

I. A PRELIMINARY NOTE ON SOME NEW  
SPECIES OF COPEPODA.

By CAPT. R. B. SEYMOUR SEWELL, B.A., I.M.S., *Surgeon-Naturalist to the Marine Survey of India and Assistant Superintendent, Zoological Survey of India.*

(With Plates IX—X.)

The following species of Copepoda, hitherto unknown to science, were obtained in two collections. The first of these is a large and extremely interesting collection made by members of the Zoological Survey of India during their survey of the Chilka Lake.<sup>1</sup> The Copepoda present an interesting mixture of freshwater and true marine forms. I give below a list of the various species that I have been able to identify from the Chilka collection :—

Family CALANIDAE.

- Genus *Paracalanus*, Boeck.  
*Paracalanus crassirostris* (Dahl).  
Genus *Acrocalanus*, Giesbrecht.  
*Acrocalanus similis*, Sewell.

Family CENTROPAGIDAE.

- Genus *Pseudodiaptomus*, Herrick.  
*Pseudodiaptomus lobipes*, Gurney.  
*Pseudodiaptomus hickmani*, Sewell.  
*Pseudodiaptomus binghami*, Sewell.  
*Pseudodiaptomus annandalei*, sp. nov.  
*Pseudodiaptomus tollingeri*, sp. nov.  
Genus *Diaptomus*, Westwood.  
*Diaptomus cinctus*, Gurney.

Family PONTELLIDAE.

- Genus *Labidocera*, Lubbock.  
*Labidocera pavo*, Giesbrecht.  
Genus *Acartia*, Dana.  
*Acartia centrura*, Giesbrecht.  
*Acartia spinicauda*, Giesbrecht.  
*Acartia southwelli*, Sewell.  
*Acartia chilkaensis*, sp. nov.

---

<sup>1</sup> See *Mem. Ind. Mus.*, Vol. V.

Genus *Acartiella*, Sewell.*Acartiella major*, sp. nov.*Acartiella minor*, sp. nov.

In addition there were present examples of *Cyclops*, *Eutерpe*, *Oithona*, and numerous Harpacticids and nauplii that I have up to the present been unable to identify.

The second collection is a smaller one made by Dr. Gravelly, Assistant Superintendent, Zoological Survey of India, in the backwater at Cochin, and contained another new species of the genus *Acartiella*, namely *A. gravellyi*, sp. nov.

It is particularly interesting to me to be able to record and describe three new species of the genus *Acartiella*; this genus was created by me (Sewell, 1914, p. 245) to accommodate two species from the Rangoon River estuary and the Gulf of Mannar respectively, and the occurrence of other species in such widely separate localities as Cochin and the Chilka Lake leads one to expect that the genus will prove to be represented throughout the brackish and estuarine waters of India.

## Family CENTROPAGIDAE.

Genus *Pseudodiaptomus*, Herrick.*Pseudodiaptomus tollingeri*, sp. nov.

(Plate X, fig. 8.)

Examples of both sexes were present in the Chilka Lake collection and in a collection from Port Canning in the Gangetic delta.

♀. Total length = 1.34 mm.

The proportional length of cephalo-thorax and abdomen—  
60 : 40 = 100.

The head and 1st thoracic segments are fused as are also thoracic segments 4 and 5. The anterior extremity presents a uniformly rounded forehead and the rostrum consists of two short stout spines.

The posterior thoracic margin is armed with a single spine situated towards the dorsal surface and ventro-laterally there is a rounded projection fringed with hair.

The abdomen consists of four segments, having with the furca the following proportional lengths:—

33 : 19 : 19 : 9 : 20 = 100.

The first three segments are each furnished with a row of spines along the dorsal part of the posterior margin, and in addition the 1st or genital segment bears a transverse row of needle-like spines across the ventral aspect anterior to the genital opening, and two transverse rows of fine spinules on the dorsal surface. The furcal rami are symmetrical and bear five setae, of

which the central or 3rd one is expanded proximally to form a spear-shaped base as in *P. binghami* ♀.

Mature females carry a pair of egg-sacs each containing 7 or 8 ova.

*The 1st antennae.*—When folded back the antenna reaches to the posterior end of the genital segment; it consists of 21 segments, having the following proportional lengths:—

Segments	1 :	2 :	3 :	4 :	5 :	6 :	7 :	8 :	9 :	10 :	11 :	12 :	13 :	14 :	15 :	16 :	17 :
	60 :	43 :	19 :	26 :	24 :	39 :	24 :	24 :	34 :	49 :	55 :	62 :	64 :	64 :	65 :	61 :	48 :
							18 :	19 :	20 :	21.							
							48 : 52 : 59 : 70 = 1000.										

*The 2nd antenna* has the form usual in this genus, but resembles that of *P. hickmani* in that it is armed with a row of fine spines on the terminal segment of the endopodite.

*The maxilliped* consists of the usual two basal segments and a terminal portion of five segments.

Basal 1 is provided with a stout spine-like seta at its distal end. Basal 2 bears 3 setae on its margin and is armed with a palisade of needle-like spines.

*The 1st pair of legs* have the usual structure, both exopod and endopod being composed of three segments.

Basal 1 is armed with a row of spines on its external margin about the middle of its length; exopod 1 bears a spine which projects as far as or a little beyond the distal end of the segment; exopod 2 is unarmed; exopod 3 bears two needle-like marginal spines and a delicate end-spine which is not quite as long as exopod 2 and 3 together.

The endopod reaches to a point a little beyond the middle of exopod 3.

*The 2nd pair of legs.*—Basal 1 bears two transverse rows of spines on its outer margin and basal 2 bears a few scattered spines externally.

*The 3rd pair of legs.*—There is a row of spines on the proximal part of basal 1, and a few spines distally on the same segment. Basal 2 bears three or four spines.

*The 4th pair of legs.*—There is a transverse row of spines on basal 1 near the distal margin, but basal 2 is unarmed.

*The 5th pair of legs.*—Each consists of a three-jointed exopod only. The 1st segment bears a few small spines on its outer border about the middle of its length and is armed internally with an oblique row of spines. The 2nd segment is produced at its distal internal angle in a lamelliform process which terminates in a sharp point; externally there is a single small needle-like spine. The 3rd segment bears three spines and is produced externally in a bluntly rounded process: of the three spines, the outer is long and curved and in length is nearly equal to the whole limb; it is finely serrated along both borders: the middle spine is straight, about half the length of the outer one and is serrated on both margins: the inner spine is somewhat curved and is short and

stout with coarse serrations on its inner, and fine teeth on its outer border.

