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Parasitic Copepoda from Australian Waters

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PARASITIC COPEPODA FROM AUSTRALIAN WATERS

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INTRODUCTION

Our knowledge of the parasitic Copepoda has greatly increased during the past 50 years. Except for a limited number of records from expeditions conducted mainly in the latter half of the last century, very little was known about their distribution and taxonomy outside European and North American waters. These early expeditions covered only limited areas of the Southern Hemisphere, and the only notable research on parasitic copepods published since then by local workers outside Europe and America has come from Japan, China and India. I was therefore greatly interested when, some years ago, the late Dr. Harold Thompson, at that time Chief of the Fisheries Division of the Commonwealth Scientific and Industrial Research Organisation in Australia, offered to send me material for examination. The collection I received from him contained the many new species I had expected—ones that were parasitic on the more stationary Teleosti. Other copepods in the same collection, taken from sharks and larger and more cosmopolitan fishes, were, as could be expected, of known species which had previously been found in other parts of the world. I am grateful for the courtesy shown by Dr. Thompson in arranging for this material to be collected by scientists on his staff. These collectors were Dr. A. G. Nicholls, Dr. M. Blackburn, Mr. A. M. Olsen, the late Mr. W. S. Fairbridge and Dr. A. M. Rapson. Some specimens were also sent to me by Mr. G. P. Whitley (ichthyologist, Australian Museum) from Perth, Western Australia, when he was temporarily associated with Dr. Thompson's administration. My thanks are due to all these gentlemen for their kind co-operation. Names of collectors are noted under species dealt with in the text.

When it was realised that the collection received was so unexpectedly extensive and yielded such a large number of new species, I decided that it was my duty to include in a report all the other unpublished material of parasitic Copepoda housed in Australian museums or universities. I therefore wrote to all of these institutions, requesting them to make available to me any specimens they might have, so that these could be determined and reported upon along with the material I had already received. The requests yielded a relatively good collection of copepods from the Australian Museum, Sydney, New South Wales, and one specimen from the South Australian Museum in Adelaide. I thank the Directors of these two institutions for having kindly placed their material at my disposal, and also Mr. F. A. McNeill, of the Australian Museum, for considerable editorial assistance.

I Suborder ARGULOIDA

Family Argulidae

Genus **Argulus** O. F. Müller, 1785

Argulus macropterus, sp. n.

Figs. 1-3

Locality, Host and Record of specimens: 1 female, the holotype, on *Mugil* sp. at Mandurah, near mouth of Murray River, Western Australia. Collected by the Chief Inspector of Fisheries, A. J. Fraser; no date. Australian Museum Reg. No. P11881.

Female: The carapace is elliptical, and longer than wide. The cephalic area is distinctly separated from the rest of the carapace, with the front margin projecting strongly forward. The posterior sinus is deep, extending forwards for about half the length of the carapace, and is lined by two very large lateral lobes, their posterior halves partly overlapping each other and reaching behind the abdomen, which they entirely cover. The abdomen is strongly bifurcated for nearly three-fourths of its length. The first antenna is five-jointed, with three basal joints, of which the third terminates with a hook; extending from the base of the hook is a two-jointed palp. The second antenna is also five-jointed, with the last joint shaped like a long and slender palp. The sucking discs are very large and prominent. The maxilliped is short and weakly developed, and without any terminal claws.

The colour of the female when alive was described as greenish.

Argulus japonicus Thiele

(Figures 4-7)

Argulus japonicus Thiele, 1900, p. 48.

Argulus trilineatus Wilson, 1904, p. 681, figures 34-38.

Argulus japonicus, Yamaguti, 1937, p. 781, figures 1-9. *Id.*, Meehean, 1940, p. 494, figure 32.

Locality, Host and Record of specimens: 1 female, parasitic on a Goldfish Carp (*Carassius auratus*)—freshwater aquarium fish from Sydney, New South Wales. Australian Museum Reg. No. P. 11179.

Remarks: This species is distributed throughout the world in almost every region where goldfish are found.

II Suborder CYCLOPOIDA

Family Chondracanthidae

As earlier recorded (Heegaard, 1947), this family belongs to the Cyclopoida, with which suborder its members have many things in common, particularly the structure of the mouth appendages. The only character they have in common with the Lernaeopodidae, where they were placed by Wilson in 1932, is the presence of pygmy males. The morphology, however, is very different, and there is an absence in the Chondracanthidae of the pupal stage characteristic of the Lernaeopodidae.

Pseudoblias gen. n.

Type species *P. lyrifera*, sp. n.

In 1863 Kröyer described under the name *Blias* a chondracanthid copepod he had received from the museum in Vienna. It had the same mouth appendages as *Chondracanthides* and two thoracic segments plus the large trunk, but the latter was round and without lappets. Furthermore, there were two abdominal segments instead of the normal single segment. Also, the two pairs of thoracopods were not of the normal unjointed bifurcate type found in chondracanthids but were unbranched and three-jointed—the first pair tipped with a well-shaped claw, while the second carries at the tip six to seven short and strong spines. Lastly, as far as could be seen, the two pygmy males attached to the female were of the normal chondracanthid type.

Kröyer's material of *Blias* was a single female from Brazil, and his record of the genus is the only one that has ever been published.

In the present material from Australia there are two females which closely resemble Kröyer's genus. Like *Blias*, they have two abdominal segments. The trunk is also round like that of *Blias*, and not flattened as in *Chondracanthus* and *Acanthochondria;* the two pairs of thoracopods are unbranched, not jointed, and are without claws or spines. Also, in one of the females the right first thoracopod has a small bud where the limb in chondracanthids should be branched, which indicates that the unbranched limb in this case is secondary. The small male from Australia is also of the typical chondracanthid type. Because of the marked difference in the thoracopods I do not feel justified in including the specimens before me in the genus *Blias*. However, as they possess characters strongly resembling those of *Blias*, and also inclining towards those of *Acanthochondria*, I have chosen to establish the new genus *Pseudoblias* for their accommodation.

Pseudoblias lyrifera sp. n.

(Figures 8-13)

Locality, Host and Record of specimens: 2 females and 1 male, including the holotype. found on gills of *Rhombosolea tapirina* in Swan River estuary, Western Australia, 24.9.1942. Collector, Mr. White.

Unfortunately, the rather poor condition of the badly preserved specimens is responsible for the somewhat brief description of this species. Dissection of the single male could not be attempted, but as the differentiating characters between males of the species of all chondracanthids is very small, no point of systematic importance is expected to be found.

Female: As previously noted, the female is very close to *Blias*. From a dorsal view the head is spindle-shaped, with a lyre-shaped figure formed by the muscles of the second antenna, from which the species name is taken.

The head is clearly separated from the trunk, which is cylindrical or sausage-like in shape and without any processes. The first two thoracic segments are weakly separated from the rest of the trunk, which is followed by two abdominal segments. The first antenna is bulbous, with a big basal joint which is followed by two small lappets, one of them extending beyond the first antennal joint and the other more to the side. A few short setae were found on the tip of the lappet, extending the proximal joint. The second antenna is two-jointed, strongly uncinate, and of the usual hook shape. The mandibles are two-jointed, falciform, and toothed along both margins. Both upper and lower lips are free, the upper being the larger and forming a roof over the mandibles. The maxilla is small and bulboidal, and the first and second maxillipeds are two-jointed, the latter being the larger. The two pairs of thoracopods are fleshy as in chondracanthids, but lack joints and claws as described by Kröyer for his *Blias;* they are also not bifurcated as in *Chondracanthia* and *Acanthochondria*. On the right first thoracopod of one of the two females present there is a small side bud, situated where the bifurcation should take place. This seems to indicate that, in the Chondracanthidae, the bifurcation is of a primitive nature. The second pair of thoracopods is much smaller than the first pair and also lacks bifurcation.

Male: Of the usual chondracanthid type.

Remarks: The most characteristic features of the species are the two-segmented abdomen in the female, the unbranched thoracopods and an absence of processes on the body. It is hoped that additional material can be collected, and thus enable a more detailed description to be published.

Genus **Acanthochondria** Oakley, 1927

Acanthochondria gemina sp. n.

(Figures 14-19)

Locality, Host and Record of specimens: 5 females (4 with males), including holotype, found in the mouth of *Neoplatycephalus richardsoni* at Redhead, near Newcastle, New South Wales. Collected by W. S. Fairbridge, 21.10.1948.

Female: This species has the general appearance of *Acanthochondria bulbosa* Heegaard and *A. spirigera* Shiino. All three have an elongated " head ", a long neck, and a trunk divided into two parts. While in the present case the neck consists of the normal two thoracic segments (each with a pair of appendages) when viewed ventrally, what appear to be three distinct segments can be counted when the copepod is seen in a strictly dorsal view. This is because the capsule of the " head " does not dorsally cover the part on which the mouth appendages are placed. The posterior part of the " head " has ventrally a large bulbous swelling, and on the posterior part of this swelling the mouth opening and its appendages are placed. The " head " itself is, from a dorsal view, of the normal ovate shape. The trunk is, in the acanthochondrian way, depressed dorso-ventrally, and is two-segmented, with a division dividing it into a larger anterior part with swollen convex lateral margins and a smaller posterior segment with more parallel lateral margins. This divisional line is very clearly seen on the ventral side of the trunk, where it makes a rather deep cut in the surface. On the dorsal side of the trunk the division is not so clearly seen, as there the two parts merge more into one; only the lateral margins have the strong incisions on each side. The trunk extends into a posterior lobe on each side, between which the small abdomen is placed in the median line. The abdomen is small, rhomboidal and furnished with a pair of two-jointed limbs—the so-called anal laminae. The first of these joints is the larger, cylindrical in shape and tipped with the smaller distal, conical-shaped joint. The egg-strings are long, about the length of the whole copepod, and consist of many small eggs. The first antenna could not be seen to be two-lobed, as in most of the chondracanthids, but it consists of at least three joints. It is sausage-shaped, and the distal joint is tipped with a single short, thick spine. The second antenna is the usual large hook-shaped organ with a thick, short terminal joint; the large sickle-shaped hook extends it as a second joint. In this species the basal joint is perhaps more visible than usual in the female.

The upper lip is narrow and covers the toothed distal joint of the mandibles, which are falcate, rather thick at the base, and with the second joint shaped in a blade regularly and uniformly cut into sharp denticles. The maxilla is short and triangular, but no spines could be seen on it. The first maxilliped is two-jointed, with the basal joint stout. The exopod of the first maxilliped is only a short narrow bulb, while the endopod is shaped as a forwardly curved stylet with teeth confined to the whole of its posterior or lateral convex margin. The second maxilliped is three-jointed, with a long basal joint followed by a shorter but thicker second joint carrying hairs on its postero-lateral margin, and tipped with the claw-shaped third joint which is curved backwards. On the second joint, underneath the claw, is a large semi-globular and hairy sensory bulb. The two pairs of thoracopods are of the usual bulbous, bifurcated type, of which the first pair is much shorter than the second. No limbs were seen on the trunk proper. The anal laminae are large and two-jointed, but without any setae; they are placed ventrally on the posterior part of the abdomen.

Length of female, 9-12 mm. Egg-strings, 10-15 mm.

Male: The male is the usual pygmy type, less than 1 mm. in length overall, with a well-rounded carapace and, for the family, a large " abdomen " divided into four segments; a small rostrum is seen in front pointing forward between the second antennae. The first antennae are, unusually for males, clearly two-jointed, with relatively large sausage-shaped basal joints tipped with very small and conical terminal joints; no setae could be seen. The second antennae are the usual large hooks, only placed a little more ventrally than in most cases, with soft and large basal joints and strong and hook-shaped distal joints. The upper lip is a transverse lamella covering the mouth-opening from the anterior, including the denticulated stylet-shaped distal joint of the mandibles, which are entirely protected by the lip. The soft cylinder-shaped basal mandibular joint is relatively long, giving strong movability to the cutting part of the mandibles, which thus become a pair of stylet knives on long shafts. The maxilla is very short, as in the female—only a bud without setae or joints. The first maxilliped is two-jointed, with a large basal joint and a smaller claw tipping this joint. The second maxilliped is three-jointed, with a long basal joint, and a shorter second joint which appears to be furnished with a sensitive pad as in the female, and in the same place, but it could not be distinctly seen.

What is called the abdomen in the male is to be considered as the trunk in the female. So the carapace in the male is only the head capsule in the female, and the diminutive abdomen in the female is then coalesced with and absorbed into the trunk in the male. Thus, the male has the anal laminae or caudal rami placed on the posterior tip of this " abdomen " or trunk. This terminology provides a reasonable explanation of the presence of the two " abdominal appendages " on the first two segments; they are the same as the two pairs of limbs on the first two segments of the trunk in the female. These limbs are small, unjointed and unbranched, as is usual in males of the family Chondracanthidae, if they are present.

Length of carapace, 0.3 mm. Length of abdomen, 0.35 mm.

Acanthochondria tasmaniae sp. n.

(Figures 20-26)

Locality, Host and Record of specimens: 1 female, the holotype, and an attached male, the allotype, were found in the mouth of a " Sea Perch " taken on the east coast of Tasmania, 15.7.1909. Australian Museum Reg. No. E. 6796.

Female: This species is short and squarish, with a short neck tapering from the trunk into the short squarish head in front. The head is strongly rounded dorsally, and much narrower anteriorly than posteriorly. The first thoracic segment is very short and pressed in between the head and the following segment, although it has on the ventral side a pair of appendages which appear as if growing out from the head. The following or second thoracic segment is much larger and wider, with a lateral lobe bulging out on each side. The same segment also carries a pair of appendages on its ventral side which is larger than the previous pair of limbs. Following the two free thoracic segments, which in the Chondracanthidae could be called the " neck ", is the trunk proper, with the acanthochondrian division anteriorly, and posteriorly a lateral incision midway along the trunk which makes the structure lyre-shaped and, in this species, very short. The trunk is not so strongly dorso-ventrally depressed as is usual in *Acanthochondria*. Posteriorly it is produced into two lateral lobes, both of which are strongly curved towards the median line of the body, and long enough to touch each other from both sides, leaving posteriorly a short and very small rounded lobe in the median line of the trunk. The genital openings are found on the ventro-lateral side of this small lobe, quite close to the abdomen. From the ventral surface of the short median posterior lobe of the trunk the abdomen is found hanging like a plum; it is small, as is usual in the Chondracanthidae, but whereas the family commonly features an abdomen wider than long or as wide as long, in the present species the length is nearly twice the width, including anteriorly the narrow neck by which it is attached to the trunk. This small abdomen carries a pair of caudal rami or abdominal laminae as a last pair of limbs.

The egg-strings are long—longer than the whole body, and filled with many small eggs.

The first antenna is a long sausage-shaped organ, with a second and third joint springing from the ventral side near its tip which together form a small club stuck to the antenna proper; no setae could be seen on any of the joints. The second antenna is the usual hook—a large and horny sickle-shaped structure with a very short basal joint. The upper lip is nearly semi-circular and somewhat withdrawn. It looks like a large roof for the mouth-opening and the first mouth appendages, as it reaches down towards the first maxillipeds. The mandible is of the usual blade pattern regularly cut into sharp denticles at its margins and carried on a shaft (the proximal joint). The maxilla consists of a bulbous basal joint from which extend two following joints which are very thin and delicate, the most distal one ending in a point. The first maxilliped is three-jointed, with proximally two cylinder-shaped joints of about equal length, followed by a terminal joint which is conical, pointed towards the tip, and with two rows of stiff tooth-like hairs placed at the anterior and posterior margins. The second maxilliped is also three-jointed, the proximal joint being the largest and more than twice as long as the following one. The second joint is furnished at its distal end with a semi-circular sensory bulb, and the joint is tipped with a backwardly-curved claw.

The first thoracopod is short and bifurcated, with the length of the branches equal to the length of the stem; no joints could be seen. The second thoracopod is larger, and has a longer stem before the bifurcation; the trunk part has no appendages. The caudal rami on the abdomen are two-jointed, placed midway on the side of the abdomen, and each consists of a small basal joint tipped with a backwardly-curved pointed claw.

Length of female, about 4 mm. Length of head, 1 mm. Greatest width of head, 1.2 mm.

Male: The male is the usual tiny dwarf, with a semi-globular carapace or head capsule which is extremely flattened ventrally. The trunk is comprised of only three segments which can be very clearly seen from a dorsal view, but their sutures progressively become weaker and finally lost along the lateral side of the body. The first antenna is small. The second antenna is the normal big, two-jointed, hook-shaped organ, with which the male clings to the female. Between the right and left second antennae the carapace is produced into an exceptionally long rostrum with a rounded tip and parallel sides. The shape of the rostrum, as seen in Fig. 25, is characteristic of the species, and from it the male can be readily recognised.

The mandible is the usual sickle-shaped, two-jointed stylet on a shaft, and cut into sharp denticles on the blade. The maxilla is small and two-jointed; the basal joint compares with that of the female, but instead of having two distal joints, only a single conical claw could be seen. The first maxilliped is two-jointed, and has a big bulbous basal joint furnished with a sickle-shaped claw which has a tip pointing forwards. The second maxilliped is three-jointed; it has a long and muscular basal joint, followed by a thinner and shorter cylinder-shaped joint on which the sensitive pad is placed. Whereas this last is a club in the female, in the male it appears to be a ring running round the distal part of the joint. The terminal joint is a weak, backwardly-curved claw. No appendages are to be found on the free thorax; only at its posterior tip are the caudal rami or anal lamina found. These are two-jointed and clearly indicate that they have originated from proper limbs.

The male is about 0.4 mm. long. The carapace, or head capsule as it is called in the female, is 2.5 mm. long and 1.7 mm. high. The abdomen is about 0.14 mm. long and averages 0.1 mm. in height.

Alimeda orientalis gen. and sp. n.

(Figures 27-36)

Locality, Host and Record of specimens: 3 females, including the holotype, from gill flaps of a Sea Hare, *Aplysia*; Port Jackson, New South Wales. Australian Museum Reg. No. P. 11570.

Female: The cephalon is coalesced with the first thoracic segment; except where produced anteriorly into a blunt rostrum, it is nearly circular in shape. The following four free thoracic segments are elliptical in shape, narrow where each comes into contact with segments in front and behind, but bulging out in the middle to their greatest width. While reduced in size towards both extremities, the first free segment (second thoracic segment) is even wider than the cephalothorax. The genital segment is small, elliptical and followed by the abdomen, which consists of four segments about equal in size and shape. The anal laminae are well developed and each is furnished with two long setae. The egg-strings are sausage-shaped, with many small eggs in several rows.

The first antenna is long, slender, and consists of eight joints. The first and third joints are short, with a long second joint in between which is the longest of all. The fourth and fifth joints are of medium length, and both of the same size. The three terminal joints gradually shorten distally. All the joints except joint number three, which is naked, are furnished with two or more setae, the three setae tipping the terminal joint being very long.

The second antenna has a bulbous stem consisting of three joints which taper in size both proximally and distally. The distal joint is furnished with a one-jointed exopod and endopod, each furnished with a nearly straight claw. A few setae are found distally on the second and third joints. The upper lip is a transverse membrane with a lunular cut placed posteriorly from its middle. This, together with the following mouth-parts, is of interesting shape because both show in all details such a close relation to the mouth-parts of the Chondracanthidae. The mandible is a long and sickle-shaped stylet with a row of teeth on its convex margin. The maxilla is vestigial, as in the Chondracanthidae, and is here only a small pointed palp. The first maxilliped is a flattened one-jointed appendage, with a toothed posterior edge; it shows clearly that the unjointed shape is not its primary shape, but is brought about by the coalescence of at least two joints. The second maxilliped is three-jointed, with a large basal joint, a medium-sized middle joint and a small conical third joint.

