easily distinguish this larva. Dimensions of a single specimen (with rostrum broken near base) collected on 2-8-1940 are given below :

Total length excluding rostrum	9·2 mm.
Median length of carapace	3·1 mm.
Anterior breadth of carapace	1·7 mm.
Posterior breadth of carapace	2·9 mm.
Length of antero-lateral spine	0·7 mm.
Length of postero-lateral spine	3·3 mm.
Length of eye-stalk	1·0 mm.
Length of corneal portion of eye	1·4 mm.
Length of telson	1·03 mm.
Breadth of telson	1·04 mm.

The carapace is small and narrow and posteriorly extends over the anterior half of the 7th thoracic segment. The antero-lateral spines are acutely pointed and are longer than the dorsal spine. The lateral margin of carapace has 1+3 spinules. The postero-lateral spines are markedly divergent posteriorly; each has a ventral spinule at about $\frac{1}{3}$ its length from base and has the tip reaching the level of the 4th abdominal segment. On the hind margin of carapace, between the postero-lateral and dorsal spines there is a characteristic small spinule.

The second antennular flagellum has 5 groups of sensory hairs. The raptorial dactylus has no free tooth other than the terminal; but clear indications of five teeth are visible beneath the skin. Postero-lateral corners of the abdominal segments are obtuse. The 6th abdominal segment has a pair of sub-median dorsal spines. The marginal spines of telson are well developed. The denticles number 1 lateral, 5 intermediate and 9 sub-median on each side. The uropod when directed backward reaches the base of the intermediate spine of telson. The exopodite of uropod has 3 free spines basally and shows indications of 3 more beneath the skin. The outer spine of the ventral prolongation of the uropod is half as long as the inner which has a very conspicuous basal swelling.

Earlier Stages of Larvae.—These are also equally rare as the final pelagic stage and only two specimens have been available for study.

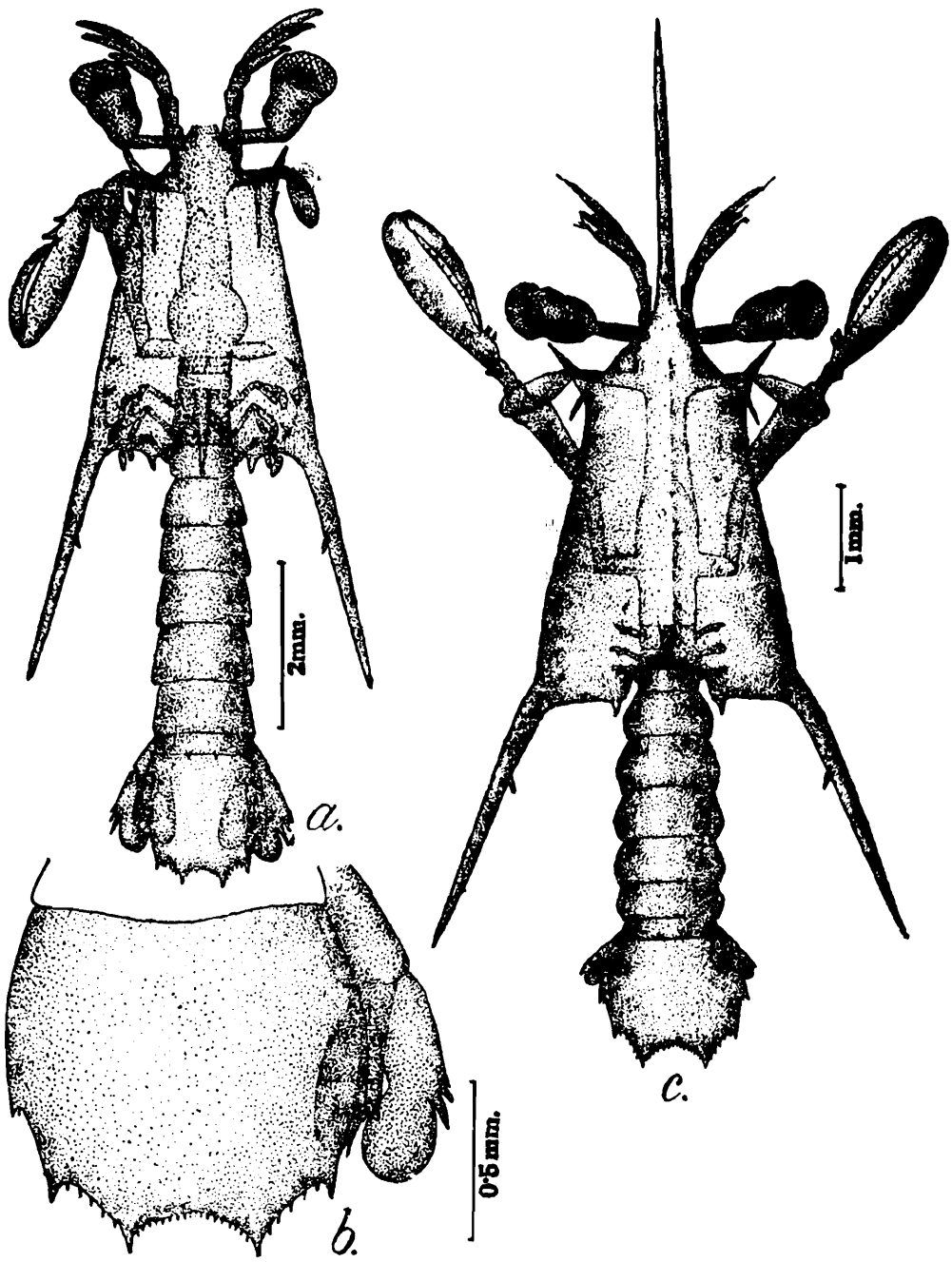
Larva, 5·1 mm. long.—The rostrum and postero-lateral spines are very long and conspicuous; the two characteristic spinules at the hind margin of carapace are present; lateral margin has 1+3 spinules; carapace posteriorly covers all the thoracic segments; shape of carapace is the same as in the final pelagic stage, and tip of the postero-lateral spine reaches the level of the telson. Antennular peduncle is short. Antennal endopodite is bud-like and reaches half-way to the tip of antennal peduncle. Rudiments of the last three maxillipeds are present, but are small; peraeopods are not formed yet. Postero-lateral corners of the abdominal segments are not pointed. 5th pleopod is rudimentary. The 6th abdominal segment and the uropods are not differentiated. Telson is longer than broad, with wide sub-median space. There are 3 intermediate and 9 sub-median denticles on each side.

Larva, 9·8 mm. long (*Text-fig. 10c*).—Spines of carapace are longer than in the final pelagic stage. Carapace is narrow, almost triangular in outline and extends over the 7th thoracic somite. Rostrum is very long and has 3 large ventral spinules. Postero-lateral spines are greatly divergent posteriorly and each has the tip reaching the level of the base of telson. Second antennular flagellum has 3 groups of sensory hairs. Eyes are large. Antennal endopodite is segmented and reaches half-way to the tip of squame. Postero-lateral corners of abdominal segments do not end in spines. Uropods when directed backward do not reach the base of the lateral spines of telson. Exopod of uropod has only 1 free spine. The ventral prolongation is just bifid at the tip and is shorter than the endopod. Telson is almost as broad as long and has the sub-median space wide. Denticles number 1 lateral, 5 intermediate and 7-8 sub-median on each side.

Colouration.—In living specimens a conspicuous bright yellow spot at the mandibular region beneath the carapace and a still larger rosy patch of colour on the protopodite of the 3rd pleopod are characteristic. The latter patch is formed of an irregular spot of deep yellow, surrounded by a rose red area. Distal portions of rostrum and postero-lateral spines of carapace and the raptorial propodus and dactylus are also provided with a few bright yellow pigment granules.

Remarks.—The final pelagic larva could not be reared to undergo metamorphosis and as such positive evidence for correlating the larva to *S. scorpio* is lacking.

Kemp (1915) describes a series of larvae from the Chilka lake and refers them to *S. scorpio* var. *immaculata* on the ground that it is the



TEXT-FIG. 10.—*Squilla scorpio* Latreille.

a. Final pelagic larva, 9·1 mm. long (excluding rostrum), dorsal view ; *b.* Telson and right uropod of the same, magnified ; *c.* Larva, 9·8 mm. long, dorsal view.

commonest stomatopod in the lake. Judging from the nature of the uropods, Kemp's largest larva (11·5 to 12·0 mm.) is probably in an earlier stage than the final pelagic. The present larvae resemble Kemp's specimens in all essential features and undoubtedly belong to the same species. It is, however, seen that they differ from the Chilka specimens in the relatively longer rostrum and postero-lateral spines of carapace and in the possession of an additional spinule on the rostrum and on the lateral margin of carapace. Of the larvae figured by Kemp, the smallest specimen, represented in his figure 2g, shows remarkable resemblance to the present form and is probably identical with it. I had also occasion to examine two collections from the Chilka lake, dated 12-6-1948 and 16-7-1948 respectively, in which, besides the stages figured by Kemp, the final pelagic larvae and a few early *Alima* were also present.* The final pelagic larva agrees in almost all details with the 11·5 to 12·0 mm. long larvae described by Kemp. Indications of five teeth on the dactylus of the raptorial claw are visible through the skin. The smallest specimen in the present Chilka Lake collections measured 5·2 mm. in total length. In none of these specimens the rostrum and postero-lateral spines are unusually long. The lateral margin of carapace invariably has only 1+2 spinules. On the other hand, all the larvae, including those the final pelagic stage, collected from Madras have the spines of carapace much longer than in the Chilka specimens and the lateral margin of carapace also has 1+3 spinules. Since the above differences are so constant I am inclined to believe that the Madras larvae and also the smallest larva figured by Kemp (as Fig. 2g) probably belong to *S. scorpio* ; while the rest of the Chilka specimens belong to the variety *immaculata.*

In a valuable contribution Komai & Tung (1929) have described a series of larval stages which they ascribe to *S. oratoria,* even though no specimen undergoing metamorphosis has come under their observation. Conclusive proof that the larvae described belong to *S. oratoria* is, therefore, lacking, the identification being based merely on the comparative abundance of *S. oratoria* in the locality concerned (Tokyo Bay). Thus, the authors conclude that " the other species of the same genus known in the same locality, namely *S. fasciata, S. mikado* and *S. scorpio* being incomparably rarer, the chance that a given *Alima* larva belongs to any one of these species is evidently negligible " This, at best, is only a probability and a careful perusal of their paper shows that in the stages ascribed to *S. oratoria* the larvae of at least two different species have been mixed up. Stages 4, 5, 6 and 7 (specimens collected on July, 12, 1919), represented by figures 1 to 26 of plate ii and 7 to 17 of plate iii seem to belong to a very different species than the supposed *S. oratoria.* The authors themselves have referred to " some remarkable differences to be found between the specimens of stages 6 and 7 collected on July, 12, 1919 and those collected on August, 27, 1917 " These larvae closely resemble Kemp's specimens from the Chilka lake and in all probability belong to *S. scorpio,* which also occurs in Tokyo bay. Even though Komai & Tung have not referred to Kemp's paper (1915), they have

* I am indebted to Mr. P. M. G. Menon for kindly placing these collections at my disposal.

observed in their specimens the characteristic spines at the hind margin of the carapace, mid-way between the zoea and the postero-lateral spines, which Kemp had already shown to be a unique feature of the larvae of *S. scorpio.*

SQUILLA LATREILLEI (Eydoux & Souleyet)

1906. *Alimerichthus a*, Tattersall, *Rept. Pearl Oyster Fish.*, figs. 27-29.

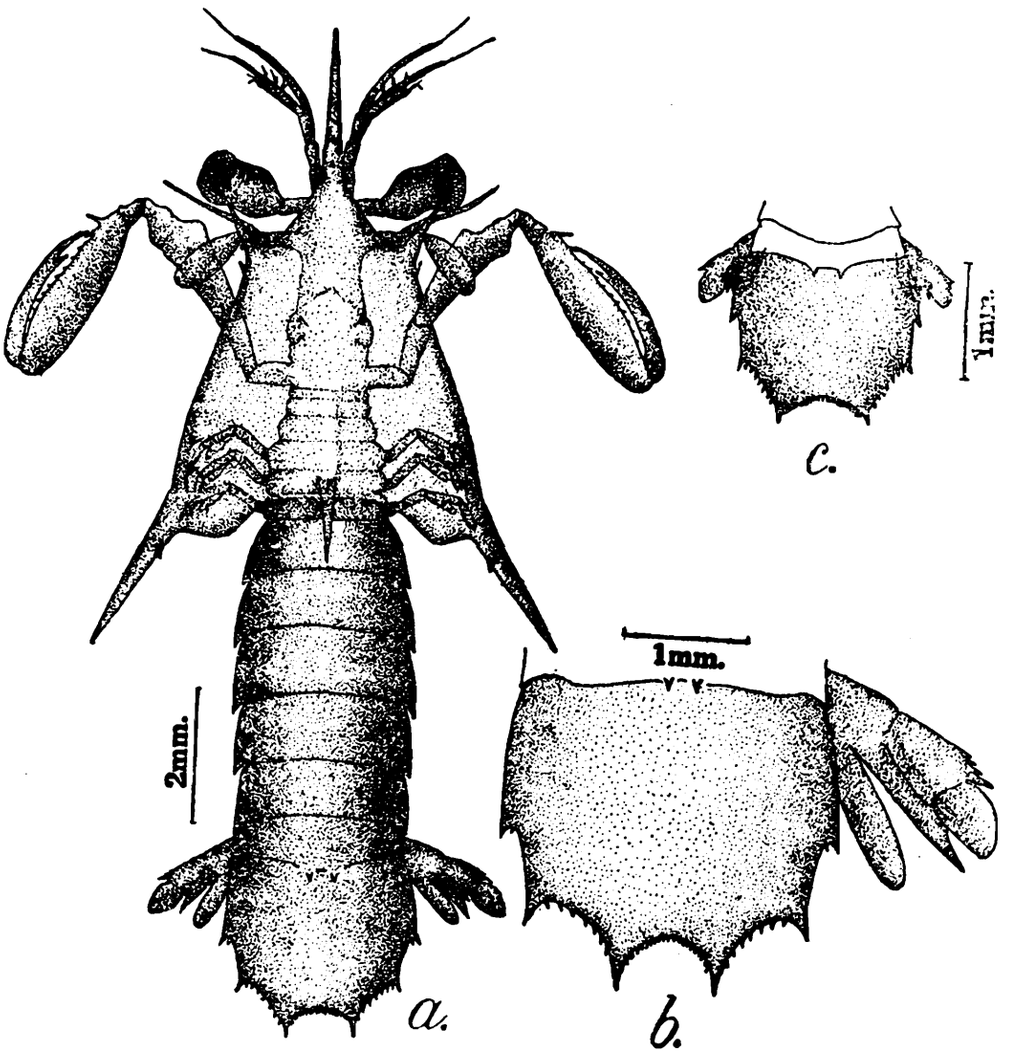
Final Pelagic Larva (Text-fig. 11).—The larva does not occur in large numbers and is only occasionally caught in the tow-net. The small size, the comparatively broad, triangular carapace and the thick robust appearance are features by which it could be easily distinguished from the larvae of other species. The length at the final pelagic stage varies slightly, specimens measuring 10·5 mm. to 13·0 mm. having been observed to undergo metamorphosis into post-larvae.

Total length	12·6 mm.
Length of rostrum	2·6 mm.
Median length of carapace	3·2 mm
Anterior breadth of carapace	2·0 mm.
Posterior breadth of carapace	4·0 mm.
Length of postero-lateral spine	2·0 mm.
Length of dorsal spine	0·9 mm.
Length of corneal portion of eye	1·1 mm.
Length of telson	2·4 mm.
Breadth of telson	2·8 mm.

The carapace is small and approaches a triangle in outline. Posteriorly it extends over the 7th thoracic segment. It is characterised by a median dorsal carina which terminates posteriorly in the conspicuous dorsal spine situated on a prominent elevation at the hind margin of carapace. The lateral, in-turned margin of carapace has only three spinules; the first of which situated at the base of the antero-lateral spine is fairly prominent and ventro-laterally directed; while the other two are situated nearer the postero-lateral corner. The rostrum is long and stout and has 2 or 3 prominent ventral spinules. The antero-lateral spines are short and stout and are only a little longer than half the length of the prominent dorsal spine. The postero-lateral spines are highly divergent posteriorly, each has a ventral spinule at about $\frac{1}{4}$ its length from the base and has the tip reaching the level of the hind border of the third abdominal segment.

The tip of antennular peduncle is far inferior to the rostral tip. The second flagellum of the antennule carries only 4 groups of sensory hairs. The eyes are comparatively large, with short stalk. Unlike species of the " nepa " and " quinquedentata " groups, in the final pelagic larva the region between the antenna and the labrum is not very much telescoped. The raptorial propodus is fairly thick; has three stout basal spines and a row of pectinations. The dactylus has an additional free tooth besides the terminal; but occasionally a second one may also be present. The thoracic and abdominal segments are very much broader

than long. The postero-lateral corners of the first five abdominal segments are produced into spines; while the 6th segment has a pair of sub-median dorsal spines and a pair of ventrally directed stout spines anteriorly. The sub-median spines of telson are long. The denticles number 1 lateral, 7 or 8 intermediate and 17 to 19 sub-median on each side. The tip of uropod when directed backwards reaches half-way between the lateral and intermediate spines of telson. The exopod carries 3 free spines, while the inner spine of the ventral prolongation is about twice the length of the outer and has a smooth prominence externally.



Text-fig. 11.—*Squilla latreillei* (Eydoux and Souleyet).

a. Final pelagic larva, 12·6 mm. long, dorsal view; *b*. Telson and right uropod of the same, magnified; *c*. Telson and uropods of larva 8·5 mm. long.

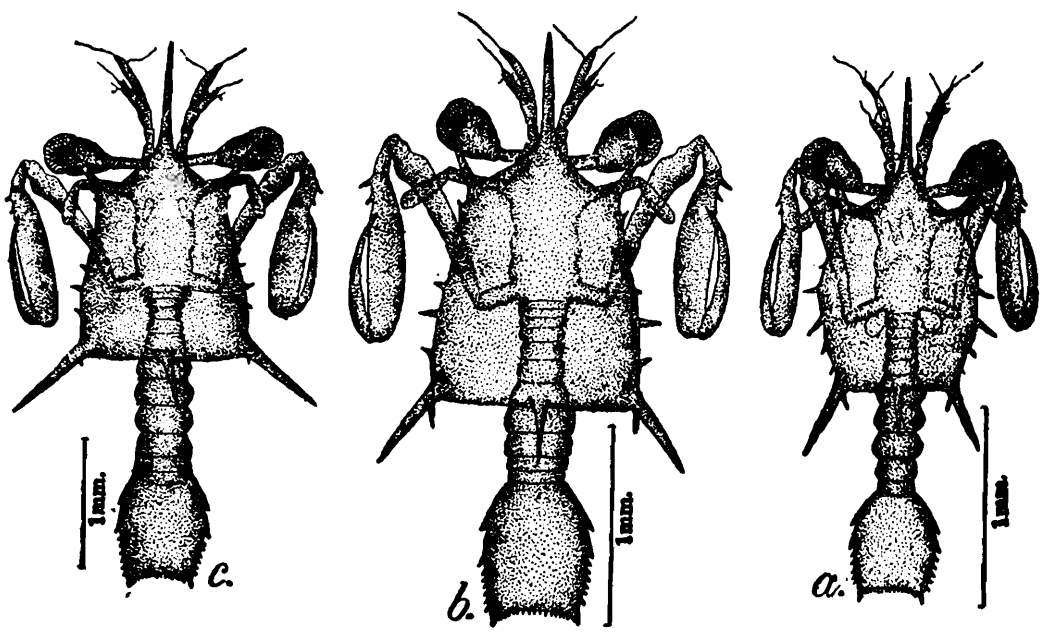
Colouration.—A general tinge of greenish yellow, due to scattered chromatophores on the margin of carapace gives the larva a beautiful appearance in the living or freshly preserved condition. The mandibular region and the basal segment of the 4th pleopod appear as conspicuous golden yellow spots to the naked eye. The basal segment of all the pleopods has a less conspicuous patch of red, and the propodus of the raptorial claw is also provided with a few yellow chromatophores. The colouration is less conspicuous in the earlier stages, but the patches on the 4th pleopod and the mandibular region are developed even at a very early stage.

Earlier Stages of Larvae.—A complete series of larval stages, each represented by several specimens, have been available for study.

Stage 1, 2·4 mm. to 2·7 mm. long (Text-fig. 12*a*).—Minute, extremely slender and with large eyes, this early *Alima* has the carapace posteriorly extending over the middle portion of the first abdominal segment. The breadth of carapace between the postero-lateral spines is almost equal to that between the antero-lateral spines; the lateral margin is smoothly convex. Rostrum is longer than the postero-lateral spines; while the two acutely pointed antero-lateral spines are shorter than the zoea spine. Postero-lateral spines are divergent posteriorly; each has a prominent ventral spinule near the base and has the tip reaching the level of the 3rd abdominal segment. Lateral margin of carapace has 6 spinules, all directed laterally. The second spinule is extremely minute; while the 3rd and 4th, situated at about the middle point of the lateral margin are large and conspicuous.

The antennular peduncle is short; the second flagellum has only 2 groups of sensory hairs; there is no endopodite on the antenna; thoracic appendages behind the raptorial limb have not appeared; there are only 4 pairs of pleopods; the fifth pleopod, the sixth abdominal segment and uropods are not developed; telson is longer than broad, with wide sub-median space and the denticles on telson number 5 intermediate and 8 sub-median on each side.

Stage 2, 2·8 mm. to 4·0 mm. long, (Text-fig. 12*b*.)—The shape of carapace has changed, its greatest breadth being between the postero-lateral spines. The antero-lateral spines are almost equal to the zoea spine in length. There are only 5 spinules along the lateral margin of carapace; the second spinule seen in the previous stage having disappeared. The last spinule is directed ventrad. Postero-lateral spines are conspicuously divergent posteriorly and each has a very conspicuous ventral spinule basally. In other features the larva agrees with the previous stage.



TEXT-FIG. 12.—*Squilla latreillei* (Eydoux and Souleyet).

a. Larva, 2·6 mm. long, dorsal view; *b*. Larva, 3·0 mm. long; *c*. Larva, 4·2 mm long.

Stage 3, 4·1 to 5·0 mm. long (Text-fig. 12*c*).—Very similar to the previous stage. Two ventral spinules have appeared on the rostrum. Rudiment of antennal endopodite has appeared. Maxillipeds 3 to 5 are indicated by minute stump-like rudiments ; the 5th being the smallest. The 5th pleopod has appeared as a small bifid structure. The 6th abdominal segment is just indicated, but not fully differentiated. There is no indication of the uropods ; while two extremely minute sub-median dorsal spines have appeared on the rudimentary 6th abdominal segment.

Stage 4, 5·1 to 5·9 mm. long (Text-fig. 13*a*).—Carapace is almost triangular in shape ; the marginal spines excepting the antero-laterals are conspicuously large ; the lateral margin is flexed inwards. There are only 3 marginal spinules on carapace, all directed ventrad. Antennal endopodite is blunt, stump-like and unsegmented. The last three thoracic appendages (peraeopods) are indicated. Postero-lateral corners of the first four abdominal segments are rounded. Those of the 5th are sub-acutely pointed. 5th pleopod is smaller than the rest. The 6th abdominal segment is better differentiated than in the previous stage and rudiments of uropods are also indicated. The shape of telson has not changed.

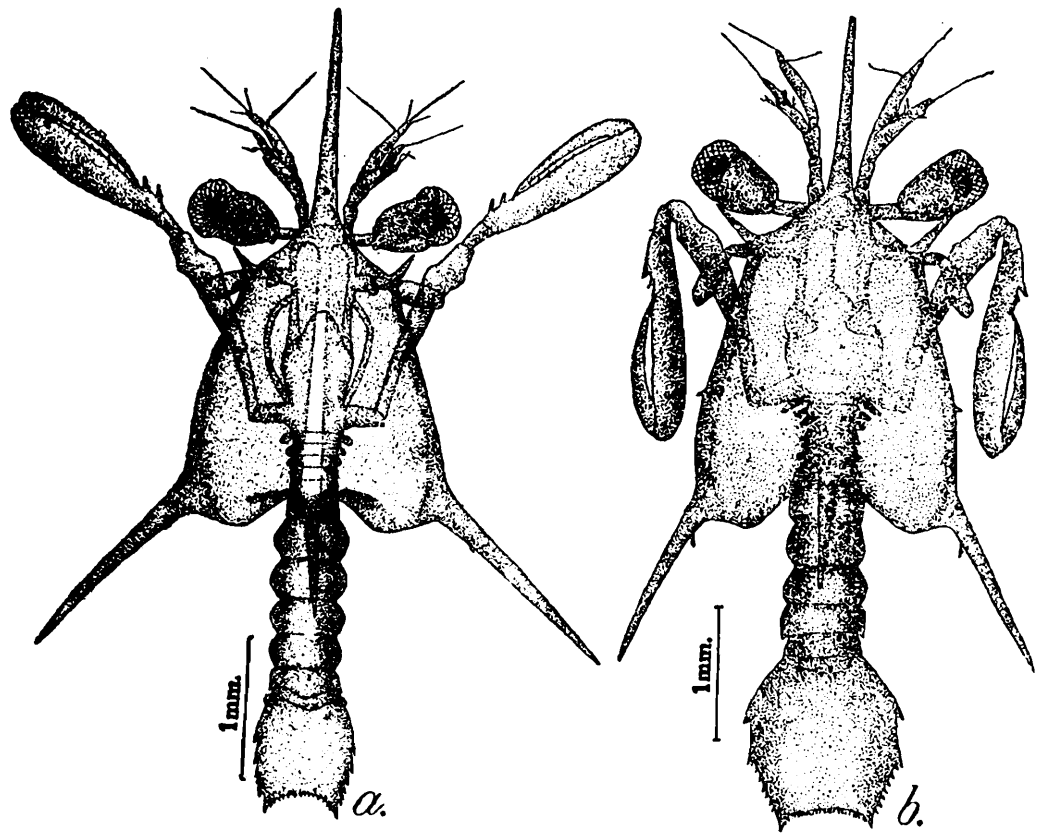
Stage 5, 6.0 to 6.5 mm. long (Text-fig. 13*b*).—Spines of the carapace are not so conspicuous as in the previous stage. Lateral margin has 1+2 spinules, but occasionally an additional minute spinule may be present a little in front of the second. Rudiments of the last three maxillipeds are short and finger-like. Peraeopods are rudimentary and bud-like, the third being the longest. Postero-lateral corners of the 4th and 5th abdominal segments are pointed. Sub-median spines on the 6th segment are more prominent. Rudiments of uropods are unsegmented. Shape of telson has changed. Denticles number 7 or 8 intermediate and 13 or 14 sub-median on each side.

Stage 6, 6.6 to 7.8 mm.—Resembles the previous stage in general appearance. Antennal endopodite is elongated and reaches to the tip of the antennal peduncle, or sometimes even projects a little beyond. The third to the fifth maxillipeds are better differentiated and are getting directed forwards. Peraeopods are more elongated. Ventral prolongation of the uropod is indicated.

Stage 7, 7.9 to 9.5 mm. (Text-fig. 11*c*).—Shape of carapace approximates to that of the final pelagic larva. All the thoracic segments are covered by the carapace. Rostrum has three spinules ventrally. Antennal endopodite reaches half-way to the tip of squame. Raptorial dactylus has one free spine besides the terminal. The second flagellum of the antennule has 4 groups of sensory hairs. Maxillipeds are all well developed. Peraeopods are still short but are bifid and fully segmented. Abdominal segments are very broad and have the postero-lateral corners sub-acutely pointed. Telson has I lateral, 6—7 intermediate and 15 sub-median denticles on each side. Uropods when directed backwards hardly reach the base of the lateral spines of telson. Exopod has one free spine. Ventral prolongation is insipiently bifid and is pointed at the tip.

With the subsequent moult the larva probably enters the final pelagic stage.

Remarks.—The final pelagic larva appears to be identical with *Alimerichthus a* of Tattersall (1906) and agrees with the latter in almost all features. Foxon (1932) however, considered Tattersall's species as synonymous with Lanchester's (1903) *Alimerichthus pyramidalis* and *A. unidens*. Describing *Alimerichthus a* Tattersall clearly stated that the prominent ventro-lateral spines on the carapace midway between the antero-and postero-lateral spines, as seen in *A. pyramidalis* and *A.*



TEXT-FIG. 13.—*Squilla latreillei* (Eydoux and Souleyet).

a. Larva, 5·6 mm. long, dorsal view ; *b*. Larva, 6·1 mm. long, dorsal view.

unidens is absent in his species. Foxon, however, was of the opinion that the above feature and the small size of the larva considered along with the stage of development, were not sufficient to justify creation of a new species for its reception. As already mentioned (*vide S. raphidea*), these two larvae which are distinguished from each other only by differences in the spinulation of the carapace, size at the final pelagic stage and the presence or absence of free spines on the dactylus of the raptorial claw, have now been shown to belong to two very distinct adult species. Foxon's contention that the above features are not of importance, cannot, therefore, be supported. Formation of free spines, other than the terminal, on the dactylus of the raptorial limb in the pelagic larvae, is characteristic of only certain species, in each of which constant specific differences are noticeable. The very close resemblance between the pelagic larvae of the different species dealt with in the present report and the simple features by which they could always be distinguished from one another, on the other hand leads one to a conclusion that is almost opposite the one expressed by Foxon.

SQUILLA FASCIATA DE HAAN

1903. *Alimerichthus unidens*, Lanchester, *Fauna and Geogr. Maldives and Laccadives Archi.*
1906. *Alimerichthus unidens*, Tattersall, *Rept. Pearl Oyster Fish.*
1907. *Alima spinigera*, Borradaile, *Trans. Linn. Soc. Zool. Lond.*, p. 215, fig. 4.
1934. *Alima spinigera*, Lebour, *Res. Sci. Voy. Indes Orient. Neerl. Prince Leopold de Belgique*, p. 12, figs. 1-2.

Final Pelagic Stage (Text-fig. 14).—In general appearance the larva closely resembles the corresponding stage of *S. latreillei*, but is easily distinguished from it by the ventro-lateral spines projecting from the lateral margin of carapace. It is generally very rare and during the period of the present investigations only two live specimens have been available for observation.

Total length	14·5 mm.
Length of rostrum ..	3·3 mm.
Median length of carapace	3·8 mm.
Anterior breadth of carapace	2·1 mm.
Posterior breadth of carapace ..	3·5 mm.
Length of postero-lateral spine ..	2·8 mm.
Length of dorsal spine	1·0 mm.
Length of eye-stalk ..	1·3 mm.
Length of corneal portion of eye ..	1·4 mm.
Length of telson	2·4 mm.
Breadth of telson ..	2·5 mm.

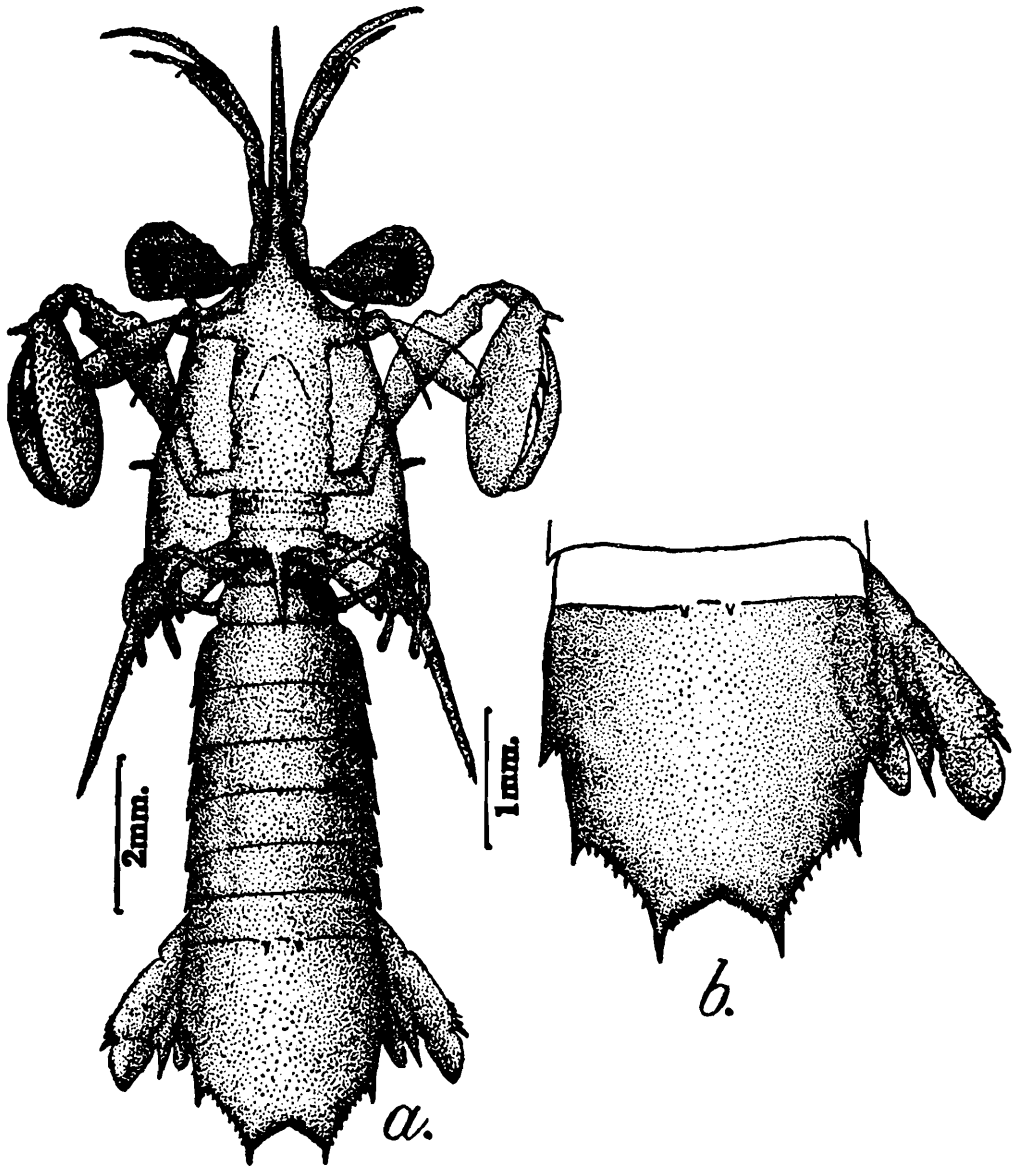
The carapace is comparatively small and narrow and posteriorly leaves the last two thoracic segments exposed. The lateral margin has 4 spinules, the first situated some distance behind the base of the antero-lateral spine, the second which is long and laterally directed, is almost mid-way between the antero- and postero-lateral spines, while the last two are nearer the postero-lateral spines. The rostrum has 3 prominent ventral spinules and a row of minute denticles. The antero-lateral spines are short and are less than half as long as the dorsal spine which is acutely pointed and conspicuous. The postero-lateral spine is provided with a ventral spinule at about $\frac{1}{3}$ its length from the base, diverges posteriorly and has the tip reaching the level of the middle portion of the 3rd abdominal segment.

The tip of antennular peduncle is far inferior to that of the rostrum. The second flagellum carries only 6 groups of sensory hairs. The eyes are comparatively large with short stalks. Peduncular segment of the raptorial limb is without any spine. Raptorial propodus is rather inflated and broad and has two stout spines ; one very short, and a series of pectinations. The dactylus has three free teeth including the terminal. The thoracic and abdominal segments are characteristically broad. Postero-lateral corners of the abdominal segments end in short, acute spines ; while, there is a pair of sub-median dorsal spines on the 6th. Telson is a little broader than long, and has the marginal spines, particularly the sub-medians, long. The denticles number 1 lateral, 8 intermediate and 19 sub-median on each side. The uropod when directed backwards, reaches half-way to the base of the intermediate spine of telson. The basal segment of the exopod carries 5 free spines ; the ventra

prolongation is deeply bifid, with the outer spine fully half the length of the inner which has a smooth basal swelling and has the tip projecting beyond that of the endopod.

Colouration.—A characteristic feature of the larva is its colouration, by which alone, in the fresh condition, it can be easily distinguished from others. There is a uniform row of yellow chromatophores along the margin of carapace. The mandibles appear golden yellow to the unaided eye. In the raptorial limb, the distal portions of the merus and the propodus have a large number of yellow chromatophores, but there is also a conspicuous patch of dark yellow colour over the proximal part of the propodus. The dactylus is of a uniform rose-red colour. The distal end of the protopodite of all the pleopods is tinged rose red, but this colour increases from the first to the last, that on the 4th and the 5th pleopods being the most prominent.

Earlier stages of Larvae.—A single specimen (Collection dated 13-3-1943), 9·5 long, has been available for study. It has the same general appearance as the final pelagic larva, with the characteristic laterally



TEXT-FIG. 14.—*Squilla fasciata* De Haan.

a. Final pelagic larva, 14·1 mm. long, dorsal view ; *b.* Telson and right uroped of the same, magnified.

directed spinule on the carapace. The rostrum however, has 5 ventral spinules. The second antennular flagellum has only 5 groups of sensory hairs. The antennal endopodite reaches only half-way to the tip of squame. Raptorial dactylus has only one free spine other than the terminal. The uropod when directed backward reaches only ½ the distance to the base of the lateral spine of telson. Exopod has only a single free spine. Tip of the ventral prolongation is bifid but is inferior to the tip of endopod.

Remarks.—While Lanchester (1903) does not give any figure of his *Alimerichthus unidens*, it is fairly clear from his descriptive account that his larva is identical with that of *S. fasciata*. Lanchester's specimen measured 12·5 mm. in length and with only a single spine other than the terminal on the raptorial dactylus, it was probably in an earlier stage than the final pelagic. Tattersall's specimens (1906) from Ceylon also represent stages earlier to the final pelagic.

The final pelagic larva also shows close resemblance to Borradaile's *Alima spinigera* and is probably identical with it. Borradaile's specimens measured 16·5 and 12·5 mm. respectively in legnth and were taken at Wasin, British East Africa. The only point of difference, however, seems to be in the shape of telson. Telson is distinctly longer than in the East African specimens and has the intermediate spines rather short and comparatively inconspicuous.