Specimens from the Chilka Lake differ slightly from the above description, which is taken from Port Canning specimens. They are slightly smaller and on the 2nd segment of the 5th pair of legs there is a corona of fine spines on the external part of the distal margin.

♂. Total length = 1.20 mm.

Proportional length of cephalo-thorax and abdomen—

$$63 : 37 = 100.$$

The cephalo-thorax resembles that of the ♀. The abdomen consists of five segments: the 1st segment is short and unarmed: the 2nd and 3rd segments are armed with a complete circle of spines around the posterior margin and in addition bear a transverse row of spines on the ventral surface: the 4th segment bears only the distal ring of spines and segment 5 is unarmed. The proportional lengths of the abdominal segments and furca are as follows:—

$$13 : 20 : 19 : 17 : 9 : 22 = 100.$$

The furcal rami are symmetrical and bear five setae of which the 3rd resembles the others and is not expanded as in the ♀.

*The 1st antennae.*—That of the left side is unmodified as in the ♀: the segments have the following proportions:—

$$\begin{array}{r} \text{Segments} \quad 1 : 2 : 3 : 4 : 5 : 6 : 7 : 8 : 9 : 10 : 11 : 12 : 13 : 14 : 15 : 16 : \\ \quad \quad \quad 65 : 54 : 19 : 32 : 38 : 22 : 24 : 27 : 27 : 43 : 54 : 59 : 65 : 65 : 65 : 59 : \\ \quad \quad \quad 17 : 18 : 19 : 20 : 21. \\ \quad \quad \quad \hline 48 : 48 : 51 : 59 : 76 = 1000. \end{array}$$

On the right side the antenna is modified to form a grasping organ: the segments have the following proportional lengths:—

$$\begin{array}{r} \text{Segments} \quad 1 : 2 : 3 : 4 : 5 : 6 : 7 : 8-10 : 11 : 12 : 13 : 14 : 15 : 16 : 17 : \\ \quad \quad \quad 75 : 53 : 22 : 19 : 19 : 11 : 68 : 19 : 26 : 30 : 64 : 64 : 68 : 56 : \\ \quad \quad \quad 18 : 19 : 20-21. \\ \quad \quad \quad \hline 113 : 105 : 169 = 1000. \end{array}$$

Segments 13 to 17 are considerably swollen; segment 17 bears a tooth-plate that extends the whole length of its upper margin and overlaps the succeeding segment; segment 18 is armed with a tooth-plate that terminates distally in a sharp point; segment 19 bears two spine-like tooth-plates, of which the proximal is about half the length of the distal, and this latter extends to the extreme limit of the segment.

All tooth-plates are stained a brown colour.

*The 2nd antennae, mouth-parts, and swimming legs* are as in the ♀.

*The 5th pair of legs.*—The right leg consists of four segments: the 1st segment (basal) is produced internally in an angular projection bearing at its internal angle a double process, the outer part rounded and the inner truncated and provided with a seta. Exopod 1 is produced at its distal external angle in a prominent

spine; exopod 2 is much dilated and bears a few spines on both internal and external margins; exopod 3 in shape closely resembles the corresponding joint in *P. lobipes*; about the middle of its length it is dilated the dilatation being fringed distally with spines, and it terminates in a long curved simple process.

The left leg consists of only three joints: of these the 1st (basal) bears a row of spines on its external margin and internally is produced into two processes which represent the remains of the endopod—the innermost is long and simple and the outer process is a broad flat plate terminating in two spines. Exopod 1 is provided with a row of needle-like spines on the proximal part of its inner margin, and externally it is produced at its distal end in a short stout spinous process, while the distal border is armed posteriorly with a row of spinules; exopod 2-3 (the terminal segment) bears a row of needle-like spines on the proximal part of its inner margin and externally it carries a large doubly-serrated spine; the terminal part of the joint is bent sharply on itself and terminates in three unequal processes.

***Pseudodiaptomus annandalei*, sp. nov.**

(Plate X, fig. 9.)

Examples of both sexes were present in the Chilka Lake collection. I have much pleasure in dedicating this species to Dr. N. Annandale, the Director of the Zoological Survey of India.

♀. Total length = 1.18 mm.

Proportional length of cephalo-thorax and abdomen—

$$71 : 29 = 100.$$

The head and first thoracic segments are fused, as also are thoracic segments 4 and 5: the forehead when viewed from above forms a sharply rounded prominence: the rostrum consists of two spinous processes. The posterior thoracic margin is rounded and is armed with a comb of 6-8 coarse curved teeth, and the last thoracic segment also bears laterally a double row of small spines.

The abdomen consists of four segments; of these the 1st is very nearly symmetrical and is produced on either side in a large recurved spine, but there are no spines on the posterior margin; segment 2 is armed with a row of very small spines on the posterior margin dorsally; segment 3 is armed with a corona of spines on the dorso-lateral part of the posterior border, which spines are somewhat larger laterally than on the dorsal surface.

The furcal rami are symmetrical and bear five setae which are short and stout and the 3rd seta is much dilated: all the setae and the inner margin of the furcal rami are fringed with bristle-like hairs. The proportional lengths of the abdominal segments and furca are as follows:—

$$40 : 14 : 14 : 9 : 23 = 100.$$

Mature females bear two egg-sacs each containing 6-8 ova.

The 1st antenna when folded back reaches to the posterior end of the genital segment of the abdomen. It consists of 21 segments having the following proportional lengths:—

Segments  $\frac{1 : 2 : 3 : 4 : 5 : 6 : 7 : 8 : 9 : 10 : 11 : 12 : 13 : 14 : 15 : 16 : 17 : 18 : 19 : 20 : 21.}{65 : 44 : 22 : 31 : 31 : 44 : 22 : 22 : 31 : 51 : 57 : 61 : 63 : 62 : 65 : 57 : 48 : 51 : 51 : 57 : 65 = 1000.}$

All the antennal setae appear to be bristle-like and devoid of plumose hairs.

The 2nd antenna is similar to that of *P. hickmani*.

The maxilliped consists of two basal joints and an end portion of 5 segments. Basal 1 bears distally a stout serrated spine; basal 2 is fringed with a palisade of spines.

The 1st pair of legs.—Basal 1 is armed with a transverse row of small spines on its external margin, and a second row about the junction of the proximal and middle thirds of the segment; basal 2 also bears an oblique row of spines. The exopod and endopod are each of three segments; exopod 1 bears a small marginal seta that barely reaches to the distal end of the segment.

The 2nd and 3rd pair of legs.—Basal 1 bears a transverse row of spines on the proximal part of the outer margin; basal 2 bears a longitudinal row of spines on its outer margin.

