

No. V.—PELAGIC CRUSTACEA DECAPODA OF THE PERCY SLADEN
EXPEDITION IN H.M.S. "SEALARK."

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(Plate 7 and 1 Text-figure.)

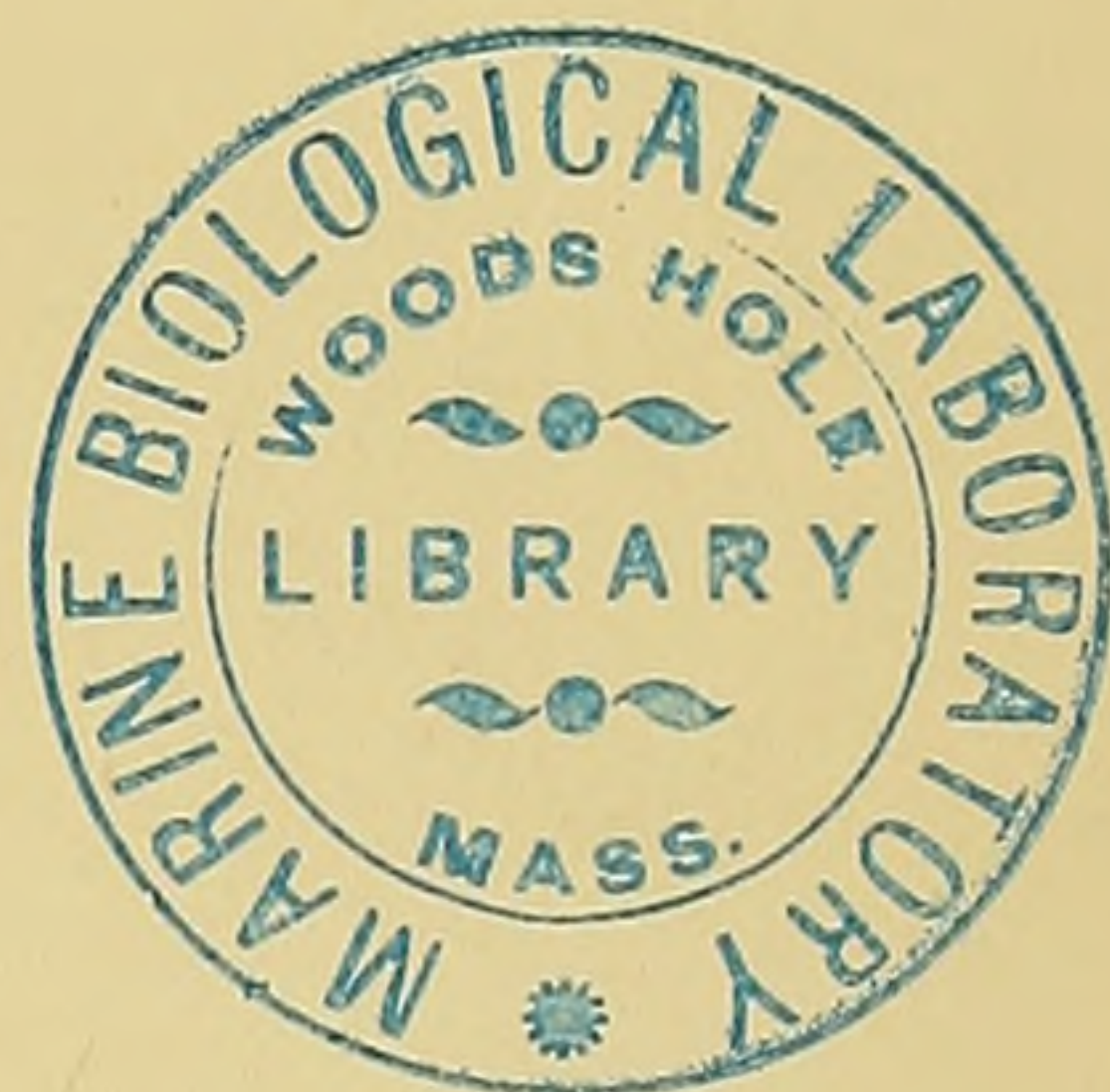
(COMMUNICATED BY PROF. J. STANLEY GARDINER, M.A., F.R.S., F.L.S.)

Read 19th June, 1913.

THE pelagic Decapod Crustaceans obtained by Mr J. Stanley Gardiner comprise only thirteen determinable species represented by adult or sub-adult individuals. Possibly if larger nets had been used the number would have been much greater; for such actively swimming animals as Decapods readily avoid capture, and even the net, 4 ft. square, employed by Mr Gardiner was not large enough to obtain them in any numbers.

The collection is, however, a very interesting one, more particularly when comparison is made between the species it contains and those found further to the north in the Arabian Sea and the Bay of Bengal. Special attention has been paid recently to the midwater fauna of these areas by the Royal Indian Marine Survey Ship "Investigator" and a large collection of pelagic Decapoda has been obtained. It is noteworthy that only four of the thirteen species found by Mr Gardiner are common to the two collections. As specific instances of this difference it may be mentioned that *Acanthephyra sanguinea*, Alcock, the common species of the genus in the Arabian Sea and Bay of Bengal is replaced in the present collection by the allied *A. purpurea*, A. M. Edw., and *Lucifer aestra*, Dana, obtained by Mr Gardiner in great quantities, appears to be of the rarest occurrence in Indian seas; the Sergestidæ also of the two areas are wholly different. *Gennadas parvus*, Bate, seems to be rare in the more northerly situations, and *G. scutatus*, Bouvier, found in its typical form in the area surveyed by Mr Gardiner, is represented nearer the coasts of India by a distinct race for which the name *indicus* is proposed.

I have to thank Mr Gardiner not only for entrusting me with this interesting collection, but also for the patient manner in which he has waited for the completion of my report, long delayed through pressure of other work.



Tribe PENEIDEA.

Family **Sergestidæ**.

SERGESTES, Milne Edwards.

1. *Sergestes challengeri*, Hansen (Plate 7, fig. 1).

Sergestes challengeri, Hansen, Proc. Zool. Soc. London, 1903, pp. 61 and 72, pl. xi, figs. 2, *a—n*; Kemp, Proc. Zool. Soc. London, 1910, p. 641, pl. liii, figs. 2—4, pl. liv, figs. 2—5.

Sept. 27, 1905. S. by E. of Farquhar; $10^{\circ} 27' S.$, $51^{\circ} 17' E.$ p. 800 to 0 fms.; one male, 23 mm. q. 1000 to 0 fms.; one young, 18 mm. and fragments of a larger female.

Oct. 16, 1905. 6 miles N.N.W. of Desroches Atoll. nn. 200 to 0 fms. one female, 29 mm.

This species is of particular interest in that it possesses a great number of luminous organs. Hitherto it was known only from a single mutilated example obtained by the "Challenger" expedition and described in detail by Hansen. The additional examples have enabled me to supplement Hansen's account of the structure of the photophores and the results of this investigation have formed the subject of a separate paper*.