The thoracopods all have a single basal joint, and the three first pairs have both a three-jointed exopod and an endopod. In thoracopod number four the exopod is still three-jointed, but the endopod consists of only two joints. In the fifth thoracopod there is present only a one-jointed exopod, and the endopod is reduced to a small process with a seta placed on the protopod; on the lateral side of the exopod and on the distal joint of the endopod short bulbous setae were found which, from their shape, most likely have a sensory function.

Remarks: This interesting species shows, in the mouth-parts and partly in its habitat, a clear relationship to the Chondracanthidae. While it and the members of the Chondracanthidae may have had the same ancestry among free-living forms, their life-histories today are different. The Chondracanthidae are all parasitic in the gill-cavities of fishes, whereas *Alimeda* has been found parasitic in the gills of a mollusc. Furthermore, this new species is of great interest because, in contrast to *Alimeda*, most of the known copepods parasitic on invertebrates have their mouth-parts much more reduced. It is therefore hoped that *Alimeda* and other closely-related genera from invertebrates, when they are better known, may clear up many points about this group's relationship. It is also hoped that, in the near future, some more material of this interesting new copepod can be examined and will reveal the yet unknown male. Most likely the male will prove to be either a pygmy, as in the Chondracanthidae, or one which reaches only the copepodit stage in which it fertilises the female, as in *Lernaea.* In either case the male will prove to be less deformed than the female, and through its morphological characters will indicate its position taxonomically. The new evidence will also most likely cause the creation of a new family. For the time being, until further knowledge is gained, *Alimeda* is placed as an appendix to the Chondracanthidae.

III Suborder CALIGOIDA

Family Caligidae

Genus Caligus Müller 1785

Caligus rapax H. Milne-Edw.

Caligus rapax H. Milne-Edw., 1840, p. 453, pl. 38, figs. 9-12.

Caligus elongatus H. Milne-Edw., 1840, p. 454.

Caligus rapax, Baird, 1850, p. 270, pl. 32, figs. 2-3; *Id.*, Kröyer, 1863, p. 71; *Id.*, Wilson, 1905, p. 568, pl. 7, figs. 79-89; *Id.*, Heegaard, 1947b, pp. 96-99, figs. 36-49.

Locality, Host and Record of specimens: About 20 females parasitic on a Skate (*Raja*); Oyster Bay, Tasmania, 15.7.1909. Australian Museum Reg. No. E. 6792.

Remarks: This species is the most common caligid in the North Atlantic area on both sides of that ocean. It is also the one that has been found on the largest number of different hosts, due possibly to the fact that both the males and females are more lively than in most species, and they frequently display this activity by leaving a host and swimming freely about. This happens more often at night than during the daytime, as evidenced by several investigators who have recorded the capture of both sexes in tow nets, together with non-parasitic copepods.

The present record appears to be the first from waters outside of the Atlantic Ocean and adjoining seas. Now that the species has been found off the Tasmanian coast, it can be expected to be later recognised from New Zealand and along the South Australian coast.

Caligus alveolaris sp. n.

(Figs. 37-44)

Locality, Host and Record of specimens: A few specimens of both sexes, including the holotype, taken from skin of a Mackerel Tuna (*Euthynnus allitteratus*) at Howick Islands, North Queensland. Collected by A. G. Nicholls, 5.11.1948.

Female: The female is about 5.5 mm. long, and has a quadrangular carapace 2.5 mm. long and a little more than 2 mm. wide. The frontal plates are wide and prominent and are not emarginate at the centre. They have large lunules which are almost circular and slightly projecting. The frontal margin between the lunules is nearly straight. The posterior sinuses are narrow and quite deep, leaving the median lobe nearly two-thirds of the entire width. The lateral lobes are narrow and curve a little inward.

The free thoracic segment is transversely linear—in the female about two-thirds as wide as the genital segment, but rather short. The genital segment is square (about 1.3 mm. long and wide) and provided with two short and blunt posterior lobes. The abdomen is nearly as long as the genital segment and made up of two segments of about equal length and 0.5 mm. in width. The terminal segment is deeply hollowed on each side posteriorly for the reception of the small, lateral anal laminae. These latter are flattened and do not reach beyond the tip of the abdomen; they each carry three long plumose setae posteriorly and a much shorter one on the outer margin. The egg-strings are short, only a little longer than the abdomen with the width of the egg-cases about half the width of the abdomen.

The first antennae are a little longer than the frontal plates; the proximal joint of each is a little longer than the distal one and much stouter. The second antennae are short and stout, with a broad terminal claw and a blunt accessory spine. No trace could be found of the first maxillae. The second maxillae are stout, broadly triangular and nearly as long as the mouth-tube; a small one-jointed palp without any setae is found at each of the basal joints. The mouth-cone is short and broadly U-shaped. The furca is Y-shaped, a little rounded at the base of the branches, and with the peduncle longer than the branches; a ridge runs underneath it across the sternum. The first maxillipeds are of the ordinary type. The second maxillipeds are three-jointed, with a slender claw and with an accessory spine; they also carry a short hooked spine on the median side of the proximal joint.

The first thoracic legs are tipped with the usual three claws, and a seta at the inner distal corner between the three terminal claws and the three posterior setae. This seta is shaped more like a spine. The claws are short and stout, all of the same length, and the second and third are on the convex side, fringed with a lamina or wing which is sharply serrate. The second and third legs are ordinary. The large spines on the exopod of the second leg are strong, with the proximal one nearly straight, and the spine on the exopod of the third leg is also stout, with a brim of hairs on the convex side. The fourth legs are large, stout and four-jointed, with the usual five spines; the spines on the second and third joints are larger and longer than usual, but all are smooth and a little curved. The fifth legs can be seen as small bulbs with short setae on the usual place, distally on the ventral side of the genital segment.

Male: The male is a little smaller, due to the reduced size of the genital segment and the abdomen; the carapace itself is nearly equal in size to that of the female. The genital segment is a little wider than long—width about 0·9 mm., length about 0.7 mm. The abdomen is two-jointed, with the proximal joint very short.

In the appendages the usual sexual dimorphism is apparent. The second antennae are a little stronger than in the female and have a stronger accessory spine, but still carry hook-shaped distal joints. Similarly, the second maxillae are more pointed, and the second maxillipeds are much stronger and stouter. The genital segment is furnished with vestigial remnants of both the fifth and sixth legs. The furca in the male is more open in its two branches.

Remarks: This species looks very like the young of *C. coryphaenae* (see Heegaard 1948), but it is smaller and with accessory spines on the second antenna and second maxilliped. It differs further in the shape of the spines on the first, second and fourth legs.

Caligus maculatus sp. n.

(Figs. 45-53)

Locality, Host and Record of specimens: This species is a parasite on the skin of the Queensland Mackerel (*Scomberomorus queenslandicus*), but is found more commonly on the Spanish Mackerel (*S. commerson*); Cape Bowling Green, North Queensland, 2.11.1948; Cape Melville, North Queensland, 5.11.1948; Cape Direction, North Queensland, 6.11.1948; Princess Charlotte Bay, North Queensland, 6.11.1948; Stephens Is., Torres Strait, 23.11.1948 (including the holotype). All the specimens were collected by A. G. Nicholls. Both sexes are represented in the series.

Female: Carapace elliptical, one-fifth longer than wide. The frontal plates are distinct; they have a slightly rounded frontal margin with an emargination at the centre. Lunelus large, semi-circular and prominent. The posterior sinuses are narrow but deep, with a strong lateral incision at the bottom, and the distal parts have approximately parallel sides. Thoracic area broad (three-fifths of the entire width), well rounded, and projecting posteriorly to about the depth of the sinuses beyond the lateral lobes. These latter are narrow and nearly parallel, the median lobe being wide—about two-thirds of the entire width of the carapace. The free thoracic segment is very wide—half as wide as the carapace, with which it is connected by a narrow neck. The genital segment is large, more or less quadrilateral, with rounded corners. It is slightly wider than long, and postero-laterally produced into two quadrangular lobes.

The abdomen consists of two segments nearly equal in size; both are quadrangular and have the same width as length. In the young female and in the male the first abdominal segment is only half the length of the second segment; and towards the free thoracic segment the genital segment has a short, transversely wrinkled neck. The anal laminae are of good size, and terminated by one short and three long plumose setae, the longest being about three times the length of the laminae. The egg-sacs are rather long for a *Caligus*.

The first antennae are short, with only few setae on the terminal joint as well as on the tip of the distal one. The second antennae are stout, placed a little to the side and anteriorly to the mouth-cone. The antennae are three-jointed with a strongly shaped, elongated hook, and a short and wide supplementary hook on the posterior margin of the basal joint. The mouth-cone is plump and short, with a quadrilateral opening fringed by the usual long setae. The mandibles are stout and strongly curved, a condition due to the plump width of the mouth-cone.

The first maxillae are small but two-jointed, with a short basal joint and a hook-shaped, strongly curved distal joint. The second maxillae are prominent, with a large conical basal joint provided with a stout short palp; a second joint is pointed and only a little curved away from the mouth-cone, with its tip reaching beyond the mouth-cone. The first maxillipeds are as stout as the rest of the limbs, with two very unequal curved claws at the tip, and a small accessory claw behind them on the lateral margin. The second maxillipeds are failry stout; the basal joint is much swollen, with a knob for the tip of the second joint to clutch against. The furca is open and cut wide beyond the centre, with the branches nearly twice as long as the base; the latter is much swollen and has two processes—one at each side of the peduncle and coalesced with it.

The first thoracic legs are of the usual form, tipped with the three claws and a seta placed at the inner distal corner between the three terminal claws and the three posterior, plumose setae. The claws are long, a little delicate, and only a little curved. The second joint or basis of the second pair of swimming legs is very stout, and with an anterior wing or process. The claw of the first exopodal joint is exceptionally long—nearly twice as long as the second joint; the claw of this joint is also large—about the length of the joint. The second joint of the endopod in the same limb is characteristically S-shaped and has a fringe of hairs on its anterior free margin.

The second pair of swimming legs is furnished with a large plate-shaped protopodite, with the two branches sitting close together. While both exopod and endopod are large they are of normal shape. The fourth pair of swimming legs are three-jointed, the basal joint being a little longer than the combined length of the two following ones. The second joint is tipped with a claw which is the longest of the five claws of the appendage. The last or terminal joint is a little longer than the previous one and is tipped with three smaller claws, the most distal one being the largest, and the other two a little shorter and of about equal size. The fifth claw is placed on the lateral margin of the terminal joint, half-way between the claws at the tip and the claw on the previous joint. At the base of each claw is a fringe of stiff hairy setae which is characteristic of the species, and of good systematic value. No fifth legs were found on the female.

Total length, 6 mm. Length of carapace, nearly 3 mm. Width of carapace, 2.25 mm. Length of genital segment, 1.5 mm. Width of posterior processes, a little more than 2 mm. Length of abdomen, 1.2 mm.

Male: The male is extremely large—nearly as long as the female. The carapace is even larger than that of the female and a little wider. The genital segment is only small, acorn-shaped and, as in the female, has a short neck towards the free thoracic segment. The abdomen is two-segmented, the first segment being less than half the length of the second. All the limbs are stout. The second antennae are of the typical male type, with the terminal claw coalesced with the previous joint, on which a triangular-shaped accessory spine is placed against the tip of the claw. Both first and second maxillae are much stouter than in the female; the second maxillae, as in the female, are furnished with a palp, but that of the female is a little shorter. The second maxillipeds are stouter than those of the female. On the genital segment of the male a fifth pair of legs is present as small processes with two setae, which can even be seen from the dorsal side.

Total length, 5 mm. Length of carapace, 3 mm. Width of carapace, 2.5 mm. Length of genital segment, 1 mm. Length of abdomen, 0.8 mm.

Remarks: The species was taken in great numbers. It is a stout caligid, easy to recognise with its spotted body, the fringe of hairs at the base of the fourth limbs, and the large open furca.

Caligus lucidus sp. n.

(Figs. 54-61)

Locality, Host and Record of specimens: Three specimens, including the holotype (both sexes represented), of this species were found attached to the skin and fins of a Chinaman Leatherjacket (*Cantherhines ayraud*) at Cape Hawke, New South Wales, 22.11.1948. Collected by W. S. Fairbridge.

Female: Carapace more than half the entire length, a little longer than wide, and narrowed anteriorly. Frontal margin a little rounded; frontal plates dominant, but with rather small lunules placed an appreciable distance from each other. Posterior sinuses shallow; lateral lobes narrow and a little pointed at the tip. Lateral aleae of carapace very large, with rounded corners, and projecting well behind the lateral lobes. Thoracic area of carapace very large, about three-fifths the length of the carapace.

The free thoracic segment is short and less than one-fourth the width of the carapace. The genital segment is a little less than two-thirds the width of the carapace and half its length; it is oblong in shape, has well-rounded corners, and two smaller posterior processes nearly as long as wide. The abdomen is nearly as long as wide. The anal laminae are large, close together, and each is tipped with three long, and one short, setae.

The first antennae are large, with a stout basal joint, and a conical distal joint with the top of the cone towards the proximal joint; the first joint is furnished with several spiny setae, and the second joint is tipped with thinner setae, some of them quite short.

The second antennae are large, with an elongated basal joint, the hook being divided by a suture into two parts. The first maxillae are two-jointed, with a short basal joint coalesced with the carapace, and a second joint shaped in a stout hook only a little curved. The second maxillae are characteristic of the species. They are two-jointed, with a short basal joint coalesced with the carapace and furnished with a two-jointed palp. The second and distal joint is blunt and tipped with a little knob. The mouth-cone is short and stout.

The first maxillipeds are longer than usual, and have a stout basal joint; the distal joint is narrow at its base, becoming flattened and widened towards the tip, like the blade of a knife. The two claws at the tip are long and very delicate, the most distal one being twice as long as the other; both are placed at the most distal corner of the joint. Further, an accessory spine of normal shape and size is found in the normal place on the distal joint. The second maxillipeds are extraordinarily small; the basal joint is only a little swollen, and the hook is very delicate and less than half the length of the proximal joint. The tip of the claw is separated from the rest by a line.

The furca is large and with flattened branches, the whole having the appearance of the head of a long-eared bat. The furca has a rounded Y-shape, the base being of the same length as the branches, but much wider. The branches themselves are very stout, blunt, and only slightly diverge. The basal portion is very narrowed at the centre, widening out considerably towards the carapace like an hour-glass.

The first pair of swimming legs is of normal size, and tipped with three delicate and curved claws; the seta at the distal corner, between the claws and the plumose setae, is lacking. The plumose setae are specially shaped; each of them is swollen at the base, and on the lateral side of this bulb a fringe of hairs can be seen—the remaining part of the setae is of the usual plumose shape. The second and third pairs of swimming legs are of very ordinary shape, with no characteristics whatsoever. Only in the third pair is there to be found a good distance between the two branches, of which the exopod especially is a little larger than usual. The fourth pair of swimming legs is two-jointed, long and slender, and furnished with four claws. The claws are delicate, exceptionally long, and both are a little bent and curved, preventing them from functioning as normal claws. Three of the claws are placed most distally on the second joint; the fourth is placed midway along the margin of the same joint, indicating that this joint must be a coalescence of two joints. The anal laminae are long and each is tipped with one short, and three long, setae.

The egg-strings are long, with a row of thick eggs.

Total length, 4.8 mm. Length of carapace, 2.7 mm. Width of carapace, 2.4 mm. Length of genital segment, 1.3 mm. Length of abdomen, 0.4 mm.

Male: The male is of nearly the same size except that, as the genital segment is much smaller than in the female, the whole copepod is a little shorter (about 4.5 mm.). The carapace is a little larger, and the genital segment much smaller, than in the female. The latter is acorn-shaped and furnished with both a fifth and sixth pair of limbs on its ventral side which are, as usual, very vestigial and can be seen as small bulbs with, respectively, three and two setae. The abdomen is two-segmented, each segment a little shorter than the abdominal segment of the female, and of equal size. The setae of the abdomen may be a little longer than they are in the female. The limbs are exceptionally weak for a male; even the second maxillipeds are not larger than those of the female.

Remarks: The whole animal is hyaline, a condition which has suggested its specific name; in other features also it is very characteristic and easy to recognise—the shape of the second maxilla and the two maxillipeds, as well as the furca, and the plumose setae on the fourth pair of swimming legs. In general appearance the species is somewhat like *C. alatus* (Heegaard 1943) but the differences in the limbs are numerous.

Caligus dentatus sp. n.

(Figs. 62-67)

Locality, Host and Record of specimens: One female, the holotype, taken on the Spotted or Japanese Spanish Mackerel (*Scomberomorus niphonius*) at Dalrymple Island in Torres Strait. Collected by A. G. Nicholls, 23.11.1948.

This is one of three small caligid species of which only a single specimen (a female) is known and recorded here.

Female: Carapace orbicular, somewhat narrowed anteriorly, with rounded sides and as long as wide. Frontal plates well developed and prominent; the lunules are small, circular and almost entirely concealed in dorsal view. Posterior sinuses narrow; the median lobe is a little less than half the entire width, and not projecting behind the well-developed lateral lobes, which are curved a little inward. The cephalic part of the carapace is nearly twice as long as its thoracic portion.

The free thoracic segment is very narrow, less than a third of the width of the carapace and much constricted in front of the fourth legs. The genital segment is elliptical, only half as wide and nearly as long as the carapace, and projects posteriorly in the form of a blunt, conical lobe on each side of the abdomen. The abdomen is two-segmented; the first segment is a little shorter than the following one, and together they are only a little shorter than the genital segment.

The anal laminae are long and narrow and inclined towards each other; they bear three long and one short terminal setae. No egg-strings were found on the specimen.

The first antenna has a very stout first joint, as long as the width of the lunules; it is provided with a fringe of short thick sensory hairs on its frontal margin. The second joint is of moderate length; it is provided with some short spiny hairs and some longer flexible ones, the latter being placed on the posterior margin of the joint near to the tip. The second antenna is three-jointed and characteristically slender, terminating in a very slender curved hook. The mandibles and the mouth-tube are of the usual type. The first maxilla is small and two-jointed, with the distal joint shaped in a slender claw; no palp was seen on the proximal joint. The second maxilla has one free joint which is strong and pointed, but a proximal joint is present which is coalesced with the carapace, forming a ridge from the mouth-cone and towards the lateral margin. The maxillary palp is present on the latter as a two-jointed bud. The first maxilliped is of the usual pattern but with a very stout basal joint, and the anterior claw is much stronger than the posterior one. The second maxilliped is very stout for a female and three-jointed; the basal joint especially is very stout and furnished with powerful muscles and a long two-jointed and strongly curved terminal claw. The two joints in the claw are probably due to age, as they are often found in young specimens; later the joints coalesce so completely that no suture can be seen between them. The furca is a delicate long fork with a bulb at the base, followed by a short delicate peduncle and two long slender branches which are blunt and curved in towards each other.