The 4th pair of legs.—Both basals are devoid of spines.

The 5th pair of legs.—Each consists of a three-jointed ramus: the 1st segment bears a row of spines on its outer surface: the 2nd segment is armed at its distal external angle with a single marginal serrated spine, and there is no trace of any internal lamelliform process such as is found in *P. tollingeri* and *P. lobipes*: the 3rd segment bears a small marginal spine and three end spines, of which the outer is by far the longest and stoutest and is serrated on both margins.

♂. Total length = 1.09 mm.

Proportional length of cephalo-thorax and abdomen—

67 : 33 = 100.

The male appears to differ very considerably from the female for the posterior thoracic margin is rounded and is totally devoid of spines, with the single exception of a small spine situated towards the dorsal end of the posterior margin. The abdomen consists of five segments having with the furca the following proportional lengths:—

11 : 22 : 20 : 17 : 9 : 21 = 100.

The 2nd, 3rd and 4th segments are each armed with a complete circle of spines on their distal margins and in addition the 2nd segment also bears a transverse row of small spines on both dorsal and ventral surfaces. The furcal setae are coarsely fringed as in the ♀, but the 3rd seta is not expanded: there is a very small dorsal accessory seta.

*The 1st antennae.*—That on the left side is unmodified and has the following proportional lengths of the segments:—

Segments  $\frac{1 : 2 : 3 : 4 : 5 : 6 : 7 : 8 : 9 : 10 : 11 : 12 : 13 : 14 : 15 : 16 : 17 : 18 : 19 : 20 : 21.}{65 : 55 : 25 : 30 : 30 : 42 : 20 : 20 : 30 : 38 : 50 : 55 : 62 : 63 : 65 : 58 : 17 : 18 : 19 : 20 : 21.}$   
 $47 : 55 : 55 : 60 : 75. = 1000.$

The right antenna is as usual modified to form a grasping organ: the various joints have the following proportional lengths:—

Segments  $\frac{1 : 2 : 3 : 4 : 5 : 6 : 7 : 8-9 : 10 : 11 : 12 : 13 : 14 : 15 : 16 : 17 : 18 : 19 : 20-21.}{68 : 50 : 17 : 14 : 15 : 13 : 9 : 50 : 15 : 20 : 22 : 26 : 64 : 57 : 61 : 57 : 18 : 19 : 20-21.}$   
 $128 : 117 : 194. = 1000.$

The "endabschnitt" consists of two joints only and the knee-joint lies between segments 18 and 19: segments 13 to 17 are swollen; segment 17 bears on its anterior margin proximally a rounded chitinous plate; segment 18 has a tooth-plate which extends for  $\frac{3}{4}$  of the length of the segment; segment 19 bears two spine-like tooth-plates, the proximal being short and armed with curved teeth.

*The 2nd antennae, mouth-parts and swimming legs* are similar to those of the ♀.

*The 5th pair of legs.*—The right leg consists of three segments. Exopod 1 is produced internally in a spinous process and is armed with a transverse row of spines on its outer margin; exopod 2 is prolonged internally in a lamelliform plate bearing two spine-like processes, a proximal short and claw-like and a distal one much longer and straight; exopod 3 is curved, terminating in a sharp point and bears a single seta on its inner margin. The left leg consists of three segments; exopod 1 is produced internally in a large irregularly triangular plate; exopod 2 is produced internally in a stout spinous process at the base of which is a short stout spine; exopod 3 bears a serrated spine on its outer margin and terminates in two sharp chitinous teeth.

### *Pseudodiaptomus binghami*, Sewell.

Associated in the Chilka Lake collection with large numbers of *P. binghami* ♀ and a few examples of *P. lobipes* were several unknown males. The female *P. binghami* was described by me from a collection made in the Rangoon River estuary, and I believe that the following form is the hitherto unknown ♂ of this species:

♂. Total length = 0.86 mm.

Proportional length of cephalo-thorax and abdomen—

$64.5 : 35.5 = 100.0.$

The head and 1st thoracic segment are fused, as also are thoracic segments 4 and 5. The forehead presents a uniform

rounded curve. The posterior thoracic margin is rounded and is armed towards the dorsal surface with a single spine.

The abdomen consists of five segments, which have with the furca the following proportional lengths:—

$$11 : 20 : 18 : 18 : 9 : 24 = 100.$$

Segments 2, 3 and 4 are each provided with a ring of spines on the posterior margin.

The furcal rami are symmetrical: the 3rd seta is not enlarged in this sex—a condition that is also found in *P. annandalei* and *P. tollingeri*.

The 1st antennae when folded back reach to the posterior thoracic margin. The left antenna is unmodified and resembles that of the ♀. I give below the proportional lengths of the various segments, and, as in my original description the terminal joints were missing, I also give the proportional lengths of the various segments in the corresponding appendage of the female for purposes of comparison.

Segments	1 : 2 : 3 : 4 : 5 : 6 : 7 : 8 : 9 : 10 : 11 : 12 : 13 : 14 : 15 :
♂	78 : 52 : 23 : 32 : 33 : 45 : 23 : 23 : 26 : 39 : 46 : 52 : 58 : 58 : 62 :
♀	78 : 39 : 19 : 28 : 28 : 39 : 22 : 22 : 28 : 39 : 48 : 50 : 59 : 62 : 64 :
	16 : 17 : 18 : 19 : 20 : 21.
	♂ 58 : 49 : 52 : 55 : 58 : 78 = 1000.
	♀ 62 : 53 : 56 : 59 : 67 : 78 = 1000.

The right antenna is as usual modified; the various segments have the following proportional lengths:—

Segments	1 : 2 : 3 : 4 : 5 : 6 : 7 : 8-9 : 10 : 11 : 12 : 13 : 14 : 15 : 16 : 17 :
	82 : 55 : 20 : 17 : 17 : 14 : 20 : 31 : 27 : 21 : 21 : 31 : 62 : 68 : 75 : 62 :
	18 : 19 : 20-21
	103 : 103 : 171 = 1000.

Segment 17 bears a tooth-plate which overlaps the proximal end of the following segment; segment 18 bears a tooth-plate; segment 19 bears two teeth plates. The tooth-plate on segment 17 is unarmed; that on segment 18 has rounded cusps and the tooth-plate on segment 19 bears spine-like teeth on its proximal portion only, the distal part being smooth.

The 2nd antennae, mouth-parts and swimming legs are identical with the corresponding appendages of *P. binghami* ♀.