The specimens are unfortunately not in good condition, but their agreement with Hansen's account is so close as to leave no doubt of their specific identity with the "Challenger" example found in the neighbourhood of the Fiji Islands. The only points in which they differ from his description are that the rostrum (fig. 1) is directed forwards and upwards, rather more horizontally than in Hansen's figure and with a much more acute apex; the hepatic spine of the carapace seems better defined and the penultimate segment of the second maxillipede is distinctly longer than the antepenultimate. In the last feature they resemble the closely allied species *S. gloriosus*, Stebbing, a form which is also provided with photophores. In the broad apex of the antennal scale, in the development of the branchiæ and in all other details noted by Hansen there is complete agreement.

The eyes, which were missing in the type specimen, extend a trifle beyond the middle of the basal segment of the antennular peduncle and are a little shorter than the antennal peduncle. In dorsal view the cornea occupies very nearly half the length of the whole organ; it is scarcely at all depressed and, seen laterally, its greatest length is about equal to its height.

I have been able, though not without considerable difficulty, to observe the photophores in all the positions noted by Hansen and, in addition, have also found the following, including those of the eyes and last two pairs of peræopods which were missing in the type:

Eye: on the under surface of the stalk, one close to the cornea and one at the proximal end.

Fourth peræopod; two on the ischium, one at the proximal and one at the distal end, and one situated distally on both merus and carpus, the latter very minute.

Fifth peræopod: same disposition as in the preceding, but the proximal photophore on the ischium is missing.

* Kemp, Proc. Zool. Soc. London, 1910, p. 639.

Fourth and fifth abdominal somites : one additional photophore on each in the mid-ventral line.

Sixth abdominal somite : an additional organ on each side of the infero-lateral margin in the anterior quarter.

These twenty-two additional organs bring the total number known in the species up to 139, and more will doubtless be found on the third maxillipedes and on the second and third legs which have been wanting in all examples which have been examined. A schematic view of the ventral surface of the cephalothorax and abdomen, showing the disposition of the photophores, will be found in the accompanying text-figure*.

Mr Gardiner informs me that on each occasion when this species was taken he noted the presence of phosphorescent prawns in the townet. This observation is of importance, being, so far as I am aware, the only occasion on which light has been seen to issue from a compound luminous organ or photophore in a Decapod crustacean.

The closely allied *Sergestes gloriosus*, described by Stebbing from the S. African coast, may be distinguished from the present species by the much narrower apex of the antennal scale. It also possesses a far greater number of photophores ; but, seeing that the example described measures 50 mm., whereas the largest known individual of *S. challengerii* is only 29 mm. in length, this character may not prove reliable, for it is by no means improbable that the number of these organs increases with age. In this connection it may be mentioned that in the male specimen of *S. challengerii*, 23 mm. in length, the petasma is rudimentary.

In Stebbing's figure of the ventral surface of the eye only one photophore is shown, the proximal one, which is very distinct in the present species, being omitted.

2. *Sergestes gardineri*, sp. nov. (Plate 7, figs. 2—5).

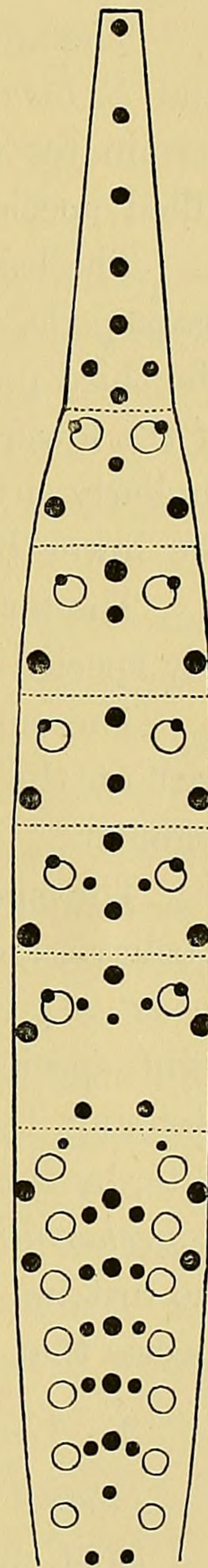
Sept. 27, 1905. S. by E. of Farquhar ; $10^{\circ} 27' S.$, $51^{\circ} 17' E.$ p. 800 to 0 fms. ; two young, badly damaged. q. 1000 to 0 fms. ; three males, three females, 15—24 mm. s. 750 to 500 fms. ; one female, 20 mm.

Oct. 6, 1905. Between Providence and Alphonse Ids. ; $8^{\circ} 16' S.$, $51^{\circ} 26' E.$ aa. 900 to 0 fms. ; one male, 17 mm.

Oct. 16, 1905. Five miles off Desroches Atoll. ll. 750 to 0 fms. ; one male, 21 mm.

The rostrum is high and projects obliquely upwards and forwards (fig. 2). The apex is slender and acutely pointed and extends well beyond the front. There is a prominent tooth in the middle of the dorsal edge. The antero-inferior margin is concave, as is also the dorsal margin between the tooth and the apex.

On the carapace there is no post-ocular spine and the hepatic is represented merely



* The black spots represent photophores and the circles the points of origin of the thoracic and abdominal appendages. The divisions between the somites are shown by dotted lines.

by a bluntly rounded lobe which, however, is conspicuous in dorsal view (fig. 3). The gastro-hepatic groove is well marked laterally, but is feebly developed in the mid-dorsal line. The cervical groove is distinct throughout.

The cornea of the eye is large, scarcely depressed, and is noticeably wider than the stalk. Seen from above it is broader than long and its length is a trifle less than that of the stalk. At the distal end of the stalk, on its inner and superior aspect, there is a small round lobe, similar to that found in *S. kroyeri*, Bate, but shorter and less cylindrical.

The basal segment of the antennular peduncle is about as long as the two following taken together. The second and third segments are stout, the latter slightly longer than the former. The breadth of the second is contained about two and a half times in the length of its internal margin; the third is scarcely three times longer than broad.

The antennal scale is not very broad at the apex (decidedly less so than in *S. robustus* and *S. bisulcatus*); the lamellar part slopes directly away from the stout spine which terminates the outer margin and does not project beyond its base as in several of the allied species.

The basal segments of the third maxillipedes are not stouter than those of the third paræopods, and the two distal segments bear bristles on both margins. Above the base of the third paræopods are two well-formed pleurobranchs, the upper nearly half the length of the lower. The upper branchia above the fourth pair of legs is a little longer than the similarly situated branchia on the preceding segment; it is about two-thirds the length of the lower branchia.

The form of the petasma, shown in fig. 4, differs considerably in detail from that of any species of the same group of which figures are extant.

The outer uropod (fig. 5) is four times as long as broad; the length of the ciliated part at the distal end of its outer margin is exactly one-third of the total length of the segment.

