III. *Notes on some Parasitic Copepoda; with a Description of a new Species of* Chondracanthus. *By* MAY E. BAINBRIDGE, *B.Sc., F.L.S.*

(Plates 8–11.)

Read 5th November, 1908.

ALL the species described in this paper, with one exception, were collected and sent to me by Miss Lebour, M.Sc. Durham, from fish brought in by the fishing-boats of North Shields, Northumberland. I am very much indebted to her for her kindness in sending them to me. *Anchorella stellata*, Kr., was found on a Hake (*Merluccius vulgaris*, Cuv.) bought at Sheringham, Norfolk. My work has been carried out in the Zoological Department of the Imperial College of Science and Technology (Royal College of Science), South Kensington. The classification is taken from Giesbrecht, but the position of some of the wholly parasitic families in his system seems still a matter of some doubt (*cf.* Dr. Calman *). Mr. Geoffrey Smith †, who has kindly given me permission to refer to his work which is still in the press, places these parasitic families (Caligidæ, Lernæidæ, Lernæopodidæ, Chondracanthidæ, Choniostomatidæ) in the Tribe Isokerandria, Giesbrecht, of the Suborder Podoplea, Giesbrecht. He has done this with Giesbrecht's consent and approval, and I have therefore adopted his system in the following paper. With regard to the nomenclature of the appendages I have followed Giesbrecht ‡ and Hansen §, who have independently arrived at the same conclusions.

Subclass **COPEPODA**, H. Milne-Edwards (1830).

Order I. EUCOPEPODA, Claus (1875).

Suborder II. PODOPLEA, Giesbrecht.

Tribe I. ISOKERANDRIA, Giesbrecht.

Fam. BOMOLOCHIDÆ.

Genus BOMOLOCHUS, Nordm.

BOMOLOCHUS SOLEÆ, Claus. (Plate 8. figs. 1–5.)

1864. *Bomolochus soleæ*, Claus, Zeitschrift für wissenschaftliche Zoologie, vol. xiv. p. 383, pl. 35. figs. 16–20, pl. 36. fig. 28.

1893. *Bomolochus soleæ*, T. Scott, 11th Ann. Report Fish. Board Scotland, pt. iii. p. 212, pl. 5. figs. 1–10.

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* Ray Lankester's 'Zoology' (Crustacea).

† 'The Cambridge Natural History,' Crustacea, ch. iii. p. 69.

‡ "Mitth. über Copepoden," 6, p. 101, in Mitth. aus der Zool. Stat. Neapel, vol. xi. (1895).

§ "Zur Morph. der Gliedmassen u. Mundtheile bei Crust. u. Insecten," in Zool. Anz. 16 Jahrg. 1893, pp. 193–198, 201–212 (section 11).

1900. *Bomolochus soleæ*, T. Scott, ibid. 18th, p. 146.
1900. *Bomolochus soleæ*, A. Scott, 14th Ann. Rept. Liverpool Marine Biol. Com. Dec. p. 12.
1900. *Bomolochus soleæ*, A. Scott, Trans. Liverp. Biol. Soc. vol. xiv. p. 139.
1901. *Bomolochus soleæ*, T. Scott, 19th Ann. Rept. Fish. Board Scot. iii. p. 121.
1902. *Bomolochus soleæ*, T. Scott, ibid. 20th, p. 288.
1905. *Bomolochus soleæ*, T. Scott, ibid. 23rd, p. 108.

This parasite seems to be very common in the nostrils of the Cod (*Gadus morrhua*) (*cf.* A. Scott). T. Scott (1893) gives a short account and some figures of this species. His figure (pl. 5. fig. 3) of the second antenna does not seem to be quite correct. This appendage (Pl. 8. fig. 3, $A.^2$) is three-jointed. The basal joint articulates with a chitinous plate, with which the mandible and first maxilla are also articulated (fig. 3, *Ch.p.*). From the inner margin of this plate a chitinous rod springs which runs inwards and forwards and is united to the front lip, which is stiffened at this point by a chitinous knob. The second joint is quite short and forms the elbow of the appendage, which is doubled back on itself; it bears two small setæ. The terminal joint is nearly as long as the basal joint and is very elaborate. There is a broad portion, which ends in a sort of paddle and is covered with short spines. At the outer side of this, about the middle of its length, is a strong sword-shaped blade, the outer edge of which bears a fringe of thick pectinate setæ. Close to the base of the blade is a strong curved claw (?) or seta. Three longer and more slender setæ lie between the blade and paddle. There are also two finer setæ on the inner side of these. This appendage is the same in both sexes.

The Mandible (Pl. 8. fig. 4, *Md.*) has a long tooth and one much smaller at its side, and agrees closely with the mandible of a variety of this species found in the nostrils of the Ling, *Molva molva* (Linn.), which T. Scott describes and figures (*op. cit.* 1902, p. 288, pl. 22. fig. 16).

Behind the first maxilla and between it and the second maxilla is an oval chitinous structure with a stout base (fig. 4, *S.l.*); the oval portion is covered with fine hairs. Claus, in his account of this species (*op. cit.* 1864, p. 375), describes and figures (pl. 35. fig. 18 *d*) a chitinous plate to which he says the palp (maxilla) appears to belong; this figure does not agree with mine; but on the same plate (fig. 23 *b*) is a figure of the mouth-parts of *Bomolochus cornutus*, and in this he shows a structure very similar to that observed in *B. soleæ*. Claus describes it as "the maxilla-plate with palp." Giesbrecht, in his account of the "Paragnathe" of the Copepoda (*op. cit.* 4, p. 75), gives his reasons for regarding similar structures in the Hersiliidæ and other Copepoda as lateral outgrowths of the lower lip and he calls them, therefore, side lips (Seitenlippen). There can be no doubt, I think, that this is the true explanation of these structures in *Bomolochus soleæ*—i. e., they are outhrowths of the lower (hind) lip, and are morphologically quite distinct from the first maxilla. Giesbrecht considers that the correct terms to use for the parts of the mouth are fore lip (Vorderlippe), hind lip (Hinterlippe), and side lip (Seitenlippe). The specimen from which the drawings were made measured 1·53 mm.

The Male (Pl. 8. fig. 2) is much smaller, one specimen measured ·71 mm., another ·8 mm. As the male has apparently not been figured before, a drawing of it, enlarged to

the same scale as the female, is given here. The abdomen is composed of three segments and the caudal furca. The first and second antennæ and the mouth-parts are the same as in the female. The first maxillipeds (fig. 5) are quite different; they are very conspicuous, and serve at once to distinguish the sexes. Claus describes them (*op. cit.* p. 377) and also the swimming-feet, the fourth pair of which differs somewhat from those of the female.

All the specimens examined were from the nostrils of the Cod (*Gadus morrhua*, Linn.).

Family CHONDRACANTHIDÆ.

Genus CHONDRACANTHUS, De la Roche (1811).

CHONDRACANTHUS INFLATUS, sp. n. (Pl. 9. figs. 9–15.)

General Appearance (female).

In appearance the female is very stout and swollen, the body being curved slightly as shown in the figure (fig. 9). The head is separated from the body by a deep constriction, and bears a pair of strong curved hooks, the second antennæ; these project considerably beyond the ventral surface of the head, and by means of them the parasite is attached to its host. There are no traces of the first antennæ. The first thoracic segment is short and rounded dorsally, and bears a pair of blunt bilobed appendages. The constriction which separates this segment from the posterior one is less marked than the division between the head and the first thoracic segment. Traces of three more segments can be made out, the first of which is the shortest and bears another pair of bilobed appendages. The postabdomen is very short and projects beyond the genital segment; it is roughly pyramid-shaped with a blunt apex, and shows traces of two or perhaps three segments. On the last of these are a pair of small caudal furca. Just anterior to the furca are the openings of the oviducts. It is doubtful whether these are true segments or only secondary foldings. There are no lateral processes. Two transparent tubes run down each side of the genital segment beneath the dorsal surface. On the ventral side of the minute postabdomen the oviducts with narrow necks and wide ends can be seen (fig. 14, *Od.*). They open to the exterior on the sides of the abdomen, at a point a little posterior to the middle of its length. No ovisacs were present, and the ova inside the body were not fully developed. A minute male was attached to the female just above the abdomen on the ventral surface (fig. 9, ♂).