Lebour (1934) has referred a larva, 13 mm. long, from North New Guinea, to *Alima spinigera*. This larva, though closely resembling Borradaile's specimens, shows a somewhat broader carapace, with no ventral spinule near the base of the antero-lateral spine and with three teeth behind " the central tooth sticking out from the lateral margin " ; has the postero-lateral corners of the abdominal segments represented as ending smoothly and has the telson characteristically broad or almost rectangular with the intermediate spines very long and highly conspicuous. Though it resembles the East African form in the unusual size of the intermediate spines, the shape of telson is noticeably different in the two forms and Lebour's specimen might well belong to a different species.

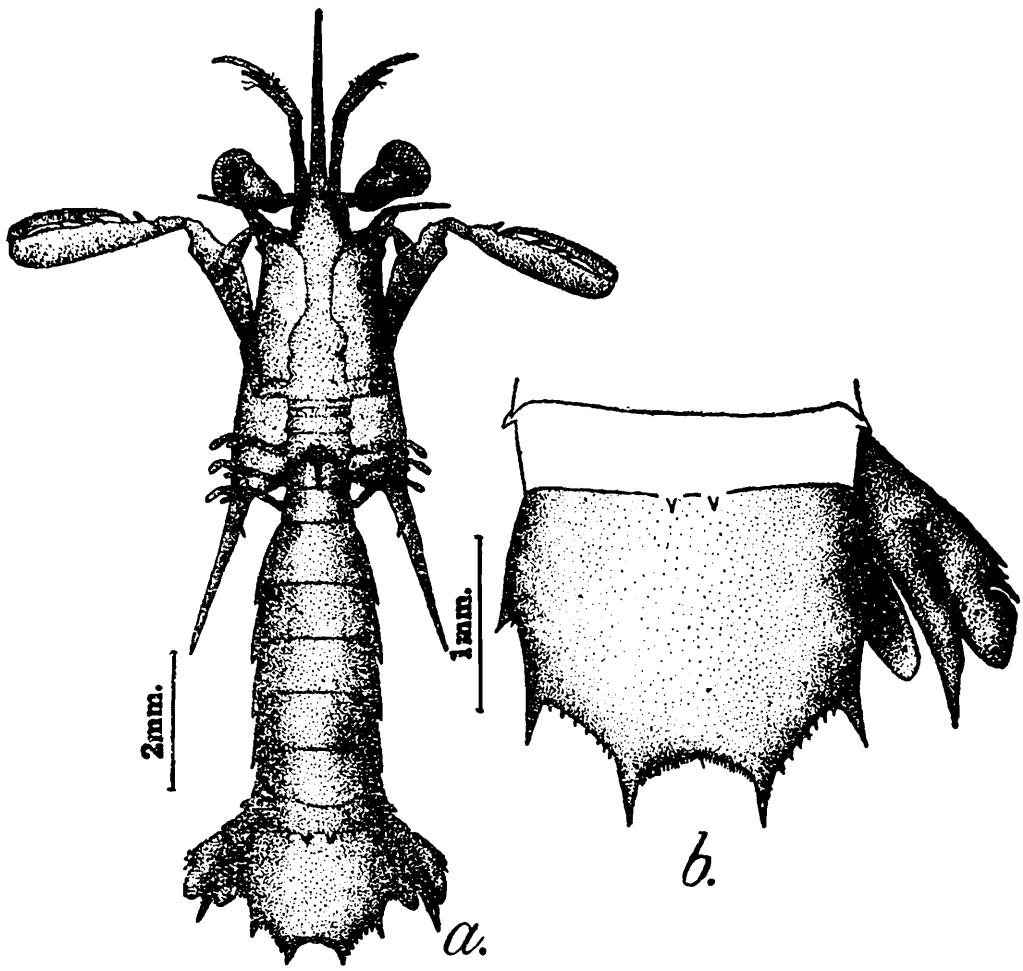
SQUILLA LATA Brooks

1932. *Alima* sp., Foxon, *Sci. Rept. Great Barrier Reef Exped.*, figs. 2-3.
1946. *Alima bermudensis*, Gurney, *Proc. Zool. Soc. Lond.*, fig. 6.

Final Pelagic Stage (Text-fig. 15).—Rather rare in the tow-net collections, this larva is easily distinguished from *S. latreillei* and *S. fasciata* by the relatively more slender appearance of the body and the very narrow carapace. The largest specimen obtained measured 13·5 mm. in total length.

Total Length	13·5 mm.
Length of rostrum	2·6 mm.
Median length of carapace	3·9 mm.
Anterior breadth of carapace	1·7 mm.
Posterior breadth of carapace	2·5 mm.
Length of antero-lateral spine	0·6 mm.
Length of postero-lateral spine	2·5 mm.
Length of eye-stalk	0·5 mm.
Length of corneal portion of eye	1·1 mm.
Length of telson	1·6 mm.
Breadth of telson	2·2 mm.

The carapace is small and narrow and leaves the last two thoracic segments exposed dorsally. In certain specimens the carapace extends over the anterior half of the seventh thoracic segment. The lateral margin of carapace carries only 3 spinules, one at the base of the antero-lateral spine, directed ventro-laterally, while the other two situated



TEXT-FIG. 15.—*Squilla lata* Brooks.

a. Final pelagic larva, 13·5 mm. long, dorsal view ; *b.* Telson and right uropod of the same, magnified.

near the postero-lateral corner are directed ventrad. The rostrum is longer than the postero-lateral spines and is armed with 4 large spinules ventrally. The antero-lateral spines are short, pointed and smaller than the median dorsal spine which is mounted on a small prominence near the hind border. The postero-laterals are slightly divergent posteriorly and have their tips reaching the level of the hind border of the second abdominal segment and sometimes even beyond. Each such spine carries a ventral spinule at about $\frac{1}{4}$ its length from the base.

The tip of antennular peduncle hardly reaches half-way to the tip of rostrum. The second antennular flagellum carries 5 groups of sensory hairs. The eyes are comparatively large, each mounted on a short stalk which is about half the median length of the corneal portion of the eye. The raptorial propodus has three spines proximally, the first of which is very much larger than the rest. The dactylus carries four free spines including the terminal ; while indications of two more are clearly visible through the larval skin. The last three thoracic segments

are almost twice as broad as long. The abdominal segments are about 1·5 to 1·8 times as broad as the thoracic segments and have their postero-lateral corners produced into acute spines. A pair of sub-median spines is present on the sixth abdominal segment dorsally ; while the antero-lateral corners of the same segment are produced into a pair of stout spines directed ventrally backwards. The intermediate and sub-median spines of telson are long and pointed. The denticles number 1 lateral, 6-7 intermediate and 19 to 21 sub-median on each side. The tip of the uropod when directed backward reaches slightly beyond the level of the intermediate spines of telson. The exopod carries four free spines externally ; the outer process of the ventral prolongation is very small, about 1/5 the length of the inner which has a prominent smooth swelling externally.

Earlier Stages of Larvae.—An almost complete series of larval stages; from the early *Alima* onwards is represented in the present collection.

Larva, 2·0 mm. to 2·6 mm. long (Text fig. 16*a*).—Extremely frail and almost transparent, this minute *Alima* is not uncommon in the tow-net catches. While it resembles the corresponding stage of *S. latreillei*, it differs from the latter in the following features :—

1. Carapace is rather small and leaves the last two thoracic segments exposed dorsally ;
2. Lateral margin of carapace bears only 4 spinules ;
3. Zoea spine is very small ;
4. Eyes are relatively small ; and
5. Telson is distinctly longer than broad and has only four intermediate denticles.

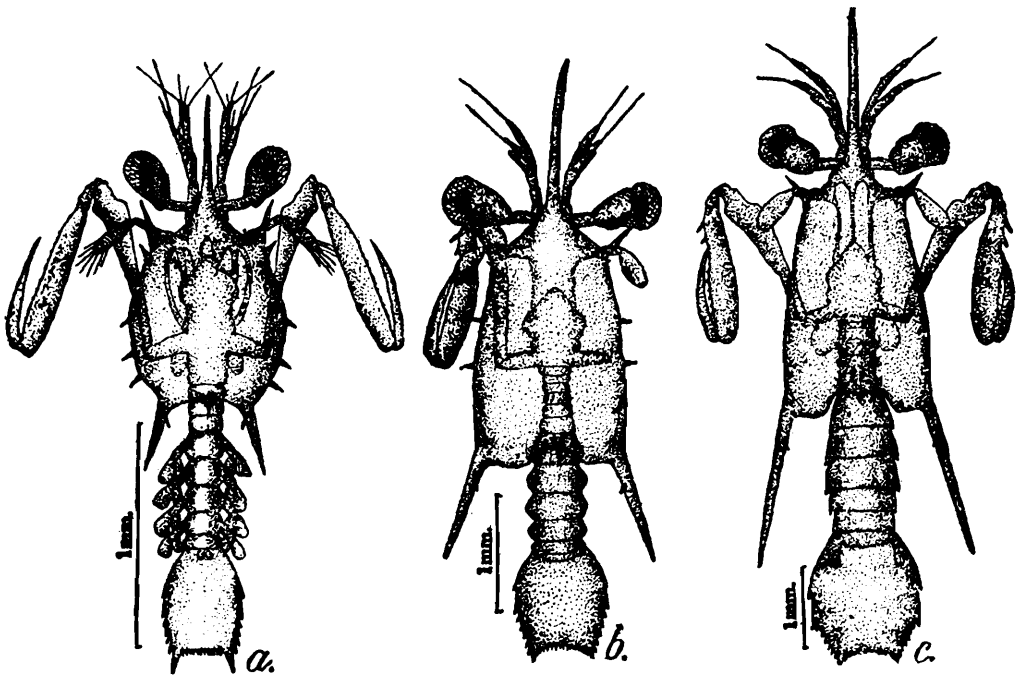
Larva, 4·2 mm. long.—Carapace is small and narrow and extends over the anterior half of the first abdominal segment. The rostrum is longer than the postero-lateral spines and is armed with 2 spinules ventrally. Antero-lateral spines are longer than the zoea spine. Lateral margin of carapace has 5 spinules, one a little behind the base of the antero-lateral spine, the 2nd and 3rd, projecting ventro-laterally at about the middle of the lateral margin, and the last two near the postero-lateral corner. Tip of the postero-lateral spine reaches the level of the last abdominal segment or even upto the telson, and carries a ventral spinule at about $\frac{1}{4}$th its length from base. Tip of the antennular flagellum is far inferior to the tip of rostrum. The second antennular flagellum has three groups of sensory hairs. Antennal endopodite is just indicated as a smooth outpushing. Thoracic appendages behind the raptorial claw are not developed. The fifth pleopod is rudimentary. Uropods are not developed. Denticles on telson number 4 intermediate and 7 or 8 sub-median on each side.

Larva, 5·1 mm. long (Text-fig. 16*b*).—Resembles the previous stage in general appearance. The following additional features are noticeable.

Antennal endopodite is knob-like and unsegmented ; minute rudiments of the last three maxillipeds are visible ; postero-lateral corners of the abdominal segments do not end in acute points ; the sixth abdominal segment is not fully differentiated from the telson ; uropods are

small, unsegmented and stump-like ; fifth pleopod is rudimentary ; telson is longer than broad ; sub-median spines are longer than the intermediate ; denticles number 5 intermediate and 7 or 8 sub-median on each side.

Larva, 6·5 mm. long.—Similar in appearance to the previous stage. Rostrum has two large ventral spinules. Of the marginal spinules of carapace, the 2nd one is very small, while the third alone now projects ventro-laterally. The antennular flagellum has a rudimentary 4th group of sensory hairs. Antennal endopodite does not yet reach the tip of the antennal peduncle. The last three maxillipeds are still rudimentary. Peraeopods are just indicated. Uropod is rudimentary, but bifid.



TEXT-FIG. 16.—*Squilla lata* Brooks.

a. Larva, 2·6 mm. long, dorsal view ; *b.* Larva, 5·1 mm. long ; *c.* La va, 8·6 mm. long.

Larva, 8·6 mm. long (Text-fig. 16*c*).—The carapace extends over the anterior half of the last thoracic segment. Tip of the postero-lateral spine reaches the level of the last abdominal segment. Marginal spinules of carapace number only 1+2, the second and third spinules seen in the earlier stages having disappeared. Even in the 6·5 mm. stage the tendency for suppression of these spinules was apparent, when the second spinule appeared much smaller than what it was in the previous stage. The second antennal flagellum has 4 groups of sensory hairs. Antennal endopodite reaches the tip of the antennal peduncle. Postero-lateral corners of the abdominal segments are sub-acutely pointed. Peraeopods are rudimentary, though segmented. Denticles on telson number 1 lateral, 6 intermediate and 14 sub-median on each side. Uropod when directed backwards hardly reaches $\frac{2}{3}$ the distance to the base of the lateral spine of telson. The exopodite carries one rudimentary spine. The ventral prolongation of the uropod is not yet bifid at the tip.

Larva, 9·5 to 10·6 mm. long.—Closely similar to the 8·6 mm. long larva, but the more advanced stage of differentiation has resulted in the following points of difference :—

The second flagellum of the antennule carries 5 groups of sensory hairs.

The raptorial dactylus carries one additional free spine besides the terminal.

Peraeopods are finger-like, bifid structures.

Postero-lateral corners of abdominal segments are pointed.

Denticles on telson number 1 lateral, 6 intermediate and 17 sub-median on each side.

Uropod when directed backwards reaches slightly beyond the base of the lateral spine of telson.

Ventral prolongation of the uropod is bifid at the tip, but the outer spine is extremely minute, while the larger inner one has no distinct basal swelling externally.

Larva, 12·6 mm. long.—Shows the following features owing to further differentiation of structure :—

Raptorial dactylus has three free spines, including the terminal.

Uropod when directed backwards reaches the level of the intermediate spines of telson.

Exopod of the uropod has 2 free spines and the inner spine of the ventral prolongation has a smooth basal swelling.

In most other features the larva resembles the final pelagic stage.

Remarks.—In size and general appearance the larva resembles the final pelagic stage of *S. latreillei* and *S. fasciata* from which, however, it is easily distinguished by the very narrow carapace.

Foxon (1932) has described an *Alima* larva from the Great Barrier Reef and has suggested that it belongs to *Squilla lata*. This larva closely resembles the one described above, but differs from it in the following points.—

i. Larger size; 16 to 18 mm.

ii. The last three segments of the thorax are exposed dorsally (In the figure only the last two segments are seen exposed).

iii. Lateral margin of carapace bears 1 + 3 spinules, which are represented in the figure as directed ventro-laterally.

iv. Exopodite of the uropod has six free spines (Only 5 shown in the figure).

v. The carapace appears a trifle narrower.

Of these, size at the final pelagic stage and the spinulation of carapace are important features that probably indicate that Foxon's larva is not, perhaps, specifically identical with the Madras form. The former should then be referred to some very closely related species like *S. gilesi.*

Foxon refers his larva to *S. lata* on the strength of the following features:.—

1. Six teeth on the dactylus of the raptorial claw ;

2. Only the sub-median carinae of the 6th abdominal segment end in spines ; and

3. The similarities seen in the telson and in the uropods.

In the pelagic larvae the carination of the abdominal segments, so characteristic of the adult species, is almost invariably suppressed. A pair of sub-median dorsal spines on the sixth abdominal segment is developed in all advanced larvae of the *Alima* and the *Alimerichthus* types, but these spines are not connected with any carina. In Foxon's figure also no carina is shown connected with the sub-median spines. Such a feature cannot therefore, be of any significance when attempting to allocate the larvae to adult species.

The early post-larva obtained by moult from the final pelagic larva had prominent serrations along the inner aspect of the ventral prolongation of the uropod as in the adult *S. lata*. It is possible that the differences pointed out are really of specific value and that the larva described by Foxon probably belongs to the allied species *S. gilesi*.

Alima bermudensis described by Gurney (1946) shows close resemblance to the corresponding stage of *S. lata* described above and appears to be identical with the latter.

LYSIOSQUILLA MACULATA (Fabricius)

Final Pelagic Stage (Text-fig. 17).—Not very common in the plankton, the larvae come up only occasionally in the tow-net catches. They are very active and are easily distinguished by their moderately large size, the characteristically stout build and the more or less opaque body. If disturbed while swimming, the larva readily folds its abdomen completely below the thorax and quietly falls down to the bottom, the whole body being then completely placed in between the lateral downward extensions of the shield-like carapace which thus forms an efficient armour against enemies. On fixation also the specimens generally assume the above posture if they are not kept properly stretched.

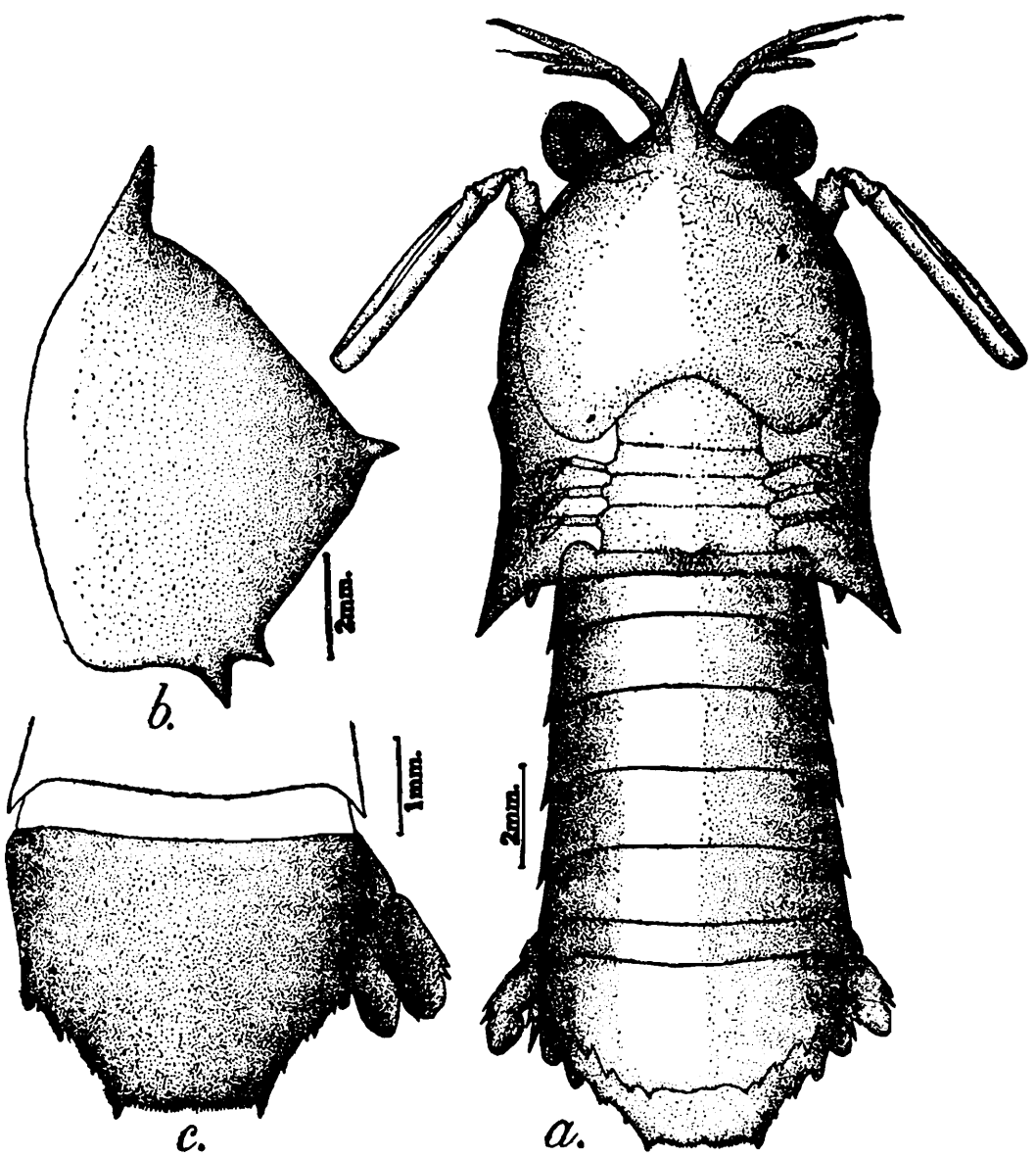
Total length	23·5 mm.
Length of rostrum	1·2 mm.
Median length of carapace	9·5 mm.
Breadth of carapace at the middle	7·0 mm.
Breadth of carapace at the base of postero-lateral spines ..	8·0 mm.
Length of corneal portion of eye	2·1 mm.
Length of telson	4·2 mm.
Breadth of telson	5·8 mm.

The carapace is a conspicuous strong shield, extending posteriorly over the middle of the first abdominal segment. Its lateral margins are produced deeply ventrad and on either side end in a conspicuous stout spine in the middle region (Text-fig. 17*b*). The rostrum is very short and stout and is unarmed ventrally. The antero-lateral spines are wanting. The postero-laterals are very short, posteriorly reaching only upto the level of the hind border of the first abdominal segment. The ' Zoea ' spine is present but in the majority of specimens it is represented only by a smooth, stump-like prominence, though in others it is in the form of a small, short, acutely pointed spine. The lateral margin of carapace has only a single spinule at the base of the postero-lateral spine, besides the stout spine mentioned above.

The antennular peduncle is short and reaches only upto the tip of rostrum. The second flagellum of the antennule has 12 groups of sensory hairs. The raptorial claw is long and relatively slender. The propodus is long and narrow and has no stout spines at its outer basal aspect. The row of pectinations on the surface facing the dactylus is thin and the pectinations alternate with slender hairs. The dactylus has no free spines other than the terminal. The last three thoracic segments are very short, the 6th being about 6 times and the 8th over

3 times as broad as long. The abdominal region is highly depressed and flat, giving the body a remarkably stout appearance. Each segment is about 4 times as broad as long and has the postero-lateral angles produced into stout, acute spines. The last abdominal segment is extremely short and has the postero-lateral corners smooth. The telson is distinctly broader than long and has the intermediate marginal spines rather short. The laterals and sub-medians are stout, the tip of the former being often curved inwards. The sub-median space is only a little over $\frac{1}{3}$ the greatest breadth of telson. The denticles number 1 lateral, 2 intermediate and 14 to 18 sub-median on each side. Between adjacent sub-median denticles there are usually 3 to 6 minute denticles. The uropod when laid backwards almost reaches the level of the lateral spines of telson. The exopod usually carries 2 free spines. The ventral prolongation is bifid distally ; with the outer spine smaller than half the length of the inner which just reaches the level of the distal extremity of the endopodite.

Remarks.—Lysierichthus duvaucellii (Guerin) has been generally supposed to be the pelagic larva of the widely distributed species,



Text-fig. 17.—*Lysiosquilla maculata* (Fabricius).

a. Final pelagic larva, 23·5 mm. long, dorsal view ; *b.* Side view of carapace of the same ; *c.* Telson and right uropod of the same, magnified.

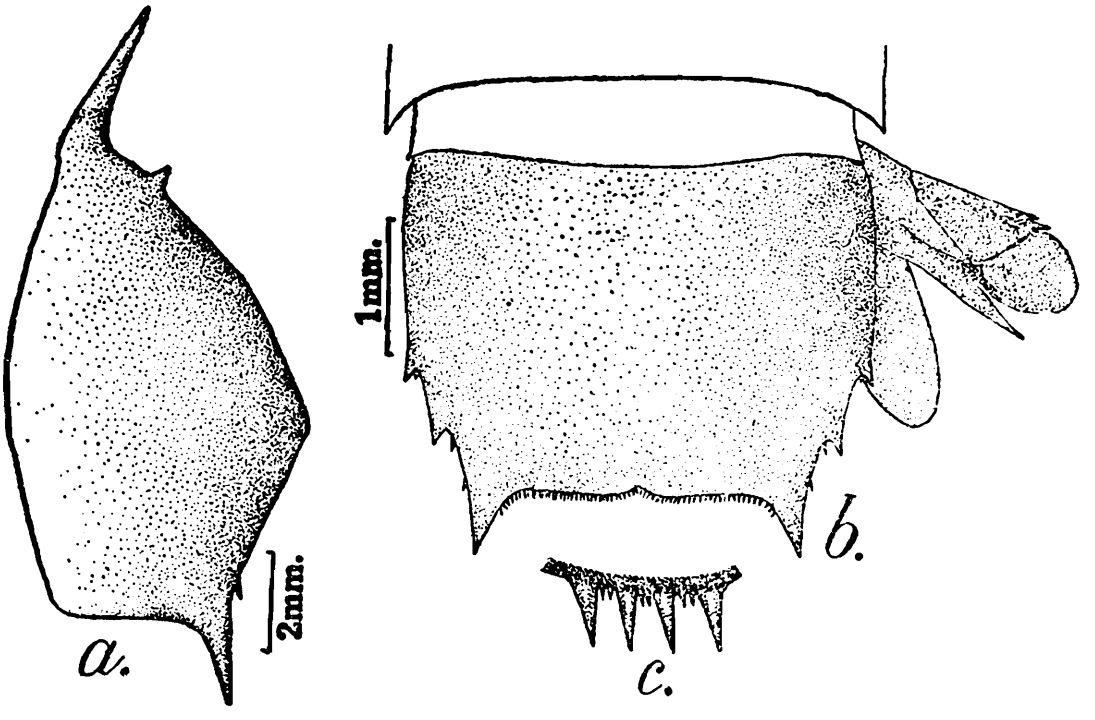
Lysiosquilla maculata. Brooks (1886) arrived at this assumption by the presence, in one of his larvae, of pigment bands characteristic of the adult. Size, distribution and the number of teeth on the dactylus of the raptorial claw led Hansen (1926) to arrive at the same conclusion as Brooks. However, a critical analysis of the material ascribed to this species by different authors clearly indicates that more than one species have been mixed up under the specific name *Lysierichthus duvaucellii.* Brooks's specimens have comparatively large carapace, with well developed antero-lateral and zoea spines. But in some of his specimens the zoea spine was absent and Tattersall (1906) suggested that Brooks might have been dealing with two different species. Borradaile (1907) also found the zoea and antero-lateral spines variable in his specimens. In Jurich's larva (1904) the carapace is comparatively longer, covers the first three abdominal segments posteriorly, has the antero-lateral and zoea spines well developed and the postero-laterals are long and acutely pointed, reaching the level of the proximal part of telson. Hansen (*loc. cit.*) observed that some of his specimens, measuring 27 mm. in length were actually of a more advanced stage of development than his largest specimen which measured 40 mm. in length. Tattersall (*loc. cit.*) doubted whether all the larvae referred to this ' distinct and rather remarkable species' by various authors really belonged to a single species and pointed out that Brooks's and Jurich's specimens might well belong to a defferent but closely related species than his Ceylon larva. The marked disparity in size in Hansen's specimens is hardly to be expected in a single species and it is quite probable that Hansen was also dealing with two distinct species which alone will explain the earlier stage of development of the longer larvae. Even though the actual length of Claus's (1871) *Erichthus duvaucellii* is not known Tattersall is almost certain that it is identical with the Ceylon larvae which measured 22 mm. in length, excluding the rostrum, *i.e.*, almost the same length as the Madras form. It may, however, be noted that *L. duvaucellii* was originally recorded from the Bay of Bengal (Guerin, 1857). The present observations, however, clearly show that the larva that has been successfully metamorphosed and reared into *Lysiosquilla maculata* is very distinctly different from *L. duvaucellii.* The thick, shield-like carapace, with short, stout rostrum and postero-lateral spines, the small or obsolete dorsal spine, the absence of antero-lateral spines and the rather pointed telson with relatively narrow sub-median space are important features in which the final pelagic larva of *L. maculata* differs from *L. duvaucellii.* In the nature of the telson and the spinulation of carapace *Erichthus duvaucellii* of Claus differs from the present larva which, in the same features, indeed differs from all the larvae so far described as *L. duvaucellii.*

LYSIOQUILLA SULCIROSTRIS (Kemp)

1837. *Erichthus duvaucellii*, Milne-Edwards, *Hist. Nat. Crust. Paris*, p. 505.
1857. *Erichthus duvaucellii*, Guerin-Meneville, *Animaux Asticules, Crustaces Stomatopodes.*
1871. *Erichthus duvaucellii.* Claus, *Abh. Ges. Wiss. Gottingen*, pl. iv, fig. 16
1906. *Lysierichthus duvaucellii.* Tattersall, *Rept. Pearl Oyster Fish.*
1939 *Lysiosquilla (Lysierichthus) maculata*, Foxon, *Sci. Rept. John Murray Exped.*

Final Pelagic Stage (Text-fig. 18).—Very closely resembling the corresponding stage of *L. maculata*, in size and appearance, it is easily mistaken for the larva of the latter species. A single specimen obtained from plankton collection dated 17th September 1942 was reared in the laboratory through metamorphosis and the post-larva survived for about 80 days in the aquarium tank. Owing to certain very distinct features of the larva, particularly in the carapace and telson and since the early post-larva and the adult are foun dto differ from *L. maculata* in certain very important features other than those listed by Kemp (1913), and which I consider to be of specific importance, I have thought it fit to raise Kemp's variety *sulcirostris* to specific rank-A detailed account of the species *L. sulcirostris* will be included in a subsequent report which will deal with the growth of post-larval stomatopods.

In the final pelagic larva the carapace appears slightly larger than in *L. maculata*. The rostrum is much longer than in the latter. Antero-lateral spines are present, but the zoea spine is wanting. Postero-lateral spine is a little over half the length of the rostrum. The lateral margin of carapace on either side is produced downwards as in *L. maculata* but does not end in an acute spine. Near the base of the postero-lateral spine there is a stout spinule. The telson is broader than long and has the sub-median space very wide and conspicuous. The denticles number 1 lateral, 2 intermediate and 20-21 submedian on each side. In other respects the larva is almost identical with the corresponding stage of *L. maculata*.



Text-fig. 18.—*Lysiosquilla sulcirostris* (Kemp).

a. Side view of carapace of final pelagic larva ; *b*. Telson and right uropod of the same, magnified ; *c*. Sub-median denticles of telson of the same, highly magnified.

Remarks.—The larva though very closely resembling the final pelagic stage of *L. maculata* differs from the latter in the following features :—

1. Longer rostrum and postero-lateral spines of carapace.
2. Presence of antero-lateral spines.
3. Absence of zoea spine.
4. Lateral downward extension of carapace not ending in acute spines.
5. Wide sub-median space.

The final pelagic larva appears to agree in all essential features with *Erichthus duvaucellii* of Claus (His fig. 16) the length of which, as pointed out by Tattersall, is not known. In the latter, however, the zoea spine is present, though varying in size (See Claus's Figs. 16 A and B) and the lateral ventral extension of carapace also ends in spine, the acuteness of which also is perhaps variable as seen from the above figures. The Ceylon larva (Tattersall, 1906) is also probably identical with the Madras specimen and so are probably the larvae referred to *L. duvaucellii* by Foxon (1939). Certain very early larvae which he found identical with *Erichthoidina armata* (Claus, 1871, Fig. 3) have also been referred to this species by him. In view of the presence of the characteristic ventrally directed spine at the lateral margin of carapace in *E. armata*, it appears that Foxon was right in referring this larva to *L. duvaucellii*. As already pointed out, more than one species appear to be mixed up in the larvae ascribed to *L. duvaucellii* by Brooks, Jurich and Hansen. In appearance and proportion of carapace Jurich's larva seems to be very different from *E. duvaucellii* of Claus ; while Hansen's 40 mm. long larva must necessarily belong to a different adult species than *L. sulcirostris*. There is thus confusion still about the identity of the larvae referred to *L. duvaucellii* and since accurate detailed description of several important features are wanting and since the larvae have not been figured in some of the records, there appears to be little hope in clearing this confusion except by rearing the planktonic larvae from the concerned localities to the post-larval stage.

LYSIOSQUILLA MULTIFASCIATA Wood-Mason.

1929. *Lysierichthus* sp., Komai & Tung, *Annot. Zool. Jap.*, pl. vii, figs. 13-19, pl. viii, figs. 1-9.

1871. *Erichthoidina brevispinosa*, Claus, *Abh. Ges. Wiss. Gottingen*, pl. i, fig. 4, pl. ii, fig. 5.

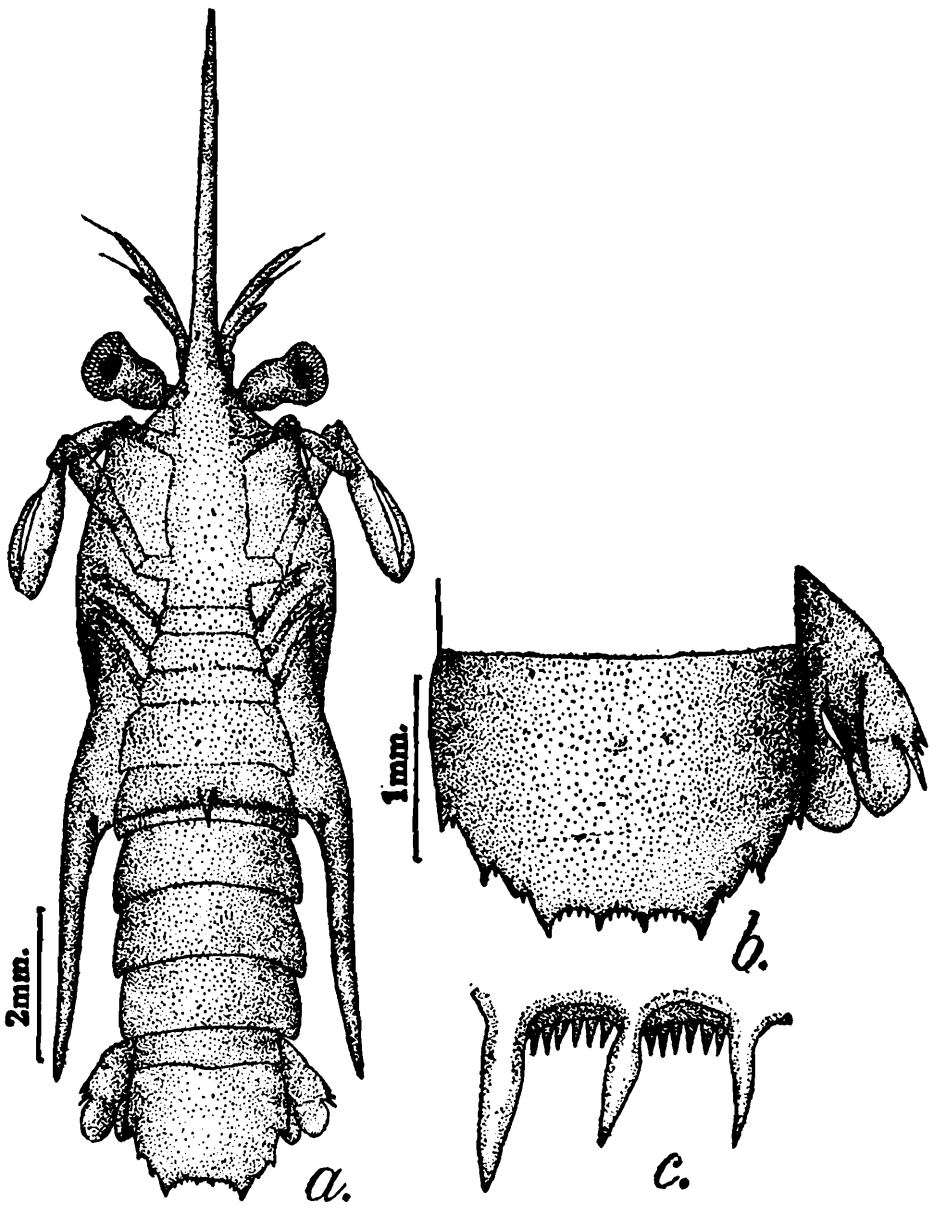
1946. *Erichthoidina brevispinosa*, Gurney, *Proc. Zool. Soc.*, fig. 9.

Final Pelagic Stage (Text-fig. 19).—Rarely obtained in the plankton catches, the larva is much smaller than the two foregoing species, *L. maculata* and *L. sulcirostris* and can be easily distinguished from them by the characteristically long rostrum and postero-lateral spines of the narrow carapace.

Total length	15·0 mm.
Length of rostrum	5·0 mm.
Median length of carapace	5·3 mm.
Anterior breadth of carapace	2·3 mm.
Posterior breadth of carapace	3·2 mm.
Length of postero-lateral spine	3·5 mm.
Length of eye ; corneal portion	1·1 mm.
Length of telson	1·4 mm.
Breadth of telson	2·1 mm.

The carapace is long and narrow and posteriorly extends over the middle of the second abdominal segment. The lateral margin is deeply flexed ventrally and has only a single spinule near the base of the postero-lateral spine. The rostrum is long and stout, almost equal to the median length of carapace and has 3 or 4 ventral spinules. The antero-lateral spines are short. The zoea spine is usually of the same size as the antero-lateral, but in certain specimens it may be a little longer. The postero-laterals are long and stout, directed very nearly parallel to the body and have their tips reaching the level of the junction between the last abdominal segment and the telson.

The antennular peduncle is very short and the flagellar tips do not reach the middle of the rostrum. The second flagellum carries only 4 groups of sensory hairs. The eyes are conspicuous, each mounted on a stalk which is only about half the length of the corneal portion. The raptorial limb is small and slender, the propodus has no stout spines at the proximal region and the pectinations are very small and almost



Text-fig. 19.—*Lysiosquilla multifasciata* Wood-Mason.

a. Final pelagic larva, 15·0 mm. long, dorsal view ; *b.* Telson and right uropod of the same, magnified ; *c.* Sub-median denticles of telson of the same, highly magnified.

alternating with long hair-like processes. The dactylus has no free teeth besides the terminal one. The thoracic segments become gradually longer from the 6th to the last which itself is about $3\frac{1}{2}$ times as broad as long. The abdominal segments are all broader than long and have their postero-lateral corners smooth. The telson is distinctly broader than long and has the lateral and intermediate spines rather small ; while the sub-medians are long and stout. The denticles number 1 lateral, 2 intermediate and 7 sub-median on each side. The 5th sub-median denticle from either side is distinctly longer than the rest, with the result that the sub-median space is divided into 3 sections, each with 4 denticles. Between adjacent sub-median denticles there are 6 to 8 minute serrations. The inner aspects of the lateral and intermediate spines are also serrated. The uropod when directed backwards reaches mid-way between the lateral and intermediate spines of telson. The exopod carries 3 free spines. The outer spine of the basal prolongation of uropod is distinctly longer than the inner.

