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DE GRAVE SAMMY

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.  
CRUSTACEA DECAPODA AND STOMATOPODA.

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## ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST.

### DECAPOD AND STOMATOPOD CRUSTACEA.

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The collection of Decapoda and Stomatopoda made by Dr. Annandale during his recent tour is one of very great interest and I am much indebted to him for the opportunity of examining it. It contains ninety-five species and subspecies all of which were obtained in fresh or brackish water.

The chief value of the collection lies in the precise information it affords regarding the environment of the different species. Little attention has been paid to this matter hitherto; when doubts arise as to the habitat of a particular form, the published accounts generally prove valueless and even where the most exact details of the locality are given no reference is as a rule made to the salinity of the water. In consequence, the number of forms which have succeeded in establishing themselves in fresh water has probably been much under-estimated; in the collection under consideration members of no less than twelve genera and subgenera were found living far beyond the reach of tidal influence.

The principal object of Dr. Annandale's tour was the investigation of the faunas of three lakes situated in eastern Asia,—Lake Biwa in Japan, the Tai Hu in the Kiangsu province of China, and the Tale Sap on the east coast of Peninsular Siam; maps and brief descriptions of these are given in the Introduction to this volume. The collection of Crustacea was, however, not restricted to the lakes; specimens were obtained in various parts of Japan, at three localities in China and at a number of places in the Malay Peninsula.

The Japanese collection contains examples of nine species and one subspecies, namely:—

|                                                               |                                        |
|---------------------------------------------------------------|----------------------------------------|
| <i>Eriocheir japonicus</i> (de Haan).                         | <i>Leander paucidens</i> (de Haan).    |
| <i>Sesarma dehaani</i> (Milne-Edwards).                       | <i>Caridina denticulata</i> (de Haan). |
| <i>Helice tridens</i> , de Haan.                              | <i>Paratya compressa</i> (de Haan).    |
| <i>Potamon</i> ( <i>Geotelphusa</i> ) <i>dehaani</i> (White). | „ „ subsp. <i>improvisa</i> , Kemp.    |
| <i>Palaemon nipponensis</i> , de Haan.                        | <i>Acetes japonicus</i> , Kishinouye.  |

*Helice tridens* and *Acetes japonicus* probably came from water that was slightly brackish; all the remainder were found in pure fresh water. The only Decapods actually found in Lake Biwa are the three prawns *Leander paucidens*, *Caridina denticulata*, and *Paratya compressa*, but the crabs *Eriocheir japonicus* and *Potamon dehaani* are said to enter the lake at times.

Since 1849, when the concluding part of de Haan's magnificent work on Japanese Decapod Crustacea was published, a considerable number of important papers on the same subject have appeared, notable contributions having been made by Doflein, Miss Rathbun, de Man and Balss. The present collection does not in consequence make any striking addition to our knowledge of the non-marine forms, though it has been possible to demonstrate the existence in the main island of Japan of two distinct races of *Xiphocaridina* (more correctly *Paratya*) *compressa*.

Compared with Japan, China is from a carcinological point of view almost unknown and the collections from this country are in consequence of very great interest. Sixteen species were found in three distinct localities, all having been obtained in pure fresh water.

TAI HU LAKE, KIANGSU PROVINCE.

|                                                        |                                                             |
|--------------------------------------------------------|-------------------------------------------------------------|
| <i>Rhynchoplax introversus</i> , Kemp.                 | <i>Palaemon nipponensis</i> , de Haan.                      |
| <i>Eriocheir sinensis</i> (Milne-Edwards).             | „ <i>asperulus</i> , von Martens.                           |
| <i>Potamon (Potamon) denticulatum</i> (Milne-Edwards). | <i>Leander modestus</i> , Heller.                           |
|                                                        | <i>Caridina denticulata</i> , subsp. <i>sinensis</i> , nov. |

SHANGHAI AND THE WHANGPOO RIVER.

|                                                             |                                         |
|-------------------------------------------------------------|-----------------------------------------|
| <i>Tympanomerus deschampsi</i> , Rathbun.                   | <i>Sesarma dehaani</i> , Milne-Edwards. |
| <i>Eriocheir sinensis</i> (Milne-Edwards).                  | <i>Leander annandalei</i> , Kemp.       |
| „ <i>leptognathus</i> , Rathbun.                            | „ <i>modestus</i> , Heller.             |
| <i>Sesarma intermedium</i> (de Haan).                       | <i>Palaemonetes sinensis</i> (Sollaud). |
| <i>Caridina nilotica</i> subsp. <i>gracilipes</i> , de Man. |                                         |

THE PEAK, HONGKONG.

|                                                 |                                     |
|-------------------------------------------------|-------------------------------------|
| <i>Potamon (Potamon) anacoluthon</i> , sp. nov. | <i>Caridina serrata</i> , Stimpson. |
|-------------------------------------------------|-------------------------------------|

It will be noticed that nine genera are represented in this collection, a very large number when it is remembered that all were found in fresh water. Three species and one subspecies had not previously been described; of these the *Rhynchoplax* is interesting in view of its habitat, while the *Leander* is of considerable importance in that it represents a type intermediate between Henderson's very remarkable *L. tenuipes* and the more normal members of the genus. *Tympanomerus deschampsi*, *Eriocheir leptognathus* and *Palaemonetes sinensis* are species only recently discovered; but our knowledge of *Palaemon asperulus*, *Leander modestus*, and *Caridina serrata* has hitherto rested on descriptions made more than fifty years ago. *Caridina nilotica* subsp. *gracilipes* is recorded far to the north of its previously known range and evidence is brought forward to show that the Chinese form of *Caridina denticulata* differs sufficiently from that found in Japan to warrant subspecific recognition.

The only species in Dr. Annandale's collections common to both China and Japan are *Sesarma dehaani* and *Palaemon nipponensis*.

The collection from the Tale Sap, a lagoon connected with the Gulf of Siam by means of a comparatively narrow channel, contains the largest number of species,

forty-seven forms being represented. At the mouth of the Patalung river and in the inner of the two lakes of which the Tale Sap is composed, the water was fresh at the time when the collection was made and probably remains so throughout the year. In the channel between the two lakes and in the outer lake it was brackish, specific gravities falling between 1.0015 and 1.0085.<sup>1</sup>

The following species were obtained in these two regions:—

PATALUNG RIVER AND INNER LAKE OF TALE SAP.

Fresh water.

|                                                             |                                                     |
|-------------------------------------------------------------|-----------------------------------------------------|
| <i>Paratelphusa</i> ( <i>Paratelphusa</i> ) <i>germaini</i> | <i>Palaemon elegans</i> , de Man.                   |
| (Rathbun).                                                  | <i>Caridina propinqua</i> , de Man.                 |
| <i>Palaemon carcinus</i> , Fabricius.                       | „ <i>gracillima</i> , Lanchester.                   |
| „ <i>lanchesteri</i> , de Man.                              | „ <i>nilotica</i> , subsp. <i>macrophora</i> , nov. |

OUTER LAKE OF TALE SAP AND CHANNEL BETWEEN LAKES.

Brackish water.

|                                                |                                                                |
|------------------------------------------------|----------------------------------------------------------------|
| <i>Rhynchoplax exiguus</i> , Kemp.             | <i>Dorippe astuta</i> , Fabricius.                             |
| <i>Gelasimus annulipes</i> , Latreille.        | <i>Clibanarius longitarsis</i> (de Haan).                      |
| <i>Dotilla wichmanni</i> , de Man.             | <i>Diogenes avarus</i> , Heller.                               |
| <i>Camptandrium sexdentatum</i> , Stimpson.    | <i>Upogebia</i> ( <i>Upogebia</i> ) <i>heterocheir</i> , Kemp. |
| <i>Grapsus strigosus</i> (Herbst).             | <i>Palaemon carcinus</i> , Fabricius.                          |
| <i>Metopograpsus messor</i> (Forskål).         | „ <i>sundaicus</i> (Heller), de Man.                           |
| „ <i>maculatus</i> , Milne-Edwards.            | <i>Alpheus paludicola</i> , Kemp.                              |
| <i>Varuna litterata</i> (Fabricius).           | <i>Caridina propinqua</i> , de Man.                            |
| <i>Sesarma quadratum</i> (Fabricius).          | „ <i>gracillima</i> , Lanchester.                              |
| „ <i>haswelli</i> , de Man.                    | <i>Penaeus indicus</i> , var. <i>merguiensis</i> , de Man.     |
| „ <i>taeniolum</i> , White.                    | „ <i>carinatus</i> , Dana.                                     |
| „ <i>siamense</i> , Rathbun.                   | <i>Penaeopsis monoceros</i> (Fabricius).                       |
| <i>Pilumnus quadridentatus</i> , de Man.       | „ <i>affinis</i> (Milne-Edwards).                              |
| <i>Scylla serrata</i> (Forskål).               | „ <i>brevicornis</i> (Milne-Edwards).                          |
| <i>Neptunus pelagicus</i> (Linn.).             | <i>Acetes indicus</i> , Milne-Edwards.                         |
| <i>Charybdis crucifera</i> (A. Milne-Edwards). | „ <i>japonicus</i> , Kishinouye.                               |
| „ <i>affinis</i> , Dana.                       | <i>Lucifer hanseni</i> , Nobili.                               |
| „ <i>callianassa</i> (Herbst).                 | <i>Squilla scorpio</i> , Latreille.                            |
| <i>Ebalia heterochalaza</i> , sp. nov.         | „ „ var. <i>immaculata</i> , Kemp.                             |
| <i>Philyra sexangula</i> , Alcock.             | „ <i>nepa</i> , Latreille (Bigelow).                           |
| „ <i>olivacea</i> , Rathbun.                   | „ <i>interrupta</i> , Kemp.                                    |
|                                                | <i>Squilla raphidea</i> , Fabricius.                           |

It is probable that a considerable number of the brackish-water forms are merely casual or seasonal immigrants to the lake and do not inhabit it permanently; the fact

<sup>1</sup> Nearly all the species were found in water the specific gravity of which varied from 1.0035 to 1.0085 (corrected).

that the specimens were all collected at one season renders it impossible to determine the precise status of individual species in this respect. It is none the less possible to institute a comparison with the Decapod and Stomatopod fauna of the Chilka Lake on the Orissa coast of the Bay of Bengal. The two lagoons are in many respects closely similar: both are shallow, with a muddy bottom, both are connected with the sea and it is practically certain that in the outer part of the Tale Sap, as in the Chilka Lake, the salinity of the water varies considerably at different times of the year. One essential difference must be noted,—that in no part of the Chilka Lake does the water remain permanently fresh; but this discrepancy may be obviated by considering for comparative purposes only the fauna of the outer lake of the Tale Sap.

Of the forty-one species of Decapods and Stomatopods which we regarded as permanent inhabitants of the Chilka Lake fifteen were found in the Tale Sap, namely:—

|                                                                |                                                        |
|----------------------------------------------------------------|--------------------------------------------------------|
| <i>Camptandrium sexdentatum</i> , Stimpson.                    | <i>Alpheus paludicola</i> , Kemp.                      |
| <i>Varuna litterata</i> (Fabricius).                           | <i>Caridina propinqua</i> , de Man.                    |
| <i>Scylla serrata</i> (Forskål).                               | <i>Penaeus carinatus</i> , Dana.                       |
| <i>Neptunus pelagicus</i> (Linn.).                             | <i>Penaeopsis monoceros</i> (Fabricius).               |
| <i>Clibanarius longitarsis</i> (de Haan).                      | „ <i>affinis</i> (Milne-Edwards).                      |
| <i>Diogenes avarus</i> , Heller.                               | <i>Lucifer hanseni</i> , Nobili.                       |
| <i>Upogebia</i> ( <i>Upogebia</i> ) <i>heterocheir</i> , Kemp. | <i>Squilla scorpion</i> , Latreille.                   |
|                                                                | <i>Squilla scorpion</i> var. <i>immaculata</i> , Kemp. |

The majority of these are species of very wide distribution, found in the open sea as well as in backwaters, and are consequently of little importance for comparative purposes. The occurrence of *Camptandrium sexdentatum*, *Upogebia heterocheir*, *Alpheus paludicola* and *Caridina propinqua* appears, however, to indicate a real relationship between the two faunas; it is also noteworthy that the species of two Oxystome genera found in the Tale Sap are closely allied to those obtained in the Chilka Lake. The fauna of the Tale Sap, like that of the Chilka Lake, has little in common with that of the Gangetic Delta, though the delta occupies a position intermediate between the two lagoons so far as the coast-line is concerned.

The Tale Sap collection is not rich in undescribed species but in a number of cases considerable additions are made to our knowledge of the geographical distribution.

The collection also contains a number of species found about fifty miles to the south-east of the Tale Sap in the Patani river, below the town of Patani in the Siamese Malay States. These specimens belong to sixteen species and were all obtained in water that at the time of their capture was quite fresh; the situation in which they were found was, however, subject to tidal influence and there can be no doubt that all the species are at times brought into contact with brackish water. The following forms were found in the Patani river:—

|                                          |                                                            |
|------------------------------------------|------------------------------------------------------------|
| <i>Varuna litterata</i> (Fabricius).     | <i>Leander potamiscus</i> , Kempf.                         |
| <i>Pyxidognathus deianira</i> , de Man.  | <i>Caridina propinqua</i> , de Man.                        |
| <i>Sesarma edwardsi</i> , de Man.        | „ <i>brachydactyla</i> , subsp. <i>peninsularis</i> , nov. |
| „ <i>siamense</i> , Rathbun.             | „ <i>gracilirostris</i> , de Man.                          |
| <i>Clistocoeloma merguense</i> , de Man. | „ <i>weberi</i> , subsp. <i>sumatrensis</i> , de Man.      |
| <i>Palaemon carcinus</i> , Fabricius.    | „ <i>weberi</i> , subsp. <i>sumatrensis</i> , de Man.      |
| „ <i>sundaicus</i> (Heller), de Man.     | <i>Acetes erythraeus</i> , Nobili.                         |
| „ <i>lampropus</i> , de Man.             | <i>Acetes japonicus</i> , Kishinouye.                      |

A number of these species were also obtained in the Tale Sap. The most interesting are the scarce *Pyxidognathus deianira*, the *Leander* and the subspecies of *Caridina brachydactyla*, a species that in its typical form is known only from Celebes, Flores and Saleyer.

In ditches in the vicinity of the Patani river *Paratelphusa germaini* (Rathbun) was found.

Dr. Annandale also made a small collection at Penang. Six species were obtained on the island, for the most part in a hill stream in the Botanical Gardens, and six at the mouth of the Prai river on the mainland opposite Penang; the latter were found in water of considerable salinity. The species are:—

## PENANG ISLAND.

|                                                                     |                                                                         |
|---------------------------------------------------------------------|-------------------------------------------------------------------------|
| <i>Sesarma</i> sp.                                                  | <i>Leander potamiscus</i> , Kempf.                                      |
| <i>Potamon</i> ( <i>Potamon</i> ) <i>stoliczkanum</i> (Wood-Mason). | <i>Caridina brachydactyla</i> , subsp. <i>peninsularis</i> , nov. [Man. |
| <i>Palaemon neglectus</i> , de Man.                                 | <i>Caridina weberi</i> , subsp. <i>sumatrensis</i> , de                 |

## MOUTH OF PRAI RIVER.

|                                                 |                                         |
|-------------------------------------------------|-----------------------------------------|
| <i>Metopograpsus maculatus</i> , Milne-Edwards. | <i>Clibanarius padavensis</i> , de Man. |
| „ <i>quadridentatus</i> , Stimpson.             | <i>Leander semmelinki</i> , de Man.     |
| <i>Myomenippe granulosa</i> (A. Milne-Edwards). | <i>Acetes erythraeus</i> , Nobili.      |

In addition there are single examples of *Paratelphusa* (*Paratelphusa*) *incerta*, Lan- chester, from the Singapore Botanical Gardens and of *Sesarma andersoni*, de Man, from Kantan in Trang.

To my account of this extensive collection I have added a description of a very interesting Grapsid (*Sesarma foxi*) presented to the Indian Museum by Mr. B. H. Buxton and obtained at the unusual altitude of 2000 ft. on Langkawi I. off the west coast of the Malay Peninsula. Reference is also made to a Javanese collection of Decapods, comprising six species, kindly obtained for us by the late Dr. W. C. Hos- sack. All these had already been recorded from the island by Dr. J. G. de Man.

In dealing with certain groups of species concerning which our knowledge was more than ordinarily deficient, I have found it advantageous to work through portions of



the undetermined material lying in the Indian Museum and to present the results concurrently with those derived from Dr. Annandale's collection. The literature of the subject being so widely scattered I have found that a great economy in time is effected by this procedure, and the conclusions reached are, I believe, of much greater value than if either collection had been examined separately. The groups treated in this manner are (i) the Hymenosomatidae, (ii) the species of *Leander* allied to *L. styliferus*, Milne-Edwards, (iii) the Atyid genus *Paratya* (= *Xiphocaridina*) and (iv) the Penaeid genus *Acetes*. On these groups separate reports, including descriptions of a number of the new species, have been already published in Vol. XIII of the *Records of the Indian Museum*.

Dr. Annandale has generously presented a complete set of the specimens he obtained, together with the types of the new species and subspecies to the collection of the Zoological Survey of India (Indian Museum).

#### Family HYMENOSOMATIDAE.

In the course of his tour Dr. Annandale obtained two species of this interesting family, both apparently new. Descriptions of these forms have been published in Vol. XIII of the *Records of the Indian Museum* in a paper devoted mainly to the elucidation of the Indian representatives of the family. In this paper I have attempted a revision of the genera and have pointed out that the Indian species referred by Alcock to *Hymenicus* should more properly be grouped under Stimpson's *Rhynchoplax*. Dana's *Hymenicus* is in my opinion synonymous with White's *Halicarcinus*.

It is unfortunate that both Dr. Tesch and I should have been occupied with this family at the same time without knowledge of each other's work. Tesch's report on certain crabs obtained by the 'Siboga' Expedition, published only five months after my own paper, also contains a revision of the genera of this family. In the application of *Rhynchoplax* we are, for the most part, in agreement<sup>1</sup>; but Tesch retains *Hymenicus* as a distinct genus and in less important details our work shows a number of discrepancies.

#### *Rhynchoplax introversus*, Kemp.

1917. *Rhynchoplax introversus*, Kemp, *Rec. Ind. Mus.*, XIII. p. 262, figs. 11a-c.

This species, which is readily distinguished from any other by the peculiar form of the lateral border of the carapace, is based on two specimens obtained in the Tai-Hu lake in China, living in water that is quite fresh at all seasons of the year. The only other Hymenosomatid known from fresh water beyond the reach of all tidal influence is *Halicarcinus lacustris* (Chilton)<sup>2</sup> which has been recorded from Australia, New Zealand and Norfolk I.

<sup>1</sup> Dr. Tesch places Hgss's *H. Kreffii* and Haswell's *H. rostrata* under *Rhynchoplax*. According to my views both these species are to be referred to *Halicarcinus* or, if it really be distinct from the latter, to *Hymenicus*. This is certainly true of Haswell's species of which I have seen specimens.

<sup>2</sup> Chilton, *Trans. N. Zealand Inst.*, XLIV, p. 128 (1912).

**Rhynchoplax exiguus**, Kemp.

1917. *Rhynchoplax exiguus*, Kemp, *Rec. Ind. Mus.*, XIII, p. 260, fig. 10.

A very small species without any strongly marked characteristics. Ten specimens were found by Dr. Annandale in the outer part of the Tale Sap, on the mainland opposite the western end of Koh Yaw. They were living in lumps of turf that had fallen into the lake owing to the undermining of the banks. The specific gravity of the water was about 1.00625.

Family OCYPODIDAE.

Subfamily OCYPODINAE.

Genus **Gelasimus**, Latreille.

**Gelasimus annulipes**, Latreille (Milne-Edwards).

1900. *Gelasimus annulipes*, Alcock, *Journ. Asiat. Soc. Bengal*, LXIX, p. 353.

1915. *Gelasimus annulipes*, Kemp, *Mem. Ind. Mus.*, V, p. 221.

A colony of this abundant species was found by Dr. Annandale at Kaw Deng at the mouth of the Tale Sap. The claws of large males were of a pale dull yellow colour in life. No specimens were observed more than a few hundred yards within the mouth of the lake, the water being practically as salt as that of the Gulf of Siam.

Subfamily SCOPIMERINAE.

Genus **Dotilla**, Stimpson.

**Dotilla wichmanni**, de Man.

1892. *Dotilla wichmanni*, de Man, in Weber's *Zool. Ergebn. Reise Niederland. Ost-Ind.*, II, p. 308, pl. xviii, fig. 8.

1895. *Dotilla wichmanni*, de Man, *Zool. Jahrb., Syst.*, VIII, p. 577.

1910. *Dotilla wichmanni*, Rathbun, *Dansk. Vid. Selsk. Skrift. (7)*, *Naturvid. og Math.*, V, p. 324.

1918. *Dotilla wichmanni*, Tesch, *Decap. Brachyur. 'Siboga'-Exped.*, I, p. 45.

A large number of specimens were obtained at Kaw Deng at the mouth of the Tale Sap on the opposite side of the channel from Singgora.

The series includes some very fine individuals with carapace nearly 8 mm. in length and consequently much larger than any of de Man's original specimens, none of which exceeded 5 mm. In males between 6 and 8 mm. in length the carapace bears three large angular projections on either side; two of these are situated, one behind the other, on the outer side of the deep groove that borders the lateral margin, while the third, which is more spinose in character and possesses a corneous apex is situated on the side-wall, immediately beneath the small tooth that defines the upper and outer limit of the orbit (text-fig. 1). These projections are not seen in females or small males.

In large males, also, there is a short but high ridge on the inner face of the carpus, situated close to the meral articulation and easily visible in dorsal view. There is no

great difference between large and small specimens in the form of the fingers of the chela, the largest examples possessing merely a low crest in the middle of the dactylus.

De Man compares this species with *D. sulcata* and remarks (p. 311) "Das sternum ist überall glatt und zeigt nicht die für *D. fenestrata* charakteristischen, durchsichtigen stellen; während aber die einzelnen segmenten bei *D. sulcata* leicht convex erscheinen, sind sie bei der neuen Art stark abgeflacht oder leicht concav, sowie deutlich gerändert." On comparing the species with *D. myctiroides* it is, however, evident that the slightly concave areas that occur on each sternal segment and occupy nearly the whole of the space between the legs and the abdomen are true 'tympana' and that so far as the sternum is concerned the difference between *D. wichmanni* and Hilgendorf's *D. fenestrata* rests merely in the number of segments on which 'tympana' are found.

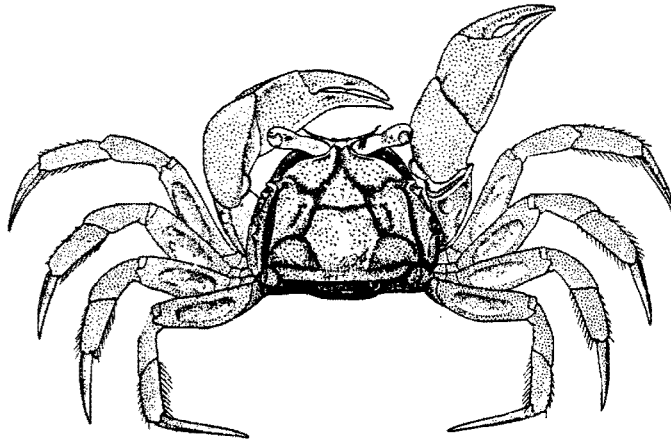


FIG. 1.—*Dottilla wichmanni*, de Man.  
Adult male.

Dr. Annandale notes that the 'runs' made by this species are not so carefully constructed and the pellets of sand not so tidily arranged as is the case with the species found living on the western side of the Bay of Bengal.

*Dottilla wichmanni* has not hitherto been recorded from Indian waters, but has, however, recently been obtained in the Andaman Is. The specimens, none of which are of large size, were found living on the sandy shores of Corbyn's Cove South, not far from Port Blair. The species has been reported from Celebes, Makassar and Atjeh in Sumatra (de Man), the Talaut Is. (Tesch) and from the coast of Koh Kong in the Gulf of Siam (Rathbun).

Genus *Tympanomerus*, Rathbun.

*Tympanomerus deschampsi*, Rathbun.

1914. *Tympanomerus deschampsi*, Rathbun, *Proc. U. S. Nat. Mus.*, XLVI, p. 356, pl. xxxii, pl. xxxiii, fig. 1.

A single female with carapace  $9\frac{1}{2}$  mm. in breadth was obtained by Dr. Annandale at the edge of the Whangpoo R., 5 to 10 miles below Shanghai. It was found in a burrow above the water-line in mud which was rapidly hardening. The water in the river at the point where the specimen was taken is quite fresh at all seasons.

The species is readily distinguished from *T. stapletoni*, de Man, by the characters given by Miss Rathbun; it has been recorded from Shanghai, where the type specimens were obtained, and from Korea.

Subfamily *MACROPHTHALMINAE*.

Genus *Camptandrium*, Stimpson.

*Camptandrium sexdentatum*, Stimpson.

1907. *Camptandrium sexdentatum*, Stimpson, *Smiths. Misc. Coll.*, XLIX, p. 138, pl. xvii, fig. 4.  
 1915. *Camptandrium sexdentatum*, Kemp, *Mem. Ind. Mus.*, V, p. 236, pl. xii, fig. 6.  
 1918. *Camptandrium sexdentatum*, Tesch, *Decap. Brachyur. 'Siboga'-Exped.*, I, p. 65, pl. v, fig. 3.

Dr. Tesch has recently redescribed this species. In the account which I published in 1915 I placed the genus in the Grapsidae and in the subfamily Varuninae, being under the impression that it was remotely allied to *Eriocheir*. Dr. Tesch, who has had the advantage of examining an adult male, considers that it belongs to the Ocypodidae and to the subfamily Macrophthalminae and is not distantly related to *Paracleistostoma*. With this view I concur.

Two females of this rare species, with carapace 7.2 and 6.7 mm. in breadth, were found by Dr. Annandale in the Tale Sap. They are a trifle smaller than the dead female found in the Chilka Lake (*v. Kemp, loc. cit.*, text-fig. 13); the sculpture of the carapace is crisper, the transverse ridge on the branchial and cardiac regions being more sharply defined and the antero-lateral teeth more prominent.

The specimens were found in the channel opposite Singgora on a bottom of mud and dead shells at a depth of  $4\frac{1}{2}$  metres and in the middle of the outer lake, N. of Koh Yaw, on a bottom of sticky mud at a depth of  $2\frac{1}{2}$  metres. The specific gravity of the water in the former locality was 1.00625 and in the latter 1.0035 (corrected).

The species has been recorded from Hong Kong (Stimpson), the Bay of Batavia (Tesch), the Chilka Lake, Orissa (Kemp) and Ennur backwater, Madras (Kemp).

Family GRAPSIDAE.

Subfamily *GRAPSINAE*.

Genus *Grapsus*, Lamarck.

*Grapsus strigosus*, (Herbst).

1900. *Grapsus strigosus*, Alcock, *Journ. Asiat. Soc. Bengal*, LXIX, p. 393.

A single dead specimen with carapace 34 mm. in breadth was found at the mouth of the Tale Sap. The species is probably not an inhabitant of the lake.

Genus *Metopograpsus*, Milne-Edwards.***Metopograpsus messor***, (Forskål) Milne-Edwards.

1900. *Metopograpsus messor*, Alcock, *Journ. Asiat. Soc. Bengal*, LXIX, p. 397.  
 1918. *Metopograpsus messor*, Tesch, *Decap. Brachyur. 'Siboga'-Exped.*, I, p. 79.

Two dead specimens were found at Kaw Deng at the mouth of the Tale Sap. The carapace of the largest is 20 mm. in breadth.

***Metopograpsus maculatus***, Milne-Edwards.

1900. *Metopograpsus maculatus*, Alcock, *Journ. Asiat. Soc. Bengal*, LXIX, p. 398.  
 1918. *Metopograpsus maculatus*, Tesch, *Decap. Brachyur. 'Siboga'-Exped.*, I, p. 80.