Appendages (female).

First Antennæ.—Not developed.

Second Antennæ.—A pair of stout hooks on a broad basal joint, very similar to these appendages in other species of *Chondracanthus*.

Mouth-parts (fig. 13).—Two pair of appendages (the second maxillæ and first maxillipeds) and part of a third pair (the first maxillæ) are situated posterior to the

fore lip. This is long and curved, with two small prolongations at each side (*F.l.*), and completely covers the mandibles.

Mandibles (fig. 12, *Md.*).—Curved blades, the outer margin bearing sharply pointed teeth, the inner margin covered with much smaller teeth.

First Maxillæ (fig. 12, *Mx.*^{1}).—These are posterior to the mandibles, and are partly covered by the fore lip. They are flat ovate appendages, bearing each two small curved setæ.

Second Maxillæ (fig. 12, *Mx.*^{2}).—Apparently three-jointed. The last joint bearing a bluntly pointed blade with curved teeth on the outer margin: below the teeth is a delicate tongue-shaped seta.

First Maxillipeds (fig. 12, *Mxp.*^{1}).—Three-jointed, the terminal joint bears a strong short claw (there is no small tooth on the upper margin of the claw as on the same appendage of *C. cornutus*). The sheath of this claw is covered with fine bristles.

The hind lip, which is leaf-like in shape, hangs down dorsally to these appendages, the posterior margin reaching to about the level of the first maxillipeds. Two chitinous structures of unknown function can be seen near the lower edge of the lip (fig. 13, *H.l.*),

Thoracic Appendages (fig. 9, *F.*^{1}, *F.*^{2}).—Two pair. They are stout and project a short distance beyond the margin of the body. The ends are blunt and bilobed and are covered with fine bristles.

General Appearance (male).

Seven segments can be distinguished including the cephalothorax. The last abdominal segment bears the caudal furca. A wide intestine full of granules fills up a large portion of the body (fig. 10, *I.*). There is a large pigment-spot posterior to the second antennæ (*Pg.*). The mouth-parts are situated a considerable distance behind these appendages.

Appendages (male).

First Antennæ.—Four-jointed, slender. The terminal joint bearing three taste-hairs or setæ at its extremity and a tiny seta at its base. One seta on the third joint and one on the second joint above its junction with the basal joint, on which is a very small seta.

Second Antennæ.—Two-jointed, very stout with a strong terminal claw. The male is attached to the female by these appendages.

Mouth-parts.—The mandibles and first maxillæ are not visible, being covered by the fore lip.

Second Maxillæ.—Somewhat shorter than the maxillipeds. Three-jointed, the terminal joint bears a stout claw and a small seta.

First Maxillipeds (fig. 11).—Three-jointed, and similar to the second maxillæ.

Thoracic Appendages (fig. 15).—Two pairs; apparently biramose. Inner branch paddle-like, bearing a long slender seta and a very short one at its distal end. Outer branch club-shaped, more slender, bearing one short seta at the end. These limbs are very minute, measuring only ·04 mm.

	mm.
Length of female measured in the position as figured (fig. 9)	5
Width of genital segment	1·8
Length of male	0·6

Habitat. A single specimen of a female with a male attached was found on the gills of *Raia radiata*.

This *Chondracanthus* seems to be somewhat like Olsson's * *Chondracanthus annulatus*, and at first sight, in spite of the great differences in size (5 mm. *Ch. inflatus*, 10–12 mm. *Ch. annulatus*), I thought it might be a young female of Olsson's species. There are, however, two important points of difference. Olsson says both the first and second pair of antennæ are very minute, and he mentions and figures short posterior processes, which, however, he describes as shorter than the tail (abdomen). In the specimen from the Starry Ray (*Raia radiata*) the first antennæ are not developed, but the second antennæ are very large and strong, and there are no posterior processes. The male of *Ch. annulatus* (length 1·4 mm.), as far as can be made out from Olsson's description, would seem to be very similar except in size to the male described above. Although it is very unsatisfactory to establish a new species from a single specimen, it seems in this case necessary to do so. The complete absence of posterior processes is remarkable, these structures being usually developed in species of *Chondracanthus*. *Chondracanthus brevicollis*, Kllr., described and figured by Kröyer †, is the only species of this genus known to me which is without posterior processes, and indeed it seems somewhat doubtful if it should be placed in this genus at all. Kröyer himself remarks that this form seems somewhat aberrant, owing to the peculiar structure of the first thoracic limbs and the abdominal appendages (the caudal furca is well developed in *Ch. brevicollis*). The host of this species is not given; locality Moluccas, East Indies.

Family Lernæopodidæ.

Genus Lernæopoda, Kröyer (1837).

Lernæopoda cluthæ, T. Scott. (Pl. 10. figs. 24–27.)

1900. *Lernæopoda cluthæ*, T. Scott, 18th Ann. Rep. Fish. Board Scotl. iii. p. 173, pl. 8. figs. 27–37.

Lernæopoda cluthæ has been described and figured by T. Scott, but the following notes and a few more figures may be useful. This species seems to be very closely allied to *Lernæopoda longimana*, Olsson ‡, a species which the Swedish naturalist found in very large numbers (he mentions having more than 300 examples, and says he had seen ten times as many) on the gills of *Raia fullonica*, and at times very frequently on *Raia batis*, also from the Skager Rack. T. Scott's specimens of *L. cluthæ* were also taken from the gills of *Raia fullonica*, Firth of Clyde; but although closely allied it would seem that these two species are distinct. Olsson's specimens of *L. longimana*

* "Prodromus faunæ Copepodorum parasitantium Scandinaviæ," Acta Universitatis Lundensis, 1868; Lunds Univer. Årsskrift, iii. p. 30, pl. 2. figs. 13–15.

† 1863. "Bidrag til Kunds. om Snyltekrebsene," Naturh. Tidsskr. (3) ii. p. 320, pl. 13. figs. 3 *a–d*.

‡ *Op. cit.* p. 38, pl. 2. figs. 18–22.

measured from 7–8 mm.; the neck was not quite twice as long as the cephalothorax, and the egg-sacs equal to the neck in length. As already stated, Olsson examined a very large number of specimens, and he says that in all these the specific characters mentioned above were very constant. T. Scott's specimens measured 5 mm., and the neck appears to be decidedly shorter than in Olsson's specimens. Scott found and described the male; but Olsson, although he examined such large numbers, never saw a male. This point is interesting, as the simultaneous occurrence of the two sexes varies considerably in different species.

About twelve specimens of a *Lernæopoda*, all females, from the gills of *Raia radiata*, were examined by me. These agreed closely with Scott's specimens in size and other particulars, and are therefore placed under his species.

The measurements are given below.

The body of the female (fig. 24) was full of large ova. The ovaries (*Ov.*) are situated on either side of the genital segment where the body begins to widen out below the neck. The ovisacs are short, the ova being very large and apparently hexagonal in shape owing to pressure. Some ova found in a shrivelled ovisac, which had shed most of its contents, were found well-developed (January), the larva showing the abdomen already developed and two pair of swimming-feet. There is a wide intestine (*I.æs.*) full of granules which seems to run straight from the mouth-tube, widening out in the genital segment and narrowing again posteriorly. The genital openings are situated on the ventral surface on two slightly raised knobs, between which lies the minute postabdomen.

Mandibles (fig. 25).—Length ·13 mm. Slender, irregularly toothed. Four large teeth, between which are three very small ones. Following these seven teeth are four more, which are very thin and delicate. Eleven teeth in all.

The organ of attachment by which the parasite is joined to its host is most remarkable; it will be described in detail in another paper on the organ of attachment in the family of the Lernæopodidæ.

	mm.
Length of female (without posterior processes)	5
,, process	0·5
,, ovisacs	(1) 2·6, (2) 2·8
,, first maxillipeds and tenaculum	4

Genus Brachiella, Cuvier.

Brachiella pastinaca, Van Ben. (Pl. 8. figs. 6, 7; Pl. 9. fig. 8.)

1851. *Brachiella pastinaca*, Van Ben. Annales des Sci. Nat. 3 sér. vol. xvi. p. 118, pl. 4. figs. 8–9.