The specimens are not in very good condition, but the characters given above are, I believe, amply sufficient for the recognition of the species. *S. gardineri* belongs to the *robustus* group of the genus *Sergestes*, which in Hansen's amended account* comprises eight species. It is readily separated from *S. challengerii*, Hansen, and *S. gloriosus*, Stebbing, by the absence of photophores and from *S. japonicus*, Bate, and *S. profundus*, Bate, by the large size of the eyes. From *S. robustus*, Smith, *S. bisulcatus*, Wood-Mason, *S. prehensilis*, Bate, and *S. kroyeri*, Bate, it is distinguished by details in the structure of the rostrum, eye, antennal scale and outer uropod. It is, apparently, in the last of these species that it finds its nearest ally.

3. ?*Sergestes edwardsi*, Kroyer.

Sergestes edwardsi, Hansen, Proc. Zool. Soc. London, 1896, p. 961.

Sept. 27, 1905. S. by E. of Farquhar, 10° 27' S., 51° 17' E. r. 500—250 fms.; one male, ca. 18 mm.

June 30, 1905. 7 miles N.W. of Yëyë, Peros Atoll. N. 400—0 fms.; one male, one female, ca. 13 mm.

* Hansen, Proc. Zool. Soc. London, 1896, p. 949, amended in Proc. Zool. Soc. 1903, p. 71.

Three specimens, in which the outer uropod is externally ciliated throughout its length, appear to belong to this widely distributed species.

I have devoted considerable time to the remainder of the *Sergestes* in the collection, but have been unable to satisfy myself of their identity. The specimens are not numerous, and are, for the most part, in poor condition. Some appear to belong to the group comprising *S. habia*, Faxon, and *S. incertus*, Hansen, while one male, 38 mm. in length, seems to represent a new species allied to the Atlantic *S. henseni*, Ortmann. This specimen is of considerable interest, but its damaged condition precludes a complete statement of its specific characters. It agrees with *S. henseni* in the possession of two pleurobranchs at the base of the third peræopods, but differs in the absence of a supra-orbital spine and in the armature and larger number of subsegments (apparently seven) in the terminal segment of the third maxillipedes.

LUCIFER, Vaughan Thomson.

The members of this genus are very imperfectly known and, owing to the incomplete accounts which most of the earlier authors have given, the synonymy of the various species is very difficult to trace.

Vaughan Thompson*, when first describing the genus, omitted to give a specific name to the form which he examined; the figure probably represents *L. ancestra* of Dana (= *L. reynaudii* of most recent authors) but of this there is no certainty.

I agree with Faxon† that Milne Edwards'‡ figure of *L. reynaudii* and his descriptions of that species and of *L. typus* are quite insufficient for exact identification; the account given by Eydoux and Souleyet§, who regard these two forms as sexes of a single species, is equally unsatisfying and it is only with the publication of Dana's work in 1852|| that a sound basis for the classification of the species is reached. Dana's treatment is fortunately very good and surpasses that of nearly all subsequent writers; the identification of all the forms which he has described should not be a matter of any considerable difficulty.

The use of the nomenclature which Dana proposed has, however, one serious drawback: the name *L. reynaudii* must be employed in a different sense from that adopted by most recent writers. The species which he recognised as that originally described under this name by Milne Edwards—a species which must henceforth bear the name *L. reynaudii*, M. Edw. (Dana)—is unquestionably distinct from the long-eyed form to which most authors have assigned the name. The latter form, as Faxon has pointed out, is *L. ancestra*, Dana.

Dana did not refer any of the species he examined to *L. typus*, M. Edw.; his *L. pacificus*, according to Ortmann¶, is to be regarded as a synonym of that form, but no

* Vaughan Thompson, Zoological Researches, Cork, 1829?, Mem. iii, p. 58, pl. 7, fig. 2.

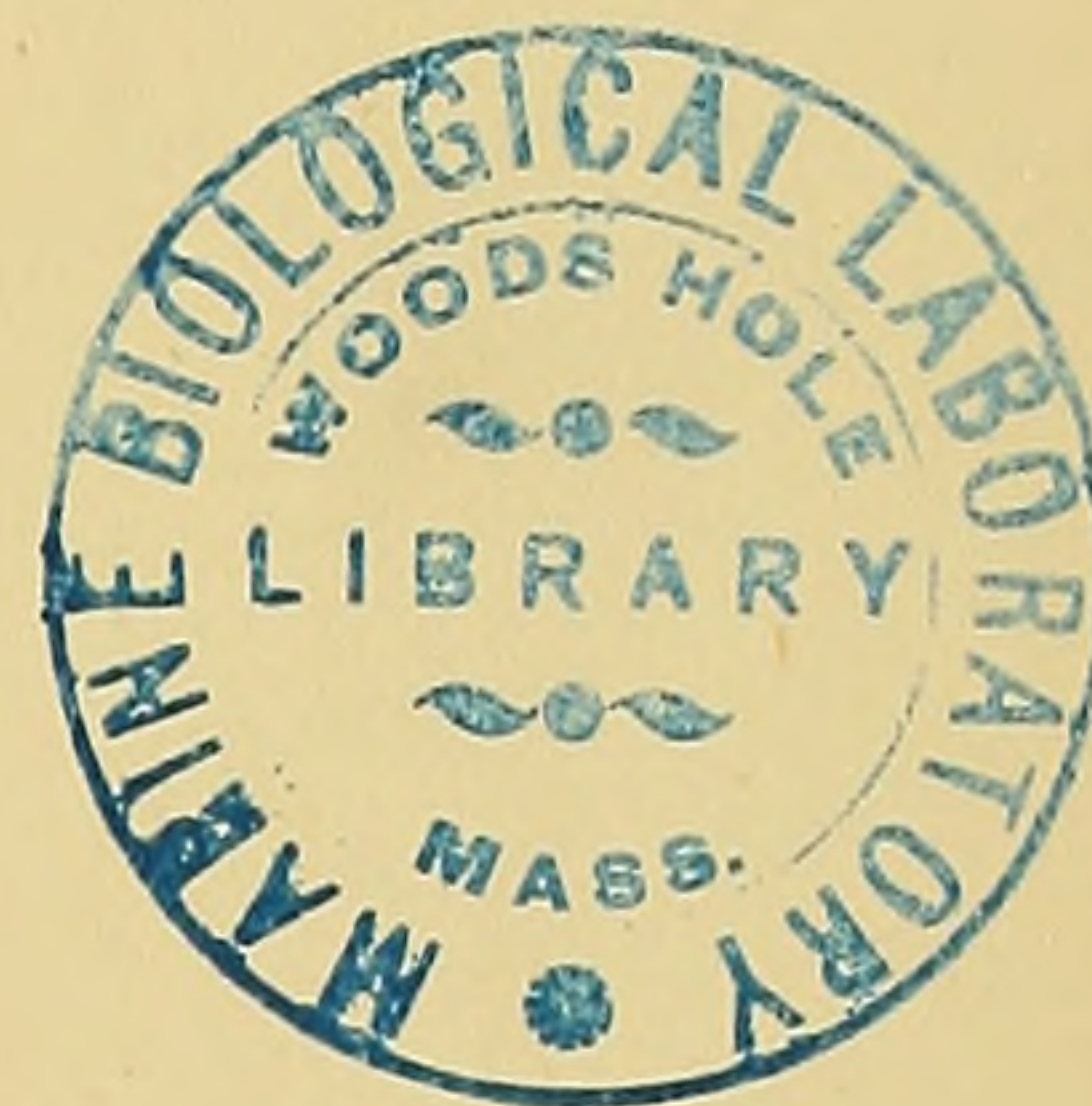
† Faxon, Mem. Mus. Comp. Zool. Harvard, xviii. 1895, p. 214.