Remarks.—The number and arrangement of the sub-median denticles (4-1-4-1-4) of telson and the larger size of the outer spine of the ventral prolongation of uropod are important features that make identification of this species from allied *Lysierichthii* easy.

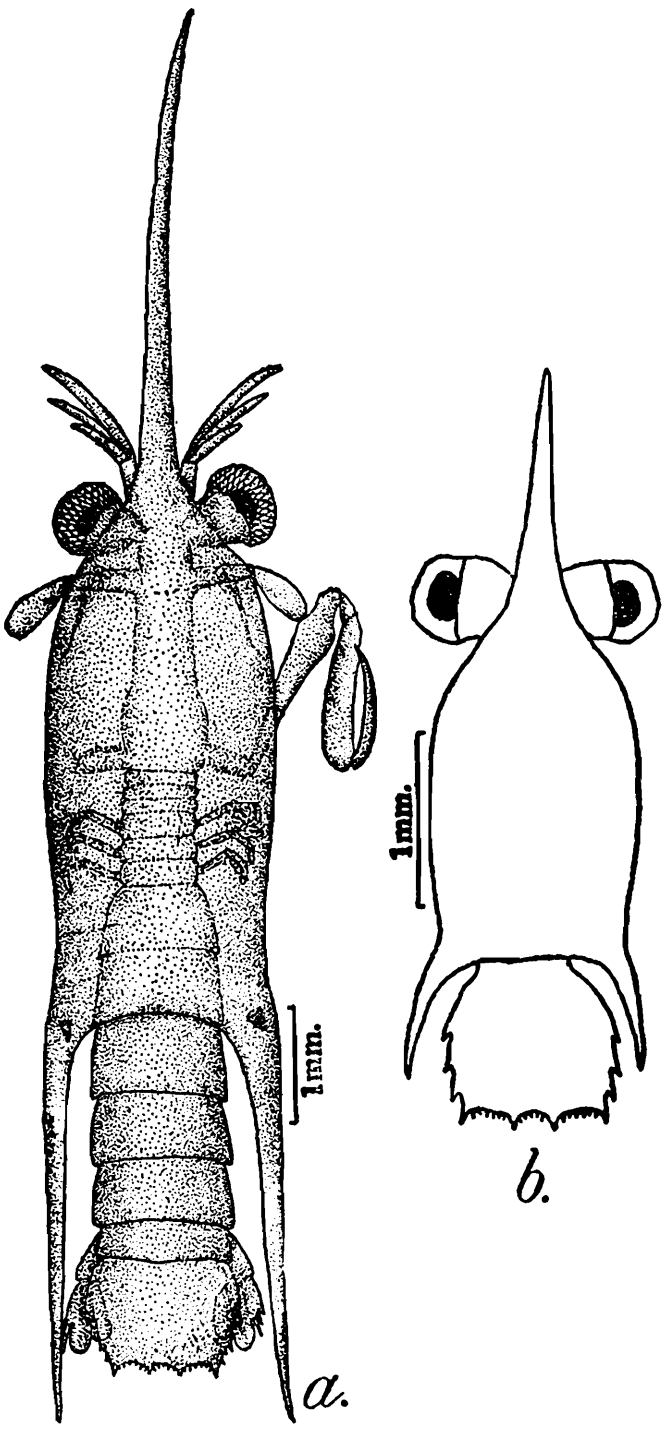
Komai and Tung (1929) describe a species of *Lysierichthus* from Seto and suggest that it is the larva of *L. multifasciata* since it is " the only adult species of *Lysiosquilla* known in the vicinity of Seto " and since it is " the commonest of all the *Lysiosquillae* occurring in the Japanese seas " This larva appears to be identical with the Madras specimen and as such Komai and Tung seem to have correctly referred it to *L. multifasciata*, even though it was purely on circumstancial evidence.

Foxon (1939) considers *Lysierichthus rostratus* (Borradaile) as the pelagic larva of *L. multifasciata* and includes a number of larvae under the possible synonymy of this species. *Erichthus* sp. of Claus (his Fig. 19) which Borradaile (1907) gives as synonymous with his *E. rostratus* is, however, different from the final pelagic larva of *L. multifasciata* ; the most conspicuous difference being the nature of the sub-median space of telson. While Tattersall's (1906) *Lysierichthus B* also does not appear to be identical with *L. multifasciata*, it is to be noted that in all probability Tattersall has mixed up to distinct larval species under the name *Lysierichthus* B. In the nature of the telson his 9 mm. long larva (his figs. 39 and 40) appears to be quite distinct from the other stages ascribed to *Lysierichthus* B. The latter differs from *L. multifasciata* in the possession of a larger number of sub-median denticles on telson (7-1-7-1-7). Tattersall's view that *Erichthoidina gracilis*, *E. armata* and *E. brevispinosa* of Claus are probably only developmental stages in the life history of one species only, does not appear to be altogether correct. *E. brevispinosa* (Claus, 1871 ; Gurney, 1946) is probably an early stage of *L. multifasciata* ; the possible relationship of *E. armata* to *L. sulcirostris* has already been pointed out ; while E. *gracilis* has a different type of telson structure than in *E. brevispinosa*.

LYSIOSQUILLA TIGRINA Nobili

1944. *Lysiosquilla* (*Lysierichthus*) *tigrina*, Alikunhi, *Curr. Sci.*, *Bangalore*, fig. 1.

Final Pelagic Stage (Text- fig. 20*a*).—Very rare in the Madras waters, only 2 specimens were collected during the period 1936 to 1943. One of these, obtained alive on 3-3-1943 moulted into post-larva in the laboratory and was reared for about 80 days. A detailed description of this larva and the early post-larval stages has already been published (Alikunhi, 1944*a*). I have now included in this report a figure of the second specimen, obtained from plankton collected on 14-3-1939, for purposes of easy identification and comparison with other species.



Text-fig. 20.—*Lysiosquilla tigrina* Nobili.

a. Final pelagic larva, 13·5 mm. long, dorsal view ; *b*. *Erichthoidina* larva, 4.3 mm. long, dorsal view.

The larva agrees in all detailes with the specimen already described. Indications of 9-10 teeth are seen beneath the skin on the dactylus of the raptorial claw.

Earlier Stages of Larvae (Text-fig. 20*b*).—Three specimens in the *Erichthoidina* stage, measuring 4·3 mm. to 4·53 mm. in total length are present in the collections. In all the three specimens the characteristic arrangement and number of sub-median denticles (6-1-5-1-6) of telson are remarkably constant. The antero-lateral spines are absen- in all the three specimens ; while a short zoea spine is present in one of the three. The carapace covers the entire body excepting the telson ; the rostrum is long and stout ; while the postero-lateral spines have their tips reaching the level of the intermediate spines of telson.

Remarks.—As has been shown (Alikunhi, *loc. cit.*) the absence of the antero-lateral and zoea spines of carapace, the characteristic number of sub-median denticles (6-1-5-1-6) and the smaller size of the outer spine of the ventral prolongation of uropod are typical of the second specimen also. The constancy in the number and arrangement of denticles in the sub-median area of telson is remarkable.

The final pelagic larva of *L. multifasciata* closely resembles the present form, but in the presence of the antero-lateral and zoea spines of carapace in the spinulation of the sub-median space of telson and in the larger size of the outer spine of the ventral prolongation of uropod the former markedly differs from *L. tigrina.*

The absence of antero-lateral spines on carapace is characteristic of the *Erichthoidina* stage of several species of *Lysierichthii* ; but with advance in age these spines make their appearance. In *L. tigrina*, the above early larval feature persists even in the final pelagic larva and in this the species is probably unique among the smaller *Lysierichthii.*

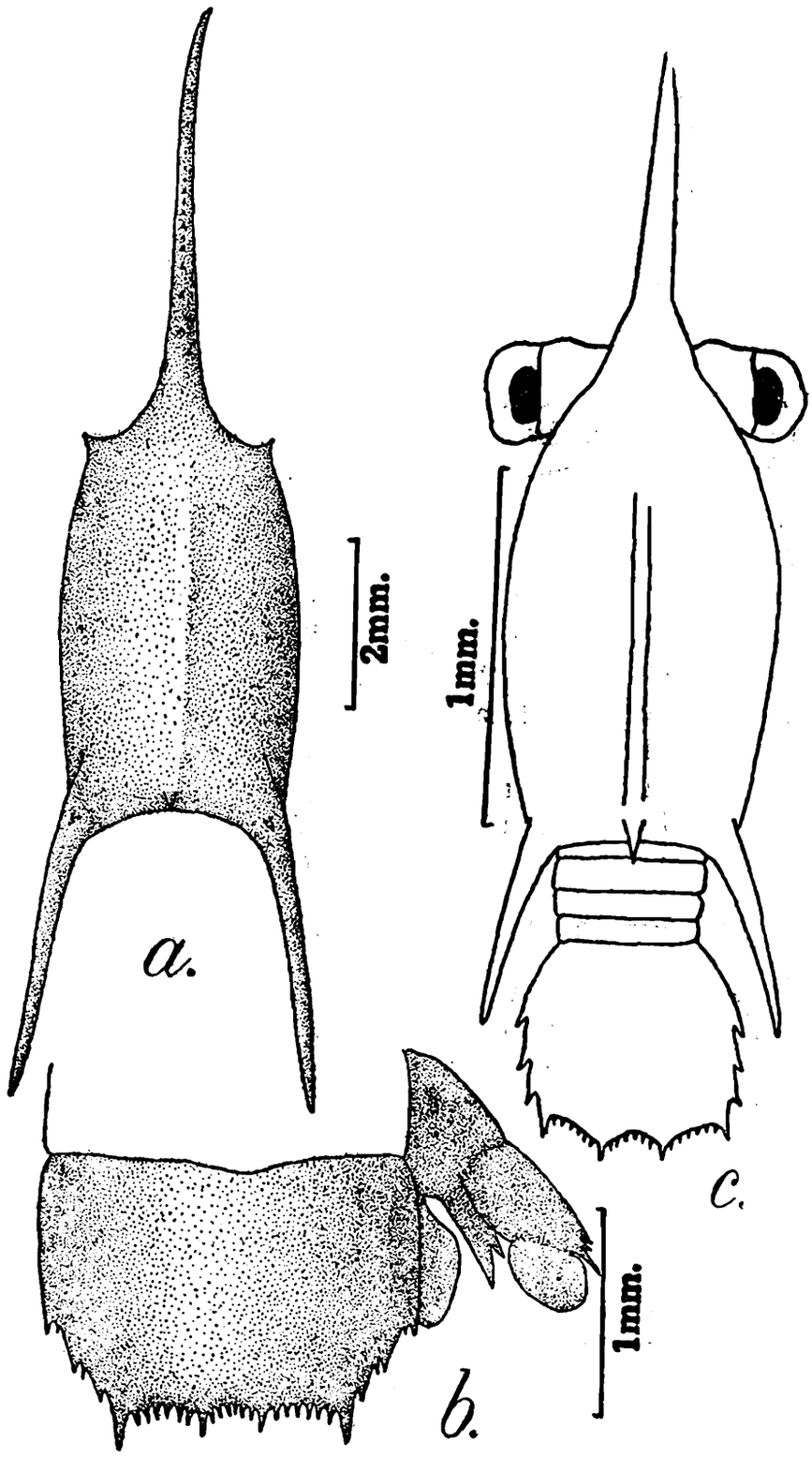
LYSIOSQUILLA ACANTHOCARPUS Miers.

Final Pelagic Stage (Text-Fig. 21*a, b*).—Extremely rare in occurrence, a single specimen was obtained from plankton on 29th March 1943 and it metamorphosed over-night into the post-larva. It closely resembles the final pelagic stage of *L. multifasciata* and is almost of the same size as the latter.

	mm.
Total length	14·0
Length of rostrum	4·5
Median length of carapace	5·1
Anterior breadth of carapace	2·1
Posterior breadth of carapace	2·6
Length of postero-lateral spine	3·4
Length of telson	1·2
Breadth of telson	1·8

The carapace is narrow, not much broader than the abdominal segments, posteriorly extends over the first abdominal segment and has a ventral marginal spinule near the base of the postero-lateral spine.

The mid-dorsal line is arched upwards and looks as if a madian carina is present. The rostrum is long and has a ventral row of several spinules, the proximal 2 or 3 of which are large. The antero-lateral spines are short and stout, while the zoea spine is extremely small. The postero-laterals are shorter than the rostrum and have their tips reaching the lelvel of the hind border of the 6th abdominal segment.



Text-fig. 21.—*Lysiosquilla acanthocarpus* Miers.

a. Carapace of final pelagic larva, 14·0 mm. long, dorsal view ; *b.* Telson and right uropod of the same, magnified ; *c. Erichthoidina* larva, 3·09 mm. long, dorsal view.

The antennular peduncle is short and does not reach the level of the first ventral spinule of rostrum. The eyes are large and conspicuous. The raptorial propodus is rather inflated and the dactylus has no free teeth other than the terminal. The abdominal segments are very much broader than long and have the postero-lateral corners smooth. The telson is only 2/3 as long as broad. Of the marginal spines the sub-medians are the largest. The denticles number 1 lateral, 2 intermediate and 10 sub-median on each side. The sub-median space is divided into three sections, the 7th denticle from either side being longer than the rest and each section has 6 denticles (6-1-6-1-6). The tip of the uropod when laid back almost reaches the base of the intermediate spines of telson. The exopod has 3 free spines. The outer spine of the ventral prolongation is definitly shorter than the inner.

Colouration.—Yellow spots on the 'Hands' of the 3rd and 4th thoracic legs and at the base of the last two pleopods and the uropods are visible to the unaided eye. Under the binoculars, the mandibular region shows a dull green tinge; a dark-brown spot surrounded by a diflused area of light red or brown is seen on the ' Hands' of the 3rd and 4th thoracic appendages ; the raptorial propodus shows only a few chromatophores ; the pigment spots on either side of the last thoracic segment are larger than those on the preceding segment ; one or two chromatophores are seen on either side of the abdominal segments and on the 6th segment there is a conspicuous patch at the base of each uropod. On the carapace the chromatophores are segregated into 2 pairs of groups, one at the level of the raptorial limb and the other at the base of the postero-lateral spines, as in *L. tigrina.*

Earlier Stages of Larvae (Text-Fig. 21c).—Two *Erichthoidina* larvae 3·09 mm. and 4·32 mm. respectively in length, are present in the collection. In the smaller larva the carapace covers the whole body excepting the distal 4/5 of the telson ; while in the second specimen only the first two abdominal segments are covered by the carapace. Postero-lateral spines are rather short. The zoea spine is present ; while the antero-laterals have not yet appeared. Telson has the characteristic arrangement and number of denticles as in the final pelagic larva (6-1-6-1-6). In the smallest larva, however, an additional denticle is present in one of the marginal sections, making the arrangement 6-1-6-1-7. A median dorsal carina is present on carapace, terminating posteriorly in the zoea spine.

Remarks.—The larva differs from *L. multifasciata* mainly in the distinctly smaller size of the zoea spine of carapace ; in the larger number of sub-median denticles and in the smaller size of the outer spine of the ventral prolongation of uropod. The presence of the antero-lateral and zoea spines of carapace easily distinguishes the species from *L. tigrina* ; while in the spinulation of the sub-median space of telson, the presence of an additional denticle in the middle section is the only difference from the latter species.

UNIDENTIFIED LARVAL FORMS.

Descriptive account of a few *Alima* and *Erichthus* larvae that could not be properly identified, is also included in this report, so as to make

the account of the larval forms in the Madras plankton as complete as possible.

SQUILLA Sp. I ("*Quinquedentata*" group?)

Final Pelagic Stage (Text-Fig. 22*a*).—Four specimens collected as follows were available for study :

8-1-1938, one specimen ; 3-4-1940, one specimen ; and 18th September 1941, two specimens.

	mm.
Total length	20·0
Length of rostrum	4·1
Median length of carapace	5·6
Anterior breadth of carapace ..	2·5
Posterior breadth of carapace	3·4
Length of antero-lateral spine	0·8
Length of postero-lateral spine	2·6
Length of eye-stalk	1·4
Length of corneal portion of eye	1·3
Length of telson	2·7
Breadth of telson	2·6

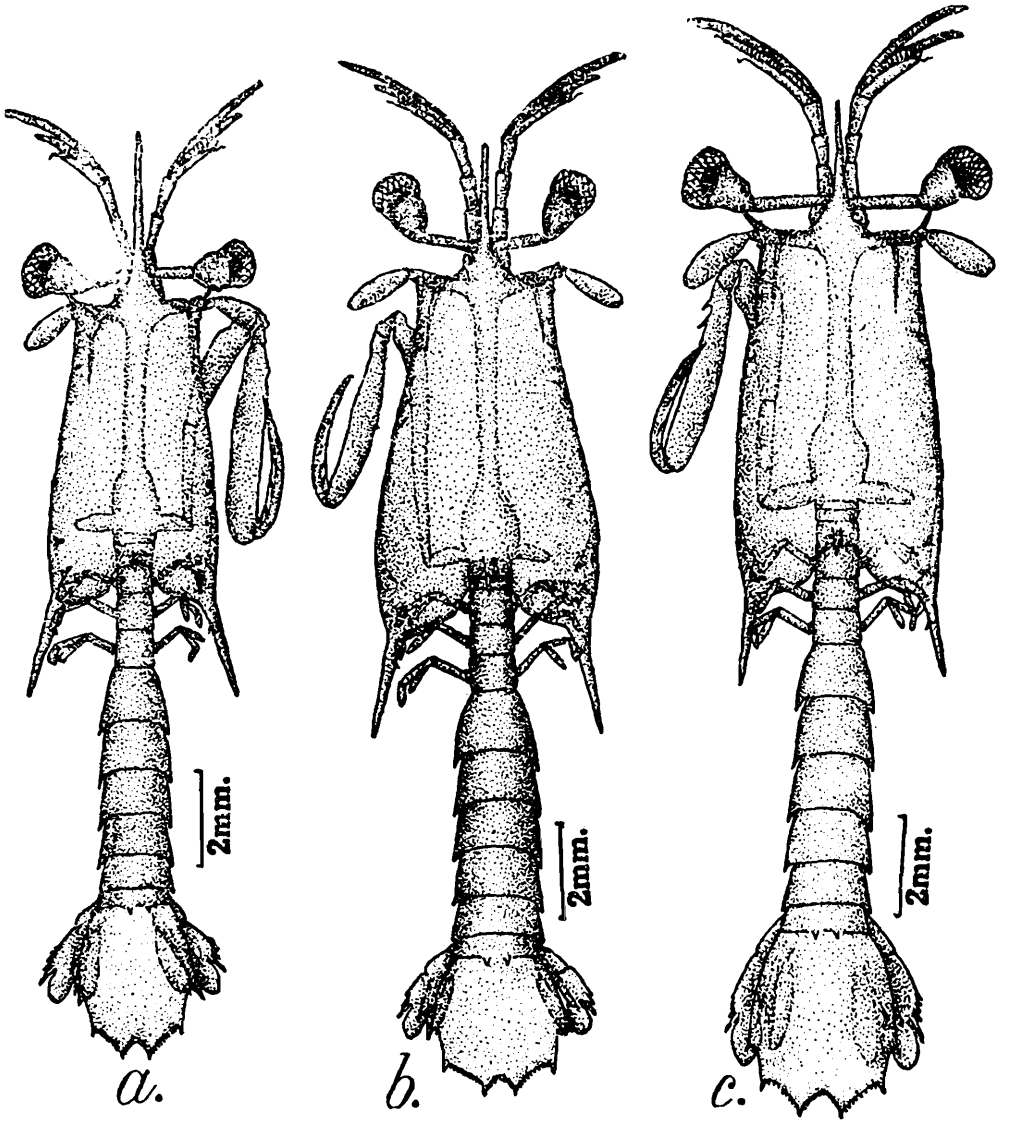
The carapace is relatively small and narrow and leaves the last three thoracic segments exposed dorsally. The lateral margin of carapace has 6+2+3 spinules, the 7th and 8th spinules being ventro-laterally directed, while the rest are directed ventrad. The rostrum is long, slender and unarmed ventrally and has the tip superior to the tip of antennular peduncle. The dorsal spine is very short and is only about half the length of the acutely pointed antero-lateral spines. Each postero-lateral spine has a ventral spinule at about 1/3 its length from base, is slightly divergent posteriorly and has the tip reaching the level of the middle portion of the first abdominal segment. The antennular flagellum carries 8 groups of sensory hairs. Dactylus of the raptorial limb has no free spines other than the terminal ; but distinct indications of five spines are visible through the skin. The thoracic and abdominal segments are relatively narrow, giving the larva a slender appearance. Postero-lateral corners of abdominal segments are produced into acute spines. The 6th abdominal segment has a pair of sub-median dorsal spines and a pair of antero-lateral, ventrally directed spines. Telson is slightly longer than broad and has the marginal spines long and slender. Denticles on telson number 1 lateral, 9 intermediate and 10 or 11 sub-median on each side. The uropod when directed backwards reaches the base of the lateral spines of telson. The basal segment of the exopodite carries 5 free spines and has indications of four more beneath the skin. The outer spine at the tip of the ventral prolongation of the uropod is only about $\frac{1}{3}$ the length of inner which has a small smooth basal swelling.

Earlier stages of larvae.—A single specimen, 17 mm. long, collected on 6th May 1943, belongs to the above species and represents an earlier stage to the final pelagic. General appearance and the proportions of

the various parts of the body are like those in the final pelagic larva. The second antennular flagellum carries 8 groups of sensory hairs. The uropod, however, is in an earlier stage of differentiation. When directed backwards it reaches only to the base of the lateral spines of telson ; the exopod has only 3 free spines and in the ventral prolongation the inner larger spine has no noticeable basal swelling. The peraeopods are shorter than in the final pelagic stage and the tip of the postero-lateral spine of carapace reaches the level of the hind border of the first abdominal segment.

Remarks.—In general appearance the larva shows close resemblance to the final pelagic larva of *S. quinquedentata*, but, the small size, long, unarmed rostrum, relatively longer postero-lateral spines, the small ventro-laterally directed spinules on the margin of carapace and the number of groups of sensory hairs on the antennular flagellum are features in which it differs from the latter species.

The superficial similarity to *S.* (*Alima*) *quinquedentata* and the indications of only five spines on the dactylus of the raptorial claw probably



TEXT-FIG. 22.—Unidentified larvae of *Squilla* spp.

a. *Squilla* sp. I, final pelagic larva, 20·0 mm. long, dorsal view ; *b.* Squilla sp. II, same, 20·5 mm. long, dorsal view ; *c.* *Squilla* sp. III, same, 20·6 mm. long, dorsal view.

reveal that the present larva belongs to the "*Quinquedentata*" group. The pelagic larvae of *S. boops*, *S. quinquedentata* and *S. gonypetes* have already been described. In the absence of any positive evidence, it is extremely difficult to assign the present larva to any of the adult species listed by Kemp from the Bay of Bengal.

SQUILLA Sp.II ("*Quinquedentata*" group?)

Final Pelagic Stage (Text-Fig. 22*b*).—A single specimen was available for study.

	mm.
Total length	20·5
Length of rostrum	3·0
Median length of carapace	6·1
Anterior breadth of carapace	2·6
Posterior breadth of carapace ..	4·0
Length of postero-lateral spine ..	2·5
Length of eye-stalk ..	1·4
Length of corneal portion of eye	1·4
Length of telson ..	2·5
Breadth of telson	2·55

The carapace is comparatively larger than in the foregoing species (*Squilla* sp. (I)), but leaves the last three segments of the thorax exposed dorsally. There are 6+2 spinules along the lateral margin of carapace. All the spinules are ventrally directed; the 7th spinule is fairly large and conspicuous. The rostrum is slender and unarmed ventrally and has its tip inferior to the tip of antennular peduncle. The median dorsal spine of carapace is shorter than the antero-lateral spine. The postero-lateral spines are not very divergent posteriorly; each has a ventral spinule at about $\frac{1}{4}$ its length from base and has the tip reaching the level of the middle portion of the first abdominal segment. The maximum width of carapace is at about the level of the raptorial limb. The second antennular flagellum carries 8 groups of sensory hairs. The dactylus of the raptorial limb has no free spines other than the terminal. Indications of 5 spines are, however, visible through the larval skin. The last three thoracic segments are broader than long; the 8th segment is longer than those in front. Postero-lateral corners of the abdominal segments are produced into acute spines. The sixth abdominal segment has a pair of sub-median dorsal spines. Telson is almost as broad as long. The marginal spines of telson are well developed, the intermediate spines being the longest. The denticles number 1 lateral, 10 intermediate and 11 sub-median on each side. The uropod when directed backwards reaches half-way to the base of the intermediate spine of telson. The exopod has three free spines, while indications of four more are visible through the skin. The outer spine of the ventral prolongation of the uropod is only about $\frac{1}{3}$ the length of the inner which has a smooth basal swelling.

Remarks.—Though of almost the same size as the final pelagic larva of *Squilla* sp. (I), it has a larger and broader carapace, shorter rostrum which has the tip inferior to the tip of antennular peduncle; and fewer spines

along the lateral margin of carapace and on the exopodite of the uropod. The shape of carapace is also different from that of the former species. Since structural differences between the pelagic larvae of closely allied species are now known to be indeed very slight, as seen in the case of *S. boops*, *S. quinquedentata* and *S. gonypetes*, I feel convinced that the present larva belongs to a different species than the one described above.

As in *Squilla* sp. (I), the indication of only 5 spines on the dactylus of the raptorial claw and the general similarity in appearance to the larva of the " *quinquedentata* " group, probably indicate that this larva also belongs to a species of that group. It appears that the typical *Alima* larvae generally belong to species of the " *nepa*" and " *Quinquedentata* " groups, while the *Alimerichthus* type of larvae are found to belong mostly to species of the " *Chloridella* " group ; and, as such, it is unlikely that the present larva belongs to a species of the latter group. Since the pelagic larvae of the species of the " *Quinquedentata* " group listed by Kemp have already been described, it is possible that the present larva belongs to an undescribed adult species.

SQUILLA Sp. III (" *Quinquedentata* " group?)

Final Pelagic Stage (Text-Fig. 22*c*).—Two specimens were available for study.

	mm.
Total length	20·6
Length of rostrum ..	2·7
Median length of carapace	6·3
Anterior breadth of carapace ..	3·0
Posterior breadth of carapace	4·0
Length of postero-lateral spine	2·1
Length of eye-stalk ..	1·5
Length of corneal portion of eye	1·5
Length of telson	3·2
Breadth of telson	2·9

The carapace is relatively long and does not appear very broad posteriorly since its anterior breadth is about $\frac{3}{4}$ the breadth at the hind portion. The last three thoracic segments are exposed dorsally. The rostrum which is unarmed ventrally, is short and has the tip at the same level as the tip of antennular peduncle. The antero-lateral spines are long and pointed, each being about thrice the length of the short dorsal spine. Postero-lateral spines are short, each has a ventral spinule at about $\frac{1}{3}$ its length from the base and has the tip reaching the level of the hind portion of the first abdominal segment. Lateral margin of carapace has 6+2 spinules, all directed ventrad. The second antennular flagellum carries 10 groups of sensory hairs. The raptorial dactylus has no free spine other than the terminal ; but indications of five spines are clearly seen through the skin. The abdominal segments are broader than long and have the postero-lateral corners produced into acute spines. The sixth abdominal segment has a pair of sub-median spines. Telson is characteristically longer than broad, but the marginal spines are relatively

short. There are 1 lateral, 8 intermediate and 10 sub-median denticles on each side. The uropod, when directed backwards, reaches half-way to the base of the intermediate spines of telson. The exopod of the uropod carries 5 free spines and shows indications of 3 more beneath the skin. In the ventral bifid prolongation of the uropod, the outer spine is about half the length of the inner which has a conspicuous basal swelling.

Remarks.—The larva shows close resemblance to *Squilla* sp. (II) and undoubtedly belongs to a very closely related species. It, however, differs from the former in the shape of the relatively longer carapace, shorter rostrum and postero-lateral spines, the characteristically long telson, the larger number of groups of sensory hairs on the antennular flagellum and in the number of denticles on the telson.

The indications of only 5 spines beneath the skin on the dactylus of the raptorial claw probably shows that the larva also blongs to a species of the "*Quinquedentata*" group. As already discussed, it is, at this stage, useless to attempt to refer this larva to any specific adult.

LYSIOSQUILLA (LYSIERICHTHUS) Sp. I.

(?) 1871. *Erichthus* sp., Claus, *Abh. Ges. Wiss. Gottingen*, pl. v, fig. 19.

(?) 1907. *Erichthus rostratus*, Borradaile, *Trans. Linn. Soc. Zool. Lond.*

Final Pelagic Stage (Text-Fig. 23).—A single specimen, apparently in the final pelagic stage, from plankton collection dated 14th March 1939, was examined :—

	mm.
Total length ..	9·72
Length of rostrum ..	2·92
Median length of carapace	3·65
Anterior breadth of carapace ..	1·65
Posterior breadth of carapace	2·10
Length of postero-lateral spine	1·98
Length of telson	1·39
Breadth of telson	1·70

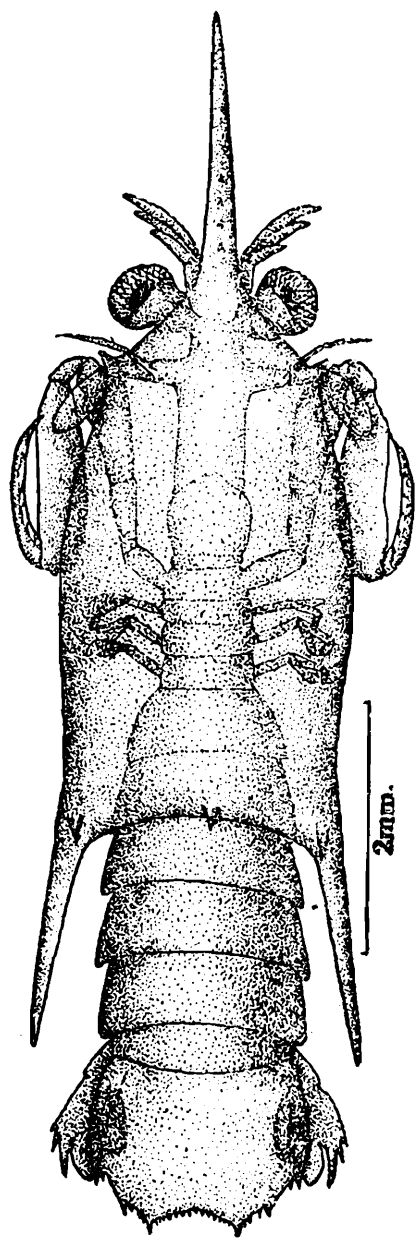
The larva has a broader carapace and looks stouter than the final pelagic stage of *L. multifasciata.* The carapace posteriorly extends over the second abdominal segment. Rostrum and postero-lateral spines are stout ; while the antero-lateral and zoea spines are short and small- Rostrum is ventrally armed with 4 spinules. The postero-lateral spines which are slightly divergent distally, have the tips reaching the level of the last abdominal segment. The outline of post-larval carapace is clearly indicated. Raptorial dactylus shows clear indications of 6 teeth beneath the skin. Abdominal segments are about double the breadth of the thoracic and have the postero-lateral corners bluntly rounded. Telson is broader than long. The sub-median space is not divided into 3 sections, unlike the species described above. The denticles number 1 lateral, 3 intermediate and 7 sub-median on each side. The uropod is well developed and when laid back, reaches beyond the base of the lateral

spine of telson. The exopod has three free spines. The outer spine of the ventral prolongation of uropod is longer than the inner, which is longer than half the length of the former.

Remarks.—The larva differs from all the *Lysierichthii* encountered during the present investigation in the appearance of the sub-median space of telson. The relatively small size, the larger carapace with rather short thick marginal spines ; the undivided sub-median space of telson, and an additional intermediate denticle (3), are features that easily distinguish the larva from other allied *Lysierichthii.*

In the nature of the telson, *Erichthus* sp. of Claus (his figure 19) is closely similar to the present form ; but the former specimen was 14 mm. long. Borradaile (1907) finds this *Erichthus* sp. synonymous with his *E. rostratus.*

Gurney (1946) has figured the telson of the final pelagic larva and the early post-larva of a species of *Squilla* (?) collected by Miss Lebour from



TEXT-FIG. 23.—Final pelagic larva of *Lysiosquilla* sp. I, 9·72 mm. long, dorsal view.

Bermuda. In this larva the spinulation of the telson as described and as represented in the figure (his Fig. 8A) is found to be 1 lateral, *2 intermediate* and 16 sub-median denticles on each side. In the post-larval telson (his Fig. 8B) a larger number, more than 12, of intermediate denticles are shown. The 6th abdominal segment is also seen to possess a pair of sub-median spines. It is difficult to accept that the larva figured actually belongs to a species of *Squilla*, particularly since, as is generally accepted, the number of intermediate denticles in an *Alima* larva is invariably 4 or more. In all probability, there has been some confusion in labelling the material he has described ; for the post-larval telson appears to be that of a species of *Squilla*, in view of the presence of the two sub-median spines on the 6th abdominal segment and the larger number of intermediate denticles on telson. The larval telson figured is most likely that of a *Lysierichthus*. The fact that its carapace did not possess any marginal spinules is additional proof thereto. In the nature of the sub-median space of telson Gurney's larva resembles the one here described ; but the much larger size (about 2 inches) of the former would indicate that it belongs to a different but related species.

The 14 mm. long Squilloid larva of Claus (his Fig. 21B) has a similar telson structure as the present larva and as shown by Hansen (1895) is a *Lysierichthus*.

LYSIOSQUILLA (LYSIERICHTHUS) Sp. II.

Final Pelagic Stage (Text-Fig. 24 *a*).—Four specimens in the final pelagic stage and a few earlier stages were available for study.

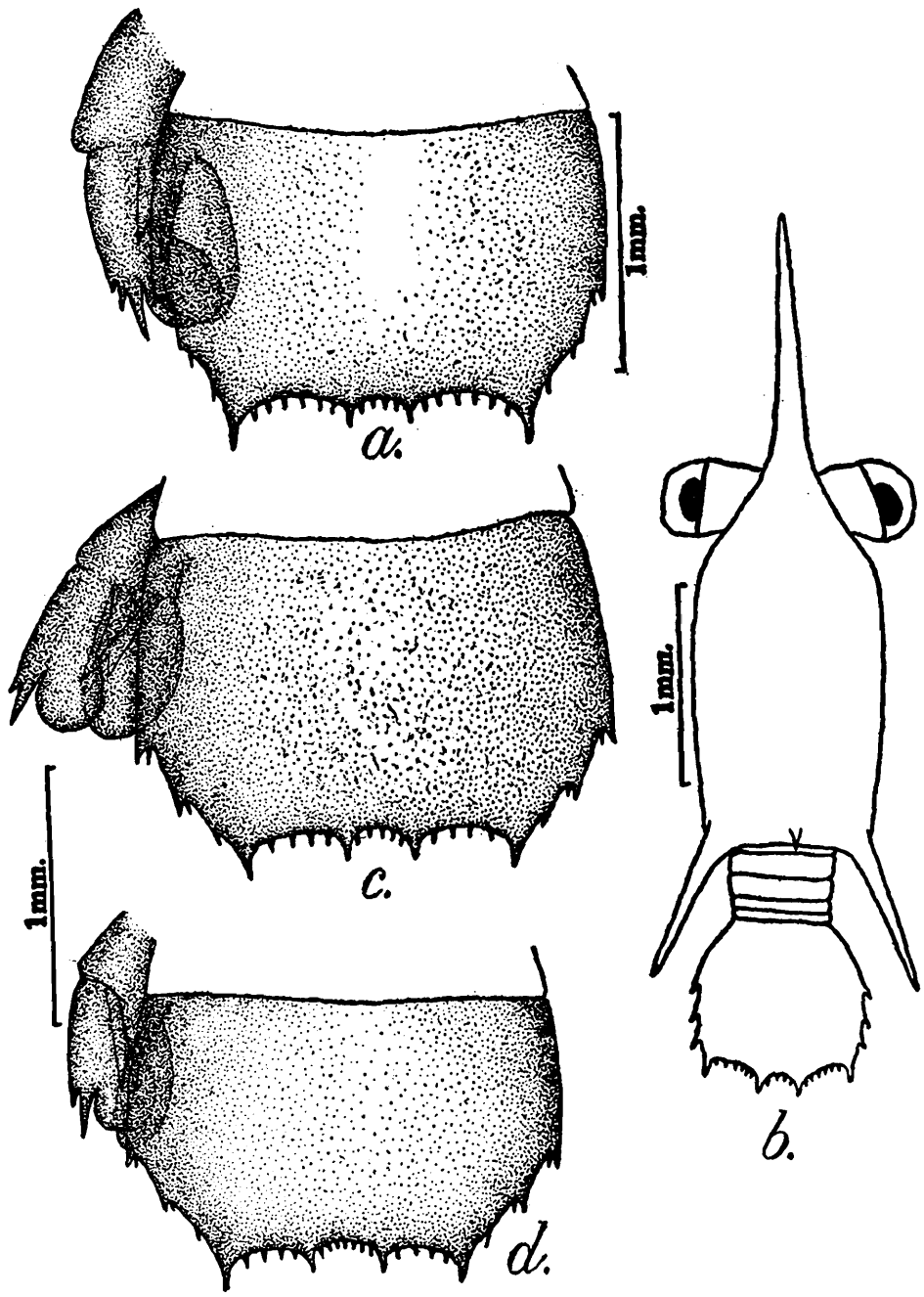
The final pelagic larva closely resembles the corresponding stage of *L. acanthocarpus*.

	mm.
Total length	12·8
Length of rostrum	4·6
Median length of carapace	3·7
Anterior breadth of carapace	1·9
Posterior breadth of carapace	2·3
Length of postero-lateral spine	3·4
Length of telson ..	1·1
Breadth of telson	1·8

Slightly smaller than the final pelagic larva of *L. acanthocarpus*, it has a relatively shorter carapace, with longer rostrum and postero-lateral spines. The carapace extends over the anterior half of the second abdominal segment and has no median dorsal carina. The zoea spine is absent. Tips of the postero-lateral spines are slightly divergent and reach the level of the lateral spines of telson. The raptorial dactylus shows indications of 6 teeth beneath the skin. The sub-median space of telson is divided into three sections ; the 7th denticle from each side being larger than the rest ; while the central section has only 4 denticles (6-1-4-1-6). The outer spine of the ventral prolongation of uropod is smaller than the inner, which reaches only about 2/3 the distance to the tip of endopod.