1877. *Brachiella pastinaca*, Kurz, Zeitschrift für wissenchaftliche Zoologie, Bd. xxix. p. 389, pls. 25, 26, 27. figs. 2, 3, 36, 45.

1880. *Brachiella pastinaca*, A. Valle, Bollet. d. Soc. Adriatica di Sci. Nat. in Trieste, vol. vi. fasc. 1, p. 77.

1904. *Brachiella pastinaca*, T. Scott, 22nd Ann. Rep. Fish. Board Scotland, iii. p. 278.

A single specimen of what I take to be this species was found in the spiracle of the Piked Dogfish (*Acanthias vulgaris*). P. J. Van Beneden's description and figures of this species, which he obtained from the nostrils of the Sting Ray (*Trygon pastinaca*),

are not very satisfactory. He says the head passes insensibly into the thorax without narrowing to form a neck, so that at the first glance you do not know where the head is. This description certainly does not apply to the parasite from the Piked Dogfish; but after a careful comparison of my specimen with Kurz's figures and description (*op. cit.*) of *Brachiella pastinaca*, I think it is correct to identify it as that species. T. Scott obtained two specimens in the nasal fossæ of *Trygon pastinaca*, Linn., but unfortunately they were lost in the post and he was not able to give any figures (*op. cit.* p. 278). It would seem to be a somewhat rare species.

The curious position of this parasite (Pl. 8. fig. 6) is very remarkable. The head is thrown back, the arms (first maxillipeds) stretched out, and the posterior processes turned up almost at right angles to the body. Kurz's description of the general form of the body is accurate, but a short account of the appendages and some more figures may be useful. The cephalic shield which covers the dorsal surface of the head is made up of two plates, down the sides of which run strong chitinous rods of a yellow colour. There is a more slender rod of chitin between the two plates.

Appendages (female).

First Antennæ (Pl. 9. fig. 8, *A.*[1]).—Slender, four-jointed, the terminal joint bearing three setæ of different shapes, and the second joint one small seta.

Second Antennæ.—Biramose, thick, and blunt; outer branch thicker than inner branch, bearing one or two small hooks and covered with fine bristles.

Mandibles (Pl. 8. fig. 7).—These lie inside the mouth-tube and are long and slender; they differ somewhat from Kurz's description and figure (p. 390, pl. xxvi. fig. 36). He mentions three principal teeth with three smaller teeth alternating with them, the five following teeth, with the exception of the first, being considerably smaller. In the specimen from *Acanthias vulgaris* there are three large curved teeth. Between the two first of these are two very small teeth (only one is shown in the figure). These five teeth are followed by two straight and sharply pointed teeth, and these again by two more, which are very slender and delicate. There are nine teeth in all. Beyond the teeth the inner margin is produced into a rounded cutting-edge.

At the sides of the mouth-tube, just anterior to the first maxillæ, are a pair of slender clawed appendages (Pl. 9. fig. 8, *p.*), each composed of a stout basal joint and a slender curved claw. Thompson *, in his description of *Brachiella parkeri*, mentions and figures somewhat similar structures; he calls them "maxillary palps."

First Maxillæ.—See Kurz (*op. cit.*).

Second Maxillæ (Pl. 9. fig. 8, *Mx.*[2]).—Kurz does not describe these appendages, but his figure (pl. xxvii. fig. 45) corresponds fairly well with my drawing. They are two-jointed, the basal joint stout and bearing on the inner margin, just below the articulation of the terminal joint, a small pad covered with tiny bristles. About the middle of the inner margin is a small seta, and below this another small pad with bristles. The terminal joint is slender and curved, its edges having strong chitinous supports; at its end is a curved claw with a small tooth on its inner edge. At the base

* 1889. 'Transactions of the New Zealand Institute,' vol. xxii. (5th of new series) p. 374, pl. 28. fig. 8 *a* (*p.*).

of this claw is a small papilla with a single hair. Near the base of the terminal joint is a small seta.

First Maxillipeds.—Short and separate along their whole length. At the base of the cup-shaped organ of attachment they are united. The parasite was so firmly fastened to its host that it was necessary, in order to obtain the specimen undamaged, to cut away some of the tissue of the host. The structure of the tenaculum will be described in another paper.

	mm.
Length (without posterior process)	5·5
„ of posterior process	2

Kurz gives 8 mm. as the length of his specimen, but he does not say whether this measurement includes the posterior processes or not.

(?) BRACHIELLA PARKERI, Thompson. (Pl. 9. figs. 16–17; Pl. 10. figs. 18–23.)

1889. *Brachiella parkeri,* Thompson, Trans. New Zealand Inst. vol. xxii. p. 374, pl. 28. figs. 8 *a*, *b*.

One specimen of what I take to be this species, or one closely allied to it, was obtained from the gills of the Long-nosed Skate (*Raia oxyrhynchus*) in May. It was a female without ovisacs. The parasite was so firmly attached to its host that it was only dissected out with great difficulty.

General Appearance (female).

The position of this creature is very remarkable (Pl. 9. fig. 16), the head being bent backwards almost at a right angle with the body, so that the head and first maxillipeds are nearly in a straight line. The arms are very long and slender, almost the same thickness throughout their length, and only tapering slightly at the distal ends, where they are united in a disc-shaped tenaculum deeply imbedded in the tissue of the host. The head to the bend of the neck measures more than half the length of the neck and genital segment together. The neck is slender and short, passing gradually into the genital segment. From the ventral surface this portion of the body is somewhat bottle-shaped, widening posteriorly. Near the hinder margin the sides curve in, ending in two short lobes. The abdomen, which is roughly square, lies between these lobes and projects a short distance beyond the genital segment. On its dorsal surface near the sides are two stout processes borne on very short stalks. On the ventral surface of the abdomen two indistinct segments can be made out: the anterior is the shorter of the two and has a small thick-lipped slit down the centre. At the sides and slightly posterior to this slit are two knobs; between the raised folds of these lie the genital openings (Pl. 10. fig. 22, *G.O.*). The posterior segment is bluntly rounded and has a slit down the centre, the opening of the anus (Pl. 10. fig. 22, *a.*). In the preserved specimen it was not possible to determine with certainty whether the two slits were continuous or not.

The head is elongated, wider posteriorly, and becoming narrower towards the anterior end, where it is bent over so that the mouth-tube is on the ventral surface. The dorsal surface of the head is flattened. At the anterior end, where it is bent over, is a small prominence with uneven edges (Pl. 9. fig. 17, *x*); the first pair of antennæ, which are

curved backwards, are borne near the base of this structure. Between the second antennæ, and making an angle of 45° with them, is the long mouth-tube, which hangs downwards. The upper and lower lips can be readily separated and the mandible is seen lying between them. Posterior to the mandibles at the base of the mouth-tube are the first pair of maxillæ. The second maxillæ are situated far behind the first pair, about half-way between the extremity of the head and the bend of the neck. Their ends are directed forwards and project considerably beyond the surface of the head. A constriction can be seen at the back of the head and another where the body is bent back; on this segment the arms are borne. Posterior to the bend is a narrow short portion passing gradually into the wide genital segment. Indistinct traces of four segments can be made out in this portion of the body. The first two subequal; the next about one and one-third longer, the fourth about three times as long as the first. It is doubtful if these are true segments. Two bands of muscle can be seen running down the centre of the genital segment; at a point which corresponds with the first constriction behind the neck their continuation seems interrupted: this is probably a true segment. These muscles run backwards almost to the base of the abdomen. On each side of them are two large masses of ova extending forwards into the first segment. There is another mass of ova beneath the ventral surface, and lying between these masses are a pair of thick-walled cement-glands (Pl. 9. fig. 16, *C.G.*), which extend forward to a point about the middle of the total length of the genital segment. From the side they can be seen curving round in the prominences at the posterior margin of the body just above the genital openings (fig. 16, *G.O.*).

Appendages (female).

First Antennæ (Pl. 10. fig. 23).—Two-jointed, basal joint one and a half times as long as the terminal joint, which is slender, bearing two delicate tapering setæ, one of which is thicker than the other, and two more very small setæ. Rather below the middle of this joint is another small seta.