The first swimming legs are slender, with three terminal claws. The most distal claw is the strongest and the most proximal one the weakest, but all three are delicate. The usual seta at the corner is well developed. The usual three plumose setae on the posterior margin of the terminal joint are missing, with no trace of them left.

Along the anterior margin of all three exopodal joints of the second pair of swimming legs a wing is present, and on the endopod both the first and the second joints have serrated anterior edges, a feature which has given the species its name.

The rami of the third legs are placed close together; on the basis a wing is found, reaching from the base of the exopod and along the lateral margin of the joint.

The fourth legs are long but very delicate, the basal joint being nearly as long as the two terminal ones; of the four spines, the largest is at the tip of the second joint, and smaller ones occur on the outer margin of the terminal joint and at the tip. The last two spines were broken off in the single female found in the collection but, judging from their bases, they could only have been small.

Total length, 4.2 mm. Length of carapace, 2 mm. Width of carapace, 1.7 mm. Length of genital segment, 1.3 mm. Length of abdomen, 0.85 mm. Egg-strings not present.

Caligus proboscidatus sp. n.

(Figs. 68-74)

Locality, Host and Record of specimens: Cape Bowling Green, 2.11.1948. Princess Charlotte Bay, 6.11.1948. Eden Reef and Princess Charlotte Bay, 6.11.1948 (including the holotype)—all North Queensland. Collected by A. G. Nicholls, from the mouths of mackerels (*Scomberomorus queenslandicus* and *S. commerson*)—a total of 5 young males; no females were found.

Male: Carapace about four-sevenths the entire length, longer than wide, and not narrowed anteriorly. Frontal plates well defined, a little more than half the width of the carapace. The lunules are large, circular, and projecting a little. Posterior sinuses wide, and slightly inclined away from the central axis. The median lobe is about half the entire width of the carapace, and projects only a little beyond the lateral lobes; the latter are blunt and well rounded.

The thoracic area is of medium size, the anterior groove being almost linear across. The free thoracic segment is transversely linear, wider than the genital segment, and very short. The genital segment is contracted into a short, narrow neck where it joins the free segment, and is wrinkled across this neck as though segmented. It is about one-and-a-half times longer than wide, and is narrow towards each end, its extreme width being less than one-third of that of the carapace. The abdomen is nearly as long as the genital segment. It is two-segmented, the segments being approximately the same length. The anal laminae are small, well separated and straight, and each has three plumose setae. The anterior antennae are short and closely depressed to the carapace. The second antennae are stout, with a strongly curved terminal hook.

The first maxillae are of medium size, with a slightly curved pointed tip and an enlarged base. The second maxillae have a stout basal joint with a little palp and a pointed, curved distal joint. The mouth cone is extraordinarily long, appearing much like that in the Pandaridae. The first maxillipeds are stout, with two short, curved terminal claws. The second maxillipeds have an exceptionally stout basal joint even for a male, and the slender strongly-curved distal joint is furnished with two accessory spines. On the proximal joint also, some spiny knobs are present at the point where the tip of the distal joint touches. The furca is small, Y-shaped and slender; its base is elongate, very narrow and about as long as the branches, which are divergent, rather slender, and blunt.

The first swimming legs are slender, with the usual terminal claws, but are very weak, and so is the seta at the corner. The usual three large plumose setae on the posterior margin of the terminal joint are missing; three small spines are found in their place. This is unusual, although in the present Australian material the same condition is also found in *C. obovatus*. In *C. dentatus* this same posterior margin is even naked. A further feature common to all three species is that they are small and a little delicate.

The claw on the proximal joint of the exopod of the second legs is long and curved; on the following joint the claw is very small. On the third exopodal joint the claw is short, and fringed on each side from the base to the tip with a lamina or wing. The frontal side of the second endopodal joint is fringed with a dentated wing or lamina, which is not found on either the previous or succeeding joints. The rami of the third legs are large and stand out prominently from the edge of the basal lamina. The fourth legs are short but very stout, three-jointed, with the basal joint especially very large; the distal joint is the shortest and smallest. The legs have five spines of about the same length situated close together along the outer margin, which are short, curved and dentated on their concave sides. The two proximal claws are dentated from their bases to their tips, and the three distal claws only nearly to their tips on their concave sides. No fifth legs could be seen.

Total length, 2.5 mm. Length of carapace, 1.35 mm. Width of carapace, 1 mm. or a little more. Length of genital segment, 0.6 mm. Length of abdomen, 0.5 mm.

Remarks: Only five males of this species were collected from three different localities. The specimens are all very young, with a little of the frontal filament left from the chalimus stage. The species is easy to recognise by its small and delicate size, the extremely long mouth-cone, the first swimming legs without the plumose setae, the serrated edge on the second endopodal joint of the second legs and the dentated claws, and the spines of the fourth legs.

Female: Unknown.

Caligus quinqueabdominalis sp. n.

(Figs. 75-82)

Locality, Host and Record of specimens: Three females, including the holotype, collected from *Scomberomorus commerson* in Torres Strait by A. G. Nicholls, 22.11.1948.

Female: Carapace orbicular and nearly as wide as long. Frontal plates dominant, with the frontal margin strongly curved. Lunules circular and widely separated, but so small that they can easily be overlooked. Posterior sinuses are shallow and widely triangular. The median lobe is more than one-half the width of the carapace and part of it projects behind the lateral lobes. Transverse groove circular, separating the cephalic from the thoracic areas almost through the centre of the carapace. The eyes are small and placed well forward.

The free thoracic segment is short and quadrangular, and is about half the width of the genital segment. It is very prominently widened at the centre through the base of the fourth leg, and has a narrow neck towards the carapace. The genital segment is two-thirds the width of the carapace and is about a third wider than long, with strongly-curved lateral margins and a somewhat indrawn, concave posterior margin.

The abdomen is of the same length as the genital segment and is five-segmented. The segments are about equal in size, and although the sutures between them are not very distinct, they can be seen without difficulty. The anal laminae are stout, and armed with small and short setae.

The anterior antennae are short—about two-thirds as long as the frontal plates, with the terminal joint a little shorter than the basal one. Both joints are only weakly armed with setae, those on the terminal joint being gathered at the tip. The second antennae are large, with the basal joint swollen. The terminal claw of these appendages is much elongated, with a short hook at the tip. The first maxillae are close to the tips of the second antennae; they are only small and shaped in a bud with two papillae—one for the following joint and one for the palp. The second maxillae are stout, strongly curved, two-jointed and very pointed at the tip, the first joint being furnished with a palp. The terminal joint projects some distance in front of the mouth-cone; the latter is of usual size or may be a little longer.

The first maxillipeds are of the usual shape, tipped with two strong claws, and have an accessory spine placed laterally on the distal joint. The second maxillipeds are rather small, the basal joint being nearly twice the length of the terminal claw; the latter is stout and strongly curved.

The furca is of medium size, not quite cut to the centre, thus making the branches a little shorter than the base. It is conical in shape, its branches only a little divergent, and ending bluntly. The base is swollen on each side at the centre, giving it a spindle shape.

The first swimming legs have a stout spine on the posterior margin, and a smaller one on the outer margin of the basal joint. The three terminal spines are nearly equal, and the seta on the corner is missing, but the three plumose setae on the posterior margin are rather long and stout. The second pair of legs has a very large spine on the first joint of the exopod, and the spines that follow taper in size towards the third joint. The second endopodal joint has a fringe of hairs on its outer margin. The rami of the third pair of legs are well separated and stouter than in most species. The fourth pair of legs is large, stout and four-jointed; the basal joint is about equal to the combined length of the other three joints, and is very stout and square. The remaining three joints are of about equal length. Joints number two and number three are each tipped with one stout spine. Joint number four is tipped with three stout and slightly curved spines of equal length, making a total of five spines on the leg. No fifth pair of legs could be seen.

Total length, 4.7 mm. Length of carapace, 2.2 mm. Width of carapace, 2 mm. Length of genital segment, 1.1 mm. Length of abdomen, 1 mm. Length of egg-strings, 2.7 mm. Eggs large.

Male: Unknown.

Remarks: The species is very easy to recognise, as hitherto none has been described with five abdominal joints.

Caligus sensorius sp. n.

(Figs. 83-91)

Locality, Host and Record of specimens: Twice found on a small Surf Fish (*Iso rhothophilus*)—once in a rock bathing pool at Long Bay, near Port Jackson, New South Wales, 5.5.1927 (Australian Museum Reg. No. P. 8928), and once at Maroubra Bay, also near Port Jackson, New South Wales, 3.6.1894; Australian Museum Reg. No. G. 5218, many specimens, including the holotype. From scales of "Snook" (*Australuzza novaehollandiae*) in Esperance Bay, Western Australia, no date (Australian Museum Reg. No. P. 5726).

Female: This is only a small species, the general shape of the body being short and stout; the elongated carapace narrows anteriorly and is only a little longer than wide. The frontal plates are dominant, with the frontal margin a little curved. Lunules are semi-circular and widely separated, but not of dominant size; they reach only a little more than half-way across the frontal plates. The posterior sinuses are shallow and a little triangular, with their inner margins inclined slightly away from the central axis, the median lobe being a little more than half the entire width of the carapace and projecting a little beyond the lateral lobes; the latter are pointed and incurved towards the axis. The eyes are only small and placed at a point about one-third along the length of the carapace. The transverse groove is circular, separating the cephalic from the thoracic areas almost through the centre of the carapace.

The free thoracic segment is triangular, with one tip pointing forward. It is very narrow, its width being only one-fourth the width of the carapace. The genital segment is transversely semi-lunar in shape and a little wider than long. Its sides are well rounded, the posterior angles being prolonged backward as stout blunt lobes. The posterior margin between these lobes is deeply concave. No fifth or sixth pair of legs are visible.

The abdomen is unjointed; the width at its base is a little more than one-fourth the width of the genital segment. The length of the abdomen is slightly greater than its width. The anal laminae are proportionally of good size, and armed with three small plumose setae and a very short one at the lateral corner.

The joints of the first antennae are elongated and the distal one is a little delicate. Second antennae are of usual size and with an accessory spine at the base of the proximal joint. The first maxillea are long, slender, well curved and two-jointed, but with very little swelling at the basal joint. The second pair of maxillae is simple, with a wide triangular base and a short blunt tip; a small palp is placed at the base. These maxillae are attached opposite the base of the mouth-tube and extend partly beyond its tip. The mouth-tube is short and evenly rounded, and is nearly as wide as it is long. The first maxillipeds are of the usual form, elongated and without an accessory spine. The second maxillipeds are only small, with a long narrow proximal joint, four times as long as it is wide, and with a short terminal joint strongly curved at the tip and less than half the length of the proximal joint. The furca is very characteristic. It is built with a very short peduncle, and two slender branches with an absolutely blunt tip; the branches are nearly parallel but very wide apart, even at their bases.

The first pair of swimming legs is of the usual form, with three terminal claws and three long plumose setae on the posterior margin of the distal joint, but lacking the long and slender seta at the corner. The second and third pairs of swimming legs are normal in all details.

The fourth pair of legs is long and very delicate; the first joint is elongated, very thin and followed by two joints of about equal length, and together they are a little shorter than the proximal joint. The second joint is tipped with one long claw, and the third joint with two claws, of which the most distal is about half again as long as the one behind; the joint itself is extended into a spiny process in front of these two claws. At the base of each of the two distal claws a hairy sensory bulb is found, which has prompted the naming of the species (see figure).

Total length, 3.5 mm. Length of carapace, 2 mm. Width of carapace, 1.7 mm. Length of genital segment, 1.2 mm. Length of abdomen, 0.3 mm. Length of egg-strings, about 2 mm.

Male: The male is much smaller, the frontal plates are more curved anteriorly, and the carapace is proportionally much narrower behind the anterior antennae than in the female.

The free segment is longer than in the female and with a narrow neck towards the carapace. The genital segment is very small and narrowed considerably both anteriorly and posteriorly, giving it a barrel shape. The abdomen is three-segmented, with three equal segments. The anal laminae are as in the female.

Of the appendages, the second antennae are of the shape often found in males, with the short incurved claw. The male second maxillipeds are very much larger and stouter than the same weak and puny appendages of the female; the basal joint is much swollen and furnished with a knob, around which the tip of the terminal claw fits snugly. The terminal claw is about half the length of the proximal joint.

Total length, 2.4 mm. Length of carapace, 1.45 mm. Width of carapace, 1.3 mm. Length of genital segment, 0.4 mm. Length of abdomen, 0.3 mm.

Remarks: This small species was taken in large numbers on the fish it was attacking. Full details of the catch appear in the Australian Museum Magazine, iii, part 4, 1927, p. 129.

The species can be readily recognised, especially by its characteristic furca, the fourth pair of swimming legs with their three claws and two sensory bulbs, and the spiny process at the tip of the distal joint.

Caligus cornutus sp. n.

(Figs. 92-98)

Locality, Host and Record of specimens: 3 males of this large caligid were found on the skin of one of the Australian Pikes, *Sphyraena jello* (?), at Cape York, North Queensland; collected by A. G. Nicholls, November, 1948. 1 male and 1 juvenile female, the holotype and allotype, on *Sphyraena* at Portland Roads, Cape York, North Queensland; collected by A. G. Nicholls, 12.12.1948.

Male: The description of this new species will have to be based mainly on the male, as only one immature female was found. Superficially it is a rather large, stout copepod, resembling *Caligus curtus*, although very different in many important details. The carapace is broad, ovate, as wide as it is long, and somewhat longer than the rest of the body. The frontal plates are distinct and broad; the anterior margin is well rounded and incised at the centre. The two lunules are large, semi-circular to circular in shape, widely separated, and project a little beyond the frontal plates. The posterior sinuses are shallow, elliptical and nearly parallel with the central axis. The median lobe of the carapace is rather wide, about half the entire total width, and reaches to the posterior line of the lateral lobes. The posterior margin of this median lobe is four-lobated, with two larger lateral lobes projecting further posteriorly, and a shorter median part with an incision in the centre. The lateral lobes of the carapace are plump and well rounded. The cephalic area of the carapace is large and more than half the length of the entire carapace; the lateral areas are also large, and the thoracic area is a little wider than long, pushed backwards and relatively small except for the part merging with the large median lobe. The fourth free thoracic segment is large and very wide—about one-third the width of the carapace. Posteriorly there is a larger median lobe overlapping the genital segment.

The genital segment is globular and of a shape which I have not seen before in any caligid. As it is known, the so-called genital segment is formed by a coalescence of segments five and six. In the male of *Caligus cornutus* this can clearly be seen because the coalescence is not complete—reference to the figure of the species will show that there is a distinct line to be seen between the two segments. On the fifth segment there are two large lateral horns, coalesced for most of their length with the lateral margin of the segment, leaving only a furrow in the division between the segment proper and each of the horns. The horns end posteriorly in two backwardly-directed spines—a large one ventrally and a smaller one dorsally. The sixth segment is much smaller than the fifth and forms the posterior part of the genital segment. On the ventral side of the sixth segment is found a pair of spines—the vestigial sixth pair of legs. The abdomen is short and nearly square, a little longer than wide, and terminates in two lateral horns. Only one abdominal joint could be found. The anal furca is stout and short, terminating in three very stout setae and a fourth shorter lateral one, making a total of four.

The anterior antennae are extremely large, with the basal joint very stout and fringed on its anterior margin with short, plumose, sensory hairs. The terminal joint is slender and very long—nearly as long as the basal joint, and tipped with a few setae. The second antennae are of the usual hook-shaped type and three-jointed, with the proximal joint coalesced with the body.

The mandible is of the usual type, with the mouth-cone short and strong. The first maxilla is of fairly large size and situated nearly in line with the second antennae. Its first joint is absorbed in the body, but the second joint is provided with two spines, the endopodal one tipping the joint and the exopodal one forming a bulb or nub on the side of the free basis joint

The second maxilla is placed behind the second antenna, close into the mouth-cone. It is three-jointed, with a basal joint followed by two endopodal joints, which show some variation in their size and shape; they are yellow and horny, and together they take on the shape of a spine. In the figure of the species the distal joint is shown as very small, but in some specimens it is larger by comparison with the previous joint. This distal joint not only varies in different specimens, but may even differ with the right and left maxilla of the same specimen. The first and terminal joints are supplied with a vestigial two-jointed exopod, shaped as a small spine.

The first maxilliped is of the usual type, with the distal joint much longer than the proximal one, and furnished with a short conical accessory spine besides the two terminal ones. The second maxilliped is of average size, with an accessory spine on the second joint, and a claw-like ridge on the medial side of the proximal joint for the subchela to close against. The sternal furca is stout and wide in the gap, and has a rounded wing on each side; being very short, it cannot be raised very much from the body.

The first thoracic legs are large and stout, the first joint being provided with a short spine at its distal end—the vestige of the endopod. The next two joints are large, the second one nearly twice as long as the proximal one, and with a fringe of hairs at the postero-medial margin. The terminal joint is much shorter, and tipped with three claws which have a row of teeth on their posterior concave margin; the claws are swallow-tailed and split into two points at their tips. The same joint lacks the seta which is sometimes found at its inner distal corner between the three terminal claws and three posterior setae. The latter are strongly plumose, especially the most distal one, the side of which, towards the claws, is strongly asymmetrical, with much longer hair towards the claws than towards the setae on the other side.

The second pair of swimming legs has a distinct coxa and basis, the coxa being short, with a single plumose seta; the basis is about three times the length of the coxa, strong and stout, and tipped with an exopod and endopod, each with three joints. The first and second exopodal joints are each furnished with a claw and a plumose seta. The third and distal joints of the exopod have two claws and six plumose setae; the latter, together with the endopod, forms an effective swimming fan. The first and second endopodal joints are each furnished with one large plumose seta and their margins are fringed with hair; the second joint has, in addition, a lobate wing at the postero-medial margin. The third and distal endopodal joint is small, but is fringed with seven large plumose setae. The third pair of swimming legs has quite widely separated rami; the claw of the exopod is large and curved. The two free distal joints of the exopod and endopod have their antero-lateral margins fringed with hairs. The fourth pair of legs is four-jointed, the second and third joints being tipped with strong and nearly straight claws. The three claws on the fourth joint are curved. All five claws have a fringe of hair at their bases. The fifth pair of legs is rather peculiar in that each leg extends from the genital segment to a point about one-fifth of its length from the anterior margin, or to one-third of the fifth segment; they each have a proximal joint and two spines, the joint lying in such a position as to appear like a lateral frame to the genital segment, and grown together for its full length, with only a furrow showing the line of coalescence. This basal joint is tipped with two free claws. The endopod is the larger one, and is in a dorso-lateral position to that of the smaller exopodal spine. On the ventral side of the sixth segment two spines are found, representing the sixth pair of thoracic limbs.

Total length, 6-7 mm. Length of carapace, 3.5 mm. Width of carapace, 3.2 mm. Length of genital segment, 1.5 mm. Width of genital segments, 1.5 mm. Length of abdomen, 0.8 mm.

Female: The single young female of the present series is little advanced beyond the last copepodit stage, with the genital segment not fully developed (see figure). It is therefore not possible to record a full description of a female specimen. All that can be mentioned is that the horns found on the genital segment and adbomen of the male are absent in the young female. Further, the two pairs of spines on the genital segment of the male, representing the limbs, are in the female each developed into only one bristle—the fifth placed laterally, the sixth ventrally, as shown in the figure.