Earlier Stages of Larvae (Text-fig. 24 *b*).—Specimens ranging from 4·39 mm. to 8·0 mm. in total length are represented in the collection. The characteristic arrangement of the sub-median denticles of telson is found even in the earliest stage collected (*Erichthoidina*, 4·39 mm. long). The antero-lateral spines are not formed in the early larva, while the zoea spine is small. Rostrum and postero-laterial spines appear relatively longer than in the final pelagic stage.

Remarks.—The characteristic appearance of the sub-median space of telson it shares in common with *L. multifasciata*, *L. tigrina* and *L. acanthocarpus* ; but in the number of sub-median denticles it differs from



TEXT-FIG. 24. Unidentified larvae of *Lysiosquilla* spp.

a. Telson and left uropod of final pelagic larva of *Lysiosquilla* sp. II, 12·8 mm. long ; *b. Erichthoidina* larva of *Lysiosquilla* sp. II, 4·39 mm. long, dorsal view ; *c.* Telson and left uropod of final pelagic larva of *Lysiosquilla* sp. IV, 12·0 mm. long, ; *d.* Telson and left uropod of final pelagic larva of *Lysiosquilla* sp. V, 12·0 mm. long.

all these species. The remarkable constancy in the number and arrangement of sub-median denticles, even from the early *Erichthoidina* stage, cannot be without significance, particularly since in those larvae that have been positively correlated with their adults even such minor differences like one denticle more or less, are seen to be of specific significance. Except slight differences in the relative size of carapace and its spines, in the arrangement of sub-median denticles and in the indications of only 6 teeth in the dactylus of the raptorial claw, the present larva is almost identical with the final pelagic larva of *L. acanthocarpus*. However, the absence of the antero-lateral and zoea spines on carapace in the earlier stages and the presence of at least the zoea spine in the corresponding stages of *L. acanthocarpus*, more or less clearly show that the former is specifically distinct from the latter.

It may be noted that of the adult species listed by Kemp (1913) from the Indo-Pacific region, *L. biminiensis*. Sub sp. *pacificus* is closely related to *L. acanthocarpus*, and has the same number of dactylar teeth (6) as indicated in the present larva.

The *Erichthoidina* larva (Brooks, 1866, Pl. XII, fig. 3 and Pl. IV, fig. 1) described by Brookes as belonging to *Gomodactylus*, appears to be identical with the larva here described and has the characteristic 6+1+4+1+6 arrangement of spinules in the sub-median space of telson.

LYSIOSQUILLA (LYSIERICHTHUS) Sp. III.

Final Pelagic stage.—Two specimens in the final pelagic stage were available for study.

	mm.
Total length ..	12·0
Length of rostrum	4·8
Median length of carapace ..	3·9
Anterior breadth of carapace ..	1·9
Posterior breadth of carapace	2·35
Length of postero-lateral spine ..	3·6
Length of telson	1.1
Breadth of telson	1·7

The narrow carapace extends over the anterior half of the second abdominal segment. The antero-lateral spines are short, while the zoea spine is wanting. Rostrum is armed with 2 ventral spinules. The postero-lateral spines are directed almost parallel and close to the sides of the abdominal segments and each has the tip reaching beyond the hind border of telson. In the raptorial dactylus 6 teeth are seen clearly differentiated beneath the skin. The sub-median space of telson is divided into 3 sections, the 5th sub-median denticle from either side being longer than the rest. There are altogether 16 denticles, the central section containing 6 ; and the arrangement is 4-1-6-1-4. There are only two intermediate denticles, while in the post-larval telson the outline of which is clearly visible beneath the larval skin, 4 intermediate denticles are seen. The exopod of the uropod has 2 or 3 free spines and shows indications

of 3 more beneath the skin. In the ventral prolongation the terminal spines are of almost equal size ; in one specimen alone the outer spine appearing just a little longer than the inner.

Remarks.—The larva though slightly smaller than the final pelagic stage of *Lysiosquilla* sp. (II), has the carapace, rostrum and postero-lateral spines relatively longer than in the latter. In the absence of the zoea spine of carapace, in the number and arrangement of the sub-median denticles of telson and in the relative size of the spines of the ventral prolongation of the uropod also, this larva differs from *Lysiosquilla* sp. (II).

In the characteristic number and arrangement of the sub-median spinules of telson the *Erichthoidina* (*Lysiosquilla*) larva from Honolulu, figured by Brooks (1886, pl. XII, figs. 1, 2 ; Pl. V, figs. 5,9) appears to be indentical with the present form.

LYSIOSQUILLA (LYSIERICHTHUS) Sp. IV.

Final Pelagic Stage (*Text-fig. 24c*).—Two specimens in the final pelagic stage were collected on 2nd August, 1940 and 29th March, 1941 respectively.

Closely agreeing with the foregoing species (*Lysiosquilla* sp. (III) it is distinguished from the latter by the following features :—

1. The outer spine of the ventral prolongation of the uropod is longer than the inner as in *L. multifasciata.*
2. In the central section of the sub-median space there are only 5 denticles ; the arrangement being 4-1-5-1-4, *i.e.*, one denticle less than in *Lysierichthus* sp. (III) and one denticle more than in *L. multifasciata.*

The larva largely resembles *L. multifaciata* and *Lysierischthus* sp. (III), but it is almost certain that it is specifically distinct from these species, since only 5 teeth are indicated on the dactylus of the raptorial claw in the early post-larva. In the corresponding stage of *L. multi-fasciata* and *Lysierichthus* sp. (III) 6 teeth are clearly indicated on the dactylus of the raptorial claw. The nature of the intermediate and sub-median denticles of telson is also different.

LYSIOSQUILLA (LYSIERICHTHUS) Sp. V

Final Pelagic Stage (*Text-fig. 24d*).—Two specimens in the final pelagic stage were collected on 18th March, 1940 and 9th July, 1941 respectively.

Almost of the same size as the two foregoing species, it is distinguished from them only by the presence of an additional denticle in the central section of the sub-median space, the general arrangement thus being 4-1-7-1-4. The dactylus of the raptorial claw shows indications of only 5 teeth. The two spines of the ventral prolongation of the uropod are of almost equal size, as in *Lysiosquilla* sp. (III).

Remarks.—While the distinguishing features of this larva are insiggnificant, it is likely that it is not specifically identical with the foregoing species.

GONODACTYLUS (GONERICHTHUS) Sp.

1906. *Gonerichthus* B. Tattersall, *Rept. Pearl Oyster Fish.* Figs. 43 to 45. (?)

Final Pelagic Stage (*Text-fig. 25*).—A single specimen was picked out from plankton collected on 10th April, 1939.

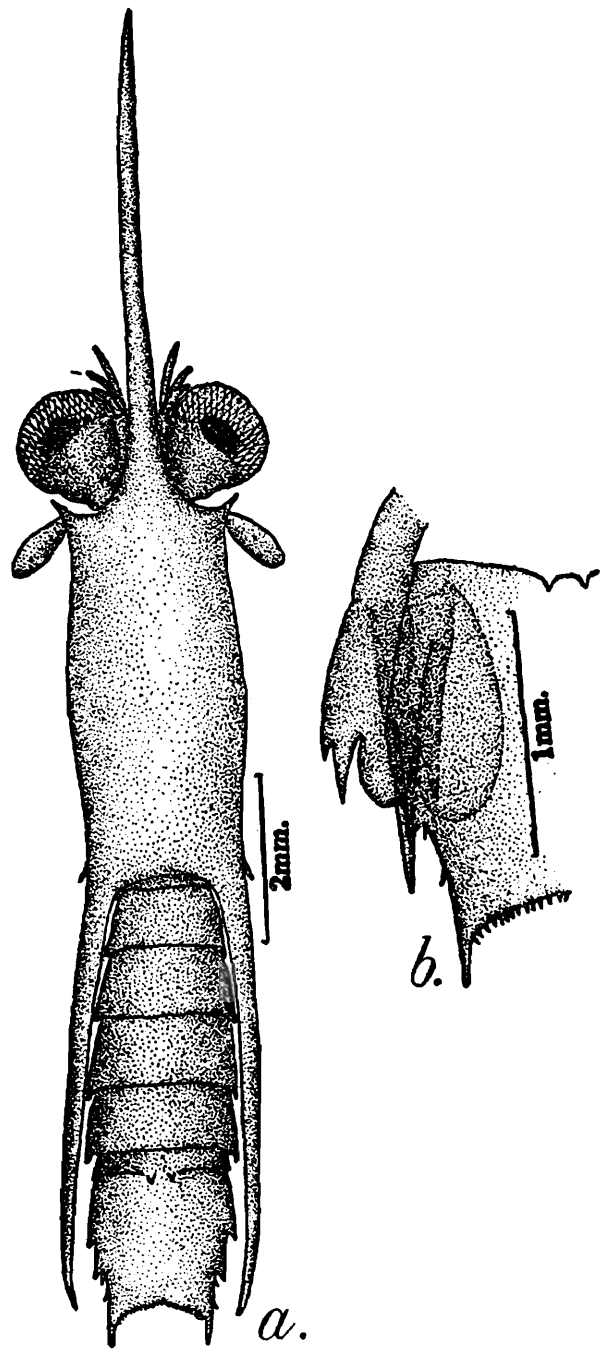
	mm.
Total length ..	14·9
Length of rostrum ..	6·0
Median length of carapace	4·1
Anterior breadth of carapace ..	1·8
Posterior breadth of carapace	1·8
Length of postero-lateral spine ..	4·9
Length of telson	1·7
Breadth of telson ..	1·6

The carapace is very narrow and extends over the first abdominal segment posteriorly. Rostrum is very long; longer than the postero-lateral spines and has 3 ventral spinules. The antero-lateral spines are short and pointed. At the base of each postero-lateral spine, on the hind corner of the lateral margin of carapace there is a ventrally directed spinule. The zoea spine is wanting. The postero-lateral spines are directed almost parallel to the abdominal segments and have their tips reaching the level of the hind border of telson. The antennular flagella are very short and the second flagellum carries 4 groups of hairs. Eyes are conspicuously large, mounted on very short stalk. Dactylus of the raptorial claw is long and slender. Peraeopods are well developed. The thoracic and abdominal segments are broad. The postero-lateral corners of the first 3 abdominal segments do not end in acute spines; while in the last 3 segments the pleura end posteriorly in short, acute spines. A pair of sub-median dorsal spines is present on the 6th abdominal segment. The telson is long and narrow, with wide sub-median space. The sub-median spines are very long. Denticles number 1 lateral, 2 intermediate and 14 sub-median on each side. The uropod is well developed and has the tip reaching the base of the intermediate spines of telson. The exopod has 2 free spines. In the ventral prolongation the outer spine is conspicuously large, the inner being only about 1/4 the length of the outer.

Remarks.—The larva shows some resemblance to *Gonerichthus B* of Tattersall (1906), but differs from it in the absence of the zoea spine, in the longer rostrum and postero-lateral spines and in the slightly larger carapace. Tattersall's specimen, however, was in an earlier stage than the present one.

The larva described as *Lysierichthus A* by Tattersall (loc. cit.) appears to show some striking features that are not generally found in *Lysierichthii*. In the majority of *Lysierichthii*, particularly the smaller species, the postero-lateral corners of the abdominal segments are not pointed but are smoothly rounded. In the larger larvae of the *maculata* group, however, the postero-lateral corners of the abdominal segments end in acute spines. Further, the presence of a pair of sub-median dorsal spines on the 6th abdominal segment is a feature that is not known to be shared

by any *Lysierichthus* that has been positively correlated with the adult species. Tattersall himself observes that his *Lysierichthus A* differs from all the *Lysierichthii* so far described in the possession of the sub-median dorsal spines on the 6th abdominal segment. In the nature of the ventral prolongation of the uropod also *Lysierichthus A* differs from the true *Lysierichthus*. Except in minor differences in the relative size of the different parts, *Lysierichthus A* shows all characters of *Gonerichthii* and I am, therefore, inclined to consider that the former should properly be placed under *Gonerichthus*.



TEXT-FIG. 25.—Unidentified larva of *Gonodactylus* sp.

a. Final pelagic larva, 14·9 mm. long, dorsal view ; *b*. Left half of telson and left uropod of the same, magnified.

PSEUDOSQUILLA (PSEUDERICHTHUS) Sp. I.

A single specimen, 4·95 mm. long, was examined.

Carapace is relatively small ; extends over the last thoracic segment posteriorly ; has the antero-lateral and zoea spines long ; tip of postero-lateral spine reaches hind border of the third abdominal segment and a single spinule is present at the postero-lateral corner of carapace, close to the base of the postero-lateral spine. Rostrum is armed with 4 ventral spinules. Eyes are large with short stalk. The raptorial claw is well developed ; the propodus has one stout basal spine and a few scattered pectinations on the inner aspect. Postero-lateral corners of abdominal segments are acutely pointed ; the 6th abdominal segment has a pair of sub-median dorsal spines; telson is long and quadrate, with wide sub-median space. The sub-median spines are long and the denticles number 1 intermediate and 15 sub-median on each side. Uropods are rudimentary.

PSEUDOSQUILLA (PSEUDERICHTHUS) Sp. II.

About a dozen specimens ranging from 3·2 mm. to 4·5 mm. in total length, were available for study.

More slender in appearance than *Lysierichthii*, they resemble true *Alima* except in the nature of the telson, the conspicuous eyes and the shape and spinulation of carapace.

In the smallest larva the carapace extends over the first abdominal segment posteriorly and the postero-lateral spines, directed almost parallel to the abdominal segments, though slightly diverging distally, reach the level of the 3rd segment. The antero-lateral and zoea spines are small. Rostrum is relatively short. The lateral margin of carapace has a single spinule near the base of the postero-lateral spine. The raptorial limb is well developed. The postero-lateral corners of abdominal segments end in acute spines. There are 5 pairs of well developed pleopods. The 6th abdominal segment which is not fully differentiated, has a pair of sub-median dorsal spines. Telson is quadrate and long ; with 1 lateral and 10 or 11 sub-median denticles on each side.

In the larger specimens the carapace extends over the second abdominal segment and the postero-lateral spines reach the level of the 4th abdominal segment. The rostrum has 2 ventral spinules. Tips of antennular flagella reach upto the tip of rostrum. Uropod is still rudimentary.

KEY FOR IDENTIFICATION OF LARVAE.

Since several species of larvae have been described in this report, it is felt that a key for their easy identification would be of use. Only those larvae that have been correlated with the adult species have been included in the key, in preparing which only characters of the advanced planktonic larvae have been taken into account. No attempt has been made to arrange the species according to the relationship exhibited by the adults ; eventhough based on larval characters also they fall into well known adult groups, with very few exceptions. As will be discussed subsequently, this might throw some light on the true affinities of the different species.

Genus SQUILLA Fabricius : ALIMA LARVAE.

Lateral margin of carapace with varying number of spinules ; postero-lateral spine ordinarily with a spinule at or near its base ; a conspicuous spinule near the base of the antero-lateral spine ; sixth abdominal segment usually with a pair of sub-median dorsal spines at the hind margin ; postero-lateral corners of abdominal segments, in advanced larvae, ending in acute or sub-acute spines ; telson ordinarily with four or more intermediate denticles ; sub-median space of telson relatively narrow, in advanced larvae.

A. Hind margin of carapace with a small spinule, mid-way between the dorsal and postero-lateral spines.

1. Rostrum and postero-lateral spines moderately long ; lateral margin of carapace with 1+2 spinules ; length at final pelagic stage : 11 to 12 mm. .. .. .. *Squilla scorpio* var. *immaculata.*

2. Rostrum and postero-lateral spines very long ; lateral margin of carapace with 1+3 spinules ; length at final pelagic stage : 11 to 12 mm. *Squilla scorpio.*

B. Hind margin of carapace without any spinule mid-way between the dorsal and postero-lateral spines.

I. Raptorial dactylus with one or more free teeth other than the terminal.

(*a*) Margin of carapace without laterally directed spinules.

i. Carapace triangular, with long, stout rostrum and postero-lateral spines ; marginal spinules 1+2 ; raptorial dactylus with one or rarely two free teeth besides the terminal ; length at final pelagic stage ; 11 to 13 mm. .. *S. latreillei.*

ii. Carapace very narrow ; marginal spinules 1+2 ; raptorial dactylus with 3 teeth besides the terminal ; length at final pelagic stage : 13·5 mm. *S. lata.*

(*b*) Margin of carapace with one laterally directed spinule on either side. Carapace fairly broad ; marginal spinules 2+2 ; raptorial dactylus with 2 free teeth besides terminal ; length at final pelagic stage : 14·5 mm. .. *S. fasciata.*

II. Raptorial dactylus without any free tooth besides the terminal.

(*a*) Margin of carapace with 2 laterally directed spinules on either side ; total number of marginal spinules 4+3 ; length at final pelagic stage : 18 to 18·5 mm. .. *S. raphidea.*

(*b*) Margin of carapace without conspicuous laterally directed spinules.

1. Rostrum with ventral spinules.

i. Last two thoracic segments exposed ; marginal spinules, 7+3 ; rostral spinules 7 ; carapace fairly wide posteriorly, tip of postero-lateral spines reaching level of 2nd abdominal segment ; 2nd antennular flagellum with 15 groups of hairs ; length at final pelagic stage : 29·5 mm. .. *S. interrupta.*

ii. Last 3 thoracic segments exposed; marginal spinules 7+3; rostral spinules 6 or 7; carapace not much wider posteriorly; tip of postero-lateral spine reaching level of hind border of last thoracic segment; 2nd antennular flagellum with 12 groups of hairs; length at final pelagic stage: 31 mm. .. *S. boops.*

iii. Last 3 thoracic segments exposed; marginal spinules 8+3; rostral spinules 8; carapace very narrow and small; tip of postero-lateral spine reaching level of junction between 7th and 8th thoracic segments; 2nd antennular flagellum with 11 groups of hairs; length at final pelagic stage: 27 to 27·5 mm. .. *S. quinquedentata.*

2. Rostrum without ventral spinules.

(*a*) One or more thoracic segments exposed dorsally.

i. Last thoracic segment alone exposed dorsally; carapace fairly large and broad; marginal spinules 8+3; tip of postero-lateral spine reaching level of 2nd abdominal segment; length at final pelagic stage: 30 mm. .. .. *S. hieroglyphica.*

ii. Last two thoracic segments exposed dorsally; carapace short, narrow; marginal spinules 6+2 or 3: tip of postero-lateral spine reaching level of 1st abdominal segment; 2nd antennular flagellum with 12 groups of hairs; length at final pelagic stage: 27 mm. .. *S. gonypetes.*

iii. Last two thoracic segments exposed; carapace long, fairly broad; marginal spinules 12+4; tip of postero-lateral spine reaching level of hind margin of 1st abdominal segment; 2nd antennular flagellum with 18 groups of hairs; length at final pelagic stage: 35·5 to 36 mm. .. *S. wood-masoni.*

(*b*) No thoracic segment exposed dorsally.

i. Carapace conspicuously large, shield-like; marginal spinules 8+3; tip of postero-lateral spine reaching level of 4th abdominal segment; 2nd antennular flagellum with 15 groups of hairs; length at final pelagic stag : 34·5 to 35 mm. .. *S. holoschista.*

ii. Carapace fairly large, shield-like; marginal spinules 8+4; tip of postero-lateral spine reaching level of 4th-5th abdominal segment; 2nd antennular flagellum with 12 groups of hairs; length at final pelagic stage: 22·5 to 25 mm. .. .. *S. nepa.*

Genus LYSIOSQUILLA Dana : LYSIERICHTHUS LARVAE.

Lateral margin of carapace ordinarily without any spinule ; postero-lateral spines of carapace, each with a spinule, almost invariably situated near the very base ; no spinule at or near the base of the antero-lateral spines ; no sub-median dorsal spines at the hind margin of the sixth abdominal segment ; postero-lateral corners of abdominal segments in the majority of cases smoothly rounded and not ending in spines ; intermediate denticles of telson always less than four ; sub-median space of telson relatively broad during all stages.

A. Postero-lateral corners of abdominal segments ending in sub-acute or acute spines.

1. Carapace thick, shield-like, without antero-lateral spines ; zoea spine short, sometimes blunt ; rostrum and postero-lateral spines very short ; lateral margin of carapace at the middle, extends downwards and ends in a stout spine on either side ; abdominal segments very broad ; sub-median space of telson relatively narrow ; length at final pelagic stage : 23·5 mm. .. .. *L. maculata.*

2. Similar to the above ; but carapace with antero-lateral spines ; zoea spine wanting ; rostrum and postero-lateral spines longer ; lateral downward extension of carapace not ending in acute spines ; sub-median space of telson broad ; and length at final pelagic stage : 24 mm. .. .. *L. sulcirostris.*

B. Postero-lateral corners of abdominal segments rounded and not ending in spines.

I. Carapace without antero-lateral and zoea spines.

Outer spine of ventral prolongation of uropod smaller than the inner ; sub-median denticles 6-1-5-1-6 ; length at final pelagic stage : 13 to 13·5. mm. *L. tigrina.*

II. Carapace with antero-lateral and zoea spines.

(*a*) Outer spine of ventral prolongation of uropod longer than the inner ; sub-median denticles 4-1-4-1-4 ; length at final pelagic stage : 15 mm. .. .. .. *L. multifasciata.*

(*b*) Outer spine of ventral prolongation of uropod smaller than the inner ; sub-median denticles 6-1-6-1-6 ; length at final pelagic stage : 14 mm. .. *L. acanthocarpus.*

DISCUSSION.

Stomatopods of the Madras Coast.—The following 19 species belonging to the genera *Squilla* and *Lysiosquilla* have been recorded from the Madras coast (Kemp, 1913 ; Gravely, 1940).

S. latreillei,
S. scorpio,
S. gonypetes,
S. oratoria, var. *inornata*,
S. wood-masoni,
S. lirata,
L. maculata,
S. microphthalma,
S. tenuispinis,
S. nepa,
S. stridulans,
S. multicarinata,
and
S. gilesi,
S. quinquedentata,
S. holoschista,
S. interrupta,
S. supplex,
S. raphidea,
L. acanthocarpus

The present investigation has resulted in the addition of seven more species from the Madras waters as follows :—

S. boops, *S. hieroglyphica*, *S. lata*, *S. fasciata*, *L. sulcirostris*, *L. multifasciata*, and *L. tigrina*.

All these seven species appear to be new records for the west coast of the Bay of Bengal. *S. fasciata*, *S. lata* and *S. boops* have been recorded from the east coast of the Bay of Bengal; while *S. fasciata* and *L. sulcirostris* have been collected from the Andaman and Nicobar area. *L. multifasciata* which is known to occur in the Arabian sea, has not hitherto been recorded from the Bay of Bengal; while *S. hieroglyphica* and *L. tigrina* are two rare species the distribution of which is extended to the Indian waters (Alikunhi, 1944 *a*, *b*). Thus, of the seven additional species obtained from the Madras coast, six are additions to the Indian Stomatopod fauna. The presence of several unidentified larvae, particularly the *Lysierichthii*, in the Madras plankton shows that our knowledge of the stomatopod fauna of the Indian coastal waters is far from exhaustive.

Correlation of Larvae with Adults.—Foxon (1939) considers description of unidentified *Alima* larvae as an unprofitable business; while Gurney (1946) feels that " apart from hatching of the first larva of any available species, the most important contribution to knowledge that can be made now would be the rearing from plankton materials of as many consecutive post-larval stages as possible ". As has already been pointed out, description of the larval forms without correlating them with the adult species has resulted in much confusion and in the absence of any definite information as to which characters indicate specific differences, in several cases more than one species of larvae have been ascribed to a single species. To remove this confusion and to obtain a true picture of the stomatopod population of any particular locality, it is necessary to rear the planktonic larvae to the post-larval stages. The habits of adult stomatopods are such that they are caught in trawling nets and other fishing tackle, mostly by chance only (Kemp, 1913). That records of the adult species from any locality will, therefore, be necessarily very incomplete and have to be supplementad by the study of larval forms from the same waters, has been well demonstrated by the present investigation, which has resulted in the positive correlation of the larvae of 12 species of *Squilla* and 5 species of *Lysiosquilla* with their adults.

Larval Characters.—The studies embodied in the present report amply illustrate that certain characters hitherto considered as of little significance as specific features, are really very useful in distinguishing even closely related larvae. Between allied species the specific differences are often trivial, but remarkably constant. The size at the final pelagic stage; the shape and spinulation of carapace; the presence or absence of teeth other than the terminal on the dactylus of the raptorial claw; the shape and spinulation of telson and the uropod, etc., are features that hardly show any variation within a species. The larvae of *S. nepa* and *S. holoschista* are very similar to each other, but they could always be distinguished by the differences in size and the number of spinules on the lateral margin of carapace. Likewise *S. scorpio* is distinguished from

its variety *immaculata,* by the presence of an additional spinule on the margin of carapace and by the relatively longer size of the rostrum and postero-lateral spines in the former. In the "*Quinquedentata*" group, the larvae of *S. boops* and *S. quinquedentata* very closely resemble each other and are distinguished from one another by characters which would not have been considered as of any specific significance, if the larvae were not actually reared into different post-larval forms. In the *Lysierichthii* of the "*Acanthocarpus*" group, the number and arrangement of denticles on telson, particularly in the sub-median space, are found to be remarkably constant features which are of definite taxonomic significance.

From their size at the final pelagic stage, the shape and spinulation of carapace and the relative size of the thoracic and abdominal segments, the *Alima* larvae dealt with in the present report could be arranged into distinct groups. The larvae of *S. latreillei, S. lata* and *S. fasciata* belong to the *Alimerichthus* type and are characterised by the relatively small size, short small carapace with a few marginal spinules and the relatively broad thoracic and abdominal segments which make the larvae appear stout. The region between the antenna and the labrum is not much telescoped in these larvae, which are also characterised by the possession of one or more free teeth other than the terminal, on the dactylus of the raptorial claw. Generalising from this, it is perhaps justifiable to suggest that the true *Alimerichthus* type of *Alima* larvae probably belongs to species of the *chloridella* group.

The larvae of *S. scorpio,* which as pointed out by Kemp (1915) are perhaps unique among *Alima* larvae in the possession of the characteristic spinule on the hind margin of carapace, mid-way between the dorsal and the postero-lateral spines on either side, are also of the *Alimerichthus* type but differ from the larvae of the "Chloridella" group, in the absence of free teeth other than the terminal, on the dactylus of the raptorial claw.

The larvae of *S. raphidea* occupy a peculiar position. Though described as belonging to the *Alimerichthus* group, they show some conspicuous differences from the typical *Alimerichthus* of the "*Chloridella*" group, *viz.*; larger size; broad, shield-like carapace and absence of free teeth other than the terminal on the dactylus. In the number of marginal spinules on carapace (4+3) these larvae perhaps occupy an intermediate position between *Alimerichthii* of the "*Chloridella*" and *Scorpio* groups on the one hand and the typical *Alima* larvae on the other. They resemble the true *Alimerichthus* only in the relatively broad thoracic and abdominal segments; the short antenna-labral region and the consequent stout build of the body.

The other larvae are all relatively large-sized and slender in appearance. These belong either to the "*quinquedentata*" group or to the "*nepa*" group. The antenna—labral region is invariably highly telescoped and the thoracic and abdominal segments are comparatively narrow, giving the abdomen a slender appearance, in sharp contrast to the condition in the *Alimerichthus* type. No free tooth other than the terminal is developed on the raptorial dactylus in any of these larvae. The lateral margin of the carapace is invariably provided with a larger number of spinules than in *Alimerichthus.*

In the "*quinquedentata*" group the carapace is generally very narrow and relatively small. *S. hieroglyphica* shows some variation from this type of carapace. The larvae of species of the "*nepa*" group consisting of *S. nepa*, *S. holoschista*, *S. wood-masoni* and *S. interrupta*, have large shield-like carapace which is characteristic. However, *S. interrupta* differs from the other three species in the possession of ventral spinules on the rostrum. In this feature it agrees with the larvae of *S. oratoria* and this probably indicates its closer relationship to the latter than to *S. nepa*, *S. holoschista* or *S. wood-masoni*.

In the *Lysierichthii* larvae also two distinct types are noticeable. Larvae of the '*maculata*" group are characterised by their large size, very broad abdominal segments; stout build of body and strong shield-like carapace with marginal spines short or moderately long. Unlike the majority of *Lysierichthii*, in these larvae the postero-lateral corners of the abdominal segments, particularly the last three, end in acute spines.

The larvae of the "*acanthocarpus*" group are generally small-sized and relatively very slender as compared with those of the "*maculata*" group. The very narrow carapace, with long marginal spines and the fairly broad thoracic and abdominal segments are characteristic. In contrast to the "*maculata*" group of larvae, in these the postero-lateral corners of the abdominal segments do not end in spines.

Considering the outstanding characters of the larvae, it is clear that in each genus they fall into distinct groups as indicated above. It is significant to note further that these different groups of larvae correspond to similar groups of adult species. Since the similarity between the adult species is thus indicated in the pelagic larvae also, it is possible that outstanding larval features might easily provide clues to the real affinities of the different groups and genera.

The distinguishing characters of the larvae of the different genera of stomatopods have been discussed thoroughly and classified by several authors, including Claus, Brooks, Hansen, Giesbrecht, Foxon and Gurney. While I do not propose to go into the details of these different classifications, certain features which are likely to be of some significance in tracing the affinities of the different genera and which have hitherto not been considered in that light are discussed below.

In his revised classification of the stomatopod larvae, Foxon (1939) separates *Lysiosquilla* and *Coronida* from the rest of stomatopods which comprise the genera *Squilla*, *Pseudosquilla*, *Gonodactylus* and *Odontodactylus*. In the position of *Pseudosquilla*, which Foxon believes as closely related to *Squilla*, his classification differs from that of Hansen (1895) and of Giesbrecht (1910), both of whom have placed *Pseudosquilla* in the *Gonodactylus* group. Gurney (1946) examining the characters on which the classification is based, feels it "difficult to find any reason for placing *Pseudosquilla* nearer to *Squilla* than to *Lysiosquilla*". While Foxon does not accept the view that there is a fundamental difference between the *Antizoea* and the *Pseudozoea*, as pointed out by Gurney, he gives much weight to the *Antizoea* for separating *Lysiosquilla* from the other genera. Eventhough the *Antizoea* in the course of later development gets transformed to the *Pseudozoea* type of body structure, it must

be admitted that in the early stages they appear fundamentally different. In spite of the structural similarity during the late larval life, *Lysiosquilla* larvae show some important differences from the larvae of the other genera. The advanced *Alima* larva invariably has the postero-lateral corners of the abdominal segments produced into acute spines and besides, the 6th abdominal segment is likewise provided with a pair of sub-median dorsal spines. These features are shared by *Pseuderichthus*, *Gonerichthus* and *Odonterichthus*; while in *Lysierichthus*, except perhaps in the "*maculata*" group, the postero-lateral corners of the abdominal segments are not produced into acute spines, but are smooth and rounded. Further, in none of these, the 6th abdominal segment is provided with the sub-median dorsal spines.

These features probably support the view that the *Antizoea* and the *Pseudozoea* are fundamentally different; in which case Foxon's classification of the larvae separating *Lysiosquilla* and *Coronida* from the other genera should be accepted as indicating the true relationship of the different forms. If the late larval characters give any indication of the affinities of the genera, the possession of pleural points on the hind corners of the abdominal segments and the presence of sub-median spines of the 6th abdominal segment bring *Squilla*, *Pseudosquilla*, *Gonodactylus* and *Odontodactylus* in one section as opposed to *Lysiosquilla* and *Coronida* in which these features are generally absent. Foxon's contention that the larval forms also fall in the same grouping as that given by Kemp for the adult genera, thus appears to be largely justified. That the larvae could be easily arranged in intra-generic groups, in the same way as the adults, has already been demonstrated.

The presence of 4 or more denticles between the intermediate and sub-median spines of telson, is accepted as one of the fundamental characters of the *Alima* type of larva. While this is almost invariably the case, it may be mentioned that in an early *Alima* of *S. scorpio*, 5·1 mm. long, there are only *three* intermediate denticles on each side. The smallest larva of *S. scorpio*, var. *immaculata* from the Chilka Lake, also measuring 5·1 mm. in length, has the sub-median denticles variable in number; in one specimen there were 3 on one side and 4 on the other; a second specimen had 3 on one side and 5 on the other. It is likely that in the earlier stages of these species the number of intermediate denticles might have been definitely less than 4 on each side.

SUMMARY.

1. The plankton collections from the sea, off the Madras coast made during the years 1936 to 1943 (seven and a half years) were analysed for the stomatopod larvae. Out of 413 collections examined, 298 contained stomatopod larvae which totalled 14,197; the maximum number per collection encountered being only 432.

2. The great majority of the larvae were of an advanced stage of development, a good many being in the final pelagic stage.

3. Larvae of *S. nepa* formed the bulk of the catches, followed by *S. holoschista*, *S. wood-masoni*, *S. quinquedentata*, *S. latreillei* and *S. interrupta* in the order of abundance.

4. *Erichthus* larvae were relatively few and were only occasionally caught.

5. The live larvae were sorted into types according to their external characters and were separately reared in laboratory aquaria. By thus obtaining the post-larval stages, the species were identified and the larvae were correlated with the adults.

6. The following species of stomatopods were, in this way, correlated with their pelagic larvae :

S. nepa,	*S. holoschista*,	*S. wood-masoni*,
S. interrupta,	*S. boops*,	*S. quinquedentata*,
S. gonypetes,	*S. hieroglyphica*,	*S. raphidea*,
S. latreillei,	*S. lata*,	*S. fasciata*,
L. maculata,	*L. sulcirostris*,	*L. multifasciata*,
L. tigrina,	and	*L. acanthocarpus*.

7. Certain larval species (3 of *Squilla*, 5 of *Lysiosquilla*, 1 of *Gonodactylus* and 2 of *Pseudosquilla*), which could not be reared and correlated with their adults, have been described for future reference.

8. The synonymy of the different species of larvae has been discussed at some length to facilitate identification of the forms already described and to remove the existing confusion about their identity.

9. A key for the easy identification of the different larvae dealt with in this report, has been included.

10. The present studies have resulted in the discovery of seven species which are new to the Madras coast. All these species are now recorded for the first time from the west coast of the Bay of Bengal. The rare species *S. hieroglyphica* and *L. tigrina* are new additions to the stomatopod fauna of the Indian waters, along with *S. boops*, *S. lata*, *S. fasciata* and *L. sulcirostris*.

11. The general characters of the different types of larvae have been discussed briefly in the light of the present studies.

12. The possible affinities of the different genera and species have been considered in the light of the larval characters.

ACKNOWLEDGEMENTS.

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REFERENCES.

For an exhaustive list of annotated bibliography of the Stomatopod larvae, together with a very useful list of the larval species described. reference should be made to Gurney (1946). The papers consulted during preparation of the present paper alone have been listed below.

ALIKUNHI, K. H. & AIYAR, R. G., 1942.—On some *Squilla* larvae from the Madras plankton. *Curr. Sci. Bangalore,* XI(2) : 56-58 ; 1 pl.

————, 1943.—Growth in some Stomatopods. *Curr. Sci. Bangalore,* XII(3) ; 80-82 ; 1 pl.

ALIKUNHI, K. H., 1944a.—Growth stages of *Lysiosquilla tigrina* Nobili. *Ibid.* ; XIII(1), 1 fig.

————, 1944b.—Final pelagic larva of *Squilla hieroglyphica* Kemp. *Ibid.* XIII(9) : 237-38 ; 1 fig.

————, 1950.—Observations on some larval and post-larval stomatopods. *Journ. Bom. Nat. Hist. Soc.,* XLIX(1) : 101-107 ; 2 pls.

BIGELOW, R. P., 1894.—Report on the crustacea of the order Stomatopoda collected by the steamer Albatross between 1885 and 1891, and on other specimens in the U. S. National Museum. *Proc. U. S. Nat. Mus.,* XVII : 489-550 ; 28 figs., 3 pls.

————, 1931.—Stomatopoda of the southern and eastern Pacific ocean and the Hawaian Islands. *Bull. Mus. Comp. Zool. Harvard,* 72.

BORRADAILE, L. A., 1907.—Stomatopoda from the western Indian ocean. *Trans. Linn. Soc. Zool.,* (2) XII : 208-216, 1 pl.

BROOKS, W. K., 1886.—Report on the Stomatopoda collected by H.M.S. Challenger during the years 1873-1876. *Challenger Reports, Zool.,* 16 : 1-116 ; 16 pls.

BROOKS, W K. & HERRICK, C. L., 1892.—The embryology and metamorphosis of the Macrura : The habits and metamorphosis of *Gonodactylus chiragra. Mem. Nat. Acad. Sci.,* 5 : 353-60 ; pls. 1, 3, 14, 15.

CHOPRA, B. N., 1934.—On the Stomatopod crustacea collected by the Bengal Pilot Service off the mouth of the river Hughly, together with notes on other forms. *Rec. Ind. Mus. Calcutta,* 36.

CLAUS, C., 1871.—Die Metamorphose der Squilliden. *Abh: Ges. Wiss· Gottingen,* 16 : 1-55 ; 8 pls.

DAKIN, W J. & COLEFAX, A. N., 1940.—The plankton of the Australian coastal waters off New South Wales. *Publ. Univ. Sidney Dept. Zool. Monogr. 1.* Stomatopoda : 191.

FAXON, W., 1882.—Selections from Embryological Monographs—1. Crustacea. *Mem. Harv. Mus. Comp. Zool.,* 9(1), pls. 7-8.

FOXON, G. E. H., 1932.—Report on Stomatopod larvae, Cumacea and Cladocera. *Great Barrier Reef Expedition Sci. Rept.,* 4 (11) ; 375-398 ; 10 figs.

————, 1939.—Report on Stomatopod larvae : *John Murray Expedition, 1933-34, Sci. Rept.,* 6(6) : 215-266 ; 4 figs.

Giesbrecht, W., 1910.—Stomatopoda : *Fauna und Flora des Golfes von Neapel—Monogr.* 33 ; 1-239 ; 11 pls., 12 tex figs.

Gravely, F. H., 1941.—Shells and other animal remains on the Madras beach. *Bull. Mad. Govt. Mus.*, V (1) : 1-112.

Guerin-Meneville, F. E., 1857.—Animaux asticules. In *Romon de la Sagra Histoire Physique, Politique et Naturelle de l'ile de Cuba, Paris.* : 1-868, 3 pls., figs. 9-12.