Second Antennæ (Pl. 10. fig. 19).—Stout, biramous. The two branches are borne on a stout basal portion which is not distinctly segmented. The outer branch is about the same thickness throughout, with a blunt truncated extremity. This portion bears three rounded knobs, the two outer smaller and more raised than the median knob. All are covered with fine bristles and a few small hooks. The outer margin of this branch is also covered with bristles. The inner branch of the main stem is not so stout as the outer branch. The outer edge is covered with bristles, and above this part is a rounded knob on which is a slightly hollow disc full of bristles with a small seta at its base and another longer seta near the outer edge. On the inner side of this disc is a strong sharp claw with a small seta at its base. The segmentation of both branches is indistinct.

Mandibles (Pl. 10. fig. 20).—Four large teeth alternating with three small teeth: these seven are followed by four more, the first two of which are longer than the other two. Behind the teeth is a cutting-edge.

First Maxillæ (Pl. 10. fig. 21).—Biramous. The outer branch bearing three long tapering setæ. The inner branch small and stump-like, bearing two small setæ. The

segmentation of this appendage is indistinct, but traces of two joints on the main stem below the inner branch can be seen.

Second Maxillæ (Pl. 10. fig. 18).—Very indistinctly segmented, traces of three joints can be made out, the last bearing a short simple claw ; below this on the inner margin of the same joint is a delicate short seta. Between the two appendages, at their base, are two small raised folds. The outer free margin is much longer than the inner, so that one appendage could not be dissected without tearing the other. The structure of these appendages is peculiar and unlike those of other species of *Brachiella*. There was no claw on the left appendage—it may, however, have been accidentally destroyed.

	mm.
Length from top of arms to end of abdomen	9·2
„ from end of head to extremity of attachment	19
„ of arms	14·5
„ of body from bend of neck to end of abdomen	8
„ of head to bend of neck	5·3
„ of process	4
Width of neck	1·5
„ of genital segment	5·2

This species seems to be nearly allied to, if not identical with, *Brachiella parkeri*, Thompson (*op. cit.*), from the gills of *Raia nasuta* and also a Stingaree (*Trygon* sp. ?), Otago Museum, but it differs from it in several particulars.

There is some difference in the size. The following are Thompson's measures of *Brachiella parkeri* :—

	mm.
Head and thorax	8
Length of arms	17
„ genital segment	11
Width	7
Length of process	10
Total length of animal from bend of thorax	12

On a comparison of these figures it will be seen that my specimen is considerably smaller, but it was without ovisacs and is probably a young female. Thompson, in his brief account of this parasite, mentions and figures a pair of " maxillary palps " at the base of the rostrum ; these appendages were not observed in the form now described. The great length of the posterior processes, 10 mm. as compared with 4 mm. in the British form, should also be noted. But, on the other hand, the position of the head in a " nearly continuous line with the arm-like appendages and bent at right angles to the genital segment " is very characteristic of my specimen. Also Thompson's description of the first maxillipeds (he calls these appendages " second maxillipeds "), as " conical protuberances which show no distinct segmentation " and which are situated " about three millimetres from the extremity of the cephalothorax," applies closely to the structure and position of these appendages in the form from the Long-nosed Skate. I

have thought it better therefore provisionally to call this parasite *Brachiella parkeri*, Thompson.

The structure of the tenaculum with its remarkable sucker will be described in another paper.

Genus ANCHORELLA, Cuvier (1817).

ANCHORELLA RUGOSA, Kröyer. (Pl. 10. figs. 28–32 ; Pl. 11. figs. 33–37.)

1837. *Anchorella rugosa*, Kröyer, Naturh. Tidsskr. Række 1, Bd. i. p. 284, pl. 2. fig. 7, pl. 3. figs. 14 *a–e*.
1840. *Anchorella rugosa*, Milne-Edwards, Hist. Nat. Crust. iii. p. 519.
1851. *Anchorella rugosa*, p. 7, Van Beneden, Ann. Sci. Nat. 3me série, vol. xvi. p. 114, pl. 6. figs. 7–10.
1863. *Anchorella rugosa*, Kröyer, Naturh. Tidsskr. Række 3, Bd. ii. p. 383.
1879. *Anchorella rugosa*, C. Vogt, Recherches Côtières faites à Roskoff; Genève.
1899. *Anchorella rugosa*, Bassett-Smith, "A Systematic Description of Parasitic Copepoda found on Fishes," Proc. Zool. Soc. London, April 1899, p. 503.
1900. *Anchorella rugosa*, T. Scott, 18th Ann. Rep. Fish. Board Scot. pt. iii. p. 176, pl. 8. figs. 45–48.

This species seems to be fairly common on the gills of the Catfish (*Anarrhichas lupus*, Linn.). There is considerable variation in the size of the female. One specimen measured 4 mm. from the base of the first maxillipeds to the end of the abdomen. The cephalothorax measured 6·5 mm. in length and the width of the genital segment was 3·6 mm. In another specimen these measures were respectively 2·3 mm., 4·4 mm., and 2·8 mm.

The Female.—Kröyer's description of this parasite is good, but his figures are poor. T. Scott (*op. cit.* 1900) also gives a short account and some figures of this species. The square outline of the genital segment and the stout wavy cephalothorax, which in life is doubled back and lies close to the dorsal surface, are very characteristic, as is also the jerky movement of the head from side to side and the slow movement up and down of the ovisacs. Kröyer mentions the peculiar movement of the end of the cephalothorax. Slighter movements of the antennæ and second maxillæ can be seen. In life the colour of the genital segment is yellowish and semi-transparent. A wide brown intestine with wavy borders runs down the cephalothorax and can be seen as a conspicuous brown mass on the ventral surface of the genital segment. The ova are paler in colour and each shows two specks of brown pigment (February). The chitinous structures are deep yellow. On the ventral surface (the side away from the cephalothorax), just anterior to the abdomen and between the ovisacs, are two yellow chitinous spots (the openings of the *receptacula seminis*); projecting from these in one specimen were two semi-transparent packets in shape like long narrow pods: these are probably spermatophores. On another female without ovisacs two globular semi-transparent bodies were observed projecting from the openings of the oviducts. They measured ·66 mm. in width and were ·8 mm. long. Possibly they are the commencement

of the ovisacs? The muscular system will be described in another paper on the attachment of this parasite.

The Male.—Males are found attached to different parts of the female, sometimes on the cephalothorax or on the postabdomen, and in one case on the dorsal surface. They are minute and easily detached, holding on by means of the claws of the second maxillæ. In life they are semi-transparent and show no distinct segmentation. A wide coiled tube, the testis (Pl. 10. fig. 29, *T.*), fills up most of the body; there is also a broad intestine (fig. 28, *I.*) with sacculated walls which narrows posteriorly and opens where the carapace curves inwards (*a*). The intestine contains numbers of brownish-green cells; these are probably the excretory cells of Claus and are mentioned also by Wierzejski * in his description of the males of *Penella varians* (?). Clear oil or fat-globules are present in numbers in the digestive tube. Beneath the dorsal surface in the median line is a patch of red pigment (figs. 28, 29, *Pg.*), and there is a less conspicuous patch near the base of the first maxillipeds. At the base of these appendages on each side is a small coiled slightly raised structure, which looks like the opening of a gland (*P.*). Kurz †, in his description of the male of *Anchorella emarginata*, a species closely allied to *A. rugosa*, mentions two protrusible papillæ, at the extremities of which are the genital openings (fig. 11, *gp.*) and which are situated behind the "second maxillipeds" (first maxillipeds). It seems doubtful, however, from the position of these openings in *A. rugosa* whether they can be genital.

The description given by Kurz of the appendages of the male of *A. emarginata* (p. 401, figs. 11, 27, 28) seems to correspond closely with those of this species.

The Second Antennæ (fig. 31) are much like his figure (fig. 28, a^2), but he does not mention two delicate setæ on the paddle-shaped branch.

The Mandibles (Pl. 10. fig. 30).—The same as in the female, but much smaller and more slender; the teeth do not appear to be quite so sharply pointed as in Kurz's figure (fig. 31) of the mandible of *A. emarginata*.

The First Maxillæ (fig. 32).—See Kurz (figs. 27, 28, *mx.*).