Remarks: The characteristics of this species are a relatively large and plump caligid type of body, with well-developed first antennae; vestigial exopods on both first and second maxillae; short, wide and strong sternal furca, with aleae on the lateral borders; bifurcated spines on the distal joint of the first thoracopod; a glogular genital segment clearly divided into two segments; a fifth pair of legs shaped like lateral horns on the genital segment; and the one-segmented abdomen extending into two postero-lateral horns. By these characters the male should be very easily recognised.

Caligus obovatus sp. n.

(Figs. 99-105)

Locality, Host and Record of specimens: Off Palm Island, North Queensland, 2.11.1948; Cape Bowling Green, North Queensland, 2.11.1948; Cape Melville, North Queensland, 5.11.1948; Cape Direction, North Queensland, 6.11.1948; Princess Charlotte Bay, North Queensland, 6.11.1948; Eden Reef and Princess Charlotte Bay, North Queensland, 6.11.1948.; Torres Strait (from two localities), 22 and 23.11.1948; 11 specimens, including the holotype. All the hosts were Mackerels, *Scomberomorus queenslandicus* and *S. commerson*, and all specimens were collected by A. G. Nicholls.

Of the large series of specimens from eight different localities, all were males; no females were found. The species is much like the previously described *Caligus proboscidatus*; it was found on the same hosts and at the same localities. Although there is a close likeness, some important differences exist, and there can be no doubt that two distinct and valid species occur on the same hosts.

Male: The circular shape of the carapace is characteristic; it is as long as wide, and more than half the entire length of the copepod. The frontal plates are well defined, but their combined length is less than half the width of the carapace. The lunules are large, circular and projecting. The posterior sinuses are wide and slightly inclined away from the central axis, the median lobe being much less than half the entire width and projecting only a little beyond the lateral lobes; the latter are pointed and strongly incurved towards the axis.

The thoracic area is large, its length equal to nearly two-thirds of the entire carapace, and the anterior groove is almost a perfect semi-circle. The free thoracic segment is short and narrow, about one-fourth the width of the carapace, and contracted into a much-narrowed neck just in front of the basis of the fourth legs. The genital segment is also contracted into a short, narrow neck where it is joined to the free segment, the same as is found in *C. proboscidatus*. It is also wrinkled across this neck as though segmented. The neck itself is about one-third longer than wide and narrow towards both ends; its extreme width is about one-fourth of that of the carapace. The abdomen is a little longer than the genital segment, is two-segmented, and the segments are of approximately the same length. The anal laminae are large, and as wide as long. They are somewhat curved in towards each other, and tipped with three strong, plumose setae and a small spine on the distal corner.

The anterior antennae have a stout proximal joint and an elongated distal joint. The second antennae are shaped as in some males, with the two first joints more elongated, and with the hook short, strongly curved and partly coalesced with the proximal part. The first maxillae are very large, with the short proximal joint carrying a small palp. The second joint is very large, hook-shaped and pointed—larger than is known in any other caligid. The second maxillae are of medium size, with a palpiform seta on the proximal joint and a little curved and pointed distal joint. The first maxillipeds have stout proximal and distal joints; the distal joint of each is tipped with the usual two strongly-curved claws, the frontal of which is twice as long as the one behind. The second maxillipeds have a stout, square basal joint, with two knots where the point of the second joint touches the proximal one. The distal joint is stout and curved, and has a small accessory spine. The furca is small, its branches being about the same length as the base. The latter are considerably divergent, and have blunt tips. The lumen between the branches of the furca is broad and trapezoid.

The first pair of swimming legs is slender, with three weak terminal claws; the seta at the corner is slender and elongated. Of the plumose setae, only two are left, both very short and delicate. And of the third and most distal plumose seta, only a diminutive spine is left.

The second pair of swimming legs is very much like those found in *C. proboscidatus*, only the claw on the second exopodal joint is not small, but of normal size; the second endopodal joint also has a dentated lamina, as in *C. proboscidatus*. The rami of the third legs are small and a little delicate, as also is the spine at the base of the exopod. The fourth legs are short, weak and three-jointed, and have five spines of about the same length. The four distal spines are situated close together along the outer margin of the distal joint, and all are a little delicate. The fifth spine is placed a little further back on the second joint, and is a little stouter. The two terminal joints of the fourth legs are of about the same length. No fifth legs were seen.

The size of this species varies considerably, but the specimens averaged about 4 mm. in total length. Length of carapace, 2 mm. Width of carapace, 2 mm. Length of genital segment, 0.7 mm. Length of abdomen, 70.8 mm.

Remarks: This species was found with the previously described *Caligus proboscidatus*, to which it is closely related. There are, however, several distinct differences which clearly separate them. *C. obovatus* has the wider carapace and remarkably large first maxillae compared with those of normal size in *C. proboscidatus*. On the other hand the mouth-cone is very large in *C. proboscidatus*, but of medium size in *C. obovatus*. Still further differences are to be found, especially in the second maxillipeds, in the furca and in the first, second and fourth swimming legs.

Female: Unknown.

Caligus longirostris sp. n.

(Figs. 106-115)

Locality, Host and Record of specimens: D'Entrecasteaux Channel, Tasmania, 4.11.1948, collected by A. M. Olsen from *Physiculus barbatus*. Nubeena, Tasmania, 27-1.1949, collected by W. S. Fairbridge, from *Platycephalus bassensis*. Several specimens, including the holotype.

Female: Carapace elliptical, as wide anteriorly as posteriorly, and more than half the entire length. Frontal plates prominent and distinct. Lunules small and widely separated. Posterior sinuses shallow and nearly parallel with the longitudinal axis. The median lobe is more than half the entire width and about the same length as or a little longer than, the lateral lobes, which are narrow and somewhat pointed. The free fourth segment is small and narrow, and has a constricted neck. The genital segment is orbicular or slightly obcordate, a little longer than wide, and with a shallow posterior emargination. It is half the length of the carapace, has symmetrically rounded sides and posterior corners with a distinct fifth pair of legs represented by two setae. The abdomen is unsegmented, a little more than half as long as the genital segment and a little less than half the width of the same, and is contracted at its base. The anal laminae are small, with short setae. The egg-strings are of different length, some of them being twice as long as those shown in the figure; the eggs themselves are rather large.

The basal joints of the anterior antennae are large and stout, with many spiny setae. Their terminal joints are of about the same length and very slender. The appendages as a whole are less than the space between the lunules. Second antennae are of more usual form but have a long and slender terminal hook; their two proximal joints are short and stout. The first maxillae are very characteristic in being three-jointed, and contrary to the usual two- or one-jointed maxillae found in caligids; the proximal joint is fully coalesced with the carapace, but the margins can clearly be seen. Following this is a partly free second joint, and a third joint which is a little curved and blunt. The second maxillae are stout, two-jointed and provided with a small two-jointed palp. The mouth-cone is very long, nearly twice as long as is usually found in species of *Caligus*, but not quite as elongated as in the previously described *Caligus proboscidatus*.

First maxillipeds are stout and large in both their joints. The two terminal claws are curved and very stout. A small accessory claw half-way along the distal joint is in the usual place when found to be present. The second maxillipeds are of medium size, the basal joint being swollen and much elongated. The terminal claw is small, but possesses an accessory spine.

The furca is stout and large, and not quite cut to its centre, making the branches a little shorter than the length of the base. The branches are conical, nearly parallel but widely separated. The base of the furca is swollen on each side at its centre, giving it a spindle shape.

The first swimming legs have a stout basal joint, and each is tipped with only one claw and a long curved seta at the corner, and there are three well-shaped plumose setae on the posterior margin. The spines on the exopods of the second swimming legs are short, and on the frontal margin of each exopod a small wing is present. The spine on the proximal exopodal joint of the third swimming legs is short and only a little curved; the two branches of the legs are well separated. The fourth legs are of medium size but rather short and three-jointed, with five spines; one spine is at the distal end of the second joint, two on the outer margin of the third joint, and two at the end of this same terminal joint. Of these spines the four proximal ones are slender and a little delicate, but the fifth and terminal one is a strong curved claw more than twice as long as the others. The earlier mentioned fifth pair of legs is present as a little bud with two setae on the ventral side of the posterior corners of the genital segment.

Total length, 5 mm. Length of carapace, 3 mm. Breadth of carapace, 2.2 mm. Length of genital segment, 1.3 mm. Length of abdomen 0.8 mm.

Male: Contrary to that found in most species, the male is a little larger than the female. The carapace is ovate like that of the female but narrowed rather more anteriorly, and is one-third longer than wide. The median lobe is much longer than in the female; it reaches far behind the lateral lobes, and the latter are more inwardly curved and pointed than in the female. The male abdomen is two-segmented, comprising a short proximal segment and a distal one which is twice as long.

The second antennae have the short curved hook as found in many males, and are further furnished with an accessory spine in the form of a flat plate. The first maxillae are distinctly three-jointed, and the second maxilliped much larger than in the female.

Total length, 6 mm. Length of carapace, 3.5 mm. Width of carapace, 2.8 mm. Length of genital segment, 1 mm. Length of abdomen, 1 mm.

Remarks: the species is of medium size for a caligid, and is easy to recognise by its long mouth-cone, the three joints in the first maxillae, and the lone claw on the first pair of swimming legs.

Caligus sp.

In 1944, Dr. A. G. Nicholls published a paper on littoral Copepoda from South Australia. At the end of the paper there is included an illustration (fig. 28) of a male *Caligus*. No related text accompanies the figure, which clearly represents an undescribed species.

Genus **Lepeophtheirus** Nordmann, 1832

Lepeophtheirus elongatus sp. n.

(Figs. 116-123)

Locality, Host and Record of specimens: About 25 females, including the holotype, were found on the palate and tongue of a Whaler Shark (*Galeolamna greyi* Owen) at Rossiter Bay, Esperance, Western Australia, collected by G. P. Whitley, 25.1.1944.

Female: This is the usual large and stout type of copepod as found on sharks. The carapace is orbicular, being even a little wider than long. The frontal plates are narrow and not so well defined. The posterior sinuses also are narrow at their entrance, and they are inclined somewhat away from the median line. The median lobe is broad and squarish, cut nearly straight posteriorly, and not projecting beyond the lateral lobes. The last-named are narrow and curved towards the median lobe posteriorly. The grooves separating the areas of the carapace are well defined and strong in the posterior half beyond the " H "-shaped cross-bar of the main grooves. Anteriorly and in front of the cross-bars the bars on the carapace are weak and not well defined. The free segment is rather elongated, commencing at the carapace with a neck which widens out backwards to a pair of shoulders for the attachment of the fourth pair of limbs. The way in which the limb is jointed to the segment is rather characteristic, because a big triangular part is without cuticle, as shown in the figure; this enables the limb to be moved straight forward. The genital segment is nearly as long as the carapace, longer than wide posteriorly, and drawn out into two lateral lobes. The abdomen is built up of three segments and is very long—about the length of the carapace plus the free fourth segment. The first two segments are of equal length, the third is a little short one. The anal laminae are flattened and parallel, tipped with four setae and a short spine medially.

The first antenna has a globular basal joint with many thick sensory hairs at its margin; the second joint is delicate, nearly four times as long as wide, and tipped with a group of short setae. The second antenna is four-jointed, with first a narrow schlerite partly absorbed in the body. The joint following this is still coalesced with the body on its ventral side, and is furnished with a backwardly directed spine. The next two joints are free, with first a squarish third joint, followed by the fourth in the form of a long slender hook. The mouth-cone, with the mandibles, is short and delicate. The first maxilla is well developed, the basal joint coalesced with the body and provided with a curved, hook-shaped endopod and a small exopodal palp. The second maxilla is two-lobated—a basal joint partly coalesced with the body and furnished with a curved one-jointed hook, the endopod, and a two-jointed exopodal palp.

As shown by Heegaard, 1955 (pp. 47-48, fig. 10), in caligids, the dorsal grooves between the eucephalic and postcephalic areas become converted into internal ridges. A second transverse grooving with internal ridges is placed between the postcephalic area, and this carries the sternal furca. Normally the first ridging between the eucephalic and postcephalic areas does not carry any spines; it is not always even clearly visible. In the present species, however, the ridging is distinct, especially when seen from the ventral side, as it passes between the second pair of maxillipeds. On the ventral side it is furnished with a pair of slender spines, with their points

directed a little towards each other just in front of the outgrowth of the furca. The furca itself is fairly strong, with its two branches widely spread; near their base they are joined with a cross bridge. To the sides of the furca proper are small supporting spines, one at each side.

The first maxillipeds are of the normal slender type but three-jointed, with the " basal joint " divided into a shorter basal joint and a longer distal one. The third joint of the maxillipeds is tipped with two fingers of nearly the same length. Placed a little proximal to these two fingers there is a smaller accessory finger, but on the same joint. The second maxillipeds are of the normal two-jointed type in the form of a subchela and are of medium size and strength.

The first pair of swimming legs is well developed, with a clear coxa and basis, a two-jointed exopod and a vestigial single-jointed endopod. The coxa is plumpish, with an anterior spine and a posterior seta. The basis is much smaller and furnished with a strong exopod, of which the first joint is more than twice the length of the second and longer than the coxa and basis together. Near the base of the second joint of the exopod there is, anteriorly, a small spine. The distal joint of the exopod is provided with the usual three spines and three plumose setae, in between which is found a single, longer, slender, and sensitive plumose seta.

An extraordinary feature of this species is the vestigial bulb-shaped endopod, which in most species is represented only by a small spine or is entirely absent.

The second pair of legs is noticeable only by the toothed anterior ridge on the first endopodal joint and a fairly well-developed swimming membrane on the frontal margin of the exopod. The rami of the third legs are closed together. The exopod has a short basal joint with a strong curved claw used when crawling on the surface of the host fish and for penetrating beneath the scales from behind. The terminal joint is followed by an elongated second and third joint, of which the third joint is flattened. The endopod is short and strong, with the usual two joints. The fourth pair of legs is long and well developed, four-jointed and with five spines, of which three are terminal. Of the three terminal spines the most distal one is long, slender and hook-shaped, followed by two shorter, nearly straight, spines. The remaining two spines tip the second and third joints. A membraneous cushion of sensory function is placed on the lateral side of joints numbers three and four, backwards from the spines on the joints and reaching nearly to their bases. The leg itself is jointed to the free fourth thoracic segment with a sort of shoulder joint, as previously mentioned. No signs of a fifth or a sixth pair of legs are to be found on the genital segment.

Total length, 11 mm. Length of carapace, 3.4 mm. Width of carapace, 3.5 mm. Length of fourth segment, 1 mm. Length of genital segment, excluding lateral lobes, 2.5 mm. Length of abdomen, 4.3 mm.

Remarks: Outstanding characteristics of this species are the long three-segmented abdomen, the shape of the furca and the sub-furca; the endopod on the first pair of legs; the toothed ridge on the first endopodal joint on the second leg; and the fourth pair of legs with its shoulder attachment to the segment, its membraneous sensory cushion and very slender hook-shaped spine. Some of these characters suggest even a new subgenus.

Male: Unknown.

Lepeophtheirus molae sp. n.

(Figs. 124-134)

Locality, Host and Record of specimens: Nearly 100 females, 1 male and 1 juvenile, from which the holotype was selected, were found parasitic on a Sunfish (*Mola mola*) in Port Jackson, New South Wales, 13.12.1882. Australian Museum Reg. No. G. 5213. A further 11 females, also taken from *Mola mola* in Botany Bay, New South Wales, 8.12.1930. Australian Museum Reg. No. P. 9990.

Female: The carapace is orbicular, even a little wider than long; its lateral areas are wide, each nearly one-third of the entire width. The dimensions bring about an unusual shape in the longitudinal ridges running down through the carapace and dividing it into a medial part and two lateral lobes. Posteriorly, these ridges are free of the carapace and are produced backwards as two spines from the dorsal surface. This character is a most distinctive one, and not known in any other *Lepeophtheirus*. The posterior corners of the two lobes referred to, each have a smaller inner lobe towards the posterior sinus. The frontal plates are small and well fused with the carapace, less than half the width of the latter, and have a shallow central incision. The eyes are small and placed less than one-third the distance from the anterior margin. The median posterior lobe is the same length as the lateral lobes, and has rather squarish corners, making the posterior margin nearly straight.

The fourth or free segment is one-third the length of the genital segment and more than two-thirds of its width, and projects prominently on each side at the bases of the fourth legs. The genital segment is ovate, with an evenly-rounded outline and prominent posterior corners; the sixth pair of legs project as spines from its ventral side. A sixth segment is fused to the genital segment, and associated with it in fully mature specimens there can be seen a small vestigial fifth pair of legs. In young females examined (figs. 130, 134) the genital segment was not yet fused, and rudimentary legs were found on the fifth segment or first genital segment.

The abdomen is two-segmented, but the basal segment is small and may easily be overlooked; it is less than half the length of the second abdominal segment. In a young female examined (fig. 134) the abdomen was clearly three-segmented, but in the normal adult state two of these segments are found fused together. The anal laminae are of medium size and curved inwards towards each other, and each is furnished with the usual four setae.

The first antenna is delicate, with a long and slender second joint and only a few setae at its tip. The basal joint has a fringe of setae at its frontal margin. The second antenna is a strong hook-shaped organ of three joints—a short basal joint with an accessory spine, a median joint which is twice as long, and a long, slender and curved hook for the distal joint. The mouth-cone is rather short and diminutive compared with the size of the copepod. The first maxilla is prominent, the circular basal portion being three or four times the diameter of the curved terminal part, and furnished with a backwardly-pointing accessory spine. The second maxilla projects far beyond the tip of the mouth-tube. It is longer than the tube itself, strongly bifurcate, slightly curved, and as long as the rest of the maxilla. At the base of the maxilla is a small papilla—the rudimentary exopod, bearing a long seta. The first maxilliped is long, slender, two-jointed, and bifurcated at the tip, with the median claw much longer than the lateral one. On the lateral side of the second joint is placed a palpiform branch, around which is a leaf-shaped membrane (fig. 125). The second maxilliped is stout, the basal joint bearing a small protuberance on its anterior or median margin. The terminal claw is of about the same length as the basal joint, strongly hook-shaped and armed with an accessory spine on its ventral surface about one-third of the way from its base. The sternal furca is delicate, elongated, and with two long, bluntly-pointed branches.

The basal joint of the first swimming legs is armed with a hairy seta midway along its posterior margin and at the posterior tip with a small bulbous process, the last part of which is the vestigial endopod. The second pair of swimming legs is of the usual pattern, with membranes on the third and fourth spines of the distal joint. The third pair of swimming legs has a flattened hairy spine on the sympodial plate, just outside the exopod. The spine on the basal joint of the exopod is large, inwardly curved and sickle-like in form. The fourth swimming legs have a strong basal joint, followed by three shorter joints of which the two first are tipped with a small claw; the last joint is tipped with one short and two long claws, the latter being toothed on their inner margins.

