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IX.

PARASITIC COPEPODS FROM NANAIMO, BRITISH COLUMBIA, INCLUDING EIGHT SPECIES NEW TO SCIENCE.

(WITH SEVEN PLATES)—PLATES III-IX.

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The following paper describes a collection of parasitic copepods which were kindly sent to the author from Nanaimo, British Columbia. At this place is located the Pacific Coast Biological Station of the Department of Marine and Fisheries of Canada. The specimens were all collected by Rev. George W. Taylor, the efficient director of the station, and were admirably preserved.

Mr. Taylor, on first assuming the position, took great interest in the fish to be obtained from the immediate vicinity of Nanaimo, and he has made a careful and earnest study of them at different seasons of the year.

Among the many valuable results of such a study this collection of parasites may well claim a prominent place, as well for its scientific as for its economic interest.

They furnish abundant proof of the care and skill with which the study has been conducted, and make a valuable addition to our knowledge of the parasitic fauna of the Pacific coast of North America.

The collection includes fourteen species of which eight prove to be new to science, as follows: *Argulus borealis* from *Lepidopsetta bilineata: Lepeophtheirus pravipes* from *Ophiodon elongatus: Lepeophtheirus nanaimoensis,* the record of whose host has been lost: *Chondracanthus palpifer* from *Gadus macrocephalus: Chondracanthus pinguis, Clavella parva,* and *Clavella robusta* from *Sebastodes auriculatus: Brachiella dentata* from *Raja binoculata.* A ninth species, *Argulus pugettensis,* was originally described by Dana in 1854, but he only saw female specimens, his types were lost soon after they were described, and there is no record of the host on which they were found. The present collection has an abundance of specimens of both sexes, and from two well known hosts. So large a proportion of new species is to be expected when we remember that this is the first collection to be made from the extreme northern portion of the Pacific coast. That region is very prolific in new forms as is abundantly testified by the results of the Harriman expedition a few years ago.

Grateful acknowledgment is further made, in behalf of the United States National Museum, for the permission generously profferred by Mr. Taylor to keep a full set of specimens from the collection for the museum. These specimens, including types of the new species, have been deposited in the museum and bear the numbers given in the text.

Argulus borealis, new Species.

Plate III.

Female.—General body form long and moderately wide; carapace elliptical, considerably longer than wide; cephalic area broadly U-shaped, projecting well anteriorly and with the base of the U reaching back nearly to the margin of the first thorax

segment; the lateral margins continuous, not broken as in *pugettensis;* eyes far forward and relatively very large; individual ocelli small and numerous; H-grooves indistinct and very difficult to trace, lateral areas broad and terminating in wide and bluntly rounded lobes which hardly reach the middle of the third thorax segment, posterior sinus broad, shallow and subrectangular.

Free thorax segments as wide as the abdomen, overlapping the basal joints of the swimming legs on either side.

Abdomen almost a perfect ellipse in outline, one-fifth longer than wide; posterior lobes very short and bluntly rounded; anal sinus little more than a shallow indentation; anal laminæ basal, short, and stout, each terminating in three setæ.

Basal joint of the first antenna with a long acuminate spine on its posterior margin, and a similar accessory one immediately behind it on the ventral surface of the head; terminal claw long and slender, with a sharp claw on the posterior margin near the base and another on the anterior margin nearer the centre; palp slender and projecting well beyond the claw. Second antennæ slender, with a long acuminate spine on the posterior margin of the basal joint. Mouth-tube short and broad, with an evenly rounded posterior margin. Sucking disks of medium size, placed well forward and separated by a considerable interval. The supporting ribs of the disk margin are made up of two parts; the basal portion is a slender chitin rod one-third the length of the rib, and bent at a right angle close to the base of the margin. At its distal end this rod passes into a series of cup-shaped plates, seven or eight in number. The distal end of each plate is slightly concave and fits over the convex proximal end of the plate next outside it. The plate at the extreme margin is shorter and wider than the others, and its distal end is straight.

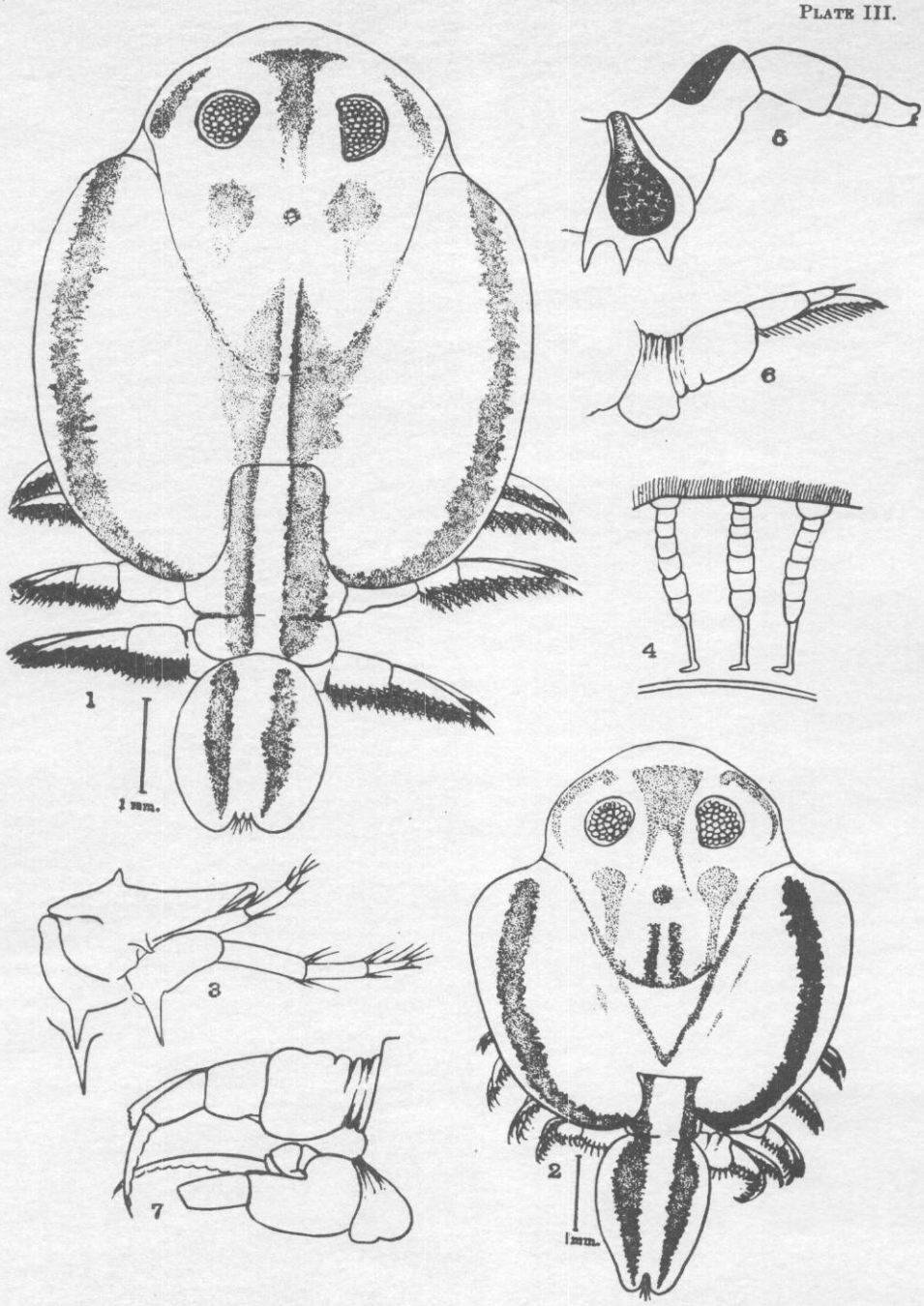
The second maxilliped has a broad basal plate, armed with three stout and acute teeth, on its posterior margin. The raised area on this plate and a similar area at the distal anterior corner of the second joint are armed with circular rough warts or papillæ. The swimming legs are of the usual pattern, except the fourth pair, which lack the projection of the basal joint.

Colour (preserved material). Ground colour of the dorsal surface a light creamy yellow: cephalic groove, a circular spot over each sucking disk, an elongate area reaching from the centre of the frontal margin back along the mid-line behind the eyes, and a small triangular area at each frontal corner of the cephalon, light cinnamon brown; eyes black; a narrow band on either side of the carapace, parallel with the lateral margin and close to it, and a wider longitudinal band on either side of the abdomen, about half way between the mid-line and the margin, dark brown, almost black: a broad median line of clear light yellow runs the whole length of the carapace and thorax, just above the digestive tube; on either side of it the tissues are darkened considerably with brown.

Ventral surface a uniform cream yellow with light cinnamon brown bands along the margins of the carapace and on the abdomen, corresponding to those on the upper surface; the inside of the sucking disks, the basal joints of the swimming legs and the second maxillipeds, a triangular spot at the centre of the frontal margin, and a small triangular area at each frontal corner of the cephalon, lightly washed with cinnamon brown. These lighter markings vary considerably in different specimens, but the bands and the heavier markings are quite uniform.

Total length, 8·5 mm. Length of carapace, 6 mm. Width of same, 5 mm. Length of abdomen, 1·9 mm.; width, 1·6 mm.

Male.—Much smaller and relatively wider than the female. Carapace more orbicular than elliptical, as wide as long, with deep lateral sinuses, behind which on either side is formed a prominent shoulder. Posterior sinus like that of the female, broad, shallow, and rectangular. Posterior lobes broad and bluntly rounded, and almost reaching the anterior edge of the abdomen, thus concealing the bases of all the legs.