The First Maxillipeds (Pl. 11. fig. 36).—Very stout and bearing strong claws. There is a small tooth on the claw, which is doubled in and seems to work on a pad covered with bristles. On the stout basal part of the appendage is a seta.

	mm.
Length of male of *A. rugosa*	·86
„ „ *A. emarginata*	·43

Mr. Bassett-Smith (*op. cit.* 1899) considers *A. emarginata* to be synonymous with *A. rugosa*, but the two species although closely allied seem to be quite distinct.

* "Ueber Schmarotzerkrebse von Cephalopoden," Zeit. wissen. Zool. Bd. xxix. 1877, 4 Heft, p. 567, pl. xxxii. fig. 1, K^2.

† "Studien über die Lernæopodiden," Zeit. wissen. Zool. Bd. xxix. 1877, p. 402, fig. 11, *g.p.*

ANCHORELLA UNCINATA, Müller (variety from the fins of the Cod). (Pl. 11. figs. 43–46.)

(For synonymy and literature, see Bassett-Smith, *op. cit.* 1899, p. 505.)

Two females of what seems to be a variety of *Anchorella uncinata*, Müller, were obtained from the fin of a Cod (*Gadus morrhua*).

General Appearance (female).

The animal is somewhat flattened and is invested by a loose bag-like membrane (fig. 43). On the fin of the host where the parasite is attached is a large oval swelling (*s.*). The tenaculum is deeply imbedded in this swelling, only a small portion of the end of the chitinous stem being free. The two arms (first maxillipeds) are short but distinct, and are only united at the base of the stem of the tenaculum. Two glands open to the exterior on the transparent investing membrane close to the base of the arms. Similar glands are present in the common form of this species. The genital segment shows traces of three segments; the third is separated from the preceding segment by a deep indentation at the sides. From this segment the pear-shaped abdomen projects beyond the posterior margin of the body; it is borne on a stalk (*p.ab.*). The cephalothorax lies close to the genital segment and is moderately stout, increasing in thickness towards the head. In the larger of the two specimens it is a little longer than the genital segment, in the smaller considerably longer. On the sides at the end of the abdomen are two openings with thickened edges: two tubes can be seen running down the abdomen to open at these points.

The tenaculum will be described in another paper.

The appendages are the same as in *A. uncinata*, Müller. This variety differs considerably from the common form in its general appearance, being much flatter, and in the position of the cephalothorax. The curious pear-shaped swelling on the fin of the host is remarkable, as the common form of *Anchorella uncinata* does not seem to produce this swelling.

	mm.
(1) Length of female	3
(2) „ „	2

ANCHORELLA STELLATA, Kröyer. (Pl. 11. figs. 38–42.)

1838–39. *Anchorella stellata*, Kröyer, Naturh. Tidssk. Række 1, vol. ii. p. 142, pl. 3. fig. 5.

1864. *Anchorella stellata*, Kr. op. cit. Række 3, vol. ii. p. 383.

1900. *Anchorella stellata*, T. Scott, 18th Ann. Rep. F. B. Scot. iii. p. 178.

1901. *Anchorella stellata*, T. Scott, op. cit. 19th, p. 134, pl. 8. figs. 1, 2.

This species was first described by Kröyer, and T. Scott gives a description of it (1900) and some figures (1901). As the species is very interesting, I give a few more notes and some drawings.

Five specimens were found on the skin of a Hake (*Merluccius vulgaris*, Linn.) near the pectoral fin. They were all females and without ovisacs. The Hake was purchased at Sheringham, Norfolk.

General Appearance (female).

The genital segment and cephalothorax are much flattened and are invested by a loose bag-like membrane. The first maxillipeds (fig. 38, *Mxp.*[1]) are rather more than one-third of the length of the cephalothorax. They appear to be quite distinct, but the investing membrane seems to be fused along the median line, so that the two appendages cannot be separated. The ends are enlarged into two semicircular folds, between which the tenaculum lies. In the genital segment on either side are two large thick-walled cement-glands (*C.G.*). The relations of the genital apparatus were not easy to make out in preserved specimens, but the following points may be noticed:—The ends of the oviducts have thick chitinous walls (*Od.*); they open on the raised knobs on either side of the minute abdomen (*G.O.*). Two boat-shaped structures with chitinous walls lie at right angles and dorsally to them, and are probably the *receptaculum seminis* (*R.S.*). At the inner side of the thick wall of the oviduct is a smaller chitinous structure (*x*), lying apparently dorsal to the *receptaculum seminis*. Vejdowski *, in his paper on *Tracheliastes polycolpus*, Nordm., figures structures not unlike these, but the canals which he observed leading from either end of the *receptaculum seminis* to the external opening were not made out in *Anchorella stellata*.

On the abdomen are two minute chitinous structures; these are probably the external openings of ducts leading into the receptacula seminis.

The appendages are very similar to those of *Anchorella uncinata*, Müller.

The Mandible (fig. 42).—This is very irregularly toothed. The first tooth is large, followed by two smaller teeth, the fourth is very long and prominent, the fifth and sixth are smaller. Following these is a curved cutting-edge. There are six teeth in all.

In size these specimens corresponded very closely with those obtained on the Hake by T. Scott.

	mm.
Length of female	6
„ cephalothorax	3·5
Width of genital segment	2

* "Unters. über die Anatomie u. Metamorphose v. *Tracheliastes polycolpus*, Nordm.," 1877, Zeit. wissen. Zool. Heft. i. p. 32, pl. 3. fig. 4, *r.s.*

EXPLANATION OF THE PLATES.

The following letters apply to all the figures:—*A.*[1], first antenna; *A.*[2], second antenna; *a.*, anus; *C.th.*, cephalothorax; *C.F.*, caudal furca; *C.G.*, cement-gland; *E.c.*, excretory cells; *F.*[1], *F.*[2], *F.*[3], first, second, third thoracic foot or swimming-foot; *F.l.*, fore lip; *G.O.*, genital opening; *G.S.*, genital segment; *I.*, intestine; *I.B.*, inner branch of second antenna or first maxilla; *H.l.*, hind lip; *M.*, muscle, muscle-band; *m.*, mouth, mouth-tube; *Md.*, mandible; *Mx.*[1], first maxilla; *Mx.*[2], second maxilla; *Mxp.*[1], first maxilliped; *O.B.*, outer branch of second antenna, or first maxilla; *Od.*, oviduct; *Œs.*, œsophagus; *Ov.*, ovary; *Ovs.*, ovisac; *Pg.*, pigment; *P.*, papilla; *p.ab.*, postabdomen; *P.p.*, posterior process; *R.S.*, receptaculum seminis; *S.G.*, excretory gland; *S.l.*, side lip or lateral outgrowth of hind lip; *T.*, testis; *t.*, tenaculum.

PLATE 8.

Bomolochus soleæ, Claus.

Fig. 1. Female. Length 1·53 mm. Ventral.
2. Male. Length ·83 mm. Ventral. Enlarged to the same scale as fig. 1.
3. Male. Second antenna, showing part of the upper lip, mandible, and first maxilla. The length AB=·1 mm. *Ch.p.*=chitinous plate.
4. Female. Mouth-parts. Cleared with potash. Length=·11 mm.
5. Males. First maxilliped. Length of AB=·14 mm., BC=·15 mm.

Brachiella pastinaca, Van Beneden.

6. Female. Length 5·5 mm.; length of head 2·4 mm. × 10.
7. Female. Mandible. Length ·18 mm.

PLATE 9.

Brachiella pastinaca, Van Beneden.

Fig. 8. Female. Mouth-parts. The length AB=1·05 mm.

Chondracanthus inflatus, sp. n.

9. Female with ♂ attached to abdomen. Length of female 5 mm.
10. Male. Ventral. Length ·6 mm.
11. Male. First maxilliped. Length ·16 mm.
12. Female. Mouth-parts, upper lip removed.
13. Female. Mouth-parts. × 139 approx.
14. Female. Abdomen, ventral, showing oviducts. Length ·5 mm.
15. Male. Thoracic limbs. Length ·04 mm.

(?) *Brachiella parkeri*, Thompson.

16. Female. × 3·3.
17. Female. Mouth-parts. × 40.

Plate 10.

(?) *Brachiella parkeri*, Thompson (female).

Fig. 18. Second maxilla. AB = ·41 mm.
19. Second antenna. AB = ·3 mm.
20. Mandible. Length ·24 mm.
21. First maxilla. Length ·21 mm.
22. Abdomen, ventral.
23. First antenna. Length ·4 mm.