Gurney, R., 1937.—Notes on some decapod and stomatopod crustacea from the Red Sea. *Proc. Zool. Soc. Lond.*, 107(A) : 319-26 ; 4 pls.

———, 1946.—Notes on Stomatopod larvae. *Proc. Zool. Soc. Lond.*, 116(1) : 133—175, 14 figs.

Hansen, H. J., 1895.—Isopoden, Cumacean und Stomatopoden der Plankton Expedition. *Ergeb. Plankt. Exped.* 2 g.c. : 63-105, 2 pls.

———, 1926.—Stomatopoda of the Siboga Expedition. *Siboga Expeditie, Monogr.* 35 : 1-48 ; 2 pls.

Jurich, B., 1904.—Die Stomatopoden der Deutschen Tiefsee Expedition. *Wiss. Ergebn. d. Deutsch. Tiefsee-Exped. und d. Dampfer 'Valdivia' 1898-99.* Bd. 7 : 359-408 ; 6 pls.

Kemp, S., 1913.—An account of the Crustacea Stomatopoda of the Indo-Pacific region. *Mem. Ind. Mus. Calcutta*, IV (1) : 1-217 ; 10 pls.

———, 1915.—Fauna of Chilka Lake : Stomatopoda. *Mem. Ind. Mus. Calcutta*, V : 191-197 ; 2 figs.

———, 1915.—On a collection of Stomatopod crustacea from the Philippine Islands. *Philip. Jour. Sci.* (D), X.

Kemp, S. & Chopra, B. N., 1921.—Notes on Stomatopoda. *Rec. Ind. Mus. Calcutta*, 22 : 297-311.

Komai, T., 1928.—Stomatopoda of Japan and adjacent localities. *Mem. Coll. Sci. Kyoto Imp. Univ.* (B) 3 : 307-354 ; 2 pls.

———, 1932.—An enormous swarm of Stomatopod larvae. *Annot. Zool. Jap.*, 13 : 352-54 ; 1 fig.

Komai, T. & Tung, Y. M., 1929.—Notes on the larval stages of *Squilla oratoria*, with remarks on some other Stomatopod larvae found in the Japanese seas. *Annot. Zool. Jap.*, 12 : 187-237 ; 9 pls ; 1 text-fig.

Lanchester, W. F., 1903.—Marine Crustaceans—viii. Stomatopoda with an account of the varieties of *Gonodactylus chiragra. Fauna & Geogr. Maldive and Laccadive Archipelagoes.* I : 444-459.

———, 1906.—Report on Crustacea. *Fasciculi Malayensis, Zool.* pt. iii ; 127-134.

Lebour, M. V., 1934.—Larval Crustacea (Decapoda and Stomatopoda) *Exped. S.A.R. Prince Leopold of Belgium*, Duke of Brabant, to the extreme east (1932). *Bull. Mus. Roy. Hist. Nat. Belgique*, 10(8) : 1-24 ; 19 figs.

LEBOUR, M. V. 1934.—Stomatopod larvae. *Results Scientifiques du voyage our Indes Orientales Neer—landaises de LL. AA. RR. le Prince et la Princesse Leopold de Belgique, Mem. Mus. Roy. Hist. Nat. Belgique,* 3 (16) : 11-17, 5 figs.

LELE, S. H., 1937.—Pelagic larva of *Squilla interrupta. Proc. 24th Ind. Sci. Congr. Hydera ad.*

MENON, M. K., 1933.—The life histories of Decapod Crustacea from Madras. *Bull. Mad. Govt. Mus.*, N. S., III (3) : 1-45 ; 10 pls.

———, 1937.—Decapod larvae from the Madras plankton. *Ibid.*, 111(5) : 1-54 ; 9 pls.

———, 1940.—Decapod larvae from the Madras plankton II. *Ibid.*, 111(6) : 1-47, 8 pls.

MILNE-EDWARDS, H., 1837.—*Histoire Naturelle des Crustaces,* 2, Pairs ; 404-509.

———1836, 1849.—Crustacea—In *Cuviers Regne Animal* (Disciples' Eddition), Paris. : 161, pl. lvii, figs. 2.

NAIR, K. B., 1942.—On the embryology of *Squilla. Proc. Ind. Acad. Sci. Bangalore* ; 14(6) :

TATTERSALL, W. M., 1906.—Report on the Leptostraca, Schizopoda and Stomatopoda, collected by Prof. Herdman at Ceylon in 1902 ; In Herdman's *Rept. Pearl. Oyster Fisheries* (*Gulf of Manaar*) : pt. 5 : 157-188 ; 3 pls.

NWEEDIE, M. W. F., 1934.—Notes on Stomatopoda of the Raffles Museum. *Bull. Raffles Mus. Singapore, 9.*

SOME NEW SPECIES OF COPEPODS FROM MADRAS COAST.

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In the course of a detailed study of over 250 samples of Madras plankton, 112 species of copepods were identified and it was found that seven were new to science. In the present paper five of these, *Labidocera bengalensis*, *Corissa indica*, *Kelleria rubimaculata*, *Macrochiron* (*Paramacrochiron*) *ornatus*, and *Saphirella enigmatus*, are described fully. The remaining two species will be described in a subsequent paper when the males of those species are obtained.

Family : PONTELLIDAE.

Labidocera bengalensis, sp. nov.

Occurrence.—Both sexes occur in large numbers in the plankton from July to December. The female holotype bearing the No. C3017/1 and the male allotype are deposited in the Zoological Survey of India.

THE FEMALE.

Length.—1·4 mm.

Colour.—The male as well as the female is of a dirty yellow colour. The abdomen is reddish in colour. Red pigment spots are scattered about on the cephalothorax also.

Body (text-fig. 1 *a*).—The anterior end of cephalosome is squared and the dorsal lenses are very prominent. Rostrum is pointed and bent downwards. Lateral hooks are present. The posterior corners of the cephalothorax are rounded. The abdomen is 3-jointed. The genital segment (text-fig. 1 *b*) is slightly swollen on the right side and bears a number of transparent papillae ventrally. Genital opening is paired. The genital segment is as long as the combined length of the next segment and the anal segment. The second abdominal segment is produced posteriorly on the left side. Caudal furca is symmetrical, each ramus bearing five setae and a small bristle (text-fig. 1 *c*). *Appendages* : The *antennule* is 22-jointed, and the joints have the following proportional lengths.

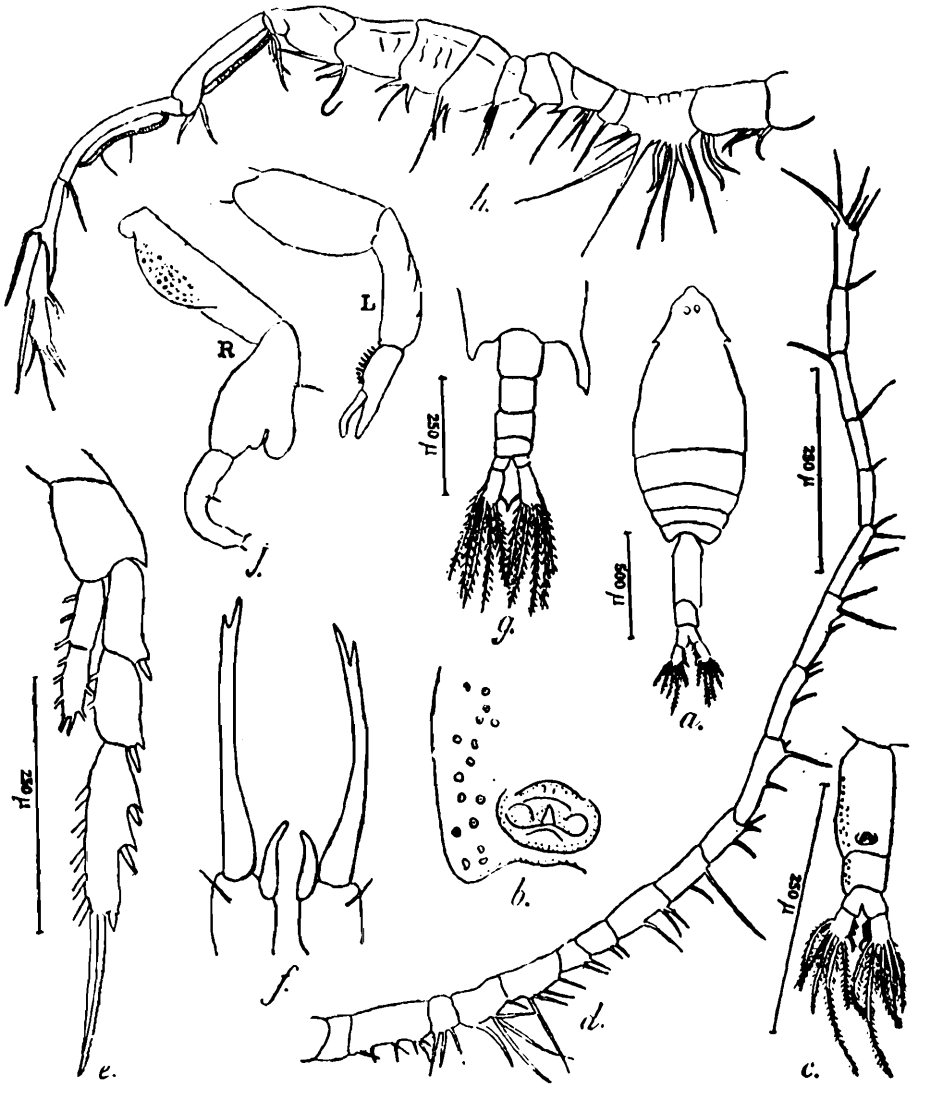
1. 2. 3. 4. 5. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 20. 18. 21. 19.

22. 10. 10. 30. 5. 12. 20. 6. 10. 20. 20. 20. 26. 26. 26. 26. 20. 20. 20.

20. 21.

The joints between three and five are not very clear. The number of setae and their arrangement are as shown in the figure (text-fig. 1 *d*). *Antenna* and *mouth parts* resemble those of other members of the genus. The first four pairs of swimming feet have a three-jointed exopod and

a two-jointed endopod. *The first swimming feet :* the first exopod-joint bears an outer spine, the second an outer spine and two inner setae, while the terminal joint bears three outer lateral spines, a serrate spine and five inner setae. The endopodite is only half as long as the exopodite. The first joint carries three inner setae while the terminal one



Text-fig. 1.—*Labidocera bengalensis*, sp. nov.

a. Female, dorsal view ; *b*. Genital segment, ♀ ventral aspect ; *c*. Abdomen, ♀ ; *d*. antennule, ♀ ; *e*. First swimming feet, ♀ ; *f*. fifth leg, ♀ ; *g*. last thoracic segment and abdomen, ♂ ; *h*. Right antennule, ♂ ; *j*. Fifth leg (R—right ; L—left).

carries two outer, three inner, and two apical setae (text-fig. 1 *e*). The second, third and fourth pairs of swimming feet resemble the first one. *Fifth leg :* consists of a basal joint and one-jointed exopod and endopod. The basipod has a seta on its outer side. The exopod is long, slender, and bifid at the distal end, and is nearly four times longer than the endopod. The endopod is short, and stout with a pointed tip which is slightly bent towards the inner side (text-fig. 1 *f*). The fifth leg resembles that of *L. brasiliense* Farran (1929, pp. 276-277, Fig 31).

The Male.

Length.—1·18 mm.

Body is slightly smaller than that of the female and is more slender. The right posterior corner of the cephalothorax is produced acutely.

The abdomen is five-jointed. The anal segment is very short being only half as long as the previous segment (text-fig. 1 *g*).

Appendages :—The *antennule* of the right side is geniculate and is composed of 17 articles which have the following proportional lengths :—

1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17.

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7. 16. 10. 5. 4. 6. 9. 4. 9. 11. 16. 11. 30. 31. 16. 12. 11.

The third joint which is indistinctly divided appears to consist of four fused articles. The sixth joint is again indistinctly divided into two, bringing the total to 21 articles. But only 17 articles are clearly seen. The hinge lies between the thirteenth and fourteenth joint, the inner margins of which are serrate. The inner end of the fifteenth joint is produced into a toothed spinous process which is as long as the succeeding joint. The number of setae and their distribution are shown in the figure (text-fig. 1 *h*). *Antenna, mouth parts* and the *first four pairs of swimming feet* are as in the female. *Fifth leg* is prehensile. Its right branch is made up of three segments, a stout basal segment whose outer margin is swollen, a similar second joint whose inner edge is produced and which carries a spine on the inner side and a terminal, stout, claw-like joint which carries four short spines. The left joint (text-fig. 1 *j*, *L.*) appears to be four jointed. The basal joint is stout. The second joint is nearly as long as the first and carries a spine on its outer side ; the third joint whose distal end is produced, bears spinules on the inner side and the terminal joint is slender and claw-like.

Remarks.—The female closely approaches *L. brasiliense* Farran (*loc. cit.*) in the structure of the fifth foot, but differs in having the posterior corners of the cephalothorax rounded, in the asymmetrical genital segment with the tubercles and in the squared anterior end of the cephalosome. The male is closely allied to *L. minuta* Giesbrecht (1892) but differs from it in the structure of the posterior corners of the cephalothorax and fifth legs. Several females and males were found in the Madras as well as Krusadai plankton.

Family : CORYCAEIDAE.

Corissa indica, sp. nov.

The occurrence of the genus *Corissa* Farran at Madras is of considerable interest, because, since the establishment of this genus by Farran (1936) on a solitary female collected from the Great Barrier Reef in Australia it has not so far been recorded from any other locality. In a tow-net collection made at Madras Harbour on the 23rd and 26th July 1948 six females and two males were obtained, which are referable to this genus. As these specimens differ from the description of the female holotype *C. parva* (the genotype of *Corissa*) they are described as a new species *C. indica*. As the number of specimens at my disposal is larger, opportunity has been taken to confirm the character of the genus. The holotype (♀) and the allotype (♂) have been deposited in the Z. S. I. and bear the Regd. No. C 3016/1,

The Female.

Length.—0·742 mm.

Colour.—The body is transparent and colourless. The 'optic-cup' is deep orange in colour.

Body (text-fig. 2 *a*).—Resembles *C. parva* in general appearance. The cephalosome bears two prominent corneal lenses at the anterior end, as in *Corycaus*, but these are not widely separated. There are five thoracic segments which decrease in breadth gradually. The cephalothorax is twice as long as the abdomen. The abdomen is three-jointed. The genital segment bears a seta on each side. The furcal rami are broad and lamellar, carrying three apical setae and one sub-apical lateral seta each, on inner and outer margins (text-fig. 2 *b*).

Appendages.—The *antennule* (text-fig. 2 *c*) is five-jointed having the following proportional lengths 1. 2. 3. 4. 5.

11. 18. 19. 10. 15.

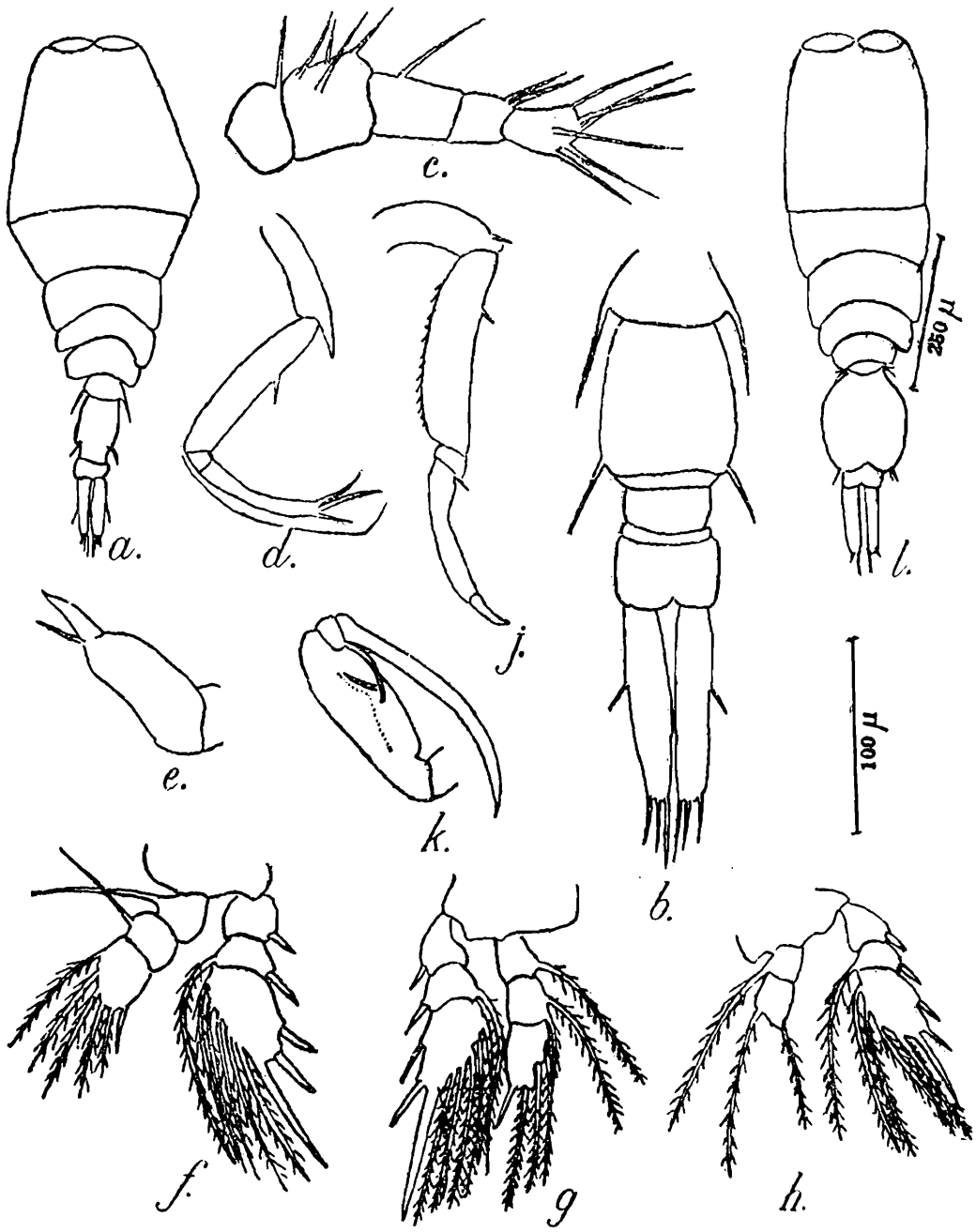
The *antenna* (text-fig. 2 *d*) is four-jointed. The basal joint bears a spine on the inner side. The second joint is twice as long as the first and carries a short spine about its middle on the inner side. The third joint is very small and devoid of spines and setae, while the terminal joint, which is six times longer than the third, carries two setae and a spine at the apex. *Mouth parts* are as in *C. parva*. The *maxilliped* (text-fig. 2 *e*), however, differs in structure. It is two-jointed and the swollen second joint carries a stout spine and a seta at the apex. There are four pairs of biramous swimming feet. *First pair of swimming feet* (text-fig. 2 *f*) the exopodite as well as the endopodite are three-jointed. The first exopodite joint has an outer lateral spine, the second an outer lateral spine and an inner seta, and the terminal two outer lateral spines, a long apical spine and five inner setae. The first and second joints of the endopodite carry a seta each towards the inner side, while the terminal one carries one stout spine and five setae. *Second pair of swimming feet* (text-fig. 2 *g*) resembles the first one in general structure but differs from it in having two inner setae in the second endopod joint and only three setae and one slender spine in the third endopod joint. The third pair resembles the second one. *Fourth pair of swimming feet* (text-fig. 2 *h*) : the exopodite is three-jointed but the endopodite is only two-jointed. The first exopod joint carries one outer spine, the second joint one outer spine and one inner seta while the terminal joint bears three spines and four inner setae. *Fifth pair of swimming feet* is represented by a single bristle which is long, reaching the end of the genital segment.

The Male.

Size.—0·711 mm. Slightly shorter than the female.

Colour.—Excepting the genital segment which is of a deep orange colour, the male is colourless and transparent.

Body (text-fig. 2 *l*).—The two corneal lenses at the anterior side are very close to each other. The last thoracic segment is very narrow and it carries three bristles on each side which represent the fifth legs. The abdomen is two-jointed. The genital segment is very swollen and carries a spinous process on each side at the posterior corners. The furcal rami are longer than broad and are provided with two setae each at the tip.



TEXT-FIG. 2.—*Corissa indica*, sp. nov.

a. Female, dorsal view ; *b*. Abdomen, ♀ ; *c*. Antennule, ♀ ; *d*. Antenna, ♀ ; *e*. maxilliped, ♀ ; *f*., *g*. & *h*. First, second and fourth swimming feet resp., ♀ ; *j*. Antenna, ♂ ; *k*. Maxilliped, ♂ ; *l*. Male, dorsal view.

Appendages.—The *antinnule* is as in female. The *antenna* (text-fig. 2 *j*) is four-jointed as in female, but differs from that of latter in (i) the absence of a spine on the basal joint, (ii) the second joint being setose on the outer side, (iii) the third joint carrying a spine on the inner side

and (iv) the terminal joint having only one claw-like spine. The *mandible* and *maxillae* are as in the female. The *maxilliped* (text fig. 2 *k*) is two-jointed. The second joint which is very stout carries a row of spinules and is hinged to an apical claw which is longer than the rest of the appendage. *Swimming appendages* are similar to those of female. *Fifth leg* is represented by two bristles.

Remarks.—The following table of comparison between *C. prava*, the *type species* of the genus, and the present form will show that we are dealing with a second species of the genus.

	Corissa parva Farran.	*Corissa indica*, sp. nov.
Length	Female 0·87 mm.	Female 0·742 mm. Male 0·711 mm.
Antennule ..	5-jointed. .. .. .. 1, 2, 3, 4, 5, 19, 36, 30, 14, 24.	5-jointed. 1, 2, 3, 4, 5, 11. 18. 19. 10. 15.
Antenna	3rd joint with two short spines on the inner side and the terminal joint with two short spines and a long spine.	3rd joint without spines or setae. Terminal joint with one claw and two setae.
First pair of swimming feet.	Exopod with 1,1,3 outer spines and 0,1,4 inner setae.	Exopod with 1,1,3 outer spines and 0,1,5 inner setae.
Second swimming feet	Basipod with outer seta	Basipod without outer seta.
	Endopod with 0,0,2 outer spines and 1,2,4 setae.	Endopod 0,0,1 outer spines and 1,2,3 inner setae.
3rd swimming feet	Endopod with 0,0,1 outer spines and 1,2,2, inner setae.	Endopod with 0,0,1 outer spines and 1,2,3 inner setae.

Corrissa indica can be defined as follows:—General shape resembling that of *C. parva*. Length of female 0·747 mm. and of male 0·711 mm. *Antennule* five-jointed. *Antenna* four jointed, the third joint without setae and the terminal joint with a claw and two setae. Exopod of first swimming feet with 1,1,3 outer spines and 0,1,5 inner setae. Endopod of second leg with 0,0,1 outer spines and 1,2,3 inner setae. The male slightly shorter than the female. Genital segment very swollen carrying two setae posteriorly. *Maxilliped* prehensile. Fifth leg represented by two bristles.

Family : LICHOMOLGIDAE.

Sub-family : *LICHOMOLINAE* (Gurney).

Kelleria rubimaculata, sp. nov.

Occurrence.—Over fifty females and males of this form were collected between July and March. Scrutiny of the structure shows that it belongs to the genus *Kelleria* Gurney which contains only seven species, namely,

Kelleria propinqu (T. Scott), *K. pectinatu* (A. Scott), *K. regalis* Gurney, *K. purpuricincta* Gurney, *K. andamanensis* Sewell, *K. camortensis* Sewell and *K. gurneyi* Sewell. The present form differs from all these seven and hence, is treated as a new species and fully described below. The types bearing the Regd. Nos. C 3020/1 (holotype) and C 3030/1 (paratypes) are deposited in the Zoological Survey of India.

THE FEMALE.

Length.—0·7 mm.

Colour.—The animal was of a dirty yellow colour with red pigment scattered about the body. The alimentary canal was conspicuous by its blue colour.

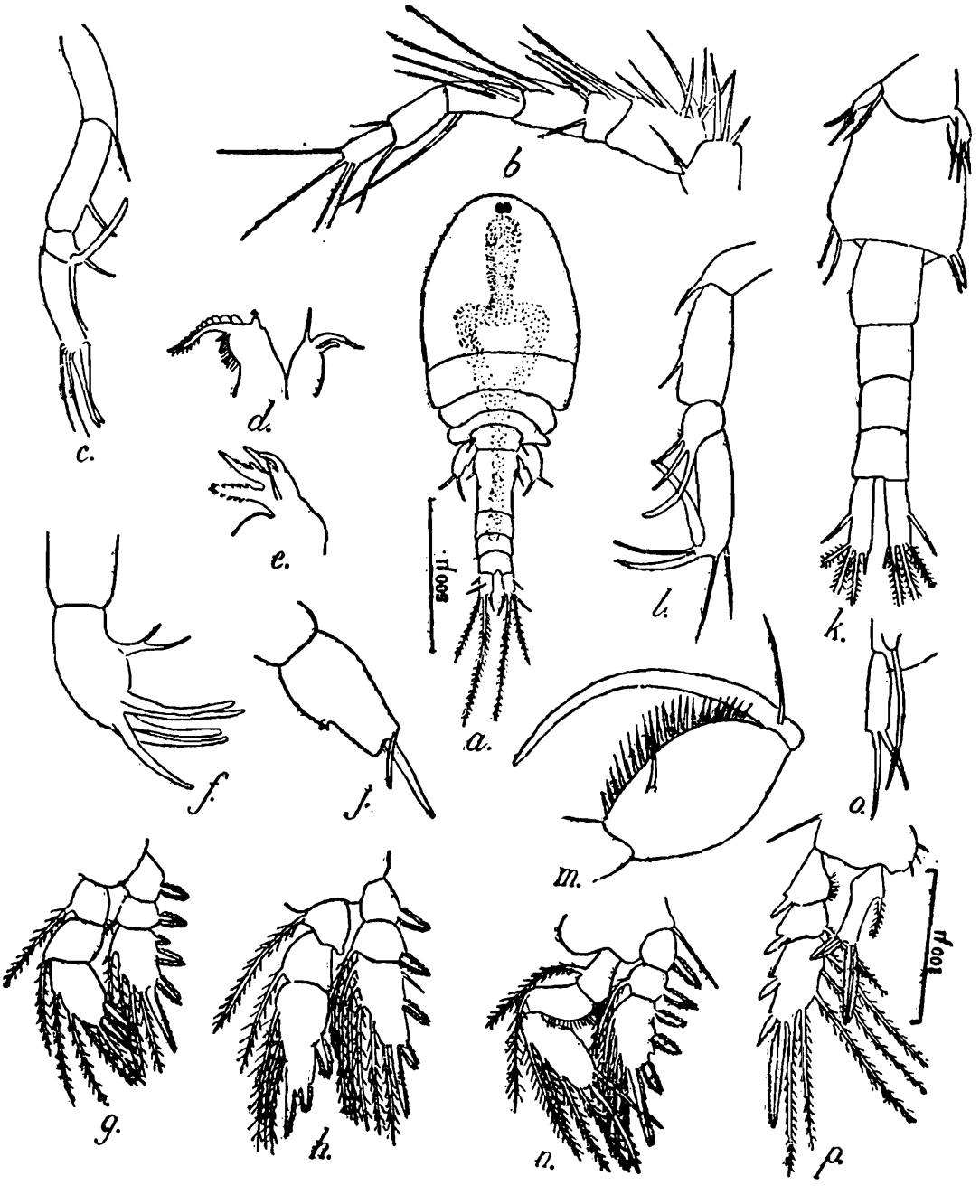
Body (text-fig. 3 *a*).—The general body shape is cyclopiform. The cephalosome forms more than a third of the total length and is longer than broad. The second, third and fourth thoracic segments appear curved anteriorly with their postero-lateral corners produced into rounded lobes. These three segments decrease in length and breadth gradually. The division between the fifth thoracic segment and the genital segment is marked off by a groove. The abdomen is four-jointed. The genital segment is longer than broad, and is swollen towards the anterior third of the length where two setae are found attached. The caudal rami are longer than broad, there being five setae and a bristle on each ramus.

Appendages.—The *antennule* (text-fig. 3 *b*) is seven-jointed and the joints have the following proportional lengths 1, 2, 3, 4, 5, 6, 7, The

9, 15, 5, 10, 11, 9, 7

number of setae and their arrangement are as shown in the figure. The *antenna* (text-fig. 3 *c*) is four-jointed, the joints one, two and four are of nearly the same length, while the third joint is much smaller, being about a fourth in length. The first and second joints bear a seta each towards the inner side while the third joint bears two setae and a claw-like spine, and the fourth joint carries terminally two stout claw-like spines as well as two setae. The *mandible* (text-fig. 3 *d*) bears a dorsal row of teeth and is produced into a flagellar process. The basal portion of its ventral side is fringed with 'hairs' The *maxilla* (text-fig. 3 *d*) is single-jointed with two short spines and a long blunt spine between. The *second maxilla* (text-fig. 3 *e*) has four processes towards the inner side, of which two are dentate. There is a short spine on the basal joint. The *maxilliped* (text-fig. 3 *f*) is three-jointed, of which the long, bulbous second joint is not clearly marked off from the third. The second joint bears distally a stout bifid spine and a stout claw-like spine, while the third is distinguished by three stout claws and a seta. In the *first pair of swimming feet* (text-fig. 3 *g*) the exopodite as well as endopodite are three-jointed. The first exopodite-joint bears a serrate spine towards the outer side, the second joint bears a serrate spine and an inner seta and the third bears three outer lateral serrate spines, a long apical spine which is serrate on the upper side only, and four inner setae. The endopodite is longer than the exopodite, and its

first and second joints carry an inner seta each, while, the terminal one carries two apical serrate spines and five inner setae. *In the second pair of swimming feet* (text-fig. 3 *h*) the exopod is three-jointed. The first joint has an outer serrate spine the second has an outer serrate spine and an inner seta while the third joint, which is as long as the first two joints combined, has two outer lateral serrate spines, a naked outer-lateral spine, an apical serrate spine and five inner setae. The endopodite which is slightly longer than the exopodite is also three-jointed. The first and second joints carry an inner seta each, while the third joint carries two outer lateral serrate spines, one apical serrate spine, and three inner setae. *The third pair of swimming feet* resembles the second pair. In the *fourth swimming feet* (text-fig 3 *p*) the exopodite is three-jointed, but the endopodite is made up of a single joint as in all members of this genus. The basipodite is broad and carries a seta towards the outer



TEXT-FIG. 3.—*Kelleria rubimaculata*, sp. nov.

a. Female, dorsal view; *b*. Antennule, ♀; *c*. Antenna, ♀; *d*. Mandible and Maxillula, ♀; *e*. Maxilla, ♀; *f*. maxilliped, ♀; *g*. & *h*. Second and fourth swimming feet resp., ♀; *j*. Fifth leg ♀; *k*. Abdomen, ♂; *l*. antenna, ♂; *m*. maxilliped, ♂; *n*. First swimming feet, ♂; *o*. Fifth leg, ♂.

side and three short spines towards the inner side. The first joint of exopod has its inner margin hirsute and carries an outer-lateral serrate spine, the second joint one outer spine and an inner seta and the third joint two outer lateral serrate spines, one apical serrate spine and five inner setae. The single-jointed endopodite carries an inner plumose seta and two unequal serrate spines at the apex. *Fifth leg* (text-fig. 3 *j*) is single-jointed, broad and laminar, with two naked spines, the outer one being longer than the inner one.

THE MALE.

Length.—0·637 mm. Slightly shorter than the female.

Colour.—As in female.

Body.—Though the general body form is like that of the female, the male can be distinguished easily by the abdomen being five-jointed, the genital segment being very swollen and slightly longer than broad, carrying three setae (text-fig. 3 *k*).

Appendages.—The *antennule* is seven-jointed and resembles that of the female. The *antenna* (text-fig. 3 *l*), which is four-jointed resembles that of the female except for an additional seta on the fourth joint. The *mandible* and *maxillae* are as in the female. The *maxilliped* (text-fig. 3 *m*) is prehensile. It is two-jointed, the second joint being very swollen and fringed with spines towards the inner margin. It bears a long, stout, claw at its proximal end. In the *first swimming feet* (text-fig. 3 *n*) the basipodite carries a seta towards the inner side. The exopodite is three-jointed. The first exopodite-joint carries an outer lateral serrate spine, the second joint an outer lateral spine and an inner seta while the third joint bears three serrate spines and four inner setae. The endopodite, which is also three-jointed, is longer than the exopodite, its first and second joints carry an inner seta each while the third joint bears four inner setae and two serrate spines. The inner margin of the second joint is hirsute. The *second, third* and *fourth swimming feet* are as in the female. The *fifth leg* (text-fig. 3 *o*) is long and slender with two unequal spines.

Remarks.—The present species resembles *Kelleria regalis* Gurney more closely than the other known species of the genus. However, it differs from the former in several character as shown in the table below :—

	Kelleria regalis Gurney.	*Kelleria rubimaculata*, sp. nov.
Length	Female 1·45 mm. Male 1·35 mm.	Female 0·7 mm. Male 0·637 mm.
1st antenna	1. 2. 3. 4. 5. 6. 7. 15. 25. 10. 20. 20. 22. 14.	1. 2. 3. 4. 5. 6. 7. 9. 15. 5. 10. 11. 9. 7.
2nd antenna	Four-jointed. Third joint with 3 inner setae. Fourth joint with six setae.	Four-jointed. Third joint with two setae and a claw-like spine. Fourth joint with two setae and two claw-like spines.

	Kelleria regalis Gurney.	*Kelleria rubimaculata*, sp. nov.
Mandible	Ventral edge strongly toothed.	Ventral edge not toothed but hirsute towards the basal side.
1st Maxilla	A simple lappet with three terminal setae and a hook-like spine.	A simple lappet with three spines.
2nd Maxilla	With a basal portion and a two-jointed upper portion. The second joint bearing three simple and two large denticulated spines.	The second joint with naked spines and two large spines which are denticulated on the upper side only.
Maxilliped ..	In Female — three-jointed. Spines on the 2nd joint bifid.	In Female — three-jointed. Spine on the distal end of 2nd joint not bifid.
1st swimming feet	Basipod with an outer seta. Third exopod-joint with four outer lateral spines.	Basipod without an outer seta. Third exopod joint with five lateral spines.
2nd swimming feet ..	Third exopod-joint with four spines and five inner setae. Endopod-third-joint with three spines.	Third exopod-joint with three serrate spines and one naked spine. Endopod-third-joint with one spine.
Fourth leg ..	Basipod with an outer seta.	Basipod with an outer seta and three inner spines.

As will be clear, from the table the present species is distinct and different from *K. regalis* and I, therefore, propose to name it as *K. rubimaculata*, sp. nov., because of its distinctive colouration. *K. rubimaculata* may be defined as follows :—*Length.* Female 0·7 mm. and male 0·637 mm. *Antennule* seven-jointed. The third joint of the *antenna* armed with two setae and a claw-like spine. Fourth joint two setae and two claw-like spines, The ventral edge of *mandible* hirsute towards the basal side. *First maxilla* a simple lappet with three spines. *Maxilliped* three-jointed in the female. The spine on the distal end of second joint not bifid. Basipod of *first swimming feet* without an outer-seta. Third exopod joint with five lateral spines. In the *second swimming feet* third exopod-joint with three serrate spines and naked spines. Third joint of the *endopod* with one spine. Basipod of *fourth* leg with an outer seta and three inner spines.

Macrochiron (Paramacrochiron) ornatus, sp. nov.

Occurrence.—Large numbers of this form were collected between August and March in the plankton. The holotype and allotype have been deposited in the Z. S. I. (Regd. No. C 3018/1).

The Female.

Length.—0·84 mm.

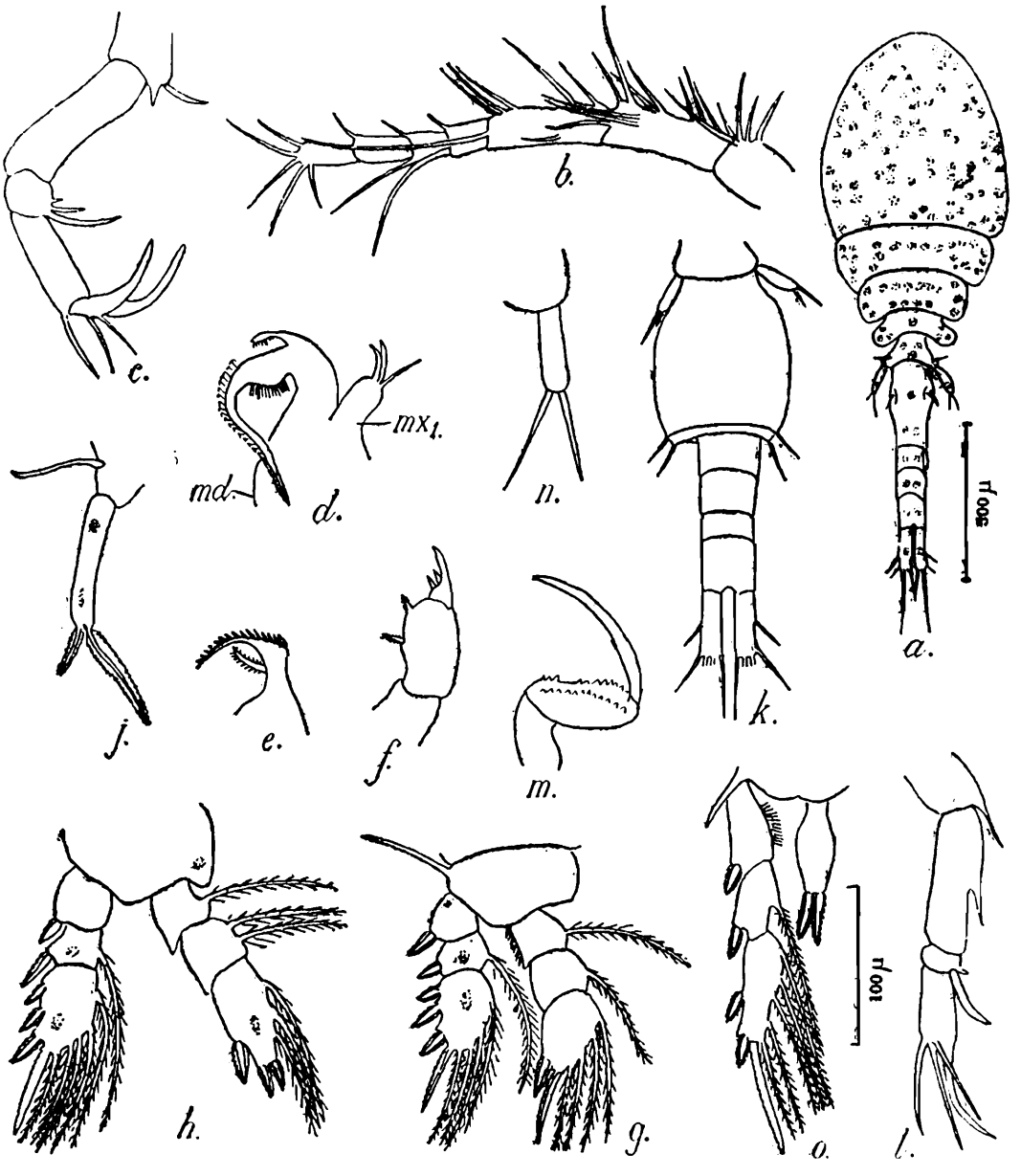
Colour.—When alive, the animal is of a dirty yellow colour with a number of blue patches, on the dorsal side of the body and even on

the swimming feet. These blue patches fade away after preservation in formalin.