The Male and Female of *Argulus borcalis*.

For ex lanation of plate see p. 100

Abdomen narrow elliptical, tapering slightly posteriorly; anal sinus a shallow slit; anal laminæ basal and linear.

The semen receptacles reach the entire length of the abdomen, and are considerably swollen.

Appendages like those of the female, except for the sexual modifications; the peg at the anterior distal corner of the second segment of the fourth legs is seemingly made up of two parts, one of which, the terminal, fits inside the other. The second joint of the third legs is not much swollen to form the accessory semen receptacles.

Both sexes are coloured alike, but in the male the dark band around the margin of the carapace is extended along the edge of the thorax, and becomes continuous with that in the abdomen on the same side, the latter being nearer the margin.

Total length, 4 mm. Length of carapace, 2·75 mm. Width of same, 2·75 mm. Length of abdomen, 1·1 m.; width, 0·75 mm. (*borealis*, boreal or northern, from its habitat).

This is a beautiful and strikingly coloured *Argulus*, occupying among the salt-water species a position similar to that of *A. versicolor* among the fresh-water forms. Eight specimens, including both sexes, were obtained from beneath the pectoral fins of ***Lepidopsetta bilineata***. Three of these, two females and a male, are made the types of the species and are numbered 38647 U.S.N.M.

Argulus pugettensis, Dana.

Plate IV.

Argulus pugettensis, Dana, 1852, p. 1351: pl. XCIV, fig. 2; Theile, 1904, p. 32: pl. VIII, figs. 77-82 (male).

Female.—Carapace obovate, as wide as long; frontal sinuses well defined; cephalic area a spherical triangle in outline, slightly longer than wide, its marginal groove broken on either side just back of the eyes; sides of the H-groove nearly straight and close together, transverse bar placed well behind the median eye. Lateral areas broad, tapered posteriorly to quite a sharp point, which extends slightly beyond the anterior margin of the fourth thorax segment; each area has a long groove extending through its centre which is met by three others, two coming from the marginal groove which surrounds the cephalic area and forming the sides of an equilateral triangle, the third extending outward toward the margin of the carapace at right angles to the body axis.

The posterior sinus is broad enough to show most of the dorsal surface of the thorax, and is slightly enlarged at its base. The abdomen is elongate-spatulate, two-sevenths of the entire length, and produced posteriorly into two narrow lobes, acutely pointed and parallel with each other. Anal sinus cut to the centre of the abdomen, narrow, with slightly flaring sides; anal laminæ basal and linear, each tipped with two minute setæ.

First antennæ with a broad laminate spine on the posterior margin of the basal joint; the terminal claw has an accessory claw on its anterior margin near the base, and a small spine on its posterior margin. Terminal portion of the claw beyond the bend very long and slender; palp two-jointed and reaching well beyond the bend in the claw. Second antennæ short and slender, the basal joint with a broad spine on its posterior border; each of the joints with a tuft of small setæ at the anterior distal corner. Mouth-tube short and narrow, and somewhat enlarged at the end; maxillæ standing out prominently in ventral view; sting long and slender, reaching forward in front of the bases of the antennæ.

Sucking disks large and placed well forward with a wide interval between them; margin wide, but not much flared, being rather cylindrical. The supporting rays are

formed of rows of crescent-shaped plates, the convex sides proximal, the concave distal. There are fourteen or fifteen plates in each row, diminshing slightly in size from the base outwards..

Swimming legs of the usual pattern, the fourth pair with short and blunt protuberances on the basal joints. This pair is entirely visible in dorsal view, since the carapace only reaches the anterior margin of the fourth segment.

Colour (preserved material).—Dorsal surface a pale yellowish green, intensified along the grooves, lighter and with more yellow over the digestive tract. Eyes and brain a deep olive green; a small elliptical spot of deep green at the base of each arm of the H-groove on the inner side. Ventral surface a uniform greenish yellow.

The specimens vary greatly in size; the largest is 11·5 mm. long, the smallest only 5 mm. Between these are several of about the same length which is accordingly taken as a fair average. Total length, 7 mm. Length of carapace, 4·66 mm.; width, 4·5. Length of abdomen, 2 mm.; width, 1·16 mm.

Male.—Much smaller and more elongate than the female; carapace widest near the centre and considerably narrowed anteriorly and posteriorly; grooving the same as in the female, except that the arms of the H are not parallel, but approach each other closely between the eyes. The posterior sinus of the carapace is shallower than in the female, and the lobes reach nearly to the middle of the fourth segment. But they still leave a considerable space in front of the abdomen and show the bases of the fourth legs in dorsal view.

Abdomen about one-third the entire length, twice as long as wide, with nearly straight sides; anal sinus two-fifths of the abdomen length; anal laminæ basal and linear; posterior lobes acuminate and parallel. Sperm receptacles elongate-elliptical, filling the entire abdomen in from of the sinus. Second joint of the fourth legs with a very long and acute peg at the inner distal corner; basal joint of the third legs only one-third the length of the second joint, the latter swollen near its proximal end to once and a half the diameter of the basal joint, forming there the secondary sperm receptacles.

Colour similar to that of the female, except that the green is more intense on the dorsal surface, especially over the sperm receptacles in the abdomen. These receptacles are also green on the ventral surface, the colour on both surfaces being considerably intensified around the entire margin, causing the organs to stand out in sharp contrast to the remainder of the abdomen.

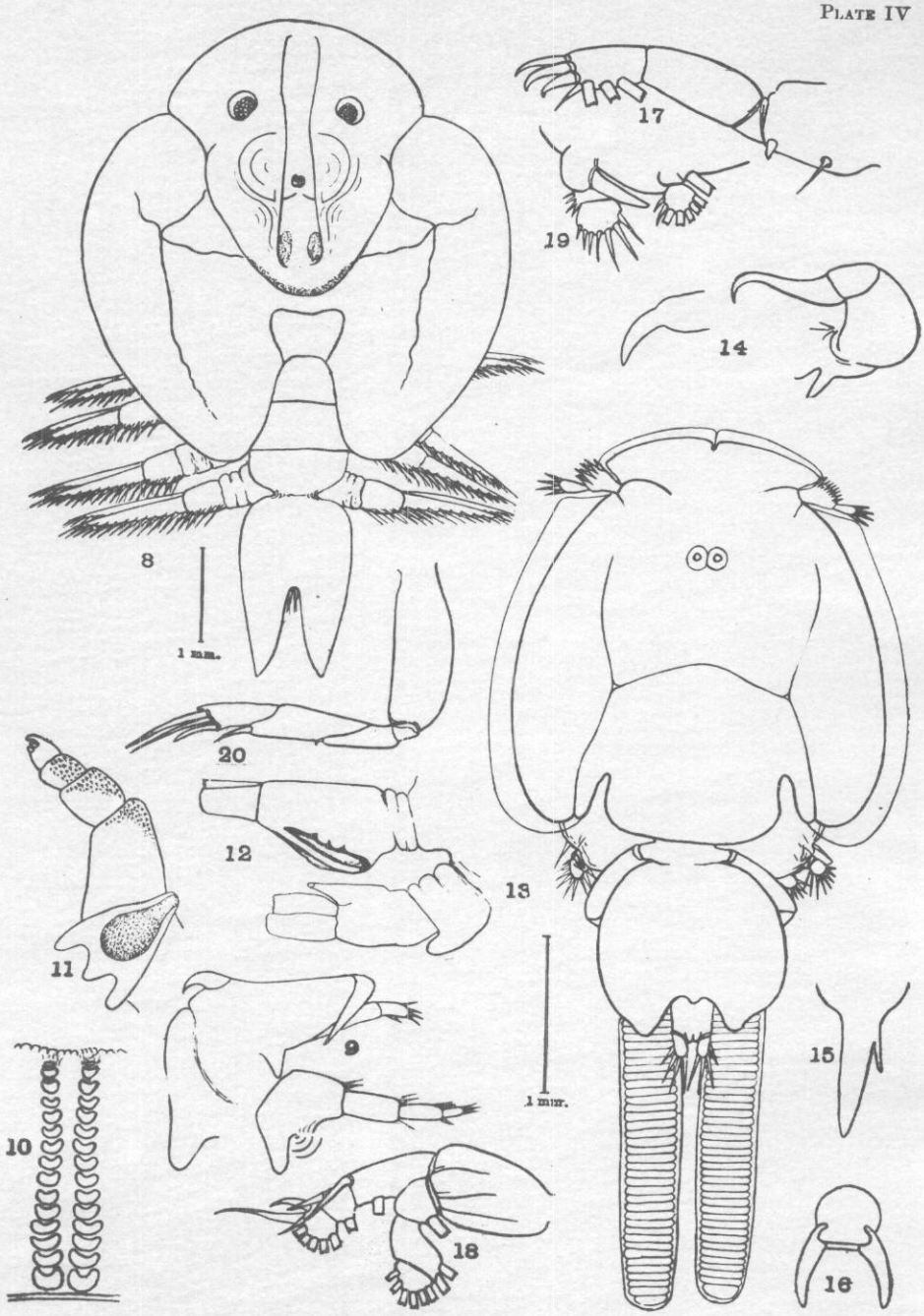
Total length, 5·33 mm.; length of carapace, 3·4 mm.; width, 3·15 mm. Length of abdomen, 1·75 mm.; width, 0·9 mm. (*pugettensis,* of or belonging to Puget Sound.)