Lernæopoda cluthæ, T. Scott.

24. Length (including posterior processes) 5·5 mm.
25. Mandible. Length ·13 mm.
26. Second antenna.
27. First maxilla. Length ·16 mm.

Anchorella rugosa, Kr. (male).

28. Side view. *Pg.* = patch of red pigment. *E.c.* = excretory cells, brownish green in colour.
29. Length ·86 mm.
30. Mandible. Length ·07 mm.
31. Second antenna. Length ·1 mm.
32. First maxilla. Length ·1 mm.

Plate 11.

Anchorella rugosa, Kröyer.

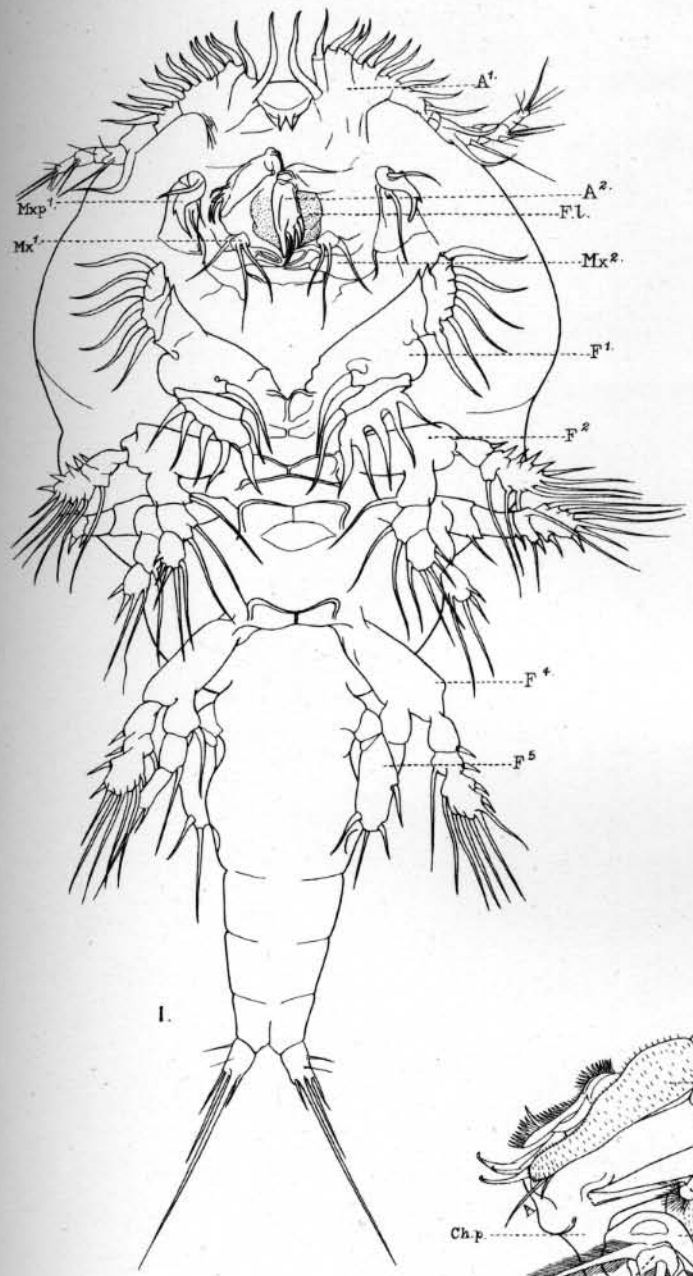
Fig. 33. Female. Mouth-parts. AB = ·8 mm. The second maxilla on the left is cut away to show the first maxilla.
34. Female. Second maxilla, terminal joint. Length ·17 mm.
35. Female. First maxilla. Length ·13 mm.
36. Male. First maxilliped. Length ·22 mm. Cleared with potash.
37. Female. Mandible. Length ·12 mm.

Anchorella stellata, Kröyer (female).

38. Length 6 mm. (including tenaculum to end of abdomen). *s.* = tissue of host; ×, part of genital apparatus.
39. First antenna. Length AB = ·13 mm.
40. Second maxilla. AB = ·17 mm.
41. First maxilla. Length ·1 mm.
42. Mandible. Length AB = ·12 mm.

Anchorella uncinata, Müller, female (variety from the fins of *Gadus morrhua*).

43. Length 3 mm. (including tenaculum to end of adbomen). *s.* = swollen tissue of host.
44. Mouth-parts. × 147 approx. Slightly compressed.
45. Second maxilla. AB = ·16 mm.
46. Mandible. Length ·09 mm.



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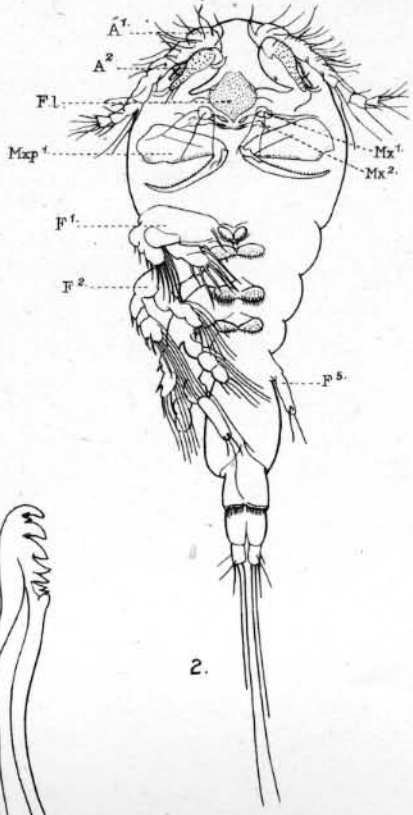

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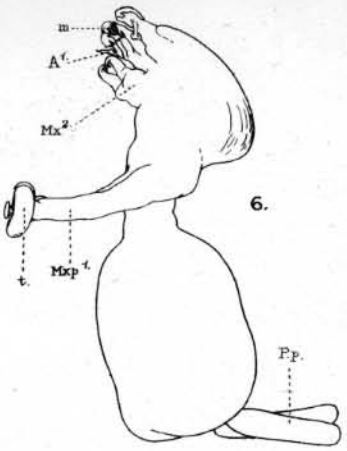

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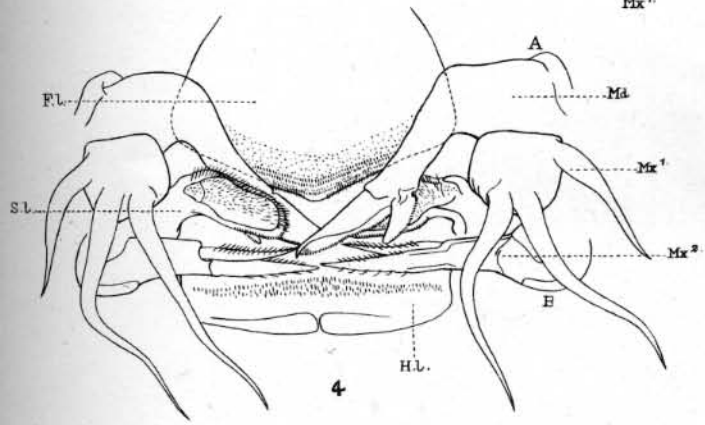

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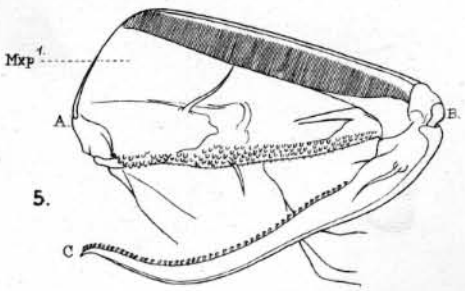