Two examples of this species, including an ovigerous female with carapace 22 mm. in breadth, were obtained at the mouth of the Prai River, on the mainland opposite Penang; they were living under stones on a mud flat exposed at low water. Two others were found under stones on the shore of Koh Yaw in the outer lake of the Tale Sap. The specific gravity of the water at the latter place (corrected) was 1.00625.

***Metopograpsus quadridentatus***, Stimpson.

1858. *Metopograpsus quadridentatus*, Stimpson, *Proc. Acad. Sci. Philadelphia*, p. 102.  
 1883. *Metopograpsus quadridentatus*, de Man, *Notes Leyden Mus.*, V, p. 158.  
 1895. *Metopograpsus quadridentatus*, de Man, *Zool. Jahrb., Syst.*, IX, p. 76, fig. 16.  
 1901. *Metopograpsus quadridentatus*, Nobili, *Boll. Mus. Torino*, XVI, no. 397, p. 3.  
 1907. *Metopograpsus quadridentatus*, Stimpson, *Smiths. Misc. Coll.*, XLIX, p. 115, pl. xvi, fig. 2.  
 1910. *Metopograpsus quadridentatus*, Rathbun, *Danske Vid. Selsk. Skrift. (7), naturvid. og math.*, V, p. 325.  
 1918. *Metopograpsus quadridentatus*, Tesch, *Decap. Brachyur. 'Siboga'-Exped.*, I, p. 79.

Five specimens were found in company with *M. maculatus* at the mouth of the Prai River near Penang. In the largest example, a male with carapace 20.5 mm. in length and 24.75 mm. in breadth, the chela precisely resembles the figure given by de Man (*loc. cit.*, 1895).

*M. quadridentatus* has not so far been found in Indian waters. It has been recorded from Macao (Stimpson), Amoy (de Man), 'Malacca' (de Man), Borneo (Nobili) and from the east coast of the Gulf of Siam (Rathbun).

## Subfamily VARUNINAE.

Genus *Varuna*, Milne-Edwards.***Varuna litterata*** (Fabr.), Milne-Edwards.

1900. *Varuna litterata*, Alcock, *Journ. Asiat. Soc. Bengal*, LXIX, p. 401.  
 1915. *Varuna litterata*, Kemp, *Mem. Ind. Mus.*, V, p. 232.

Several specimens were obtained in the outer lake of the Tale Sap, at and near Singgora and at Koh Yaw. They were found in fishermen's nets, under stones on the shore, and in pools and ditches. The specific gravity of the water in which they were taken varied from about 1.004 to 1.0085 (corrected). Crabs of this species were also taken in the Patani River, fifty miles to the south-east of the Tale Sap, in water that was quite fresh, though subject to tidal influence.

Genus *Eriocheir*, de Haan.*Eriocheir japonicus* (de Haan).

1835. *Grapsus (Eriocheir) japonicus*, de Haan, in Siebold's *Fauna Japonica, Crust.*, p. 59, pl. xvii.

This is the common edible crab of the main island of Japan and is sold in large numbers at Kyoto. It is said to be migratory in habit, making its way towards the sea or into lakes after heavy rain. There is a specimen in the Otsu laboratory from the southern end of Lake Biwa, but Dr. Annandale was unable to find examples in the lake in October and November 1915. Young and half-grown specimens were abundant in the main channel of the Yodo River, just above Osaka, at the beginning of December. The species does not appear to have been found in the sea; it has occasionally been recorded from brackish water, but is almost always found in water that is quite fresh.

Four very large specimens obtained in the Kyoto market and said to have come from Echizen province to the north of Lake Biwa yield the following measurements (in mm.):—

|                                    | ♂   | ♂   | ♀   | ♀   |
|------------------------------------|-----|-----|-----|-----|
| Length of carapace .. ..           | 83  | 82  | 67  | 66  |
| Greatest breadth of carapace .. .. | 94  | 91  | 73  | 72  |
| Length of chelipede .. ..          | 134 | 130 | 76  | 75  |
| Length of chela .. ..              | 82  | 82  | 43  | 43  |
| Breadth of chela .. ..             | 45  | 44  | 22  | 21  |
| Length of second walking leg .. .. | 155 | 151 | 123 | 128 |

In the largest males the whole palm on both outer and inner sides, except for a small area at the proximal end of the lower surface, is thickly covered with woolly hair, which also invests the anterior margin of the carpus and the base of the dactylus. In other males, with carapace about 38 mm. in length, the hair is less abundant; the entire lower surface of the palm is bare, on the inner side there is only a comparatively small patch in the neighbourhood of the finger-cleft and there is very little on the anterior margin of the carpus. In males between 11 and 12 mm. in length the chela is apparently nude, but on close inspection is seen to be largely covered with a fine and very close pubescence. In these smallest individuals the carapace is flatter and its antero-lateral margins are straighter than in adults.

*Eriocheir sinensis* (Milne-Edwards).

1854. *Eriochirus sinensis*, Milne-Edwards, *Arch. Mus. Hist. nat. Paris*, VII, p. 146, pl. ix, figs. 1-10.

1880. *Eriocheir sinensis*, Kingsley, *Proc. Acad. Sci. Philadelphia*, p. 210.

The collection contains a large male and female from Moo-Too, Tai Hu, Kiangsu province, China, and a number of young individuals obtained in the Whangpoo River, between Shanghai and Woosung at depths of  $5\frac{1}{2}$  to  $7\frac{1}{2}$  metres. The carapace of the largest specimen is 54 mm. in length.

In young examples, as in *E. japonicus*, the antero-lateral borders of the carapace are much straighter than in adults and there is less hair on the hands. In a male with carapace 15 mm. in length the hair is restricted to the outer surface of the chela and it is completely absent in all specimens under 12 mm. in length. The four teeth on the front are very sharply pointed in adults, but much blunter in young individuals.

*Eriochair rectus*<sup>1</sup> (Stimpson) is perhaps merely a synonym of this species. It was described from a specimen 0.92 ins. in length and is chiefly characterised by its straighter lateral margins and blunter frontal lobes, thus closely resembling the young of *E. sinensis*.

Dr. Annandale informs me that this is the common edible crab of Shanghai and is to be found on sale in all the village markets round the Tai Hu, where it is chiefly captured in narrow creeks. Doflein<sup>2</sup> records the species from Shasi on the Yang-tse-kiang, 1300 kilometres from sea, and also from brackish water in the neighbourhood of Shanghai.

#### ***Eriochair leptognathus*, Rathbun.**

1914. *Eriochair leptognathus*, Rathbun, *Proc. U. S. Nat. Mus.*, XLVI, p. 353, pl. xxxiii, figs. 2, 3.

To this species I refer a small male with carapace 9.1 mm. in length and 9.6 mm. in breadth. It agrees on the whole very well with Miss Rathbun's description. The edge of the front is almost straight, only very obscurely trilobed, the postero-lateral margins of the carapace are parallel rather than convergent and the hindmost tooth of the antero-lateral border is extremely small and inconspicuous. The outer surface of the palm is bare, as in the type, but there is a dense patch of woolly hair on the inner side, extending on to the base of both fingers.

The granulate ridge, anteriorly concave, that runs inwards from the hindmost tooth of the antero-lateral margin is well marked; it is finer and less elevated than in *E. japonicus* or *E. sinensis* and in front of it there is no trace of the comparatively deep depression found in those species. There is, moreover, a noticeable distinction in the size of the eyes. If specimens of similar dimensions be compared it will be seen that the cornea is much smaller in *E. leptognathus* than in the two allied species and is decidedly narrower than the basal part of the stalk. The most obvious character in which the species differs from other members of the genus is, however, the presence of only three instead of four teeth on the antero-lateral margin of the carapace; this feature seems to have escaped Miss Rathbun's attention though it is clearly shown in her figure.

The single specimen was found in company with young *E. sinensis* in the Whangpoo River, between Shanghai and Woosung at a depth of 5½ to 7½ metres. It was found in pure fresh water.

The female described by Miss Rathbun was 10.6 mm. in length and 11.6 mm. in breadth and was obtained at Shanghai.

<sup>1</sup> *Eriochirus rectus*, Stimpson, *Proc. Acad. Nat. Sci., Philadelphia*, X, p. 103 (1858) and *Smiths. Misc. Coll.*, XLIX, p. 125 (1907).

<sup>2</sup> Doflein, *Abhandl. K. Bayer. Akad. Wiss.*, XXI, p. 665 (1902).

Genus **Pyxidognathus**, A. Milne-Edwards.**Pyxidognathus deianira**, de Man.

1888. *Pyxidognathus deianira*, de Man, *Journ. Linn. Soc. Zool.*, XXII, p. 148, pl. x, figs. 4-6.

Dr. Annandale obtained a single specimen of this scarce species among the roots of a dead palm trunk in the Patani River, below the town of Patani in the Siamese Malay States. The individual is a male with carapace 9 mm. in breadth. Except for the slightly more acute teeth on the antero-lateral margin of the carapace, the specimen bears the closest resemblance to two smaller males, co-types of the species, that are preserved in the Indian Museum.

The species has hitherto been recorded only from Mergui, where it was obtained in mangrove swamps.

Subfamily **SESARMINAE**.Genus **Sesarma**, Say.**Sesarma quadratum** (Fabricius).

1887. *Sesarma quadrata*, de Man, *Zool. Jahrb., Syst.*, II, p. 683, pl. xvii, fig. 2.

1890. *Sesarma quadrata*, de Man, *Notes Leyden Mus.*, XII, p. 99.

1892. *Sesarma quadrata*, de Man, in Weber's *Zool. Ergebn. Reise Niederl. Ost-Ind.*, II, p. 328.

1895. *Sesarma (Parasesarma) quadrata*, de Man, *Zool. Jahrb., Syst.*, IX, p. 182.

1917. *Sesarma (Parasesarma) plicata*, Tesch, *Zool. Meded. Mus. Leiden*, III, p. 187 (syn.).

Several specimens were found at different places in the outer lake of the Tale Sap (Kaw Keoh, Kaw Deng, Koh Yaw and Singgora); they were for the most part found under stones or running on the shore at some distance from the water. All appear to belong to the true *S. quadratum* as redefined by de Man.

**Sesarma haswelli**, de Man.

1888. *Sesarma haswelli*, de Man, *Journ. Linn. Soc.*, XXII, p. 175.

1917. *Sesarma (Chiromantes) haswelli*, Tesch, *Zool. Meded. Mus. Leiden*, III, p. 158.

A single example of this species, an ovigerous female 16 mm. in breadth, was obtained by Dr. Annandale near Singgora.

Alcock<sup>1</sup> included *S. haswelli*, along with *S. lividum*, A. Milne-Edwards, and *S. dussumieri*, Milne-Edwards, in his synonymy of *S. bidens* (de Haan), being evidently of the opinion that the five forms distinguished by de Man in 1888 in his "section C" (*loc. cit.*, p. 175) were only based on individual variations of a single wide-spread species. De Man in 1902<sup>2</sup> dissented from Alcock's opinion.

In the Indian Museum are preserved the type of *S. haswelli*, other specimens from Mergui originally determined by de Man as *S. livida*, a large number of examples examined by Alcock and several additional samples obtained in recent years.

On examining this material I find little difficulty in separating it into groups, corresponding to those that de Man and Tesch recognize as distinct species. I have no doubt that Alcock formed a wrong estimate of the variability of the forms included in the *bidens*-group and that it will be necessary to subject the Indian material to a thorough revision.

<sup>1</sup> Alcock, *Journ. Asiat. Soc. Bengal*, LXIX, p. 415.

<sup>2</sup> De Man, *Abhandl. Senck. naturf. Ges., Frankfurt*, XXV, p. 538 (1902).



It should be noted that the specimens from Mergui, recorded by de Man in 1888 under the name *S. livida*, have since been described by him as a new species—*S. onychophora*.<sup>1</sup>

***Sesarma andersoni*, de Man.**

1888. *Sesarma andersoni*, de Man, *Journ. Linn. Soc.*, XXII, p. 172, pl. xii, figs. 1-4.

1917. *Sesarma (Parasesarma) andersoni*, Tesch, *Zool. Meded. Mus. Leiden*, III, p. 129.

A single specimen, with carapace 8.6 mm. in breadth, was obtained by Dr. Annandale at Kantang in Trang, on the west coast of peninsular Siam. It was caught running on the piers of the landing stage above water-level.

***Sesarma edwardsi*, de Man.**

1888. *Sesarma edwardsi*, de Man, *Journ. Linn. Soc.*, XXII, p. 185, pl. xiii, figs. 1-4.

1917. *Sesarma (Sesarma) edwardsi*, Tesch, *Zool. Meded. Mus. Leiden*, III, p. 147.

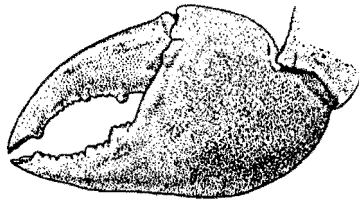
Two males and one female, the largest with carapace 15½ mm. in breadth, were found in the Patani River in the Siamese Malay States. The specimens were obtained in fresh water, but in a locality subject to tidal influence.

***Sesarma intermedium* (de Haan).**

1865. *Sesarma intermedia*, Heller, *Reise 'Novara', Crust.*, p. 64.

1918. *Sesarma (Sesarma) intermedium*, Tesch, *Zool. Meded. Mus. Leiden*, III, pp. 162, 243.

Two males from Shanghai are referred to this species. The carapace of the larger is 27 mm. in length and 31 mm. in greatest breadth; that of the smaller is 17.5 mm. in length and 20.8 mm. in breadth. In both specimens there is a single well marked tooth on the lateral margin behind the extra-orbital angle, but further back there is scarcely a trace of a rudimentary third lateral tooth, such as has been described in certain *Sesarma* referred to this species.



a.



b.

FIG. 2.—*Sesarma intermedium* (de Haan).

a. Left chela of a specimen 27 mm. in length.

b. Left chela of a specimen 17.5 mm. in length.

The crest on the upper margin of the merus of the chelipedes does not possess a subterminal tooth, as in *S. tetragonum*; the upper surface of the carpus is smooth and its inner margin bears a few small tubercles, but is not toothed. The upper margin of the palm is defined by an obscure and feebly crenulate ridge; its outer surface shows only the slightest traces of rugosity, but bears the oblique longitudinal line referred to by Tesch. The fingers are smooth except for a slight tuberculation on the dorsal surface of the dactylus near its proximal end. In both specimens the fingers gape, meeting only at the tips, the extent of the gape

being very much greater in the larger specimen.

<sup>1</sup> De Man, *Zool. Jahrb., Syst.*, IX, p. 214 (1895), and X, pl. xxxi, fig. 39.

The walking legs are comparatively slender. The merus in the first pair is about two and a half times as long as broad in the larger specimen, about two and a quarter times in the smaller.

In certain respects the two specimens obtained by Dr. Annandale do not entirely agree with the descriptions given by de Man. In the notes published in 1880 he mentions the existence of traces of a third tooth on the lateral margins of the carapace and remarks that the ambulatory legs agree with those of *S. tetragonum*, in which species the merus is greatly expanded, that of the first pair being only twice as long as broad. In 1887 he compared the species with the closely allied *S. sinensis*, Milne-Edwards, distinguishing the latter by the proportionately longer fingers of the chela and more slender meropodites of the walking legs.

Dr. Annandale's specimens seem to some extent intermediate in character between *S. intermedium* and *S. sinensis* as understood by de Man. In the comparative slenderness of the walking legs they incline to *S. sinensis*, in which the merus of the first pair is described as being three times as long as broad (de Man, *loc. cit.*, 1887, p. 670), while in the proportionate length of the fingers of the chelipedes they appear to agree with *S. intermedium*. Outlines of the chelae of the two specimens are shown in text-figs. 2 a, b. The examples agree very closely with de Haan's original figure, in which the meropodites of the legs do not appear to be much expanded, and I have little doubt that my identification is correct.

The specimens recorded by de Man in 1888 from Mergui as *S. intermedia*<sup>1</sup> are unquestionably distinct; de Man has redescribed them under the name *S. moeschii*.<sup>2</sup>

The larger of the two specimens was obtained by Dr. Arthur Stanley from a creek near Shanghai, the smaller was found dead in a burrow on the banks of the Whangpoo River in the same neighbourhood. Both were from fresh water. The habits of the species appear to resemble those of *S. dehaani* (*infra*).

The species has been recorded from Japan, the Liu-Kiu Is., Shanghai and Hongkong. De Haan's supplementary record from Sourabaya in Java requires confirmation.

#### ***Sesarma dehaani*, Milne-Edwards.**

1917. *Sesarma (Holometopus) dehaani*, Tesch, *Zool. Meded. Mus. Leiden*, III, pp. 143, 238 (*ubi lit.*).  
 ? 1917. *Sesarma (Holometopus) neglecta*, Tesch, *ibid.*, pp. 178, 238.

Examination of a limited number of specimens from both China and Japan leads me to believe that de Man's *S. neglecta* is not specifically distinct from *S. dehaani*, though it is possible that the name should be retained in a subspecific sense. *S. neglecta* was described from Shanghai, and *S. dehaani* from Japan, and the differences between the two have recently been summarised by Tesch (*loc. cit.*, p. 145).

The material I have examined consists of a large and small male and two females of medium size from the Yodo R., near Osaka (Yoshida coll.), a large male from

<sup>1</sup> De Man, *Journ. Linn. Soc.*, XXII, p. 182 (1888).

<sup>2</sup> De Man, in Weber's *Zool. Ergebn. Reise Neiderland, Ost-Ind.*, II, p. 331, pl. xx, fig. 14 (1892).

Yokohama (Berlin Mus.), a large male from Shanghai (Haberer coll.) and three rather small females from the same locality (Annandale coll.).

The carapace in these specimens yields the following measurements (in mm.) :—

| LOCALITY.          | Sex. | Breadth at extra-orbital angles. | Breadth at base of penultimate legs. | Length. |
|--------------------|------|----------------------------------|--------------------------------------|---------|
| Yodo R., nr. Osaka | ♂    | 31·8                             | 33·3                                 | 30·5    |
| "                  | ♀    | 25·9                             | 27·1                                 | 24·1    |
| "                  | ♀    | 21·9                             | 22·0                                 | 20·2    |
| "                  | ♂    | 19·0                             | 18·4                                 | 17·0    |
| Yokohama           | ♂    | 32·6                             | 33·7                                 | 31·0    |
| Shanghai           | ♂    | 32·0                             | 31·8                                 | 29·9    |
| "                  | ♀    | 19·7                             | 19·5                                 | 17·7    |
| "                  | ♀    | 19·9                             | 19·3                                 | 17·4    |
| "                  | ♀    | 15·9                             | 15·2                                 | 13·6    |

It will be seen that as regards the proportion between length and extra-orbital breadth there is scarcely any difference between Japanese and Chinese specimens; but in large males from Japan the breadth at the base of the penultimate legs is a trifle greater than that at the extra-orbital angles, whereas the reverse is found in the large male from Shanghai. The difference is an extremely small one.

In large Japanese specimens the front is much more deeply excavate in dorsal view than in the large male from Shanghai, but this character is variable in smaller specimens from both localities.

In the large male from Shanghai the outer surface of the palm is obscurely granulate in its lower half, the upper half being nearly smooth. In the large males from Japan it is coarsely tuberculate both above and below. The vertical row of large tubercles on the inner face of the palm in the latter specimens is represented in example from Shanghai by a number of much smaller tubercles not arranged in a definite row.

The collection seems to indicate that while Japanese and Chinese individuals of small or medium size are altogether indistinguishable, large males from the two countries exhibit certain small but possibly constant differences. The material at my disposal is not sufficient to indicate the range of normal variation in adults.

The specimens from Japan were presented by Dr. S. Yoshida; they were obtained

in fresh water in the R. Yodo, above Osaka, where they run about on the piers of landing stages and on embankments at the edge of the river.

In the neighbourhood of Shanghai Dr. Annandale found the species common, along with *S. intermedia*; though found in fresh water it apparently does not penetrate so far inland as the Tai Hu. The banks of all the small freshwater creeks at Shanghai and ponds in the same neighbourhood are full of its burrows and large numbers of crabs may be seen in warm weather running on the mud. In winter they stay inside the burrows, only appearing in exceptionally warm sunny weather. None were seen in December at places where they were stated by residents to be common in summer, but young specimens were obtained by digging in embankments near the Whangpoo River; probably the burrows of the adults were much deeper.

#### *Sesarma taeniolatum*, White.

1900. *Sesarma taeniolatum*, Alcock, *Journ. Asiat. Soc. Bengal*, LXIX, p. 419.

Numerous specimens, the largest an ovigerous female with carapace  $34\frac{1}{2}$  mm. in breadth between the outer orbital angles, were obtained by Dr. Annandale in the outer part of the Tale Sap. The ovigerous female was dug from a large and not very deep burrow at the edge of a small freshwater stream near the point where it entered the lake on Koh Yaw. Others were taken on fishing stakes and the piers of a landing stage above the water-line.

It is probable that the female recorded from Singgora by Lanchester<sup>1</sup> under the name *Sesarma lafondi*, Jacq. and Lucas,<sup>2</sup> was in reality an example of this species.

#### *Sesarma siamense*, Rathbun.

1910. *Sesarma (Chiromantes) siamense*, Rathbun, *Danske Vid. Selsk. Skrift. (7), naturvid. og math.*, V, p. 328, text-figs. 11 a-c.

Five specimens are in the collection, the largest a full-grown male with carapace 10.2 mm. in length and 11.3 mm. in breadth at the outer orbital angles. The epibranchial tooth is bluntly rounded in all the specimens and behind it rudimentary traces of a second tooth are usually visible. The large male has six sharp spinules on the upper edge of the dactylus; in the females there are four, five or six. The striae on the upper surface of the palm bear a close resemblance to Miss Rathbun's figure, but the very short distal stria that runs backwards from the dactylar articulation is only visible in one female.

The specimens were found among the roots of dead palm trees at Kaw Deng near the mouth of the Tale Sap, on fishermen's stakes opposite Koh Yaw in the same neighbourhood and in the Patani River, south-east of the Tale Sap, in the Siamese Malay States. The water in the first two localities was brackish, its specific gravity varying from 1.004 to 1.0085 (corrected); in the Patani River it was quite fresh when the specimens were taken, though probably brackish under certain conditions of tide.

<sup>1</sup> Lanchester, *Proc. Zool. Soc. London*, 1901, p. 550.

<sup>2</sup> Vide Tesch, *Zool. Meded. Mus. Leiden*, III, p. 164, pl. xv (1917).

*S. siamense* was described by Miss Rathbun from the eastern side of the Gulf of Siam, from Koh Kong, Koh Kut and Koh Chick.

***Sesarma foxi*, sp. nov.**

I take this opportunity of describing a very interesting species of *Sesarma* obtained in 1914 by Mr. B. H. Buxton at a height of 2000 ft. on Gunong Raya, in Langkawi I., N. of Penang. Species of this typically estuarine genus have seldom been recorded from considerable altitudes, though a number have been taken on land some distance from the coast-line. The following list, so far as I am aware, comprises all species of the genus that have been recorded from definite heights above sea-level.

*Sesarma maculata*, de Man. Halmahera, 2000 ft.

"*Sesarma maculata*," Lanchester (? de Man). Bukit Besar, near Patani, Siamese Malay States, 2500 and 3500 ft.

*Sesarma trapezoidea*, Guérin. Halmahera, 2500 ft.

*Sesarma thelxinõe*, de Man. Andamans, 800 ft.

*Sesarma* sp. (*vide infra*, p. 240). Penang, 1200 ft.

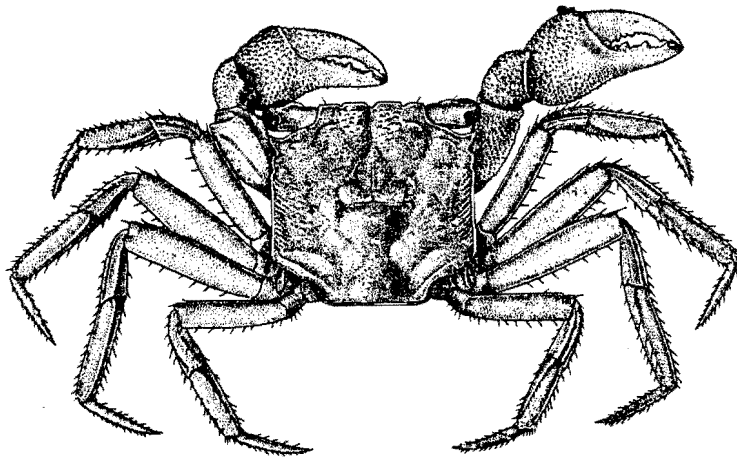


FIG. 3.—*Sesarma foxi*, sp. nov.

It appears probable that in these places the *Sesarma* have been able to adopt a strictly terrestrial mode of life and to ascend to considerable altitudes owing to the damp climate that prevails; in the Andamans the entire absence of competitors in the form of Potamonidae is doubtless an important factor.

The carapace in *S. foxi* is exactly quadrilateral, its length being precisely, or almost precisely, equal to its breadth; the lateral margins are strictly parallel, the breadth at the base of the third pair of legs being equal to that at the outer orbital angle. The carapace is slightly convex fore and aft and from side to side and is everywhere distinctly rugose and faintly pitted. A trifoliate gastric areola is distinct and behind it there is a slight prominence on the cardiac region; these areas are a little smoother

than the rest of the carapace. The front is abruptly and vertically deflexed and is not visible in dorsal view. When viewed obliquely, the edge is seen to be produced to two broadly rounded lobes on either side of a median excavation. The four post-frontal lobes are sharp-edged and present a straight transverse line; those of the inner pair are broader than those of the outer and are separated by a deep mid-dorsal groove that extends to the anterior end of the gastric region. Behind the outermost post-frontal lobes on a level with the inner angle of the orbit there is a small but distinct elevation. The superior margin of the orbit is oblique and sinuous; the outer orbital tooth is sharp and rather broad, but does not extend so far outwards as the end of the cornea. There are two small epibranchial teeth, both obtuse and inconspicuous; the breadth between the foremost pair is a trifle less than that between the outer orbital angles. The lateral margin of the carapace is defined on either side by a sharp ridge, and the postero-lateral surface, though indistinctly rugose, bears no oblique striae, except for one, of considerable length, immediately over the bases of the last two pairs of legs.

The chelipedes much resemble those of *S. sylvicola*, de Man. The upper border of the merus ends in a subrectangular, subterminal lobe; the inner and outer margins are denticulate, the former being slightly produced near the distal end. The inner surface bears two longitudinal rows of hairs and the outer surface is furnished with a number of conspicuous granules. The

upper surface of the carpus is strongly rugose; on its inner margin there are numerous denticles, but no outstanding tooth. The chela, in its general form, almost precisely resembles that of *S. sylvicola*. The palm is swollen and strongly tubercular externally, the tubercles being, however, confined to its proximal three-quarters, being absent in the neighbourhood of the

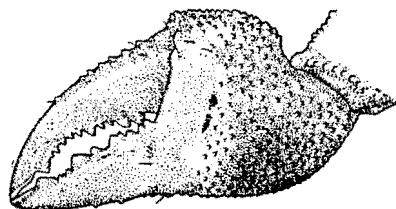


FIG. 4.—*Sesarma foxi*, sp. nov.  
External view of left chela of male.

finger-cleft, where there is a perfectly smooth, conspicuous depression (text-fig. 4). The tubercles are most closely packed on the upper border and from those which are scattered irregularly over the lower surface a single series, composed of four or five, extends on to the base of the fixed finger. The inner surface much resembles the outer, being similarly tuberculate and having a similar depression near the base of the fingers. It shows no distinct transverse row of tubercles. The fixed finger, except for the few tubercles at the proximal end of its lower margin, is smooth. The dactylus is nearly twice the length of the upper border of the palm; at its proximal end there are numerous small tubercles which extend in a single row a little beyond the middle of its length. In lateral view from six to eight tubercles are visible. There are occasional short, dark brown hairs on the carpus, palm, and at the base of the dactylus.

The walking legs are exceptionally slender. The merus in each pair bears a prominent subterminal tooth on its anterior margin; the segment in the penultimate pair is little less than four times as long as broad. The dactylus in the first three

pairs is about five-sixths the length of the propodus, that of the last pair is longer, almost equal to the length of the propodus. On all the legs there are conspicuous slender spinules, not very thickly set, on the carpus, propodus and dactylus; each spinule is dark brown basally and white distally.