In 1904 Johann Thiele published a description of this species based upon specimens in the Vienna museum, but no record is given of the date at which the specimens were obtained.

Thiele states that according to the labels the museum specimens were found on sea-trout from Puget Sound, and on *Salmo heydeni* Steind. from California. He also mentions a third very doubtful locality, 'Magdalena island, Straits of Magellan, on *Trichocera oregonensis* Dana,' and gives it as his opinion that this refers to the group of islands in the Gulf of St. Lawrence. It may be noted, however, that the usual spelling of the St. Lawrence islands is Magdalen, while there is a Magdalena island off the west coast of Lower California with a bay and town of the same name on the mainland.

It would seem much more likely for a vessel to pick up specimens from Puget Sound, California and Lower California than to skip to the Gulf of St. Lawrence.

These accounts by Dana and Thiele are the only ones up to date based upon actual specimens of this species.



The Male and Female of *Argulus Puyettensis* and the Female of *Lepeophtheirus Nanaimoensis*.
For explanation of plate see p. 100

While they supplement each other and thus make the description of both sexes quite complete, it still seems advisable to present a third account of the Nanaimo specimens, especially since it differs in some of its details from the others, and will thus show the variations of the species.

As worthy of special notice we may first mention the shortness of the carapace in the female. These females are much smaller than those described by Thiele (his being 16 mm. long), and the carapace barely overlaps the anterior margin of the fourth segment instead of covering half the abdomen. Evidently the relative length of the carapace increases with the age and size of the parasite.

But even though both sexes in the present specimens are considerably smaller than the figures given by Thiele, the chitin ribs which stiffen the soft margins of the sucking disks are made up of a greater number of pieces or joints than in the larger specimens figured by Thiele.

The average of several counts was fifteen, the number represented in figure 10, and some of the ribs had as many as eighteen or twenty joints.

Furthermore in the present instance the hosts are not the same as those upon which the Vienna specimens were obtained, thus widening the range of the species.

One lot of these Nanaimo specimens, including both sexes, was found upon the Rainbow trout, *Salmo irideus*, which to judge from the number of parasites is one of the common hosts of the species. Three females and a male have been selected from this lot and placed in the National museum to serve as supplementary types of the species; they are numbered 38641, U.S.N.M. A single female was also obtained from the blue perch, *Taeniotoca lateralis* and is numbered 38648, U.S.N.M.

Lepeophtheirus Nanaimoensis, New Species.

PLATE IV.

Female.—General body form short and stout; carapace broadly ovate, as wide as long, evenly rounded anteriorly, nearly squarely truncated posteriorly. Lateral grooves some distance from the margin; transverse groove five-sevenths the length of the carapace in front of the posterior margin. Lateral lobes broad and evenly rounded; median lobe four-tenths of the entire width, with prominent corners and a slightly rounded posterior margin, which projects a little behind the lateral lobes. Eyes one-third the length of the carapace from the anterior margin, large and well defined; optic area narrow and elongate. Fourth (free) thorax segment one-fourth the width of the carapace and very short; lateral margins projecting strongly from the attachment of the fourth legs. Genital segment as wide as long, its lateral margins prominent and evenly rounded; lobes at the posterior corners broad, bluntly rounded and projecting nearly to the posterior margin of the abdomen. Two pairs of rudimentary legs on the ventral surface of these lobes, the inner pair projecting well beyond the posterior margin of the lobes, broad at their base and abruptly narrowed to a slender tip, armed with one seta on the outer margin at the center and a bunch of three at the tip, of which the two outer ones are about the same length, the inner one much shorter.

The outer pair of these legs are short knobs or papillæ, situated close to the outer margin of the inner pair.

Abdomen one-jointed, wider than long, tapering posteriorly, with nearly straight sides. Anal laminæ widely separated, slightly convergent, half the length of the abdomen, each tipped with three setæ, of which the two inner are about equal

and much longer than the outer one. Egg-sacs broad, half the length of the body and slightly tapering posteriorly, about 30 eggs in each case.

First antennæ short, scarcely projecting beyond the transparent margin of the carapace, the two joints the same length and well armed with short and stout setæ. Second pair with a slender terminal claw as long as the rest of the appendage, abruptly bent near its tip. The basal joint carries a stout blunt spine on its anterior margin near the centre. Maxillary hooks long and slender, not very close to the margin of the carapace, the base enlarged for about half the entire length, the tip only moderately curved. First maxillæ long, projecting well beyond the tip of the mouth-tube, narrow and rather bluntly pointed; the two rami are very uneven, the outer one many times longer than the inner. So great is this difference that the endopod seems like a tiny slender spine attached to the inner margin of the exopod near its base. Furca broad and stout, its basal portion nearly circular, its branches a little longer than the basal portion and widely separated with a straight margin between them. Maxillipeds slender, the basal joint four times as long as wide, the terminal claw five times the length of the basal joint, with a triangular thickening near the centre. Swimming legs of the usual pattern, the basal joint of the first pair with a slender seta on the posterior margin near the proximal end, and a stout, blunt spine near the distal end. Of the three terminal claws on these legs, the anterior one is the longest and the others diminish regularly in size backwards.

The spines along the outer margin of the exopods of the second legs are unusually long and slender; the rami of the third legs are widely separated, the spine on the basal joint of the exopod being so long that it reaches over nearly to the endopod, but it is also very stout. Fourth legs slender, the basal joint as long as the next two, the three terminal joints about the same length; second joint tipped with a short claw, third joint with a spine of medium length, fourth joint with three unequal spines, the two inner ones the same length and twice as long as the outer one.

Total length, 4 mm. Length of carapace, 2·64 mm.; width of same, 2·65 mm. Length of genital segment, 1 mm.; width, 1·2 mm. Length of egg-strings, 2 mm.

Colour (preserved material).—Light horn yellow deepening into orange in the thickest part of the body; genital segment and egg strings a dull orange.

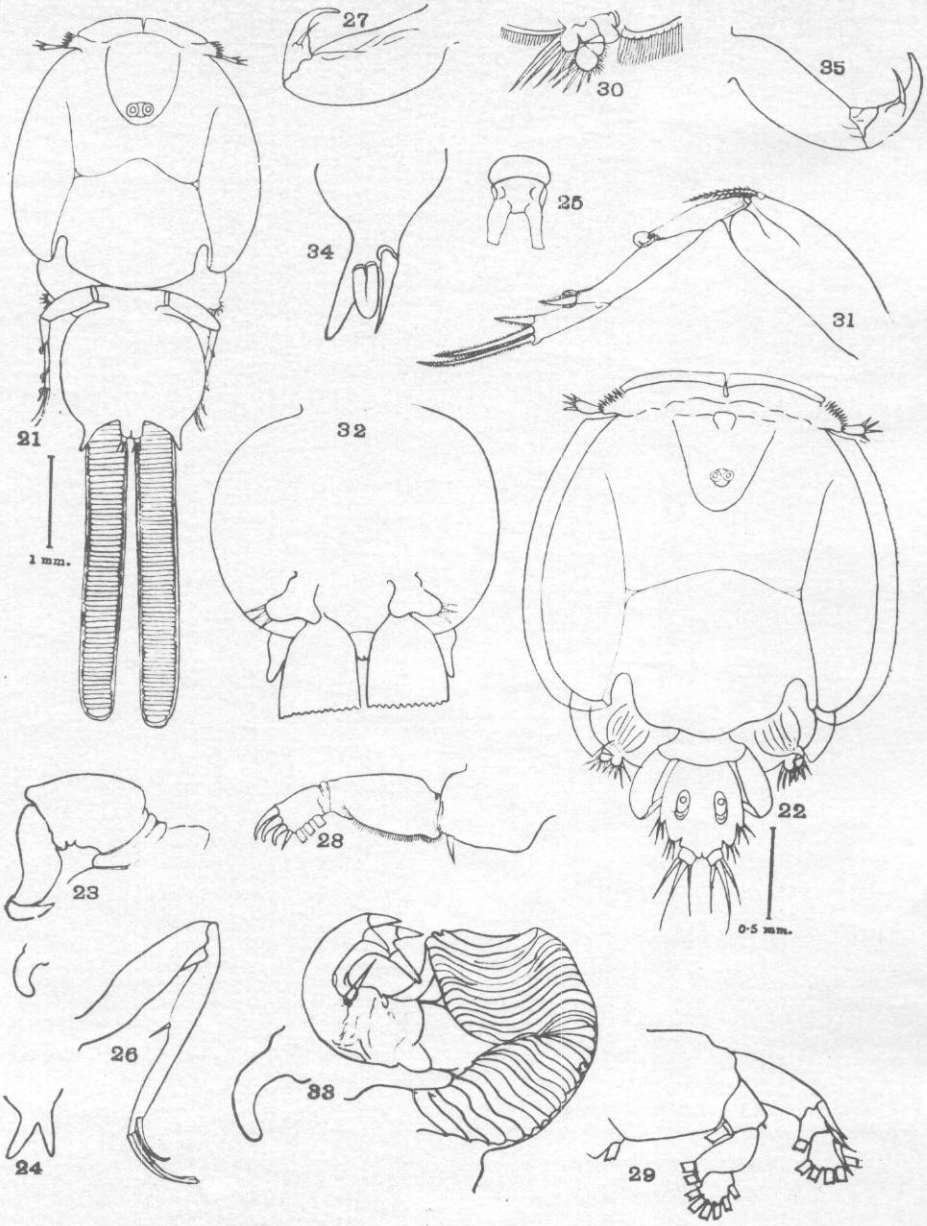
(*nanaimoensis*, of or belonging to Nanaimo.)