‡ H. Milne Edwards, Hist. Nat. Crust. ii. 1837, p. 469, pl. 26, fig. 10.

§ Eydoux and Souleyet, Voy. de la "Bonite," Zool. i. 1841, p. 249.

|| Dana, U.S. Explor. Exped. Crust. i. 1852, p. 668.

¶ Ortmann, Zool. Jahrb. Syst. v. 1890, p. 454.



reasons for this course are given, and in view of the imperfection of Milne Edwards' account its adoption cannot be recommended. *L. pacificus*, Dana, is without doubt distinct from the species to which most authors have applied the name *typus*.

In Mr Gardiner's collection there are two species of *Lucifer*. One, which was found in great abundance, is *L. ancestra*, Dana (= *L. reynaudii*, auct.), while the second, of which only three specimens were obtained, is, I believe, Dana's *L. reynaudii*, a species distinct from the form common on the Indian coast, *i.e.* the *L. typus* of most authorities.

4. *Lucifer ancestra*, Dana.

Lucifer ancestra, Dana, U.S. Explor. Exped., Crust., i, 1852, p. 671, pl. 44, fig. 9, and Faxon, Mem. Mus. Comp. Zool. Harvard, xviii, 1895, p. 214 (synonymy).

May 16, 1905. N. of Chagos Archipelago; 3° 31' S., 72° 27' E. **A.** 25 to 0 fms.; two. 50 to 0 fms.; five.

May 17—18, 1905. N. of Chagos Archipelago; 4° 16' S., 71° 53' E. **B.** 25 to 0 fms.; one. **C.** 1200 to 0 fms.; four. **H.** surface; six.

June 30, 1905. 7 miles N.W. of Yëyë, Peros Atoll. **M.** 25 to 0 fms.; twelve. 75 to 0 fms.; one. **N.** 600 to 0 fms.; seven.

June 30, 1905. 1—2 miles N.W. of passage into Salomon Atoll. **O.** 180 to 0 fms.; one.

July 4—5, 1905. Off passage into Salomon Atoll. **Q.** surface; twenty-nine.

Aug. 22, 1905. 5 miles W. of Black River, Mauritius. **a.** 25 to 0 fms.; twenty.

Sept. 4, 1905. S. of Saya de Malha Bank. **m.** 50 to 0 fms.; three.

Sept. 7, 1905. Between Saya de Malha Banks; forty.

Sept. 9, 1905. N. of N. Saya de Malha Bank. **n.** surface; eleven.

Sept. 27, 1905. S. by E. of Farquhar, 10° 27' S., 51° 17' E. **p.** 200 to 0 fms.; nine. 300 to 0 fms.; thirteen. 400 to 0 fms.; twenty-four. 500 to 0 fms.; eight. 600 to 0 fms.; seven. 800 to 0 fms.; seven. **q.** 1000 to 0 fms.; many. **s.** 250 to 0 fms.; very many.

Oct. 1—2, 1905. N. of N. Farquhar. **w.** surface; two.

Oct. 2—3, 1905. Providence, off Cerf. **x.** surface; nine.

Oct. 6, 1905. Between Providence and Alphonse, 8° 16' S., 51° 26' E. **aa.** 900 to 0 fms.; twenty-five. **bb.** 140 to 0 fms.; nineteen.

Oct. 7, 1905. S. of Alphonse. **dd.** surface; eleven.

Oct. 16, 1905. 3 miles N.W. of entrance into Desroches Atoll. **kk.** 50 to 0 fms.; four.

Oct. 16, 1905. 6 miles N.N.W. of entrance into Desroches Atoll. **nn.** 200 to 0 fms.; five.

5. *Lucifer reynaudii*, H. Milne Edwards (Dana).

Lucifer reynaudii, Dana, U.S. Explor. Exped., Crust., i, 1852, p. 672, pl. 45, figs. 1 a—d.

June 30, 1905. 7 miles N.W. of Yëyë, Peros Atoll. **M.** 25 fms.; one male.

July 5, 1905. Off passage into Salomon Atoll. **Q.** surface; one female.

Oct. 7, 1905. S. of Alphonse Island. **dd.** surface; one male.

The principal characters of the two male specimens are as follows:—

In the cephalothorax the neck is about one-quarter longer than the thorax. At the junction of the two there is a prominent outstanding spine on either side, and at the extreme anterior end there are five spines, one representing the rostrum, one behind each eye, and one at each antero-lateral angle.

The eyes are club-shaped and, apparently, of somewhat variable size. In the two specimens their length is contained respectively four and three-quarter and five and a half times in the length of the cephalothorax. They are a little shorter than the basal antennular segment.

The second segment of the antennular peduncle is about one and a half times the length of the third; the antennal scale reaches to the middle of the former segment. The last pair of peræopods reaches to, or slightly beyond, the anterior extremity of the cephalothorax.

On the first abdominal somite there is a pair of stout outstanding spines situated subdorsally close to the cephalothorax, and there is a similar but more slender spine on either side of the first five somites at the base of the pleopods. All these spines are conspicuous in dorsal view. The sixth somite is a little shorter than the two preceding taken together. It terminates dorsally in a sharp spine, and on its inferior margin bears two large teeth, the first of which, situated in the middle of the ventral margin, is smaller and more sharply pointed than the posterior. Behind the latter tooth there is a pair of small and very sharp spinules.

The telson reaches to about half the length of the outer uropod and is provided with a prominent rounded lobe on its inferior aspect, a little behind the middle point. The telson bears two pairs of dorsal spinules, the anterior being situated immediately above the proximal edge of the ventral lobe. The apex is slightly concave, with a long spine at each outer angle and two shorter pairs between them, the median pair being the shortest. There are minute prickles on the inner side of the outer spines and on both sides of the two inner pairs.

The inner uropod reaches to a point midway between the apices of the outer uropod and telson. The outer uropod is a little more than five times as long as broad, and the spine which terminates the outer margin reaches well beyond the apex of the lamella.

The specimens measure about 8.5 and 9 mm. respectively from the tip of the eye to the apex of the outer uropod.

The single female is of considerably larger size, measuring 12 mm., and differs in several details from the male. The eyes are decidedly smaller, their length being contained six times in the length of the cephalothorax. The sixth abdominal somite is unarmed below, except for a pair of fine spinules in the same position as those found in the male. The distal armature of the telson exactly resembles that of the male; the outer uropod has the same proportions, but the spine on the external margin does not surpass the apex of the lamella.