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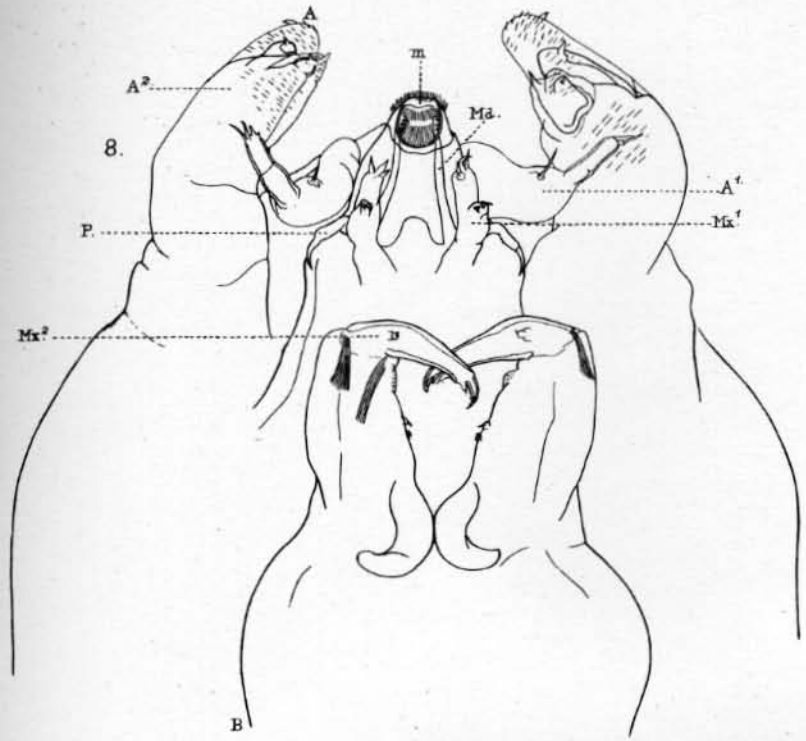
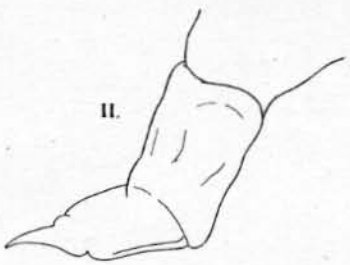
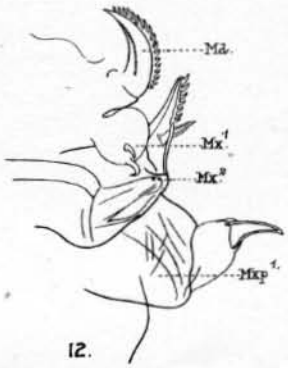
M.E.B. del.

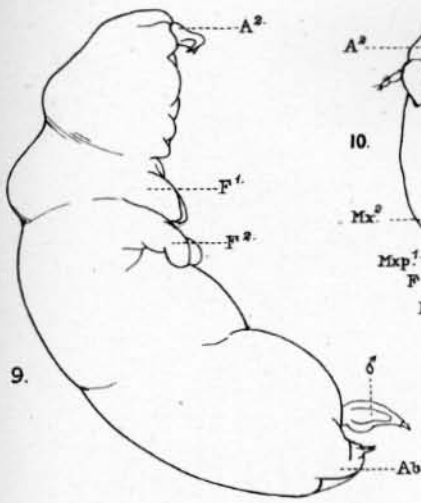
PARASITIC COPEPODA.

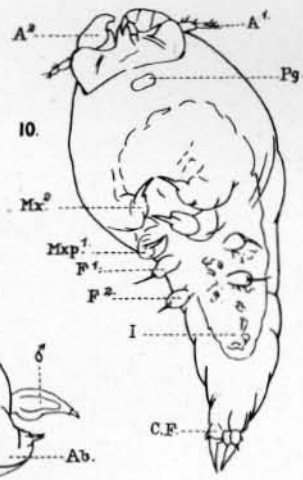
M.P. Parker lith.
Parker & West imp.

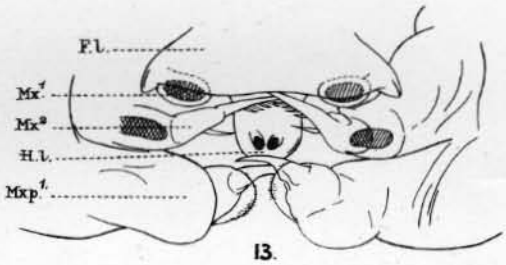


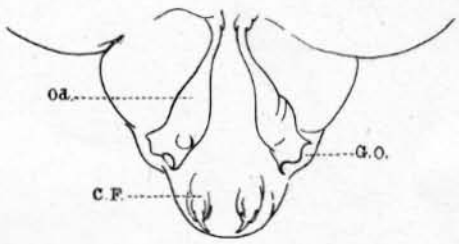


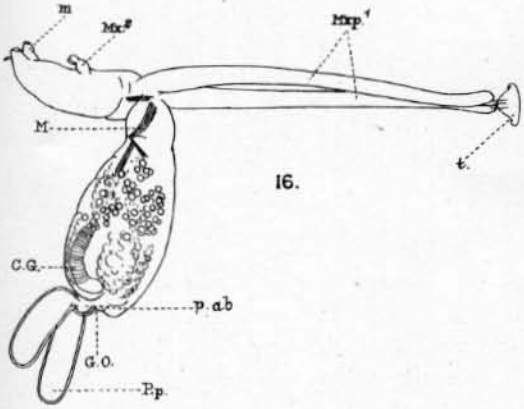


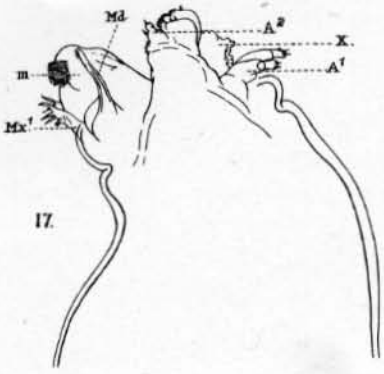


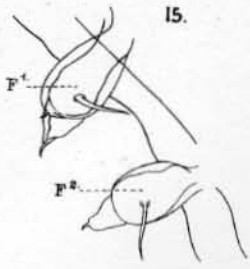








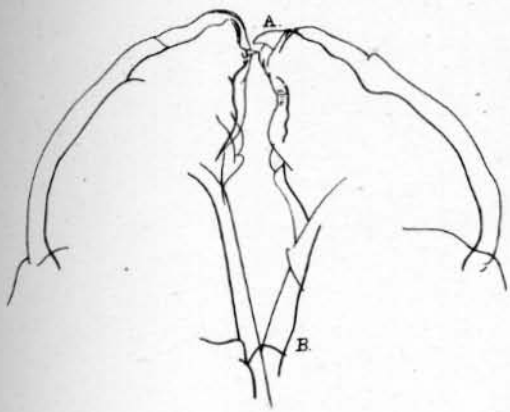




M. E. B. del.

PARASITIC COPEPODA.

M.P Parker lith.
Parker & West imp.



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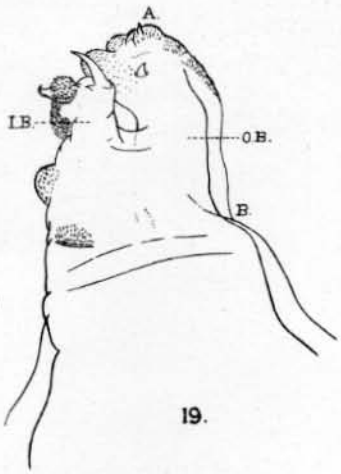

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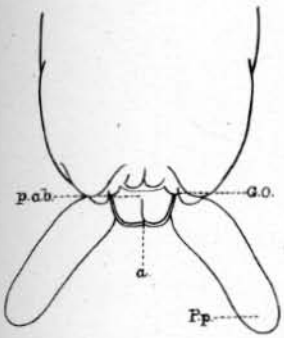

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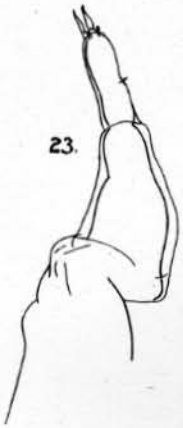
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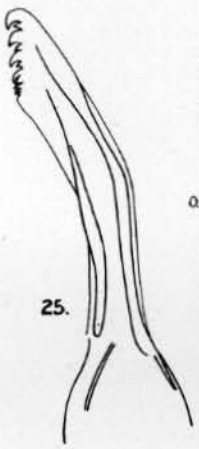
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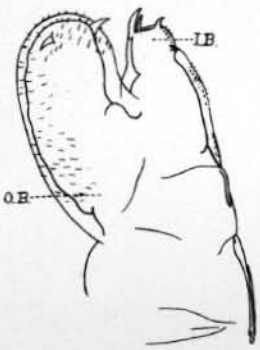