The abdomen of the male is broad and closely resembles that of *S. sylvicola*.

In colour the carapace of the specimens is of a very dull reddish brown; the chelipedes are pale yellow suffused with pale red on the carpus and palm; the walking legs are deep brown with a fine mottling and dark chromatophores are thickly sprinkled on the abdomen.

The species is described from two males which yield the following measurements (in mm):—

|                                                  |         |      |      |
|--------------------------------------------------|---------|------|------|
| Length of carapace                               | .. .. . | 9.8  | 9.7  |
| Breadth of carapace between outer orbital angles | .. .. . | 9.8  | 9.8  |
| Breadth of carapace at base of 3rd walking legs  | .. .. . | 9.8  | 9.8  |
| Breadth of front                                 | .. .. . | 5.0  | 5.0  |
| Length of penultimate walking legs               | .. .. . | 22.0 | 21.5 |
| Length of merus of penultimate walking legs      | .. .. . | 7.5  | 7.3  |
| Breadth of merus of penultimate walking legs     | .. .. . | 2.0  | 1.9  |

The species differs from all the allied forms described by de Man in his Report on Max Weber's expedition to the Dutch East Indies in the shape of the carapace, which is not wider behind than in front; it is allied to *S. sylvicola*, from Sumatra, but in addition to the form of the carapace, differs in the tuberculation of the chelae, in the blunter epibranchial teeth and more slender merus of the walking legs. It is also closely related to *S. ocyroda*, Nobili<sup>1</sup>, from Sumatra, from which it differs in the form of the carapace, in the number of denticles on the dactylus of the chela and in the proportions of the meropodites of the walking legs. Its nearest ally, however, is perhaps *S. aranea*, Nobili,<sup>2</sup> from Nias, in which the carapace is described as "perfettamente quadrato"; this species is smoother than *S. foxi*, the tuberculation on the outer face of the chela is obsolete inferiorly and the merus of the walking legs is less slender.

The specimens obtained by Mr. Buxton, the types of the species, were found on Gunong Raya in Langkawi I, at a height of 2000 ft. They were collected in moist places under stones or rotten wood at some distance from any stream. At Mr. Buxton's request I have named the species after Mr. Fox of Langkawi I.

The types of the species are in the Indian Museum, where they bear the number 9457/10.

#### *Sesarma* sp. ?

I do not venture to name three small specimens of *Sesarma* obtained by Dr. Annandale on Penang Hill in the island of Penang at a height of 1200 ft. The specimens are all young; the carapace of the largest is only 7.5 mm. in length and its chelae do not appear to have assumed their adult form.

<sup>1</sup> Nobili, *Ann. Mus. Civ. Genova* (2), XX, p. 513.

<sup>2</sup> Nobili, *ibid.*, p. 510.

Though the two forms are clearly allied there are many conspicuous differences between these young individuals and *S. foxi*. The carapace is decidedly broader than long and its lateral margins are posteriorly divergent. The orbital tooth is narrower, the first epibranchial tooth more prominent and a strong ridge runs obliquely inwards and backwards from the rudimentary second epibranchial tooth. The walking legs are much stouter, the merus of the penultimate pair being scarcely more than two and a half times as long as broad.

It is possible that these are young examples of the form described by Lanchester from "Lacom" and Bukit Besar as *Sesarma maculata*, de Man, but they differ noticeably from de Man's description, especially in the form of the penultimate segment of the male abdomen. It appears to me exceedingly improbable that the true *S. maculata*, which was described from Flores, can occur in the Malay Peninsula.

#### **Sesarma politum**, de Man.

1888. *Sesarma polita*, de Man, *Journ. Linn. Soc.*, XX, p. 189, pl. xiii, figs. 7-9.

Three specimens were found at the mouth of the Tale Sap on the shores of Kaw Deng. The largest is a female with carapace 21.5 mm. in length. In the smallest the carapace is only 7.5 mm. long and the second epibranchial tooth is undeveloped.

#### Genus *Helice*, de Haan.

#### **Helice tridens**, de Haan.

1894. *Helice tridens*, Ortmann, *Zool. Jahrb. Syst.*, VII, p. 727.

A single male, with carapace 26 mm. in breadth, was presented to Dr. Annandale by Prof. S. Yoshida. It was obtained in brackish water near Osaka in Japan.

#### Genus *Clistocoeloma*, A. Milne-Edwards.

#### **Clistocoeloma merguense**, de Man.

1900. *Clistocoeloma merguense*, Alcock, *Journ. Asiat. Soc. Bengal*, LXIX, p. 429.

Two specimens, a male and a female, were obtained by Dr. Annandale in fresh water near the mouth of the Patani River in the Siamese Malay States. The carapace of the male is 8.3 mm. in length and 9.4 mm. in breadth; that of the female is 9.9 mm. in length and 11.8 mm. in breadth. The specimens were found in burrows in wet mud, under the trunk of a dead palm tree.

#### Family POTAMONIDAE.

In determining the ten species of river-crabs in the present collection I have followed the classification proposed by Alcock in 1910.<sup>1</sup> Alcock divides the family into two groups, the Potamoninae and the Gecarcinucinae, mainly on characters drawn from the structure of the mandibular palp. In the former subfamily the terminal segment of the palp is "simple, sometimes thickened at the base for the attachment of a bunch of hairs," whereas in the latter it is "cut into two lobes which em-

<sup>1</sup> Alcock, *Cat. Indian Decap. Crust.*, I, fasc. ii, p. 17 (1910).



brace the incisor-process of the mandible." Calman,<sup>1</sup> whose notes on the point will be read with much interest, has since shown that in certain crabs from Madagascar the form of the palp is in some degree intermediate in character, though it is still quite clear that the species in question belong to the Potamoninae. My own experience with Indo-pacific species tallies with that of Alcock: the distinction between the two groups is absolute and the structure of the palp can easily be made out without dissection.

Even if it should be shown in course of time that the two groups intergrade in certain countries, necessitating some nomenclatorial changes in Alcock's system, the character will none the less retain considerable systematic importance and there is no doubt that it will prove a very essential factor in all problems connected with the distribution of the family.

Alcock's classification is unfortunately attended by some inconvenience. Prior to 1910, the date when his memoir was published, the structure of the mandibular palp is never mentioned in specific descriptions, with the result that it is frequently impossible to refer a species to its correct genus without actual examination of specimens. A case in point has occurred among the species in the present collection. *Potamon* (*Geotelphusa*) *dehaani* (White) from Japan bears a very close external resemblance to the Javanese crab originally described as *Geotelphusa kuhli*, so much so that de Man, when instituting the latter species, compared it in detail with the former. The two species have, however, no real affinity; that from Japan is a true *Geotelphusa*, belonging to the Potamoninae, whereas the Javanese form is a *Paratelphusa*, belonging to the subfamily Gecarcinucinae and to Alcock's subgenus *Liotelphusa*.

It is to be hoped that in all future work on the Potamonidae note will be made of the structure of the mandibular palp.

#### Subfamily POTAMONINAE.

##### Genus *Potamon*, Savigny.

1910. *Potamon*, Alcock, *Cat. Indian Decap. Crust.*, I, fasc. ii, p. 18.

##### Subgenus *Potamon*, Ortmann.

##### *Potamon* (*Potamon*) *denticulatum* (Milne-Edwards).

1904. *Potamon* (*Potamon*) *denticulatus*, Rathbun, *Nouv. Arch. Mus. Paris* (4), VI, p. 260, pl. ix, fig. 6.

Fourteen specimens of this species, the largest a female with carapace 40 mm. in breadth, were collected by Dr. Annandale in the Tai Hu, in the Kiangsu province of China. They were obtained from a Chinese fishing boat with examples of *Eriocheir sinensis* and were said to have been caught in a creek opening into the lake.

##### *Potamon* (*Potamon*) *granulatum* (de Man).

1904. *Potamon* (*Potamon*) *granulatus*, Rathbun, *Nouv. Arch. Mus. Paris* (4), VI, p. 274.

An adult female and four young specimens, of which only one is a male, were obtained by the late Dr. W. C. Hossack in Java.

<sup>1</sup> Calman, *Proc. Zool. Soc. London*, 1913, pp. 922-925.

As in the case of the female recorded by Nobili,<sup>1</sup> the granulation of the carapace appears to be rather less pronounced than in the large male described by de Man,<sup>2</sup> though it is far more conspicuous than in any allied species. The extreme development shown in de Man's figures is doubtless to be found only in adult males.

As de Man has pointed out, the crest of the antero-lateral border is decidedly shorter than in related forms: in this respect a marked difference exists between *P. granulatum* and *P. andersonianum* (Wood-Mason). In the specimens in the present collection, however, the granules on this border are more numerous than is indicated by de Man; they are never less than ten in number and are very irregular in their size and distribution.

*Potamon larnaudii* (A. Milne-Edwards), as Miss Rathbun has shown, is readily distinguished by the greater breadth of the mesogastric area.

The specimens examined were found in the Government Quinine Gardens at Tijnproean at an altitude of 5600 ft. The carapace of the large female is 41 mm. in breadth and 32 mm. in length. The species has hitherto been recorded only from Tijibodas.

**Potamon (Potamon) stoliczkanum** (Wood-Mason).

1910. *Potamon (Potamon) stoliczkanum*, Alcock, *Cat. Ind. Decap. Crust.*, I, fasc. ii, p. 53.

Two small males were obtained by Dr. Annandale in the Botanical Gardens at Penang; they were found under stones in a rapid running stream.

There is apparently some variation in the form of the epigastric and post-orbital crests. Those of the larger example do not form an absolutely transverse line, but are a trifle more advanced in the middle than at the sides. In the smaller individual the line formed by the crests is more nearly transverse, almost as much so as in the types.

In the larger individual the carapace is 21 mm. in length and 26 mm. in breadth, the length of the second walking leg being nearly 47 mm.

*P. stoliczkanum* has only been recorded from Penang (Wood-Mason) and "Lacom" (Lanchester). The specimens recorded by de Man from Mergui, under the name *Telphusa stoliczkana*, have been referred to *P. thagatense*, Rathbun.

**Potamon (Potamon) anacoluthon**, sp. nov.

The carapace is longer than in most species of the genus, the breadth being only about one and one fifth times the length. The upper surface is slightly convex fore and aft and from side to side. The usual H-shaped groove is conspicuous, but otherwise the carapace is almost wholly without distinction of regions. The middle portion of the cervical groove is indicated by a broad and very shallow depression and between this depression and the antero-lateral limits of the H-shaped groove there is, in both the specimens examined, a small flattened tubercle standing in the middle of a shallow pit. The entire surface, though it has a shiny appearance when dried, is coarsely and evenly punctate, the punctae being sometimes connected by exceedingly

<sup>1</sup> Nobili, *Ann. Mus. Civ. Genova* (2), XX, p. 500 (1900).

<sup>2</sup> De Man, in Weber's *Zool. Ergebn. Reise Nied. Ost-Ind.*, II, p. 290, pl. xvi, fig. 5 (1892).

fine grooves, to be seen only under a strong lens. The epigastric crests are prominent; their anterior edges are strongly and irregularly rugose and they are separated in the middle by a deep groove which, however, does not extend backwards behind them. The protogastric or post-orbital crests are practically obsolete, being represented merely by a slight roughened declivity separated by a faint transverse depression from the upper orbital margin. Internally the crests are on a line with, and only indistinctly separated from, those on the epigastric region; from this point they slope backwards on either side, completely disappearing before reaching the lateral margin. The upper border of the orbit is practically smooth; the lower margin is beaded and there is a distinct sinus beneath the outer orbital angle. The front is faintly emarginate in the middle and its breadth is contained about two and two-thirds times in that of the carapace. The edge is very finely crenulate and the upper

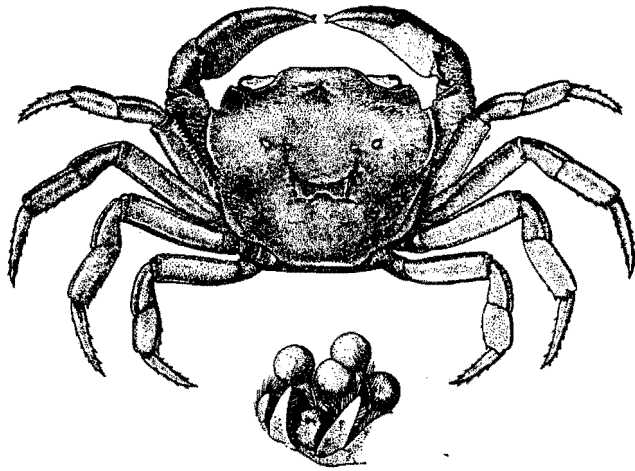


FIG. 5.—*Potamon (Potamon) anacoluthon*, sp. nov.  
Male, 17·8 mm. in breadth of carapace, and eggs of female drawn to same scale.

surface finely rugose. The epibranchial tooth is very strong and is situated at some distance from the outer orbital angle; the surface in its vicinity is distinctly roughened. The level of the carapace in front of the epibranchial tooth is the same as that behind it. The margin between the tooth and the outer orbital angle is beaded; behind the tooth it is finely denticulate. The postero-lateral walls bear a few fine oblique striae; the lower surface, on either side of the buccal cavern, is covered with short rugae from which small setae arise.

The ischium of the outer maxillipedes is traversed longitudinally in its middle by a fine and deep groove; it bears very large punctae, especially near the antero-internal angle. The merus is much broader than long, with raised outer and inner borders and with its antero-external angle rounded off. The basal portion of the exopod reaches to the middle of the merus; the flagellum is very long.

The chelipedes of the male are scarcely longer than the breadth of the carapace. The upper edge of the merus is granular and terminates in a blunt and obscure sub-terminal lobe. Both inferior margins are granular and the outer surface bears numbers of small rugae arranged transversely. The carpus is rugose above; the internal tooth is very strong and behind and beneath its apex there are one or two conspicuous tubercles. The chela is slender, the depth of the palm being only about one and a half times the length of the upper border. The outer surface is slightly rugose proximally and bears numerous punctae, some of which form a conspicuous, median, longitudinal row. The fingers are nearly twice the length of the upper border of the palm; they are strongly fluted and pitted and meet throughout their length when the claw is closed, the tips crossing each other.

The second walking legs, which are the longest, are about one and three quarters the length of the carapace.

The abdomen of the male is very broad and is irregularly pitted. The segments increase successively in length, that of the sixth being only one third its basal breadth; the seventh segment is simply triangular, with a slightly sinuous proximal border, and its length is contained about one and three quarter times in its basal breadth. In the female the last abdominal segment is still more broadly triangular, its length being scarcely more than one half its basal breadth. The eggs are extremely large, each being from 2.0 to 2.5 mm. in diameter (text-fig. 5).

The species is described from two specimens, a male and a female, the latter ovigerous, but lacking the chelae. In the male the carapace is 14.6 mm. in length and 17.8 mm. in breadth; in the female it is 17.3 mm. in length and 19.9 mm. in breadth. The female in life was dull olive brown with bright red eggs; the male was of a distinctly blue shade of grey, a colour that has not apparently altered after nine months' preservation in spirit.

*P. anacoluthon* appears in some measure to form a link between the subgenera *Potamon* and *Geotelphusa*, agreeing with the former in the presence of a strong epi-branchial tooth and with the latter in the almost complete suppression of the post-orbital crests. It does not seem to possess close affinities with any species hitherto described.

The two specimens, types of the species, were found by Dr. Annandale on the Peak at Hongkong, under large stones at the edge of a small stream at an altitude of 1000 ft. They are preserved in the Indian Museum and bear the number 9475/10.

#### *Potamon (Geotelphusa) dehaani* (White).

1905. *Potamon (Potamonautes* <sup>1</sup>) *dehaanii*, Rathbun, *Nouv. Arch. Mus. Paris* (4), VII, p. 204, pl. xviii, fig. 4.  
 1907. *Geotelphusa Dehaani*, Stimpson, *Smiths. Misc. Coll.*, XLIX, p. 112 (*nec. syn.*).  
 1916. *Potamon (Geotelphusa) Dehaanii*, Parisi, *Atti Soc. Ital. Sci. Nat.*, LV, p. 163.

The collection contains numerous specimens from Japan. The species was common in hill streams, in ponds and in irrigation channels in the country round Lake

<sup>1</sup> Presumably a clerical error for *Geotelphusa*, but repeated in a footnote under Stimpson's record.

Biwa. It is said to enter the lake itself, but Dr. Annandale could find no specimens there. In wet weather it often travels a considerable distance from water and one individual was found in the streets of Otsu. The precise localities of the specimens are (i) from hill streams and garden paths near Otsu; (ii) from irrigation channels at Hikone on the western shore of L. Biwa; (iii) from hill streams above Sakamoto on the eastern shore of L. Biwa; (iv) from a small lake at Komatsu on the same shore of the lake.

In the largest male, a specimen with carapace 30 mm. in breadth, the right chela is enormously enlarged, 31.5 mm. in length, with very widely gaping fingers.

Subfamily *GECARCINUCINAE*.

Genus *Paratelphusa*, Milne-Edwards.

1910. *Paratelphusa*, Alcock, *Cat. Indian Decap. Crust.*, I, fasc. ii, p. 70.

Subgenus *Paratelphusa*, Wood-Mason.

*Paratelphusa* (*Paratelphusa*) *tridentata*, Milne-Edwards.

1905. *Potamon* (*Paratelphusa*) *tridentatus*, Rathbun, *Nouv. Arch. Mus. Paris* (4), VII, p. 234, pl. xi, fig. 2.

A number of distinct species were at one time confounded under this name: the series so labelled in the Indian Museum collection contains, in addition to the true *P. tridentata*, examples of *P. convexa*, de Man, *P. maculata*, de Man and *P. oxygona*, Nobili. In determining this material I have derived much assistance from de Man's papers, particularly that published in 1879,<sup>1</sup> as well as from Miss Rathbun's key and full references to the literature.

The specimens of *P. tridentata* in the present collection are five in number, all collected by the late Dr. W. C. Hossack in Java. There are three males and a female from Buitenzorg Gardens, alt. 300 ft., and one female from Garoet, alt. 3000 ft. The carapace of the largest individual, a female, is 42 mm. in breadth.

The species is recorded from Borneo, Java, Sumatra and the neighbouring islands.

*Paratelphusa* (*Paratelphusa*) *convexa*, de Man.

1905. *Potamon* (*Paratelphusa*) *convexus*, Rathbun, *Nouv. Arch. Mus. Paris* (4), VII, p. 237.

Three specimens were obtained by Dr. Hossack in Java in company with examples of the preceding species. A male and female with carapace respectively 27 and 28.5 mm. in breadth were found in Buitenzorg Gardens and a female of similar size at Garoet. The specimen from the latter locality differs from the others in colour, being rather closely mottled with deep purple on a dull olive ground.

*P. convexa* is known from Timor, New Guinea, Borneo, Java and Nias.

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<sup>1</sup> De Man, *Notes Roy. Zool. Mus. Leyden*, I, p. 61 (1879).

**Paratelpusa (Paratelpusa) incerta** (Lanchester).

1905. *Potamon (Paratelpusa) incertus*, Rathbun, *Nouv. Arch. Mus. Paris* (4), VII, p. 238  
(ubi syn.).

Of this species Dr. Annandale obtained a single fine male, with carapace 55 mm. in breadth, in the Botanical Gardens at Singapore. It was found on a wet day in a rubber plantation, sitting at the edge of a burrow in the bank of an irrigation channel.

*Paratelpusa incerta* is very closely related to the Sumatran *P. maculata*, de Man; but, so far as I am able to judge from the examination of a single specimen, is not merely a variety of that species as suggested by Nobili.<sup>1</sup> Compared with a series of *P. maculata* from Deli in Sumatra, the following differences are apparent:—

(i). The carapace is broader and shorter: measured in the middle line the distance from the edge of the front to the cervical suture is conspicuously less than half the greatest breadth of the carapace. In *P. maculata* these two measurements are exactly the same.

(ii). An imaginary line joining the tips of the posterior epibranchial teeth is situated rather further forwards than in *P. maculata*.

(iii). The lateral extremities of the post-orbital crests reach a point only a little in front of the middle of the foremost epibranchial tooth and are thus situated further backwards than in the allied form.

(iv). The external orbital angle is rather more obtuse and the two epibranchial teeth project outwards more strongly. The distance between the extra-orbital angle and the first lateral tooth is only a little greater than that between the first and second lateral teeth.

*P. incerta* is known only from Singapore and was originally described by Lanchester from a specimen found in the Botanical Gardens. The individual recorded by Lanchester from Borneo<sup>2</sup> has been referred by Miss Rathbun<sup>3</sup> to Nobili's *P. oxygona*.

**Paratelpusa (Paratelpusa) germaini** (Rathbun).

1901. *Potamon (Paratelpusa) sinense*, Lanchester, *Proc. Zool. Soc. London*, p. 545.  
1905. *Potamon (Paratelpusa) germaini*, Rathbun, *Nouv. Arch. Mus. Paris* (4), VII, p. 246,  
(ubi cet. syn.), pl. xi, fig. 9.  
1906. *Potamon (Paratelpusa) sex-punctatum*, Lanchester, *Fasciculi Malayenses, Zool.*, III,  
p. 129, fig. 2.

Dr. Annandale found this species in abundance in ditches and ponds and at the edge of the Tale Sap at Lampam, where the water of the lake is quite fresh. It was common also at Singgora, but apparently does not enter the brackish outer portions of the lake though it occurs in ditches containing water that is slightly saline. It was also common in ditches at Patani and in pools on the sand near the sea.

In a very old male, much overgrown with alga, the carapace is 56 mm. in breadth

<sup>1</sup> Nobili, *Boll. Mus. Zool. Torino*, XVI, no. 397, p. 8 (1901).

<sup>2</sup> Lanchester, *Ann. Mag. Nat. Hist.* (7), VI, p. 255, pl. xii, fig. 2 (1900).

<sup>3</sup> Rathbun, *loc. cit.*, p. 239.

and 44 mm. in length; the chela is 64 mm. in length with very widely gaping fingers. Adults are invariably of a rich reddish crimson colour, stains of which not infrequently occur on the sternum. The six punctae described by Lanchester in his account of *P. sexdentatum* are visible in most of the specimens and four of them are often rendered conspicuous by their colouration, which is pale yellow and contrasts sharply with that of the general surface. Young individuals are of a dull olive-brown tint.

There can be little doubt that the synonymy given above is correct. *P. germaini* is recorded by Miss Rathbun from many localities in French Indo-China and Siam and also from the islands off the west coast of the Malay Peninsula and (doubtfully perhaps) from Japan. It is evidently the common river crab of the country round the Tale Sap, from which it was recorded by Lanchester under the name *Potamon* (*Paratelphusa*) *sinense*.

#### Subgenus *Liotelphusa*, Alcock.

1910. *Liotelphusa*, Alcock, *Cat. Indian Decap. Crust.*, I, fasc. ii, p. 109.

#### *Paratelphusa* (*Liotelphusa*) *kuhli* (de Man).

1883. *Geotelphusa Kuhlii*, de Man, *Notes Leyden Mus.*, V, p. 154.

1892. *Geotelphusa Kuhlii*, de Man, in Weber's *Zool. Ergebn. Reise. Nied. Ost-Ind.*, II, p. 288, pl. xv, figs. 3a-c, pl. xvi, fig. 3.

1905. *Potamon* (*Geotelphusa*) *kuhlii*, Rathbun, *Nowv. Arch. Mus. Paris* (4), VII, p. 208.

Other references are supplied by Miss Rathbun. Hitherto the species has invariably been referred to *Geotelphusa*; in general appearance it bears a very close resemblance to *Potamon* (*Geotelphusa*) *dehaani* (White), and it has been compared in detail with that species by de Man. Examination of the mandibular palp shows, however, that in spite their external similarity there is no close affinity between the two forms. In *P. (G.) dehaani* the terminal segment of the palp is simple, the species belonging to Alcock's subfamily Potamoninae. In "*Geotelphusa*" *kuhlii* the terminal segment is formed of two lobes which embrace the incisor-process of the mandible; the species will therefore find a place in the subfamily Gecarcinucinae of Alcock's classification and must be referred to the genus *Paratelphusa* and the subgenus *Liotelphusa*. It is by no means distantly related to *P. (L.) levis* (Wood-Mason).

*Paratelphusa kuhlii* is represented in the collection by a series of more than thirty specimens of all ages. In her key to the species of the subgenus *Geotelphusa*, Miss Rathbun lays stress on the presence in this species of a rudimentary epibranchial tooth. The use of this character is, however, likely to prove misleading, for the tooth is entirely absent in a number of the specimens in the present collection, while in all the others only the faintest traces of its presence can be detected.

The specimens were found by the late Dr. W. C. Hossack in the Government Quinine Gardens at Tijnproean in Java at an altitude of 5600 ft. The species is only known from Java.

## Family XANTHIDAE.

## Subfamily MENIPPINAE.

Genus *Myomenippe*, Hilgendorf.*Myomenippe granulosa* (A. Milne-Edwards).

1898. *Menippe* (*Myomenippe*) *granulosa*, Alcock, *Journ. Asiat. Soc. Bengal*, LXVII, p. 179.

Two small specimens, the largest with carapace 18.5 mm. in breadth, were found at the mouth of the Prai River, opposite Penang, on mud flats left bare at low tide.

## Subfamily PILUMNINAE.

Genus *Pilumnus*, Leach.*Pilumnus quadridentatus*, de Man.

1888. *Pilumnus seminudus*, de Man, *Journ. Linn. Soc.*, XXII, p. 65.

1895. *Pilumnus* (*Parapilumnus*) *quadridentatus*, de Man, *Zool. Jahrb. Syst.*, VIII, p. 537 and IX, pl. xiii, fig. 6.

1906. *Pilumnus quadridentatus*, Nobili, *Ann. Sci. nat., Zool.* (9), IV, p. 278.

A male and an ovigerous female, 9.3 mm. and 8.8 mm. in breadth respectively, were found in dead shells of *Balanus* on fishing stakes in the channel off Singgora at the mouth of the Tale Sap. A very young individual, with carapace only 5 mm. in breadth, was also found among mangrove roots near Koh Yaw.

In addition to the long hairs on the upper surface of the front and to those which extend inwards in a curved line from the last tooth of the antero-lateral margin, there are two conspicuous setose areas on the gastric region. These are situated further forwards than in de Man's figure and each is oval in outline and is produced externally forwards and outwards towards the middle of the orbital margin (text-fig. 6). In a specimen from Mergui, one of those identified by de Man in 1888 as *P. seminudus*, Miers, I can find no trace of these patches; but they are easily removed in cleaning the carapace and leave practically no trace of their existence.

The granulation of the outer surface of the palms of the chelipedes is conspicuous in all the specimens, the larger granules being arranged in longitudinal rows. De Man notes that in very large males the granules almost completely disappear.

In all other respects the specimens agree very closely with de Man's detailed description. The species is evidently closely allied to *P. malardi*, de Man,<sup>1</sup> a form also found in dead *Balanus* shells, but differs in the shape of the front and the form of the teeth on the antero-lateral margin.

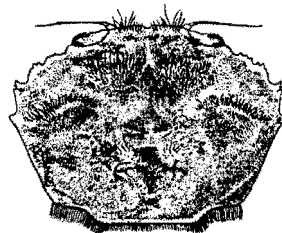


FIG. 6.—*Pilumnus quadridentatus*, de Man.  
Carapace.

<sup>1</sup> De Man, *Bull. Soc. Zool. France*, XXXIX, p. 330 (1914)



## Family PORTUNIDAE.

## Subfamily PORTUNINAE.

Genus *Scylla*, de Haan.*Scylla serrata* (Forskål), de Haan.

1899. *Scylla serrata*, Alcock, *Journ. Asiat. Soc. Bengal*, LXVIII, p. 27.

This species is the common edible crab of the Malay Peninsula. Dr. Annandale found it abundant in the outer part of the Tale Sap and young specimens were observed in ditches of brackish water and in mangrove swamps.

Genus *Neptunus*, de Haan.*Neptunus pelagicus* (Linn.).