The specimens differ from Dana's description of individuals from the Sooloo Sea in having the cephalothorax proportionately shorter; the peræopods, moreover, are

considerably longer than is indicated in his figure. I believe, none the less, that the specimens may safely be referred to the same species: the presence of the spinules on the inferior margin of the last abdominal somite in the male appears to constitute a valid specific criterion.

Lucifer typus, auct., as typified by a number of specimens from the Ceylon coast, is very closely allied to this species; but males may easily be distinguished from it by the invariable absence of the pair of spinules behind the posterior tooth on the ventral edge of the last abdominal somite. Both sexes differ from Dana's *L. reynaudii* in the proportions of the outer uropod. These segments are broader in *L. typus*, not more than four and a quarter times as long as wide, and the spine which terminates the outer margin does not reach so far backwards.

Family Peneidæ.

GENNADAS, Spence Bate.

Considerable difficulties are encountered in the determination of the species of *Gennadas*, and this seems more especially to be the case with the several closely allied forms occurring in the Indian Ocean, the Bay of Bengal and the Arabian Sea. The species found in these waters are, for the most part, very closely allied, and the sexual characters are almost the only features of diagnostic value. These characters are, indeed, well defined, and their use renders the recognition of any species which has been adequately figured a comparatively simple matter: the difficulty lies in recognising the two sexes of a single species. *Gennadas parvus*, Bate, and *G. sordidus*, Kemp, afford an instance of this. Both species have been described from the male sex only, and though the petasmata yield distinctions of a quite obvious nature, in other respects the characters of the two are so closely similar that very little reliance can be placed upon them for specific determination. In examining Mr Stanley Gardiner's collection several females were found which must certainly be referred to one of these two species, while others which must also be identified with one of the two forms, but have a different type of thelycum, are included in a fine collection of *Gennadas* recently made in Indian waters by the R.I.M.S.S. "Investigator." On consideration, I have decided that Mr Gardiner's specimens represent the female of *G. parvus*, while those obtained by the "Investigator" are females of *G. sordidus*. In making these determinations I have, however, been largely influenced by the fact that males of *G. parvus*, which are very scarce in the "Investigator" material, are found to the exclusion of male examples of *G. sordidus* in Mr Gardiner's collection. The conclusions, therefore, are not based on evidence of a really satisfactory nature and, should further investigations reveal the existence of a third form of male exhibiting the same affinities in general structure that exist between *G. parvus* and *G. sordidus*, the matter will be still further complicated.

6. *Gennadas parvus*, Spence Bate (Plate 7, figs. 6, 7).

Gennadas parvus, Kemp, Proc. Zool. Soc., 1909, p. 721, pl. 83, figs. 1-6, pl. 75, fig. 1.

Sept. 27, 1905. S. by E. of Farquhar, 10° 27' S., 51° 17' E. p. 800—0 fms.; one female. q. 1000 to 0 fms.; one male and four females. s. 750 to 500 fms.; two females.

Oct. 16, 1905. 4 miles N.W. of Desroches Atoll. ll. 750 to 0 fms.; one male.

The two male specimens agree closely with the description of the type published in 1909. The mid-dorsal carina of the carapace is, however, continued as far as the posterior margin, and the distance between the gastro-hepatic and cervical grooves*, though somewhat variable, seems always to be less than one-quarter the distance from the latter groove to the posterior edge. The description of the type specimen, which was badly damaged, is probably unreliable in these respects.

Considerable variation exists in the form of the mandibular palp, and this is noteworthy owing to the importance which Bouvier has assigned it as a specific determinant. In the type the ultimate segment is longer than the greatest width of the basal segment; but in the two males in the present collection the proportions are different. In one the last segment is in length about equal to the width of the basal segment, while in the other it is even shorter.

The third segment of the endopod of the first maxillipedes is, in these specimens, only one and a half times the length of the second. In the first pair of paræopods, which was missing in the type, the carpus is a little more than two-thirds the length of the merus, and is about as long as the chela.

The petasmata of the two specimens are as nearly as possible in exact agreement with that of the "Challenger" example (*loc. cit.*, pl. lxxv, fig. 1). The distal lobes are, as usual, bent inwards and outwards in a very curious manner and, when seen from below, present the appearance shown in fig. 6.

Six females, four of which were taken in the same net as one of the males already mentioned, are also referred to this species, the female of which was previously unknown. The evidence for this determination is, as I have outlined above, somewhat inconclusive.

The form of the thelycum is illustrated in fig. 7. It bears a very close resemblance to that of *G. tinayrei*, Bouvier, a species which in this respect exhibits a rather unusual amount of variation and has hitherto been found only in the Atlantic. In the present examples, however, the design is very constant and differs from that of *G. tinayrei* in the presence of an additional pair of tubercles between the legs of the third and fourth pairs.

7. *Gennadas scutatus*, Bouvier.

Gennadas scutatus, Bouvier, Rés. Camp. Sci. Monaco, xxxiii. 1908, p. 42, pl. 8.

Oct. 16, 1905. Near Desroches Atoll. mm. 400 to 0 fms.; one male, one female.

The specimens differ from Bouvier's description in a few unimportant details. The endopod of the second maxilla bears from two to four curved spines on its dorsal aspect near the apex. The third segment of the endopod of the first maxillipede is broadly oval in the male specimen, while in the female it is narrow, as shown in Bouvier's figure. The widest part of the merus of the second maxillipede is, in one specimen, situated much closer to the distal end of the segment than is indicated by Bouvier. The apex of the

* In previous papers I have called these grooves the cervical and post-cervical respectively; the terminology here employed seems preferable.

telson, which is only extant in the male example, is slightly convex and is furnished with four pairs of plumose setæ.

The petasma is quite typical and resembles that of the Atlantic specimen figured by Bouvier* rather more closely than that of the "Challenger" specimen† from the N. Pacific, and is noticeably different from that of the individuals recorded from the Indian Ocean, S. of Cape Comorin. Several additional examples bearing the closest resemblance to those from Cape Comorin have recently been obtained by the "Investigator." The differences which are noted in Rec. Ind. Mus., 1910, p. 178, pl. xiii, fig. 10, are in my opinion sufficiently constant and well marked to entitle the form to subspecific rank. It may be known as *G. scutatus*, subsp. *indicus*.

The thelycum of the female specimen collected by Mr Gardiner has the curious form figured by Bouvier and, except that there is a small median notch in the distal or anterior margin of the long plate lying between the last three pairs of legs, agrees exactly with his account. The triangular biperforate plate between the legs of the third pair is clearly seen.

The examples are unfortunately in very bad condition, and in both the third maxillipedes and all five peræopods are wanting. When complete neither specimen appears to have exceeded 20 mm. in length.

8. *Gennadas alcocki*, Kemp (Plate 7, fig. 8).

Gennadas alcocki, Kemp, Rec. Ind. Mus., 1910, v. p. 174, pl. 13, figs. 5—8.

Sept. 27, 1905. S. by E. of Farquhar; 10° 27' S., 51° 17' E. p. 800 to 0 fms.; one female, 24 mm.