Body (text-fig. 4 *a*).—The cephalosome is broadly ovate and is about twice as long as broad with posterior edge concave. The rostrum is broadly triangular and is bent on the ventral side. The abdomen is four-fifth the length of the cephalothorax. It is four-jointed, the first of which (the genital segment) is as long as the three others put together and is inflated in its anterior half. There are two setae in the genital pore. Each ramus bears a seta externally and three terminal setae of which the second from the inner side is the longest. This seta was never in tact in any of the specimens.

Appendages.—The *antennule* (text-fig. 4 *b*) is seven-jointed, the joints having the following proportional lengths $\frac{1.\ 2.\ 3.\ 4.\ 5.\ 6.\ 7.}{12.\ 18.\ 5.\ 12.\ 11.\ 8.\ 8.}$ Each joint bears a large number of setae, arranged as shown in the figure. The *antenna* (text-fig. 4 *c*) is four-jointed. The basal joint bears two short spines towards the inner side of its distal margin. The second joint is the longest and is devoid of spines and setae. The third joint is the shortest and bears two short spines and a claw towards the inner side. The terminal joint bears three unequal spines and two stout 'claws' which are probably used when this copepod chooses to attach itself on a host. *Mandible* (text-fig. 4*d*, *md*) consists of a swollen base produced into a long flagellar extension. A short plumose spine on the dorsal side and the patch of hairs on the ventral side mark the base of the flagellar process. The *first maxilla* (text-fig. 4*d*, *mx 1*) is single-jointed and is armed with three terminal setae. The *second maxilla* (text-fig. 4*e*) is also flagellar and armed with spinules on the dorsal side. There is a plumose spine at its base on the ventral side. The *maxilliped* (text-fig. 4*f*), which appears to be prehensile, is three-jointed. The second joint is swollen and bears two plumose spines on its inner edge. The terminal joint is short and claw-like and bears a spine and a short seta towards the inner side. *First swimming feet* (text-fig. 4*g*) are biramous, both the rami being three-jointed. The basipodite bears a seta towards the outer side. The proximal joint of the exopodite bears on the outside a short, lanceolate spine with serrate edges. The second joint bears a similar spine on the outer edge and a plumose seta on the inner margin. The terminal joint has three such spines, a long, straight spine on the outer edge and four setae on the inner side. The outer edge of the basal joint of the endopodite is hirsute while the inner edge bears a plumose seta, its second joint a seta on the inner side and the third bears two serrate spines and four plumose setae. *The second* (text-fig. 4*h*) *and the third swimming feet* are similar. The endopod is a little longer than the exopod. The first and second exopod joints are as in the first swimming feet, the third exopodite joint is large, being as long as the first and second joints put together and bears five plumose setae and four serrate spines. The first endopodite-joint bears one, and the second, two, plumose setae on the inner side while the third joint which is far longer, carries three serrate spines, one on the outer side and two terminally and three plumose setae on the inner side.

In the *fourth foot* (text-fig. 4*o*) exopodite is three-jointed while the endopodite is single-jointed. The single-jointed endopodite is tipped with two serrate spines and is 'hairy' on the inner side. The first



TEXT-FIG. 4.—*Macrochiron* (*Paramacrochiron*) *ornatus*, sp. nov.

a. Female, dorsal view; *b*. Antennule, ♀; *c*. Antenna, ♀; *d*. Mandible (*Md*.) and Maxillule (*Mx*.) ♀; *e*. Maxilla, ♀; *f*. maxilliped, ♀; *g*., *h*. & *o*., First, second and fourth swimming feet resp., ♀; *j*. Fifth leg, ♀; *k*. Abdomen, ♂; *l*. antenna, ♂; *m*. maxilliped, ♂; *n*. fifth leg, ♂.

exopod-joint bears an outer spine. The second joint bears a spine on the outer side and a plumose seta on the inner side. The terminal joint bears three serrate spines, of which the terminal one is several times longer than the other two, and five inner setae. *Fifth leg* (text-fig. 4*j*) is single-jointed, and tipped with two serrate spines of unequal length. There is a seta attached to the part of the body bearing this fifth leg.

THE MALE.

Length.—0·635 mm.

Body.—It resembles that of the female in general shape as well as colour, but is shorter in size. The abdomen (text-fig. 4*k*) is composed

of five segments. The genital segment is very swollen, more or less barrel-shaped carrying two short spines at the outer marginal end on each side.

Appendages.—The *antennule* is seven-jointed as in female. The second and fourth joints bear two long 'aesthetes' in addition to the setae. The setae are arranged as in the female. The *antenna* (text-fig. 4*l*) is four-jointed. Its first joint is armed with only one spine. The second joint bears a short spine about the middle of the joint, the third joint a shot spine and a long claw, while the terminal joint bears one claw and three setae. The *mandible* and *maxillae* are as in the female. Of the three joints of the prehensile *maxilliped* (text-fig. 4*m*), the second joint is swollen and is furnished with a row of spinules on the inner side. The terminal joint is long and a stout claw, hinged to the second joint. First four pairs of swimming feet resemble those of the female. The *fifth* one (text-fig. 4*n*), however, differs from that of the female in being tipped with two simple setae.

Remarks.—This new species approaches *P. malayense* Sewell (1949) in the structure and armature of the terminal joint of the antenna, and the mandible and the first swimming feet, but differs from it in size, the armature of the furcal ramus, the structure of the 4th endopod and fifth leg. It resembles *P. parvum* (Scott) in the structure of the second maxilla, the maxilliped and the 4th swimming feet but differs in the structure of the antenna, mandible and first maxilla.

Family : CLAUSIIDIIDAE.

Saphirella enigmatus, sp. nov.

Since 1894, when Scott established the genus *Saphirella* with the type species *S. abyssicola*, three more species, viz., *S. tropica* Wolfenden (1905), *S. indica* Sewell (1924) and *Saphirella* sp. Gurney (1945) have been described. These four species fall into two size groups and different opinions have been expressed as regards their being either larval immature forms or adult ones or neotonic larvae. The present form, though clearly belonging to this genus, differs from the above mentioned four species, and is, hence, described as new to science. The holotype, bearing the Regd. No. C 3019/1, is deposited in the Zoological Survey of India.

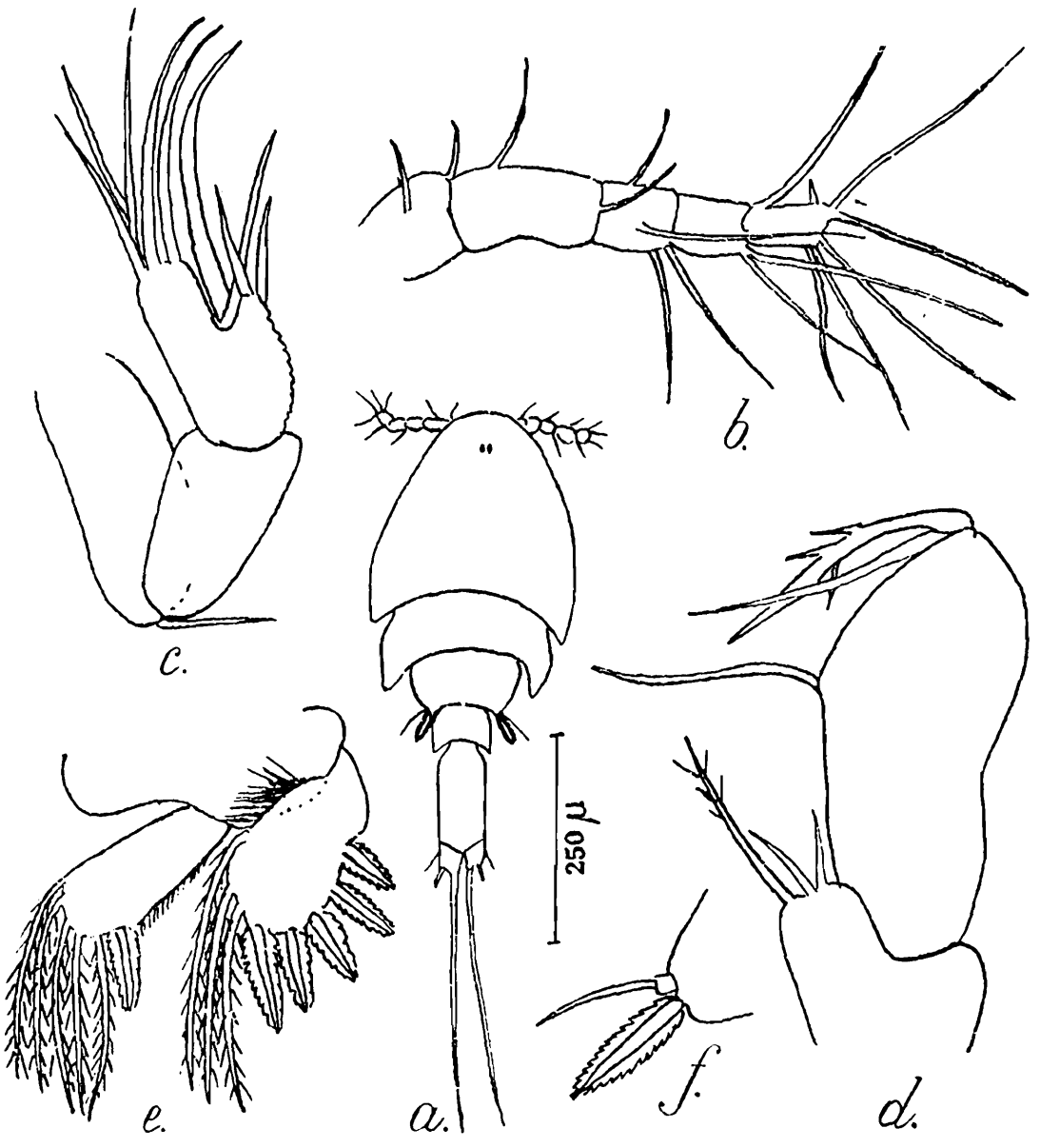
Occurrence.—Over 20 specimens were collected from Madras as well as Krusadai plankton between July and March.

Size.—1·7 mm. long (average length) from the tip of the cephalic plate to the tip of the caudal setae.

Colour.—Of a dark yellow colour and appeared very robust.

Body.—(text-fig. 5 *a*).—The cephalosome is elliptical with its postero-lateral corners produced acutely. The second thoracic segment is broader than long and has acute hind corner. The third segment which is about half as wide as the previous segment, carries a dagger-shaped spine and a seta on each side of its posterior margin (text-fig. 5 *f*). The next segment is narrower, leading to the still narrower abdomen.

Appendages.—The *antennule* (text-fig. 5 *b*) is five-jointed, the proportionate lengths of the joints being $\frac{1.\ 2.\ 3.\ 4.\ 5.}{4.\ 6.\ 3.\ 2.\ 3.}$ There is no aesthete such as Sewell (1924) and Gurney (1945) found in the third and fourth joints. The antenna (text-fig. 5 *c*) is three-jointed as in other species. The basal joint is the longest and bears a marginal seta, the second joint is slightly smaller and devoid of any spine or seta while the third joint has a serrate inner margin and is bilobed, the inner lobe carrying three spines and a long, stout, curved seta and the outer one carrying five long setae. All the mouth parts resemble those of *S. tropica* except the *maxilliped* (text-fig. 5 *d*) which is two-jointed, the basal joint carrying two small spines and a long plumose spine towards the inner margin, and the second joint bearing a long spine in the middle and two long, stout and scarcely plumose setae towards the upper part. *Swimming*



TEXT-FIG. 5.—*Saphirella enigmatus*, sp. nov.

a. Dorsal view ; *b*. Antennule ; *c*. Antenna ; *d*. Maxilliped ; *e*. First swimming feet ; *f*. Spine on the posterior corner of the third thoracic segment.

feet (text-fig. 5 *e*) : The laminate rami of the only two pairs of swimming feet present are unsegmented. The exopodite bears two apical and three sub-apical dagger-shaped spines and three inner setae. The inner margin of the exopodite is hirsute. The endopodite has its outer margin fringed with hairs and carries a dagger-shaped spine and five inner setae.

Taxonomic discussion.—A careful study of more than twenty specimens undoubtedly proved that this form is referable to *Saphirella* T. Scott, a genus which was provisionally created by Scott in 1894 to accommodate *S. abyssicola*. In 1905 Wolfenden added another species *S. tropica* from the Laccadives and Maldives. In 1924, Sewell, who described yet another species *S. indica*, felt that *Giardella* Canu (1886) and *Paurocope* Brady (1895) must be assigned a place in this genus. Nicholls (1944), however, rejected the suggestion to include *Paurocope robusta* in *Saphirella*. He also suggested that *Saphirella tropica* is only a juvenile stage of *Hemicyclops* sp. as the two agree in the structure of mouth appendages. Gurney (1945) felt that the name *Saphirella* should be restricted to the large form (measuring above 1 mm.). According to this definition the genus *Saphirella* will include only *S. abyssicola*, *S. tropica* and two specimens recorded by Gurney from Samoa as *Saphirella* sp. Sewell (1949. p. 66), who described *S. nicobarica* from Nicobar Is., states that " the known species of this genus *Saphirella* fall into two groups according to the length of the furcal rami." In the first group, the furcal remus is short, *e.g.*, *S. abyssicola* and *S. tropica*, and in the second group it is nearly one-third of the length of the abdominal segment, *e.g.*, *S. indica*, *S. nicobarica*. The present form, *S. enigmatus*, sp. nov. falls into the first group.

It is hoped that a careful and comparative examination of the specimens belonging to all these species may yet reveal diagnostic features, more reliable than merely a distinction based on size. So far as the present form is concerned it falls into *Saphirella* as defined by Gurney and is distinct from *S. abyssicola* T. Scott, *S. tropica* Wolfenden as well as the Samoan form described by Gurney. Hence it is described as a new species. It can be defined as follows : Body very robust. *Length* 1·5 mm. to 1·8 mm. *Antennule* five-jointed. The outer edge of the terminal joint of the *antenna* serrate, carrying two spines and two setae. The basal joint of the *maxilliped* with two spines and a seta. The endopodite of *swimming feet* with one apical dagger-shaped spine, and five sub-apical setae.

Remarks.—The present form is also of interest from the point of view of its maturity. While Scott (1912), Brady (1905) and Wolfenden (1905) considered *Saphirella* to be an adult male later workers like Sewell (1924), Nicholls (1944) and Gurney (1945) consider this to be an immature form. According to Gurney (*loc. cit.*) this " must belong to an adult genus not yet discovered or must be a persistent larval form comparable to the giant larval forms of Decapods " The second assumption is difficult to accept, as he himself points out later, since the larva is still in the first copepodite stage and is confined to the inshore waters unlike the Decapod larvae which live in the open sea.

ACKNOWLEDGMENTS.

It is with great pleasure that the author takes this opportunity to express his grateful thanks to Dr. C. P. Gnanamuthu, Director, Zoology Laboratory, Madras University for the guidance and help throughout the course of this work and to Col. R. B. Seymour Sewell, F. R. S. of Cambridge for his helpful criticisms and suggestions. To the Syndicate of the Madras University, the author is very thankful for the award of a studentship during the tenure of which the present work was carried out.

REFERENCES.

FARRAN, G. P., 1929.—Crustacea. Pt. X Copepoda. *British Antarctic ("Terra Nova") Expedition*, 1910. *Zoology* Vol. VIII, No. 3.

——, 1936.—Copepoda. *Sci. Reports of the Great Barrier Reef. Exped.* Vol. V, No. 3.

GIESBRECHT, 1892.—Systematik und Faunistic-der pelagischen copepoden des Golfes von Neapel. *Fauna und Florades Golfes von Neapel*, Vol. XIX.

GIESBRECHT & SCHMEIL, 1898.—Copepoda. 1. Gymnoplea. *Das Tierreich.* Band. 6.

GURNEY, R., 1927.—Report on the crustacea copepoda, littoral and semiparasitic. *Trans. Zool. Soc. Lond.* Vol. XXII, pp. 451-577.

——, 1945.—Notes on *Saphirella. Ann. Mag. Nat. Hist.* Vol. II, pp. 825-829.

MONOD, T. & DOLFUS,* 1932.—Les copepodes parasites de Mollusques. *Ann. parasitol. Hum. et. Comp.* Vol. 10 (2), pp. 129-204.

NICHOLLS, A. G., 1941.—Littoral copepoda from S. Australia. II Calanoida, Cyclopoida, Notodelphyoidea, etc. *Rec. S. Aust. Mus.* Vol. VI, pp. 381-427.

SARS, G. O., 1903.—An account of the crustacea of Norway. IV Copepoda Calanoida.

——, 1913-1918.—*Ibid*, Vol. VI. Copepoda Cyclopoida.

SCOTT, A., 1909.—Copepoda of the 'Siboga' Expedition. *Siboga Expedite.* Vol. 29. A.

SEWELL, R. B. S., 1932.—The copepoda of Indian seas, Calanoida (Pt. 2) *Mem. Ind. Mus.* Vol. X.

——, 1947.—Free swimming and planktonic copepoda. Systematic account. *John Murray Exped., Sci. Reports*, Vol. VIII, No. 1.

——, 1949.—Littoral and semi-parasitic Cyclopoida, Monstrilloida, etc. *Ibid* Vol. XI, No. 1.

TANAKA, O., 1939.—Some new species of copepoda from Sangami Bay. *Japanese Journal of Zoology, Trans. & Abstracts.* Vol. VII, pp. 31-36.

——, 1939.—Copepods of the Deep Waters of Saruga Bay. *Ibid.* Vol. VII, pp. 251-271.

THOMPSON, I.C. & A. SCOTT, 1903.—Report on the copepoda. *Ceylon Pearl oyster Fisheries Suppl. Rep.* No. VII, the Royal Society Lond.

WOLFENDEN, R. N., 1906.—Notes on the collection of copepoda. *Fauna and Geography of the Maldive and Laccadive Archepelagos 11.* Cambridge.

SIX NEW SPECIES OF TREMATODES BELONGING TO THE GENUS *PRICEA* CHAUHAN.

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Introduction.

The genus *Pricea* was established by Chauhan in 1945 with the type species *Pricea multae*. While studying a collection of trematodes from about 28 seer-fish, *Cybium guttatum*, which is netted at Madras from August to November 1950, the present author found that they belonged to seven distinct species of the genus *Pricea*. Of these one was *P. multae* Chauhan, while the rest appear to be new. Therefore a full account of these six species *P. tetracanthum*, *P. armatum*, *P. tricanthum*, *P. melane*, *P. minutum*, and *P. robustum* was deemed fit. In the present paper a key to the species of this genus and also certain additions to the generic characters made by Sporston (1946) are added. Of Chauhan's three species, the type species *Pricea multae* was taken from *Cybium lanceolatus*, while the other two were from *Thynus pelamys* and *Scomber microlepidotus*. The present record of the type species as well as six others is from the gills, in some cases more than one species infesting the gill on the same side of the host fish. It may also be added that the gills of this fish were infested by trematodes belonging to *Pseudomicrocotyle elegatis*, *Thoracocotyle sp.*, *Microcotyle species* as well as copepods of the genus *Pseudocycnus*. The type specimens are lodged in the Zoological Survey of India, Calcutta.

Family Gastrocotylidae Price, 1943.

Genus **Pricea** Chauhan, 1945.

Pricea tetracanthum, sp. nov.

(Text-Fig. 1, *a*—*e*.)

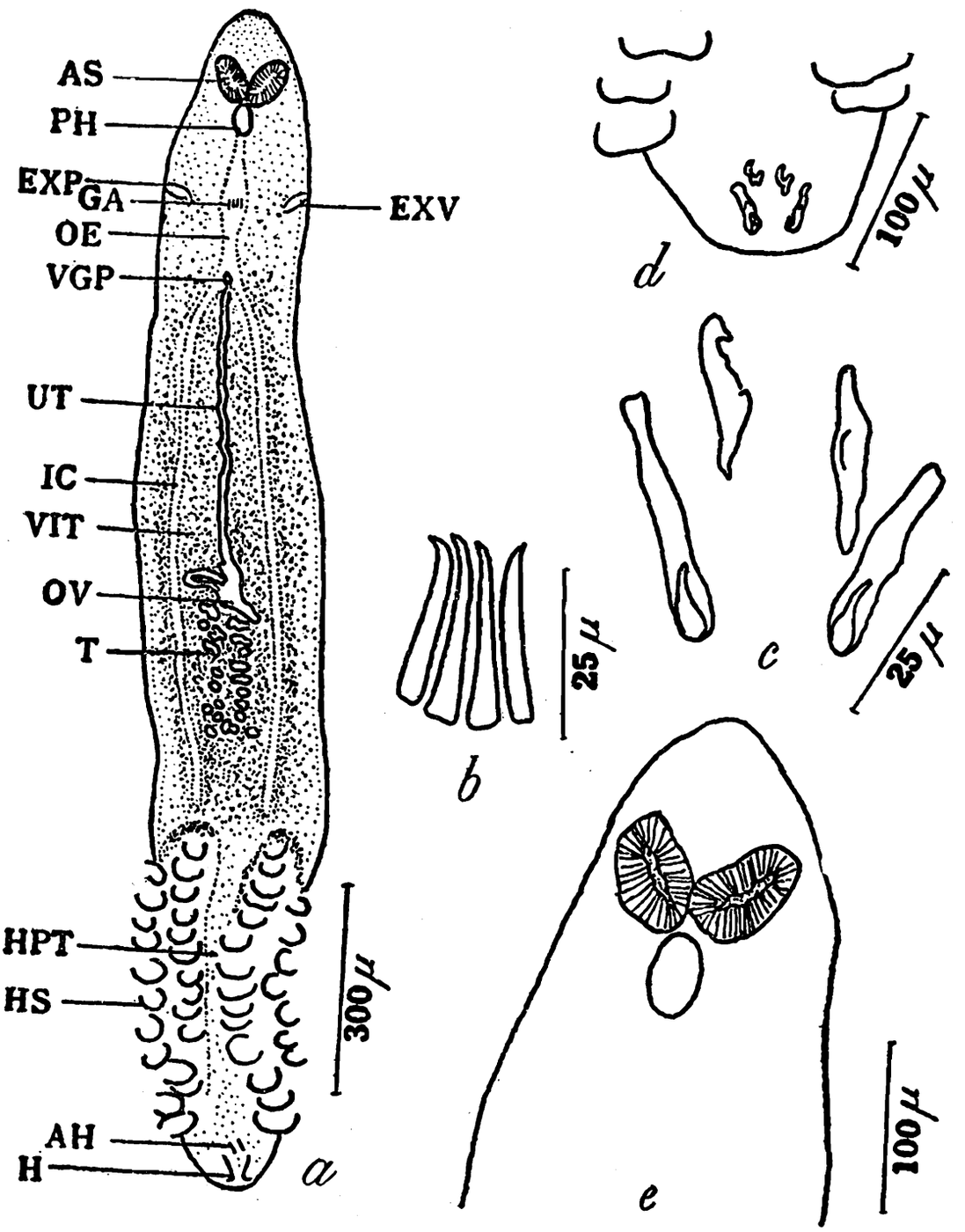
Host and record.—Of the seven *Cybium guttatum* examined in August 1950, only one of the parasite of this species was collected.

Site of infection.—Gills.

Locality.—Madras.

The form measures 1·678 mm. in length and ·357 mm. in its maximum breadth near the region of the ovary. The shape of the form is elongate and cylindrical, with the sides of the body almost parallel. The haptor (HPT) is at the posterior end of the body and measures ·499 mm. in length and ·258 mm. in breadth. The ratio of the size of the haptor to the body is roughly 1 : 3. The haptor bears 42 clamps (HS), arranged in two rows on each side. The clamps are all pedunculated and measure 39$\mu \times$ 59μ. The clamp structure is of the same type as described for the type species *P. multae* and consists of twenty four skeletal pieces, a pair of two thin long bars bent upon themselves (X and Y) in the Text Fig. 6c., a pair of transverse bars (TRB) located within the bent extrimity of the

inner lateral pieces (Text Fig. 6, D) situated outside the three pronged middle piece, giving support to the transverse ribs. The haptor ends in a blunt extension in which is borne a pair posterior hooks or anchors (H). In addition to them a little in front and in between them a pair of additional hooks is present. They measure 39μ and 27μ respectively. The additional hooks may be both situated close together in the



Text-fig. 1.—*Pricea tetracanthum*, sp. nov.

a. Entire specimen ; *b*. Genital hooks ; *c*. One pair of posterior hooks and a pair of additional hooks ; *d*. Position of hooks *in situ* ; *e*. Anterior portion of the body showing aseptate and speculate suckers and pharynx.

AH, additional hook ; AS, anterior sucker ; EXP, exeretory pore ; EXV, exertetory vesicle ; GA, genital atrium ; H, posterior hook, or anchor ; HPT, haptor ; HS, haptoral sucker ; IC, intenstinal crura ; OE, oesophagus ; OV, ovary ; PH, pharynx ; T, testes ; UT, uterus ; VGP, vaginal pore ; VIT, vitellaria.

middle or front or hind region of the haptor, or they may be separately situated one in front of the other, in front or middle or hind regions of the haptor.

Digestive System.—The sub-terminal mouth leads into the buccal cavity in which is situated a pair of oval, elongated, aseptate and spiculate oral suckers or anterior suckers (AS). The oral sucker measures 36μ× 68μ. The buccal cavity leads to the pharynx (PH) 42μ×36μ which is located immediately behind and in between the pair of oral suckers, ·132 mm. from the anterior end. The pharynx is led by the oesophagus ·272 mm. in length and bifurcates at ·446 mm. from the anterior end. It extends down as two diverticula (IC) ending blindly just in front of the haptor. The diverticula give out branches both on their inside and outside.

The vitellarian follicles (VIT) are not dense, are scattered very loosely and extend from the anterior region just behind the vaginal opening to the end of the diverticula. Few follicles are scattered in the region of the genital atrium. Vitellarian follicles do not extend into the haptor. The size of the follicle is 4μ×4μ. There is no deposit of pigment granules (PG).

Reproductive System.—The male reproductive system consists of the testes (T), post-ovarian in position, lying in the posterior region of the body in between the intestinal diverticula and anterior to the haptor arranged in two lateral rows. The testes, 20 in number are situated, ·874 mm. from the anterior end and extend ·196 mm. posteriorly. The size of the follicles varies from 21—27μ×14—16μ.

The course of the vas deferns (VD) is not seen well, but it opens in the genital atrium (GA), situated in the middle line on the oesophagus at a distance of ·259 mm. from the anterior end. The genital corna consists of twelve crochets (CH), long and slender 29μ in length.

The female reproductive system consists of the ovary (OV) pretesticular in position, lying in the middle of the body, in the middle line in between the diverticula at a distance of ·794 mm. from the anterior end and extends over a distance of 62μ posteriorly. The uterus (UT) proceeds from the ovary, running along the middle line anteriorly and opens at the unarmed vaginal opening (VGP) situated in the region of the intestinal bifurcation, ·420 mm. from the anterior end. No U-shaped vaginal hook is present. No eggs were present.

Exertory system.—Two excretory vesicles (Ex V) which open by marginal pores, are situated at the level of the genital pore.

Remarks.—*P. tetracanthum* resembles the species *P. multae, P. minimae* and *P. microcotylae* established by Chauhan, 1945 in the general shape of the body and the haptor and in the general structure of the clamps of the haptor. It agrees with *P. multae* and *P. microcotylae* in having 12 genital hooks. It is unique in having four hooks in the haptor, two as additional hooks and two as posterior hooks or anchors, but differs from the rest in the absence of the vaginal hook, in having 20 testes and haptoral suckers 42 in number. This species is distinguished by the presence of four hooks in the haptor.

Pricea armatum, sp. nov.

(Text-Fig. 2, *a*—*g*.)

Host and record.—Of the five *Cybium guttatum* examined one parasite of this species was got.

Site of infection.—Gilis.

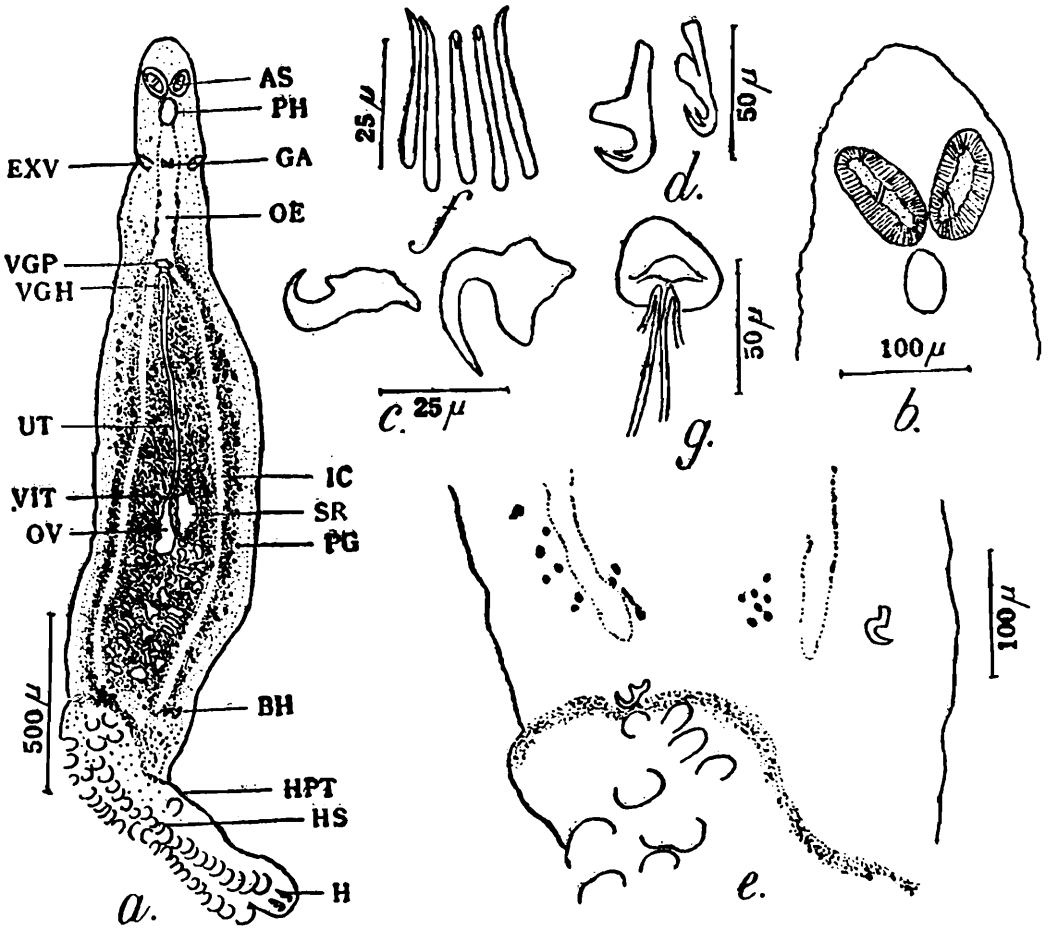
Locality.—Madras.

Body length 2·695 mm., breadth ·473 mm., Haptor length ·757 mm., breadth ·170 mm. Number of clamps 50, measuring 50μ×71μ. 5 or 6 transverse ribs. The anchors measure 48μ. There are two body hooks of pre-haptoral hooks, one situated just below the left diverticula, a little above the haptor and the other is situated on the right side of the right diverticula and measures 21μ.

Digestive System.—Anterior suckers septate and spiculate, measure 43μ×91μ. Pharynx 30μ×39μ. Oesophagus ·457mm. long.

Vitellarian follicles in dense clusters ; size of the follicle 7μ×5μ. Normal amount of pigment deposit.

Reproductive System.—Testes 31 in number, disposed irregularly and not in two lateral rows, in the inter-caecal area behind the ovary; situated



Text-fig. 2.—*Pricea armatum*, sp. nov.

a. Entire specimen ; *b*. Anterior part of the body showing the septate and spiculate anterior suckers and pharynx ; *c*. Body hooks or pre-haptoral hooks ; *d*. Posterior hooks ; *e*. Position of the body hooks *in situ* ; *f*. Genital hooks ; *g*. Pseudogenital sucker and the vaginal hook.

BH, body hook ; PG, pigment granules ; SR, receptaculum semiris ; VGH, vaginal hook. (Rest of the lettering as in Test-fig. 1.)

1·284 mm. from the anterior end. Size of the follicles ranging from 23μ× 32μ×35μ—60μ. Genital atrium ·348 mm. from the anterior end, consists of 14 hooks, 32μ in length.

Ovary situated 1·284 mm. from the anterior end. Vaginal opening is armed with an U-shaped hook, one of its arm measuring 61μ and is provided with fleshy muscular flaps giving the appearance of a pseudo-genital sucker.

Two excretory vesicles a little above the level of the genital opening.

Remarks.—The present species *P. armatum* agrees with the other forms in the general shape of the body, the haptor and in the general pattern of the clamp structure. It agrees with Chauhan's species in having armed vaginal pore and two body hooks. But it differs from *P. tetracanthum* in having vaginal hook and in the absence in the additional hooks and differs from all the species in having 31 tests, 50 clamps in the haptor and in the position of the body hooks, one just below left intestinal diverticula and the other on the right side of the right diverticula.

Pricea tricanthum, sp. nov.

(Text-Fig. 3, *a—f.*)

Host and record.—Out of the six *Cybium guttatum* examined only one of this species was got.

Site of infection.—Gills.

Locality.—Madras.

Body length 2·1 mm., breadth ·24 mm. Haptor ·66 mm. in length and ·24 mm. in breadth ; 20 pairs of pedunculated clamps measuring 43μ ×66μ. Six transverse ribs. Posterior hooks or anchors 27μ in length. There is an additional hook (AH) in the haptor and the other as pre-haptoral hook in front of the haptor and measurers 30μ and 23μ. The position of the additional hook as well as the body hook varies in their position in the haptor and in the body respectively.

Digestive System.—Anterior suckers septate and spiculate, measure 36μ×77μ. Pharynx 36μ×32μ. Oesophagus ·316 mm. in length. Bifurcation of the intestine ·446 mm. from the anterior end.

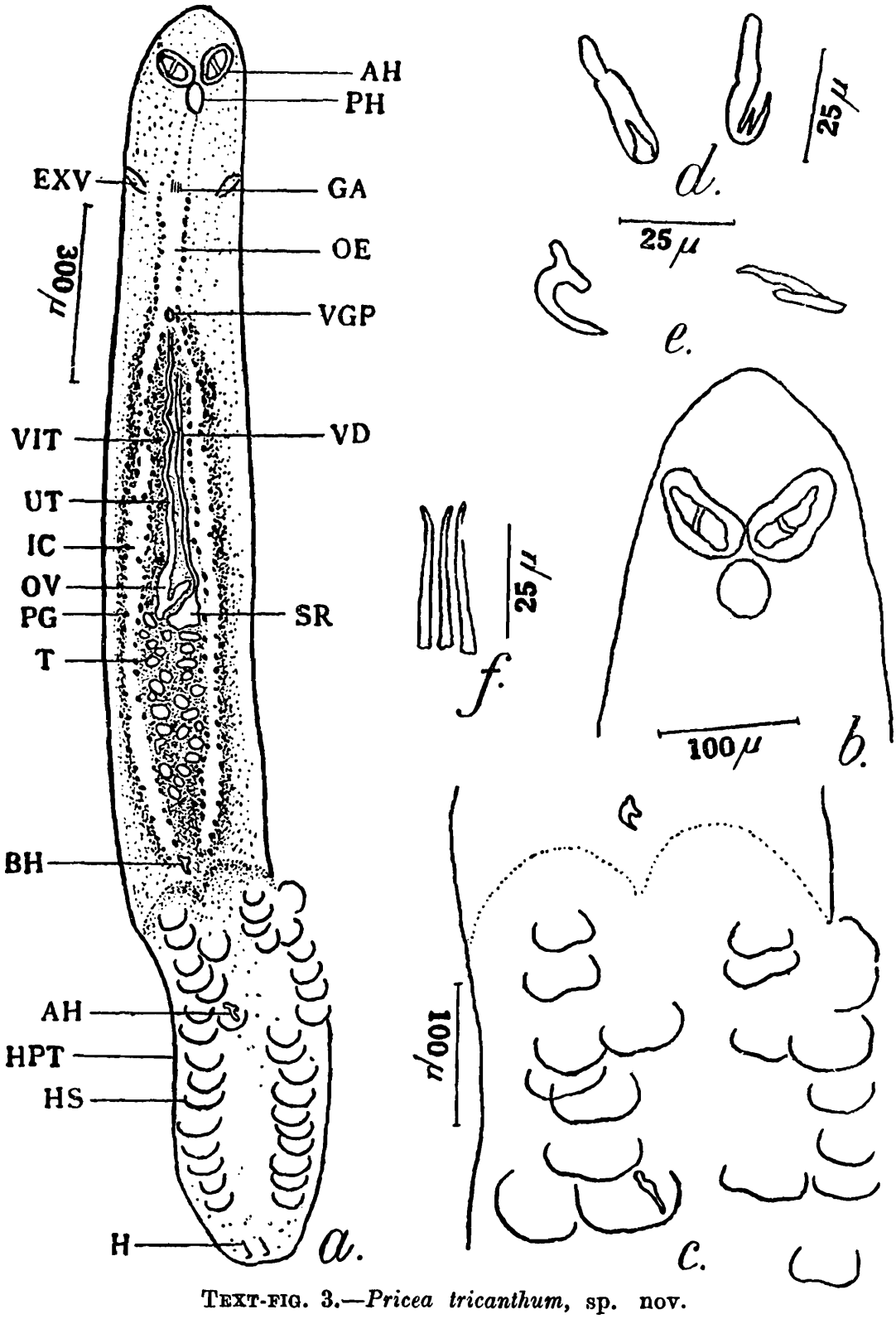
Vitellarian follicles uniformly spread and not in dense clusters, Pigment deposit very little along the sides of the diverticula.