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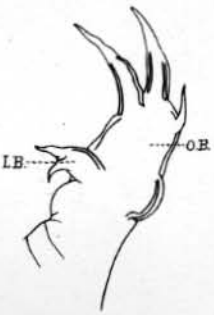

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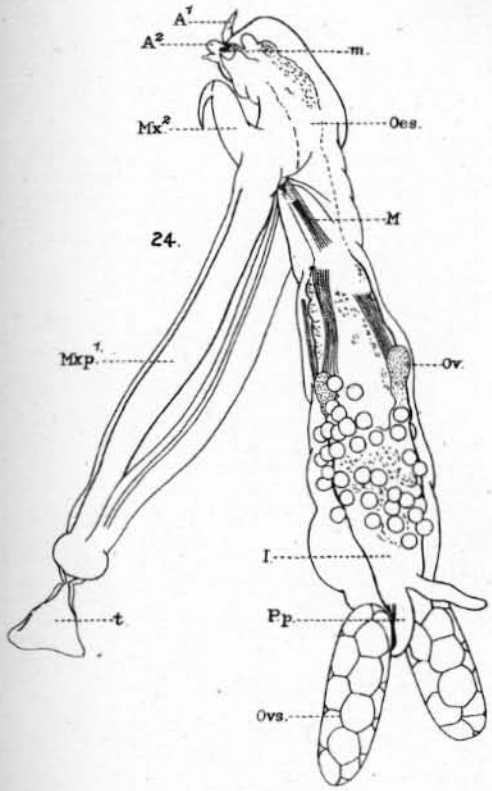

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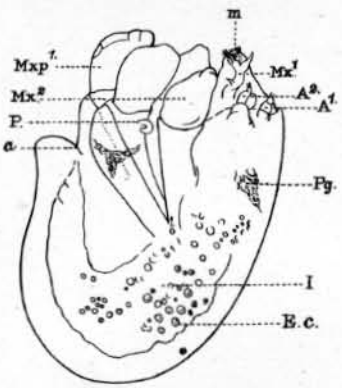

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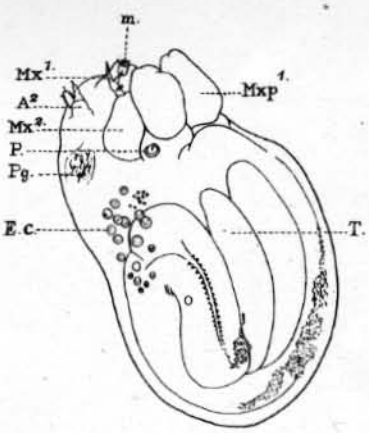

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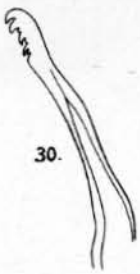
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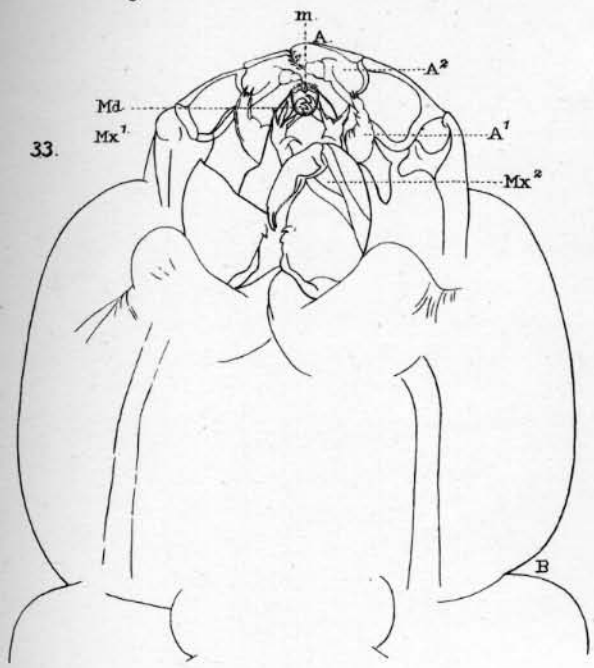

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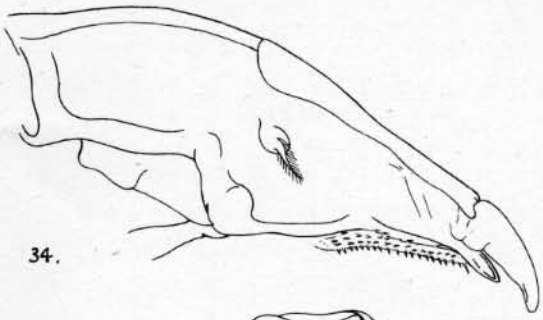
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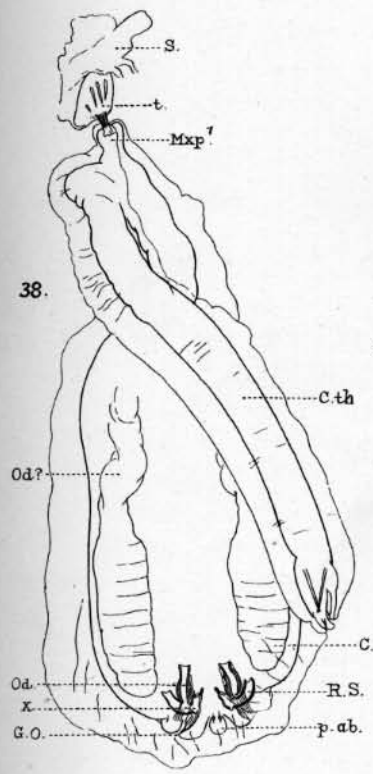

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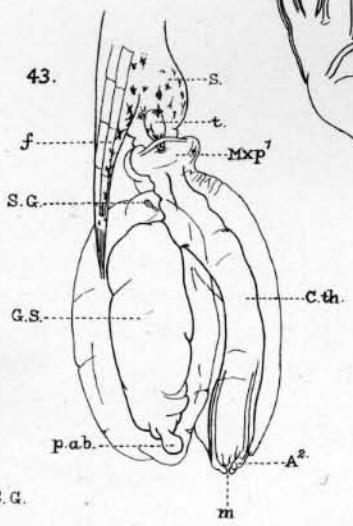

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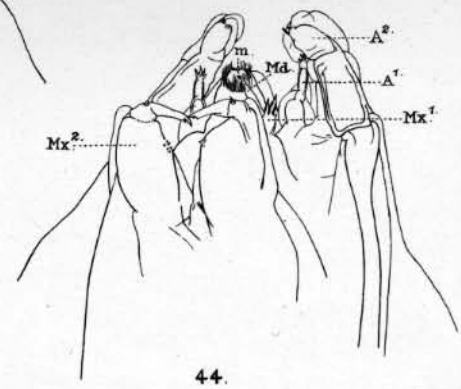

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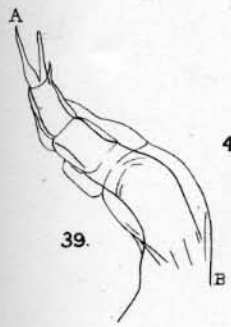

39.

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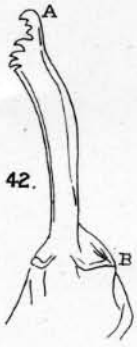
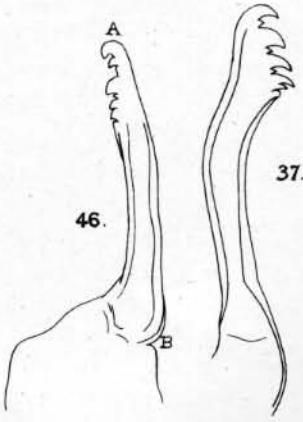


42.

45.



46.

37.

M.E.B. del.

PARASITIC COPEPODA.

M.P Parker lith.
Parker & West imp.