Oct. 16, 1905. 4 miles N.W. of Desroches Atoll. ll. 750 to 0 fms.; one female, 26 mm.

The basal segment of the endopod of the first maxillipede is, in one specimen, provided with only two spines on the inner margin, whereas in the type five are found in this situation. Bouvier, in his exhaustive memoir on the Atlantic species of this genus, defines the proportions and spinulation of the oral appendages at considerable length; but my own experience leads me to believe that these details are very variable and of little taxonomic value.

In the two examples of *G. alcocki* contained in the present collection the thelycum is closely similar in pattern to that of the type, but in both specimens the plate lying between the legs of the third pair is shaped even more clearly in the form of a **W** than in the original example (see fig. 8).

9. *Gennadas* sp.? (Plate 7, fig. 9).

Oct. 16, 1905. 4 miles N.W. of Desroches Atoll. ll. 750 to 0 fms.; one female, ca. 24 mm.

The rostral crest is of the usual form, and is continued backwards as a carina which extends to the posterior margin of the carapace. Both antennary and infra-antennary

* Bouvier, Bull. Mus. Océanog. Monaco, 1906, No. 80, text-fig. 13, p. 11.

† Kemp, Proc. Zool. Soc. 1909, Pl. 75, fig. 2.

angles are sharply acute, and in dorsal view a small but distinct branchiostegal spine is visible. The distance between the gastro-hepatic and cervical grooves, measured dorsally, is about one-quarter the distance from the latter groove to the posterior margin of the carapace.

The antennal scale appears to have been very strongly narrowed distally: its tips are broken. The second segment of the antennular peduncle is long; seen in lateral view its dorsal measurement is more than three-quarters that of the ultimate segment.

The second segment of the mandibular palp is, in length, just equal to the greatest width of the basal segment. The internal lobes of the second maxilla are widely separated from one another, but the anterior lobe of the internal lacinia is not wider at the apex than at the base as in *Gennadas præcox* and *G. calmani*. The posterior lobe of the external lacinia is about one and a half times as wide as the adjacent lobe of the internal lacinia. At its base the slender apex of the endopod bears on its external aspect two curved spines. The basal segment of the endopod of the first maxillipede is furnished with three spines; the third segment is about one and a quarter times the length of the second.

In the first pair of peræopods the carpus is about equal in length to the chela and the dactylus is shorter than the palm. In the second pair the chela is a trifle shorter than the carpus and is a little more than two-thirds the length of the merus. The last three pairs of legs are missing and the tip of the telson is broken off.

The thelycum is an elaborate structure quite unlike any which have hitherto been observed. Fig. 9 will convey a better idea of its appearance than a long description. The large cordiform plate between the legs of the last pair is free and unattached to the sternum in its anterior third.

The female on which the above description is based represents, I believe, a species hitherto undescribed. If I am right in my supposition that the undescribed females in Mr Gardiner's and in the "Investigator" collections belong respectively to *Gennadas parvus* and to *G. sordidus*, the only species known from the Indian Ocean of which the female remains unrecognised is *G. præcox*, and it seems clear from the very different shape of the lobes of the second maxilla that the present specimen cannot be assigned to that form. From male *Gennadas parvus* and *G. sordidus* it may be distinguished by the comparatively greater length of the second segment of the antennular peduncle.

Two female specimens from the vicinity of Farquhar Island, 1000 to 0 fms., seem to belong to the same species as that described above; but they are very badly mutilated.

Tribe CARIDEA.

Family Hoplophoridae.

HOPLOPHORUS, H. Milne Edwards.

10. *Hoplophorus gracilirostris*, A. Milne Edwards.

Hoplophorus gracilirostris, A. Milne Edwards (*Oplophorus*), Ann. Sci. Nat. Zool. (Sér. 6), xi. 1881, art. 4, p. 6 and Recueil figs. Crust. nouv. ou peu connus, 1883, pl. 29; Alcock, Desc. Cat. Indian deep-sea Crust. Macrura and Anomala, 1901, p. 73.

Oct. 16, 1905. 3 miles N.W. of Desroches Atoll. **kk.** 250 to 0 fms.; one young, 27 mm.

I am unable to find any valid distinction between this small specimen and larger examples of *H. gracilirostris* determined by Alcock. The rostrum is of great length, one and a half times that of the carapace, and the spine on the third abdominal somite is of enormous size, reaching as far as the posterior edge of the fifth somite and completely overshadowing that of the fourth somite which has the same proportions as in the adult. These characters, in my opinion, are correlated with post-larval growth and do not afford specific distinctions.

The rostrum bears ten small teeth above and eight below, and there are twelve spinules on the outer margin of the antennal scale. The carinæ of the carapace and the spines on its antero-lateral and postero-lateral edges are closely similar to those of adult examples.

11. *Hoplophorus foliaceus*, Rathbun.

Hoplophorus foliaceus, Rathbun, Bull. U. S. Fish Commission for 1903 (1906), xxiii., pt. III., p. 922, text-figs. *a*, *b*,

Sept. 27, 1905. S. by E. of Farquhar; 10° 27' S., 51° 17' E. **p.** 500 to 0 fms.; one young, *ca.* 25 mm.

In this young example the apex of the rostrum is broken off. Except that the third paræopods are proportionately somewhat shorter it agrees exactly with Miss Rathbun's account. The long spines on either side of the finely crenulated apex of the telson appear a little shorter than in Miss Rathbun's figure.

The spine on the *second* abdominal segment—a feature which at once distinguishes this species from all other members of the genus—is very strongly developed; its apex reaches beyond the middle of the fourth somite. The spine on the third somite reaches the posterior margin of the fourth, while that on the latter somite is about half its length. The branchiostegal spine is prominent, but does not form the termination of a carina as in *H. gracilirostris*, and the lateral carinæ of the rostrum posteriorly curve downwards behind the orbit and are not continued backwards on either side of the median crest as in that species. The two posterior rostral teeth are situated on the carapace behind the longitude of the orbital notch.

Hoplophorus foliaceus was described by Miss Rathbun from specimens obtained in 337 and 442 fathoms in the vicinity of the Hawaiian Islands.

ACANTHEPHYRA, A. Milne Edwards.

12. *Acanthephyra purpurea*, A. Milne Edwards.

Acanthephyra purpurea, Kemp, Fisheries, Ireland, Sci. Invest. for 1905, p. 4 (synonymy) and Coutière, Bull. Mus. Océanog. Monaco, no. 70, 1906, p. 12.

May 17, 1905. N. of Chagos Archipelago, 4° 16' S., 71° 53' E. **C.** 1200 to 0 fms.; one male, three females, 52—72 mm.

Sept. 27, 1905. S. by E. of Farquhar, 10° 27' S., 51° 17' E. **q.** 1000 to 0 fms.; one male, one female, 66 and 69 mm., and one damaged post-larval example.

Oct. 16, 1905. 4 miles N.W. of Desroches Atoll. ll. 750 to 0 fms.; two young, 22 and 36 mm.