There is a single lot of this new species containing many specimens, all females. The record of the host has been lost, and therefore it remains unknown. These parasites were themselves compelled to serve in turn as the hosts of other parasitic and commensal species, chiefly *Vorticellidæ*. Two of them were so heavily covered that it would have been impossible for them to do any swimming had occasion arisen. Five of the best specimens were selected to serve as types of the new species and have been numbered 38640 U.S.N.M.

Lepeophtheirus pravipes, New Species

PLATE V.

Female.—General body form long and slender; carapace ovate, longer than wide, with evenly rounded margins. Lateral grooves rather near the margins, leaving a wide space between: transverse groove about the centre of the carapace; this groove is not straight, but curves forward in a broad loop. Eyes one-third the distance from the anterior margin, rather small; optic area broadly obovate. Lateral lobes narrowed posteriorly and rather pointed; median lobe more than half the entire width and projecting considerably beyond the lateral ones. Fourth (free) thorax segment one-third



The Male and Female of *Lepeophtheirus pravipes*.

For explanation of plate see p. 100

the width of the carapace, but very short and somewhat over-lapped by the carapace anteriorly.

Genital segment wider than long, its sides projecting strongly and with an even curve; posterior lobes narrow and acute, and reaching even beyond the tips of the setæ on the anal laminæ. Rudimentary sixth legs large, situated just in front of the openings of the oviduct, each the same distance from the lateral margin that the two legs are from each other. These legs are shaped like a human foot, the two heels turned inward and the toes outward, the latter being armed with three spines of equal length. The size, shape, and position of these legs form one of the most marked characteristics of the species.

Abdomen only one-sixth the width of the genital segment and nearly quadrangular; anal laminæ minute, less than one-third the length of the abdomen and widely separated, each tipped with three setæ of about equal length.

Egg-strings each twice the width of the abdomen and a little more than two-thirds the length of the body, 45 or 50 eggs in each string.

Joints of the first antennæ about the same length but the terminal one much narrower. The terminal claw of the second pair is very broad at the base but narrows rapidly toward the tip. The maxillary hooks are short, broad, and bluntly rounded; first maxillæ of the usual form, the outer branch a trifle longer and more bluntly pointed than the inner. Furca with a broadly obovate base and rather slender branches of about the same length; the latter are slightly divergent, separated by a short distance at their base, and squarely truncated at their tips.

The terminal joint of the second maxillæ is much longer than the basal, with a stout spine on its anterior margin near the centre. Maxillipeds with a stout basal joint twice as long as wide, the terminal claw slender, only half as long as the basal joint and strongly curved, with an accessory spine on the ventral surface near the base.

Swimming legs of the usual pattern; basal joint of the first pair with a single spine on the posterior margin close to the distal end. Spines on the exopod of the second pair short; rami of the third legs close together, the spine on the basal joint of the exopod short and stout.

Fourth legs reaching nearly to the posterior margin of the genital segment; the basal joint stout and bearing a long plumose seta on its anterior margin near the distal end; a short and strongly curved claw at the tip of the second joint reinforced by a fan-shaped plate of chitin; a straight serrate spine at the tip of the third joint, and another the same size at the outer corner of the terminal joint, each reinforced by small chitin plates. The inner spine on the terminal joint is three times as long as the outer and the median spine is only slightly smaller, both of them minutely serrate.

Colour.—(Preserved material), orange yellow, deepened along the centre of the body; genital segment tinged with pink; egg-strings a deep orange like beeswax, and in nearly all the specimens having a distinctly waxy appearance.

Total length, 4·66 mm. Length of carapace, 3 mm. Width of same, 2·66 mm. Length of genital segment, 1·5 mm. Width of same, 1·66 mm. Length of egg-strings, 3·33 mm. (*pravipes, pravus,* misshapen, and *pes,* foot, alluding to the deformed sixth legs).

Male.—General body form short and broad, considerably smaller than the female. Carapace nearly orbicular, the same width and length; frontal margin straight, and deeply incised at the centre; posterior sinuses wide and shallow; median lobe two-fifths the width of the carapace, lateral lobes wide and blunt. Fourth segment wider than the genital segment, one-fourth the width of the carapace, narrowed strongly anteriorly where it joins the carapace.

Genital segment one-fifth the width of the carapace, the sides only moderately projecting; separation of the fifth and sixth segments clearly indicated on the ventral

surface, each with a pair of rudimentary legs; fifth pair projecting from the lateral margins near the posterior end; sixth pair constituting the posterior lobes; fifth pair tipped with four setæ, three long ones of equal length and one much shorter; sixth pair with only the three long setæ, no short one. Abdomen more than twice as wide as long, made up of a single segment deeply incised at the anus posteriorly. Anal laminæ hemispherical in shape, each armed with six setæ of unequal length, of which three are much longer and stouter than the others. Appendages like those of the female except the second antennæ, the first maxillæ, and the usual sexual enlargement of the maxillary hooks. The second antennæ are much enlarged, the basal and second joints are heavily corrugated on the ventral surface, the two terminal joints are about the same size, the last one not forming a claw, but curved into a half circle and tipped with four stout spines, in two sets of two each, the two sets approximately parallel.

In the first maxillæ, the outer ramus has a secondary spine on its inner margin near the base, which is stout, nearly as long as the ramus itself, and bluntly rounded at the tip. Colour as in the female.

Total length, 2·66 mm. Length of carapace, 2 mm. Width of same, 2·1 mm. Length of genital segment, 0·41 mm. Width of same, 0·46 mm.

Female larva, 2 mm. long.

This larva shows some interesting peculiarities. The carapace is relatively much larger than in the adult, being seven-tenths of the entire length and three times as wide as the rest of the body. The fourth segment is fully as long and as wide as the genital segment; the fifth segment is distinctly separated from the genital or sixth segment, but has no rudimentary legs. The genital segment is twice as wide as long, with well developed lobes at the posterior corners. The abdomen is as wide as long; the anal laminæ are hemispherical like those of the adult male, and each is armed with five setæ, three large ones of equal length on the tip and two much smaller ones on the outer margin. The fourth legs are stout and short, the three terminal joints together no longer than the basal joint, their spines short, non-serrate, and without the accessory chitin plates.

Total length, 2 mm. Length of carapace, 1·52 mm. Width of same, 1·4 mm. Fourth segment, 0·14 mm. long; 0·42 mm. wide. Fifth segment, 0·1 mm. long; 0·5 mm. wide. Sixth (genital) segment, 0·25 mm. long; 0·42 mm. wide. Abdomen, 0·15 mm. long; 0·2 mm. wide.

Female larva, 3·33 mm. in length.

In this developmental stage we find the transition into the adult form. The carapace has diminished in size, the fourth segment is still as large as the genital segment, the fifth segment is greatly reduced in size and is barely visible in front of the genital segment. The latter is still wider than long, with the sixth legs forming prominent lobes at the posterior corners, and reaching nearly to the tip of the abdomen. Each of these sixth legs is armed with five setæ, three larger ones in the centre and a shorter one on either side. The abdomen has lengthened so that it is now longer than wide, and each anal laminæ carries five setæ, three large ones at the tip and two shorter ones on the outer margin.

Total length, 3·33 mm. Carapace, 2·46 mm. long; 2·40 mm. wide. Fourth segment, 0·33 mm. long, 0·75 mm. wide. Abdomen, 0·33 mm. long, 0·2 mm. wide.

This species is common on *Ophiodon elongatus;* a lot containing a dozen females and half as many males has been selected as types of the new species, and is numbered 38645. A second lot of five females from the same host is numbered 38639, and will serve as co-types.

Lepeophtheirus salmonis, Kröyer.

Lepeophtheirus salmonis, Kröyer, 1863, p. 137; Verrill and Smith, 1874, p. 576; Rathbun, 1884, p. 487; Wilson, 1905, p. 640.

Three lots of this common species were obtained from the Coho or Silver Salmon, *Oncorhynchus kisutch*, and are numbered respectively 39527, 39529, 39547.

Lepeophtheirus parviventris, Wilson.

Lepeophtheirus parviventris, Wilson, 1905, p. 635.

Four lots of this interesting species were obtained; two of these numbered 39530 and 39532, were obtained from one of the northern flounders, *Lepidopsetta bilineata;* the other two numbers, 39533 and 39534, are from the head and fins of the common cod of the north Pacific, *Gadus macrocephalus*.

Chondracanthus palpifer, New Species.

PLATE VI.

Female.—General body form elongate and narrow; cephalothrax distinctly separated from the rest of the body by a short neck, contracted to less than half the width of the head.

Cephalothorax ovate in shape, almost squarely truncated anteriorly, with the two pairs of antennæ projecting from the anterior margin. Second, third, and fourth thorax segments fused into the body, which is elongate-elliptical with smoothly rounded corners, the divisions between the segments being indicated by depressions in the lateral margins, with no visible grooves. Genital segment one-third the width of the body, wider than long, with rounded and projecting lateral margins. Abdomen reduced to a mere knob at the posterior end of the genital segment; no anal laminæ.

Egg-strings about as long as the entire body, narrow cylindrical, and of uniform width throughout, with bluntly rounded ends.

First antennæ three-jointed, the basal joint three times as long as the other two combined, and twice as wide as either. The terminal joint carries a tuft of four small setæ at the distal end, the other joints are unarmed.