The genital segment is a coalescence of two segments, as claimed earlier on the characters displayed by a young female. The larger legs were found on the sixth, and not on the fifth segment, as is usually the case. This sixth pair of legs is, in the adult female, shaped as two spines projecting posteriorly from the ventral side of the genital segment (figs. 124, 130). The spines are two-jointed, as there is still a suture to be seen near their tips. Near their base a transverse ridge is found, indicating where another joint is located. This shows that there were originally at least three joints, as was so much more clearly evident in the young female already discussed. The spines are further furnished with some vestigial setae. Also to the sides of them there is placed a small bud with two setae. These buds are not seen in all the specimens—only in some of the larger females. The buds are actually the rest of the fifth pair of legs which, because of the swelling of the genital segment, has been pushed behind the spiny sixth pair of legs.

Total length, 12 mm. Length of the carapace, 7 mm. Width of carapace, 8 mm. Length of genital segment, 2.5 mm. Length of abdomen, 1.3 mm.

Male: The carapace is similar to that of the female, but relatively much larger. The eyes are also more prominent. The fourth free segment is much narrower than in the female, almost square, and only a little wider than the genital segment that follows. This latter is clearly made up of two segments, and has the typical shape of a male genital segment. It is furnished with two pairs of spines of about equal size which represent the vestiges of the fifth and sixth pairs of legs, each shown to be three-jointed. The abdomen is clearly two-segmented.

The first maxilla is stout, and shorter than in the female. The second maxilliped is small but very stout, with a crest on the side of the clasping joint near the claw. The coxal plates of the third pair of legs are very large.

Total length, 5.5 mm. Length of carapace, 3.5 mm. Width of carapace, 4 mm. Length of fourth segment, 0.5 mm. Length of genital segment, 1 mm. Width of genital segment, 0.7 mm.

A single young specimen of the series examined was found to have a two-segmented genital segment and a three-segmented abdomen (fig. 134).

Remarks: This species has a strong resemblance to *Lepeophtheirus spinifer* Kirtisinghe (1937, p. 442), but a number of differences can be readily detected. The ridges of the carapace are not identical; the second joint of the first antenna is more slender in *L. molae*; the setae on the distal joint of the first pair of legs differ in number and shape; the third endopodal joints of the second pair of swimming legs differ, as also do the spines on the fourth pair; there is a difference in the size and shape of the sixth pair of legs, and also in several other points concerning size. Kirtisinghe's species from a *Chorinemus* was less than half the size of this species.

Another species, *L. insignis* Wilson 1908 (p. 444) was also found occurring on a Sun Fish, *Mola mola*. At first glance it appeared to be identical with the present species, but a further study revealed so many points of difference that it was decided to create a new species for the material before me. Only a direct study of Wilson's material can show whether this action can be justified. Among the differences can be mentioned the presence of a spine on the carapace of *L. molae*, the two-segmented abdomen, and the cresta on the first maxilliped which is not described by Wilson. Then there is the coxal spine on the third pair of legs, and the shape of the fifth and sixth pair of legs which are entirely different from Wilson's description. Finally, the genital segment of the male and its appendages are different from what is described by Wilson.

Family Euryphoridae

Caligulus gen. n.

Type species **C. longispinosus** sp. nov.

This new genus has all the characters of *Caligus*, with the addition that dorsal plates from the third thoracic segment entirely cover the fourth segment.

Caligulus longispinosus sp. n.

(Figs. 135-144)

Locality, Host and Record of specimens: One female, the holotype, and one male, the allotype, were found on the skin of *Euthynnus alitteratus* (Mackerel Tuna) at Howick Islands, North Queensland. Collected by A. G. Nicholls, 6.11.1948.

Female: This small species has a markedly elongated carapace, its length being about one-and-a-half times its greatest width, and with nearly parallel lateral margins. The frontal plates are wide and large, distinctly separated from the rest of the carapace by the anterior transverse ridge. The lunules are of medium size, circular, and project only a little in front of the anterior margin of the frontal plates. The lateral lobes are very narrow and the medial lobe very large. The latter occupies more than two-thirds of the entire width of the carapace, and extends far backwards to form a big dorsal plate which, through its transverse lunules, clearly shows it to have been originally paired. This medial dorsal plate extends backwards to entirely cover the fourth segment, and even slightly overlaps the genital segment. Because of this elongated plate the thoracic area appears to be nearly twice as long as the cephalic area. The posterior lunules of the carapace are shallow, pointing a little in a medial direction. The eyes are small and placed far anteriorly—in about the first third of the cephalic area. The genital segment is quadrangular, with an incision well posterior for the one-segmented abdomen, the latter furnished with an anal lamina of normal size.

The first antenna is small, with its basal joint furnished only with few and very short setae; the distal joint is short, club-shaped, and tipped with a few short setae. The second antenna is short, three-jointed, and placed well backwards behind the mouth-tube; the basal joint, coalesced with the carapace, is the largest, and is followed by a cylinder-shaped medial joint; the distal joint is nearly straight, ending in a small hook furnished with an accessory spine which is only small in the female, but in the male it is as large as the tip of the joint, giving it a bifurcated character. The first maxilla was found to be torn off in the female specimen, so it may possibly have been a strong hook embedded in the skin of the fish host, although it was not found strongly bent in the male. The second maxilla is short-jointed, with the free distal joint pointing directly backwards. The mouth-tube is broad but short, with rather short mandibles, and its base is a little in front of the second antenna. The first maxilliped is small and a little delicate; it has a short basal joint followed by two longer joints, of which the second

or the third has a small accessory palp medially. The same appendage is tipped with two fingers, of which the medial one is more than twice the length of the lateral one, and this is further two-jointed and strongly bent into a semi-circle. The second maxilliped is small and weak and three-jointed; first and second joints are of normal shape, and the third joint shaped into a claw furnished with an accessory spine. The sternal furca is short and wide, with its two branches shaped like a horse-shoe, and extended into two very blunt tips.

The first swimming leg is small, with the first joint very short, squarish, and dorsally extended into a small lobe above the following joint. Ventrally, a small spine is all that is left of the endopod. Of the two following exopodal joints, the first has a convex medial margin with a fringe of short setae, and a short spine dorso-laterally. The distal joint is tipped with three short claws, followed by a small sensory seta. The three feather-shaped spines on the medial margin of the same joint are furnished on their inner lateral parts with short spiny hairs which, for the rest of the seta, are followed by the normal hairs of a feather-like seta (fig. 141). The second swimming leg is short, with a very short coxal joint having one feather-like seta directed posteriorly. The basis is large, plump, squarish to elliptical in shape, and lacks setae. Both exopod and endopod are three-jointed. The first exopodal joint is as long as the two following ones together. It has a long feather-like seta on the medial border, and a long bent, concave spine at the latero-distal corner. The following joint is short, with one spine and one seta, and the terminal joint is furnished with five feather-like setae and three spines, the latter increasing in length from proximal to distal, the two most distal spines being half feather-shaped, with hairs on their medial sides. The most distal spine has, in addition, a membrane on its lateral margin. The endopod is of the usual three-jointed type, with one, two and six feather-like setae on the three joints—from proximal to distal. The second endopodal joint is further toothed on its lateral margin. The third leg has a very large elliptical sympodial plate which enables the limb to reach back to the genital segment. The claw on the basal joint of the exopod is nearly straight; the two branches of the limb are placed far apart, with the endopod a good distance behind the exopod. The fourth leg is three-jointed and slender with one spine on the second joint and three spines on the distal joint. With the exception of the first, these spines are very long and delicate, and partly curled in shape (fig. 144); they appear to be functionally useless. Unfortunately, the distal joint of the fourth legs was missing in the single male specimen, so that the description of this character can refer only to the single female, in which it is possibly partly misshapen. Normally, this distal joint must surely be long and delicate. No fifth or sixth pair of legs were found on the genital segment of the female. The egg-strings were long and slender—longer than the total length of the female.

Total length, 3.5 mm. Length of carapace, 2.5 mm. Width of carapace, 1.6 mm. Length of genital segment, 0.9 mm. Width of genital segment, 1 mm.

Male: The male is about the same size as the female, but has the frontal plates and lunules noticeably more prominent than in the female; the carapace also is a little larger and stouter. The genital segment is more rounded elliptically than in the female; its two lateral lobes are tipped with two small spines, each the vestigial part of the fifth pair of legs.

Of the appendages, the accessory spine on the distal second antennal joint is as large as the tip itself, making this bifurcate. The first maxilla is a stout hook attached to a small basal plate, which is coalesced with the carapace. The second maxilla is larger than in the female, but more straight. The second maxilliped is, unexpectedly, as weak in the male as in the female, but the sternal furca is much larger in the male, its two branches bifurcating directly outwards from its basal plate, with the gap between them increasing distally.

Total length, 3.2 mm. Length of carapace, 2.7 mm. Width of carapace, 1.8 mm. Length of genital segment, 0.6 mm. Width of genital segment, 0.8 mm.

Remarks: This small species can be recognised principally by its swimming legs and the accessory spine on the second antenna. The presence of dorsal plates on the carapace covering the fourth segment and overlapping the frontal margin of the genital segment is the character which establishes the new genus.

Genus **Tuxophorus** Wilson, 1908

Tuxophorus cervicornis sp. n.

(Figs. 145-150)

Locality, Host and Record of specimens: Four females, including the holotype, were found on the mouth, and probably the gills, of a *Scomberomorus commerson;* the exact location on the fish cannot be stated with any certainty. The species was found in company with *Caligus maculatus* Heegaard, *C. circularis* Heegaard, and *Paracycnus lobosus* Heegaard, but no further details accompanied the specimens. The fish host was caught in Torres Strait, North Queensland, by A. G. Nicholls, 23.11.1948. A similar host fish infested with one female of the same copepod was caught by A. G. Nicholls, 6.11.1948, eight miles south of Cape Direction North Queensland.

Female: The carapace is ovate, nearly orbicular, a little longer than wide, and about half the entire length of the body. The frontal plates are prominent and furnished with small hemispherical lunules. The lunules are widely separated and project a little in front of the anterior margin of the frontal plates. Between the lunules a narrow membrane is found in advance of the frontal plates. The posterior sinuses are narrow and shallow, and nearly closed at the opening from the corners of the medial lobe and the two lateral lobes. The medial lobe takes up about half of the entire width of the lateral lobes, and projects only a trifle beyond them. It is quite squarely truncated posteriorly, with prominent corners towards the lunules, the cephalic area being nearly twice as long as the thoracic area. The lateral lobes are broad and curved inwards towards the medial line at the posterior tips. The eyes are very small, but with prominent lenses, and are placed in the middle of the cephalic area between the encephalic area and the post-cephalic area; the two latter are of about equal size.

The free segment is large and squarish in shape, and nearly twice as wide as long. It is covered with a pair of broad wings, differing from other previously known species of *Tuxophorus* in that they extend as much forwards as backwards; they extend outwards to a level with the lateral margins of the genital segment, and far enough backwards to cover over the base of the same. The frontal margins of these wings or aleae are curved and inclined slightly forwards; in younger individuals, especially, they reach and overlap the posterior margin of the carapace. In older specimens the fourth segments appear to grow a neck, which places the frontal margins of the wings a little further backwards so that they do not reach the carapace. This older stage of development is shown in the figure. The wings bear a remote resemblance to those of a moth or a butterfly.

The genital segment is quadrangular and about two-thirds the width of the carapace. At its postero-lateral corner the fifth pair of legs is shaped in large branched horny spines pointing postero-laterally, appearing like the antlers of a deer. The abdomen is elongated and two-segmented, like that of *T. caligodes* Wilson (see Heegaard, 1955); the segmentation is not very clearly defined, and can easily be overlooked. The anal laminae are long and pointed and without setae, like those of *T. cybii* Nunes-Ruivo.

Egg-tubes are of about medium length, each containing 60 to 100 eggs. The first antenna is, as usual, two-jointed, the basal joint being longer than the distal one and heavily clothed with short plumose setae; the distal joint is tipped wiih only a few setae. The second antenna is three-jointed. The first joint, which is coalesced with the carapace, has a posteriorly-pointing spine. The following two-joints are free, the distal one being formed into a strong hook. The maxillae are small and two-jointed, the first joints being coalesced with the body. The second joints are formed posteriorly into pointed hooks. No palp could be seen on either of the maxillae. The mouth-cone is rather short and blunt, with a short pair of mandibles.

The first pair of maxillipeds is long and slender, as in *Caligus* but, unlike *Caligus*, the distal joint is divided into two joints, with the partition just behind the little palp on the lateral margin. The distal joint is tipped with two fingers, of which the medial one is twice as long as the other; both fingers are somewhat curved. The second maxilliped is also unusual in that it possesses an extra joint. The limb is relatively small and weak, with a basal joint of normal shape and size, followed by two joints instead of one—first a short joint and then a large, curved, terminal claw. The sternal furca is strongly developed, with a large massive basal plate from which extend the two posteriorly-pointing horns. This is the first of the known species of *Tuxophorus* with a sternal furca of relatively simple build; even the closely-related *T. cybii* has an extra spine on the furcal branches. It shows that the furca does not have to be of a complicated form in the genus *Tuxophorus*. Among the known species of *Tuxophorus*, the present one comes closest in several points to the genus *Caligus*.

The first pair of swimming legs is three-jointed. The first joint is rectangular, with a lateral swelling and a small palp at the medial-distal corner, representing the vestigial endopod. The second joint is elongated, fringed with setae at its medial margin, and has a small, short spine at the latero-distal corner. The third and last joint is short, and tipped with the usual three spines, which are embryonic; the presence of small embryonic hairs shows that these have been derived from a feather seta. The three feather setae on the medial margin of the same joint are exceptionally short, especially the most distal one. The second leg has a normal stem with a short coxa furnished with one seta, and followed by the basis, without any setae. The endopod is three-jointed, with one seta on the first joint, two on the second, and six setae on the third joint. Further, the first and second joints of the endopod are fringed with hairs on their lateral margins. The exopod is exceptional in that it is four-jointed; the length of the first joint is equal to that of the three following ones. The first three joints are each furnished with a spine and a long swimming seta. The fourth joint has a spine and five setae; the seta nearest to the spine is half spine, half seta. The appendages of the genital segment are only the branched

spines at the posterior distal corner of the segment. From this the impression might be gained that the basal spine is one branch of the limb and the large distal spine with two side spines branching from it represents the other limb-branch. It was because these spines on the genital segment were so very characteristic that the species was given its specific name, *cervicornis*.

Male: Unknown.

Genus **Gloiopotes** Steenstrup and Lütken, 1861

Gloiopotes longicaudatus (Marukawa)

(Figs. 151-153)

Caligus longicaudatus Marukawa, 1925, p. 1243, fig. 2396; 1947, p. 927, fig. 2654.

Gloiopotes sp., Yamaguti, 1936, pt. 3, p. 4, pl. 2, fig. 20; pl. 3, figs. 21-35.

Gloiopotes longicaudatus, Shiino, 1954, 4, p. 273, figs. 1-2.

According to Shiino (1954) this species was first described by Marukawa in 1925 as *Caligus longicaudatus*, but its record in an Encyclopaedia of the Fauna of Japan was overlooked by Yamaguti (1936), who described further Japanese material of the same species under the name *Gloiopotes* sp., because of a resemblance to both *G. ornatus* Wilson (1905) and *G. constatus* Wilson (1919). Besides the listing of some minor variations from these two species, Yamaguti describes as the main difference the fringes of hairs on the carapace. The differences, however, are numerous enough for the full establishment of a species. The same conclusion was reached by Shiino (1954), who returned it to Marukawa's specific name, but placed this in the genus *Gloiopotes*, thus agreeing with Yamaguti. He further redescribed the species. These three authors were all Japanese and had their material from the Pacific coast of Japan and the Mariana Islands. The hosts were *Tetrapterus mitsukurii* Jordan and Snyder, *Parathynnus sibi* (Temminck and Schlegel), *Xiphias gladius* L., and an unknown host collected at the Palao Islands.

Locality, Host and Record of specimens: Both males and females of this copepod are represented in the material before me, all belonging to the Australian Museum in Sydney. First there are 24 specimens from the skin near the anal fin of a Striped Marlin (*Marlina zelandica*) at Bateman's Bay, New South Wales, 11.3.1936 (Reg. No. P. 10750). A second capture of 23 specimens from the gill-opening of a Black Marlin Swordfish (*Istiompax australis*) caught off Port Jackson, New South Wales, 12.3.1948; collected by Mr. Holliday, a visitor from the Peabody Museum, U.S.A. (Reg. No. P. 11903). A third series of 8 specimens are from another Black Marlin Swordfish caught off Broughton Island, Port Stephens, New South Wales (Reg. No. P. 11806). From these and earlier records it can be assumed that the species occurs in the Western Pacific from Japan to Australia and probably eastwards from there to New Zealand, whence it has not yet been recorded. Its range also very likely extends farther eastwards into the island waters of Polynesia. The hosts are the larger species of the scomber or mackerel family, belonging to the travelling pelagic fishes, and from this it is reasonable to assume that the parasite has a vast distribution within the Pacific Ocean.

The figures of the species printed in this paper show some points varying both from Shiino's description and also from Yamaguti's (1936) description of *Gloiopotes* sp. While the publication of these figures is justified, I have no doubt that all three of us are dealing with the same species. Marukawa's 1925 description of the species has not been accessible to me, and I know it only through Shiino.

In the figures of both Yamaguti and Shiino the carapace is shown to be a little longer than wide, but the present material shows it to be proportionately wider in older and larger specimens. On each half of the genital segment I have found three large spines placed dorsally in a distinct line and one spine placed laterally from this line. Both Yamaguti and Shiino recorded the presence of four similarly-situated spines, but in a different arrangement. The abdomen is clearly two-segmented, and the anal laminae consists of two joints. Of the latter the basal joint is short and wide, while the distal joint is long and slender and tipped with two or three very short and reduced setae. The first antenna is three-jointed as described by Shiino, with the medial joint carrying no setae. The second antenna is four-jointed, with the two first joints coalesced with the body. The fifth thoracic leg, shaped in the form of a postero-lateral spine from the genital segment, has a variable number of teeth or smaller spines. In addition a hairy, bulbous spine on a stalk is found on its medial margin towards the tip, which is clearly of a sensory nature (fig. 151, pl. 5).

Genus **Alebion** Kröyer, 1863

Alebion carchariae Kröyer

Alebion carchariae Kröyer, 1863, p. 165, pl. xii, fig. 1, a-l; *Id.*, Bassett-Smith, 1898, p. 366, pl. xii, fig. 1, a-d; *Id.*, Heegaard, 1955, p. 49, figs. 12-18.

Locality, Host and Record of specimens: Four females from pectoral fin of female Tiger Shark (*Galeocerdo cuvier*); Peron Peninsula, Shark Bay, Western Australia. Collected by G. P. Whitley, 3.9.1944.

Remarks: Kröyer had a single female of this species, without egg-strings, which caused him to determine it as a male. It was found on a large shark in the Atlantic Ocean. Thirty-five years later it was found for a second time by Bassett-Smith, who recorded two females on the pectoral fin of a small shark caught at Aden. Then a lapse of more than fifty years occurred before a single female from West Africa was presented to the author and redescribed (Heegaard, 1955). These were followed by the latest material from Shark Bay, Western Australia. The male of the species is still unknown. As the Tiger Shark host is widely spread in the tropics and the copepod species now has been recorded first from the Atlantic and twice since from the Indian Ocean, it can be expected to be found occurring much more commonly than its present records suggest.

Family Pandaridae

Genus **Perissopus** Steenstrup and Lütken, 1861

Perissopus serratus sp. n.