Reproductive System.—Testes 28 in number, in two irregular lateral rows, follicle size ranging from 12μ—29μ×21μ—39μ. Testes located ·893 mm. from the anterior end and extend ·401 mm. posteriorly. Genital atrium ·256 mm. from the anterior end and has 14 hooks measuring 29μ in length.

Ovary ·775 mm. from the anterior end. Uterus opening, at the unarmed vaginal opening, ·428 mm. from the anterior end.

Two excretory vesicles opening by marginal pores, a little above the level of the genital opening.

Remarks.—The present form resembles the other species in the general shape of the body, the haptor and in the structure of the clamps. It agrees with *P. armatum* sp. nov. and *P. minimae Chauhan*, 1945 in having 14 genital hooks, with *P. tetracanthum* in having the vaginal pore unarmed. It differs from all the species in having one body-hook and three hooks in the haptor, one as additional hook and two as anchors or posterior hooks and also in having 28 testes and 40 clamps. The presence of three hooks characterizes *P. tricanthum.*



Text-fig. 3.—*Pricea tricanthum*, sp. nov.

a. Entire specimen ; *b.* Anterior part of the body showing the septate and spicluate anterior suckers and pharynx ; *c.* Additional hook and pre-haptoral hook *in situ* ; *d.* Posterior hooks ; *e.* Pre-haptoral hook (left) and additional hook (right) ; *f.* Genital hook.

VD, vas deferens (rest of lettering as in text-figs. 1 and 2).

Pricea melane, sp. nov.

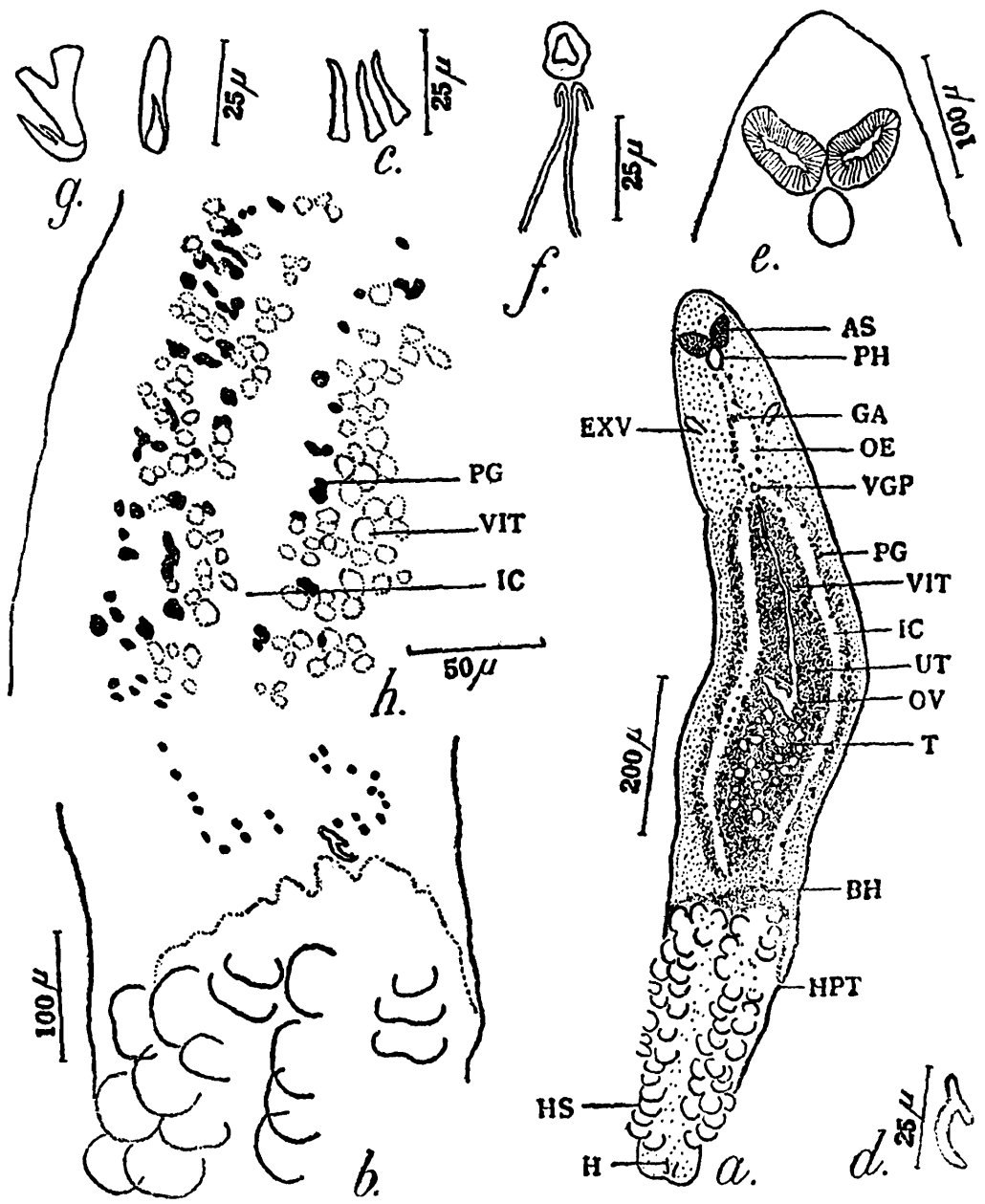
(Text Fig. 4, *a—h.*)

Host and record.—Out of the four *Cybium guttatum* examined on parasite of this species was got.

Site of infection.—Gills.

Locality.—Madras.

Body length 1·981 mm. and breadth ·393 mm. Haptor length ·660 mm. and breadth ·295 mm., 56 pedunculated clamps measuring 37μ×66μ. Six to eight transverse ribs. Posterior hooks or anchors measure 33μ. A single pre-haptoral hook alone is present just anterior to the haptor and in the body region, measuring 25μ.



TEXT-FIG. 4.—*Pricea melane*, sp. nov.

a. Entire specimen ; *b.* Body hook or pre-haptoral hook *in situ* ; *c.* Genital hook ; *d.* Body hook ; *e.* Anterior part of body showing the aseptate and spiculate anterior suckers and pharynx ; *f.* Pseudogenital sucker and vaginal hook ; *g.* Posterior hooks ; *h.* A portion of the body enlarged to show distribution of the vitellaria and pigment granules.

(Lettering as in Text-figs. 1 and 2.

Digestive System.—Anterior suckers aseptate and spiculate 39μ×71μ; pharynx 50μ×39μ. Oesophagus ·271 mm. in length. Intestinal bifurcation ·446 mm. from the anterior end.

Vitellarian follicles in dense clusters. Pigment deposit very heavy along the sides of the diverticula.

Reproductive System.—Testes 23 in number, disposed irregularly in the intercaecal area behind the ovary. Testicular follicles size ranging from 14μ—39μ×21μ—48μ, situated ·973 mm. from the anterior end and extend ·223 mm. posteriorly. Genital atrium ·259 mm. from the anterior end and consists of 12 hooks, 21 μ long.

Ovary situated ·866 mm. from the anterior end. Uterus opens at the armed vaginal opening, situated ·439 mm. from the anterior end, one of its arm measuring 48μ.

Two excretory vesicles opening by marginal pores a little above the level of the genital opening.

Remarks.—Like the previous species the present species agrees with other forms in the general shape of the body and the haptor. It differs from *P. minimae*, *P. armatum*, and *P. tricanthum* in having 12 genital hooks, agrees with Chauhan's species and *P. armatum* in having U-shaped vaginal hook. It differs from all the species in having only one body hook, 23 testes and 56 haptoral suckers. The numerous pigment granules all along the intestinal diverticula render the species *P. melane* dark coloured.

Pricea minutum, sp. nov.

(Text-Fig. 5, *a—f.*)

Host and record.—Out of the three *Cybium guttatum* examined only one parasite of this species was got.

Site of infection.—Gills.

Locality.—Madras.

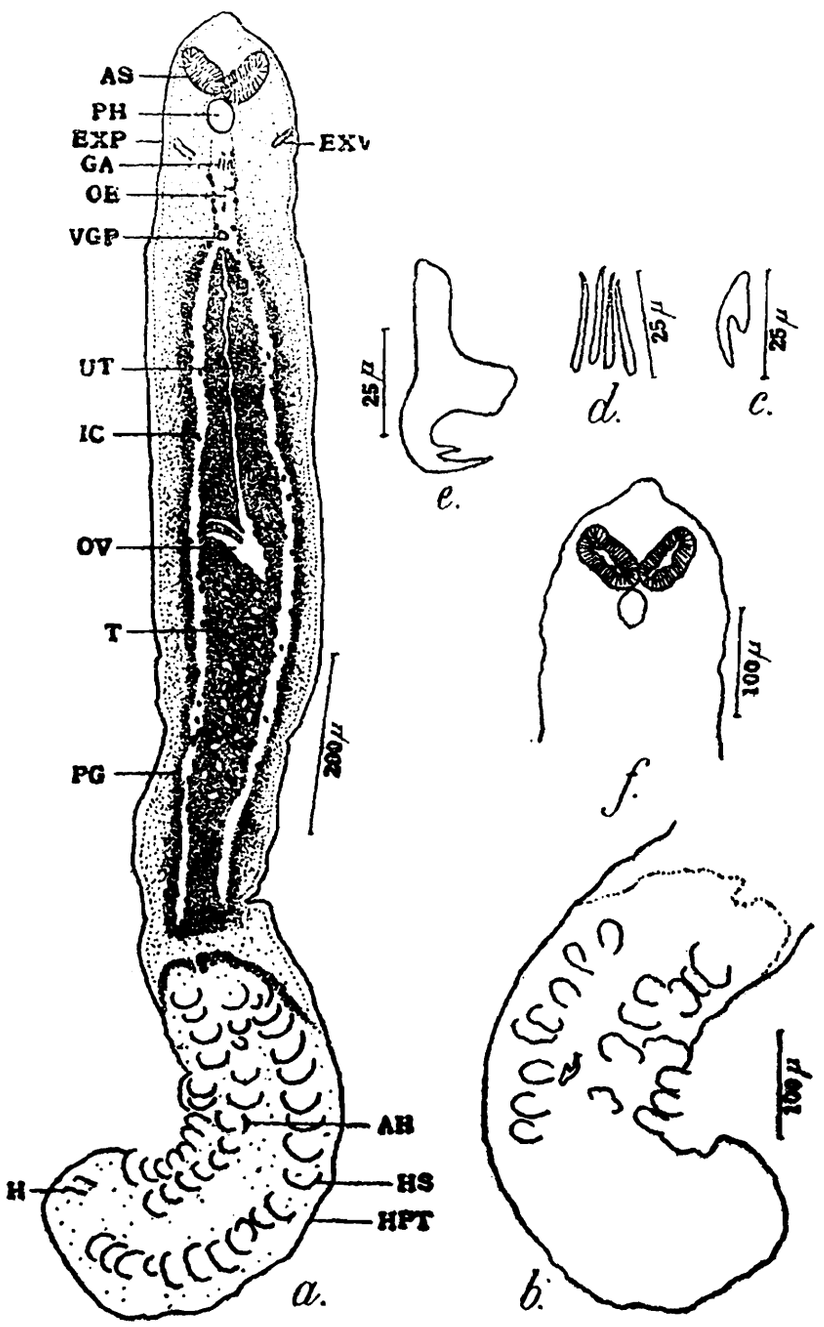
Body length 1·464 mm. and breadth ·201 mm. Haptor length ·384 mm. and breadth ·170 mm. 46 pedunculated clamps measuring 21μ×47μ. Five or six transverse ribs. Posterior hooks or anchors measure 36μ in length. An additional hook near the middle of the haptor, measuring 27μ in length, whose position may be located in front, middle or hind region of the haptor.

Digestive system.—Anterior suckers aseptate, spiculate and measure 36μ×68μ. Pharynx 25μ×25μ. Oesophagus length ·127 mm. and the intestinal bifurcation ·259 mm. from the anterior end.

Vitellarian follicles not so much dense. Pigment granules along the sides of the diverticula.

Reproductive System.—Ovary situated 0·571 mm. from the anterior end, uterus opening at the unarmed vaginal opening, situated 0·253 mm. from the anterior end.

Remarks.—The species resembles the other forms in the general shape of the body, the haptor and in the general pattern of the clamp. It agrees with *P. tetracanthum* and *P. tricanthum* in the absence of the



TEXT-FIG 5.—*Pricea minutum*, sp. nov.

a. Entire specimen ; *b*. Additional hook *in situ* ; *c*. Additional hook ; *d*. Genital hooks ; *e*. Posterior hooks ; *f*. Anterior portion of body showing the asep tate and spiculate anterior sucker and pharynx.

(Lettering as in Text-figs. 1 and 2.)

U-shaped vaginal hook, with *P. multae*, *P. microcotylae* Chauhan, 1945, *P. tetracanthum* and *P. melane* in having 12 genital hooks, with P. armatum in having 31 testes, differing from all the species in having only one additional hook and also differes in having 46 clamps. *Pricea minutum* is the smallest recorded so far.

Pricea robustum, sp. nov.

(Test fig. 6, *a*—*b*).

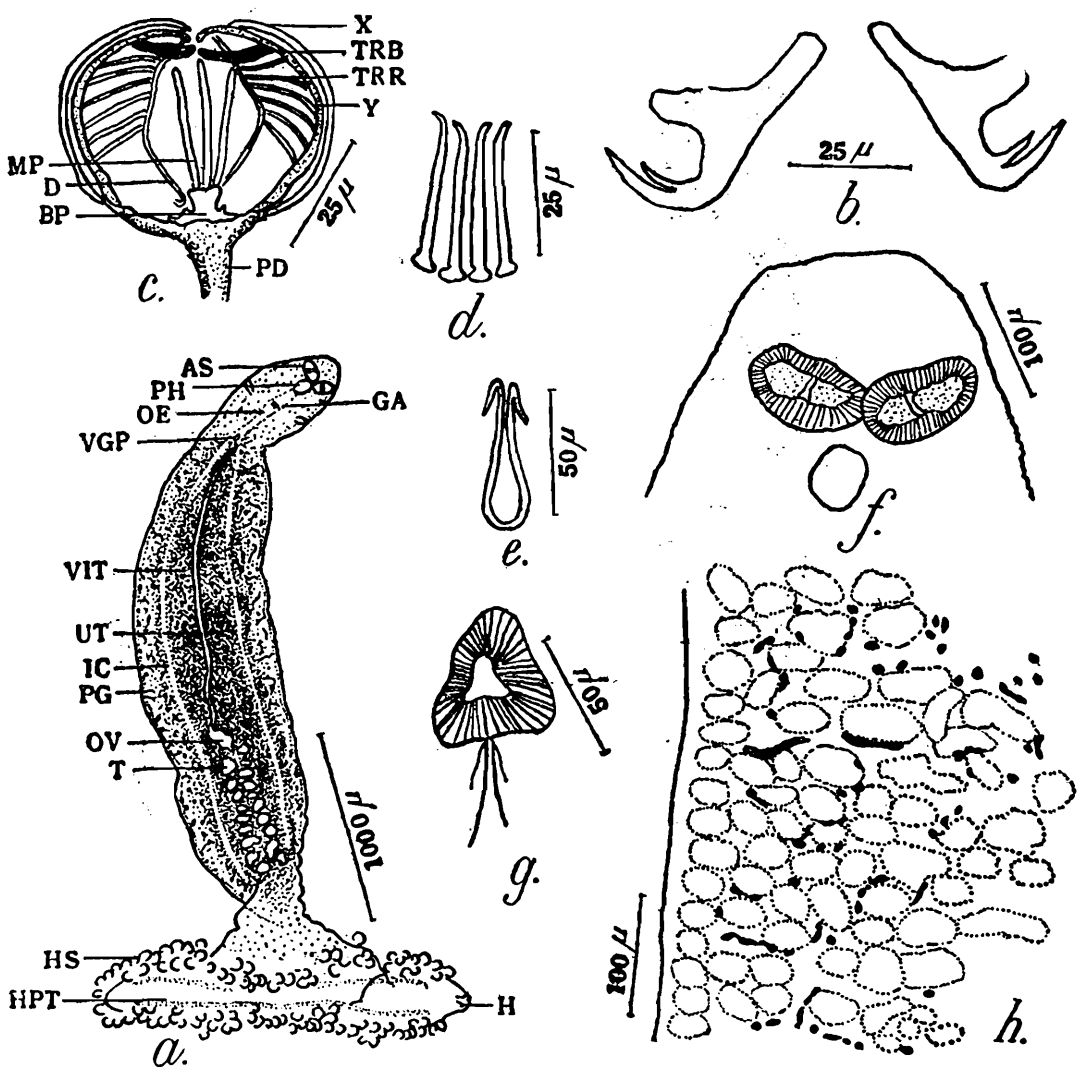
Host and record.—Out of the three *Cybium guttatum* examined many parasites of this species were got.

Site of infection.—Gills.

Locality.—Madras.

This species was collected alive and presented an appearance as shown in Text Fig. 6.a. with the haptor at right angles to the long axis of the body. The other forms described and sketched were not alive and the haptor appears in line with the axis of the body, probably due to post-mortal contraction.

Body length 3·53 mm. and breadth ·75 mm. Haptor 1·88mm. in length and ·35 mm. in breadth. 110 pedunculated clamps measuring 46μ—51μ ×58μ—69μ. Neither pre-haptoral hooks nor additional hooks present. Posterior hooks or anchors present, 23μ in length.



Text-fig. 6.—*Pricea robustum*, sp. nov.

a. Entire specimen ; *b*. Posterior hooks ; *c*. A haptoral sucker or clamp ; *d*. Genital hooks ; *e*. Vaginal hook ; *f*. Anterior part of the body showing the septate and spiculate anterior suckers and pharynx ; *g*. Pseudo-genital sucker and vaginal hook ; *h*. A portional of the body enlarged to show the distribution of the vitellaria and pigment granules.

BP, basal piece ; *D*, innermost thin and lamallar latera and picea ; *MP*, piece; *PD*, peduncle ; *TRB*, transverse bar ; *TRR*, transverse rib ; X, median outermost picea Y middle piece, (Rest of lettering as in Text-figs. 1 and 2).

Digestive System.—Anterior suckers septate and spiculate, measuring 35μ×75μ. Pharynx 45μ×35μ. Oesophagus ·382 mm. in length and the intestinal bifurcation ·552 mm. from the anterior end.

Vitellarian follicles in dense clusters and heavy deposit of pigment granules all over the body behind the region of the vaginal opening and in front of the haptor.

Reproductive System.—Testes 19 in number, in two lateral rows, situated 2·12 mm. from the anterior end and extend ·62 mm. posteriorly. Testicular follicles, size ranging from 44μ—54μ×49μ—98μ. Genital, atrium 14 hooks, measuring 30μ in length situated ·31 mm. from the anterior end.

Ovary situated 1·96 mm. from the anterior end and the uterus open at the armed vaginal opening ·545 mm. from the anterior end, one arm of the vaginal hook measuring 39μ. Vaginal opening with fleshy muscular flaps, giving the appearance of pseudo-genital sucker.

The excretory vesicles two in number open by marginal pores situated a little above the level of the genital atrium.

Remarks.—*P. robustum* resembles the other forms in general form of the body, the haptor and in the general structure of the clamps. It agrees with Chauhan's species and *P. armatum* and *P. melane* in having U-shaped vaginal hook, with *P. armatum P. tricanthum* and *P. minimae* in having 14 genital hooks. But differs from all the species in the absence of both body hooks as well as additional hooks, in having 19 testes and 110 haptoral suckers. *Pricea robustum* is the largest described in this paper.

KEY TO THE SPECIES OF THE GENUS *Pricea* CHAUHAN.

In addition to the characters given by Chauhan, 1945 and Sproston 1946—,'46 for this genus, the presence of one or two body hooks and the presence of one or two additional hooks are features of this genus which have been included.

1.	Body hooks present	2
	Body hooks absent	5
2.	Number of hooks two	3
	Number of hooks one	4
3.	Number of testes 26, genital hooks 12	*P. multae* Chauhan.
	Number of testes 28, genital hooks 10	*P. minimae* Chauhan.
	Number of testes 25, genital hooks 12	*P. microcotylae* Chauhan.
	Number of testes 31, genital hooks 14	*P. armatum*, sp. nov.
4.	One hook in the body only	*P. melane*, sp. nov.
	One hook in the body and other hook in the haptor	*P. tricanthum*, sp. nov.
5.	Additional hooks present in the haptor	6
	Additional hooks absent in the haptor	*P. robustum*, sp. nov.
6.	Two additional hooks in the haptor	*P. testracanthum*, sp. nov.
	One additional hook in the haptor only	*P. minutum*, sp nov.

Acknowledgments.

I am greatly indebted to Prof. C. P. Gnanamuthu, M.A., D. Sc., F.Z.S., Director, University Zoology Laboratory, Madras, for the guidance and valuable help throughout my work. My thanks are also due to Dr. B. S. Chauhan M. sc., Ph. D., F. Z. S., F. A. Sc., F. Z. S. I., of the Zoological Survey of India, Calcutta.

References.

Chauhan, B.S. (1945).—Trematodes from Indian Marine fishes Part I. On some new Monogenetic Trematodes of the sub-orders *Monopisthocotylea*, Odhner, 1912 and *Polyopisthocotylea* Odhner, 1912. *Proc. Indian Acad. Sci.*, **21** Sec., B. pp. 129-159., figs. 1—48 (1945).

Sproston, N. G. (1946).—A synopsis of the Monogenetic Trematodes. *Trans. Zool. Soc. London.* Vol. **25**, pp. 185—600.

A Comparative Table showing the Characters of Existing and New Species of Pricea.

Host & Site of Infection.	*Pricea mulatea* Chauhan *Cybium lanceolatus* Gills.	*Pricea minimae* Chauhan *Thynus pelamys* Gills.	*Pricea microcotylae* Chauhan *Scomber microlepidotus* Gills.	*Pricea tetracanthum*, sp. nov. *Cybium guttatum* Gilis.	*Pricea armatum*, sp. nov. *Cybium guttatum Gills.*	*Pricea tricanthum*, sp. nov. *Cybium guttatum* Gilis.	*Pricea melan* *Cybium gutte*
Shape and Size of the body.	Body elongately cylindrical and the sides of the body almost parallel. Length 3·22 mm. Breadth 0·4 mm.	Body elongately cylindrical and the sides of the body almost parallel. Length 3·46 mm. Breadth 0·27 mm.	Body elongately cylindrical and the sides of the body almost parallel. Length 7·0 mm. Breadth 0·37 mm.	Body elongately cylindrical and the sides of the body almost parallel. Length 1·678 mm. Breadth 0·357 mm.	Body elongately cylindrical and the sides of the body almost parallel. Length 2·695 mm. Breadth 0·473 mm.	Body elongately cylindrical and the sides of the body almost parallel. Length 2·1 mm. Breadth 0·24 mm.	Body elongately c the sides of the parallel. Length 1·981 mm. Breadth 0·393 mm
Shape and Size of the haptor.	Haptor elongately oval structure whose long axis is at right angles to the axis of the body. Length 1·02 mm. Breadth 0·33 mm.	The entire haptor has the same relation to the body as a foot has to the leg. Length 0·12 mm. Breadth 0·033 mm.	The haptor asymmetrically placed. Length. Breadth.	Haptor elongately oval with the long axis of the haptor in line with the long axis of the body. Length 0·499 mm. Breadth 0·258 mm.	Haptor elongately oval with the long axis of the haptor in line with the long axis of the body. Length 0·757 mm. Breadth 0·170 mm.	Haptor elongately oval with the long axis of the haptor in line with the long axis of the body. Length 0·66 mm. Breadth 0·24 mm.	Haptor elongately long axis of the with the long ax Length 0·660 mm. Breadth 0·295 mm
Number of clamps and size.	122 pedunculated retractile clamps with seven transverse ribs. 70μ	70 retractile and pedunculated clamps with 5—7 transverse ribs. 30μ × 70μ.	113 pedunculated retractile clamps with seven transverse ribs. 26μ × 78μ.	42 pedunculated clamps with seven transverse ribs. 39μ × 59μ.	50 pedunculated retractile clamps with 5—6 transverse ribs. 50μ × 71μ.	40 pedunculated retractile clamps with six transverse ribs. 43μ × 66μ.	56 pedunculated re with 6—8 transv 37μ × 66μ.
Number of testes	26	28	25	20	31	28	23
Position and Size of the body hook as well as additional hook.	A pair recurved hooks (pre-haptoral) situated in the posterior end of the body just above the haptor. 30μ in lenght.	Body hooks one behind the other on the posterior end of the body proper. One hook situated on the right intestinal caecum, near its posterior end and the other just anterior to the haptor slightlly to the left. 40u in length.	Body hooks situated one behind the other at the posterior end of the body proper, one not on the right intestinal caecum as in the last species. 80μ in length.	One pair hooks present as additional hooks in the haptor, just in front of and in between the pair of posterior hooks. 27μ in length.	Two pre-haptoral hooks, one situated just below the left diverticula and the other on the right side of the right diverticula. 21μ in length.	One hook as additional hook in the middle of the haptor and other as prehaptoral hook just anterior to the haptor and in the mid-line. 30μ and 23μ in length.	A single prehapto body region just haptor. 25μ in l
Posterior hooks or anchors.	80μ	60μ	110μ	39μ	48μ	27μ	33μ
Number of Genital hooks & their size.	12 genital hooks, situated 0·23 mm. from the anterior end. 25μ in lenght.	10 genital hooks, situated 0·21 mm. from the anterior end. 30μ in length.	12 genital hooks, situated 0·26 mm. from the anterior end. 50μ in length.	12 genital hooks, situated 0·259 mm. from the anterior end, 29μ in length.	14 genital hooks, situated 0·348 mm. from the anterior end, 32μ in length.	14 genital hooks, situated 0·256 mm. from the anterior end. 29μ in length.	12 genital hooks, mm. from the 21μ in length.
Extent of Vitellaria	Vitellaria extending from the level of the genital pore up to the extent of the testes though few follicles extending posteriorly, on the intestinal caeca up to the point of their termination.	Vitellarian follicles very few.	Vitellaria extending from the region anterior to the vaginal pore up to a distance a little posterior to the end of the intestinal crura.	Vitellarian follicles not dense and scattered very loosely.	Vitellarian follicles in dense clusters.	Vitellarian follicles uniformly spread and not in dense clusters.	Vitellarian follic clusters.

, sp. nov.	*Pricea minutum*, sp. nov.	*Pricea robustum*, sp. nov.
um Gills.	*Cybium guttatum* Gills.	*Cybium guttatum* Gills.
lindrical and body almost	Body elongately cylindrical and the sides of the body almost parallel. Length 1·464 mm. Breadth 0·201 mm.	Body elongately cylindrical and the sides of the body almost parallel. This species is comparatively bigger in size. Length 3·53 mm. Breadth 0·75 mm.
oval with the haptor in line s of the body.	Haptor elongately oval with the long axis of the haptor in line with the long axis of the body. Length 0·384 mm. Breadth 0·170 mm.	Haptor elongately oval whose long axis at right angles to the long axis of the body. The specimen of this species were got alive and present an appearance as shown in Text fig. 6a. where as the specimens of the rest of the species described were not alive and the haptor appears to be in line with the axis of the body, probably due to post-mortal contraction. Length 1·88 mm. Breadth 0·35 mm.
tractile clamps erse ribs.	46 pedunculated retractile clamps with six transverse ribs. 21μ × 47μ.	110 pedunculated retractile clamps with six transvers ribs. 46—51μ × 58μ—69μ.r.
	31	19
al hook in the anterior to the ngth.	Only one additional hook near the middle of the haptor. 27μ in length.	There are neither body hooks nor additional hooks.
	36μ	23μ.
situated 0·259 anterior end.	12 genital hooks, situated 0·161 mm. from the anterior end. 25μ in length.	14 genital hooks, situated 0·31 mm. from the anterior end. 30μ in length.
les in dense	Vitellarian follicles in not so much in dense clusters.	Vitellarian follicles in dense clusters.

ON TWO NEW SPECIES OF THE GENUS *SQUILLA* FABR., WITH NOTES ON OTHER STOMATOPODS IN THE COLLECTIONS OF THE ZOOLOGICAL SURVEY OF INDIA.

By KRISHNA KANT TIWARI, *M.Sc., Zoologist,* and SADABRATA BISWAS, *M.Sc., Zoological Assistant, Zoological Survey of India, Calcutta.*

INTRODUCTION.

Although the Indian Stomatopods have been studied fairly intensively by Kemp[1], and later by Kemp and Chopra[2], and Chopra[3], we have still found a part of the material, accumulated in the Zoological Survey of India since the publication of Chopra's (*loc. cit.*) account of the Stomatopoda collected off the mouth of river Hoogly, of considerable scientific interest. This material includes a new species, *Squilla bengalensis*, obtained from the Salt Lakes, Lower Bengal. It is also found that *Squilla raphidea* Fabricius, as defined at present, actually consists of two closely allied but distinct species, one of which is *S. harpax* DeHaan, uptill now regarded as a synonym of *S. raphidea*. *Lysiosquilla multifasciata* Wood Mason, which has so far not been recorded from the Bay of Bengal, is now known to occur in this region and is represented in the collections by a single example from Cox's Bazar, Chittagong (East Pakistan). The rediscovery of *Gonodactylus gyrosus* Odhner in the Andamans, after it was first described from the Gilbert Island by Odhner[4], is also of interest.

In addition to Indian material, notes on three species of Stomatopods collected by Dr. S. F. Light from coastal waters of Amoy (S. China) have also been added. It appears that these specimens were left behind when the Light collection was passed on by Dr. Kemp to Dr. Waldo L. Schmitt[5]. Among these, *Squilla microphthalma* H. Milne-Edwards has been recorded for the first time from Chinese coast and additional remarks on the structural features of *S. costata* DeHaan and *S. scorpio* Latr. have been added.

ACKNOWLEDGMENT.

We acknowledge with deep sense of gratitude, the assistance which Dr. L. B. Holthuis of Rijksmuseum van Naturlijke Historie, Leiden gave us in confirming our opinion regarding *S. raphidea*, after a close scrutiny of deHaan's cotypes of *S. harpax*, and examination of the entire '*raphidea*' material of Leiden Museum.

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[1] Kemp, S., *Mem. Indian Mus.* IV, pp. 1-217, pls. i-x (1913).

[2] Kemp, S. & Chopra, B., *Rec. Indian Mus.* XXII, pp. 297-311 (1921).

[3] Chopra, B., *Ibid.* XXXVI, pp. 17-43 (1934).

[4] Odhner, T., *Goteb. Vetensk. Samh. Handl.* XXVII, No. 4, pp. 1-16 1 pl. (1923).

[5] The collections made by Dr. S. F. Light from Southern China were first submitted for study to Dr. S. Kemp, who was at that time connected with the Indian Museum. As Dr. Kemp could not complete this work, on account of other engagements, before taking over charge of the "Discovery" Expedition he sent on the collection, along with his notes, to Dr. W. L. Schmitt who worked it out and published a report on it.

Systematic Account.

Squilla microphthalma H. Milne-Edwards.

1913. *Squilla microphthalma*, Kemp, *Mem. Indian Mus.* IV, p. 31, pl. i, figs. 17-20.

1941. *Squilla microphthalma*, Holthuis, *Temminckia* VI, p. 242.

A single female from Amoy, measuring 39·0 mm., agrees with the description and figures of this species given by Kemp, except in the following features :—

(i) The base of rostrum is somewhat broader than in the typical examples. (ii) The lateral spine on the fifth thoracic segment is acute and strong. (iii) The intermediate carinae on segments 6-8 are sharp and well-defined. (iv) First five abdominal somites bear faint but distinct submedian carinae which are complete on the fourth and fifth segments.

This example is registered as under :—

C.2991/1 .. Santu, N. Fukien, Amoy, China. Dr. S. F. Light 2-1-24. 1♀, 39 mm.

The easternmost limit of this species was so far Samarinda, East Borneo (Holthuis, 1941). Its presence on the Chinese coast, besides constituting its first record from this region, extends its range further North Eastwards. This species appears to be rare.

Squilla merguiensis, sp. nov.

While doubtfully referring a male specimen from Mergui to *Squilla microphthalma* Milne Edwards, Kemp and Chopra[1] enumerated the following features in which this particular specimen differed from other typical examples of this species (Text-fig. 1*a*) :—

(i) The rostrum is much narrower and is about one and a half times as long as wide.

(ii) The cornea is decidedly more expanded, its breadth being contained about two and a quarter times in the total length of the eye.

(iii) The eye reaches well beyond the end of the basal antennular segment and fully to the middle of the ultimate segment of the antennal peduncle. In typical *S. microphthalma* the eye does not nearly reach the end of the basal antennular segment and barely reaches the base of the ultimate segment of the antennal peduncle, much as in Brooks' figure of *S. chlorida*[2].

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[1]Kemp, S. & Chopra, B., *Rec. Indian Mus.* XXII, pp. 299-300 (1921).
[2]Brooks, '*Challenger*' *Rep. Stomatop.*, pl. ii, figs. 1, 3 (1886).

(iv) The lateral process of the fifth thoracic somite is short, stout and directed strongly forwards, whereas in typical *S. microphthalma* it is directed straight outwards.

(v) The raptorial dactylus bears five teeth (the terminal one included), all of which are well developed and evenly spaced. The proximal tooth is not greatly reduced and does not lie close against the next of the series as in those specimens of *S. microphthalma* which possess the same number of teeth.

(vi) There are clear indications of a pair of submedian carinae on the fifth abdominal somite.

In addition to the above-mentioned differences recorded by Kemp and Chopra, we have found the following further characters which distinguish this specimen from *S. microphthalma* :—

(i) The inferior surface of fifth thoracic somite is provided with a spine in its lateral part on each side. In *S. microphthalma* this spine is absent, and the inferior surface of fifth thoracic somite is smooth.

(ii) The following abdominal carinae end in spines :—

Carinae.	Abdominal somites.	
	Mergui specimen.	*S. microphthalma.*
Submedian	6	6
Intermediate	3, 4, 5, 6	5, 6
Lateral	(3[1]), 4, 5, 6	5, 6
Marginal	5	3, 4, 5

Kemp and Chopra have further stated, " It perhaps represents a species hitherto unknown, but the resemblances to *S. microphthalma* are so great that we hesitate to describe it as new." We, too, might have been of the same opinion, but for such definite characters as the spinuous undersurface of the lateral part of the fifth thoracic somite, and the striking difference between the spines on abdominal carinae. In our opinion these characters, combined with those enumerated by Kemp and Chopra, justify our assigning this specimen to a new species, *Squilla merguiensis.*

Holotype.—♂, 40 mm., Regd. No. C. 302/1, Zoological Survey of India.

Type-locality.—4 miles N. N. E. of Kabusa Is., Mergui Archipelago, 33 fathoms (collected by R. I. M. S. "Investigator").

This species is obviously closely related to *S. microphthalma,* from which it differs in the characters mentioned above. According to Kemp and Chopra "it differs from Brooks' account of *S. chlorida* (i) in the form of the rostrum, (ii) in the length of the eye compared with that of the antennal and antennular peduncles, and (iii) in the direction of the lateral process of the fifth thoracic somite".

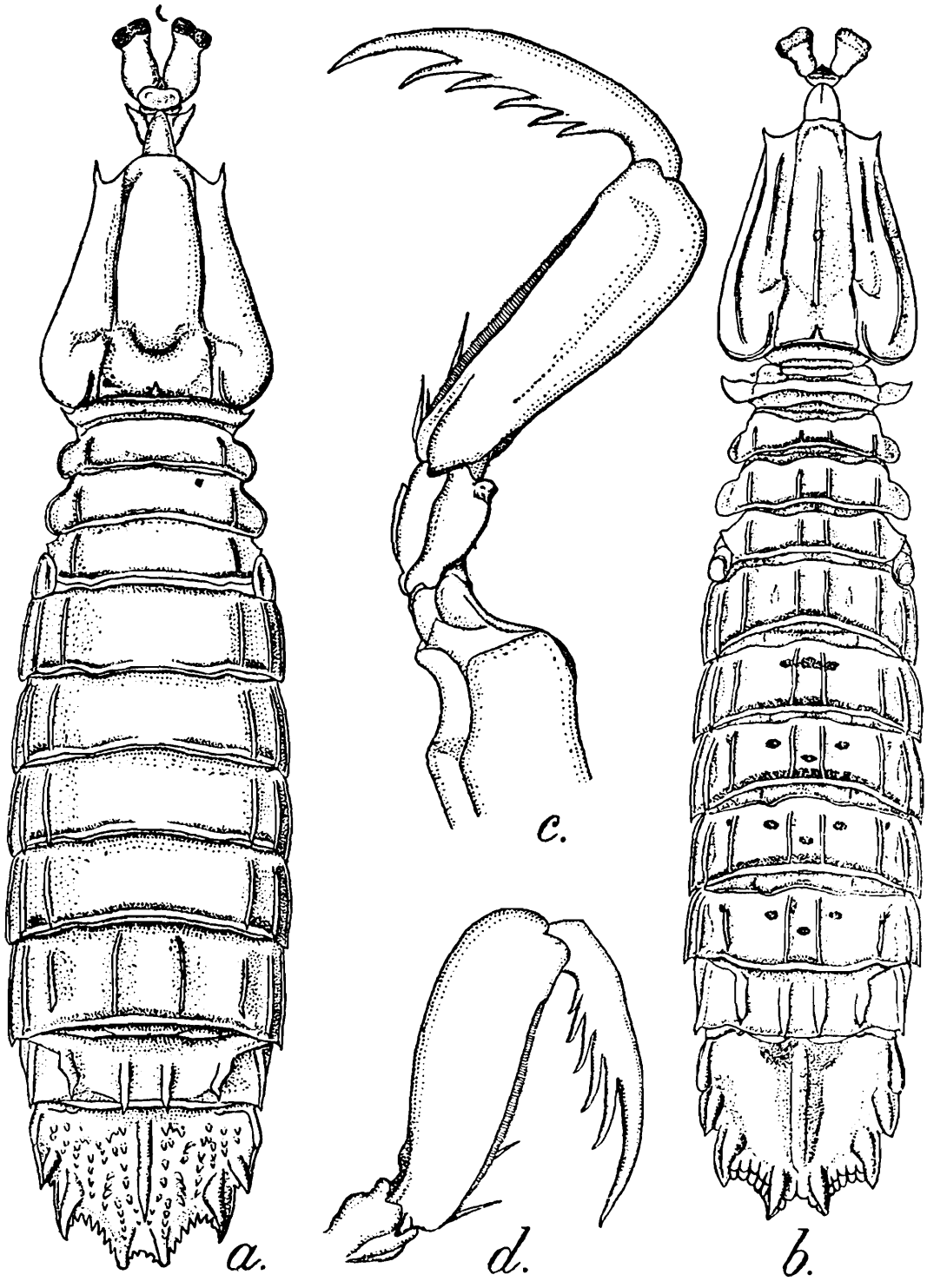
In having a spine on the inferior margin of the fifth thoracic somite, *S. merguiensis* resembles *S. decorata* Wood Mason.