The 5th pair of legs very closely resemble those of *P. lobipes* with which this form was associated in the collection. The right leg: basal 1 carries a rounded eminence on its margin; basal 2 bears a similar projection; exopod 1 is produced in a long spine which is serrated on its inner margin only; exopod 2 is produced internally in a blunt chitinised tubercle; exopod 3 is curved and slender; its inner margin is produced about the middle of the length of the segment in a flattened plate, which at its upper angle bears a small rounded tubercle; below the tubercle the margin is armed with a series of small spines and above it the distal margin bears 3 teeth; beyond this plate the distal part of the





The cephalo-thorax resembles that of the ♀.

The abdomen consists of 5 segments, having with the furca the following proportional lengths:—

$$10 : 31 : 20 : 6 : 14 : 19 = 100.$$

The abdominal segments are all devoid of spines and the 2nd furcal seta is not appreciably longer than the others.

*The 1st antennae.*—This appendage when folded back does not quite reach as far as the posterior thoracic margin. The distal segments have the following proportional lengths:—

$$\text{Segments } \frac{13 : 14 : 15 : 16 : 17 : 18 : 19-21 : 22-25.}{37 : 43 : 31 : 37 : 82 : 85 : 85 : 159.}$$

Segment 17 bears a spine-like tooth-plate which projects beyond the distal border over the following segment; segment 18 bears a palisade of fine needle-like spines on its anterior border; segment 19 bears two spine-like tooth-plates and carries a single long seta at its distal end.

*The 2nd antenna* resembles that of *A. centrura*.

*The maxilliped* resembles that of *A. southwelli*.

*The 5th pair of legs.*—The right leg forms the usual claw; basal 1 bears a stout seta; exopod 2 is produced internally in a roughly quadrilateral plate, and exopod 3 is curved and is armed with a spine on its inner margin and a terminal spine. The left leg: exopod 1 is produced internally in a rounded projection from the base of which arises a seta; exopod 3 is curved and rounded at the top and bears a long seta on its inner margin.

Similar examples of the ♂ were obtained in both collections: it is interesting to note that the specimens from Cochin are somewhat larger than those from the Chilka Lake measuring 0.82 mm. in total length and furthermore the abdominal segments are armed, segments 2, 3 and 4 all bearing a row of minute spines on the posterior margin dorsally. As, however, the specimens agree in all other particulars, I am inclined to regard this as a local variation; a very similar state of affairs exists in specimens of *A. southwelli* obtained from the Gulf of Mannar and the Chilka Lake.

#### Genus *Acartiella*, Sewell.

##### *Acartiella gravelyi*, sp. nov.

(Plate IX, fig. 7; Plate X, figs. 1, 4 and 5.)

Several examples, of both sexes, were present in the collection from Cochin.

♀. Total length = 1.4 mm.

Proportional length of cephalo-thorax and abdomen—

$$62.8 : 37.2 = 100.$$

The head and 1st thoracic segment are separate, as also are thoracic segments 4 and 5.

The anterior end of the head presents a uniformly rounded "forehead" and the rostrum is absent. The posterior thoracic margin is rounded and unarmed. The abdomen consists of three segments, of which the 3rd is extremely short, so short that it gives the appearance of a two-jointed abdomen. The furcal rami are not symmetrical, that on the right side being the longer.

The abdominal segments and furca have the following relative lengths:—

$$35 : 41 : 5 : 19 = 100.$$

The genital swelling forms a well-marked projection on the ventral aspect of the 1st abdominal segment. The 2nd furcal seta is stouter and considerably longer than the rest; the 5th seta arises from the external margin, at the junction of the middle and distal thirds of the segment, and there is a well-developed accessory dorsal seta.

The 1st antenna when folded back reaches to the middle of the 2nd abdominal segment. As in other members both of this genus and of the genus *Acartia*, the proximal segments of the antenna tend to become fused together: as the line of demarcation between segments frequently runs in a spiral round the antenna, the least change in position gives a totally different length measurement for any given joint. So far as I can make them out the following are the proportional lengths of the various segments in this species:—

$$\begin{array}{l} \text{Segments } \frac{1 : 2.4 : 5.6 : 7 : 8.9 : 10 : 11 : 12 : 13-14 : 15 : 16 : 17 : 18 : 19 : 20 :}{53 : 120 : 37 : 42 : 50 : 32 : 24 : 26 : 66 : 37 : 79 : 55 : 55 : 63 : 50 :} \\ \frac{21 : 22 : 23 : 24 : 25.}{53 : 40 : 55 : 42 : 21 = 1000.} \end{array}$$

Segments 2 to 4, 5 and 6, 8 and 9 and 13-14 appear to be fused together and segment 15 is also partially fused with the preceding segment. Many of the segments bear oblique rows of fine hair-like spines on their posterior surface.

The 2nd antenna has the same peculiar form as in *A. tortaniformis* (vide Sewell, 1912, p. 347 and pl. xxi, fig. 4).

The mandible bears four teeth of which the 1st is separated by an interval from the remaining three as in *A. tortaniformis*.

The maxilliped very closely resembles that of *A. tortaniformis*: the end joint bears the same four spinous processes, but the basal segment is armed with a row of 10-12 small spines instead of four large ones.

The 1st pair of legs.—Each consists of a two-jointed basal portion, a three-jointed exopod and a two-jointed endopod. Exopod 1 and 2 are devoid of marginal spines; exopod 3 bears one long seta-like marginal spine and the usual end-spine. On the inner margins the segments of the exopod bear 1, 1, and 5 setae respectively.

The 2nd pair of legs.—The exopod is three-jointed; exopod 1 bears a small marginal spine and one internal seta; exopod 2 has no marginal spine but bears one internal seta; exopod 3 bears a

marginal and an end-spine and carries five setae internally. The endopod is two-jointed. Endopod 1 bears two and endopod 2 seven setae.

*The 3rd pair of legs.*—The basal portion is two-jointed. The exopod consists of three joints; exopod 1 bears a claw-like marginal spine and one seta; exopod 2 has no spine and one seta; exopod 3 bears one marginal spine, one end-spine and five setae. The endopod is two-jointed, the joints bearing 2 and 7 setae respectively.

*The 4th pair of legs.*—The basal portion is two-jointed. The exopod consists of three joints; exopod 1 bears a claw-like marginal spine and one seta; exopod 2 bears a claw-like marginal spine and one seta; exopod 3 bears a claw-like marginal spine and one end-spine, and there are 5 setae. The endopod is two-jointed; the joints bearing 3 and 7 setae respectively.

*The 5th pair of legs.*—Each consists of a basal segment bearing an external seta, and as is usual in this genus a single-jointed exopod and endopod.