Second antennæ also three-jointed, the basal joint very large and stout, the second joint reduced to half the width, the terminal joint a long and powerful claw curved abruptly near the tip. Mandible with a large crescent-shaped cutting blade, armed with coarse saw-teeth along its posterior margin, and a row of much finer teeth starting from the tip of the blade, and running diagonally backward along its ventral surface. The palp is attached to the posterior distal corner of the basal joint, just behind the cutting blade; it is composed of a single joint, acorn-shaped, the point of the acorn being attached to the basal joint. From the outer straight margin (base) of the acorn project two spines, side by side, the posterior one twice the size of the anterior.

The maxilla has a straight and acuminate cutting blade, armed with five coarse teeth on the posterior margin, near the base. A small conical palp, twice the size of the largest tooth, is attached to the posterior distal corner of the second joint, with a tuft of five or six small spines at its tip. First maxilliped with a powerful basal joint, but the rest of the appendage rather slender; the terminal claw almost linear and curved into a sickle shape.

At the base of the claw on the ventral side is a short finger-like process with a semi-circular row of spines on its tip.

First swimming legs very small, each composed of a single joint, enlarged and two-lobed at the tip. Second legs also bi-lobed; third and fourth pairs consisting of a single long cylindrical process. These three pairs of legs are each about as long as the body of the animal and project their entire length from the lateral body margins. Colour (preserved material) a pale cartilage yellow, the ovaries and appendages white.

Total length, 6·5 mm. Cephalothorax, 2·28 mm. long, 1·5 mm. wide. Body, 3·63 mm. long, 2 mm. wide. Egg-strings, 5·5 mm. long, 0·5 mm. wide.

Male.—First and second thorax segments fused with the head, the first segment only covered by the carapace; cephalothorax strongly arched dorsally, projecting but little ventrally.

Third and fourth thorax segments free and about the same size, but without swimming legs. Genital segment acorn shaped, without lobes or appendages; abdomen a small knob attached to the posterior end of the genital segment; anal laminæ long and narrow and close together, destitute of setæ. Appendages like those of the female with the usual sexual variations. Maxilla without teeth on its posterior margin but with a palp; maxillipeds large and powerful, but with a slender terminal claw curved into a half circle. First and second swimming legs rudimentary, each leg composed of a single elliptical lamina tipped with two small spines; other legs wanting.

Total length, 1 mm. Cephalothorax, 0·75 mm. long, 0·4 mm. wide. Free thorax and abdomen, 0·25 mm. long, 0·15 mm. wide (*palpifer, palpus*, a palp, and *fero*, to bear, alluding to the well developed palps on the mandibles and maxillæ).

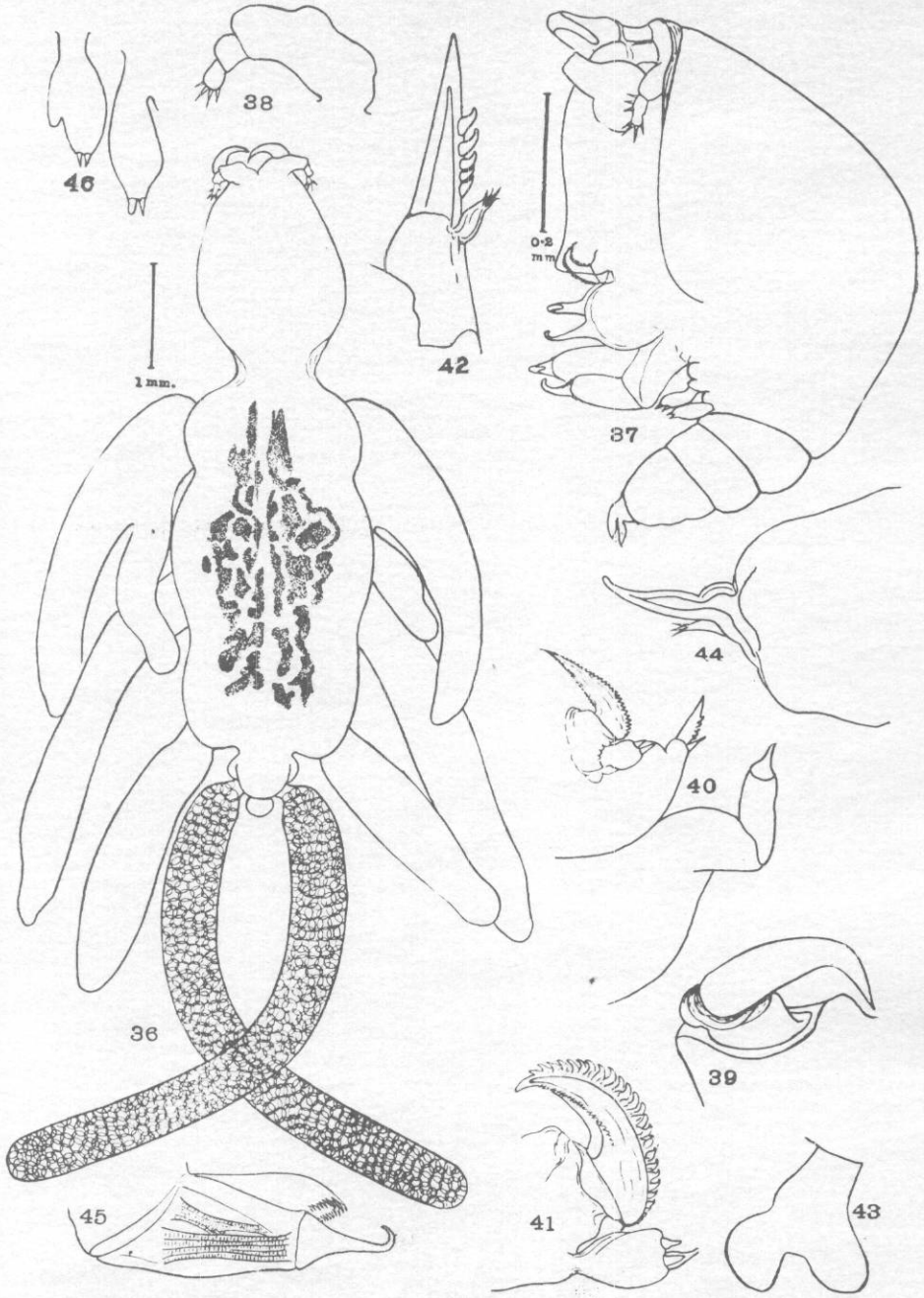
Only two females of this species were obtained. Fortunately, one of them had a male attached to the genital segment, and this pair were made the types of the new species and numbered 38635, U.S.N.M. The female was fully mature and carried a pair of well-developed egg-strings and both sexes are excellently preserved.

Chondracanthus pinguis, New Species.

PLATE VII.

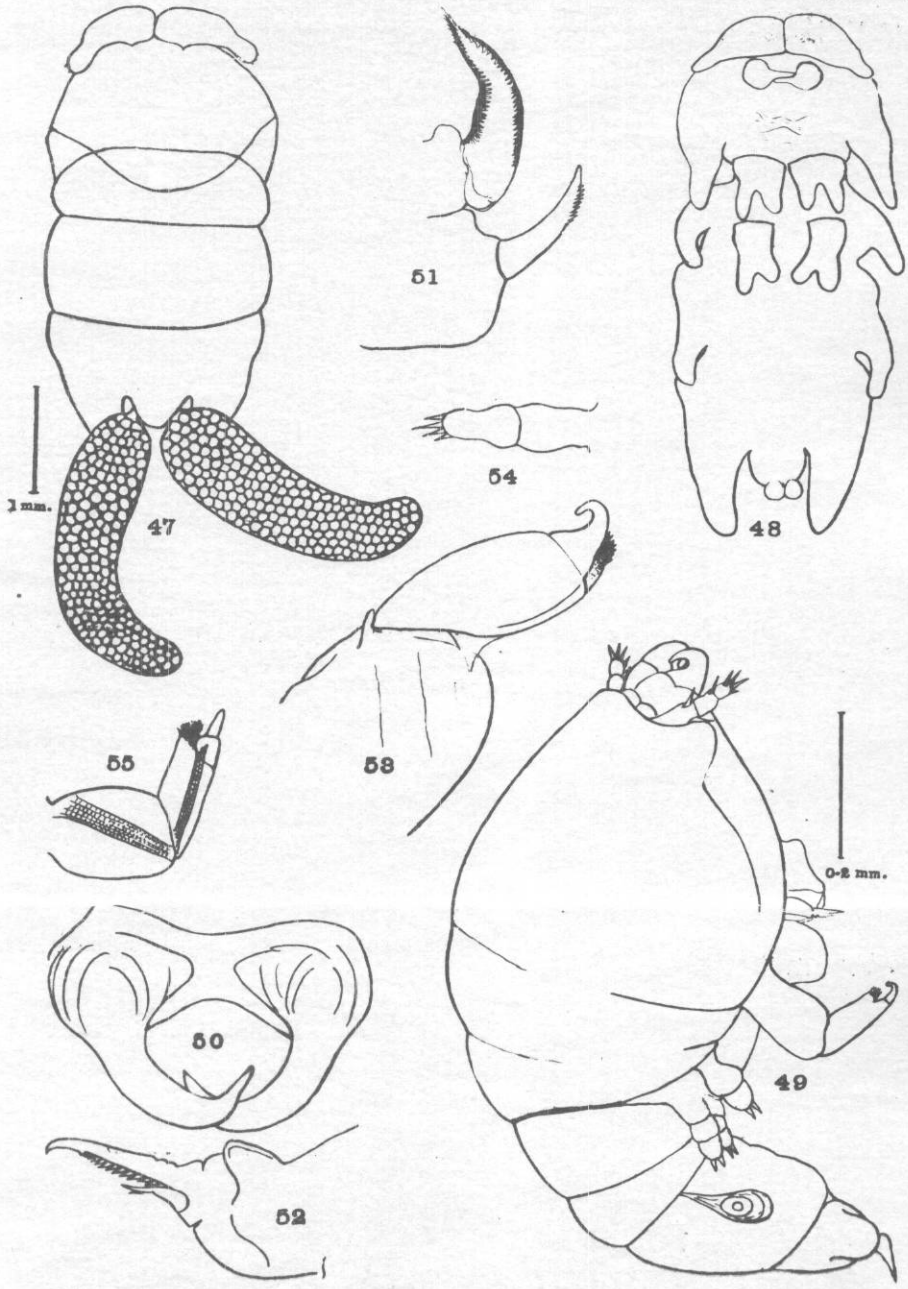
Female.—General body form short and stout; cephalothorax transversely elliptical one-sixth wider than long, with a conical process or lobe attached to the ventral surface at the centre of each lateral margin. Second, third and fourth thorax segments fused into the body of the parasite, which is the same width as the cephalothorax, and about twice as long; the divisions between the segments are clearly indicated by grooves; each segment bears on its lateral margins a pair of processes similar to those on the cephalothorax; those on the fourth segment are larger than the others, extending back on either side of the genital segment and abdomen and reaching considerably beyond them. The genital segment is less than one-third the width of the body, wider than long and without lobes or processes. The abdomen is small and two-lobed, attached directly to the genital segment and without anal laminæ. The egg-strings are two-thirds the length of the body, largest anteriorly and tapering posteriorly. The eggs are small and arranged in 8 or 10 rows with about twenty-five in each row.