(Figs. 154-161)

Locality, Host and Record of specimens: Two females, including the holotype, from nostrils of a shark (species unknown); Flinders Island, North Queensland. Collected by A. G. Nicholls, 5.11.1948.

This new species is closely related to *Perissopus dentatus* Stp. and Ltk. and *P. communis* Rathbun, both from the Atlantic Ocean. The present record represents the first recognition of the genus from the Pacific Ocean.

The new species is distinguished from the two other known species of the genus by its proportionately longer and narrower body, even longer than in *P. communis*. The postero-lateral angles of the cephalothorax are also comparatively much longer, and point backwards like a long curved sabre-shaped alea on each side. Other differences are the strong dentation of the free margins of all the dorsal plates on the thorax, and the shape of the genital segment and anal laminae. Again, the second antenna, thoracic appendages and swimming feet all differ from those of the two other species.

Female: The body is elongate, its length being about twice the width, but the carapace is wider than long, its medial part running out laterally in two long aleae, semi-elliptical in shape. The frontal plates are wide and prominent, placed like a bar across the front of the animal and drawn out in two rounded, free lappets partly covering the first antennae. Anteriorly there is a semi-lunular incision in the frontal plates. The lateral lobes of the carapace are narrow but projecting far backwards and drawing the carapace out into a lobe-like process on each side, making the posterior margin of the carapace strongly concave. This feature is much more prominent than in any of the other previously known species of the genus. Anteriorly on the carapace a line of three small eyes is found, the middle one a little smaller and a little posterior to the lateral ones. These eyes are not very distinctly seen in the adult female, and can be easily overlooked. The visible part of the dorsal plates of the second thoracic segment somewhat resemble in shape the same plates in *P. communis*, but they point more to the rear and are not inclined to the sides as in that species. The same plates are smaller and more elliptical than in *P. dentatus*. In general it can be said that all the dorsal plates are strongly serrated along their free margins—much more so than in the other known species. A wide space between the bases of the plates of the second segment and behind the posterior margin of the carapace is left uncovered, or has a narrow central plate which, at the medial line, runs backwards into a tip. The distance between the two plates of this segment is larger than in the other known species of the genus, and thus leaves a very broad but short open part. The dorsal plates of the third thoracic segment are wider but not so long as the first pair, and are semi-circular in outline. They are placed nearly horizontally or only slightly obliquely, with their tips meeting in the medial line. Their free posterior margins have short and sharp teeth.

The third pair of dorsal plates belonging to the fourth thoracic segment are considerably enlarged, circular, and extend across the entire width of the body. Their bases are covered by the posterior part of the second pair of plates, and their posterior margins are serrated and, in turn, reach for some distance over the genital segment. The genital segment is larger in size than the carapace and evenly-rounded anteriorly. Its lateral margins are convex, and its posterior margin is cut obliquely on each side with, at each posterior corner, a sharp and pointed spine curved towards the medial line. There is also a wide and deep median sinus on the posterior margin, and between the sinus and the corner spine on each side is a double or S-shaped curve, sweeping backwards at the side of the sinus into a dentated lobe that is turned forwards close to the spine.

The abdomen is small and plump, a little longer than wide, double barrel-shaped and one-segmented; it is entirely concealed beneath the genital segment. The anal laminae, also covered by the genital segment, are short, triangular and armed with minute and irregular teeth. The egg-strings are long, with large flattened eggs. They extend far behind the body and are about equal to it in length.

The first antenna is small and two-jointed. The basal joint is wider and longer than the terminal one, and its tip reaches beyond the margin of the frontal plate. Both joints are armed with thick setae. The second antenna is long, slender and four-jointed; at its basal joint a small adhesion pad is found. The third and fourth joints are formed into a hook shape, the terminal joint being strongly toothed at its medial concave margin (see figure). Behind the second antenna there is an elliptical adhesion pad of which the longitudinal axis inclines outwards and forwards at an angle of 45° to the body axis. This adhesion pad must, from its position, be the first maxilla. Enlarging on this question, it is worthy to note that, in all species of the genus *Perissopus*, the adhesion pads are placed on the basal joint of the appendage, and thus support the claim that they are the remnants of the basal joints of the first maxillae. The mouth-tube is very long, as commonly found in the Pandaridae. The mandibles are of the usual shape, but at their basal part outside the mouth-tube they are armoured with a narrow half-moon-shaped adhesion pad. The second maxilla is lammelar, and tipped on each side with a long and narrow spine placed close up to the mouth-tube.

The first maxilliped is of the usual pattern, but small and two-jointed. The terminal claws are rather stout, the external one considerably longer than the internal; on the side of the external one there is found a small accessory claw. The second maxilliped has a basal joint which is very fleshy and swollen. On the lateral side of the distal part of this joint is a large kidney-shaped adhesion pad. Wilson (1907) describes this adhesion pad in *P. communis* as representing the terminal joint, but this is contrary to the placement of all other adhesion pads, which are always found on the basal joint. In the present species it is seen that the adhesion pad is not the end of the limb, for on its posterior margin is placed a small vestigial joint with a small claw. These and the adhesion pad are pressed up against the large and fleshy basal joint and are certainly functionless, for they are far too weak. For clarity in illustration, this part is shown in the figure as removed from its natural position close to the large first joint, where it was difficult to see.

Each of the swimming legs consists of a smaller or larger plate-shaped basal joint which increases rapidly in size from front to rear, the basal joints of the fourth pair being many times the size of the first. The legs are biramous, with each ramus of the two first pairs distinctly two-jointed. The third and fourth pairs have only a two-jointed endopod, but the exopod is wholly fused into a single joint. There is a stout spine on the first exopodal joint of the first and second pairs, and three smaller spines on the second exopodal joint. The endopods are two-jointed and without spines or setae. In Pe_3 and Pe_4 the exopod is tipped with the three spines from the distal joint, but the stout spine on the proximal joint is missing, as this joint is coalesced with the following one. The endopod is two-jointed and without spines on Pe_3. In Pe_4 the one-jointed exopod has four small spines, the endopod one small bud on the first joint, and two on the second and distal joints.

Total length, 3.4 mm. Length of carapace, 1.3 mm. Width of carapace, 1.8 mm. Length of genital segment, 1.9 mm. Width of same, 1.9 mm.

Remarks: This is the smallest of the three known species of the genus, and the first from the Pacific region. It is also interesting in the shape of its second antennae, with their dentated tips, but more especially in the second maxillipeds, where a small vestigial terminal joint with a claw was found attached to the adhesion pad which, from its position, supports the evidence of a constant placement on the basal joint.

Genus **Echthrogaleus** Steenstrup and Lütken, 1861

Echthrogaleus coleoptratus (Guerin)

Dinematura coleoptrata Guerin, 1837, pl. 35, fig. 6.

Dinematura alata Guerin, 1837, pl. 35, fig. 7.

Echthrogaleus coleoptratus, Steenstrup and Lütken, 1861, p. 380, pl. 8, fig. 15; *Id.*, Wilson, 1907, p. 367, pl. 19, figs. 40-50.

Locality, Host and Record of specimens: About 25 females were found parasitic on a Blue Shark (*Prionace glauca*), caught off Cape Catastrophe, South Australia. Australian Museum Reg. No. E. 6793.

Remarks: The species is a fairly common parasite on various kinds of sharks. It has previously been collected in the Atlantic Ocean, Indian Ocean, south of Africa, and Japanese seas. The present new record from South Australian waters provides a natural link between south of Africa, Japan, and the Mariana Islands.

Genus **Dinematura** Burmeister, 1833

Dinematura producta (O. F. Müller)

Caligus productus O. F. Müller, 1785, p. 132, pl. 21, figs. 3-4.

Dinemoura producta, Latreille, 1829, p. 197.

Dinematura producta, Burmeister, 1833, p. 284.

Pandarus lamnae Johnston, 1835, p. 203, fig. 22.

Nogagus productus, Gerstaecker, 1853, p. 63, pl. 4, figs. 1-10.

Dinematura producta, Steenstrup and Lütken, 1861, pp. 371-374, pl. 7, fig. 13; *Id.*, Wilson, 1907, p. 380, pl. 13.

Locality, Host and Record of specimens: 12 females from the skin of a Basking Shark (*Cetorhinus maximus*). Locality unknown. Australian Museum Reg. No. P. 13225.

Remarks: The species has been recorded as a parasite on sharks from both sides of the North Atlantic. The following species in this record (*D. latifolia*) is a closely related copepod with a known cosmopolitan distribution, and this indicates that *D. producta* will later prove to be similarly dispersed wherever it finds shark hosts. Although without locality data, the present series of *D. producta* is assumed to have been collected in Australian waters.

Dinematura latifolia Steenstrup and Lütken

Dinematura latifolia Steenstrup and Lütken, 1861, p. 378, pl. 8, fig. 16; *Id.*, Wilson, 1907, p. 383, pl. 24, 25; *Id.*, Shiino, 1954, p. 308, figs. 9-10.

Locality, Host and Record of specimens: Four females found on a Blue Pointer Shark (*Isuropsis mako*) at Port Hacking, New South Wales, 12.5.1943. Australian Museum Reg. No. P. 13223.

Remarks: The species appears to be fairly common as a parasite of large sharks along the North Atlantic coasts of America and Europe. It is also found in the Mediterranean, south of Africa, Japan, and there is one record from the Pacific coast of the United States. Judging from the distribution of the species, it can be assumed that it has a cosmopolitan distribution, into which the present Australian record fits very well.

Genus **Pandarus** Leach, 1816

Pandarus bicolor Leach

Pandarus bicolor Leach, 1816, p. 405, pl. 20, 2 figs.

Pandarus boscii Leach, 1816, p. 406, pl. 20, 10 figs.

Caligus bicolor, Lamarck, 1818, p. 142.

Pandarus fissifrons H. Milne-Edw., 1840, p. 470.

Pandarus bicolor, Wilson, 1907, p. 400, pl. 27.

Locality, Host and Record of specimens: Four specimens found parasitic on a Blue Pointer Shark (*Isuropsis mako*) at Port Hacking, New South Wales, 12.5.1943; Australian Museum collection. About 25 specimens from skin of a shark captured at Lord Howe Island,

east of New South Wales; Australian Museum Reg. No. P. 6137. Four females from a shark captured at Marouard Island, east coast of Tasmania, 2.4.1911; Australian Museum Reg. No. E. 6791. Five specimens from a shark captured outside Oyster Bay, Tasmania, 15.7.1909; Aust. Museum Reg. No. E. 6795. Three specimens from Port Jackson, New South Wales; Australian Museum Reg. No. G. 5215.

Remarks: This copepod is recorded from European waters, East America and West Africa. The present additional records from Australian seas prove the species to be much more abundant than was formerly believed. There is every indication that it will later be found to have a cosmopolitan distribution.

Genus **Nesippus** Heller, 1865

Nesippus australis sp. n.

(Figs. 162-172)

Locality, Host and Record of specimens: Three females, including the holotype, were found, together with two females of *Perissopus serratus* Heegaard, on the mouth and nostrils of a shark at Flinders Islands, North Queensland. Collected by A. G. Nicholls, 3.11.1948.

Although this new species is closely related to *Nesippus alatus* Wilson, as well as to *N. orientalis* Heller, the characters separating the three are well marked and leave no doubt that they are all distinct. Well marked differentiating characters are found in the plates on the fourth segment, the genital segment, and several parts of the appendages. The species, *N. alatus*, as far as is known, occurs only in the Atlantic, and the present new species is from the Pacific coast of Australia.

Female: The carapace is nearly circular and a little transversely elliptical—width 2 mm., length 1.3 mm. The frontal plates are of the typical shape among species of *Nesippus* with an orbicular carapace, being rather narrow in the middle anteriorly, then widening laterally into two lamellar lobes which partly cover the first free segment of the first antenna. In the middle between the two frontal plates is an incision at the point where the larval filament is placed. The posterior lunules are deep, and curved in a semi-circle so that, at the apex, they point nearly horizontally towards the median line. The lateral areas of the carapace are semi-circular, leaving about half the width of the carapace for the medial lobe. The cephalic area is small, and the thoracic area much larger and nearly square. The eyes are distinctly tripartite but small, appearing as three separate circular lenses arranged in a triangle in the centre of the posterior part of the cephalic area. The second and third thoracic segments are fused together and carry a rectangular lobe or plate on each side, which extends obliquely backwards nearly to the tips of the posterior lobes of the carapace. The posterior part of the third thoracic segment is in line with the anterior neck of the fourth segment, in front of the genital segment. This fourth segment is free and considerably narrowed anteriorly, but with strong convex lateral margins, each ending in a small lobe posteriorly and with a wide but shallow incision between these lobes. The same segment is covered with a pair of fused dorsal plates, each of them being nearly circular in outline, with the shallow incision between in strong contrast to the angular pair of plates on both the second and third segments. The fourth segment is, however much narrower than the following genital segment, over the anterior margin of which the plates of the fourth segment extend for nearly one-third of their length. The genital segment is elliptical or slightly ovate, with an evenly-rounded margin except for the postero-lateral corners, where there is a distinct incision, giving a median lobe to the posterior margin of the otherwise somewhat ovate-shaped segment. The length of the genital segment is about one-and-a-half times its greatest width, which is found a little behind the middle of its length. The abdomen is invisible in dorsal view, but the two large anal laminae project for nearly their entire length behind the posterior margin of the genital segment. Each lamina is a little wider than long, and is armed with four slender plumose setae. Seen ventrally, the abdomen is small and strongly triangular in shape—more so than in any of the other known species of the genus. It is attached for about its entire length in front of the posterior margin of the genital segment, so as to be concealed by this from a dorsal view. To the apex of the triangle formed by the abdomen is added a narrow neck where the abdomen joins the genital segment, while the broad base which declines a little to the sides is at the posterior margin where the anal laminae are attached. The egg-strings are almost pure white, long and slender, and with small thin eggs in the strings.

The first antenna has two free joints, and what seems to be a third one coalesced with the body. Of the two free joints the first is the larger, and is about twice as long as the following one. The former is cylinder-shaped and armoured at its distal end with several stout sensory hairs. The distal joint is conical, with the apex stuck into the previous joint, and armoured with setae at its tip. The second antenna is large, four-jointed, and with a long and stout terminal

claw. The first joint is squarish, with a backwardly-pointing spine, and laterally a circular adhesion pad is present. The second joint is conical towards the third joint, which is a short squarish cylinder tipped with the terminal hook-shaped joint, the latter being furnished on its median concave margin with a small accessory hook. The first maxilla is placed close up behind the first antenna, but a little to the side of the base of that appendage, and close to the margin of the carapace. It is one-jointed, and its tip is shaped into an elliptical to triangular adhesion pad. This pad is built up of longitudinal running furrows, and from its placement on the distal part of the joint, it appears most likely to represent the first maxilla in the caligids. In a proximal position to the pad the rest of the joint is to be found partly coalesced with the ventral side of the body. The second maxilla is placed close to the mouth-tube. It is of the normal Pandarin type, consisting of a basal knob furnished with two palps. The exopodal palp is only a backwardly-pointing spine, but the endopod consists of two small joints without any setae or spines.

The maxillipeds are rather complicated organs. The first of them is basally a very movable joint to the carapace, not covered with thick cuticle, which gives to the appendage the possibility of circular movements. After the basal joint there follow two joints proper, the first of which is the larger. The second joint is furnished with two branches, the larger one with three spiny ridges running in an open spiral up along the side (see figure). This same branch is further tipped with a small bulb, with an incision in its tip. The smaller branch of the second joint also has two parts—a thin slender hairy palp which, like the larger one, is tipped with a bulb featuring the same type of incision. It is not known how the bulbous organs function, but there is no doubt that they are of a sensory nature, and possibly the three rows of teeth on the basal part of one of the branches has a rasping function. The basal part of the second maxilliped is coalesced with the body, running as a strong ridge from front to rear nearly parallel with the median line. At the anterior base of this ridge is an adhesion pad carried on a sort of stalk springing from the appendage. After this coalesced part, there follows a free, swollen fleshy section carrying at its end a larger bud-shaped adhesion pad, somewhat like a mushroom in shape, the free fleshy joint being the stalk. From the fleshy joint underneath the adhesion pad there extends a small free joint tipped with a flat hook-shaped claw (see figures for further details).

The four pairs of swimming legs are all biramous. The rami of the first three pairs are two-jointed, and those of the fourth pair one-jointed. Further, the basal plate in the first and the fourth pairs is one-jointed, but in the second and third pairs a clear suture is to be seen dividing the plate into a coxa and a basis. The first swimming leg is the smallest, having a small rectangular basal plate, and two rami and a seta on its margin. The first exopodal joint has a single plumose seta, but like all the other setae, this is plumpish, weak and with very thin and few hairs. The second exopodal joint has a fringe of the same vestigial setae, and the two-jointed endopod has setae only on its distal joint. The second swimming leg has both a coxal and a basal part. The endopod is two jointed, with one seta on the first joint and a fringe of setae on the second joint. The exopod is also two-jointed, but the main part of the basal joint is transformed into a thin adhesion pad carrying only a single reduced seta. On the second exopodal joint there is also an adhesion pad, but much smaller in size, occupying only the lateral margin of the joint, which for the rest is tipped with the reduced type of setae. A reason for the poor development of the setae is that the function of the limbs has been changed partly into adhesion pads, with the help of which the copepod is able to skid around on the surface of the host. The third swimming leg is like the second except that the adhesion pad is here found only on the lateral margin of the second exopodal joint, and is very diminutive. The fourth swimming leg is small, but not as small as the first one. It has an undivided basal plate and both exopod and endopod are only one-jointed, but larger than the joints on the other legs, and probably act as support to propel the parasite forward when it is creeping on the surface of the host.

Total length, 3.8 mm. Length of carapace, including second and third segment, 1.9 mm. Width of carapace, 2 mm. Length of plates on fourth segment, 0.3 mm. Width of same, 0.6 mm. Length of genital segment, 1.8 mm. Width of genital segment, 1.2 mm.

Nesippus incisus sp. n.

(Figs. 173-181)

Locality, Host and Record of specimens: 20 females, including the holotype, found on a Gummy Shark (*Mustelus antarcticus*) from New South Wales waters. Australian Museum Reg. No. P. 13230.

In its general habits this species is very much like the previously described *Nesippus australis*. However, the aleae on the second thoracic segment are narrower; the aleae on the fourth segment are much larger, considerably overlapping the genital segment, and with a deep incision between the alea; the posterior median lobe of the genital segment is larger, and thus covers the entire abdomen and the basal half of the anal laminae. Several differences are also found in the appendages, which clearly establish the species as new.