1899. *Neptunus pelagicus*, Alcock, *Journ. Asiat. Soc. Bengal*, LXVIII, p. 34.

Very abundant in the outer part of the Tale Sap. Young specimens were taken in the channel opposite Singgora and round Koh Yaw in from 3 to 4½ metres, usually among dead shells.

Genus *Charybdis*, de Haan.*Charybdis crucifera* (A. Milne-Edwards).

1899. *Charybdis (Goniosoma) crucifera*, Alcock, *Journ. Asiat. Soc. Bengal*, LXVIII, p. 51.

Common at Singgora. Many dead specimens were seen at the edge of the lake.

*Charybdis affinis*, Dana.

1899. *Charybdis (Goniosoma) affinis*, Alcock, *Journ. Asiat. Soc. Bengal*, LXVIII, p. 56.

Two large specimens, with carapace 67 mm. and 51 mm. in breadth, are in the collection. They are considerably larger than any other examples in the Museum and differ from Alcock's description in the almost complete absence of the transverse ridge on the cardiac region of the carapace. This character, which is used by Alcock in his key to the Indian species of the genus, is evidently not valid in the case of very large specimens.

The specimens were taken in fishing nets at Singgora.

*Charybdis callianassa* (Herbst), A. Milne-Edwards.

1899. *Charybdis (Goniosoma) callianassa*, Alcock, *Journ. Asiat. Soc. Bengal*, LXVIII, p. 57.

Found with the preceding at Singgora.

## Tribe OXYSTOMATA.

## Family LEUCOSIIDAE.

## Subfamily LEUCOSIINAE.

Genus *Ebalia*, Leach.*Ebalia heterochalaza*, sp. nov.

The carapace is sharply polygonal in outline and is broader than long in the proportion of 14 to 13. The lateral and posterior margins are coarsely granulate and

the postero-lateral border is divided into thirds by two clusters of enlarged and prominent tubercles (text-fig. 7). The grooves and depressed portions of the carapace are smooth and the elevated parts tubercular. The sculpture of the dorsum is much as in *E. diadumena*, Alcock, but the grooves are not so deep. The elevations on the gastro-cardiac, intestinal and branchial regions are coarsely granulate and in the middle of the two former are several very large upstanding tubercles of a pearly appearance and of a size much greater than those on any other part of the carapace. The gastro-cardiac and intestinal elevations are imperfectly separated from one another by a transverse furrow; the granules on them are very dissimilar in size. The front is deeply hollowed in the middle line; its antero-lateral portions bear numerous fine denticles. The anterior margin is practically straight, the edge of the epistome being visible in dorsal view. The hepatic facet is well defined; its lower border is excavate posteriorly and is edged with exceptionally large tubercles. Its upper margin is defined by smaller tubercles which form a cluster near the middle of its length. The posterior limit of the facet is marked on either side by a large tubercle and the margins between these tubercles and those that define the widest portion of the carapace are straight and posteriorly divergent. The posterior margin is narrow, slightly sinuous, a little prominent at the middle point and with protruding lateral angles. The lower surface of the carapace, on either side of the outer maxillipedes, is conspicuously granular.

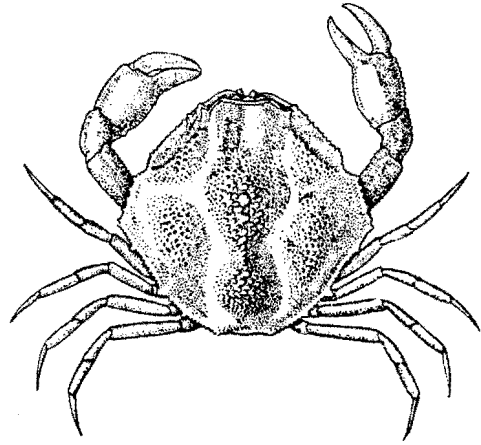


FIG. 7.—*Ebalia heterochalaza*, sp. nov.

The cornea of the eye is scarcely visible in dorsal view; the orbits are in open communication with the antennular fossae. The margin of the epistome bears two sharp processes separated by a median emargination.

The endopod of the outer maxillipedes is very narrow; the merus is almost exactly the same length as the inner border of the ischium. The exopod is only a trifle shorter than the endopod and has a strong outward bulge; it is conspicuously granular and its outer margin is very strongly curved.

The chelipedes in the male are scarcely longer than the carapace. The merus is trigonal with granular edges; it is covered with minute granules on its lower side and with a few near the base of its upper surface. There are minute granules on the carpus. The upper edge of the palm is roughened and on its lower surface are two finely beaded lines that extend from its base to the tip of the fixed finger. The uppermost of these lines is better defined than the lower and the space between them is smooth. The fingers are heavy and meet only in the distal half of their lengths, where they

are provided with teeth; both fingers are obscurely grooved and there are minute asperities on the upper surface of the dactylus.

The walking legs are smooth and slender; in those of the last pair the dactylus is fully one and a half times the length of the propodus.

The sternum of the male is granular throughout, the granules being very large and vesiculous opposite the bases of the chelipedes. The abdomen of the male consists of four pieces, a transverse basal portion, perhaps partially fused with that which follows, and three distal pieces, the two last being each about half the length of that which precedes them. The basal breadth of the penultimate portion is scarcely less than half its length; there is no median tubercle. The middle parts of all except the ultimate portion are closely covered with minute granules.

The species is described from two males with carapace respectively 5.2 and 4.6 mm. in length.

*Ebalia heterochalaza* appears to be nearly allied to *E. granulata* (Rüppell), re-described by Nobili in 1906,<sup>1</sup> the latter form differs, however, in the granulation of the carapace; the front and orbital margins are smooth and there are enlarged granules on the branchial regions similar in size to those in the middle line. The front in *E. granulata* is also conspicuously bilobed, there are no granules on the third maxillipedes or on the sternum and there is a large tubercle on the penultimate segment of the male abdomen. The last character affords a distinction between *E. heterochalaza* and *E. abdominalis*,<sup>2</sup> in which also the chelipedes are much longer and do not possess longitudinal granular ridges on the lower surface of the palm. From *E. diadumena*, Alcock,<sup>3</sup> it differs conspicuously in the shallower sculpture of the carapace and in the presence of a well-defined hepatic facet.

The specimens were found at a depth of about 4½ metres, on a bottom composed of soft mud with many dead shells, just inside the mouth of the Tale Sap, near Singgora. They were obtained in water of low salinity, its specific gravity being about 1.004 (corrected).

The two specimens, types of the species, are registered under no. 9426/10 in the Indian Museum books.

#### Genus *Philyra*, Leach.

#### *Philyra sexangula*, Alcock.

1896. *Philyra sexangula*, Alcock, *Journ. Asiat. Soc. Bengal*, LXV, p. 241, pl. vii, fig. 2 and (1899) *Illust. Zool. 'Investigator' Crust.*, pl. xxix, figs. 6, 6a.  
1900. *Philyra sexangula*, Lanchester, *Proc. Zool. Soc. London*, p. 765.

A very small male, with carapace only 3.2 mm. in length, was obtained by Dr. Annandale. The sculpture in this individual is more clean-cut than in the larger specimens recorded by Alcock. The outline of the carapace is much more sharply angular,

<sup>1</sup> Nobili, *Ann. Sci. nat., Zool.* (9), IV, p. 155, pl. ix, fig. 1 (1906).

<sup>2</sup> Nobili, *ibid.*, p. 157, pl. ix, fig. 2 (1906).

<sup>3</sup> Alcock, *Journ. Asiat. Soc. Bengal*, LXV, p. 187, pl. vii, fig. 4 (1896).

the oblique carinae on the branchial regions are exceedingly strong and in the middle line are five large blunt tubercles of which only traces remain in adults. The chelipedes have the same proportional length as in older examples, but are practically devoid of granules.

The specimen was found in the same locality as *Ebalia heterochalaza*, in water of specific gravity 1.004.

The species was hitherto known from the Godaveri Coast and Persian Gulf (Alcock), from the Matlah river in the Gangetic Delta, whence a large female, 9.5 mm. in length, was obtained a few years ago by Dr. J. T. Jenkins, and from Singapore (Lan-ches-ter).

#### *Philyra olivacea*, Rathbun.

1909. *Philyra olivacea*, Rathbun, *Proc. Biol. Soc. Washington*, XXII, p. 108.

1910. *Philyra olivacea*, Rathbun, *Danske Vid. Selsk. Skrift. (7), nat. og math.*, V, p. 312, pl. ii, fig. 17, and text-fig. 4.

Two specimens, both males, are in the collection; in most respects they agree well with Miss Rathbun's description. The posterior margin of the carapace, described as trilobate in the original examples, is merely sinuous with the outer angles prominent. The two oblique lines which run inwards from the postero-lateral margins and converge are exceedingly obscure, though visible in both specimens; they consist merely of a single row of low and widely spaced granules and might easily be overlooked.

There is a considerable difference between the two specimens in the form of the angulation of the lower margin of the hepatic facet. In the smaller specimen it is much the more prominent and is quite pale in colour, the remainder of the carapace being a very dark grey. The larger individual is pale in colour throughout.

The specimens are respectively 9.5 and 8.0 mm. in length. One was taken along with the examples of the two preceding species near Singgora, in water of specific gravity 1.004; the other was found in the bottom of a fishing boat at Patani, far to the south of the Tale Sap, and had probably come from Patani Bay.

The species was previously known only from the Coast of Lem Ngob on the eastern side of the Gulf of Siam.

#### Family DORIPPIDAE.

#### Genus *Dorippe*, Fabricius.

#### *Dorippe astuta*, Fabricius.

1896. *Dorippe astuta*, Alcock, *Journ. Asiat. Soc. Bengal*, LXV, p. 280.

A specimen with carapace about 11 mm. in length was found dead near the mouth of the Tale Sap and two smaller individuals were taken in the channel opposite Singgora in water of specific gravity 1.004 (corrected). They were found on a bottom of mud and dead shells at a depth of 4½ metres and neither of them carried anything in the last pair of legs. Alcock states on the authority of Giles that it is the custom of this species to carry an inhabited worm-tube.

Tribe **PAGURIDEA**.Family **PAGURIDAE**.Subfamily **PAGURINAE**.Genus **Clibanarius**, Dana.**Clibanarius padavensis**, de Man.1888. *Clibanarius padavensis*, de Man, *Journ. Linn. Soc.*, XXII, p. 242, pl. xvi, fig. 1.

Three specimens were found by Dr. Annandale at the mouth of the Prai River, opposite Penang, on mud-flats exposed at low water. They were living in *Murex* and other marine shells.

**Clibanarius longitarsis** (de Haan).1887. *Clibanarius longitarsis*, de Man, *Arch. f. Naturgesch.*, LII, i, p. 441.

This species was very abundant at Kaw Deng and in other localities near the mouth of the Tale Sap. All the larger individuals were inhabiting marine shells, but very small ones were usually found in *Potamides fluviatilis*. Dr. Annandale noted that the legs in living specimens were very deep blue with bright blue longitudinal stripes and that the eyestalks were bright olivaceous brown.

- Genus **Diogenes**, Dana.**Diogenes avarus**, Heller.1905. *Diogenes avarus*, Alcock, *Cat. Indian Decap. Crust.*, II, fasc. i, p. 68, pl. vi, fig. 6.

Two very small specimens, dredged in the outer part of the Tale Sap, opposite Singgora, appear to belong to this species.

Tribe **THALASSINIDEA**.Family **CALLIANASSIDAE**.Subfamily **UPOGEBIINAE**.Genus **Upogebia**, Leach.**Upogebia (Upogebia) heterocheir**, Kemp.1915. *Upogebia (Upogebia) heterocheir*, Kemp, *Mem. Ind. Mus.*, V, p. 257, pl. xiii, figs. 6, 7.

Two specimens were dredged towards the northern part of the channel connecting the inner and outer parts of the Tale Sap near Pak Payum at depths of  $3\frac{1}{2}$  to  $5\frac{1}{2}$  metres. They were taken in a thin layer of soft mud overlying a bottom of coarse sand in water of specific gravity 1.0015 (corrected).

One of the specimens is very much damaged; the other is a male approximately 16 mm. in total length. In this specimen the first pereopods differ from those of the types in the absence of the subterminal tooth on the upper edge of the merus and in the presence of only one tooth on the upper border of the propodus. The extent of

the variation in the number of spinules on the legs is thus rather greater than was gathered from examination of the Indian specimens.

The species has hitherto been found only in the Chilka Lake on the Orissa coast of India, where it was obtained in water ranging in specific gravity from 1.000 to 1.0265.

## DECAPODA NATANTIA.

### Tribe CARIDEA.

#### Family PALAEMONIDAE.

#### Genus *Palaemon*, Fabricius.

#### *Palaemon carcinus*, Fabricius.

1890. *Palaemon carcinus*, Ortmann, *Zool. Jahrb., Syst.*, V, p. 700, pl. xlvii, fig. 1.  
 1902. *Palaemon* (*Eupalaemon*) *carcinus*, de Man, *Abhandl. Senck. naturf. Ges.*, XXV, p. 763.  
 1910. *Palaemon carcinus*, Henderson and Matthai, *Rec. Ind. Mus.*, V, p. 281, pl. xv, figs. 1 a-g.  
 1914. *Palaemon carcinus*, Cowles, *Philippine Journ. Sci.*, Sect. D, IX, p. 324, pl. i, figs. 1, 1a-j.

The collection contains numerous specimens of this well-known species from the Malay Peninsula. Three males, which doubtless came from the Patalung river where the water is always fresh, were bought in the market at Lampam and a large number of specimens were obtained from fishermen's nets at Singgora in the Tale Sap in water of specific gravity varying from 1.004 to 1.0085.

It is a remarkable fact that all the Singgora specimens, with one exception, are females and that nearly all of them bear eggs. In our investigations on the fauna of the Chilka Lake on the Orissa coast of India, we drew attention to the fact that certain species of *Palaemon*, *P. rudis* and *P. malcolmsoni*, visit the lake each year at the period when its waters are at their freshest in order to liberate their young. In the case of *P. malcolmsoni* this migration is undertaken only by the ovigerous females, whereas in *P. rudis* the males accompany the females.<sup>1</sup>

It appears that a similar phenomenon occurs in the Tale Sap in the case of *P. carcinus*. Dr. Annandale found only a single male and very few females without eggs out of many hundreds of specimens examined at Singgora and there can be little doubt that the females migrate to the lake for breeding purposes. The specimens were obtained in January at the beginning of the dry season when the water of the outer part of the lake was probably fresher than at other times.

The specimens agree well with the published descriptions. The rostrum as a rule extends much beyond the antennal scale, but in one male from Lampam, 168 mm. in total length, reaches beyond this point only by some 5 mm. There are from 12 to 15 teeth on the upper border of the rostrum and from 10 to 14 (usually 12 to 14) on the lower border. Nine specimens yield the following measurements (to the nearest mm.) :—

<sup>1</sup> Kemp, *Mem. Ind. Mus.*, V, p. 203 (1915).

| LOCALITY.        | Sex. | Total length. | Length of carapace. | Length of 2nd peraeopod. | SECOND PERAEPOD : LENGTH OF |        |         |       |           |
|------------------|------|---------------|---------------------|--------------------------|-----------------------------|--------|---------|-------|-----------|
|                  |      |               |                     |                          | Ischium.                    | Merus. | Carpus. | Palm. | Dactylus. |
| Lampam .. .. .   | ♂    | 174           | 42                  | 132                      | 23                          | 25     | 29      | 28    | 25        |
| " .. .. .        | ♂    | 168           | 46                  | 140                      | 23                          | 26     | 29      | 32    | 29        |
| " .. .. .        | ♂    | 156           | 39                  | 115                      | 21                          | 22     | 26      | 24    | 20        |
| Singgora .. .. . | ♂    | 173           | 46                  | 205                      | 28                          | 44     | 48      | 48    | 37        |
| " .. .. .        | ♀    | 199           | 53                  | 166                      | 29                          | 33     | 37      | 35    | 29        |
| " .. .. .        | ♀    | 175           | 42                  | 117                      | 23                          | 23     | 30      | 22    | 16        |
| " .. .. .        | ♀    | 148           | 34                  | 88                       | 18                          | 18     | 23      | 16    | 12        |
| " .. .. .        | ♀    | 139           | 32                  | 80                       | 16                          | 15     | 20      | 14    | 11        |
| " .. .. .        | ♀    | 128           | 29                  | 73                       | 14                          | 14     | 20      | 12    | 10        |

There are also in the collection two very small individuals, 43 and 46 mm. in total length, that I consider to be young examples of this species. They were obtained in the Patani river, below the town of Patani in the Siamese Malay States.

In the Indian Museum collections I have not been able to find any specimens of *P. carcinus* as small as these; the youngest, which are from Garia, near Calcutta, being 65 and 69 mm. in total length.

In the larger of the Patani river specimens the rostrum extends beyond the antennal scale by about one-quarter its length, and bears 12 teeth above and 10 below. In the smaller individual the rostrum reaches beyond the scale by about one third of its length, and bears 14 teeth above and 11 below. In the young specimens from Garia the rostrum is fully as long as in the smaller Patani individual, and bears 13 or 14 teeth above and 12 or 14 below. The second legs in both Patani specimens reach beyond the end of the scale by the length of the chela—in those from Garia by the chela and fully one-third of the carpus. The segments yield the following measurements (in mm.):—

| LOCALITY.                   | Sex. <sup>1</sup> | Total length. | Length of carapace. | Length of 2nd peraeopod. | SECOND PERAEPOD : LENGTH OF |        |         |       |           |
|-----------------------------|-------------------|---------------|---------------------|--------------------------|-----------------------------|--------|---------|-------|-----------|
|                             |                   |               |                     |                          | Ischium.                    | Merus. | Carpus. | Palm. | Dactylus. |
| Garia, nr. Calcutta .. .. . | ♂                 | 69            | 14.7                | 39                       | 7.8                         | 8.1    | 11.0    | 6.5   | 4.6       |
| " .. .. .                   | ?                 | 65            | 14.0                | 37                       | 7.6                         | 7.9    | 10.8    | 5.8   | 4.1       |
| Patani river .. .. .        | ?                 | 46            | 9.8                 | 25                       | 5.1                         | 5.2    | 6.6     | 3.6   | 2.4       |
| " .. .. .                   | ?                 | 43            | 8.4                 | 19.5                     | 4.2                         | 4.3    | 5.3     | 3.1   | 1.8       |

<sup>1</sup> In the largest specimen, which is evidently a male, the appendix masculina is represented by a small bud; in the others no trace of it can be detected.

The measurements are closely comparable to those of some adult females, the chief difference being that the dactylus is a little shorter in relation to the palm. De Man<sup>1</sup> records a young male specimen of this species, 65 mm. in total length, in which the carpus of the second legs was 9 mm. in length, the palm  $4\frac{1}{2}$  mm. and the fingers  $2\frac{3}{4}$  mm.

The telson tip in the Patani individuals differs conspicuously from that of adults, the inner pair of subterminal spinules extending beyond the apex by more than half their length. The specimens from Garia represent an intermediate stage, the spinules just reaching the apex.

Lanchester, in his account of the Crustacea of the "Skeat Expedition,"<sup>2</sup> refers to a specimen, 43 mm. in length, under the name *P. carcinus* var. *lamarrei*. This individual is doubtless a young *P. carcinus*, Milne-Edward's *P. lamarrei* being, as de Man has shown,<sup>3</sup> quite distinct from the Fabrician species.

*Palaemon carcinus* is evidently an abundant species and has a distribution extending from India to New Guinea and the Philippines.

#### *Palaemon lanchesteri*, de Man.

1901. *Palaemon paucidens*, Lanchester, *Proc. Zool. Soc. London*, p. 568, pl. xxxiii, fig. 4 (not *P. paucidens*, Hilgendorf, *Sitz-ber. Ges. naturf. Freunde, Berlin*, Jahrg. 1893, p. 155).

1911. *Palaemon (Eupalaemon) lanchesteri*, de Man (*nom. nov.* for *P. paucidens*, Lanchester nec Hilgendorf), *Notes Leyden Mus.*, XXXIII, p. 264, footnote.

Lanchester, when describing this species, noted that notwithstanding the presence of ovigerous females it might eventually prove to be merely the young of *P. idae*. In my opinion there can be no doubt that the species is valid, its nearest relative being apparently *P. lamarrei*, Milne-Edwards. In both species the secondary sexual characters seem never to be strongly developed and the second peraeopods differ little, if at all, in their proportions from those of the young.

I have little to add to Lanchester's description. The rostrum in its length and dentition agrees with his account. The posterior tooth of the dorsal series is situated on the carapace, the second being as a rule immediately over the orbit; the distance between the first and second is generally not greater than that between the second and third. The apex is nearly always bifid.

The second legs are rather shorter than indicated by Lanchester, those of ovigerous females reaching beyond the scales by scarcely more than the length of the chela, those of males by the chela and not more than one third of the carpus (for measurements see table on p. 258). The apex of the telson is sharply pointed, the inner pair of subterminal spinules extending beyond the tip by more than half their length. The eggs are large, about 1.05 mm. in length and 0.78 mm. in breadth.

Sixteen large specimens and a number of young individuals were obtained by Dr. Annandale at the inner end of the Tale Sap in ponds and ditches of fresh water near Lampam. Lanchester records the species from Singgora, but Dr. Annandale obtained no evidence that it enters the lake at that place.

<sup>1</sup> De Man, *Notes Leyden Mus.*, I, p. 165 (1879).

<sup>2</sup> Lanchester, *Proc. Zool. Soc. London*, 1901, p. 565.

<sup>3</sup> De Man, *Rec. Ind. Mus.*, II, p. 222, pl. xix, fig. 4 (1908).



| Sex.    | Total length. | Length of carapace. | Length of 2nd peraeopod. | SECOND PERAEPOD: LENGTH OF |        |         |       |           |
|---------|---------------|---------------------|--------------------------|----------------------------|--------|---------|-------|-----------|
|         |               |                     |                          | Ischium.                   | Merus. | Carpus. | Palm. | Dactylus. |
| ♀ ovig. | 41            | 8.8                 | 18.8                     | 3.9                        | 4.3    | 6.2     | 2.2   | 1.7       |
| ♀       | 38.5          | 8.2                 | 17.9                     | 3.7                        | 3.7    | 6.0     | 2.0   | 1.6       |
| ♂       | 35            | 6.7                 | 14.6                     | 3.0                        | 3.3    | 4.7     | 1.7   | 1.2       |
| ♂       | 34.5          | 6.4                 | 14.2                     | 2.9                        | 3.1    | 4.8     | 1.6   | 1.2       |

***Palaemon nipponensis*, de Haan.**

1890. *Palaemon nipponensis*, Ortmann, *Zool. Jahrb., Syst.*, V, p. 715.

1902. *Bithynis nipponensis*, Rathbun, *Proc. U.S. Nat. Mus.*, XXVI, p. 53.

1914. *Palaemon nipponensis*, Balas, *Abhandl. math.-phys. Klasse K. Bayer. Akad. Wiss.*, Suppl. Bd. II, Abh. 10, p. 59.

The synonymy has been dealt with by Ortmann; more recent references are supplied by Balas.

A number of specimens which show a considerable amount of variation are referred to this species; they were obtained in China and Japan and the largest, which is from the former country, is only 90 mm. in total length. Miss Rathbun has remarked the close relation that exists between *P. nipponensis* and *P. longipes* and has noted certain points of distinction, but the use of these characters has not enabled me to separate the collection into two groups.

In Japanese specimens from 70 to 85 mm. in length the fingers of the second peraeopods are always shorter than the palm, varying from three quarters to nine tenths of its length; the carpus in specimens with longer fingers is usually more slender, about seven and a half times as long as its distal breadth, while in those with shorter fingers the carpus is generally stouter, hardly more than six times its distal breadth. Distinctions based on these grounds break down entirely when a number of specimens are compared. The upper edge of the rostrum is comparatively straight and in nearly all cases bears 12 or more teeth. I can find no differences in the hairiness or tothing of the fingers of the large chela.

In young Japanese specimens from 40 to 50 mm. in length the degree of variation in the proportions of the chela of the second legs is even greater than in adults, the fingers being a little longer than, equal to, or only three-quarters the length of the palm. The dorsal teeth on the rostrum are as numerous as in adults, whereas, according to Balas, there are only 7 or 8 in young *P. longipes*.

A Palaemonid from Sagami Bay, about 55 mm. in length, received in exchange from the Munich Museum and determined by Balas as *P. longipes*, differs in a conspicuous manner from all the specimens in Dr. Annandale's collection. The rostrum is shorter and more strongly arched above, the carapace is thickly covered with minute

spinules, the second legs are proportionately longer and much stouter with the carpus shorter than the palm.<sup>1</sup>

The Japanese specimens were obtained in the Yodo river, about one mile above the town of Osaka and in the lagoon at Kasumi-ga-ura. The Chinese examples were caught in the Tai Hu lake.

***Palaemon asperulus*, von Martens.**

1868. *Palaemon asperulus*, von Martens, *Arch. für Naturgesch.*, Jahrg. XXXIV, i, p. 43, pl. i, fig. 5.

1890. *Palaemon asperulus*, Ortmann, *Zool. Jahrb., Syst.*, V, p. 708.

This species, which apparently has not been recorded<sup>2</sup> since it was originally described by von Martens in 1868, is represented in Dr. Annandale's collection by ten specimens, obtained in the Tai Hu.

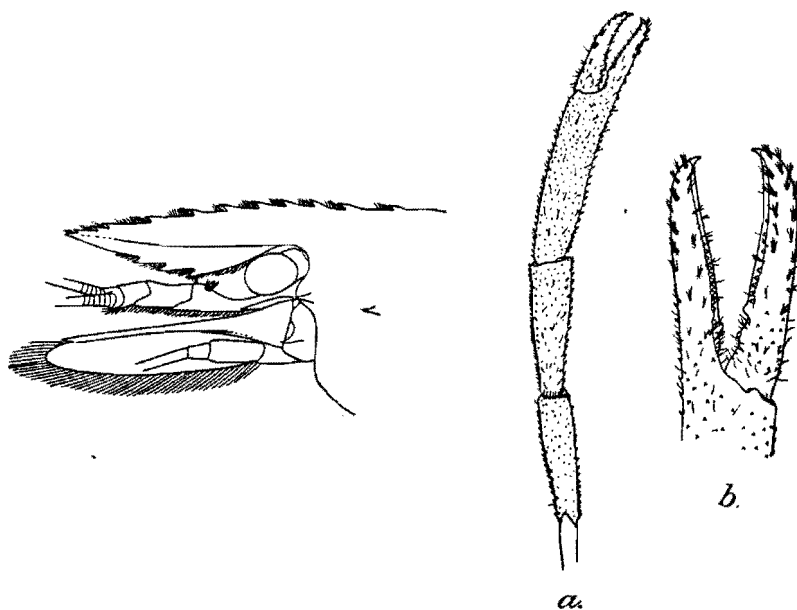


FIG. 8.—*Palaemon asperulus*, von Martens.

Anterior part of carapace, rostrum, etc.

(a) Second pereopod.

(b) Fingers of same further enlarged.

The largest male is rather smaller than von Marten's type and is 75 mm. in length; in this individual, however, the second pereopods are noticeably smaller than in one only 63 mm. long.

In the three largest specimens there are a few minute asperities on the carapace behind the eye and below the hepatic spine; the others are almost or quite smooth.

<sup>1</sup> In this respect the specimen differs from the published descriptions of large males of the species.

<sup>2</sup> The specimen which de Man referred to *P. asperulus* in 1904 is apparently a different species (see p. 261).

The rostrum reaches almost to the tip of the antennal scale in adults (text-fig. 8) ; in the young it is a trifle longer. The upper margin is straight or very slightly convex and bears from 8 to 11 teeth<sup>1</sup>; the hindmost is rather widely separated from the next of the series and the posterior two or three are placed on the carapace behind the level of the orbit. On the lower border there are 2 or 3 large teeth.

The accessory ramus of the outer antennular flagellum is longer than the peduncle.