The exopod is curved and ends in a sharp point: about midway along its external margin is a single small spine, and the distal fourth of the inner margin is finely serrated. The endopod is about  $\frac{1}{2}$  the length of the exopod and also terminates in a sharp point, and on the distal part of the external margin bears four teeth.

♂. Total length = 1.16 mm.

Proportional length of cephalo-thorax and abdomen—

$$64.6 : 35.4 = 100.0.$$

The head and thorax are the same as in the ♀.

The abdomen consists of five segments and the furca: of the abdominal segments the anal is very short and the 2nd and 3rd are by far the longest.

The furcal rami are very slightly asymmetrical, the right ramus being slightly the longer: the furcal setae are similar to those of the ♀.

The proportional lengths of the segments and furca are as follows:—

$$11 : 22 : 21 : 11 : 3 : 32 = 100.$$

*The 1st antennae.*—That of the left side is unmodified and resembles that of the female, though in several cases the segments are not as completely fused, thus rendering it possible to determine the lengths of individual segments:—

$$\begin{array}{l} \text{Segments } 1 : 2.4 : 5.6 : 7 : 8 : 9 : 10 : 11 : 12 : 13 : 14 : 15 : 16 : 17 : 18 : \\ 44 : 103 : 33 : 18 : 24 : 12 : 36 : 36 : 27 : 36 : 36 : 41 : 84 : 62 : 62 : \\ 19 : 20 : 21 : 22 : 23 : 24 : 25. \\ 68 : 54 : 56 : 47 : 59 : 44 : 18 = 1000. \end{array}$$

The right antenna is modified to form a grasping organ; the various segments have the following proportional lengths:—

Segments 1 : 2-4 : 5 : 6 : 7 : 8-10 : 11 : 12 : 13 : 14 : 15 : 16 : 17 : 18 : 19-21 :  
 41 : 120 : 35 : 17 : 18 : 111 : 23 : 23 : 44 : 35 : 44 : 47 : 73 : 111 : 108 :  
 $\frac{22-25.}{150 = 1000.}$

The knee-joint is situated between segments 18 and 19 and the "endabschnitt" consists of two joints only. Segments 2 to 4 and 8 to 10 are fused; the 13th to 17th segments are somewhat dilated, though not markedly so; the 17th segment bears a tooth-plate which does not extend beyond the distal extremity of the segment; the 18th segment bears a tooth-plate and has two fang-like spines distally as in *A. tortaniformis*, and the 19th segment has two tooth-plates. All the tooth-plates are furnished with fine teeth.

The 2nd antenna, mouth-parts, and swimming legs are similar to those of the ♀.

The 5th pair of legs.—Each leg consists of a single ramus. The right leg possesses four segments; of these the basal one is produced distally in a pair of rounded wing-like flaps, which overlap the proximal part of the next segment; the 2nd segment carries a single seta on its external margin; the 3rd segment bears a single seta on its internal margin, and the 4th distal segment is pointed and claw-like and bears a single seta on its inner margin. The left leg consists of the common basal segment and three free segments; the 1st segment bears a single bristle externally; the 2nd segment is armed with a small marginal spine distally on the external margin, and the terminal segment bears a single marginal spine on its external border, a small spine on its internal margin and terminates in two unequal spines.

I have much pleasure in dedicating this species to Dr. F. H. Gravely, Assistant Superintendent, Zoological Survey of India, by whom the collection from Cochin was made.

#### *Acartiella major*, sp. nov.

(Plate IX, fig. 8 and Plate X, figs. 2, 3 and 6.)

Numerous examples of both sexes were present in the Chiika Lake collection.

♀. Total length = 1.41 mm.

Proportional length of cephalo-thorax and abdomen—

$$67 : 33 = 100.$$

The head and 1st thoracic segment are separate: thoracic segments 4 and 5 are fused.

The head presents a rounded anterior surface, and the posterior thoracic margin is rounded and unarmed. The rostrum is as usual absent.

The abdomen consists of three segments, having with the furca the following proportional lengths:—

$$39 : 31 : 8 : 22 = 100.$$

The 1st abdominal segment bears a slight rounded prominence posteriorly near the right border.

The furcal rami are symmetrical, and the furcal setae are five in number, of which the 2nd is longer and stouter than the others.

*The 1st antennae.*—The proportional lengths of the various segments are as follows:—

Segments	<u>1</u>	<u>2-4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8-9</u>	<u>10</u>	<u>11</u>	<u>12-13</u>	<u>14</u>	<u>15</u>	<u>16</u>	<u>17</u>	<u>18</u>	<u>19</u>
	64	108	32	37	23	44	23	25	71	34	37	44	57	57	71
			<u>20</u>	<u>21</u>	<u>22</u>	<u>23</u>	<u>24</u>	<u>25</u>							
			54	54	44	57	44	20	= 1000.						

There are oblique rows of hairs on segments 7 to 18 very like the rows of fine spines on the segments of the antenna in *A. tortaniformis*.

*The 2nd antenna* is of the same form as in *A. tortaniformis*.

*The 1st and 2nd maxillae* are as figured.

*The maxilliped* terminates in the usual segment bearing four long spines, but on the margin of the 1st segment there are only 2 spines.

*The 1st pair of legs.*—This appendage closely resembles that of *A. graveleyi* but differs in that exopod 3 bears two fine hair-like marginal spines as well as the usual end-spine.

*The 2nd-4th pair of legs.*—As in *A. graveleyi*.

*The 5th pair of legs.*—Each basal segment carries a marginal seta; the exopod is long and curved, terminating in a sharp point; the inner margin is serrated along the distal  $\frac{1}{3}$ , and on the outer margin is a single spine: the endopod is quite short, being only  $\frac{1}{4}$  the length of the exopod, and it bears 2 or 3 teeth distally on its outer margin.

♂. Total length = 1.25 mm.

Proportional length of cephalo-thorax and abdomen—

$$65 : 35 = 100.$$

The abdomen consists of five segments, having with the furcal rami the following proportional lengths:—

$$11 : 21 : 18 : 9 : 5 : 36 = 100.$$

The furcal rami are not quite symmetrical, the right one being slightly the longer: the furcal setae are as in the ♀.

*The 1st antennae.*—That on the left side is unmodified as in the ♀ and its terminal joints have the following proportional lengths:—

Segments	<u>11</u>	<u>12</u>	<u>13</u>	<u>14</u>	<u>15</u>	<u>16</u>	<u>17</u>	<u>18</u>	<u>19</u>	<u>20</u>	<u>21</u>	<u>22</u>	<u>23</u>	<u>24</u>	<u>25</u>
	27	34	34	34	34	48	62	66	70	52	55	39	55	39	20.