The first antennæ are large and swollen, covering the entire anterior margin of the cephalothorax, with the joints so thoroughly fused as to be indistinguishable; each is armed with four small spines at the tip. The second antennæ are also large and stout, with strong terminal claws bent abruptly near the tip. The mandible is



The Male and Female of *Choudracanthus palpifer*.

For explanation of plate see p. 100



The Male and Female of *Choudracanthus pinguis*.

For explanation of plate see p. 101

made up of the usual basal joint and cutting blade; the latter is sickle-shaped, very long and acuminate, with a row of sharp and slender spines along either margin; the palp is entirely lacking.

The maxilla has a long and slender cutting blade, curved at the tip and armed with ten or twelve slender saw-teeth along the posterior margin; the palp is slender and acuminate and half as long as the cutting blade.

The maxilliped carries a slender terminal claw, bent into a half circle, and a rounded knob armed with short spines and ventral to the base of the claw.

There are two pairs of swimming legs, each consisting of a single flattened joint, bi-lobed at the tip and unarmed.

Colour (preserved material) yellowish white, the ramifications of the ovaries nearly snow-white, the eggs and egg-cases sulphur yellow.

Total length, 5 mm. Cephalothorax, 1·56 mm. long, 2·15 mm. wide. Body, 3·44 mm. long, 2·15 mm. wide. Egg-strings, 2·65 mm. long, 0·76 mm. wide anteriorly. riorly.

Male.—General body form long and slender; cephalothorax not inflated as much as in *palpifer*, more ellipsoidal in form and somewhat pointed anteriorly. First two thorax segments imperfectly joined with the head, each carrying a pair of swimming legs; these legs are distinctly two-jointed and each ends in two small spines of equal length. There are two free segments, of about the same length and destitute of legs, in front of the genital segment; the latter is conical and as long as both the segments preceding it.

The abdomen is short, conical and one-jointed; the anal laminæ are half as long as the abdomen, slender and destitute of setæ. The first antennæ are relatively much smaller than in the female and distinctly jointed; the basal joint is no wider than the terminal and is tipped with four spines, of which one is considerably longer than the others.

The other appendages are similar to those of the female, with the usual sexual differences.

Colour (preserved material) a uniform cartilage yellow. (*pinguis*, fat, chunkey).

Total length, 1·11 mm. Cephalothorax, 0·66 mm. long, 0·44 mm. wide. Diameter of genital segment, 0·20 mm.

Two females of this species, each with an attached male, were obtained from the inside of the operculum of the brown rockfish, *Sebastodes auriculatus*, one in November and one in December, 1908. They are made the types of the new species and are numbered 38637 U.S.N.M. Evidently the species is not a very common one; it can be recognized by the proportions of the various body parts.

Clavella parva, New Species.

Plate VIII.

Female.—Cephalothorax slender and cylindrical, turned at right angles to the body and almost one-half longer than the latter.

Body short and plump, ellipsoidal in form with evenly rounded outlines, the longitudinal and transverse diameters in the proportion of two to three. Abdomen a small process or protuberance at the posterior end of the body on a level with the dorsal surface; anal laminæ wanting.

Egg-strings the same length as the body, one-third as wide as long, and slightly enlarged at the distal ends; eggs large, arranged in six or eight longitudinal rows, about ten in a row.

The first antennæ are two-jointed, the basal joint shorter than the terminal but two and a half times as wide, with a stout spine at the inner distal corner; the ter-

minal joint ends in three spines, of which the middle one is much stouter than the others and more than twice as long.

The second antennæ are long, of medium width, and pointed at the end; the palp is short and stout and unarmed.

The mandible is stout and spathulate, enlarged in the centre, the outer and inner margins both convex, and the very tip contracted to one-third the width and armed with four short teeth slightly curved; the remaining teeth are much longer, more strongly curved, and unequal in size. The maxilla is slender and ten times as long as wide, with a bi-lobed tip, each lobe ending in two stout spines of unequal size.

The palp is short and one-jointed, and ends in two short spines whose tips just reach the bases of the terminal lobes of the main appendage.

The maxillipeds are close to the mouth-tube; their basal joint is stout and strongly inflated, while the terminal joint is slender, about half the length of the basal joint, and ends in two claws, of which the outer one is much stouter than the inner one and twice as long. The second maxillæ are at the base of the cephalothorax where it joins the body, two mm. behind the first pair; they are short and very stout.

Colour (preserved material) body and neck white, slightly tinged with yellow; eggs and egg-cases a clear sulphur yellow. Total length, 5 mm. Cephalothorax, 3 mm. long, 0·5 mm. wide. Body, 1·8 mm. long, 1·2 mm. wide. Egg-strings, 1·8 mm. long, 0·65 mm. wide.

(*parva*, small).

A single lot of these tiny parasites was obtained from the soft dorsal fin of the brown rockfish, *Sebastodes auriculatus*. There were ten females but unfortunately no male; six of the females have been selected as types of the species and are numbered 39525 U.S.N.M.

A word of explanation is called for with regard to the generic name here used. The genus *Clavella* was founded by Oken in his Lehrbuch der Naturgeschichte, 3 Th. 1 Abth., 1815, p. 358, upon the type *Clavella (Lernæa) uncinata* which Müller had described in 1776. This species has been recognized by practically every author who has written on the Parasitic Copepods, and has been described in detail by such authors as Baird, Kröyer, Claus, Vogt, and T. Scott.

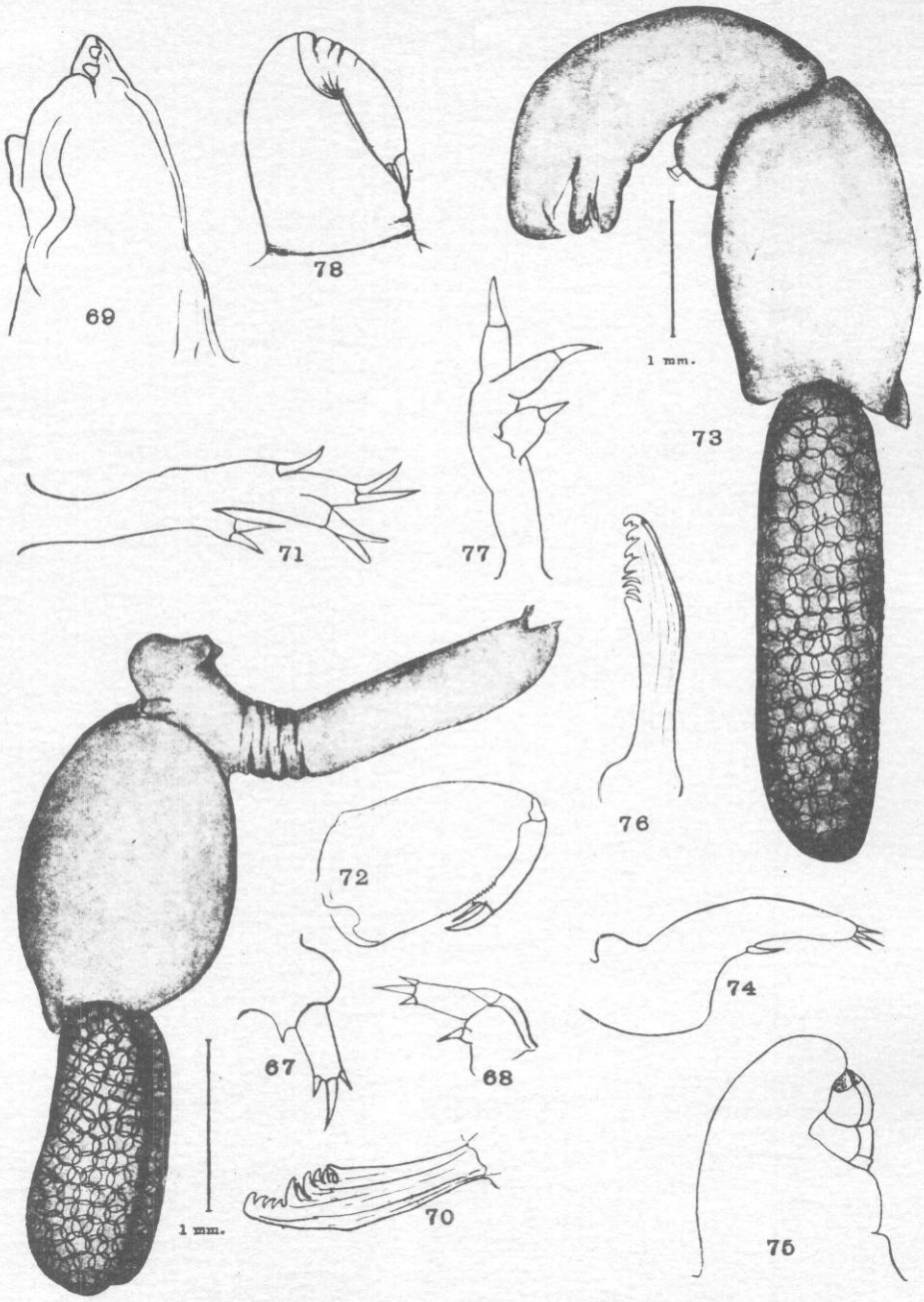
It thus clearly takes precedence over the name *Anchorella* which was first proposed by Cuvier in his Régne Animal, 1830, Vol. III, p. 257. The first species (type of the genus) mentioned by Cuvier was *Anchorella adunca*, which was very imperfectly described by Ström in 1762, and has never been satisfactorily recognized since. Clavella has been wrongly used to designate certain species among the Dichelestiidæ, but it clearly belongs with the Lernæopodidæ as here placed.