The second peraeopods (text-figs. 8a, b) are equal and in well developed males reach beyond the end of the antennal scale by the chela and at least half the length of the carpus; in the largest individual, however, they are proportionately shorter, reaching beyond the same point only by three quarters the length of the chela. Five specimens yield the following measurements :—

| Sex. | Total length. | Length of carapace. | Length of 2nd peraeopod. | SECOND PERAEPOD: LENGTH OF |        |         |       |           |
|------|---------------|---------------------|--------------------------|----------------------------|--------|---------|-------|-----------|
|      |               |                     |                          | Ischium.                   | Merus. | Carpus. | Palm. | Dactylus. |
| ♂    | 75            | 22.4                | 42.0                     | 7.0                        | 8.4    | 9.3     | 9.6   | 5.6       |
| ♂    | 63            | 18.1                | 52.5                     | 8.4                        | 9.5    | 10.9    | 13.3  | 8.6       |
| ♂    | 57            | 16.1                | 50.5                     | 7.7                        | 9.3    | 10.4    | 13.4  | 8.3       |
| ♀    | 49            | 13.2                | 38.5                     | 5.9                        | 7.2    | 8.4     | 9.2   | 6.2       |
| ♀    | 43            | 11.2                | 30.7                     | 5.5                        | 5.5    | 7.1     | 7.0   | 4.4       |

It will be noticed that the carpus is decidedly shorter than the propodus in all the larger specimens. In those below 45 mm. in length the proportions are, however, different, the carpus being almost as long, or even (as in the specimen measured) a shade longer than the palm.

In the male 63 mm. in length the carpus is 2.7 mm. in breadth at the distal end, the segment thus being about four times as long as broad. In all the larger specimens the segments bear minute asperities, specially noticeable on the inner and under surfaces of the carpus and propodus where they tend to form longitudinal rows. The fingers bear few hairs; on their inner margins there is a fine ridge extending from the base to the tip; there is a single small tooth at the base of the fixed finger and two in a similar position on the dactylus.

The telson is produced to a sharp apical point which is, however, exceeded by the innermost of the two pairs of terminal spinules.

The specimens collected by Dr. Annandale were found not far from Shanghai, the locality from which von Martens described the species. There is thus little doubt that they represent the true *P. asperulus*.

<sup>1</sup> The rostral formulae in ten specimens are,—8/2, 9/2, 9/3, 9/3, 10/3, 10/3, 10/3, 11/3, 11/3.

The female, 45 mm. in length, from South Hu-peh, referred by de Man<sup>1</sup> to *Palaemon* (*Parapalaemon*?) *asperulus*, is without doubt different. In none of Dr. Annandale's specimens can I find any trace of carinae on the first abdominal somite and the peraeopods differ conspicuously from de Man's account. In the case of the Hu-peh specimen the merus of the second leg is 5.2 mm. in length, the carpus 6.4 mm., the palm 7.5 mm. and the fingers 5.5 mm., proportions which differ slightly from those of Shanghai individuals. In the latter specimens, moreover, there is no trace of a longitudinal ridge on the outer side of the merus and carpus. The last three peraeopods are also much stouter in the Hu-peh specimen, the merus of the third pair being only five times, and the propodus seven times as long as broad. In Dr. Annandale's examples the merus of this limb is six and a half times and the propodus about nine times as long as broad.

The specimens were deeply pigmented in life, but without any characteristic markings. They were taken from small basket traps set among weeds in and at the mouths of narrow creeks opening into the Tai Hu. They were found along with *Palaemon nipponensis* and *Leander modestus*, but were much less abundant than either of those species.

***Palaemon sundaicus* (Heller?), de Man.**

1862. *Palaemon sundaicus*, Heller, *Sitz.-ber. Akad. Wiss. Wien*, XIV, p. 415, pl. ii, figs. 38, 39.  
 1892. *Palaemon* (*Eupalaemon*) *sundaicus*, de Man, in *Weber's Zool. Ergebn. Reise Niederländ. Ost-Ind.*, II, p. 437, pl. xxvi, fig. 35.  
 1897. *Palaemon* (*Eupalaemon*) *sundaicus*, de Man, *Zool. Jahrb., Syst.*, IX, p. 779 and X, pl. xxxvii, fig. 71 (1898).  
 1914. *Palaemon sundaicus*, Cowles, *Philippine Journ. Sci.*, Sect. D, IX, p. 355, pl. ii, figs. 3, 3a-f.

To this species I refer a number of rather small specimens in which the chelipedes (after nine months' preservation in alcohol) are deeply mottled with purplish brown. They almost certainly belong to the same species as those with identical colour markings described by de Man and Cowles (*loc. cit.* 1897 and 1914).

De Man has described two varieties of *P. sundaicus* from Atjeh and Batavia, distinguishing the latter under the name var. *bataviana*. Dr. Annandale's specimens agree most nearly with the typical form.

Of the twelve specimens in the collection, ten have 10 or 11 (usually 11) teeth on the upper edge of the rostrum and 5 to 7 (usually 6) on the lower edge. One specimen has 13 dorsal teeth and 6 ventral and one which has clearly suffered injury—the antennal scale on one side being only half its normal size—has 14 teeth above and 11 below. In all cases there are three teeth on the carapace behind the orbital notch. Towards the apex the rostrum is always rather strongly upturned, reaching beyond the antennal scale by a proportion varying from one tenth to one fifth of its length. The carapace is smooth throughout.

The second peraeopods are slender and in the larger specimens reach beyond the scale by rather more than the chela and carpus. The merus, carpus and

<sup>1</sup> De Man, *Trans. Linn. Soc., Zool.* (2), IX, p. 293, pl. xviii, figs. 2-8 (1904).

palm are thickly covered with small spinules which are larger on the inner and under sides of the carpus and palm where they tend to form longitudinal rows. These spinules are visible even in the smallest individuals. In the larger males and the oldest female the fingers are thickly clothed with hair. There are two small teeth on the inner margin of the dactylus near its proximal end and one similar tooth which fits between them on the fixed finger.

Seven specimens yield the following measurements :—

| Sex. | Total length. | Length of carapace. | Length of 2nd peraeopod. | SECOND PERAEOPOD : LENGTH OF |        |         |       |           |
|------|---------------|---------------------|--------------------------|------------------------------|--------|---------|-------|-----------|
|      |               |                     |                          | Ischium                      | Merus. | Carpus. | Palm. | Dactylus. |
| ♂    | 76            | 17.5                | 77                       | 12.1                         | 15.2   | 23.0    | 15.2  | 10.7      |
| ♂    | 71            | 17.3                | 61.5                     | 10.4                         | 11.5   | 16.8    | 12.1  | 8.3       |
| ♂    | 53            | 11.3                | 42.5                     | 8.0                          | 8.0    | 12.4    | 6.5   | 6.4       |
| ♂    | 43            | 9.1                 | 32.0                     | 6.0                          | 6.2    | 8.5     | 4.7   | 4.8       |
| ♀    | 76            | 21.3                | 67                       | 12.4                         | 14.0   | 18.6    | 11.7  | 8.1       |
| ♀    | 57            | 13.5                | 49                       | 8.8                          | 9.2    | 14.2    | 8.7   | 6.3       |
| ♂    | 82            | 21.7                | 121                      | 16.8                         | 23.0   | 40.5    | 32.0  | 11.6      |

It is doubtful if the last of these specimens, which is separately referred to below, is correctly referred to *P. sundaicus*. The measurements of the remainder tend to show that in the course of growth the palm increases considerably in length in proportion to the merus and fingers. In young males it is much shorter than the merus and little if at all longer than the fingers, whereas in large males it is equal to or a little longer than the merus and almost one and a half times as long as the fingers.

In the male 76 mm. in length the carpus is 2.5 mm. in breadth at its distal end and the palm 2.4 mm., the segments being respectively about nine times and six and a third times as long as broad. In the female of the same length these measurements are 2.3 mm. and 2.5 mm., the carpus being eight times and the palm six and two thirds times as long as wide.

If the figures tabulated above are analysed and compared with those given in other descriptions, certain small differences are evident; these, however, do not appear to be sufficiently well marked to afford any basis for the foundation of a subspecies. In the males from the Tale Sap, for instance, the merus and carpus seem proportionately a trifle longer and the palm and dactylus a little shorter than in those described by de Man as *P. sundaicus* var.<sup>1</sup> and the same features may be detected if the Tale Sap females are compared with de Man's typical *P. sundaicus* from the Java Sea.<sup>2</sup>

<sup>1</sup> De Man, *loc. cit.*, 1897, p. 783.

<sup>2</sup> De Man, *loc. cit.*, 1897, p. 782.

The large male, the last of those included in the table of measurements, is referred to *P. sundaicus* with very considerable doubt, but is perhaps merely an abnormality. Both legs of the second pair are detached and only one is complete. The rostrum resembles that of the other specimens, extending a little beyond the scale, with an upturned apex and with 10 teeth above and 5 below. The second peraeopod shows very faint traces of mottling, but is proportionately much longer than in the other specimens and exhibits great differences in the relative lengths of the segments. The dactylus is proportionately much shorter and the carpus and palm longer. Cowles (*loc. cit.*) has given the measurements of a number of Philippine specimens of *P. sundaicus* of sizes comparable with this male; but in all of them the fingers are considerably more than half the length of the palm, whereas in Dr. Annandale's specimen they are little more than one third the length.

The specimens in the collection were found in the Tale Sap near Singgora and in pools and ditches in the vicinity; they were obtained in water of specific gravity varying from 1.004 to 1.0085. There are also a few small individuals from the Patani river in the Siamese Malay States. These were found in fresh water, but in a locality subject to tidal influence. Dr. Annandale notes that, in addition to the tortoise-shell-like mottlings on the chelipedes, living specimens showed a small dark spot on each side of each abdominal somite.

Specimens which I regard as specifically identical with those obtained by Dr. Annandale are recorded by de Man from Java, Flores and Celebes and by Cowles from the Philippines. Most other records appear somewhat doubtful.

Henderson and Matthai<sup>1</sup> regard *P. sundaicus* as a synonym of *P. idae*, but I am not at present prepared to follow them in this view. The specimens I have examined seem to differ conspicuously in the form of the rostrum from any of those which they have recorded from S. India under the latter name. *P. sundaicus* was described by Heller from a very young specimen and its true identity is still uncertain. The notes made by Koelbel on the type and published by de Man<sup>2</sup> have led the latter author<sup>3</sup> and Coutière<sup>4</sup> to suggest the possibility of its identity with von Martens' *P. dispar* and this view seems to have more to recommend it than that adopted by Henderson and Matthai. If proved it will, however, have unfortunate consequences, for *P. dispar* must then be known as *P. sundaicus*, while a new name will probably be necessary for the form described above.

De Man (*loc. cit.*, 1897) has also suggested that Heller's *P. sundaicus* may be specifically identical with Dana's *P. equidens* from Singapore. But Dana's species was described from a mutilated specimen which, apparently, is not now in existence. It is exceedingly improbable that the species will ever be recognised with certainty and it is best that it should be altogether ignored in future work.

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<sup>1</sup> Henderson and Matthai, *Rec. Ind. Mus.*, V., p. 285 (1910).

<sup>2</sup> De Man, *loc. cit.*, 1892, p. 437.

<sup>3</sup> De Man, *loc. cit.*, 1897, p. 781.

<sup>4</sup> Coutière, *Ann. Sci. nat., Zool.* (8), XII, p. 335 (1901).

***Palaemon elegans*, de Man.**

1892. *Palaemon (Eupalaemon) elegans*, de Man, in *Weber's Zool. Ergebn. Reise Niederländ Ost.-Ind.*, II, p. 440, pl. xxvi, fig. 36.

1903. *Palaemon (Eupalaemon) elegans*, de Man, *Abhandl. Senck. naturf. Ges., Frankfurt*, XXV, p. 764.

The specimens in the collection are from Patalung in Lower Siam. They agree closely with the original description and also with an adult male from Buitenzorg determined by de Man and preserved in the Indian Museum: there are, however, slight differences in the form of the rostrum.

In Javanese specimens the upper edge of the rostrum is usually convex and at the apex is straight or directed a little downwards. In those from Patalung the upper edge is usually a trifle sinuous and the apex is straight, or (more particularly in young males and females) directed a little upwards. The teeth on the upper edge vary in number from 9 to 13,<sup>1</sup> with 2 or 3 situated on the carapace, thus agreeing exactly with de Man's account. On the lower edge, however, there are from 4 to 6 teeth (usually 4 or 5),<sup>2</sup> whereas in Javanese specimens there are only 2 or 3 and rarely 4.

The spinules on the carapace of the male, except in the case of the largest specimen, are restricted to the lateral walls and to the region in the vicinity of the hepatic spine.

The identity of the Patalung specimens with *P. elegans* is proved beyond doubt by the form of the chelae of the adult male which agree in every particular with those of the specimen from Buitenzorg referred to above. The fingers are clothed with hair in their basal two-thirds, with teeth at their proximal end exactly as described by de Man, while the movable finger bears distally the characteristic double row of tubercles. Seven specimens yield the following measurements:—

| Sex.    | Total length. | Length of carapace. | Length of 2nd pereiopod. | SECOND PERAEPOD : LENGTH OF |        |         |       |           |
|---------|---------------|---------------------|--------------------------|-----------------------------|--------|---------|-------|-----------|
|         |               |                     |                          | Ischium.                    | Merus. | Carpus. | Palm. | Dactylus. |
| ♂       | 61            | 16.5                | 8                        | 9.9                         | 16.7   | 23.5    | 18.5  | 15.6      |
| ♂       | 57            | 15.7                | 7.5                      | 10.4                        | 14.0   | 19.7    | 13.4  | 14.0      |
| ♂       | 58            | 14.3                | 54                       | 8.0                         | 11.4   | 13.7    | 10.8  | 9.4       |
| ♂       | 58            | 14.3                | 65                       | 9.4                         | 13.0   | 19.1    | 13.5  | 11.6      |
| ♂       | 60            | 14.2                | 43                       | 7.1                         | 8.5    | 11.7    | 7.9   | 7.7       |
| ♂       | 49            | 12.2                | 37.7                     | 6.5                         | 7.7    | 9.7     | 7.3   | 6.5       |
| ♀ ovig. | 47            | 11.3                | 31.5                     | 5.4                         | 5.7    | 8.8     | 5.1   | 4.3       |
| ♀ ovig. | 40            | 9.7                 | 24.5                     | 4.7                         | 4.9    | 6.6     | 3.9   | 3.5       |

<sup>1</sup> Of twenty-three specimens two have 9 dorsal teeth, seven have 10, nine have 11, four have 12 and one has 13.

<sup>2</sup> Of twenty-three specimens twelve have 4 ventral teeth, ten have 5 and one has 6.

The eggs are very large, about 1.5 mm. in length and 1.15 mm. in breadth. One specimen is parasitised by a Bopyrid.

It appears to me probable that the six larger specimens recorded by Lanchester from the Tale Sap under the name *Palaemon nipponensis*<sup>1</sup> are in reality examples of this species. De Man has noted the great resemblance that exists between the two forms and judging from Dr. Annandale's collection *P. nipponensis* does not occur in Lower Siam. The rostrum in Lanchester's larger specimens bears 10 or 11 teeth above and 4, 5 or 6 below, agreeing with the individuals described above. Lanchester's smaller examples with 6, 7 or 8 teeth on the upper border of the rostrum and 3, 4 or 5 below, probably belong to some other species; in young *P. elegans* that I have examined the rostral formula is the same as in adults.

Dr. Annandale's specimens of *P. elegans* were obtained at Lampam in Patalung in fresh water. They were found in the Patalung river and in ponds and ditches in the vicinity. In the Tale Sap itself the species was not found. *P. elegans* is recorded by de Man from Buitenzorg and Sinagar in Java.

#### *Palaemon neglectus*, de Man.

1888. *Palaemon acutirostris*, de Man (*nec* Dana), *Journ. Linn. Soc.*, XXII, p. 280, pl. xviii, fig. 7.  
 1891. *Palaemon acutirostris* (de Man *nec* Dana), Ortmann, *Zool. Jahrb., Syst.*, V, p. 707.  
 1892. *Palaemon* (*Eupalaemon*) *equidens*, de Man (*nec* Dana), in *Weber's Zool. Ergebn. Reise Niederländ. Ost-Ind.*, II, p. 453, pl. xxvi, fig. 37 (*not the synonymy*).  
 1906. *Palaemon* (*Eupalaemon*) *neglectus*, de Man, *Notes Leyden Mus.*, XXVI p. 201, pl. xv, fig. 6.

To this species belong a number of specimens obtained by Dr. Annandale in the Botanical Gardens at Penang.

The rostrum is a little shorter than the antennal scales; its upper margin is straight or a little convex near the base and is a trifle upturned at the tip. On the dorsal edge there are from 11 to 13 teeth (usually 12),<sup>2</sup> of which the three hindmost are placed on the carapace, the fourth being immediately above the posterior limit of the orbit. On the lower edge there are 4 or 5 teeth (nearly always 4).<sup>3</sup>

The largest male, a specimen 88 mm. in total length, bears a great number of very small spinules on the carapace; but these are absent in all the other examples. Six specimens yield the measurements shown on the next page.

The proportions of the segments of the second peraeopods are rather variable. In males the carpus is usually shorter than the merus or equal in length with it, whereas in females it is a little longer than the merus. In the larger claw of the largest male the fingers are a little longer than the carpus; in all other cases they are decidedly shorter. In males the chelipedes are always stout; in the larger limb of the male 88 mm. in total length the merus is 4.7 mm. thick at its distal end and the carpus 5.0 mm.; the palm is very slightly flattened, being 5.4 mm. in breadth and 4.9 mm. in thickness.

<sup>1</sup> Lanchester, *Proc. Zool. Soc. London*, 1901, p. 566.

<sup>2</sup> Of fifteen specimens three have 11 dorsal teeth, nine have 12, two have 13 and one abnormal individual has 9.

<sup>3</sup> Of fifteen specimens fourteen have 4 ventral teeth and one has 5.



| Sex. | Total length.   | Length of carapace. | Length of 2nd pereiopod. | SECOND PERAEPOD: LENGTH OF |        |         |       |           |
|------|-----------------|---------------------|--------------------------|----------------------------|--------|---------|-------|-----------|
|      |                 |                     |                          | Ischium.                   | Merus. | Carpus. | Palm. | Dactylus. |
| ♂    | 88              | 25.6                | 84                       | 10.8                       | 16.1   | 15.5    | 23.5  | 15.8      |
|      |                 |                     | 72                       | 10.4                       | 14.9   | 13.8    | 17.9  | 12.3      |
| ♂    | 72              | 19.5                | 54                       | 8.3                        | 10.4   | 10.2    | 13.2  | 9.5       |
|      |                 |                     | 44                       | 7.7                        | 8.8    | 8.8     | 9.6   | 7.3       |
| ♂    | 66              | 17.5                | 45.5                     | 7.5                        | 9.1    | 8.7     | 11.1  | 7.2       |
|      |                 |                     | 37.5                     | 6.6                        | 7.9    | 7.9     | 8.2   | 5.8       |
| ♂    | 75 <sup>1</sup> | 20.5                | 50.5                     | 8.1                        | 11.0   | 10.3    | 12.4  | 7.8       |
|      |                 |                     | 43                       | 7.6                        | 9.3    | 8.7     | 9.4   | 6.6       |
| ♀    | 53              | 13.1                | 32.5                     | 5.6                        | 6.6    | 7.1     | 7.3   | 5.1       |
|      |                 |                     | 30                       | 5.2                        | 6.5    | 6.8     | 6.4   | 4.8       |
| ♀    | 43              | 11.0                | 28.5                     | 4.9                        | 5.7    | 6.0     | 5.7   | 4.5       |
|      |                 |                     | 25                       | 4.5                        | 5.0    | 6.0     | 4.7   | 3.9       |

The spinules on the chelipedes agree closely with de Man's description. On the outer surface of the carpus there is a comparatively broad longitudinal smooth line which separates the closely packed small spinules of the upper surface from the very much larger and more sparsely distributed spinules of the lower surface.

In the largest male there are on both chelae five teeth on the fixed finger and four on the dactylus; in the smaller individuals they are less numerous, two or three on each finger. The anterior tooth on the dactylus is placed a little behind its middle point, the foremost on the fixed finger being posterior to it. These two teeth are larger than any of the others and the margin behind each of them is distinctly concave.

The synonymy of *P. neglectus* has been dealt with by de Man. In the Indian Museum there are two of the specimens which he recorded from Mergui in 1888 under the name *P. acutirostris*. These appear to be specifically identical with those described above, but unfortunately all the chelipedes are missing except one, which is small.

The specimens obtained by Dr. Annandale were found in a rapid running stream in the Botanical Gardens at Penang. All of them, in life, bore a small black spot on each side of the abdomen at the junction of the 1st and 2nd, 2nd and 3rd, 4th and 5th and 5th and 6th abdominal somites. No spot occurred at the junction of the 3rd and 4th somites. In the smaller individuals there was a dark slanting line near the posterior margin of the carapace and another, similar to it, not far from the anterior

<sup>1</sup> Both chelipedes detached.

margin, the two sometimes being joined together to form an N-shaped figure. In the largest male the carapace was olivaceous green, marbled and streaked and without definite markings. The chelipedes in this specimen were blackish externally and pale olive internally, the fingers being black with white tips. In smaller individuals the chelipedes were olive, with white fingers and with two scarlet bars on the chela. The first of these was situated at the proximal end of the palm and the second at the base of the fingers. The walking legs bore alternate pale and dark bars.

*Palaemon neglectus* has hitherto been recorded from King I. and Elphinstone I. in the Mergui Archipelago and from Deli on the E. coast of Sumatra.

#### *Palaemon pilimanus*, de Man.

1891. *Palaemon pilimanus*, Ortmann, *Zool. Jahrb., Syst.*, V, p. 735, pl. xlvii, fig. 9.  
 1892. *Palaemon (Macrobrachium) pilimanus*, de Man, in Weber's *Zool. Ergebn. Reise Nied Ost-Ind.*, II, p. 471, pls. xxvii and xxviii, figs. 44, a-i.  
 1900. *Palaemon (Macrobrachium) pilimanus*, Borradaile, *Proc. Zool. Soc. London*, p. 93.  
 1901. *Palaemon pilimanus*, Lankester, *Proc. Zool. Soc. London*, p. 567.

A large number of specimens collected in Java by the late Dr. W. C. Hossack belong to this variable species; they agree with de Man's description and with three Javanese specimens determined by de Man and preserved in the Indian Museum.

About sixty specimens, including one ovigerous female, were obtained in the Government Quinine Gardens at Tijnproean, at an altitude of 5600 ft., while two others were found at Garoet at an altitude of about 3000 ft. The ovigerous female is 45 mm. in total length and the largest male 59 mm.

The species is known from Java, Sumatra and Borneo and on the continent of Asia from Aring in Kelantan and the Belimbing River.

#### *Palaemon lampropus*, de Man.

1892. *Palaemon (Macrobrachium) lampropus*, de Man, in Weber's *Zool. Ergebn. Reise Nied. Ost-Ind.*, II, p. 493, pl. xxix, figs. 49a-c.  
 1901. *Palaemon lampropus*, Lankester, *Proc. Zool. Soc. London*, p. 568.  
 1902. *Palaemon lampropus*, Schenkel, *Verh. naturf. Ges. Basel*, XIII, p. 511.

Fifteen specimens were obtained by Dr. Annandale in the Patani River, below the town of Patani in the Siamese Malay States. The series agrees very well with de Man's account, but the rostrum is longer than in the large male that he described in detail, reaching to, or even a little beyond the apex of the scale. There are from 15 to 18 teeth on the upper border of the rostrum<sup>1</sup> of which 3 or 4 (usually 4) are situated on the carapace behind the orbit. On the lower margin there are 3 or 4 teeth, usually 4.

The specimens are small, the largest being only about 45 mm. in length; the chelipedes in several individuals are equal and in no case do they reach beyond the antennal scale by more than the length of the chela. In their form, however, and in the dentition of the fingers they are in precise agreement with de Man's description.

<sup>1</sup> Of fifteen specimens two have 15 dorsal teeth, six have 16, five have 17 and two have 18.

The series includes several ovigerous females, each bearing a great number of very small eggs.

*Palaemon lampropus* is known to occur in Celebes and Timor and has been recorded by Lanchester from Aring in Kelantan. The number of dorsal teeth on the rostrum in Lanchester's specimens (12 or 13) is considerably lower than in any of those found by Dr. Annandale.

#### Genus *Leander*, Desmarest.

In a recent paper in the *Records of the Indian Museum* I have revised the section of this genus that comprises Milne-Edward's *Leander styliiferus* and related forms. This paper contains descriptions and figures of three of the five species obtained by Dr. Annandale in the course of his tour.

#### *Leander annandalei*, Kemp.

1917. *Leander annandalei*, Kemp, *Rec. Ind. Mus.*, XIII, p. 211, text-figs. 1-4.

This remarkable species is based on a single individual dredged in the Whangpoo River, between Shanghai and Woosung, at a depth of  $5\frac{1}{2}$  to  $7\frac{1}{2}$  metres. It was found in pure fresh water.

*Leander annandalei* is particularly interesting in that it forms a link between *L. tenuipes*, Henderson, in which the last three pairs of legs are excessively long and filiform, and more normally constituted species of the genus.

#### *Leander modestus*, Heller.

1917. *Leander modestus*, Kemp, *Rec. Ind. Mus.*, XIII, p. 221, pl. ix, fig. 1.

From material obtained by Dr. Annandale at Shanghai I have been able to draw up a fresh description of this species, which was hitherto known only from the account given by Heller more than fifty years ago.

The species is common at the margins of the Tai Hu Lake and is caught in large numbers in basket traps set among weeds. A few individuals were dredged from a bare muddy bottom in the middle of the lake and others were obtained in the Whangpoo River between Shanghai and Woosung at depths of  $5\frac{1}{2}$  to  $7\frac{1}{2}$  metres. Young examples are common in ditches and ponds in the neighbourhood of Shanghai. All the specimens were obtained in pure fresh water.

In redescribing this species I unaccountably omitted to notice that Henderson in 1893 recorded *Leander modestus* from Madras. I have recently obtained from this locality specimens of a form which is without doubt identical with that examined by him. The specimens are, in my opinion, to be referred to *L. semmelinki*, a species which in many respects bears a close resemblance to *L. modestus*.

#### *Leander semmelinki*, de Man.

1881. *Leander semmelinkii*, de Man, *Notes Leyden Mus.*, III, p. 137.

1890. *Leander semmelinkii*, Ortmann, *Zool. Jahrb., Syst.*, V, p. 517.

1893. *Leander modestus*, Henderson (*nec* Heller), *Trans. Linn. Soc., Zool.* (2), V, p. 441.

1903. *Leander semmelinkii*, Nobili, *Boll. Mus. Torino*, XVIII, no. 455, p. 8.

The specimens agree almost precisely with de Man's account. The only discrepancy that I have noted is that the lower border of the rostrum, described as "scarcely emarginate at the base," is, as in most species of the genus, distinctly concave above the eye, being at its narrowest only about two-thirds as deep as in the vicinity of the hindmost inferior tooth.

The rostrum bears from 7 to 10 dorsal teeth, usually 8 or 9; the first is remote from the others and is situated on the carapace, the second being as a rule immediately above the hinder limit of the orbit. On the lower border are from 2 to 5 teeth, nearly always 3.

The branchiostegal tooth is not very much smaller than the antennal. The outer margin of the basal segment of the antennular peduncle ends in a spine that extends much beyond the produced, setose, antero-external portion of the segment. The two rami of the outer antennular flagellum are fused basally for a distance varying from two-fifths to one half the entire length of the shorter ramus. The antennal scale is about three times as long as wide, narrowed apically and with the distal end of the lamella not extending very far beyond the terminal spine of the outer margin.

The mandibular palp is composed of only two segments, the joint between the second and third being suppressed. In this respect the species is comparable to the European *L. squilla* in which precisely the same modification is found.

The chela of the second peraeopods is nearly always a trifle longer than the carpus, but is occasionally about equal to it, as noted by Ortmann. In reference to the last three pairs of peraeopods de Man remarks, "end of the terminal joint armed with three small and two longer spines." This is doubtless a clerical error, the segment referred to being the propodus. The description, thus amended, applies well enough to the third and fourth pairs; in the fifth the spinules are much more numerous towards the distal end. In the third pair the propodus is one and three quarter times the length of the carpus and two and a third times as long as the dactylus. In the fifth pair the propodus is longer both relatively and actually; it is about twice the length of the carpus and three and a quarter times as long as the dactylus. The sixth abdominal somite, measured dorsally, is rather more than half the length of the carapace.