The segments are furnished with oblique rows of hairs as in the ♀.

The right antenna is modified to form a grasping organ: segments 13 to 17 are somewhat expanded and the knee-joint is situated between segments 18 and 19. The "endabschnitt" consists of two joints only; segments 19 to 21 and 22 to 25 are fused together.

The proportional lengths of the end segments are as follows:—

$$\text{Segments } \frac{13 : 14 : 15 : 16 : 17 : 18 : 19-21 : 22-25.}{45 : 48 : 41 : 48 : 57 : 123 : 109 : 140.}$$

Segment 17 bears a tooth-plate that slightly overlaps the following segment; segment 18 bears a tooth-plate and is armed with the usual two fang-like spines distally; segment 19-21 bears two tooth-plates, both of them spine-like, the distal being much the longer and overlapping the next segment; segment 19-21 also bears two setae, a terminal one and a small one about the middle of the length of the toothed surface. All tooth-plates are provided with fine needle-like teeth; on the proximal plates these are long, but on the distal plate of segment 19-21 they are very short.

*The 5th pair of legs.*—On the right side the basal joint is produced in a double flat process, the outer division being sharply pointed and the inner one rounded and wing-like. Each leg consists of three segments having the form typical of the genus.

On the right side exopod 1 bears a marginal seta; exopod 2 bears a single internal seta and exopod 3 terminates in a sharp point and bears a single seta on its inner margin.

On the left side exopod 1 bears a marginal seta; exopod 2 carries a distal marginal spine, and exopod 3 bears one marginal spine and three end-spines.

#### *Acartiella minor*, sp. nov.

(Plate IX, fig. 6 and Plate X, fig. 7.)

Examples of both sexes were present in the Chilka Lake collection.

♀. Total length = 1.14 mm.

Proportional length of cephalo-thorax and abdomen—

$$67 : 33 : = 100.$$

The head and 1st thoracic segment are separate and thoracic segments 4 and 5 are fused.

The forehead presents a rounded curved surface and the rostrum is absent; the posterior thoracic margin is rounded and devoid of spines.

The abdomen consists of three segments, having with the furca the following proportional lengths:—

$$31 : 20 : 26 : 23 = 100.$$

The furcal rami are asymmetrical, that of the right side being the longer; the furcal setae are as in *A. gravelyi*, the 5th seta arising from the external margin about the middle of the segment, while the 2nd seta is much longer than the rest.

*The 1st antennae.*—This resembles that of *A. gravelyi*; when folded back it reaches to the middle of the 1st abdominal segment.

The various joints of the antenna have the following proportional lengths:—

Segments	1 : 2-4 : 5 : 6 : 7 : 8 : 9-10 : 11 : 12-14 : 15-16 : 17 : 18 : 19 : 20 :
	46 : 101 : 38 : 19 : 39 : 43 : 58 : 37 : 89 : 78 : 56 : 58 : 68 : 52 :
	$\frac{21 : 22 : 23 : 24 : 25.}{54 : 43 : 58 : 43 : 20 = 1000.}$

Segments 2 to 4, 9 and 10, 12 to 14 and 15 and 16 are respectively fused together. There are no spines on any of the segments.

The 2nd antennae, mouth-parts and swimming legs are as in *A. graveyi*.

The 5th pair of legs have the form typical of the genus. The exopod is unserrated and is 3 to 4 times the length of the endopod which is short and pointed and is unarmed.

♂. Total length 1.07 mm.

Proportional length of cephalo-thorax and abdomen—

$$65 : 35 = 100.$$

The head and thorax are similar to those of the ♀.

The abdomen consists of five segments, having with the furca the following proportional lengths:—

$$10 : 20 : 16 : 10 : 6 : 38 = 100.$$

The furcal rami are nearly, though not quite, symmetrical, the right ramus being slightly the longer.

The 1st antennae.—That of the right side is modified to form a grasping organ. The proximal segments are so irregularly fused that it is almost impossible to determine their limits of demarcation. Segments 13 to 17 are somewhat swollen, and the knee-joint lies between segments 18 and 19. The "endabschnitt" consists of two joints.

The proportional lengths of the distal segments are as follows:—

$$\text{Segments } 13 : 14 : 15 : 16 : 17 : 18 : 19-21 : 22-25. \\ 47 : 47 : 47 : 47 : 66 : 109 : 105 : 134.$$

Segment 17 bears a tooth-plate that projects as a spine over the proximal end of segment 18; segment 18 bears a tooth-plate and two fang-like spines distally; segment 19-21 bears two spine-like tooth-plates of which the distal is much the longer and projects beyond the end of the joint; distally, segment 21 bears a single long seta. All the tooth-plates are armed with fine needle-like teeth.

The left antenna when folded back reaches to the hind end of the 3rd abdominal segment; it is unmodified as in the ♀. The proportional lengths of the distal segments are as follows:—

$$\text{Segments } 11 : 12 : 13 : 14 : 15 : 16 : 17 : 18 : 19 : 20 : 21 : 22 : 23 : 24 : 25. \\ 13 : 33 : 38 : 38 : 38 : 44 : 61 : 55 : 65 : 53 : 57 : 41 : 61 : 41 : 19.$$

The mouth-parts and swimming-legs are as in the ♀.

The 5th pair of legs.—The basal segment is produced on the right side in a single stout conical process which overlaps the



proximal end of exopod 1. On the right side, exopod 1 is a stout segment bearing a single seta on its external margin; exopod 2 bears a rounded prominence on its inner aspect about the middle of its length, from the summit of which a seta arises; exopod 3 is curved, tapering to a point and bears a single seta on its inner border.

On the left side exopod 1 bears on its inner margin distally a single small spiniform process; exopod 2 bears a single small marginal spine distally; exopod 3 bears a small spine on its outer border, on the inner margin is a single small seta, and terminally are three unequal spines.

The original species of the genus *Acartiella*, *A. tortaniformis* (Sewell) was discovered in a collection from the Rangoon River Estuary (Sewell, 1912, p. 346), and all these new species occur in similar localities where the water is brackish: it is interesting to note the association of *Pseudodiaptomus binghami*, Sewell, with *Acartiella major* and *minor* in the Chilka Lake collection, for the only other locality in which *P. binghami* has hitherto been found is the above-mentioned Rangoon River Estuary.