Acanthephyra purpurea has not hitherto been recorded from the Indian Ocean. Judging from the fact that no specimens have been obtained by the "Investigator," it seems probable that it does not occur in the more northerly portions of this region, but is replaced in the Arabian Sea, the Bay of Bengal and the Andaman Sea by its near ally, *A. sanguinea*. From this species, as Alcock has pointed out, it is readily distinguished by the presence of a prominent branchiostegal spine which is buttressed by a short carina.

Little indication of the great variation which is known to exist in the species is shown in the six adult examples contained in the collection. The rostrum is in all cases longer than the carapace and its dorsal and ventral teeth are well spaced; the telson extends noticeably beyond the uropods and bears from four to five dorso-lateral spinules. In these features the specimens closely resemble the type (from the Atlantic) figured by A. Milne Edwards, and differ from the form found most commonly, though not invariably, in the N.E. Atlantic. Coutière (*loc. cit.*, p. 18) recognises the form with numerous spinules on the telson under the name, var. *multispina*, but considering the enormous range of variation which is known I am not of the opinion that such details merit recognition in the nomenclature.

The specimens in the collection exhibit the following rostral armature :

$$\frac{8}{5}, \frac{8}{5}, \frac{8}{6}, \frac{9}{6}, \frac{9}{6}, \frac{9}{6}, \frac{10}{6}, \frac{10}{6}.$$

The eyes are in most cases damaged. In examples in which they exist the cornea is of a dark reddish brown and is not jet-black as in all other examples that I have examined. Differences in eye-colour seem to afford useful taxonomic indications; in the present case the colour may have been altered by prolonged immersion in formalin, though such treatment does not appear to have had this effect in *Notostomus* and *Sergestes*.

NOTOSTOMUS, A. Milne Edwards.

In determining the solitary example of this genus contained in Mr Gardiner's collection I have had occasion to consider the known species as far as it is possible to do so from the published descriptions, and, with a view to affording some slight assistance to those who may subsequently be working at the genus, I have appended a partial synopsis of the twelve that have been described.

The knowledge acquired within recent years of the considerable post-larval changes that occur in an allied genus leads one to suppose that, with the acquisition of more abundant material, the present taxonomy of *Notostomus* must be subjected to revision. In species of *Acanthephyra* there is often a great range of variation in regard to the length of the rostrum and the dorsal armature of the abdominal somites, and, in the case of the former character, it has been shown that this variation is largely correlated with growth. In very young post-larval examples of *Acanthephyra purpurea* the rostrum is short; at a later stage, before the fully adult phase is attained, it has a comparatively great length, whereas in the adult it again becomes relatively short, but not so short as

in the early post-larval stages. That this extraordinary development also takes place in *Notostomus* admits of very little doubt. Smith has, indeed, remarked that in an example of *N. robustus*, 53 mm. in length, the rostrum is very much longer than in two other specimens measuring 135 and 150 mm. respectively. In the following synopsis the characters employed are drawn for the most part from the carination of the carapace; there is reason to believe that this feature does not alter during the course of late post-larval growth.

Partial synopsis of the species of *Notostomus**.

- I. The lateral carina of the rostrum terminates near the post-orbital carina but is not continuous with it.
- A. In the posterior half of the carapace the customary short carina immediately below the post-orbital is absent; there is no post-antennal carina *fragilis*, Faxon.
- B. A short carina is present in the posterior half of the carapace immediately below the post-orbital; a post-antennal carina is distinct, at least in the hepatic region.
1. The post-antennal carina is indistinct behind the ridge separating the branchial and hepatic regions *vescus*, Smith.
2. The post-antennal carina is sharp and distinct throughout almost the whole length of the carapace.
- a. The post-orbital carina curves downwards in its extreme anterior part, but behind this is practically straight.
- i. The dorsal ridge of the carapace, viewed laterally, is straight over a considerable part of its median portion *japonicus*, Bate.
- ii. The dorsal ridge of the carapace is very strongly arched in lateral view, *patentissimus*, Bate; *westergreni*, Faxon; *longirostris* †, Bate.
- b. The post-orbital carina curves downwards in its extreme anterior part, and behind this is descendant to the upper limit of the branchio-hepatic ridge and ascendant from this point to the posterior margin *robustus*, Smith.
- II. The lateral carina of the rostrum is continuous with the post-orbital.
- A. There is no carina in the posterior half of the carapace *immediately* below the post-orbital, *gibbosus*, A. M. Edw.; *elegans* †, A. M. Edw.; *murrayi* †, Bate.
- B. A short carina is present in the posterior half of the carapace *immediately* below the post-orbital, *perlatus*, Bate; *brevirostris*, Bate.

13. *Notostomus perlatus*, Spence Bate (Plate 7, fig. 10).

Notostomus perlatus, Spence Bate, Voy. H.M.S. "Challenger," xxiv., Crustacea Macrura, 1888, p. 831, pl. 124, fig. 2.

? *Notostomus brevirostris*, Spence Bate, *ibid.*, p. 832, pl. cxxxiv., fig. 4.

May 17, 1905. N. of Chagos Archipelago; 4° 16' S., 71° 53' E. 1200—0 fms.; one male, 138 mm.

* For descriptions of the species the following papers should be consulted:

A. Milne Edwards, Ann. Sci. Nat. Zool. (Sér. 6), xi. 1881, art. 4, p. 7 and Recueil, figs. Crust. nouv. ou peu connus, 1883, pls. 19, 40.

Smith, Ann. Rep. U.S. Fish Commission for 1882 (1884), p. 377 and *id.* for 1885 (1886), p. 72.

Bate, Voy. H.M.S. "Challenger," xxiv. Crust. Macrura, 1888, p. 824.

Faxon, Mem. Mus. Comp. Zool. Harvard, xviii. 1895, p. 170.

Notostomus corallinus, A. M. Edw., does not seem to be correctly referred to this genus.

† The position of this species is doubtful.

The rostrum is slender, slightly damaged at the extreme apex, and reaches to about two-thirds the length of the antennal scale. On the upper margin there are four small widely-spaced teeth, while a fifth, which appears to have existed near the apex, is broken off. On the lower margin there are six similar but larger teeth.

The carapace is very strongly arched dorsally and its greatest depth is more than half its extreme length including the rostrum. In the mid-dorsal line it is very sharply carinate and is furnished with a series of small spinules about 70 in number, which extend from the rostral base as far as the posterior margin. Laterally there are several prominent longitudinal carinæ, three of which extend throughout almost the whole length of the carapace. The uppermost of these, the post-orbital carina, commences very close to the posterior margin, defines the upper limit of the branchial region, and is continuous anteriorly with the carina on the side of the rostrum. Before reaching the base of the latter it gives off a small branch from its lower side which runs towards the back of the orbital notch, but disappears before reaching the margin. On comparison with other species, such as *N. armata*, Smith, it will be seen that this branch is the real anterior extremity of the post-orbital carina. Another short carina curves upwards and forwards from the margin of the orbital notch and fuses with the lateral keel of the rostrum. In the posterior half of the carapace, immediately below the orbital and parallel with it, there is a short carina and there are also two long carinæ near the inferior margin. The uppermost of the latter, the post-antennal carina, begins very near the posterior margin and terminates anteriorly, before reaching the margin, in a sharp outstanding spine which projects over the base of the antenna. This carina is connected with the orbital by a well-defined oblique ridge separating the branchial and hepatic regions. The other carina, the marginal, runs close to the inferior margin, fading away shortly before reaching the anterior end of the carapace; it is continuous behind with the fine keel that borders the posterior edge. On the anterior margin a sharply rounded lobe defines the inferior limit of the orbit and immediately below this lobe there is a short spine. The antero-inferior angles are broadly rounded. The surface of the carapace is finely corrugated, especially on its postero-lateral portions and on either side of the dorsal crest.