The largest specimen in the collection is a female, 40 mm. in total length. The eggs are of medium size, about  $0.73 \times 0.58$  mm. in longer and shorter diameter.

The rostrum is proportionately longer in small specimens than in adults.

*L. semmelinki*, as de Man has remarked, bears a rather close resemblance to Heller's *L. modestus*; but in the latter species (i) the basal crest of the rostrum is much more elevated, (ii) the interval between the 1st and 2nd dorsal teeth of the rostrum is not greater than that between the 2nd and 3rd, (iii) the two rami composing the outer antennular flagellum are fused for a shorter length, (iv) the antennal scale is parallel-sided, not narrowed distally, (v) the mandibular palp is composed of three segments, (vi) the fingers of the first peraeopod are nearly one and a half times as long as the palm, (vii) the fingers of the second peraeopod are conspicuously longer than the palm and (viii) the last three peraeopods are

more slender, with a proportionately longer dactylus, that of the third pair being three quarters the length of the propodus.

The specimens collected by Dr. Annandale were obtained in February, 1914, in brackish water at the mouth of the Prai River opposite Penang; the species was extremely abundant in very shallow water at the edge of mud flats and, when alive, was whitish in colour without definite markings.

Other examples in the Indian Museum are from Fisher Bay, Port Owen, Tavoy I., Burma, obtained in November, 1911, by the R.I.M.S. 'Investigator' and from Bandra, near Bombay, collected in February 1911 by Mr. J. W. Caunter, from Ennur backwater near Madras, collected by myself in May 1918 in water of specific gravity 1.02625. There are ovigerous specimens from all the localities.

*Leander semmelinki* has been recorded from the roads of Makassar in Celebes (de Man), from Luzon in the Philippines (Ortmann) and from Singapore (Nobili).

#### *Leander potamiscus*, Kemp.

1917. *Leander potamiscus*, Kemp, *Rec. Ind. Mus.*, XIII, p. 225, text-fig. 7.

This species, which has been described from material collected by Dr. Annandale, differs from all known members of the genus with the exception of *L. fluminicola*, Kemp, in the complete absence of the branchiostegal spine of the carapace.

The type specimens were collected by Dr. Annandale in the Patani River, below the town of Patani in the Siamese Malay States and the species was also found at Telok Tikus on Penang I. Other specimens in the collection of the Zoological Survey of India are from Middle I., in the Andaman group and from the Sarguem and Tuari Rivers in Portuguese India. All the specimens were found in fresh water, but in places subject to tidal influence.

#### *Leander paucidens* (de Haan).

1907. *Leander paucidens*, de Man, *Trans. Linn. Soc. Zool.* (2), IX, p. 409.

1914. *Leander paucidens*, Balss, *Abhandl. math.-phys. Klasse K. Bayer. Akad. Wiss.*, Suppl. Bd. II, Abh. 10, p. 58.

Of this species, which is by far the commonest freshwater prawn in Japan, large numbers of specimens were obtained by Dr. Annandale. There are long series from Lake Biwa and from Ogura pond near Kyoto and other less numerous examples from the Yodo R., 1 mile above Osaka, from Kasumi-ga-ura on the Pacific coast and from Sapporo in Hokkaido: the specimens from the last locality were presented by the Otsu laboratory. All were collected in fresh water and a number of the females bear eggs.

The species was found in all parts of Lake Biwa, but was most abundant near the shore. Individuals were obtained in nets hauled in deepest part of the lake, at a depth of 320 ft., and as the species appears to live exclusively on the bottom there is every probability that they actually came from the depth indicated. Specimens from over 200 ft. are all small, none exceeding 35 mm. in length; nearer the shore larger examples, up to 48 mm. in length, were obtained. The largest specimens in the collec-

tion are from Kyoto and Sapporo and reach a length of about 54 mm. Miss Rathbun<sup>1</sup> has remarked that examples from the sea are larger than those from fresh water, attaining a length of 66½ mm. Dr. Annandale's specimens from Lake Biwa are, however, considerably larger than any that she examined from that locality.

According to an excellent colour sketch, made by Dr. T. Kawamura of the Otsu laboratory, living specimens are closely mottled with dull olive green with a dark posterior border to each abdominal somite. On either side of the carapace are three characteristic dark lines; two of these are on the branchiostegal wall and are nearly vertical, converging a little as they approach the inferior margin; the third extends obliquely downwards and forwards from the cardiac region, running between the two other lines at its lower end. The articulations of all the leg segments are tinged with yellow; there are dark patches at the base of the pleopods and at the tip of each uropod there is a large pale spot bordered with purplish brown. Dr. Annandale notes that specimens from bare ground, either in deep or shallow water, were almost colourless, though still retaining traces of the characteristic markings on the carapace. Examples with the deepest colouration were found among dense weed at a depth of about 10 ft.

The species forms one of the most important commercial products of Lake Biwa, being caught near Otsu in very large numbers in small basket traps.

De Man has given a list of the localities from which *Leander paucidens* has been recorded. It is evidently abundant in all parts of Japan and is known from Hokkaido and the Kurile Is. Miss Rathbun has recorded it from Fusan in Korea.

#### Genus *Palaemonetes*. Heller.

1911. *Allocaris*, Sollaud, *Bull. Mus. d'Hist. nat. Paris*, p. 50.

1913. *Allocaris*, synonymous with *Palaemonetes*, Pesta, *Ann. K.-K. Hofmuseums Wien*, XXVII, p. 9.

1914. *Coutierella*, Sollaud, *Bull. Soc. zool. France*, XXXIX, p. 318.

A small Palaemonid, obtained by Dr. Annandale in fresh water in the vicinity of Shanghai, is without doubt identical with that described by Sollaud under the name *Allocaris sinensis*. The new genus created for this species differs from *Palaemonetes* only in two points,—the wide separation of the coxal and basal segments of the first maxillipedes and the greater number of plumose setae at the apex of the telson.

Sollaud was apparently so impressed with the importance of these characters that he regarded *Allocaris sinensis* as the representative of an isolated branch which had evolved independently of all other Palaemonidae. His views, however, have been severely criticised by Pesta, who regards *Allocaris* as a synonym of *Palaemonetes* and has even expressed the opinion that *A. sinensis* is nothing more than a local race of the European *P. varians*. No two views could possibly be more divergent.

In reference to the characters noted above, Pesta has shown that the form of the first maxillipede is very variable in *Palaemonetes varians*, in some cases bearing an exceedingly close resemblance to that of *Allocaris*, while the number of setae at the

<sup>1</sup> Rathbun, *Proc. U.S. Nat. Mus.*, XXVI, p. 51 (1902).

apex of the telson is, in the same species, by no means constant. I have checked Pesta's observations by an examination of Irish specimens of *P. varians* and can in a large measure substantiate his statements.<sup>1</sup> Consideration of the text-figures which Pesta has given, affords convincing proof that *Allocaris* is nothing more than a synonym of *Palaemonetes* and that Sollaud formed a completely erroneous estimate of the value of the characters he discovered. On the other hand Pesta is undoubtedly wrong in suggesting that the Chinese species is merely a local race of *P. varians*.

More recently Sollaud has described another genus, *Coutierella*, based on a fresh-water Palaemonid from South China, and this also must be relegated to the synonymy of *Palaemonetes*. *Coutierella* is distinguished from *Palaemonetes* only by the form of the second maxilla and first maxillipede, the latter bearing a very close resemblance to the same appendage in *Palaemonetes sinensis*, while the former appears to differ from that of all Palaemonids in which it has been examined in the absence of the re-entrant angle in the margin below the two distal laciniae and in the presence of setae on this margin. It is clear from Pesta's work that the characters drawn from the first maxillipede do not form a valid generic distinction, and even in the Palaemonidae, in which genera are separated by such comparatively slight distinctions, the features of the second maxilla cannot by themselves be held to have the importance that Sollaud has ascribed to them.

In describing Caridea a study of the mouth-parts is far too often neglected; it is much to be regretted, therefore, that Sollaud in his discovery of certain most interesting points in the structure of these appendages in the Chinese species of *Palaemonetes* has adopted such extreme views regarding their evolution and classification.

#### *Palaemonetes sinensis* (Sollaud).

1911. *Allocaris sinensis*, Sollaud, *Bull. Mus. d'Hist. nat.*, p. 50, text-figs. 1, 2.

This species is certainly not a local race of *P. varians* as suggested by Pesta (*loc cit.*). It may be distinguished by the following characters:—

(i) The teeth on the upper border of the rostrum extend nearer to the apex. In *P. varians* the distal quarter of the rostrum is usually unarmed, whereas in *P. sinensis* it bears a tooth. In *P. sinensis* the foremost tooth of the dorsal series is situated above, or in advance of, the distal tooth on the lower border; in *P. varians* the foremost inferior tooth is in advance of all those on the upper edge.

(ii) The two ultimate segments of the antennular peduncle are proportionately shorter and the free portion of the accessory antennular ramus is nearly four times as long as the fused basal part. In *P. varians* the fused portion is very much longer, the free part of the accessory ramus being only about one third its length.

(iii) The antennal scale is a little broader (about two and two third times as long as wide) and is a trifle more broadly rounded distally.

(iv) The coxa and basis of the first maxillipede are more widely separated.

<sup>1</sup> In a number of Irish specimens the form of the first maxillipede is intermediate between those shown in Pesta's figs. 9 and 10 and in some it is almost as extreme as in fig. 10. There are as a rule only two setae at the apex of the telson, but in a few examples four were found.

(v) In the second peraeopods the chela is equal in length with the merus and is only about two-thirds as long as the carpus. In *P. varians* the chela is decidedly longer than the merus and only a little shorter than the carpus.

(vi) The dactylus of the last three peraeopods is a little longer; that of the third pair is about half as long as the propodus in *P. sinensis*, rather less in *P. varians*.

(vii) There are more setae (9 or 10) at the apex of the telson.

In other respects the two species appear to be in close agreement.

The teeth on the upper border of the rostrum vary in number from 4 to 6,<sup>1</sup> the hindmost being placed on the carapace behind the level of the orbit. On the lower margin there are from 1 to 3 teeth.<sup>2</sup>

On the ciliated margins of the antennules and buccal appendages there are numerous small cysts of a Protozoan apparently identical with that described by Sollaud.

Sixteen specimens of *Palaemonetes sinensis* were obtained by Dr. Annandale in the vicinity of Shanghai in small ponds and ditches of fresh water. They were found in the month of October in company with *Caridina* and young *Leander modestus*: none of the females carry eggs.<sup>3</sup>

#### Family ALPHEIDAE.

#### Genus *Alpheus*, Fabricius.

#### *Alpheus paludicola*, Kemp.

1915. *Alpheus paludicola*, Kemp, *Mem. Ind. Mus.*, V, p. 303, pl. xiii, figs. 11-13.

The only difference I am able to detect between specimens collected by Dr. Annandale in Lower Siam and those originally described from the Chilka Lake in Orissa is that the rostrum is very slender and rather longer, extending considerably beyond the end of the orbital hoods. In the form of the chelae and in all other particulars there is precise agreement. The eggs are 1.3 or 1.4 mm. in diameter.

According to Dr. Annandale's notes the specimens differed somewhat in colour from those observed in the Chilka Lake, the transverse bands of pigment on the abdomen being missing. They were translucent, without definite markings, but tinged, owing to the presence of scattered chromatophores, with reddish brown. The eyes were black and the palm and fingers of both chelae were deeply tinged with blue, especially on the dorsal surface. The eggs were pale green.

The specimens were obtained in the Tale Sap, in the channel connecting the upper and lower lakes at a depth of 3½ to 8 metres. They were found in a shallow layer of dense mud overlying a coarse sandy bottom and occurred in company with *Upogebia heterocheir*. The specific gravity of the water in the channel was variable according to the state of the tide, but probably does not rise much above 1.004.

*Alpheus paludicola* has hitherto been found only in the Chilka Lake on the Orissa coast of India.

<sup>1</sup> Of sixteen specimens five have 4 dorsal teeth, ten have 5 and one has 6.

<sup>2</sup> Of sixteen specimens seven have 1 inferior tooth, eight have 2 teeth and one has 3.

<sup>3</sup> See Addendum, p. 297.



## Family ATYIDAE.

Genus *Caridina*, Milne-Edwards.

All the species recorded below possess epipods at the base of the first four peraeopods and a gill-formula which is apparently the same as that given for the genus by Calman and Bouvier.<sup>1</sup>

*Caridina propinqua*, de Man.

1908. *Caridina propinqua*, de Man, *Rec. Ind. Mus.*, II, p. 227, pl. xix, figs. 6, 6a-f.

1913. *Caridina propinqua*, Bouvier, *Trans. Linn. Soc. Zool.* (2), XV, p. 463.

1915. *Caridina propinqua*, Kemp, *Mem. Ind. Mus.*, V, p. 309.

The specimens agree closely with those from the neighbourhood of Calcutta. In young individuals the rostrum extends little, if at all, beyond the end of the basal segment of the antennular peduncle, whereas in adults it almost or quite reaches the end of the second segment. On the upper border there are from 11 to 20 teeth,<sup>2</sup> of which from 2 to 4 (usually 3 or 4) are situated on the carapace. On the lower border there are from 0 to 4 teeth (usually 2).

The carpus of the first peraeopods is from 2.8 to 3.2 times as long as broad. In the third pair the propodus is from 2.7 to 3.2 times the length of the dactylus; the latter segment is slender and is armed with 6 or 7 spines, the terminal claw included. The propodus of the fifth peraeopod is from 2.4 to 2.8 times the length of the dactylus, the latter segment bearing from 43 to 55 spinules. There are from 11 to 16 movable spines on the outer uropod.

The eggs are from 0.64 mm. in length by 0.39 mm. in breadth, when freshly extruded, to 0.70 mm. in length by 0.44 mm. in breadth, when on the point of hatching. Oviparous females vary greatly in size, being from 12 to 20 mm. in total length.

Dr. Annandale found *Caridina propinqua* in abundance in the Tale Sap in January and February, 1916. It occurred among weeds in all parts of the lake, both in the inner portion where the water is in all probability fresh throughout the year and in the outer lake near the island of Koh Yaw in water of low salinity. There are also numerous specimens in the collection from the Patani River, below the town of Patani in the Siamese Malay States. The water in this locality, though fresh at the time the specimens were obtained, is subject to tidal influence.

<sup>1</sup> Bouvier, *Ann. Sci. France Belgique*, XXXIX, p. 68 (1905).

<sup>2</sup> In fifty specimens the numbers of rostral teeth are as follows:—

| Dorsal teeth. |                          | Ventral teeth. |                        |
|---------------|--------------------------|----------------|------------------------|
| 2             | specimens have 11 teeth. | 1              | specimen has no tooth. |
| 3             | " " " 12 "               | 6              | specimens have 1 "     |
| 2             | " " " 13 "               | 30             | " " " 2 teeth.         |
| 7             | " " " 14 "               | 12             | " " " 3 "              |
| 8             | " " " 15 "               | 1              | specimen has 4 "       |
| 8             | " " " 16 "               |                |                        |
| 9             | " " " 17 "               |                |                        |
| 6             | " " " 18 "               |                |                        |
| 3             | " " " 19 "               |                |                        |
| 2             | " " " 20 "               |                |                        |

*Caridina propinqua* has hitherto been recorded only from the vicinity of Calcutta and from the Chilka Lake and the neighbourhood of Puri in Orissa.

***Caridina nilotica*, Roux,  
subsp. *gracilipes*, de Man.**

1892. *Caridina wyckii*, var. *gracilipes*, de Man, in Weber's *Zool. Ergebn. Reise Nied. Ost-Ind.*, II, p. 393, pl. xxiv, figs. 29, a-e.  
 1902. *Caridina wyckii gracilipes*, Schenkel, *Verh. naturf. Ges. Basel*, XIII, p. 498, pl. viii, fig. 5 (in part).  
 1904. *Caridina wyckii* var. *gracilipes*, Roux, *Rev. Suisse Zool.*, XII, p. 554.  
 1905. *Caridina nilotica* var. *gracilipes*, Bouvier, *Ann. sci. France Belgique*, XXXIX, p. 73.  
 1908. *Caridina nilotica* var. *bengalensis*, de Man, *Rec. Ind. Mus.*, II, p. 265, pl. xx, figs. 6, 6a, 6b.  
 1908. *Caridina nilotica* var. *gracilipes*, de Man, *ibid.*, p. 207, pl. xx, figs. 7, 7a, 7b.  
 1915. *Caridina nilotica* var. *bengalensis*, Kemp, *Mem. Ind. Mus.*, V, p. 307.

I have already drawn attention to the fact that Indian specimens of *C. nilotica* subsp. *bengalensis* show a greater range of variation than is indicated by de Man and that in consequence it becomes almost impossible to separate the Indian race from the subsp. *gracilipes*, described from Celebes.

A short series of specimens obtained by Dr. Annandale at Shanghai still further emphasizes the close relationship that exists between the two races, and I am therefore forced to the conclusion that *bengalensis* must be regarded merely as a synonym of *gracilipes*. In a few points differences may certainly be detected between the forms inhabiting India, Celebes and N. China, but these in my opinion are too trivial to justify nomenclatorial recognition; in most cases they can only be discerned by taking the average characters of a large number of specimens and they are clearly of far less weight than those employed in the case of other subspecies.

In the Shanghai specimens the rostrum reaches a little beyond the end of the antennal scale and is armed dorsally at its proximal end with from 10 to 20 teeth (usually 12 to 17).<sup>1</sup> Of these the first 1 or 2 are placed on the carapace behind the orbital notch. At the apex there are from 1 to 3 dorsal teeth (nearly always 1); in no case are there any isolated teeth between these and the foremost of those comprising the proximal series. The teeth on the lower border are from 6 to 14 in number, usually 7 to 12.<sup>1</sup>

<sup>1</sup> In thirty-three specimens the numbers of teeth are as follows:—

| Dorsal teeth.            | Ventral teeth.          |
|--------------------------|-------------------------|
| (Proximal series only.)  |                         |
| 1 specimen has 10 teeth. | 1 specimen has 6 teeth. |
| 1 " " 11 "               | 3 specimens have 7 "    |
| 3 specimens have 12 "    | 2 " " 8 "               |
| 4 " " 13 "               | 8 " " 9 "               |
| 6 " " 14 "               | 9 " " 10 "              |
| 3 " " 15 "               | 6 " " 11 "              |
| 7 " " 16 "               | 2 " " 12 "              |
| 4 " " 17 "               | 1 specimen has 13 "     |
| 1 specimen has 18 "      | 1 " " 14 "              |
| 1 " " 19 "               |                         |
| 2 specimens have 20 "    |                         |

The carpus of the first peraeopods is from 2.0 to 2.2 times as long as wide. The propodus of the third peraeopod is from 2.9 to 3.3 times as long as the dactylus. The dactylus bears from 9 to 11 spines; excluding which it is from 3.8 to 4.2 times as long as broad. In the fifth peraeopods the propodus is from 2.7 to 3.1 times as long as the dactylus; the latter segment is from 4.8 to 5.2 times as long as broad and bears from 42 to 50 spinules. There are 8 or 9 movable spines on the outer uropod.

The eggs are from 0.50 to 0.52 mm. in length and from 0.31 to 0.32 mm. in breadth.

Dr. Annandale was unable to recognise any difference in colouration between these specimens and those of *C. denticulata* subsp. *sinensis* taken with them, though he noted that two species were probably present in the Shanghai ditches.

As regards the number of rostral teeth it will be noticed that the average of the dorsal series is 15 in the case of the Shanghai specimens, about 15.8 in de Man's examples from Celebes and from 16.8 to 22.7 in various samples from the coasts of India and Ceylon (*v. Kemp, l.c.*, 1915, p. 308). In this respect, therefore, the Shanghai specimens are in close agreement with those from Celebes. The teeth on the lower margin are much less numerous than usual; the average number in the Shanghai examples is 9.8, whereas in those from Celebes it is 14.4 and from 12.0 to 15.6 in those from India and Ceylon. In the length of the eggs (0.50 to 0.52 mm.) the specimens correspond most nearly with Indian specimens, the length in the latter being from 0.41 to 0.49 mm. as compared with 0.33 to 0.40 mm. in the case of those from Celebes.

Miss Rathbun, writing in 1902,<sup>1</sup> refers Hickson's *Atya wycki* from Celebes to the synonymy of the Japanese *C. leucosticta*, Stimpson,<sup>2</sup> while de Man in 1908,<sup>3</sup> follows other authors in regarding the form described by Hickson as a subspecies of *C. nilotica*. Three specimens of *C. leucosticta*, obtained in Japan and determined by Balss,<sup>4</sup> are in the Indian Museum; they almost certainly belong to the same form as those examined by Miss Rathbun and agree well enough with Stimpson's brief description. The specimens are unfortunately in very poor condition, but it seems fairly certain that they represent merely a race of *C. nilotica*. The carpi of the first legs are, however, slender—about twice as long as broad—, a fact which precludes the suggestion that they belong to *C. nilotica* subsp. *wycki*, while the comparative measurements of the dactyli of the last three legs and the very small eggs indicate affinity with the subspecies *gracilipes*.

Though the material from Japan is quite insufficient to justify any definite statement, the probability that a race of *C. nilotica* inhabits that country should not be forgotten. The Japanese form appears to be closely related to the subspecies *gracilipes* and may indeed prove to be identical with it, Stimpson's name in the latter event having priority as a subspecific term.

From the comparatively small amount of knowledge that we at present possess it

<sup>1</sup> Rathbun, *Proc. U.S. Nat. Mus.*, XXVI, p. 50 (1902).

<sup>2</sup> Stimpson, *Proc. Acad. Sci. Philadelphia*, 1860, p. 28.

<sup>3</sup> De Man, *loc. cit.*, 1908, p. 269.

<sup>4</sup> Balss, *Abhandl. math.-phys. Klasse K. Bayer. Akad. Wiss.*, Suppl. Bd. II, Abh. 10, p. 25.

would appear that there is a discontinuity in the distribution of this form. It occurs in India and Ceylon on the one hand and in Celebes, N. China and possibly Japan on the other hand, but is apparently absent from Java, Sumatra and the Malay Peninsula. Max Weber's extensive collections of Atyidae from Java and Sumatra seem to indicate that no form of the wide-spread *C. nilotica* occurs in those islands, while, judging from Dr. Annandale's collection, the species is represented in the Malay Peninsula only by the distinct variety described below.

***Caridina nilotica* (Roux),**  
subsp. ***macrophora*, nov.**

A subspecies of *Caridina nilotica*, readily distinguished by the very large size of its eggs from all the Asiatic races hitherto known, was found by Dr. Annandale in the

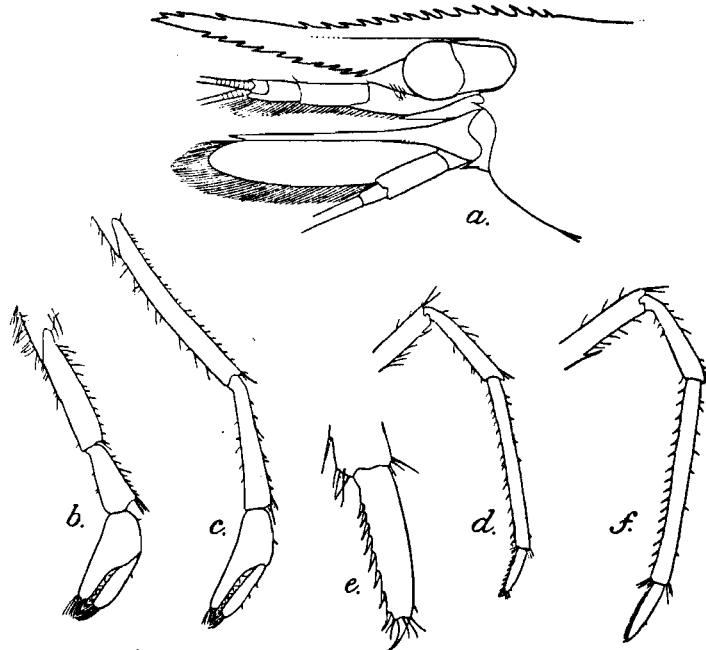


FIG. 9.—*Caridina nilotica*, subsp. *macrophora*, nov.

- |                                              |                                       |
|----------------------------------------------|---------------------------------------|
| a. Carapace, rostrum, etc., in lateral view. | d. Third peraeopod.                   |
| b. First peraeopod.                          | e. Dactylus of same further enlarged. |
| c. Second peraeopod.                         | f. Fifth peraeopod.                   |

Tale sap in Peninsular Siam. It occurred only in the inner part of the lake in water that in all probability is permanently fresh.

The rostrum (text-fig. 9a) usually extends a little beyond the apex of the antennal scale. In lateral view it is directed somewhat downwards in its proximal half, while distally it is a little ascendant. The proximal part of the upper margin bears a series

of 13 to 20 close set teeth,<sup>1</sup> of which from 1 to 3 (usually 2) are situated on the carapace behind the orbital notch. The foremost of the series is, as a rule, not situated in front of the middle point of the second segment of the antennular peduncle. There are from 1 to 3 (most commonly 2) subterminal dorsal teeth and between these and the foremost of the proximal series there is, in a few cases, a single isolated tooth. The lower margin bears from 6 to 12 teeth (usually 6 to 10)<sup>1</sup> which decrease regularly in size from behind forwards.

The lateral process of the antennular peduncle does not reach the end of the segment to which it is attached. The antennal scale is about  $3\frac{1}{2}$  times as long as broad.

In the first peraeopods (text-fig. 9b) the carpus is about  $2\frac{1}{2}$  times as long as broad; the chela is one third longer than the carpus with the dactylus about  $1\frac{1}{2}$  times the length of the palm.

The carpus of the second peraeopods (text-fig. 9c) is very slender, from  $5\frac{1}{2}$  to 7 times as long as broad and about one fifth longer than the chela. The dactylus is  $1\frac{1}{2}$  times the length of the palm.

The last three pairs of peraeopods possess the usual large spines on the lower margins of the ischium, merus and carpus. In the third pair (text-figs. 9d, e) the propodus is from  $3\frac{1}{2}$  to  $3\frac{3}{4}$  times the length of the dactylus (terminal spine included). Excluding the spines the latter segment is from  $4\frac{1}{2}$  to nearly 5 times as long as broad: the spines vary in number from 6 to 10.

In the fifth peraeopods (text-fig. 9f) the propodus is from  $3\frac{1}{2}$  to  $3\frac{3}{4}$  times the total length of the dactylus. Excluding the spinules, which vary in number from 35 to 45, the latter segment is from  $4\frac{1}{2}$  to  $4\frac{3}{4}$  times as long as broad.

The outer uropod bears 8 or 9 movable spines.

The eggs are very large, from 0.90 to 0.96 mm. in length and from 0.52 to 0.58 mm. in breadth.

Large specimens do not exceed 23 mm. in total length.

Classified on the lines adopted by de Man in his excellent paper on the races of *Caridina nilotica*,<sup>2</sup> the form from the Tale Sap would find a place near the subspecies *gracilipes* and *bengalensis* from both of which it is immediately distinguished by the very large size of the eggs. Eggs of more than 0.75 mm. have hitherto been known

<sup>1</sup>In fifty specimens the numbers of rostral teeth are as follows:—

| Dorsal teeth.                  | Ventral teeth.            |
|--------------------------------|---------------------------|
| (Not including those at apex.) | 5 specimens have 6 teeth. |
| 7 specimens have 13 teeth.     | 6 " " 7 "                 |
| 9 " " 14 "                     | 13 " " 8 "                |
| 11 " " 15 "                    | 11 " " 9 "                |
| 9 " " 16 "                     | 11 " " 10 "               |
| 5 " " 17 "                     | 3 " " 11 "                |
| 4 " " 18 "                     | 1 specimen has 12 "       |
| 4 " " 19 "                     |                           |
| 1 specimen has 20 "            |                           |

Twenty specimens have one subterminal dorsal tooth, twenty-eight have two and two have three.