The only truly marine form in this genus is *Acartiella kempi*, Sewell, which occurs in the Gulf of Mannar, and it is exceedingly interesting to note that this species in some respects tends to approximate to species both of the genus *Tortanus*, a purely marine genus, and of the genus *Acartia* in which many of the species are truly marine: thus in all other members of the genus the 2nd antenna has the peculiar flattened form which I described and figured originally in my description of *A. tortaniformis* (*Acartia tortaniformis*, Sewell, 1912, p. 346 and pl. xxi, fig. 4), but in *Acartiella kempi* it presents the form commonly found in species of the genera *Acartia* and *Tortanus*; again the 5th pair of legs in *A. kempi* ♂ is different in form from the corresponding appendage of other members of the genus in that it possesses a long process on the segment exopod 1 of the right leg, and further there is no process on the basal joint of the same leg, a condition that approximates to that found in the genus *Tortanus*: as regards the length of the abdomen *Acartiella kempi* ♀ nearly approximates to the genus *Acartia*. The known forms of this genus form a distinct series in respect of the proportional length of cephalo-thorax and abdomen, and I give the varying proportions below together with the proportion in two species of *Acartia*:—

♀	Species.	Cephalo-thorax.	Abdomen.
	<i>Acartiella tortaniformis</i> ..	1·5	1·0
	<i>Acartiella gravelyi</i> ..	1·7	1·0
	<i>Acartiella major</i> }	2·0	1·0
	<i>Acartiella minor</i> }		
	<i>Acartiella kempi</i> ..	2·5	1·0
	<i>Acartia chilkaensis</i> ..	2·85	1·0
	<i>Acartia southwelli</i> ..	3·5	1·0

I give below an identification table by means of which the various species of the genus *Acartiella* can be distinguished from each other :—

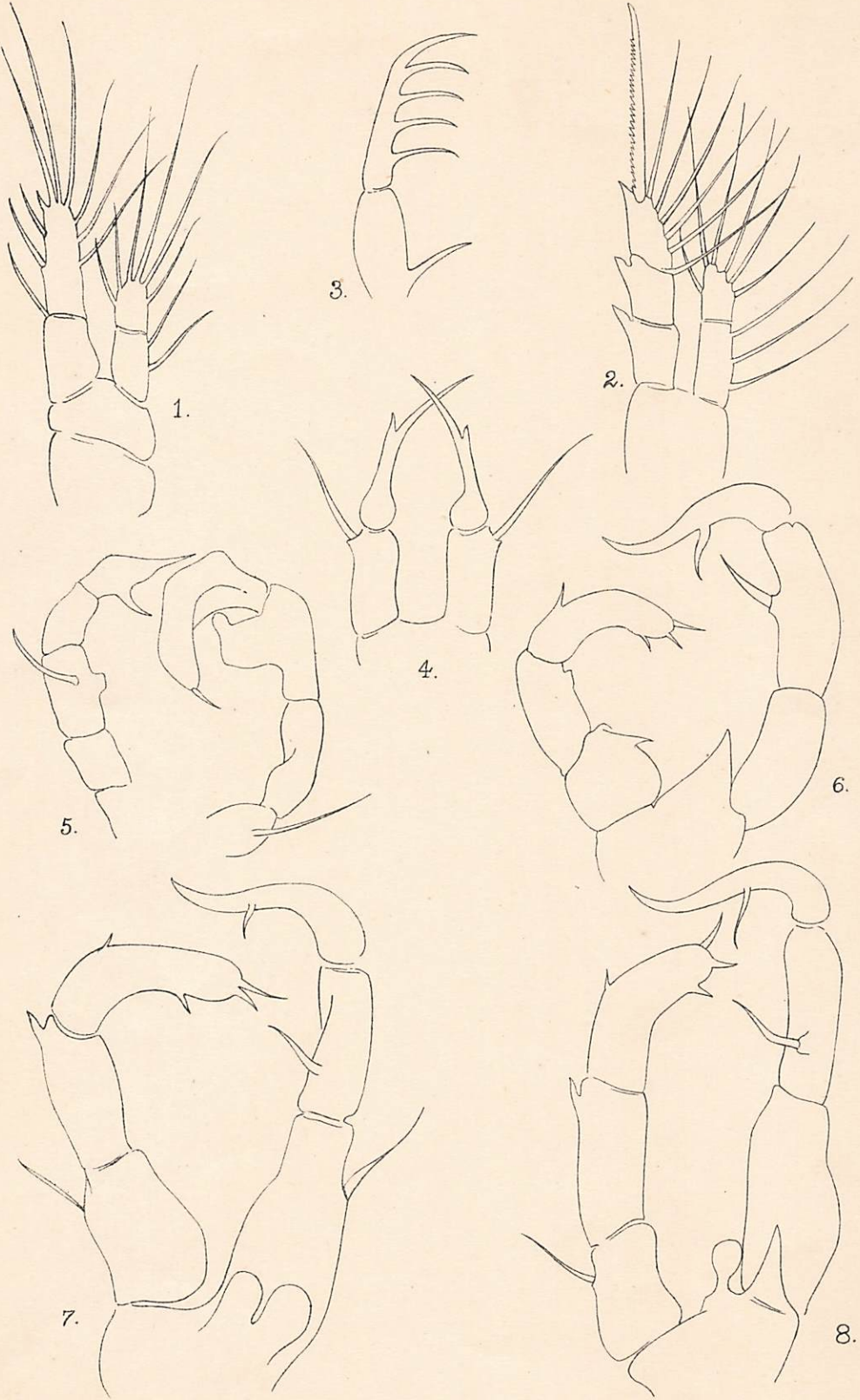
I. ♂ and ♀.	(a) 4th and 5th thoracic segments separate ... ..	<i>A. gravelyi.</i>
	(b) 4th and 5th thoracic segments fused ... ..	vide II.
II. ♂ and ♀.	(a) 2nd antenna normal; <i>Acartia</i> -like. ... ..	<i>A. kempi.</i>
	(b) 2nd antenna having the flattened form typical of the genus ... ..	vide III.
III. A. ♀.	(a) 5th leg: endopod $\frac{1}{2}$ length of exopod and both serrated ... ..	<i>A. tortaniformis.</i>
	(b) 5th leg: endopod short, $\frac{1}{4}$ length of exopod :—	
	(1) Exopod serrated on inner margin ... ..	<i>A. major.</i>
	(2) Exopod unarmed on inner margin ... ..	<i>A. minor.</i>
III B. ♂.	(a) Basal of right leg produced in a single process.	
	(1) A short triangular plate ... ..	<i>A. minor.</i>
	(2) A long narrow process ... ..	<i>A. tortaniformis.</i>
	(b) Basal of right leg produced in two processes, one rounded and the other triangular ... ..	<i>A. major.</i>

#### REFERENCES TO LITERATURE.

- Sewell, 1912.—“Notes on the Surface-living Copepoda of the Bay of Bengal, I and II.” *Records of the Indian Museum*, Vol. VII, Part IV, No. 29.
- Sewell, 1914.—“Notes on the Surface Copepoda of the Gulf of Mannar.” *Spolia Zeylanica*, Vol. IX, Part XXXV.