Female: The carapace is strongly transversely elliptical, being 2.6 mm. in width and 1.5 mm. in length. The frontal plates are not so narrow in front as in *N. australis*, but more even in width. The free lateral lobe covering over the first antenna is also larger in *N. incisus* than in *N. australis*. The frontal plates are, together with the anterior and free margin of the cephalic area, projecting in a half circle from the anterior margin, deeply incised at the centre. The posterior lobes are short and only a little overlapping the lateral lobes of the second and the third segments. The cephalic area is small and narrow posteriorly, where the eyes are placed. The latter are of the usual tripartite type, with three separate circular lenses arranged in a triangle. Anteriorly, the cephalic area widens out, having its greatest width where it meets with the frontal plates. The thoracic area of the carapace is quadrilateral and nearly twice as large as the cephalic area. The lateral areas are semi-circular, and on their free margins anteriorly each begins with a small semi-circular lobe where the first maxilla is placed. This character is typical, and one not found in any hitherto known species. Along each free margin of the lateral areas of the carapace is found a thin adhesion membrane which commences anteriorly behind the small, semi-circular lateral lobe. The same membrane is also continued around the lateral area on the lateral side of the posterior lunules, where this side is made up of the lateral area of the carapace. The second and third thoracic segments are fused together, and carry a single rectangular lobe or plate on each side. In the young female (fig. 173B) the distinction between the second and third segments can still be seen, showing that the lateral plates belong to the second segment. From the third segment it can be seen how the basal plates of the limbs of that segment are placed as a second pair of wings. In their outline they follow behind the marginal contours of the lateral plates of the second segment, which extends obliquely backwards to the posterior tip of the lateral lobes of the carapace. By this means a complete circle is formed by the outer margins of the frontal plates, lateral areas of the carapace, posterior margins of the lateral plates of the second segment, and the basal plate of the third pair of thoracic limbs. The fourth segment is free and, anteriorly towards the third segment, begins with a narrow neck. The rest of the dorsal side of the segment is covered with a pair of large plates. In the anterior part these two plates touch each other and have grown together, but the slit between them becomes widened posteriorly, so that they far overlap the anterior part of the following genital segment as two large rounded lobes.

The genital segment is elliptical or slightly ovate, but with a distinct posterior lobe adding to its posterior margin. There is a strong incision in the margin on both sides where the lobe meets the margin of the rest of the genital segment. The same kind of posterior lobe is found also in *N. australis*, but is much larger in the present species, as it covers not only the abdomen, but also half of the anal laminae where they extend from the abdomen. Seen ventrally, the abdomen is small and triangular in shape and attached to the genital segment just in front of the posterior lobe of this segment. The apex of the triangle is directed forwards at its attachment to the genital segment. The anal laminae are shorter and more rounded than in *N. australis*, and each is furnished with the usual four plumose setae, plus a small lateral spine.

The egg-strings are of the usual shape found in *Nesippus*—long and thin, with many strongly compressed eggs in the string.

The first antenna has a short basal joint partly coalesced with the body, followed by two entirely free joints. The first of the free joints is long, cylinder-shaped, and with several plumose sensory setae at its tip. The terminal joint is much smaller, and extends from a little behind the tip of the large previous joint. It is conical in shape, with the apex of the cone at the point of union with the second joint. This same terminal joint is furnished with a few setae at its tip. The second antenna consists of four to six joints; the variation in number is caused by the three most distal joints forming the hook in older females being only a single joint in younger examples. The typical hook, consisting of two or three joints, is shown in the figure. The basal antennal joint is short, and is furnished on its side with a circular adhesion pad. The second joint is the largest, and is followed by a more quadratic joint which precedes the hook proper. In cases where the hook consists of three joints, as in the figure, the middle joint of the three is furnished on its concave side, half-way along its length, with a little bulb, and at its distal end, on the same concave side, there is found a delicate accessory spine.

The first maxilla consists mainly of a round adhesion pad. This is placed behind the first antenna on the anterior little lobe of the lateral margin of the lateral areas of the carapace. The second maxilla is close to the mouth-tube, and consists of a bulb with a single conical spine. The mouth-tube itself is shorter than in *N. australis*, but otherwise of the normal shape, and encloses the mandibles. The first maxilliped is three-jointed, as in *N. australis*. As in that species, the third joint is furnished with longitudinal ridges and on its tip a small bulb is present. A hairy palp or a plumose seta is also placed at the base of this same ridged joint. Again, as in *N. australis*, the whole appendage is attached to the body by a short stalk, giving it great mobility. The second maxilliped has its long stem coalesced with the body, and extending from the anterior end is an elliptical adhesion pad. The free end carrying the large adhesion pad is fleshy and bulbous, but not as fleshy as in *N. australis*. The short free segment furnished with the flattened curved claw extends laterally from the joint, underneath the pad.

The four pairs of swimming legs are all biramose, the rami of the first three pairs two-jointed and those of the fourth pair one-jointed. The first three pairs all have a bulb extending from the basal plate, lateral to the exopod. This bulb is clearly sensory on the second and third pairs of swimming legs but not on the first pair; on the fourth pair the bulb is replaced by a seta. Additional smaller adhesion pads are found on the lateral margin of the first exopodal joint of the second pair of swimming legs, and on both the first and second exopodal joints of the third pair of swimming legs. The first pair of swimming legs has a seta on the basal plate in a medial position to the two rami. Of the latter, the first endopodal joint is naked, while the second is furnished with three plumose setae and lined with hairs on its lateral margin. The first exopodal joint is the larger and has one seta; the second and shorter exopodal joint has several setae. The second swimming legs have the typical spiny sensory bulb or pad on the basal plate, lateral to the exopod. The latter is two-jointed, with only a tiny spine on the first joint, but it has a relatively large adhesion pad on the basal joint. The second joint is furnished with several plumose setae. The first endopodal joint has one plumose seta, and the second seven plumose setae. The third swimming legs are built like the second pair, being only a little larger in the basal plate. The sensory bulb is placed in the same position on the limb, but this is also a little larger. Both the first and second exopodal joints are furnished with adhesion pads. In addition, the first joint has one small seta, and the second eight setae on its border which increase in size towards the median line. The two-jointed endopod has one and four plumose setae respectively. The fourth swimming legs are smaller than the third pair, with both exopod and endopod one-jointed, and with nine and four setae respectively, but without adhesion pads or sensory bulbs. In place of the latter a seta is found to be present.

Total length, 4.6 mm. Length of carapace, including second and third segments, 2.2 mm. Width of carapace, 2.6 mm. Greatest width of fourth segment, 1.2 mm. Length of plates on fourth segment, 0.7 mm. Length of genital segment, 2.2 mm. Width of genital segment, 1.5 mm. Length of abdomen, 0.4 mm.

Remarks: Four species of *Nesippus* are more closely related than others within the genus, and together constitute a well-defined group. These are *N. orientalis* Heller, *N. alatus* Wilson, and the two new species, *N. australis* and *N. incisus*.

Family Anthosomidae

Genus **Anthosoma** Leach, 1816

Anthosoma crassum (Abildgaard)

Caligus crassus Abildgaard, 1794, p. 54, pl. 5, figs. 1-3.

Anthosoma smithii Leach, 1816, p. 406, pl. xx, fig. 1.

Anthosoma crassum, Steenstrup and Lütken, 1861, p. 397, pl. 22, fig. 24.

Locality, Host and Record of specimens: Eight females from inside lower jaw of Mako Shark (*Isuropsis mako*); French Pass, Cook Strait, New Zealand. Collected by A. M. Rapson, 27.3.1946. Australian Museum Reg. No. P. 13,224. 2 females from a shark; Port Jackson, New South Wales. Australian Museum Reg. No. G. 5,211. 4 females from mouth of shark, *Carcharias*; probably from New South Wales. Australian Museum Reg. No. P. 13,231. 1 female from mouth of shark, *Isuropsis bideni*; South Africa. Australian Museum Reg. No. P. 13,226. 5 females from jaw of Mako Shark (*I. mako*); off Long Reef, near Port Jackson, New South Wales, 12.11.1938. Australian Museum Reg. No. P. 11,015.

Remarks: This is a very common copepod with a cosmopolitan distribution. Although it has not been recorded before from Australian seas, G. M. Thomson states that numerous specimens have been collected in New Zealand waters. The abundant representation in the present collection shows the species to be an equally prevalent member of the Australian marine fauna.

Family Cycnidae Kröyer, 1863

(= Pseudocycnidae Wilson, 1932)

Paracycnus gen. n.

Type species *P. lobosus* sp. n.

This genus, based only on the female sex, is very closely related to *Cycnus* and *Pseudocycnus*. The head is fused with the first segment, only the second segment being free, and the rest of the segments are fused with the genital segment into a cylindrical body several times longer than wide and uniform in diameter. The fused abdomen is one-segmented, the border line being distinguishable only by an invaginated ring. The caudal rami are also coalesced

to the abdomen, and they are long, large and fleshy. Egg-strings are long, with the eggs placed linear-fashion and strongly flattened. The first and second antennae are somewhat like those of *Cycnus*, except that in *Paracycnus* the second antenna has three joints. Also, as in *Cycnus*, the maxilla is very small and, similarly, the first maxilliped, but in *Paracycnus* the latter is placed at the base of an enormously large, three-jointed, second maxilliped. The first legs are uniramose, as in *Pseudocycnus*, but much longer, and jointed. Pairs of biramose, unjointed appendages occur on the second, third and fourth segments.

Although *Cycnus* and *Pseudocycnus* are known to the author only from the literature, it is considered that they are markedly different from *Paracycnus*, and so justify its establishment as a new genus.

Bassett-Smith's *Helleria* is another genus with some striking resemblances to the new *Paracycnus*. However, if Bassett-Smith's text and figures are followed, there appears to be too many differences for the two to be united. The final answer to this can come only from an examination of Bassett-Smith's specimens. From his description one learns that in *Helleria* the first segment is not fused with the head, the trunk is much shorter, and small differences are found in the appendages.

Following is a comparison of characters of the four genera discussed above:—

	Cycnus	*Paracycnus*	*Helleria*	*Pseudocycnus*
1 segment ..	Fused with head	Fused with head	Not fused with head	Fused with head
Following segments	2, 3 segm. free, rest fused with genital segm.	2 segm. free, rest fused with genital segm.	1, 2, 3 segm. free, rest fused with genital segm.	2, 3 segm. free, rest fused with genital segm.
A_1 ..	Several joints ..	Several joints ..	As in *Paracycnus*..	Few joints.
A_2 ..	Subchela	Subchela	Like *Paracycnus* ..	Subchela.
M_x ..	Vestigial	Vestigial	3-jointed, small ..	Vestigial.
M_{xp1} ..	Vestigial	3-jointed, small ..	3-jointed, small ..	3-jointed, small
M_{xp2} ..	Delicate	Enormously large..	Large, like *Paracycnus*, except for the basal joint.	Well developed.
Pe_1 ..	Bifurcate ..	Uniramose, 4-jointed.	Pe_2 uniramose ..	Uniramosal, 1 joint.
Pe_{2-4} ..	Bifurcate, jointed ..	Bifurcate, unjointed.	Pe_3 missing, Pe_4 uniramose.	Pe_2 bifurcate, unjointed. Pe_{3-4} uniramose.

Paracycnus lobosus sp. n.

(Figs. 182-190)

Locality, Host and Record of specimens: Three specimens on *Scomberomorus commerson*, from Cape Direction, North Queensland. Collected by A. G. Nicholls, 6.11.1948. Four female specimens, one selected as the holotype, from Torres Strait. Collected by A. G. Nicholls, 22.11.1948. 16 specimens; Torres Strait. Collected by A. G. Nicholls, 23.11.1948. One specimen on *Scomberomorus queenslandicus* at Eden Reef and Princess Charlotte Bay, North Queensland. Collected by A. G. Nicholls, 6.11.1948.

Female: The carapace is ovate, narrowed anteriorly, with the lateral margins curved into well-rounded lobes, and terminating with the posterior corners prolonged into well-rounded lobes; the narrow portion between the posterior lobes represents the first segment, and carries the first legs. The second segment is free, a little wider than the carapace, and the free lateral margins are drawn out into postero-laterally pointing lobes. The third and the fourth segments have the same kind of lateral lobes, but those on the third segment are double. The main parts

of these segments, together with the fifth segment and the genital segment, are fused into a long cylindrical body several times longer than wide and uniform in diameter. The abdomen is also fused with this cylindrical trunk, but is attached to it a little on the ventral side. From this very short, one-segmented abdomen (fig. 186) there extends a pair of long fleshy caudal rami; their greatest width is at the base, and they taper off towards their tips.

The first antenna is long, slender and seven-jointed, with a large horn-shaped seta on the second joint. Further, all the joints except numbers one, two and four are furnished with common setae. The second antenna is three-jointed and strongly prehensile. The first joint is short, the second about twice the length of the first, and the third joint is shaped into a curved claw with an accessory spine midway along its concave side. This third joint is very movable, and can be bent backwards to form a subchela with the second joint. The mouth-cone is short, and on each side of it the maxilla is only a vestigial bud. The next visible part is the enormous second maxilliped, which has a basal joint running as a lateral lamella on the ventral side of the head. Then follows a large swollen second joint tipped with a hook-shaped claw with an accessory spine placed in the same position as the one on the second antenna. The second maxillipeds and the second antennae are the large prehensile organs of the copepod. At the inner base of the second maxilliped is found a small three-jointed organ which is the vestigial remains of the first maxilliped.

The first pair of limbs is uniramose and four-jointed. The second, third and fourth limbs consist of a sympodial bulb with two small unjointed lobes, the exopod and the endopod, each furnished with a short seta.

Length of head, 0.9 mm. Greatest width, 1.1 mm. Length of free segment, 0.5 mm. Length of trunk, 5 mm. Width of trunk a little less than 1 mm.

Male: Unknown.

Hyponeoidae fam. n.

In the collection received from the Australian Museum was a sample from the Australian Antarctic Expedition, 1911-14, containing some parasitic copepods in a rather poor state of preservation. At first glance they appeared to be closely related to the Chondracanthidae, but on examination they proved to belong to the suborder Caligoida, though they would not fit into any of the known families of that group. Although no male was found in the material, it was felt necessary to establish the new family Hyponeoidae in order to deal with the material.

Female: Head covered with a carapace dorsally, having lateral and anterior lobes. First and second thoracic segments free, but partly fused together dorsally; ventrally, a distinct suture shows the partition between them. The second thoracic segment with lateral lobes. The third, fourth and fifth thoracic segments are coalesced with the genital segment into a trunk. No dorsal plates are present. The abdomen consists of one to a few segments terminating with swollen caudal rami.

The first and second antennae consist of several joints, the second terminating with a powerful, prehensile claw. Labium and labrum shaped into an elongated tube enclosing the mandibles. Maxilla bifurcate but plumb. Maxillipeds with powerful terminal claws, especially the second maxilliped, which has its terminal claw bearing against a large and swollen basal joint to form a chela. First two thoracic segments with vestigial, but biramous, swimming limbs, with the stem of the limbs in the shape of a swollen bulb. The trunk may be furnished ventrally with four pairs of bulbs, which seem to be vestigial in character; their placement also suggests that they should be looked upon as limbs.

The egg-strings are linear and in the type genus are rolled up in a spiral.

Male: Unknown.

Hyponeo australis gen. and sp. n.

(Figs. 191-200)

Locality, Host and Record of specimens: Eight females, including the holotype, found on a fish by the Australian Antarctic Expedition, 1911-14. Australian Museum Reg. No. P. 8,060. No further information is available.

Female: The head is wider than long and covered dorsally with a carapace; its lateral sides are furnished with two forwardly-directed lobes. Behind the head are two free thoracic segments which are partly fused together; the fusion is total dorsally, but on the ventral side the dividing line between the two segments can clearly be seen. The first segment is narrow—about two-thirds the width of the head. The second segment is wider, and furnished with a

pair of lateral lobes turned in an anteriorly-directed curve. Behind the narrowed part of the body is a large trunk comprising a coalescence of the three following thoracic segments and the genital segment. The segmentation can be seen only from a dorsal view as weak, broken furrows crossing the trunk. The genital part of the trunk is provided with a pair of postero-lateral lobes, behind which is a small lobe or bulb on which the genital apertures are found. Towards the abdomen the genital part of the trunk becomes narrow and sunken so that it cannot be seen from the dorsal side. This is due to the part being covered by the egg-coils, which are placed rather dorsally. On the same narrow part of the trunk there is found a pair of lateral lobes pointing partly backwards. The abdomen is unsegmented, short, cylindrical in shape, and tipped with a pair of fleshy caudal rami, the combined width of which is about the same as that of the abdomen. No setae could be seen, but the specimens examined were in a poor state of preservation; there may formerly have been some small vestigial setae attached to the caudal rami.

The first pair of antennae is long and slender, consisting of six joints; all except the short and squarish terminal joint are of nearly equal length. Two short, spiny setae were found on the medial margins of the second, third and fourth joints. The terminal joint is furnished with many setae, with the shorter ones on the medial margin; the tip of the joint carries three long and slender setae and two shorter ones. The second antenna is a true prehensile organ, consisting of four joints. The first and second joints are short, the two terminal joints long, and the fourth joint shaped into a strong sickle-shaped claw.

The labium and labrum are drawn out into a proboscis enclosing the stylet-shaped mandibles. The maxillae are placed on each side of the mouth-cone, each consisting of an elliptical bulb with two small, clawed fingers—the exopod and the endopod. Like the maxillae, the first maxillipeds are also diminutive; they are placed posteriorly, a little lateral to the maxillae. Each of them consists of three joints, of which the terminal one is a curved claw, pointing anteriorly, and may be prehensile. From the shape, however, the function seems to be more of an aid in feeding, possibly to hold the skin of the host extended, so the mandibles can cut more easily through it. The second maxillipeds are large prehensile organs, each consisting of three joints—a large swollen basal joint, followed by a short joint carrying a large sickle-shaped claw with a small accessory bulb on the concave side near its tip. The appendage functions as a sub-chela, with the hook of the claw pressed up against the lateral margin of the basal joint of the limb, and is comparable to that found in the caligids.

Each of the first two thoracic segments has one pair of limbs. They consist of a large swollen protopod, which is much larger on the limb of the second thoracic segment than on the first. The big swollen protopod is furnished on both segments with a small vestigial exopod and endopod, both consisting of two joints. No setae are seen on the limbs, a state which may be due to the poor preservation of the specimens.

On the ventral side of the trunk four pairs of bulbs are present, of which the most posterior pair are rather small, and from their placement and number appear to be vestigial appendages. Their slightly nodular surfaces suggest that they may be of a sensory nature.

The egg-strings are long, linear, curled up in a short spiral placed dorsally on the abdomen and thus obscuring this part of the body from view.

Male: Unknown.

Family Eudactylinidae

Genus **Nemesis** Risso, 1826

Nemesis lamna Risso

(Fig. 201)

Nemesis lamna Risso, 1826, p. 135, pl. 5, fig. 25.

Nemesis mediterranea Heller, 1865, p. 220, pl. 21.

Nemesis lamna, Wilson, 1932, p. 461, pl. 32.

Locality, Host and Record of specimens: 12 specimens, including two males, were found on a shark at Port Jackson, New South Wales. Australian Museum Reg. No. P. 13,232.

Remarks: This copepod is known from the Mediterranean, and European seas, as well as from the Californian coast and the Atlantic coast of Massachusetts, U.S.A. The present record from Port Jackson, New South Wales, Australia, strongly indicates that the species will ultimately prove to be one of cosmopolitan distribution.

Family Dichelesthiidae

Genus **Hatschekia** Poche, 1902

Hatschekia elongata sp. n.

(Figs. 202-206)

Locality, Host and Record of specimens: One female, the holotype, from a Leather Jacket fish (*Brachaluteres jacksonianus*), washed ashore at Cronulla Beach, near Port Hacking, New South Wales, 28.2.1932. Australian Museum Reg. No. P. 13,229.