<sup>2</sup> De Man, *Rec. Ind. Mus.*, II, p. 257 (1908).

only in two races of the species,<sup>1</sup> viz. the typical form, which is found in Egypt, and the subspecies *paucipara* from Natal. From both these forms the subspecies *macrophora* is distinguished by the greater proportionate length of the dactylus of the third legs, while from *paucipara* it also differs in the smaller number of spinules on the dactylus of the last leg.

*C. n. macrophora* may also be distinguished from all the other known races by the reduced number of teeth on the rostrum, a feature which is especially marked in the case of those on the lower border.

I have little doubt that the two mutilated specimens recorded by Lanchester<sup>2</sup> from the River Petwi, Tale Sap, as *Caridina wycki* are to be referred to this subspecies.

The specimens were all obtained in January, 1916, at the northern end of the Tale Sap in and near the mouth of the Patalung River. The water where they were found was quite fresh, though subject to slight alterations of level according to the state of the tide, and probably remains fresh throughout the year. The types bear the number 9664/10 in the register of the Zoological Survey of India.

### *Caridina brachydactyla*, de Man.

1892. *Caridina wyckii*, de Man (*nec* Hickson), in Weber's *Zool. Ergebn. Reise Nied. Ost-Ind.*, II, p. 386, pl. xxiv, figs. 29 f, g, i, ii, k, cc, dd.  
 1908. *Caridina nilotica* var. *brachydactyla*, de Man, *Rec. Ind. Mus.*, II, p. 269.  
 1913. *Caridina brachydactyla*, Bouvier, *Trans. Linn. Soc., Zool.* (2), XV, pp. 463, 466.

subsp. **peninsularis**, nov.

A number of specimens collected by Dr. Annandale near Patani, in the Siamese Malay States and on Penang I. appear to represent a local race of de Man's *C. nilotica* var. *brachydactyla*. This form, hitherto known only from Celebes, Flores and Saleyer, differs notably from all other varieties of *C. nilotica* in the very short dactyli of the last three pairs of legs and Bouvier, whom I follow, has recently given it full specific rank.

Minor points of distinction are to be found between individuals from Patani and those from Penang, while the specimens from both these localities in my opinion differ sufficiently from those described by de Man to justify their separation as a distinct subspecies.

The rostrum (text-fig. 10a) always exceeds the length of the antennular peduncle and in some cases extends a trifle beyond the end of the antennal scale. It is a little upturned distally, more rarely straight, and is armed above with a series of 21 to 37 (usually 25 to 32) teeth of which 3 or 4 (usually 3) are situated on the carapace behind the orbital notch. In most of the specimens examined by de Man a considerable length of the rostrum towards its distal end is unarmed, except for the presence of from 1 to 3 subterminal teeth, in this respect resembling *C. nilotica*. In the specimens before me the condition is quite different. The teeth, in the great majority of cases, stretch un-

<sup>1</sup> The size of the eggs in *C. nilotica* subsp. *wycki*, Hickson, a race found in Lake Tondano in Celebes, is at present unknown. No ovigerous females occur among cotypes of the subspecies preserved in the Indian Museum.

<sup>2</sup> Lanchester, *Proc. Zool. Soc. London*, 1901, p. 560.

interruptedly from the base to the apex, with the result that it is quite impossible to draw any line of separation between the subterminal teeth and those that form the proximal series. The teeth are crowded at the base and the interspaces between them sometimes increase in size as they approach the tip. In a very few cases there is a distinct break in the series and such specimens seem to differ only in a small degree from some from Mbawa in Flores examined by de Man. He notes that in these

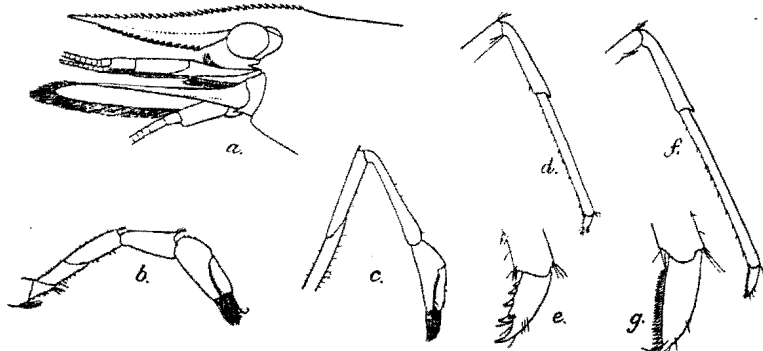


FIG. 10.—*Caridina brachydactyla*, subsp. *peninsularis*, nov.

- a. Anterior part of carapace, rostrum, etc. e. Dactylus of same further enlarged.  
 b. First pereopod. f. Fifth pereopod.  
 c. Second pereopod. g. Dactylus of same further enlarged.  
 d. Third pereopod.

examples "der distale ungezähnte Theil des oberen Randes ist kurz, nicht selten sehr kurz, zumeist ein wenig aufgebogen; vor der Spitze stehen 1-3 Zänchen, aber nicht selten rücken zwei oder drei Zänchen der proximalen Reihe mehr nach vorn und stehend dann auf dem sonst gewöhnlich zahnlosen Theile" (de Man, *l.c.*, 1892, p. 393, pl. xxiv, figs. 29*i*, *ii*). The lower margin of the rostrum bears from 6 to 10 teeth in the few specimens from Patani, from 8 to 17 in those from Penang.<sup>1</sup> The teeth may

<sup>1</sup> The numbers of rostral teeth in the few specimens from Patani and in fifty examples from Penang are as follows:—

| Number of dorsal teeth. | NUMBER OF SPECIMENS |           |
|-------------------------|---------------------|-----------|
|                         | Penang.             | Patani R. |
| 21                      | 1                   | ..        |
| 22                      | ..                  | ..        |
| 23                      | 2                   | 1         |
| 24                      | ..                  | ..        |
| 25                      | 6                   | ..        |
| 26                      | 2                   | 2         |
| 27                      | 4                   | 2         |
| 28                      | 7                   | 4         |
| 29                      | 8                   | 2         |
| 30                      | 7                   | ..        |
| 31                      | 2                   | ..        |
| 32                      | 4                   | 1         |
| 33                      | 2                   | ..        |
| 34                      | 2                   | ..        |
| 35                      | 1                   | ..        |
| 36                      | 1                   | ..        |
| 37                      | 1                   | ..        |

| Number of ventral teeth. | NUMBER OF SPECIMENS |           |
|--------------------------|---------------------|-----------|
|                          | Penang.             | Patani R. |
| 6                        | ..                  | 1         |
| 7                        | ..                  | ..        |
| 8                        | 3                   | 2         |
| 9                        | 5                   | 5         |
| 10                       | 10                  | 4         |
| 11                       | 5                   | ..        |
| 12                       | 5                   | ..        |
| 13                       | 8                   | ..        |
| 14                       | 7                   | ..        |
| 15                       | 3                   | ..        |
| 16                       | 3                   | ..        |
| 17                       | 1                   | ..        |

extend throughout the anterior two-thirds of the lower border, or may cease some little distance behind the apex.

The cornea is proportionately larger than in any *C. nilotica* that I have seen, while the stalk is shorter and broader. In dorsal view the length of the cornea is greater than that of the stalk, whereas in *C. nilotica* subsp. *gracilipes* the reverse is the case.

The preocular length of the antennular peduncle is at least 0.82 times the post-ocular length of the carapace. The lateral process is short, not reaching the end of the basal segment. The antennal scale is from 3.6 to 3.8 times as long as broad; the second segment of the antennal peduncle is produced distally as a spine immediately below the insertion of the scale.

The carpus of the first peraeopods (text-fig. 10b) is about 2.2 times as long as broad in the Patani R. specimens, from 2.4 to 2.6 times in those from Penang. The fingers are about 1.5 times the length of the palm.<sup>1</sup>

In the second peraeopods (text-fig. 10c) the carpus is one quarter longer than the chela and is from 4.9 to 5.8 times as long as broad. The fingers are about 1.5 times the length of the palm.<sup>1</sup>

The last three pairs of peraeopods usually bear from 2 to 4 spines on the lower edge of the merus and, occasionally, one near the distal end of the carpus. The propodus of the third pair (text-fig. 10d) is from 5.6 to 6.6 times as long as the total length of the dactylus in the Patani R. specimens, from 5.5 to 5.8 (exceptionally 5.1) times in the case of those from Penang. Excluding the spines, which vary in number from 5 to 7, the dactylus (text-fig. 10e) is from 2.0 to 2.6 times as long as broad. In the fifth peraeopods (text-figs. 10f, g) the propodus is from 4.8 to 6.8 times the length of the dactylus; the dactylus is from 2.5 to 2.8 times as long as broad and bears from 29 to 43 (usually 36 to 43) spinules.

There are from 3 to 5 pairs of dorsal spines on the telson and from 8 to 10 at the apex. On the outer uropod there are from 12 to 14 movable spines.

The eggs vary from 0.35 to 0.42 mm. in length and from 0.22 to 0.25 mm. in breadth; they do not differ in size in specimens from the two localities.

Large specimens reach a length of about 28 mm. In examples of 18 to 20 mm. in length the rostrum is not longer than in adults whereas in varieties of *C. nilotica* it is proportionately longest in adolescent individuals.

The subspecies *peninsularis* is based solely on the character of the upper border of the rostrum; in the subspecies the teeth extend along the whole length of this border, whereas in the typical form there is an untoothed portion close behind the apex.

The few Patani specimens were obtained in the river in muddy water which was fresh though subject to tidal influence, while those from Penang came from a stream of clear water in the Botanic Gardens. In the latter locality they occurred in places where the flow of water was not very rapid and where the banks were not overgrown

<sup>1</sup> The length of the palm is measured from the hindmost limit of the chela to the dorsal point of junction between palm and dactylus, the dactylus from its tip to the same point. De Man appears to have measured these segments differently.



with dense jungle. They were most abundant among the roots of grasses, etc., at the edge.

The types of the subspecies, which are from Penang, bear the number 9667/10 in the register of the Zoological Survey of India.

***Caridina gracilirostris*, de Man.**

1892. *Caridina gracilirostris*, de Man, in Weber's *Zool. Ergebn. Reise Nied. Ost-Ind.* II, p. 399, pl. xxv, fig. 31.  
 1904. *Caridina gracilirostris*, Roux, *Rev. Suisse Zool.*, XII, p. 555.  
 1905. *Caridina gracilirostris*, Bouvier, *Ann. sci. France Belgique*, XXXIX, p. 72.  
 1908. *Caridina* sp., de Man, *Rec. Ind. Mus.*, II, p. 227.

This species, hitherto recorded only from Celebes, Flores and Sumatra, is represented in Dr. Annandale's collection by a number of specimens from Peninsular Siam. There are also in the Indian Museum numerous examples from four widely separated parts of India. The following is a list of the localities from which specimens have been examined:—

- Dhappa, near Calcutta. N. Annandale. Brackish water. Three specimens (much damaged; recorded by de Man in 1908 as *Caridina* sp.).  
 Garia, near Calcutta: Dec., 1910, and Jan., 1911. S. Kemp. Brackish water. Seventeen specimens.  
 Sanguem R., Sanvordem, Portuguese India: Sept., 1916. S. Kemp. In water fresh at the time of capture, but subject to tidal influence. Six specimens.  
 Udaiyarpettai Kulam, Tinnevely, S. India: Sept., 1911. J. R. Hill. Fresh water. Twenty-three specimens.  
 Tambrapani R., Tinnevely, S. India: Sept., 1911. J. R. Hill. Fresh water. About sixty specimens.  
 Vellaney, Travancore: March and Sept., 1911. S. N. Pillay. Fresh water. About fifty specimens.  
 Patani R., below town of Patani, Siamese Malay States. N. Annandale. In water fresh at the time of capture, but subject to tidal influence.

In addition there are three specimens from Celebes, determined by de Man and received in exchange from Prof. Max Weber.

Ovigerous females were found in the months of September, December, January, February and March and occur in samples from all the localities listed above with the exception of Dhappa.

I have made a close comparison of the available material with a view to determining the possible existence of distinct races of the species. Specimens from different localities, however, agree very closely in structure and the few small differences that were observed in the case of one or two samples are of far too trivial a character to justify subspecific recognition.

The rostrum varies very considerably in length and is apparently longest in adolescent individuals between 25 and 30 mm. in length. In these it not infrequently exceeds twice the length of the carapace. In adults, especially in large

females, it is usually shorter and in rare cases is less than one and a half times the length of the carapace. The dorsal teeth, excluding that at the apex, vary in number from 4 to 10 (usually 5 to 9). In the specimens from Tinnevely the number appears to be decidedly lower than in those from other localities, while de Man has recorded examples with an exceptionally high number from the Bari R. in Flores. There is, almost without exception, a single subapical dorsal tooth: I have seen single specimens with 2 and 3 teeth in this position.

The ventral teeth of the rostrum vary still more, from 17 to 42, the majority having from 23 to 32. Here again the specimens from Tinnevely seem to have, on the average, a lower number than the others, but the material is not sufficiently abundant for accurate determination of the point.

The numbers of teeth in specimens from the five principal localities are as follows:—

| Number of dorsal teeth. | NUMBER OF SPECIMENS. |            |            |           |         |
|-------------------------|----------------------|------------|------------|-----------|---------|
|                         | Garia.               | Sanvordem. | Tinnevely. | Vellaney. | Patani. |
| 4                       | ..                   | ..         | 5          | ..        | ..      |
| 5                       | ..                   | ..         | 23         | 6         | ..      |
| 6                       | 1                    | ..         | 19         | 11        | 1       |
| 7                       | 2                    | 2          | 3          | 18        | 2       |
| 8                       | 6                    | 2          | ..         | 15        | 7       |
| 9                       | 3                    | ..         | ..         | 3         | 2       |
| 10                      | ..                   | 2          | ..         | 1         | 1       |

| Number of ventral teeth. | NUMBER OF SPECIMENS. |            |            |           |         |
|--------------------------|----------------------|------------|------------|-----------|---------|
|                          | Garia.               | Sanvordem. | Tinnevely. | Vellaney. | Patani. |
| 17                       | ..                   | ..         | 1          | ..        | ..      |
| 19                       | ..                   | ..         | 11         | ..        | ..      |
| 20                       | ..                   | ..         | 2          | ..        | 1       |
| 21                       | ..                   | ..         | 1          | ..        | 1       |
| 22                       | ..                   | ..         | 3          | 1         | 1       |
| 23                       | 1                    | ..         | 7          | 3         | 1       |
| 24                       | ..                   | ..         | 8          | 1         | ..      |
| 25                       | ..                   | 1          | 6          | 5         | 1       |
| 26                       | 1                    | ..         | 5          | 3         | 2       |
| 27                       | 3                    | 1          | 6          | 4         | 3       |
| 28                       | ..                   | ..         | 3          | 11        | 2       |
| 29                       | ..                   | ..         | 2          | 6         | ..      |
| 30                       | 2                    | 2          | 1          | 1         | ..      |
| 31                       | 1                    | ..         | 2          | 3         | 1       |
| 32                       | 3                    | ..         | ..         | 4         | ..      |
| 33                       | ..                   | ..         | 2          | ..        | ..      |
| 34                       | ..                   | ..         | ..         | 3         | ..      |
| 35                       | ..                   | 1          | ..         | 1         | ..      |
| 36                       | ..                   | ..         | ..         | 1         | ..      |
| 37                       | 1                    | ..         | ..         | ..        | ..      |
| 38                       | ..                   | ..         | ..         | 1         | ..      |
| 41                       | ..                   | 1          | ..         | 1         | ..      |
| 42                       | ..                   | ..         | ..         | ..        | ..      |

The antennal scale is from  $3\frac{3}{4}$  to 4 times as long as wide. The lateral process of the antennular peduncle is short, not reaching the end of the basal segment. The second segment is about twice as long as broad.

In the third maxillipedes the epipod is long and straight; the terminal segment bears from 8 to 10 spines.

The carpus of the first peraeopods is from  $1\frac{3}{4}$  to 2 times as long as wide and is

moderately excavate anteriorly; I have not seen any individual with this segment as slender as in de Man's examples from the Nargi River in Flores (de Man, *l.c.*, 1892, p. 403, pl. xxv, fig. 31*d*). The fingers are usually a little longer than the palm.

In the second peraeopods the carpus is from  $1\frac{1}{2}$  to  $1\frac{1}{3}$  times as long as the chela and is from 4 to  $4\frac{1}{2}$  times as long as its greatest breadth.

The usual spines are present on the ischium, merus and carpus of the last three peraeopods. The dactylus of the third pair generally bears from 8 to 10 spines, but in specimens from the Patani River the number is higher, from 12 to 15. In the fifth peraeopods the propodus is from  $3\frac{3}{4}$  (Tinnevely) to  $4\frac{1}{2}$  times (Patani R.) the length of the dactylus. The latter segment usually bears from 32 to 39 spinules; but, as in the case of the third pair, the number is higher in specimens from the Patani River, varying from 45 to 55.

The outer uropod is provided with from 8 to 11 movable spines.

Large specimens reach a total length of about 38 mm.

The size of the eggs is somewhat variable. In specimens from Calcutta, Portuguese India and the Patani River they are from 0.35 to 0.43 mm. in length and from 0.23 to 0.28 mm. in breadth. In those from Travancore and Tinnevely they are slightly, but noticeably larger, from 0.50 to 0.52 mm. in length and from 0.32 to 0.33 mm. in breadth. The lowest of these determinations agrees with de Man's description, in which the length is stated to be  $\frac{1}{2}$  mm. Even between the extremes the variation is small, but it is noteworthy that the specimens from Travancore and Tinnevely that possess the largest eggs were found in fresh water, whereas all the rest, including those from which de Man drew up his description, were obtained in places within the reach of tidal influence.

Summarizing the foregoing observations it may be stated that material from five distinct regions (four situated in the Indian Peninsula and one in Siam) shows little signs of local variation. Three points only call for emphasis,—(i) in specimens from the Tinnevely district in S. India the average number of upper rostral teeth is below normal, (ii) in specimens from Lower Siam the number of spines on the dactyli of the last three legs is above normal, and (iii) specimens from water that is brackish or subject to tidal influence have smaller eggs than those obtained in fresh water.

The colouration of living specimens is distinctive. The animal as a whole is translucent with the rostrum, the lower surface of the last abdominal somite, the distal two-thirds of the telson and frequently the tips of the uropods deeply pigmented. The carapace is without markings, but there is a short transverse row of chromatophores on the third abdominal somite and a longitudinal line of similar chromatophores near the inferior margin of the first five somites. The depth of pigmentation is variable. In extreme cases the whole of the rostrum, the antennules, the inner edge of the antennal scale and the tail-fan are deeply pigmented and there is a broad lateral longitudinal band on either side of the abdomen.

In my experience *C. gracilirostris* is a scarce form, much less abundant than other species of the same genus with which it is found associated.

The localities from which specimens have been examined have already been enumerated. The range of the species so far as known is Peninsular India, Lower Siam, Sumatra, Flores and Celebes.

***Caridina gracillima*, Lanchester.**

1901. *Caridina gracillima*, Lanchester, *Proc. Zool. Soc. London*, p. 560, pl. XXXIV, fig. 1.

1905. *Caridina gracillima*, Bouvier, *Bull. sci. France Belgique*, XXXIX, p. 72.

1913. *Caridina gracillima*, Bouvier, *Trans. Linn. Soc., Zool.* (2), XV, p. 463.

As Lanchester has pointed out this form is very closely related to *C. gracilirostris*; it may indeed be no more than a well marked local race of that species. The principal distinctions between the two are as follows:—

| <i>C. gracillima</i> , Lanchester.                                              | <i>C. gracilirostris</i> , de Man.                                         |
|---------------------------------------------------------------------------------|----------------------------------------------------------------------------|
| Rostrum shorter, usually not more than $1\frac{1}{2}$ times length of carapace. | Rostrum longer, usually more than $1\frac{1}{2}$ times length of carapace. |
| Ventral teeth of rostrum less numerous, usually not more than 20.               | Ventral teeth of rostrum more numerous, usually more than 20.              |
| Outer uropod with 6 to 8 movable spinules.                                      | Outer uropod with 8 to 11 movable spinules.                                |
| Eggs larger, from 0.65 to 0.70 mm. in length.                                   | Eggs smaller, from 0.33 to 0.52 mm. in length.                             |
| Size smaller; total length not exceeding 25 mm.                                 | Size larger; total length up to 38 mm.                                     |

The differences noted by Lanchester in regard to the proportionate lengths of the first two peraeopods and the spinulation of the telson break down on actual comparison of specimens.

In fifty specimens the number of dorsal teeth<sup>1</sup> on the proximal part of the rostrum varies from 5 to 10. In forty-nine specimens there is a single subapical dorsal tooth and in one specimen two such teeth. The ventral teeth vary from 13 to 22 (usually 14 to 20).

The antennal scale is from  $3\frac{1}{2}$  to nearly 4 times as long as broad. The peraeopods agree almost precisely with those of the allied species. The dactylus of the third bears from 6 to 9 teeth and that of the fifth from 30 to 47 (52 according to Bouvier).

According to Dr. Annandale's notes living specimens were transparent, with the

<sup>1</sup> The teeth in these specimens are arranged thus:—

| Dorsal teeth.             | Ventral teeth.           |
|---------------------------|--------------------------|
| 7 specimens have 5 teeth. | 1 specimen has 13 teeth. |
| 6 " " 6 "                 | 4 specimens have 14 "    |
| 20 " " 7 "                | 2 " " 15 "               |
| 12 " " 8 "                | 15 " " 16 "              |
| 3 " " 9 "                 | 10 " " 17 "              |
| 2 " " 10 "                | 9 " " 18 "               |
|                           | 4 " " 19 "               |
|                           | 2 " " 20 "               |
|                           | 2 " " 21 "               |
|                           | 1 specimen has 22 "      |

rostrum, posterior and lower margins of each abdominal somite, the margins of the telson and a longitudinal streak on each branchial region dark olive green. Suffusions of the same colour were sometimes present on other parts of the body. The eggs were greenish.

The numerous specimens in the collection were all obtained in the lower reaches of the Patalung River and in the Tale Sap in Lower Siam. In the inner lake they were common in fresh water, among weeds at the mouth of the Patalung River and at the edges of the lake in the same neighbourhood. In the outer lake they were equally abundant, living among weeds round the island of Koh Yaw in water of specific gravity 1.006.

Ovigerous females were obtained in both parts of the lake, but the size of the eggs—0.65 to 0.70 mm. in length and 0.40 to 0.45 mm. in breadth—does not differ in correlation with the different specific gravity of the water. It will be noticed that the eggs of specimens obtained in slightly brackish water are nearly twice the size of those of *C. gracilirostris* living in similar situations. This fact, more than any other, has induced me to retain *C. gracillima* as a distinct species.

Lanchester was in some little doubt as to the precise locality at which his specimens were obtained. They were found by Dr. Annandale and Dr. R. Evans in 1899, when attached to the "Skeat" Expedition, and were caught in the inner lake of the Tale Sap, just inside the mouth of the Patalung River. The species has not been recorded from any other locality.

#### *Caridina denticulata* (de Haan).

1849. *Caridina denticulata*, de Haan, in Siebold's *Fauna Japonica, Crust.*, p. 186, pl. xlv, fig. 8 (as *Hippolyte*).
1894. *Caridina denticulata*, Ortmann, *Proc. Acad. Sci. Philadelphia*, p. 406.
1902. *Caridina denticulata*, Rathbun, *Proc. U.S. Nat. Mus.*, XXVI, p. 49.
1902. *Caridina denticulata*, Doflein, *Abandl. math.-phys. Klasse Bayer. Akad. Wiss. München*, XXI, p. 632, text-figs.
1905. *Caridina denticulata*, Bouvier, *Bull. sci. France Belgique*, XXXIX, p. 74.
1914. *Caridina denticulata*, Balss, *Abhandl. math.-phys. Klasse Bayer. Akad. Wiss. München*, Suppl. Bd. II, Abh. 10, p. 24.

This species has been recorded both from China and Japan and good series from each of these countries are in Dr. Annandale's collection. On comparison certain small but apparently constant differences are to be found between the two sets of specimens and I have, in consequence, given the Chinese form subspecific rank.

An important character of *C. denticulata* is the presence of an acute forwardly directed tooth on either side of the carapace at the antero-inferior angle. Though clearly shown in Doflein's figures, and less distinctly in that of de Haan, its existence is not mentioned in any of the published descriptions. The antero-inferior angle of the carapace<sup>1</sup> is rounded off in most known species of Atyidae, but

<sup>1</sup> Bouvier in his key to certain species of *Caridina* (1913) separates some forms by the presence or absence of spines at the points he calls "l'angle orbitaire" and "l'angle sous-antennaire." By the former term he apparently refers to the angle on the anterior border of the carapace which is frequently called the antennal angle or antennal spine and by

is produced to form a tooth in *C. pasadenae*, Kingsley,<sup>1</sup> from California and *C. davidi*, Bouvier<sup>2</sup> from China. A similar tooth is frequently to be found in Indian specimens of a form closely allied to *C. weberi*, subsp. *sumatrensis*; but it is here variable in its development and in some localities at least does not even possess racial significance.<sup>3</sup>

Classified according to the scheme outlined by Bouvier<sup>4</sup> in 1913, *C. denticulata* would find a place alongside the Chinese *C. davidi*, Bouvier. Balss regards the latter species as synonymous with the former, but in this he is certainly in error. *C. davidi*, co-types of which are in the Indian Museum, differs in many respects from *C. denticulata* and may be distinguished at a glance by the depressed rostrum and by the strong curvature of the propodi of the last three pairs of legs.

The Japanese and Chinese races of *C. denticulata* may be distinguished in the following manner:—

| Typical form.<br>Japan.                                                                       | subsp. <i>sinensis</i> . nov.<br>China.                                                       |
|-----------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| Rostrum usually with 10 to 15 teeth above and with 2 to 5 below <sup>5</sup> (text-fig. 11a). | Rostrum usually with 14 to 22 teeth above and with 3 to 8 below <sup>6</sup> (text-fig. 11c). |
| Anterior margin of carpus of first peraeopod slightly excavate (text-fig. 11b).               | Anterior margin of carpus of first peraeopod deeply excavate (text-fig. 11d).                 |

the latter to a projection on the infero-external aspect of the second segment of the antennal peduncle (*cf.* description of *C. brevisstris*, p. 452). He makes no mention of a tooth or spine at the antero-inferior angle of the carapace.

<sup>1</sup> Kingsley, *Bull. Essex Inst.*, XXVII, p. 98, pl. iii, figs. 1-7 (1897).

<sup>2</sup> Bouvier, *Bull. Sci. France Belgique*, XXXIX, p. 83, fig. 7.

<sup>3</sup> *Vide* Kemp, *Rec. Ind. Mus.*, XIV, p. 100 (1918).

<sup>4</sup> Bouvier, *Trans. Linn. Soc. Zool.* (2), XV, p. 462 (1913).

<sup>5</sup> In fifty specimens from the neighbourhood of Lake Biwa in Japan the numbers of rostral teeth are as follows:—

| Dorsal teeth.              | Ventral teeth.            |
|----------------------------|---------------------------|
| 6 specimens have 10 teeth. | 1 specimen has no tooth.  |
| 4 " " 11 "                 | 1 " " 1 "                 |
| 12 " " 12 "                | 7 specimens have 2 teeth. |
| 11 " " 13 "                | 17 " " 3 "                |
| 8 " " 14 "                 | 16 " " 4 "                |
| 7 " " 15 "                 | 8 " " 5 "                 |
| 1 specimen has 16 "        |                           |
| 1 " " 17 "                 |                           |

<sup>6</sup> In fifty specimens from the Tai Hu in China the numbers of teeth are as follows:—

| Dorsal teeth.            | Ventral teeth.            |
|--------------------------|---------------------------|
| 1 specimen has 12 teeth. | 2 specimens have 2 teeth. |
| 3 specimens have 13 "    | 5 " " 3 "                 |
| 2 " " 14 "               | 13 " " 4 "                |
| 7 " " 15 "               | 12 " " 5 "                |
| 6 " " 16 "               | 9 " " 6 "                 |
| 8 " " 17 "               | 5 " " 7 "                 |
| 7 " " 18 "               | 3 " " 8 "                 |
| 6 " " 19 "               | 1 specimen has 9 "        |
| 3 " " 20 "               |                           |
| 1 specimen has 21 "      |                           |
| 4 specimens have 22 "    |                           |
| 1 specimen has 23 "      |                           |
| 1 " " 26 "               |                           |

The specimens recorded by Miss Rathbun from Fusan in Korea, with 14 to 18 teeth on the upper margin of the rostrum and 4 to 6 on the lower margin, most probably belong to the subspecies *sinensis*, and this is almost certainly true of Doflein's specimens from Pekin with 14 to 16 dorsal teeth and 3 to 5 ventral. In the figure given by the latter author the deeply excavate anterior margin of the carpus of the first legs is clearly shown.