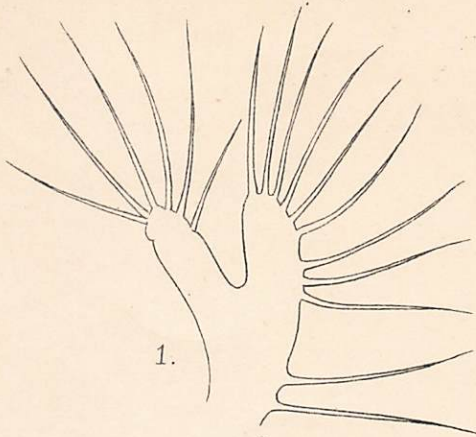
EXPLANATION OF PLATE IX.

- FIG. 1.—*Acartia chilkaensis*, sp. nov., 1st pair of legs.  
,, 2. ,, ,, ,, 2nd-4th pair of legs.  
,, 3. ,, ,, ,, maxilliped.  
,, 4. ,, ,, ,, 5th pair of legs ♀.  
,, 5. ,, ,, ,, 5th pair of legs ♂.  
,, 6.—*Acartiella minor*, sp. nov., 5th pair of legs ♂.  
,, 7. ,, *gravelyi*, sp. nov., 5th pair of legs ♂.  
,, 8. ,, *major*, sp. nov., 5th pair of legs ♂.

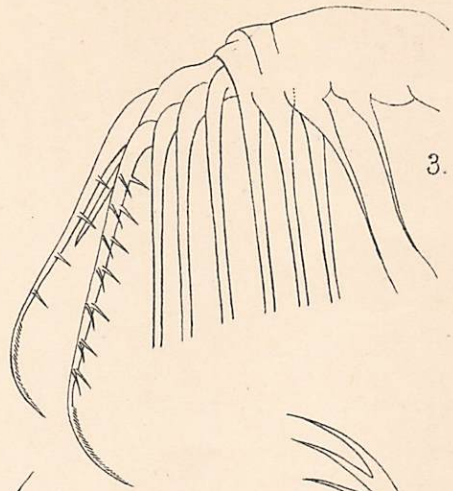


EXPLANATION OF PLATE X.

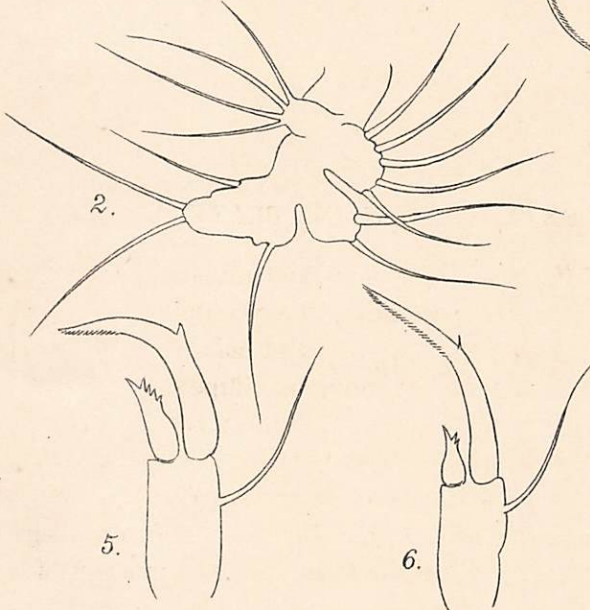
- FIG. 1.—*Acartiella gravelyi*, sp. nov., 2nd antenna.  
,, 2. ,, *major*, sp. nov., 1st maxilla.  
,, 3. ,, ,, ,, 2nd maxilla.  
,, 4. ,, *gravelyi*, sp. nov., maxilliped.  
,, 5. ,, ,, ,, 5th leg ♀.  
,, 6. ,, *major*, sp. nov., 5th leg ♀.  
,, 7. ,, *minor*, sp. nov., 5th leg ♀.  
,, 8.—*Pseudodiptomus tollingeri*, sp. nov., 5th pair of legs ♂.  
,, 9. ,, *annandalei*, sp. nov., 5th pair of legs ♂.



1.



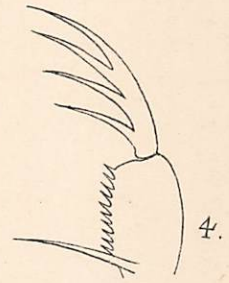
3.



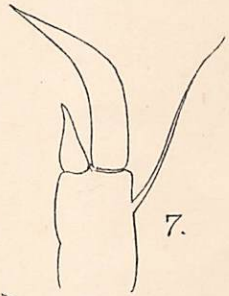
2.

5.

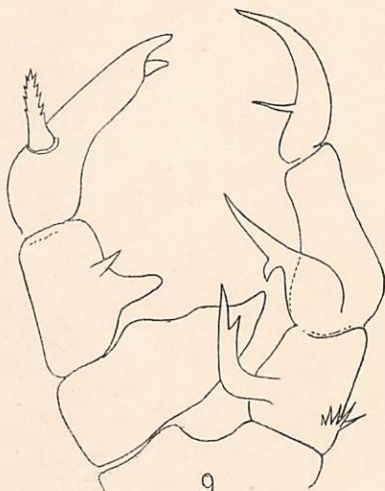
6.



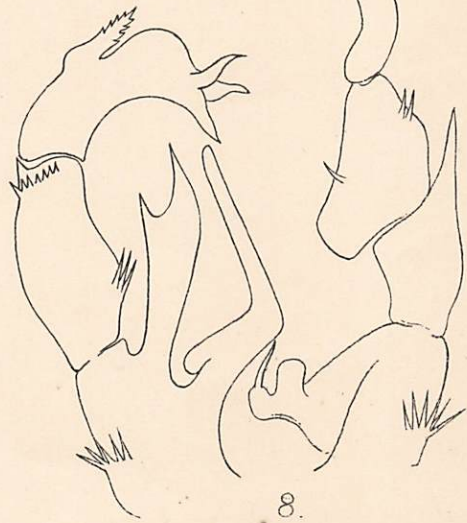
4.



7.



9.



8.