Clavella robusta, New Species.

PLATE VIII.

Female.—General body form short and stout; head and neck a little longer than the body, but only one-third as wide. Head quadrilateral in dorsal outline with rounded corners, neck the same width as the head, but much longer and passing abruptly into the body without being enlarged. Body quadrilateral, as long as wide, side of the mid-line and close to it. These processes and those on the posterior corners posterior margin nearly straight, with a pair of slightly larger processes, one on either side of the mid-line and close to it. These processe and those on the posterior corners are on a level with the dorsal surface; there is a third pair, about the size of those at the posterior corners, but on the ventral surface below the bases of the egg-strings.

Abdomen rudimentary, little more than a slight projection from the posterior



The Females of *Clavella parva* and *Clavella robusta*.

For explanation of plate see p. 101

margin of the body, just beneath the two longest processes. Egg-strings of medium width and not much narrowed at the ends, five-sevenths as long as the entire body; eggs small, arranged in six or eight longitudinal rows, about twenty-five eggs in a row.

First antennæ rather slender, the joints so fused as to be indistinguishable ,with one spine on the anterior margin near the centre, and a tuft of three of about the same length at the tip. Second antennæ short and squat, the joints thoroughly fused; the palp does not reach the end of the appendage, is distinctly two-jointed, and terminates in a blunt point. The mandible is long and slender and considerably enlarged at the base; the outer margin is swollen at the centre, while the inner margin is nearly straight. It is armed with eight long teeth at the anterior end, the last three curved, bluntly pointed, and with an accessory tooth or notch on the proximal margin; the other teeth are narrower, longer and sharper. The maxillæ are long and slender, and bipartite at the tip, the two rami are of the same size, and each ends in a long and slender spine; the palp is short and stout and made up of a single joint, tipped with a slender spine similar to those on the rami; the tip of the palp reaches a trifle beyond the bases of the terminal rami.

The maxillipeds have a very stout basal joint and a slender terminal joint, the latter one-third the width and two-thirds the length of the former. At the tip is a short and nearly straight claw, and a still shorter spine, ventrad to the base of the claw. The second maxillæ are removed a long distance from the first pair; they are very short and stout and resemble knobs on the ventral surfaces at the junction of the neck with the body; the attachment disk is minute, black in colour and in the form of a button. When this button is buried in the tissues of the host, the body of the parasite just clears the outer surface of the skin, so short are the maxillæ.

Colour (preserved material) is the usual cartilage yellow; ovaries white and standing out in contrast to the yellow background. Eggs and egg-case darker and greyish.

Total length, 4·33 mm. Head, 1 mm. long; 0·75 mm. wide. Neck, 1·33 mm. long, 0·75 mm. wide. Body, 2 mm. long, 2·1 mm. wide. Egg-strings, 3 mm. long. (*robusta*, stout, plump).

A single lot of this species, consisting of half a dozen females, was taken from the gill cavity of the Brown Rock-fish, *Sebastodes auriculatus*. They are made the types of the new species and have been numbered 39531 U.S.N.M.

Clavella uncinata, Müller.

Lernæa, Müller, 1776, Vol. I., p. 38, pl. XXXIII., fig. 2.

Clavella uncinata, Oken, 1815, 3 Th., 1 Abth, p. 358.

Anchorella uncinata, Cuvier, 1830, Vol. III., p. 258.

Two lots of this common species were obtained from the northern cod of the Pacific coast, *Gadus macrocephalus*. A few specimens from each of these lots have been combined and are numbered 39526 U.S.N.M.

Brachiella dentata, New Species.

PLATE IX.

Female.—General body form elongate and of medium width; cephalothorax turned back against the dorsal surface of the body, the two making an angle of about 60°. This cephalothorax is three-quarters as long as the rest of the body and a little more than half as wide, almost squarely truncated anteriorly and contracted posteriorly at the base of the second maxillæ, into a neck two-thirds as wide as the rest of the cephalothorax. The body is elongate-triangular, widest posteriorly and tapering gradually forward to the bases of the second maxillæ. It is flattened dorso-ventrally

with rounded uotlines and without processes or appendages, the joints being indicated by broad and shallow indentations on the lateral margins. The abdomen is very short one-jointed and thoroughly fused with the body; it carries at the posterior corners a pair of short spines, the rudiments of the anal laminæ. The eggs-strings are narrow, three-quarters as long as the body; the eggs are rather small and are arranged in ten longitudinal rows, about fifty eggs in a row. The first antennæ are small and slender and two-jointed, with a tuft of short spines at the tip of the terminal joint. The second antennæ are broad and stout, and are curved over ventrally at the tip, with a roughened margin around the entire end; the palp is wide and stout and roughly three-jointed, the terminal joint is one-third the width of the other two and covered with stout curved spines.

The mandible is slender with the outer margin reentrant and the inner margin straight; it is armed with eight stout teeth at the distal end, the first four with considerable intervals between them, and a small accessory tooth at the bottom of each intervening space.

The maxillipeds are slender, close to the mouth-parts and also close to each long and slender curved claw; the palp is about the centre of the outer margin of the appendage, and is bi-lobed, each lobe ending in a curved claw, much shorter than those on the main appendage, and not reaching half way to the terminal lobes of the latter.

The first maxillipeds are slender, close to the mouth-parts and also close to each other; the basal joints have a roughened knob on the inner margin close to the head, and a stout articulate spine near the centre. The terminal joint is very slender, two-thirds as long as the basal joint, and carries a small knob, tipped with a short spine near the centre of the outer margin. At the tip of this joint are two claws, the outer one curved and twice the size of the straight inner one. The second maxillæ are removed a long distance (3 millimeters) from the first pair; they are short and stout and three-quarters as long as the cephalothorax; the basal portion is thick and fleshy but a little beyond the centre it is abruptly narrowed to one-fourth of its previous diameter; the attachment disk is small and mushroom-shaped.