In both races the rostrum reaches almost to, or a little beyond, the apex of the antennular peduncle. Its upper border is dorsally concave with the distal quarter or third of its length unarmed. Two or three of the posterior dorsal teeth are situated on the carapace behind the level of the orbit. The preorbital length of the antennular peduncle is about seven-tenths the post-orbital length of the carapace.

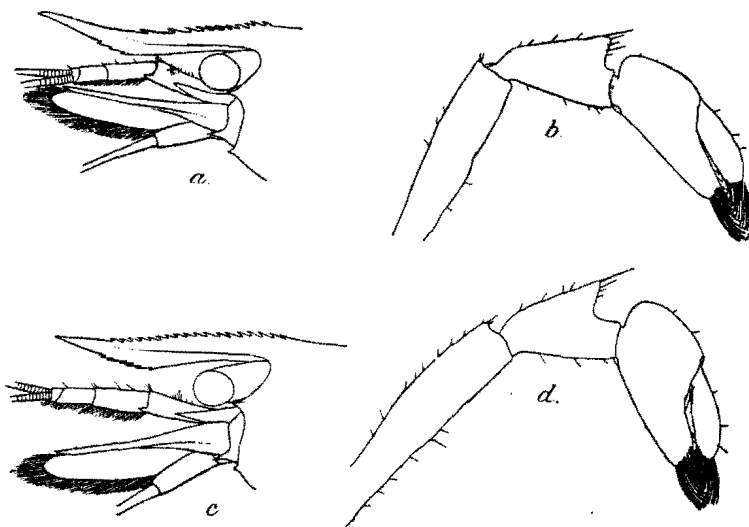


FIG. 11.—*Caridina denticulata* (de Haan).  
*a, b.* Typical form. *c, d.* Subsp. *sinensis*, nov.  
*a, c.* Anterior part of animal in lateral view.  
*b, d.* First peraeopod.

The merus of the third peraeopods bears 3, very rarely 4 teeth on its lower border; the dactylus bears 7 to 10 spines in Japanese specimens, 8 to 13 in those from China. The merus of the last pair of peraeopods also has 3 teeth on its lower edge; the propodus is from  $2\frac{1}{2}$  to  $2\frac{3}{4}$  times the length of the dactylus. The latter segment is about 4 times as long as broad; it bears about 40 to 60 teeth in Japanese specimens and about 50 to 70 in those from China. The number of movable spines on the outer uropod varies from 10 to 16.

Large specimens reach a length of about 28 mm.; none are ovigerous.

According to notes made by Dr. Annandale on Japanese specimens the species in life varies considerably in colour, as a rule it was brownish with mottled and marbled

sides, with a broad pale bar running from the rostrum to the tip of the telson, and with the edges of the uropods irregularly pale. Occasionally the whole animal was dead black, except for the longitudinal mid-dorsal bar, which was then yellowish, and for the pale edging to the uropods. Chinese individuals were similarly coloured, but were as a rule rather paler.

The parasitic Temnocephalid, *Caridinicola*, was very abundant on the Chinese specimens.

The Japanese specimens were obtained at Hikone on the eastern shores of Lake Biwa and in ditches at the edge of the Seta River at its exit from the lake. The Chinese specimens were found in creeks and irrigation channels at the edge of the Tai Hu lake in Kiangsu province.

#### *Caridina laevis*, Heller.

1862. *Caridina laevis*, Heller, *Sitzber. K. Akad. Wiss. Wien*, XLV, p. 411.  
 1892. *Caridina laevis*, de Man, in *Weber's Zool. Ergebn. Reise Nied. Ost-Ind.*, II, p. 376, pl. xxiii, fig. 27.  
 1905. *Caridina laevis*, Bouvier, *Bull. sci. France Belgique*, XXXIX, p. 74.  
 1913. *Caridina laevis*, Bouvier, *Trans. Linn. Soc., Zool.* (2), XV, p. 464.

A large number of specimens of this species have been presented to the Indian Museum by the late Dr. W. C. Hossack, who obtained them in September 1916, in Lake Situ Bagendit, Garut, Java, at an altitude of about 3000 ft. The series includes a number of ovigerous females and agrees very closely with de Man's description of specimens from the same locality. *Caridina laevis* is known only from Java.

#### *Caridina serrata*, Stimpson.

1860. *Caridina serrata*, Stimpson (not of Richters),<sup>1</sup> *Proc. Acad. Sci. Philadelphia*, p. 29 (98 of reprint).  
 1905. *Caridina serrata*, Bouvier, *Bull. sci. France Belgique*, XXXIX, p. 76.

The species does not seem to have been found since it was briefly described by Stimpson from Hong Kong more than fifty years ago. The specimens collected by Dr. Annandale are also from Hong Kong and agree fairly well with the original description.

The rostrum (text-fig. 12a) is very short but varies somewhat in length. In lateral view it is horizontal or inflected downwards and its apex may fall a little short of, or reach a little beyond the end of the first segment of the antennular peduncle. In dorsal view it is comparatively very broad at the base and bears above from 5 to 18 (nearly always 9 to 14)<sup>2</sup> small forwardly directed teeth, of which from 1 to 3 are usually situated on the carapace behind the orbit. The teeth are largest proximally and the series extends along almost the whole length of the upper border. Stimpson does not make any reference to teeth on the lower border of the rostrum, from which it might well be

<sup>1</sup> *Caridina serrata*, imperfectly described by Richters as a new species in Möbius' *Meeresfauna Mauritius*, p. 163, pl. xvii, figs. 24-27 (1880), is different. Thallwitz in 1892 suggested for it the name *C. richtersii* (*Abh. Ber. K. Zool. Mus. Dresden*, 1890-91, no. 3, p. 27).

<sup>2</sup> In seventeen specimens, in which the rostrum is complete, the numbers of teeth are as follows:—



inferred, as has been done by Bouvier, that they were altogether absent. In the comparatively short series of specimens before me the lower margin bears from 1 to 4 very small teeth in its distal third; it is therefore not improbable that it is occasionally toothless.

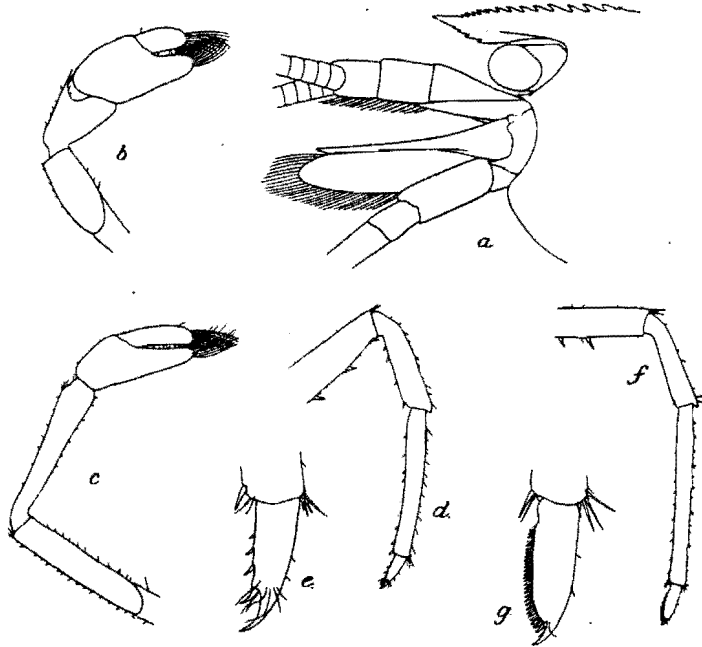


FIG. 12.--*Caridina serrata*, Stimpson.

- a. Carapace, rostrum, etc. in lateral view.      d. Third pereopod.  
 b. First pereopod.      e. Dactylus of same further enlarged.  
 c. Second pereopod.      f. Fifth pereopod.  
 g. Dactylus of same further enlarged.

The preorbital length of the antennular peduncle is only about half the postorbital length of the carapace. The lateral process of the basal peduncular segment is long, much as in *C. serratirostris*, de Man, reaching a little beyond the end of the segment to which it is attached.

In lateral view the distal end of the second segment of the antennular peduncle is

| Dorsal teeth.    |          | Ventral teeth.   |          |
|------------------|----------|------------------|----------|
| 1 specimen has   | 5 teeth. | 2 specimens have | 1 tooth. |
| 1    "    "      | 8    "   | 4    "    "      | 2 teeth. |
| 3 specimens have | 9    "   | 8    "    "      | 3    "   |
| 2    "    "      | 10   "   | 3    "    "      | 4    "   |
| 5    "    "      | 11   "   |                  |          |
| 1 specimen has   | 12   "   |                  |          |
| 2 specimens have | 13   "   |                  |          |
| 1 specimen has   | 14   "   |                  |          |
| 1    "    "      | 18   "   |                  |          |

produced to a tooth at its infero-external angle. The antennal scale is nearly three times as long as wide and its outer margin is very slightly concave.

The second maxillipedes are remarkable for the possession of a large protruding lobe, quadrate in outline, at the proximal end of the propodite. The third maxillipedes reach to the end of the antennal scale, the exopod extending beyond the end of the antepenultimate segment.

In the first peraeopods (text-fig. 12*b*) the carpus is equal in length with the palm and its greatest breadth is about two-thirds its extreme length; anteriorly it is very deeply hollowed to receive the rounded proximal end of the chela. The second peraeopods (text-fig. 12*c*) are long and slender, reaching a little beyond the end of the scale. The carpus is about one and a third times the length of the chela and is between  $5\frac{1}{2}$  and 6 times as long as its greatest breadth. The palm is two-thirds the length of the dactylus. In the third peraeopods (text-figs. 12*d*, *e*) the merus bears four spines on its lower margin and the carpus one near its distal end. The propodus is provided with a series of spinules on the same margin; it is about 8 times as long as broad and rather more than  $3\frac{1}{2}$  times as long as the dactylus (terminal spine included). The dactylus bears in all 5 or 6 spines, the outermost large and strongly curved. The fifth peraeopods (text-figs. 12*f*, *g*) bear spines on the merus, carpus and propodus, much as in the case of the third pair. The propodus is from 11 to  $13\frac{1}{2}$  times as long as broad and from 4 to  $4\frac{1}{2}$  times the total length of the dactylus. The latter segment bears from 29 to 34 slender spines; excluding these its length is a trifle more than three times its breadth.

The outer uropod is provided with a series of from 18 to 21 movable spinules.

Well-grown specimens reach a length of about 17 mm. The eggs are large and few in number: about 0.96 mm. by 0.70 mm. in longer and shorter diameter.

*Caridina serrata* is allied to *C. parvirostris*, de Man, and *C. pareparensis*, de Man, but differs from both in the much greater proportionate length of the lateral process of the antennular peduncle. In addition it differs from *C. parvirostris* in the large size of the eggs and from *C. pareparensis* in the more deeply excavate carpus of the first pair of legs. In Bouvier's latest scheme of classification (1913) it would come nearest to *C. serratirostris*, de Man, which it resembles in the length of the lateral process of the antennule. From this species, however, it differs in many respects, notably in the length and dentition of the rostrum and the form of the carpus in the first pair of legs.

Dr. Annandale informs me that, in life, the specimens were mottled with brownish pigment and were consequently very difficult to detect on the rocks on which they commonly sat. They were found in pools in very small streamlets of clear water, devoid of weeds, on the Peak at Hong Kong, at altitudes of 1200-1500 ft. The specimens were collected in September, three of the females being ovigerous. Two additional specimens from the same locality, collected by Capt. F. H. Stewart, I.M.S., have recently been presented to the Museum.

Stimpson gives the habitat of his specimens as "ad insulam Hong Kong; in rivulis."

**Caridina weberi**, de Man.subsp. **sumatrensis**, de Man.1892. *Caridina weberi* var. *sumatrensis*, de Man, in Weber's *Zool. Ergebn. Reise Nied. Ost-Ind.*, II, p. 375, pl. xxii, fig. 23 g.1905. *Caridina weberi* var. *sumatrensis*, Bouvier, *Bull. sci. France Belgique*, XXXIX, pp. 75, 83.

The principal characters of the specimens that I refer to this subspecies are as follows :—

The rostrum reaches nearly to, or a little beyond the end of the second segment of the antennular peduncle and is armed above with from 12 to 21 (usually 15 to 19)<sup>1</sup> teeth of which from 4 to 6 (usually 4 or 5) are situated on the carapace behind the orbital notch. The lower margin bears from 2 to 9 teeth (usually 3 to 6).

The lateral process of the antennular peduncle does not nearly reach the end of the basal segment. The longitudinal carina on the dorsal surface of the antennular somite is high. The antero-inferior angle of the carapace is rounded.

The carpus of the first peraeopods is deeply excavate anteriorly and is from 1·8 to as 2·0 times as long as its greatest breadth. In the second pair the carpus is very slender, 6·7 or 6·8 times as long as broad. The propodus of the third peraeopods is from 4·3 to 4·7 times the length of the dactylus, the latter segment bearing 7 spines. In the fifth legs the propodus is 5·2 times as long as the dactylus (4·5 times in a very large individual); the spinules on the dactylus vary in number from 36 to 57. The outer uropods bear 18 or 19 movable spines.

Fully developed eggs are from 0·46 to 0·47 mm. in length and from 0·28 to 0·29 mm. in breadth. An exceptionally large specimen is about 24 mm. in total length.

The specimens are from Penang I. and the lower reaches of the Patani River; in both localities they were found together with the examples of *C. brachydactyla* subsp. *peninsularis*. There are thirty-one specimens from Penang and two from the Patani River.

The subspecies *sumatrensis* was described from Sumatra and has also been recorded from Bombay.

Genus **Paratya**, Miers.1882. *Paratya*, Miers, *Ann. Mag. Nat. Hist.* (5), IX, p. 194.1909. *Xiphocaridina*, Bouvier, *Comptes Rendus Acad. Sci. Paris*, p. 1729.1917. *Paratya*, Kemp, *Rec. Ind. Mus.*, XIII, p. 293.

<sup>1</sup> In thirty specimens (from Penang) the numbers of teeth as are follows :—

| Dorsal teeth. |               | Ventral teeth. |               |
|---------------|---------------|----------------|---------------|
| 1 specimen    | has 13 teeth. | 3 specimens    | have 2 teeth. |
| 4 specimens   | have 15 "     | 7 "            | " 3 "         |
| 8 "           | " 16 "        | 6 "            | " 4 "         |
| 6 "           | " 17 "        | 7 "            | " 5 "         |
| 5 "           | " 18 "        | 4 "            | " 6 "         |
| 3 "           | " 19 "        | 2 "            | " 7 "         |
| 2 "           | " 20 "        | 1 specimen     | has 9 "       |
| 1 specimen    | has 21 "      |                |               |

I have recently given some notes on the species and races of this genus and have pointed out that the form inhabiting Australia is not, as was hitherto supposed, conspecific with that found in Japan. The information I have been able to give regarding the two races found in the latter country is, in the main, derived from material obtained by Dr. Annandale.

**Paratya compressa** (de Haan).

1917. *Paratya compressa*, Kemp, *Rec. Ind. Mus.*, XIII, p. 296, text-figs. 1 a-f.

The typical form of this species was found in abundance by Dr. Annandale among weeds and dense vegetation at Komatsu and in pools and backwaters round Lake Biwa; in the lake itself it was much scarcer. Other specimens are from Ogura and Yodo ponds near Kyoto. The Temnocephaloid worm *Caridinicola* was present in the gill-chambers of a large proportion of the individuals examined at Komatsu.

subsp. **improvisa**, Kemp.

1917. *Paratya compressa*, subsp. *improvisa*, Kemp, *Rec. Ind. Mus.*, XIII, p. 299, text-figs. 2 a-f, 3.

The race differs from the typical form in certain well-defined rostral characters. Judging from the material examined it is restricted to the north-eastern parts of the main island, while the typical form inhabits the south-western regions. The boundary between the two races appears to be just to the north-east of Lake Biwa.

The specimens I have examined are from the lagoon Kasumi-ga-ura in Hikachi province, collected by Dr. Annandale; from Tokio, collected by Hilgendorf (Berlin Mus.); from Lake Haruna, near Ikao, about 3000 ft., collected by Dr. K. Nakazawa and from Lake Suwa, in the Shinano province, 2660 ft., collected by Dr. T. Kawamura.

Tribe **PENAEIDEA**.

Family **PENAEIDAE**.

Subfamily **PENAEINAE**.

**Penaeus indicus**, Milne-Edwards.

var. **merguiensis**, de Man.

1906. *Penaeus indicus* var. *merguiensis*, Alcock, *Cat. Indian Decap. Crust.*, III, i, p. 13, pl. ii, fig. 4.

1911. *Penaeus merguiensis*, de Man, *Decap. 'Siboga' Exped.*, *Penaeidae*, p. 104, and (1913), pl. ix, figs. 33 a-c.

Two specimens obtained by Dr. Annandale in Lower Siam are referred with some doubt to this form. The principal distinction between typical *indicus* and the variety *merguiensis* rests in the comparative length of the terminal segment of the third maxillipede of the male, and both the specimens in the collection are female.

In the larger individual, which is about 120 mm. in length, the rostrum is much elevated at the base, as in Alcock's figure, and the foremost tooth on the upper

border is situated above the middle of the terminal segment of the antennular peduncle. In the smaller example, which is 85 mm. in length, the rostrum agrees precisely with de Man's fig. 33a.

The large specimen was taken from fishermen's nets opposite Singgora in the outer lake of the Tale Sap; the smaller individual is from Patani Bay, at the mouth of the Patani river in the Siamese Malay States.

#### **Penaeus carinatus**, Dana.

1906. *Penaeus semisulcatus*, Alcock (not of de Haan), *Cat. Indian Decap. Crust.*, III, i, p. 10, pl. i, fig. 2.  
 1911. *Penaeus carinatus*, de Man, *Decap. 'Siboga' Exped., Penaeidae*, p. 101.  
 1915. *Penaeus carinatus*, Kemp, *Mem. Ind. Mus.*, V, p. 317.

Two males and one female, varying in length from 176 to 186 mm., are in Dr. Annandale's collection. They were obtained from nets and stakes set by fishermen opposite Singgora in the outer part of the Tale Sap in Lower Siam.

#### Genus **Penaeopsis**, Bate.

##### **Penaeopsis monoceros** (Fabricius).

1906. *Metapeneus monoceros*, Alcock, *Cat. Indian Decap. Crust.*, III, i, p. 18, pl. iii, figs. 7, 7a-c.  
 1911. *Penaeopsis monoceros*, de Man, *Decap. 'Siboga' Exped., Penaeidae*, p. 55 and (1913), pl. vi, figs. 14a-c.

Numerous examples of both sexes, the largest 107 mm. in length, were found by Dr. Annandale in the Tale Sap, along with the preceding species. The petasma does not appear to be fully developed in any of the specimens.

##### **Penaeopsis affinis** (Milne-Edwards).

1906. *Metapeneus affinis*, Alcock, *Cat. Indian Decap. Crust.*, III, i, p. 20, pl. iii, figs. 8, 8a-d.  
 1911. *Penaeopsis affinis*, de Man, *Decap. 'Siboga' Exped., Penaeidae*, p. 57 and (1913), pl. vi, figs. 15 a, b.

Nine males were found in company with *P. monoceros*. All are young, the largest being only 78 mm. in length. The fifth legs are not appreciably longer than in *P. monoceros* of similar size, and in no case reach beyond the end of the second segment of the antennular peduncle. The petasma precisely resembles that figured by de Man and differs conspicuously from that of the larger specimens recorded from the Chilka Lake<sup>1</sup> and from Alcock's figure. The differences, as de Man has noted, are probably due to age.

##### **Penaeopsis brevicornis** (Milne-Edwards).

1906. *Metapeneus brevicornis*, Alcock, *Cat. Indian Decap. Crust.*, III, i, p. 22, pl. iv, figs. 10, 10 a, b.

The collection contains two large females from the Tale Sap, found with *P. monoceros*, and one male and four females from Patani Bay, at the mouth of the Patani

<sup>1</sup> Kemp, *Mem. Ind. Mus.*, V, p. 321 (1915).

river in the Siamese Malay States. The females are from 76 to 117 mm. in length and the male 73 mm.

In both sexes the rostrum is more elevated at the base than in Alcock's figure; in the male it reaches only a little beyond the eyes, whereas in the female it is much longer, extending to or a trifle beyond the end of the antennular peduncle. Alcock has not noted any difference between the sexes in the proportionate length of the rostrum, but some of the females determined by him are in close agreement with those in the present collection. The petasma agrees almost exactly with Alcock's figure. The thelycum varies considerably, more especially as regards the size of the central plate between the bases of the fourth legs.

#### Family SERGESTIDAE.

##### Genus *Acetes*, Milne-Edwards.

The characters of the different species of *Acetes* have hitherto been very imperfectly known, and the determination of the three forms in the collection proved in consequence to be a matter of some difficulty. It was only after an examination of the long series of undetermined specimens in the Indian Museum that definite conclusions were reached. The results of my examination of this material (with which that collected by Dr. Annandale is included) have been published in the *Records of the Indian Museum*. In this paper Milne-Edwards' *A. indicus* is redescribed and figured along with *A. erythraeus*, Nobili, *A. japonicus*, Kishinouye, and a hitherto unknown form from Borneo. In three of the species well marked sexual differences are to be found in the length of the last segment of the antennular peduncle. In the fourth species, *A. erythraeus*, Nobili, the males appear to be dimorphic in respect of the proportionate length of this segment, the specimens on which this interesting observation is based forming part of Dr. Annandale's collection.

##### *Acetes indicus*, Milne-Edwards.

1917. *Acetes indicus*, Kemp, *Rec. Ind. Mus.*, XIII, p. 47, text-figs.

The specimens in Dr. Annandale's collection are from the Tale Sap. Eleven examples were obtained in the channel between the inner and outer lakes in the vicinity of Pak Raw and Pak Payun, the specific gravity of the water varying from 1.0015 to 1.00225 (corrected). Four individuals were also found at the mouth of the outer lake near Singgora in company with *Acetes japonicus*, the specific gravity of the water here varying from 1.004 to 1.0085.

##### *Acetes erythraeus*, Nobili.

1917. *Acetes erythraeus*, Kemp, *Rec. Ind. Mus.*, XIII, p. 51, text-figs.

This species is represented in the collection by four males from the mouth of the Prai river, opposite Penang and by a few of each sex from the Patani river, below the town of Patani in the Siamese Malay States. In the latter locality the species was found with *Acetes japonicus*, occurring in water that was quite fresh, though in a situation subject to tidal influence.

In the paper cited above I have drawn particular attention to the four individuals from the Prai river, for it is on their characters that I have based my statement that the male in this species is dimorphic. In all the four specimens (precisely as in males of *A. indicus* and *A. erythraeus*) the ultimate segment of the antennular peduncle is slender and longer than the basal segment. In examples of the same sex from the Patan river, as well as in numerous males from three separate localities on the west coast of the Bay of Bengal, the ultimate peduncular segment is invariably short, closely resembling that of the female<sup>1</sup>: the specific identity of the Prai river specimens is proved beyond doubt by the distinctive form of the petasma.

#### **Acetes japonicus**, Kishinouye.

1917. *Acetes japonicus*, Kemp, *Rec. Ind. Mus.*, XIII, p. 56, text-figs.

The collection contains numerous specimens obtained in the market at Osaka in Japan, a considerable number from the Tale Sap and a few from the Patani river in the Siamese Malay States. The examples from the Tale Sap were found along with a few *A. indicus* at the mouth of the outer lake near Singgora in water of specific gravity varying from 1.004 to 1.0085 (corrected). Those from the Patani river were taken in company with *A. erythraeus* in water that was fresh at the time of their capture but subject to tidal influence.

#### Genus **Lucifer**, Thompson.

##### **Lucifer hanseni**, Nobili.

1906. *Lucifer hanseni*, Nobili, *Ann. Sci. nat., Zool.* (9), IV, p. 25, pl. ii, fig. 1 and text-fig. 3b, p. 27.

1915. *Lucifer hanseni*, Kemp, *Mem. Ind. Mus.*, V, p. 324, text-figs. 37a-d.

1916. *Leucifer hanseni*, Borradaile, *Brit. Antarct. Exped., 'Terra Nova,' Zool.*, III, p. 83.

A number of specimens were obtained in the outer lake of the Tale Sap, between Koh Yaw and the mainland and at the mouth of the lake near Singgora. The specific gravity of the water in which they were found varied from 1.00625 to 1.0085 (corrected).

*Lucifer hanseni* was described by Nobili from the Red Sea and has recently been recorded by Borradaile from Melbourne.

### **STOMATOPODA.**

#### Family **SQUILLIDAE.**

##### Genus **Squilla**, Fabricius.

Four species and one variety of Stomatopoda, all belonging to the genus *Squilla*, were found by Dr. Annandale at the mouth of the Tale Sap in Peninsular Siam. They were obtained in fishermen's nets and all were caught in water of specific gravity 1.0085 (corrected).

<sup>1</sup> I have recently examined a large male of *A. erythraeus* from Silavathurai Lagoon, near Tuticorin, S. India, which agrees exactly with the specimens from the Prai River. This is the first record of the "high" dimorphic male from the coasts of British India. We are indebted to Mr. J. Hornell for the specimen.

**Squilla scorpio**, Latreille.

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

Five specimens are in the collection, the largest a male 75 mm. in length. Apart from the fact that the lateral carinae of the fourth abdominal somite occasionally terminate in spines, the specimens agree exactly with the description in the paper quoted above.

var. **immaculata**, Kemp.

1913. *Squilla scorpio* var. *immaculata*, Kemp, *loc. cit.*, p. 45, pl. ii, fig. 31.

Six specimens, the largest a male 73 mm. in length, were obtained in company with typical *scorpio*. As in the case of the collection from the Chilka Lake,<sup>1</sup> where both forms also occur, no specimen with intermediate characters is to be found. The variety *immaculata* has hitherto not been recorded east of the Bay of Bengal.

**Squilla nepa**, Latreille (Bigelow).

1913. *Squilla nepa*, Kemp, *loc. cit.*, p. 60, pl. iv, fig. 49.

Two specimens were obtained, the largest a male 70 mm. in length. *S. nepa* has not hitherto been reported from brackish water.

**Squilla interrupta**, Kemp.

1913. *Squilla interrupta*, Kemp, *loc. cit.*, p. 72, pl. v, figs. 60-62.

A number of young specimens were obtained, the largest only 46 mm. in length. In very small individuals the tubercles on the upper edge of the carpus are represented only by two obscure lobes. This species also was not previously known to inhabit brackish water.

**Squilla raphidea**, Fabricius.

1913. *Squilla raphidea*, Kemp, *loc. cit.*, p. 88, pl. vii, fig. 77.

Two specimens were obtained, a female 255 mm. in length and a male 200 mm. in length. The latter individual differs from the majority of large examples of the same sex, preserved in the Indian Museum, in the complete absence of the angular projection on the external border of the dactylus of the raptorial claw. In the paper cited above attention is drawn to the existence of the same phenomenon in a male 190 mm. in length. *S. raphidea* has not hitherto been recorded from brackish water.

## ADDENDUM.

While this paper was in the press I received from Soochow, through the kindness of Prof. N. Gist Gee, some further specimens of *Palaemonetes sinensis* (see p. 272). The largest of these individuals is 40 mm. in length, whereas none of those collected by Dr. Annandale exceed 25 mm. Some of the Soochow specimens are ovigerous, bearing eggs about 1.2 × 0.94 mm. in longer and shorter diameter.

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<sup>1</sup> Kemp, *Mem. Ind. Mus.*, V, p. 193 (1915).