The eyes are well pigmented; the cornea is broader than the stalk and is set very obliquely on it. The small ocellus is distinct in dorsal view and is connected with the cornea. The antennal scale is about two and a half times as long as wide; its distal margin is convex and terminates in a spine which reaches a little beyond the narrow apex of the lamellar part. The upper (and outer) ramus of the antennular peduncle is greatly thickened at the base. This swollen portion comprises rather more than fifty joints and extends, in the single male examined, beyond the apex of the antennal scale by two-thirds the length of that organ.

In the second maxilla the two lobes of the distal lacinia project beyond the proximal lacinia, the whole appendage resembling that of *Acanthephyra purpurea*. The endopod of the first maxillipedes differs from that of *Hymendora*, and resembles *Acanthephyra* in being composed of three distinct segments. The third maxillipedes reach a little beyond the apex of the antennal scale, as do also the peræopods of the third and fourth pairs.

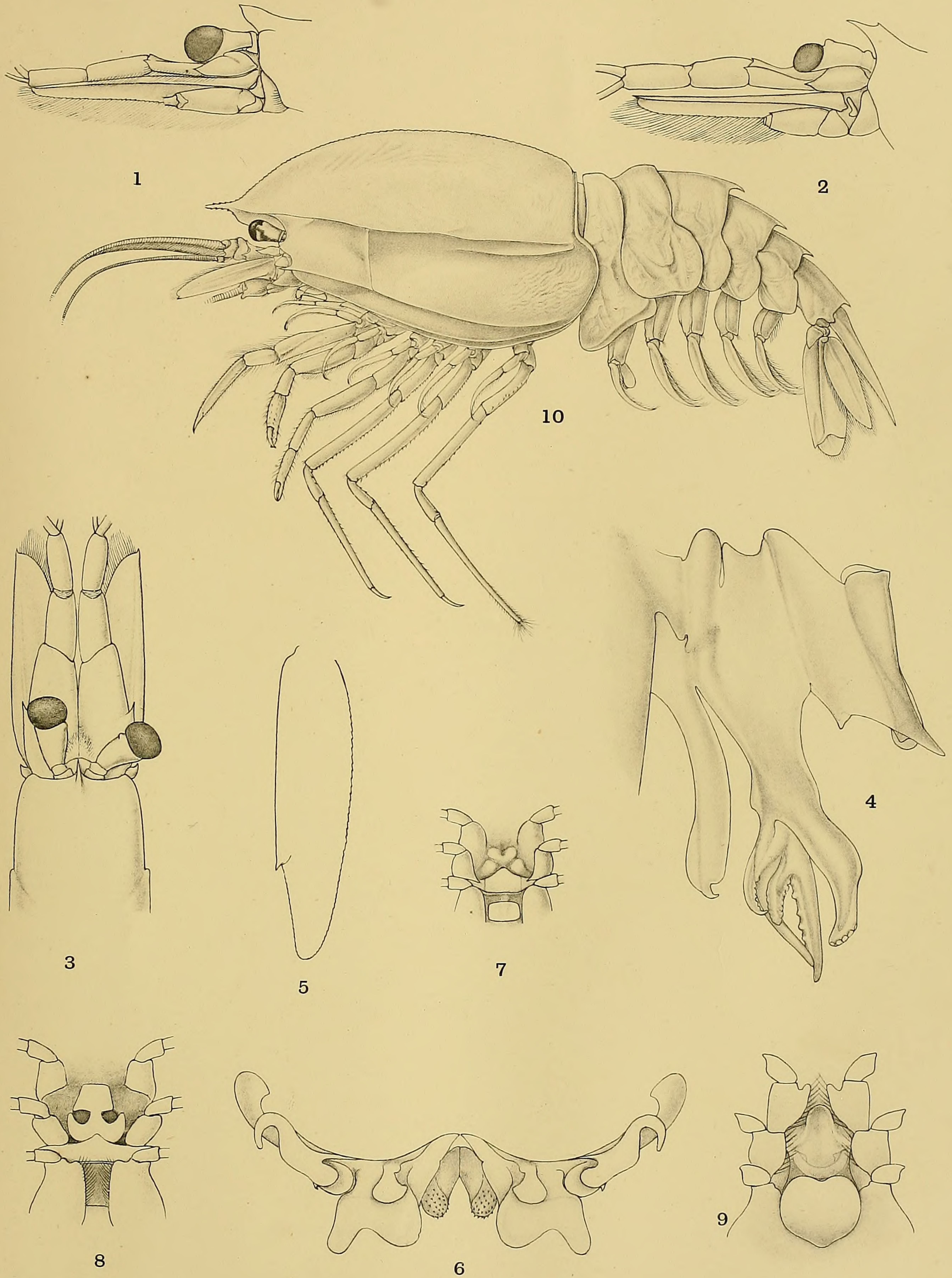
The fifth paræopods reach about to the apex of the scale; the dactylus is exceedingly small and is hidden in a dense tuft of setæ.

There are sharp carinæ on all the abdominal somites, those of the last four terminating in long spines. The telson is about twice the length of the sixth somite and extends beyond the apices of the inner uropods. Dorsally it bears two carinæ which are connected anteriorly and join again shortly before reaching the very narrow apex. There appear to have been two pairs of dorso-lateral spinules on the telson in its posterior third.

The identity of this specimen with that described by Spence Bate from 2150 fms. in the neighbourhood of Celebes is, I believe, certain. *N. brevirostris* from the Atlantic coast of S. America is synonymous with *N. perlatus* if it really differs from that form only in the trivial distinctions mentioned by Bate.

EXPLANATION OF PLATE 7.

- Fig. 1. *Sergestes challengeri*, Hansen, anterior part in lateral view.
 Fig. 2. *Sergestes gardineri*, sp. nov., anterior part in lateral view.
 Fig. 3. " " " anterior part in dorsal view.
 Fig. 4. " " " petasma.
 Fig. 5. " " " outer uropod.
 Fig. 6. *Gennadas parvus*, Bate, lobes of petasma seen from beneath.
 Fig. 7. " " " thelycum.
 Fig. 8. *Gennadas alcocki*, Kemp, thelycum.
 Fig. 9. *Gennadas* sp., thelycum.
 Fig. 10. *Notostomus perlatus*, Bate, lateral view.



S. Mondul. A. Chowdhary; del.

PELAGIC DECAPODA