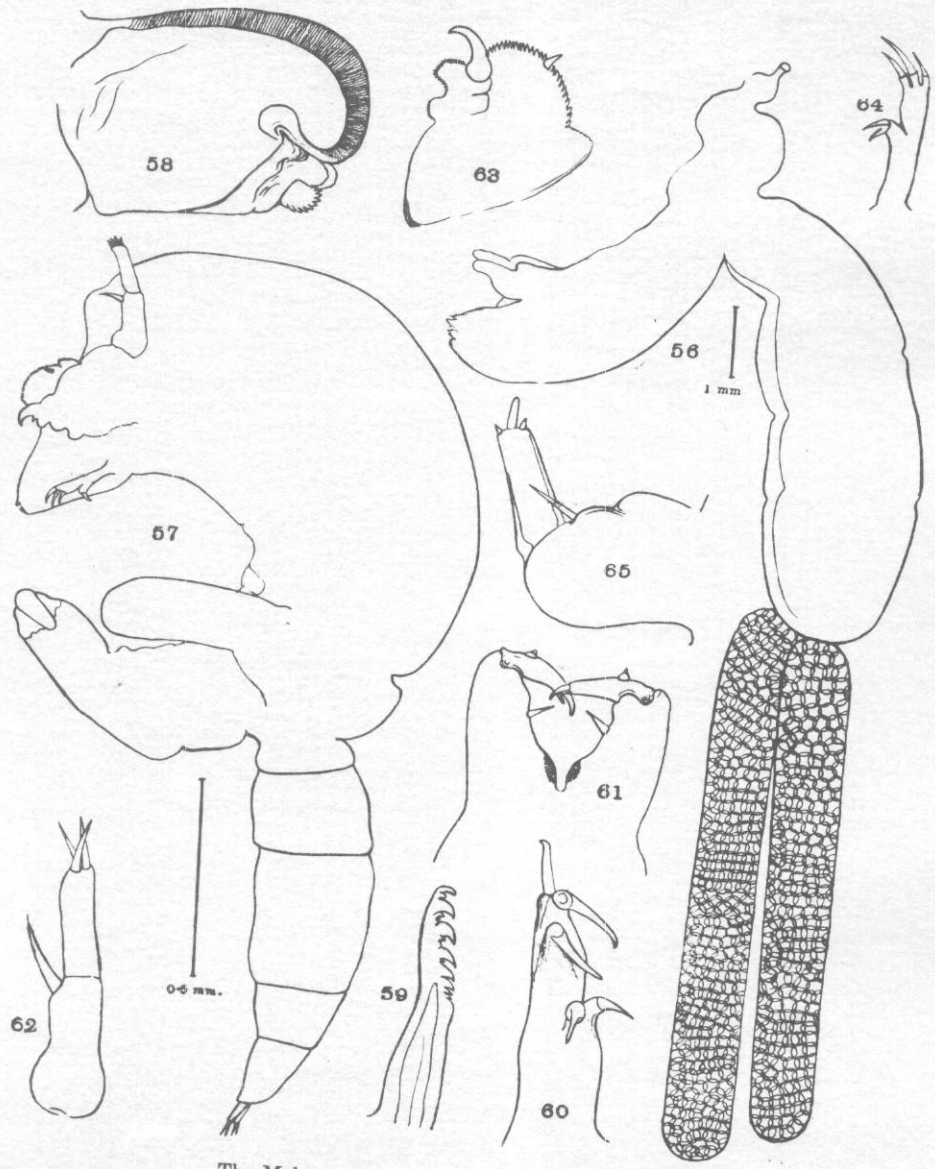
These appendages were not straight in a single specimen, but were always twisted and convoluted, so as to appear much shorter than they really were. It does not seem probable that this can be the result in any way of the method of preservation since none of the other species show anything of the sort, and in other respects the present species appear to be exceptionally well preserved.

Colour a uniform light yellow, the eggs and egg-cases considerably darker than the body.

Total length, 10 mm. Cephalothorax, 3 mm. long, 1·8 mm. wide. Body, 7 mm. long, 3·2 mm. wide. Second maxillipeds, 2·6 mm. long. Egg-strings, 7 mm. long.

Male.—General body form in side view that of an interrogation mark ?; cephalothorax forming the curved portion, three-fifths of the entire length, and strongly arched dorsally but equally concave ventrally, so that it is about the same diameter throughout. Maxillipeds and second maxillæ close together and a long distance behind the mouth-tube, with their bases fused and separated from the rest of the head by a distinct groove as though forming a well defined joint. Thorax and abdomen distinctly jointed and spindle-shaped, the widest part being in the genital segment. Abdomen two-jointed, the terminal joint conical and ending in a blunt point; anal laminæ linear and one-third the length of the terminal joint, each tipped with two minute hairs.

First antennæ two-jointed, joints of the same length but the basal one considerably the wider; there is a long, slender and curved spine at the inner distal corner of the basal joint, and three of about the same length at the tip of the terminal joint. The tips of the second antennæ are covered with saw-tooth spines, while the terminal joint of the palp has a stout curved claw at its inner corner.



The Male and Female of *Brachiella dentata*.

For explanation of plate see p. 101

3138—8½

The mouth-tube is stout and conical and projects well in front of the appendages. The maxillipeds are situated between the bases of the second maxillæ, their basal joint is swollen and armed on its inner border near the distal end with a stout spine; the terminal joint ends in three spines, of which the middle one is twice the length of the other two. The second maxillipeds are twice the size of the first pair, stout, and armed with powerful muscles; the terminal claw is long and slender.

Colour similar to the female, but a little lighter..

Total length, 2·7 mm. Cephalothorax, 1·7 mm. long, 0·7 mm wide.

(*dentata*, toothed, the mandibles possessing both primary and secondary teeth, exceptionally well developed).

This is a common species found around the gill arches in the throat of the large skate, *Raja binoculata*. The collection includes six lots of from twenty to twenty-five specimens each, all of them very clean and exceptionally well preserved. They have been numbered as follows: 36636, 38642, 38643, 38644, 39537, 39540 U.S.N.M. Many males were found attached to the females; in the first lot (38636) the sexes have been separated so as to be readily accessible, and these are made the types of the new species, the other lots standing as co-types. This is a large and finely proportioned species readily recognized by the length of the cephalothorax, and the narrowing and twisting of the second maxillipeds. Most of the specimens were obtained in the month of November, 1908, and the parasite appears to be very plentiful at about that season.

Hæmobaphes cyclopterina, Müller.

Lernæa cyclopterina, Müller, 1776, p. 2745. *Haemobaphes cyclopterina*, Steenstrup and Lütken, 1861, p. 405; pl. XIII., fig. 30; Rathbun, 1884, p. 492.

Two females of this species were obtained from the gills of *Oligocottus borealis*; one of them has been placed in the National museum collection and is numbered 39535.

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EXPLANATION OF PLATES.

PLATE III.

The female and male of *Argulus borealis*, new species.

FIG. 1. Dorsal view of the female.
FIG. 2. Dorsal view of the male.
FIG. 3. First and second antennæ of female.
FIG. 4. The chitin ribs which support the border of the sucking disks.
FIG. 5. Second maxilliped of female.
FIG. 6. Fourth leg of female.
FIG. 7. Third and fourth legs of male, showing the accessory sex organs.

PLATE IV.

The female and male of *Argulus pugettensis* Dana, and the female of *Lepeophtheirus nanaimoensis*, new species.

FIG. 8. Dorsal view of female *Argulus pugettensis*.
FIG. 9. First and second antennæ.
FIG. 10. Two of the chitin ribs of the border of the sucking disks.
FIG. 11. The second maxilliped.
FIG. 12. Third and fourth legs of the male, showing accessory sex organs.
FIG. 13. Dorsal view of *Lepeophtheirus nanaimoensis*, a female with fully developed egg-strings.
FIG. 14. Second antenna and maxillary hook.
FIG. 15. First maxilla, the smaller branch is nearer the mouth
FIG. 16. The furca.
FIG. 17. The first swimming leg.
FIG. 18. The second swimming leg.
FIG. 19. The third swimming leg.
FIG. 20. The fourth swimming leg.

PLATE V.

The female and male of *Lepeophtheirus pravipes*, new species.

FIG. 21. Dorsal view of the female.
FIG. 22. Dorsal view of male.
FIG. 23. Second antenna and maxillary hook.
FIG. 24. First maxilla, the right hand branch being nearer the mouth.
FIG. 25. The furca.
FIG. 26. The second maxilla.
FIG. 27. The maxilliped.
FIG. 28. The first swimming leg.
FIG. 29. The second swimming leg.
FIG. 30. The third swimming leg.
FIG. 31. The fourth swimming leg.
FIG. 32. The ventral surface of the genital segment, showing the peculiarly shaped fifth legs.
FIG. 33. The second antenna and maxillary hook of the male.
FIG. 34. Ventral view of first maxilla, the narrow, acuminate right-hand branch being nearer the mouth.
FIG. 35. The maxilliped of the male.

PLATE VI.

The female and male of *Chondracanthus palpifer*, new species.

FIG. 36. Dorsal view of female.
FIG. 37. Side view of male.
FIG. 38. First antenna.
FIG. 39. Second antenna.
FIG. 40. Mandible, maxilla, and maxilliped of female.
FIG. 41. Mandible enlarged, showing the palp.
FIG. 42. Maxilla enlarged, showing the palp.
FIG. 43. First swimming leg.
FIG. 44. Maxilla of male, showing the palp.
FIG. 45. Tip of maxilliped of male, showing terminal claw.
FIG. 46. The first (right) and second (left) swimming legs of the male.

PLATE VII.

The female and male *Chondracanthus pinquis*, new species.
FIG. 47. Dorsal view of female.
FIG. 48. Ventral view of female without egg-strings and with two spermatophores fastened to the abdomen.
FIG. 49. Side view of male.
FIG. 50. Second antennæ.
FIG. 51. Mandible and maxilla.
FIG. 52. Maxilla.
FIG. 53. Tip of maxilliped.
FIG. 54. First antenna of male.
FIG. 55. Maxilliped of male.

PLATE VIII.

The females of *Clavella parva* and *Clavella robusta*, both new species.
FIG. 66. Side view of *Clavella parva*.
FIGS. 67 and 68. Dorsal and ventral views of first antenna.
FIG. 69. Second antenna.
FIG. 70. Mandible.
FIG. 71. Maxilla.
FIG. 72. Maxilliped.
FIG. 73. Side view of *Clavella robusta*, female.
FIG. 74. First antenna.
FIG. 75. Second antenna
FIG. 76. Mandible.
FIG. 77. Maxilla.
FIG. 78. Maxilliped.

PLATE IX.

The female and male of *Brachiella dentata*, new species.
FIG. 56. Side view of female.
FIG. 57. Side view of male.
FIG. 58. Second antenna of female.
FIG. 59. Mandible.
FIG. 60. Maxilla.
FIG. 61. Maxillipeds.
FIG. 62. First antenna of male.
FIG. 63. Second antenna.
FIG. 64. Maxilla.
FIG. 65. Maxilliped.