[1]On one side only.

Squilla bengalensis, sp. nov.

This species closely resembles *S. scorpio* Latr. and *S. scorpio*, var. *immaculata* Kemp. It can, however, be distinguished from these by the following characters (Text-fig. 1*b*) :—

Carapace is distinctly more than half as long as its breadth behind the antero-lateral angles. There is no blunt lobe beneath each antero-lateral spine of carapace. Rostrum, as in *S. scorpio*, var. *immaculata*, is about as long as broad. Eye is small and elongated. Cornea, which is obliquely set on the eyestalk, is wider than the length of eye.



Text-fig. 1.—*a. Squilla merguiensis*, sp. nov., entire specimen in dorsal view ×3½ ; *b. Squilla bengalensis*, sp. nov., entire specimen in dorsal view : ×1 ; *c.* Raptoria claw of *S. bengalensis* : ×2 ; *d.* Raptorial claw of *S. scorpio* : ×2⅔.

Antennular peduncle is about two-thirds as long as the carapace.

Mandible bears a three-jointed palp.

The dorsal carina of carpus of the raptorial claw is entire. The outer margin of raptorial dactylus is convex, but the proximal lobe characteristic of *scorpio*, and its variety *immaculata* is obsolete. The inner edge of the dactylus bears six teeth (Text fig. 1*c*) including the apical one.

Only first two pairs of thoracic appendages bear epipodites.

The last three thoracic somites possess distinct, though weak, submedian carinae and strong intermediate carinae. The pair of lobes on the inferior margin of fifth thoracic somite is more acute and pointed. The lateral lobe on the fifth thoracic somite is broad and less acute.

The number and disposition of abdominal carinae agree with those in *scorpio* but the spine formula of the carinae is different. The following abdominal carinae end in spines :—

Carina.	Abdominal somites.
Submedian	6
Intermediate	5, 6
Lateral	(1), (2), 3, 4, 5, 6
Marginal	(1), 2, 3, 4, 5, 6

The prelateral teeth on the telson are strong and clearly marked.

In general, the scheme of coloration agrees with that of var. *immaculata*. The lateral projections of the fifth thoracic somite are without black spots. The second abdominal somite has a transverse band of black between the submedian carinae in the anterior region. On each of the following somites there are three patches of black pigment, a posterior patch between the submedian carinae, and one each between the submedian and intermediate carinae, anteriorly. There is a deep patch of black on the basal region of the outer uropod, and a suffusion of light black on the inner uropod.

Holotype.—Male, 121·4 mm., Regd. No. C 3013/1, Zoological Survey of India.

Type-locality.—Salt Lakes, Lower Bengal ; Coll : Dr. T. N. Poddar.

Besides the holotype, one more specimen of this new species is present in the collections, registered as under :—

C.3014/1 .. Piali River, Uttar- Dr. S. L. Hora. 1♂, 55·5 mm.
bhag, Lower Bengal. 23-5-1934.

Remarks.—The presence of a three-jointed mandibular palp, and six teeth on the raptorial dactylus distinguish this species from *scorpio* and its variety, from which it also differs in the spine formula of the abdominal carinae.

Squilla scorpio Latreille.

1913. *Squilla scorpio*, Kemp, *Mem. Indian. Mus.* IV, p. 42, pl. ii, fig. 30.

1929. *Chloridelta scorpio*, Schmitt, *Lignan Sci. J.* VIII, p. 133.

C. 2992/1 .. Guanto, near Foo- Dr. S. F. Light 1♂, 71 mm.
chow, (Amoy). 21-1-24.

This specimen belongs to the Light Collection from South China. Its raptorial dactylus bears six teeth (Text-fig. 1*d*.) (cf. *S. bengalensis*, sp. nov., *vide ante*), differing in this respect from typical examples of *S. scorpio* in which there are only five teeth. The submedian carinae on the last three thoracic somites are also strong. The marginal carinae on the fourth and fifth abdominal somites end in spines.

In the number of teeth on the raptorial dactylus this example resembles *S. bengalensis* but the absence of a mandibular palp and other characters definitely assign it to *S. scorpio*.

Squilla costata De Haan.

1913. *Squilla costata*, Kemp, *Mem. Indian Mus.* IV, pp. 84-86, pl. vi, figs. 70-72.

Two examples, one male and another female, of this species, like the previous one, belong to the Light Collection. Schmitt[1], in his report on this collection, has not made any mention of this species. These two specimens (Text-fig. 2*a*, *c*, *d*, *f* & *h*) agree in almost all details with the Japanese examples of *S. costata* (referred to by Kemp) except that the number of tubercles on the body is less and the dorsal carinae on the abdominal somites are fewer in number. In the shorter example the portion of abdominal somites between the marginal and lateral carinae is free from tubercles and the spines on the external margin of uropodal peduncle are nine in number.

The specimens bear the following numbers :—

C 3025/1 .	Amoy .	Dr. S. F. Light	♀, 71·2 mm.
C 3026/1	Amoy .	Dr. S. F. Light	♂, 48·3 mm.

Squilla, sp. prox. **costata** De Haan.

Kemp[2] referred an aberrant example from Burmese Coast to *S. costata*. He, however, enumerated certain features in which this example differed from the typical examples, a Japanese specimen of which he was able to secure for comparison. Later on Kemp and Chopra[3] recorded another example from the Burma Coast, which agreed with the example earlier mentioned, except in certain minor features. We have re-examined this specimen, compared it with the Japanese specimen, and also with those from Amoy. Besides the features mentioned by Kemp, and Kemp & Chopra, this specimen shows the following additional points of difference :—

(i) The anterior end of rostrum is narrow and rounded (Text-fig. 2*b*). In the examples from Japan and China the anterior end of rostrum is broad and truncated.

(ii) The carapace (Text-fig. 2*b*) is comparatively narrow, the ratio of its length to breadth being 2·6 in this example, as against 2·3 in the typical specimens.

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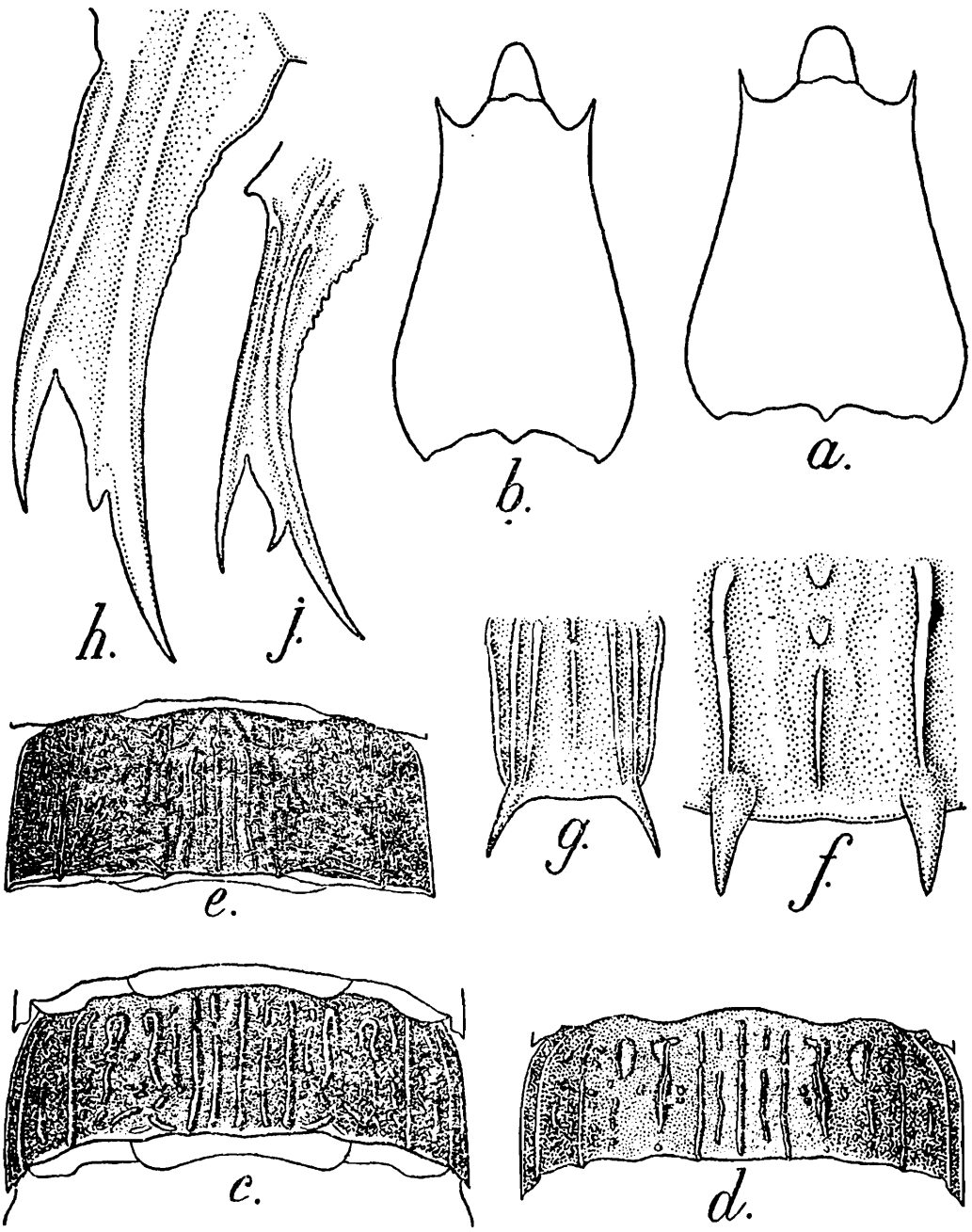
[1] Schmitt, W. L., *Lignan Sci. Jour.* VIII, pp. 127-148, 4 pls. (1929).
[2] Kemp, S., *Mem. Indian Mus.* IV, pp. 84-86, pl. vi, figs. 70-72 (1913).
[3] Kemp, S., & Chopra, B., *Rec. Indian Mus.* XXII, p. 303 (1921).

(iii) The sculpturing of second abdominal somite (Text-fig. 2*e*) is different.

(iv) The lateral lobe on the external margin of the inner spine of the bifurcate base of uropod (Text-fig. 2*j*) is long and acute and its edge is distinctly concave.



TEXT-FIG 2.—*a. Squilla costata* deHaan, dorsal view of carapace and rostrum in a specimen from Amoy, China : ×3⅓ ; *b. Squilla*, sp. prox. *costata*, carapace and rostrum : × 4⅔ ; *c.* Second abdominal somite of *S. costata*, Chinese example : ×3⅓ ; *d.* The same in a Japanese specimen : ×4⅔ ; *e.* The same in *Squilla* sp. prox. *costata* : ×8 ; *f.* Posterior margin of sixth abdominal somite in the Chinese example of *S. costata* and, *g.* in *Squilla* sp. prox. *costata* : ×14 ; *h.* and *j.* Bifurcate process of uropodal peduncle in *S. costata* and *Squilla* sp. prox. *costata* resp.: ×8.

In all probability the Burmese specimens represent a race of *S. costata*. In the absence of more material, however this question has to be deferred.

Squilla raphidea Fabricius.

1901. *Squilla raphidea*, var. *africana*, Balss, *Abh. Klasse K. Bayer. Akad. Wiss.*, Suppl. Bd. II, Abh. 2., p. 8., figs. 2*a-b*.

A re-examination of the material, named as *Squilla raphidea* Fabr., preserved in the Zoological Survey, shows that this consists of a mixture of two distinct but very closely allied forms which can be distinguished from each other by the breadth of cornea, presence or absence of a spine on the lateral margin of fifth thoracic segment and the condition of submedian carinae. Prof. L. B. Holthuis of Rijksmuseum van Naturlijke Historie, Leiden, to whom we referred this, also confirmed our view[1] after an examination of the entire named material of *Squilla raphidea* in the Leiden Museum, and of cotypes of *S. harpax* DeHaan. As was suspected by us, one of these two forms belongs to *S. harpax* DeHaan[2], and this is also corroborated by Prof. Holthuis.

Fabricius'[3] description of *Squilla raphidea* applies equally well to both these forms and his types are no longer extant. It is, therefore, impossible to judge as to which of these two forms his material belonged. Under the circumstances the views of DeHaan, who first revised this species, have to be accepted. DeHaan (*loc. cit.*, p. 221) in his key distinguished under "*S. raphideae*, n." two species, *viz.*, *S. raphidea* Fabricius and *S. harpax*, n., on characters of telson and thoracic legs. He identified as *S. raphidea* the specimen figured on pl. 324 of *Encycl. Method.* This figure, according to Prof. Holthuis, shows distinct submedian carinae and thus is identical with one of the forms distinguished by us. We, therefore, propose to revive the name S. *harpax* DeHaan for one of the forms while retaining *S. raphidea* Fabr. (although not strictly in the sense in which Fabricius used it) for the other.

As the common characters of these two species have already been described and figured by Kemp[4], we shall content ourselves with giving such characters of these two forms, as will serve to differentiate them from each other.

The following are the distinguishing features of *S. raphidea*:—

(i) The apex of rostrum is generally long and acute and the lateral edges bordering it are sinuous. (Text-fig. 3*a*.)

(ii) The cornea is narrow (Text-fig. 3*a*). The ratio of the median length of carapace to the breadth of cornea varies from 3·8 to 5·3 (average, 4·3).

(iii) Lateral margin of fifth thoracic segment bears a spine (Text-fig. 3*c*) on each side.

(iv) Submedian carinae (Text-fig. 3*c*) on 6-8 thoracic somites are sharp and well defined.

(v) Intermediate carinae of at least the seventh and eighth thoracic somites end posteriorly in spines.

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[1]Prof. Holthuis writes, " ..... .I have examined all our material assigned to that species. I entirely agree with you that there are here two species, especially the characters afforded by the carinae and the spines on the thorax and abdomen are distinct. There are also some differences in the shape of the rostrum."

[2]DeHaan, W., in Siebold's *Faun. Japon. Crust.* p. 222, pl. li, fig. 1 (1849).

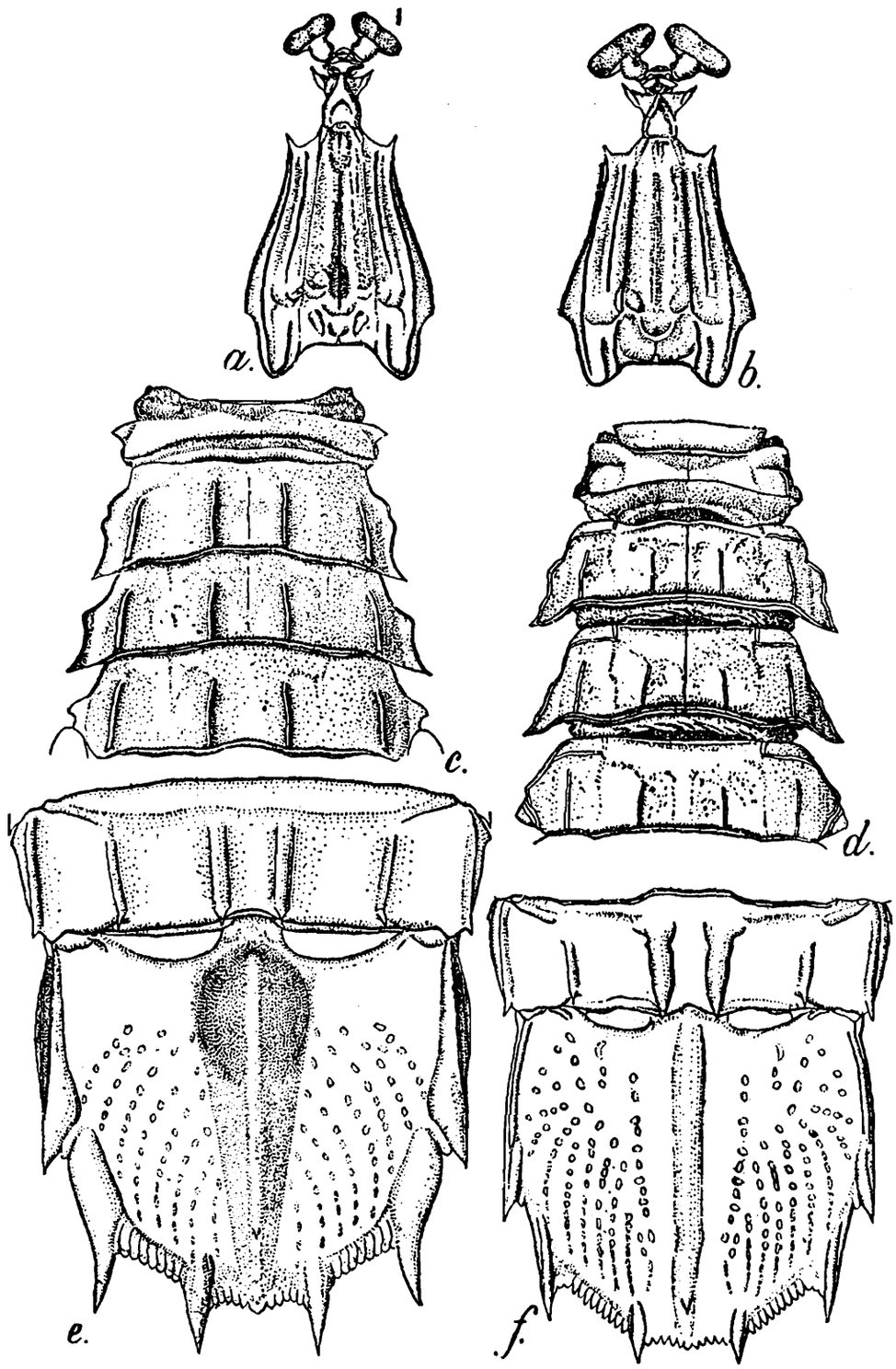
[3]Fabricius, J. C., *Ent. Syst. Suppl.*, p. 416 (1798).

[4]Kemp, S. W., *Mem Indian Mus.* IV, pp. 88-92, pl. vii, fig. 77 (1913).

(vi) Submedian carinae on first five abdominal somites are sharp and distinct.

(vii) Carinae supporting the marginal teeth of telson are strong and massive (Text-fig. 3*e*) and in very large specimens sometimes obliterate the marginal denticles.

(viii) This species attain a large size, very large examples measuring more than a foon in body length.



TEXT FIG. 3.—*a.* Anterior region of *Squilla raphidea* Fabr.: ×¾ *b.* The same in *S. larpax* DeHaan : ×17/20 ; *c.* and *d.* Thoracic somites of *S. raphidea* and *S. harpax* resp. ×1½ ; *e.*, and *f.* Telson of *S. raphidea* and *S. harpax*, resp. ×1½.

In characters of the carapace, antennule, antennae, raptorial claw etc., this species agrees with Kemp's description.

Balss' *S. raphidea*, var. *africana* appears to be identical with this species, as is apparent from his description and figures.

This species is represented in the collections of the Zoological Survey of India by the following material :—

7318-20/10	Off Puri	"Golden Crown"	1 ♂, 272 mm., and 1♀, 237·5. mm.
C 3011/1	Chandipur, Balasore	5-3-39	3♀♀, 181 mm. 233 mm.
C 3012/1	Bay of Bengal, N. & S. of Eastern Channel.	"Lady fraser" March' 24.	2♀♀, more than 250 mm.
765/10	Off Saugor Island		1♀, 269 mm.
3097/5	Sandheads, mouth of the R. Hooghly	"Lady Fraser"	2♂♂, 264 mm-265 mm.
C 2475-6/1	Ditto	Ditto . .	2♀♀, 221 mm., 270 mm.
8031/9	Ditto	R. M. Daly	1♂, 275 mm.
C 324/1	Sunderbans	Abdul Rahim .	1♀, 243 mm.
C 3027/1	Calcutta Bazar .	..	1♀, 230 mm.
C 323/1	Tale' Sap, Siam .	N. Annandale 21-1-'06 .	1♂, 196·5 mm., 1♀, 254 mm.
4746/9	Singapur .	Raffles Mus. . .	1♀ 241 mm.
C 2479/1	Kuching Fish Market, Sarawak.	Sarawak Mus.	2♀♀, 160 mm. and 190 mm.
4726/10	No locality .	..	1♀, 211 mm.

Squilla harpax De Haan.

1849. *Squilla harpax*, DeHaan, *Faun. Japon. Crust.* p. 222, pl.li, fig. 1.

This species was so far regarded as a synonym of *Squilla raphidea* Fabr.

The characters of this species mentioned by DeHaan on pp. 222-223 of *Faun. Japon. Crust.* are very vague and cannot serve to distinguish this species. We, therefore, enumerate below the diagnostic features of this species :—

(i) Rostrum generally ends in a short, acute apex (Text-fig. 3*b*). The lateral margins bordering the apex are concave.

(ii) Cornea is wide (Text-fig. 3*b*). Ratio of median length of carapace to the width of cornea varies from 2·7 to 3·2 (average, 2·9), this ratio for *S. raphidea* being 3·8-5·3 (ave. 4·3).

(iii) The lateral edge of fifth thoracic somite is not armed with a spine (Text-fig. 3*d*).

(iv) Submedian carinae on the thoracic somites and the first five abdominal somites are obsolete.

(v) The intermediate carinae on the thoracic somites do not end posteriorly in spines.

(vi) The carinae supporting the marginal teeth of telson are not massive (Text-fig. 3*f*).

(vii) Telson is proportionately longer than in *S. raphidea.*

(viii) This species does not attain a large size, the largest specimen in our collection, a female from Sandheads, measuring 172·5 mm. Among DeHaan's cotypes of this species the largest example is 193 mm. long.

The fact that this species is smaller in size than *S. raphidea* might suggest that this is only a growth stage of the latter. Breadth of the cornea and the condition of thoracic and abdominal carinae suggest this explanation. But the presence of a spine on the lateral margin of the fifth thoracic somite in *S. raphidea* only, cannot be accounted for by growth. Moreover, in same-sized specimens of the two species these characters are very distinct.

The specimens of *S. harpax* in the collections of the Zoological Survey of India are from the following localities :—

C 3022/1	Off Bombay, 20-25 fathoms.	S. T. William Carrick	2♂♂, 110·5 mm. an 114 mm. 1♀, 129 mm.
7323/10	Madras Presidency	" Golden Crown "	1♀, 153·5 mm.
C 2476-7/1	Sandheads, Mouth of R. Hoogly.	P. V. " Lady Fraser "	3♀♀, 138 mm-175 mm.
C 3023/1	Ditto	Ditto	1♂, 133·8 mm. 10♀♀, 131·5 mm.-172·5 mm.
C 3112/5	Ditto	A. Miller	1♀, 136·5 mm.
C 2478/1	Port Blair	R.P. Mullens, June, '18	1♂, 144 mm. 1♀, 148·5 mm.
C 3021/1	Singapore	Capt. Hutchinson 19th April, '14.	2♂♂, 83 mm. and 132 mm.
3328/9	Hongkong	G. Dennys	4♂♂, 145 mm-157·5 mm. 2♀♀, 143 mm, and 155 mm.
9834-9/6	Ditto	Hongkong Mus.	4♂♂, 108 mm.-135 mm. 2♀♀, 112 mm. and 115 mm.
4849/9	Ditto	G. Dennys	1♀, 138 mm.

Lysiosquilla acanthocarpus Miers.

1934. *Lysiosquilla acanthocarpus*, Chopra, *Rec. Indian Mus.* XXXVI, pp. 30-31.

This rare species is known from the Bengal coast through a single specimen, collected by the " Lady Fraser " from Sandheads, off the mouth of river Hooghly (Chopra, *loc. cit.*). The unnamed collections

contain another specimen from the Bay of Bengal, this time from the Chittagong coast in East Bengal. This specimen is registered as under.

C 2996/1	Sandy Beach at Cox's Bazar, Chittagong (East Pakistan).	Dr. B. N. Chopra, 14-24.II-'38.	1♂, 60 mm.

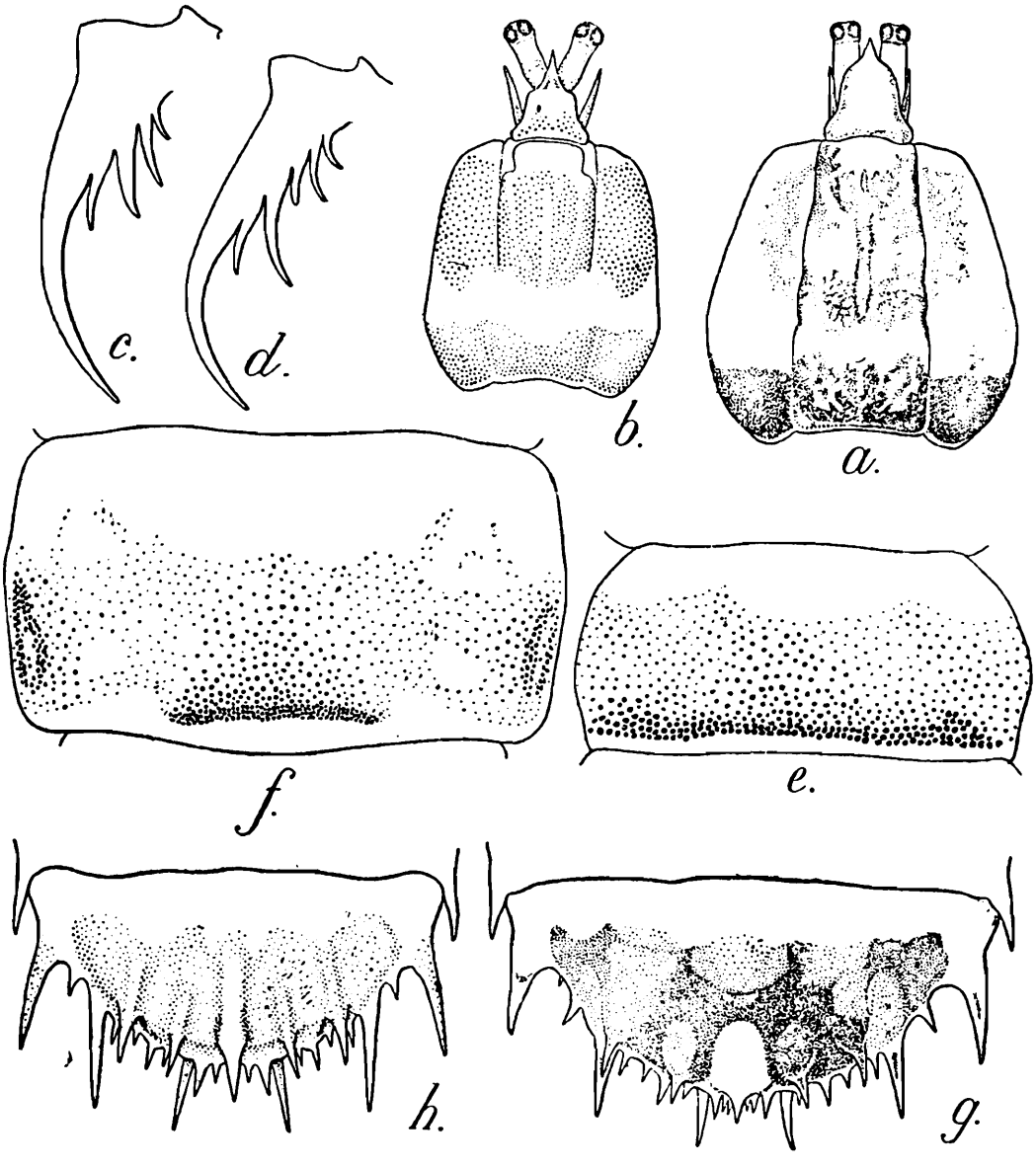
Other records of this species from Indian Region include both the coasts of Peninsular India, Trincomali in Ceylon and the Andaman Islands.

Lysiosquilla multifasciata Wood Mason.

1913. *Lysiosquilla multifasciata*, Kemp, *Mem. Indian Mus.* IV, pp. 122-124.

1939. *Lysiosquilla multifasciata*, Chopra, *Sci. Rep. John Murray Exped.* VI, No. 3, pp. 162-165, text-figs. 8, 9.

A single male specimen from Cox's Bazar, Chittagong, measuring 50 mm. is referred to this species. On comparison with Wood Mason's



Text-fig. 4.—*Lysiosquilla multifasciata* Wood—Mason *a*. Carapace and rostrum in a specimen from Bombay : ×2 ; *b*. The same in Cox's Bazar example : ×2 ; *c* and *d*. Raptorial dactyli of Bombay and Cox's Bazar examples resp. ×4 ; *e*. A thoracic segment, and *f*., an abdominal segment of Cox's Bazar example; × 4 ; *g*. Telson in Bombay specimen : ×4 ; *h*. The same in Cox's Bazar example : ×4.

type of this species from Bombay, and with the Philippine examples preserved in the Zoological Survey,[1] this specimen shows the following differences :—

(i) The eyestalks are long and narrow (Text-fig. 4*b*), the eye extending up to end of second segment of antennular peduncle. In the typical examples the eye extends only as far as the end of first segment of the antennular peduncle (Text-fig. 4*a*). Chopra (*loc. cit.*) has recorded numerous variations in the shape and size of the rostrum in relation to eyestalks.

(ii) The base of rostrum is broad. Its lateral margins are sinuous at the base and they converge gradually towards the apex which is produced into a long spine extending as far as the middle of eyestalks. In the type-specimen of *L. multifasciata* the lateral margin of rostrum is feebly sinuous and the apex extends up to the corneal region of eyes.

(iii) Raptorial dactylus bears six teeth, (Text-fig. 4 *d*.)

(iv) The dorsal as well as the marginal spines of telson are longer (Text fig. 4*h* ; cf. also fig. *g*.). There are only two pairs of denticles between the movable submedian teeth, as in one of Nobili's[2] examples from the Red Sea.

(v) The pigmentation of the body is also different. Unlike the type specimen. there are no dark transverse bands of dense pigment, but only suffusions of scattered pigment granules, which are denser in the basal region of the thoracic and abdominal somites, but rarer towards the sides and in front. The scheme of coloration on the carapace, thoracic and abdominal somites and telson can be best understood by reference to Text fig. 4*a*, *b*, and *e*, *f*, *g*, *h*.

The present specimen is registered as under :—

C 3024/1	Cox's Bazar (purchased).	Dr. Chopra 18-2-38.	♂, 50 mm.

Lysiosquilla multifasciata was originally described from Bombay (Wood Mason[3]). It is known from waters around Japan (Komai[4]), China (Schmitt[5]), the philippines (Kemp[6] ; Roxas & Estampador[7]), Borneo (Nobili[8]), Gulf of Oman, Arabian sea (Chopra, *loc. cit.*) and Red Sea (Tattersal[9] ; Dolfuss[10] ; Holthuis[11]). This species was so far not known from the Bay of Bengal and the present is its first record from this region. Alikunhi[12] in an unpublished work has, however, recorded eleven larval specimens of this species from the Madras Plankton.

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[1]These specimens have been dealt with by Kemp, *vide* Kemp, S., *Philippine J. Sci. Manilla* X, p. 175, pl. i, figs. 2, 3 (1915).

[2]Nobili, G., *Ann. Sci. nat. Zool. Paris* (9) IV, pp. 326-342 (1906).

[3]Wood Mason, H., *Figs. and Descr. of* 9 *Squillidae* p. l, pl. i, figs. 4-7 (1895).

[4]Komal, T., *Annot. Zool Japon*, XVII, p. 271 (1938).

[5]Schmitt, W. L., *Lignan Sci. J.* VIII, p. 144, pl. xix, figs. 15-18 (1929).

[6]Kemp, S., *Philippine J. Sci. Manilla* X, p. 175, pl. i, figs. 2, 3 (1915).

[7]Roxos, H. A., & Estampador, E., *Natural & Applied Sci. Bull. Manilla* I, p. 113 (1930).

[8]Nobili, G., *Boll. Mus. Torino* XVIII, No. 447, pp. 28-32 (1903).

[9]Tattersal, E., *J. Linn. Soc. Zool.* XXXIV, p. 359. pl. xxviii, fig. 6 (1921).

[10]Dolfuss, R. P., *Mem. Inst. Egypt.* XXXVII, p. 203, fig. 11 (1938).

[11]Holthuis, L. B., *Temminckia* VI, p. 274 (1941).

[12]Alikunhi, K. H., *Rec. Indian Mus.* XLVIII (in press).

Gonodactylus lenzi Holthuis.

1905. *Protosquilla glabra*, Lenz, *Abh. Seneckcnb. Naturf. Gesellsch.* XXVII p. 388, pl. xlvii, fig. 13.

1913. *Gonodactylus glaber*, kemp. *Mem. Indian Mus.* IV, p. 182, pl. x, fig. 121.

1941. *Gonodactylus lenzi*, (new name for *G. glaber* Lenz), Holthuis, *Temminckia* VI, p. 288.

One male specimen (Regd. No. C 2994/1) measuring 16 mm., from Ross Island, Andamans (Shore collection, 19th May, 1930) is referred to this rare species. This species has already been recorded from Great Coco Islands, N. Andamans by Kemp. It is also known from Zanzibar and Ceylon (Lenz, *loc. cit.*), the Bay of Batavia (Holthuis, *loc. cit.*) and the Philippines (Kemp[1] ; Roxas and Estampador[2]).

Gonodactylus glyptocercus Wood Mason.

1913. *Gonodactylus glyptocercus*, Kemp, *Mem. Indian Mus.*, IV. pp- 186-187.

C 2993/1	Nancouri Harbour, Andamans. Stn. No. 702.	Marine Survey 12-1-26.	1♂, 21·5mm.

This species is not known from localities West of the Andamans. It extends up to Oceania and Japan. So far it has not been found in the costal waters of India.

Gonodactylus gyrosus Odhner.

1923. *Gonodactylus gyrosus*, Odhner, *Goteb. Vetench. Samh. Handl.* XXVII No. 4, pp. 11-13, pl. i, figs., 4, 5.

We refer to this species a single female (Text-fig. 5) from Brooksabad, Andamans, which, while agreeing with Odhner's (*loc. cit.*) description and figures in general, shows the following differences :—

(i) Rostrum is somewhat longer than that of the type specimen. It is fully four times as long as its undivided part. It slightly exceeds the cornea and extends as far as the end of basal segment of antennular peduncle. The lateral spines of rostrum reach almost up to the middle of eye stalks.

(ii) Eyes are long, being slightly less than a third of carapace length and reaching up to the middle of second joint of the antennular peduncle.

(iii) The pattern of pigmentation of the abdominal somites and telson is also somewhat different from that of the tyye.

C 2995/1	Brooksabad, Andamans.	Dr. H. S. Rao, 3-1-34.	1♀, 28·3mm.

This example was caught in "holes and crevices amidst dead coral between tide marks.

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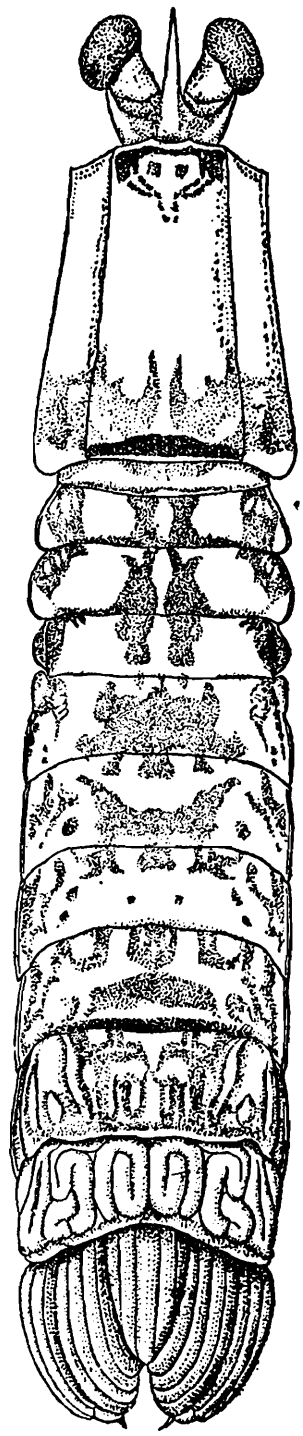
[1]Kemp, S., *Philippine J. Sci. Manilla* X, p. 186 (1915).

[2]Roxas, H. A. & Estampador, E., *Natural and Applied Sci. Bull Manilla* I, p. 124, pl. iii, fig. 5 (1930).

G. gyrosus was originally described from the Gilbert Island. The only other record of this species, known to us, is by Ward[1] from Diego



TEXT-FIG. 5.—*Gonodactylus gyrosus* Odner.

Garcia, Chagos Archipelago. Ward's material consisted of " one female measuring 57 mm. in maximum length"

The occurrence of this species in the Andamans is, therefore, very interesting.

[1]Ward, M., *Mauritius Inst. Bull.* II, pt. 2, pp. 49-108, pls. v, vi. (*Gonodactylus gyrosus*, p. 56).

MGIPC—M—7 ZSI—14-10-52—450.