Female: The single female of this small species is less than 1½ mm. long. It was found to be in a rather bad state of preservation, and this difficulty has prevented the preparation of a full description. The cephalon is small, wider than long, and followed by an oval trunk carrying a pair of egg-strings. No abdomen could be seen.

The first antenna is seven-jointed, its distal joint being tipped with four swollen sensory setae. The second antenna has a long and slender basal joint, tipped with a terminal hook-shaped claw. The maxilla is vestigial, consisting of a short basal joint with the exopod and endopod extended as two branches of a fork. The exopod is a little larger than the endopod. Both are one-jointed, and tipped with a single blunt spine. The maxilliped is three-jointed, with a large basal joint followed by a slender second joint, and terminated by a third short joint with two awkward-looking setae.

Male: Unknown.

Family Lernaeidae

Genus **Lerneaenicus** Le Sueur, 1824

Lerneaenicus hemiramphi Kirtisinghe

(Figs. 207-208)

Lerneaenicus hemiramphi Kirtisinghe, 1933, p. 550, Figs. 4-7.

Locality, Host and Record of specimens: One female, removed from the eye of a Garfish, *Hemiramphus intermedius;* St. Vincent Gulf, South Australia. South Australian Museum collection.

Female: The single female of this species resembles Kirtisinghe's description and figures in most of its characters. The head is the same, including the three characteristically-placed horns and the appendages.

The eye was not clearly seen, but a doubtful spot was found where it may have been located. This organ is commonly present in *Lerneaenicus*. It is, however, likely to disappear in older specimens when, as a parasite, the copepod has its head deeply embedded in the host. The single individual on which the present record is based is an old museum specimen with no remaining pigmentation. The mouth is rather characteristic, with a wide, circular, chitinous-lined pharynx. It has strong muscles which, on the surface round the mouth-opening, take the shape of small knobs.

The species has a close resemblance to *L. polynemi* Bassett-Smith, but the thoracic limbs in that copepod are well developed, with the first and second limbs two-branched, and each of them two-jointed. Also, the third and fourth limbs are single-branched and three-jointed. In *L. hemiramphi* all limbs are unbranched buds.

Specimens of *L. hemiramphi* recorded by Kirtisinghe were from *Hemiramphus xanthopterus*, a fish host closely related to the host of the present single parasite from South Australian waters.

Genus **Lernaeolophus** Heller, 1863

Lernaeolophus sultanus (Nordmann)

(Fig. 209)

Pennella sultana Nordmann, 1864, p. 485, pl. 5, figs. 12-16.

Pennella sultana, H. Milne-Edw., 1840, p. 523.

Lernaeolophus sultanus, Heller, 1865, p. 251, pl. 25, fig. 7; *Id.*, Brian, 1906, p. 91; *Id.*, Wilson, 1917, p. 91, pl. 13, figs. 108-113.

Locality, Host and Record of specimens: One female from lower lip of a Toado Fish (*Tetraodon*); Lord Howe Island, east of New South Wales, Australia. Australian Museum Reg. No. P. 13,222.

Remarks: This species is known from the west coast of Europe, the Mediterranean and the east coast of North America. The present Australian locality is the first known one for the species outside the Atlantic Ocean and adjoining seas. The record provides another instance of a far wider distribution for a species than previously believed.

Family Pennellidae

Genus **Pennella** Oken, 1815

Pennella instricta Wilson

Pennella instricta Wilson, 1917, p. 122, pl. 18, figs. 141-147.

Locality, Host and Record of specimens: Seven specimens from skin of a Black Marlin Swordfish (*Istiompax australis*); off New South Wales coast; Australian Museum Reg. No. P. 11,013. Two specimens found embedded in skin of Striped Marlin Swordfish (*Marlina zelandica*); off Port Jackson, New South Wales, 1940; Australian Museum Reg. No. P. 11,291. Two specimens belonging, with little doubt, to this species; the cephalothorax on both was missing, thus preventing absolute certainty of determination. They were found on a Black Marlin Swordfish (*Istiompax australis*) off Broughton Island, near Port Stephens, New South Wales; Australian Museum Reg. No. P. 11,804.

Remarks: The species has been recorded before only by Wilson from the Atlantic coast of the United States of America. The host for Wilson's specimens was the Atlantic Swordfish (*Xiphias gladius*).

Pennella remorae Murray

(Figs. 210-213)

Pennella remorae Murray, 1856, p. 229, 5 figures in text.

Locality, Host and Record of specimens: One female from a Sucker Fish (*Remora remora*) removed from a shark, probably the Mako Shark (*Isuropsis mako*); Bay of Islands, New Zealand. Australian Museum Reg. No. P. 13,228.

Female: The single specimen at hand clearly indicates that the species is a small one, length only 13.5 cm. The head is globular and bears short minute papillae on the ventral side. The papillae (fig. 211) are arranged in four groups—two larger lateral groups and smaller dorsal and ventral groups. All four groups are further placed together inside a larger ring of papillae. Also on the head are three short, blunt horns—a medial one pointing backwards and the other two pointing outwards from each side. The neck is about one-fourth of the total length of the copepod, increasing posteriorly in width and gradually descending into the wider trunk. The abdomen is short—about 3 cm. long—and covered on its ventral and lateral surfaces with a thick fringe of plumose appendages, in front of which are the two egg-strings, extending from the posterior part of the trunk. A clearly pointed rostrum (fig. 212) is present on the head, and from each of its sides extends a three-jointed, sub-chelate second antenna. No trace of first antennae could be found, although these may be found in some younger specimens and could have been broken off the present female example. The four pairs of thoracopods present were very diminutive (fig. 213) and uniramous. Of the first two pairs, the left one of each has a small second joint. A small second joint is also present in the right leg of the third pair. The fourth pair was found to be only one-jointed and very diminutive.

Remarks: Special characteristics of this species are the arrangement of the papillae on the head, the position of the three horns, the particularly well-developed rostrum, second antenna, and the strongly reduced thoracopods.

When Murray described this species in 1856, he stated that it was found attached to the sucking disk of a Sucker Fish (*Remora remora*). However, all that he described and figured of the copepod was that portion of it that was free of the disk; the part buried in the tissues of the fish host was destroyed in an attempted dissection. Further, the posterior free portion of the parasite had characters plainly showing that the material Murray described was immature, the plumose appendages having only just started to grow. For these reasons Wilson (1917) rejected the species as invalid. The female on which the present record is based is a fully-grown specimen complete with egg-strings. While it cannot be claimed to fit the species as described by Murray, it was found parasitic on the same kind of fish host. Although this vexed question of synonymy can never be finally proved, the present author feels justified in assuming that the New Zealand specimen recorded here represents the adult stage of Murray's *P. remorae*, and refrains from erecting a new species for its accommodation.

Genus **Trifur** Wilson, 1917

Trifur physiculi sp. n.

(Figs. 214-220)

Locality, Host and Record of specimens: Three female specimens, including the holotype, from the skin of a fish, *Physiculus*; Twofold Bay, New South Wales; collected by W. S. Fairbridge, 27.1.1949. Four specimens from *Physiculus barbatus* (Red Rock Cod); D'Entrecasteaux Channel, Tasmania; collected by A. M. Olsen, 4.11.1948. Three specimens from skin, same host; Corner Inlet, Victoria; collected by M. Blackburn, October, 1948. Two specimens, same host; Hobart, Tasmania. Australian Museum Reg. No. G. 3,926. Eleven specimens, parasitic on local Cod (*Physiculus*); Oyster Bay, Tasmania, 11.7.1909. Australian Museum Reg. No. E. 6,794.

The species is very close to Wilson's *Trifur tortuosus*, on which the genus was established. There are, however, small differences in the shape of the horns and of the appendages, which justify the establishment of a new species.

Female: The cephalothorax is enlarged, nearly at right angles to the neck, and armed with a dorsal posterior median horn and two conical lateral horns. The posterior horn is slightly curved and directed backwards; it is conical, and bluntly rounded at the tip. The two lateral horns are a little variable in shape and size. They may be either longer and thinner than the posterior horn, with a somewhat drawn-out appearance, or they may be shorter, more conical, rather thick at the base, and end bluntly. The mouth-cone is like a big bell; it is bent, and points backwards ventrally. The neck is long, about twice the length of the trunk, and that part outside the flesh of the host may by growth be curved in two or three different directions. The cephalothorax is perfectly smooth, without knobs or horns. The front part of the trunk or the genital segment is somewhat like that of *Lernaea*, but is less swollen and perfectly smooth except for a pair of processes placed laterally to the oviduct openings. It is also compressed a little laterally and shaped in a semi-circle. The abdomen is fleshy, club-shaped and enlarged a little at the tip. It is without any knobs or processes, and about half the diameter of the genital segment. The same structure is also bent in a half circle where it leaves the genital segment, and is straight for the rest of its length.

The egg-strings are each curled in an open spiral. The anal laminae are so small that they can scarcely be seen, but there is a tiny single-haired bulb on each side of the anus. Unfortunately, Wilson has not given any detailed figures of the appendages of his *T. tortuosus*; he describes them only in the text. In the present *T. physiculi* the first antenna is very short and unjointed. Wilson states that *T. tortuosus* has an indistinctly jointed first antenna, but this appendage in both species is turned outwards away from the midline. Further, in *T. tortuosus* it is tipped with four small setae. The second antenna, placed inside the first antenna, is rather large and three-jointed, consisting of a larger basal joint, and the chela which is comprised of the following two joints. Both the first and second antennae are placed on a semi-globular dorsal swelling of the cephalothorax (see fig.).

The four pairs of swimming limbs are strongly reduced in this species. All of them are uniramose and thus differ from Wilson's species, but each of the limbs is two-jointed, with a larger basal joint and a smaller distal joint; no setae could be seen on the specimens examined. The first two pairs of limbs are placed above the bend of the neck towards the cephalothorax, with the proboscis reaching down to a point where it is level with them. The last two pairs of limbs are placed a little more apart and below the bend of the neck.

Total length when fully extended, 30-40 mm.

Male: Unknown.

IV Suborder LERNAEOPODOIDA

Family Lernaeopodidae

Lernaeopodella gen. n.

Type species *L. major* sp. n.

Generic characters—female: Cephalothorax at an oblique angle with the trunk but much smaller, the two parts separated with a distinct groove. The dorsal carapace is small and poorly defined. Trunk long, like *Lernaeopoda*, but the first two segments are not so clearly separated from the rest. Two posterior processes are found in a ventral position to the egg-strings, and these extend from the genital process itself.

First antenna three-jointed, with a swollen basal joint. Second antenna with a three-jointed protopod, a one-jointed endopod at the termination of the protopod, and a thumb-shaped, two-jointed exopod. Each of the first maxillae on a long shaft. Second maxillae shaped in long free arms connected together only by the bulla. Maxillipeds placed together on an unpaired ventral process. Each maxilliped is two-jointed, and tipped with a small claw. Egg-strings stout.

The copepod appears to be one that reaches a relatively large size.

Male: Unknown.

Lernaeopodella major sp. n.

(Figs. 221-224)

Locality, Host and Record of specimens: Three females, including the holotype, found on a shark at Eden, New South Wales. Australian Museum Reg. No. P. 3,717.

Female: The cephalothorax is small, ovoid, flattened dorso-ventrally, and covered dorsally with a carapace which does not reach very far down on the sides; it is inclined at nearly right angles to the trunk axis. The first two segments of the trunk are differentiated from the rest of the trunk, but not very distinctly. The segments that follow are coalesced with the genital segment, and are only partly indicated by surface grooves. The trunk as a whole is cylindrical, more or less strongly flattened dorso-ventrally, and about three or four times as long as wide; its posterior end has prominent, well-rounded corners. In the centre, between but a little ventrally from the bases of the egg-strings, two ventral posterior processes extend from a median bulb or genital process, in which there is a deep cleft. The egg-strings are about equal to the length of the body, slender, cylindrical and with many rows of minute eggs.

The first antenna is three-jointed, with a thick swollen basal joint followed by two delicate joints, but the appendage is not tipped with any setae. The second antenna is remarkable in that it has a distinctly three-jointed protopod. The first two joints of this latter are short, and the third joint about equals the combined length of the first two joints. The exopod is two-jointed, the endopod only one-jointed but more swollen at the tip than at the base; the two together look like a hand with a free thumb. The mouth-tube is short, swollen and thick. The mandibles are normal, but have only four teeth. The first maxilla is on a long shaft, and tipped with three fingers, each of them terminating with a small claw. The second maxillae are a pair of long, slender, entirely separated arms joined together only by the bulla which, unfortunately, was missing in all three specimens examined; the structure must have been lost when the copepods were removed from the host.

The maxillipeds are relatively short and extend from far behind. They are placed on a large fleshy bulb which makes it possible for them to reach the mouth-cone. Each of the appendages is two jointed, and tipped with a little claw. The first joint is much swollen, with two short but strong spines on the flattened postero-lateral margin. The second joint functions as a clasping sub-chela which bears against the first joint. It is of the usual shape of such joints, and tipped with a short claw.

Of the three specimens measured, the one medium in size was the one selected as the type. Its dimensions are: Total length, 5.5 mm. Length of cephalothorax, 1.7 mm. Length of trunk, 4 mm. Width of trunk, about 2 mm. Length of posterior processes, 2.5 mm

No male was found on any of the three females examined.

Genus **Tracheliastes** Nordmann, 1832

Tracheliastes chimaerae sp. n.

(Figs. 225-232)

Locality, Host and Record of specimens: Approximately 50 specimens, including the holotype, found on the clasper of a Ghost Shark (*Chimaera ogilbyi*), 30 miles south of Cape Everard, Victoria, 270 fathoms, 22.10.1914; trawled F.I.S. " Endeavour ". Australian Museum Reg. No. E. 5,975.

Female: The cephalothorax is very minute, with no dorsal carapace, but has a long proboscis curved forwards ventrally between the second maxillae. It is separated from the trunk on each side by a deep invagination, and also by a dorsal and ventral groove. The trunk is large, massive, and strongly flattened dorso-ventrally; posteriorly, it becomes gradually enlarged and then slightly contracted. The posterior margin is almost squarely truncated, with

rounded corners and a wide medial rounded lobe extending into a small two-lobated genital process. No posterior processes, abdomen or anal laminae are present. The convolutions of the oviducts form a series of slight rounded swellings, and are seen along each side of the median line. The swellings are all of about equal size along the trunk, and are of a darker colour than the rest of the trunk. The egg-strings are stout and very long—longer than the trunk and containing many small eggs. In the adult females very little seems to be left of the appendages; first and second antennae, and also the first maxillae, are missing. The mouth-cone is a long proboscis of about equal diameter, except for near its extremity, where it terminates in a conical tip. The upper lip is relatively large, for it makes up nearly one-third of the cylinder of the mouth-tube. The anterior opening of the mouth-tube is fringed with fine hairs. The mandibles are very long, extending into the usual position at the base of the mouth-tube, and reaching as far as the tip of the mouth-cone. Only three strong teeth are left at the tip of the mandible. The second maxilla consists first of a little bulb with the maxillary gland at its opening, after which follows a long fleshy arm curved round the mouth-tube and what is left of the cephalothorax. The two maxillary arms are entirely free. The bulla has a long thin stalk extending into a large globular bulb.

The maxilliped, which is placed behind the second maxilla, is minute and three-jointed. The first joint is stalk-like, and is followed by a swollen joint that appears to have once been combined with the claw of the third joint to form a sub-chela. Altogether, the whole appendage is vestigial and of little functional use.

In a young female with bulla not fully formed, indicating recent attachment to the host, some more details of structure can be seen. The cephalothorax points forwards, but is naked and without carapace. The mouth-tube is small, as in other Lernaeopodidae. The first antenna is three-jointed and slender, with the two first joints equal in length, and the length of each nearly three times their diameter. The third joint is a small tipped claw. The second antenna is bifurcate, and has a short single-jointed protopod with two large branches. The exopod is bulbous, but has a half-moon incurvation on the ventral side near the tip which is provided with two small setae. The endopod is a little longer than the exopod and tipped with a claw and a small accessory spine behind the claw. No first maxilla could be found.

Length of proboscis, 1.7 mm. Length of trunk, 6 mm. or more. Width of trunk, about 4 mm.

Male: The male sex represented in the material of the present new species is the first to be known for the genus. The cephalothorax is egg-shaped, naked, and pointed anteriorly. The trunk is elongated, and at least three segments can be distinguished. Posteriorly, it is tipped with a pair of small three-jointed anal laminae.

The first antenna is three-jointed as in the female, with the terminal joint tipped by a claw. The second antenna is different from that of the female in that both the endopod and the exopod are two-jointed. In consists of a short unjointed protopod, followed by the two branches. The exopod has a short swollen basal joint, and a thin finger-shaped distal joint. The endopod is also two-jointed, and has a swollen basal joint like that of the exopod, but longer than the combined length of both exopodal joints. The second endopodal joint is of a peculiar chelate form, but without any movability in the finger of the chela. The chela is further furnished with a long slender accessory spine.

The first maxilla is a long, stalked, three-partite organ, but without any division into joints. The second maxilla is three-jointed, its basal joint wrinkled and like a stalk. The second joint of the maxilla is large and swollen, and the third is a sickle-shaped claw. The maxilliped also has three joints, all smaller than those of the second maxilla, but otherwise of the same shape.

Total length, about 0.8 mm. Length of cephalothorax, about 0.4 mm. Length of abdomen, about 0.4 mm.

Genus **Brachiella** Cuvier, 1830

Brachiella cirrocauda sp. n.

(Figs. 233-236)

Locality, Host and Record of specimens: 12 females (some with males), including the holotype, from inside the mouth of a Red Rock Cod (*Physiculus barbatus*); Corner Inlet Victoria. Collected by M. Blackburn, Oct., 1948.

Female: The cephalothorax is stout, cylindrical and considerably longer than the trunk. The head, compared with the rest of the cephalothorax, is enlarged and covered with a carapace. The neck is flexible and usually bent ventrally. The second maxillae are short, with the arms separated. The trunk is short, wider than long, and a little flattened dorso-ventrally. It has

two ventral posterior processes, and between them a small one-segmented genital process. The posterior processes are about as long as the trunk or a little longer, and straight. Laterally and dorsally to the posterior processes are the egg-strings which, in most cases, are longer than the processes and contain many small eggs.

The first antenna is somewhat swollen at the base, three-jointed, and with the first joint much thicker than the following ones; the terminal joint is tipped with four short setae. The second antenna is biramose and turned down over the frontal margin. The appendage extends from its base with a two-jointed protopod—first a short joint, followed by a longer joint about three times the length of the basal joint. Of the unarmed endopod tipping the protopod, the dorsal ramus is large, bluntly rounded and one-jointed. The ventral ramus of the exopod is comparatively minute, two-jointed and terminated by a tuft of small setae, of which the most lateral seta appears to be the largest.

The mouth-tube is long and cylindrical, and reaches the exopod of the second antenna. The lower lip is fleshy, large at its tip and fringed with hairs. The upper lip is also fleshy, but perhaps a little more narrow than usual. The mandibles are of the usual type, reaching to the opening in the mouth-tube. The first maxilla is three-partite. The palps are one-jointed, and each is tipped with a single spine. The second maxilla is short and slender, and the arms separate except at their tips. The bulla can be compared with a stalked cone of the cypress-like kind, the short stalk at the base of the cone being situated between the cone and the maxilla. The openings of the maxillary glands are surrounded by a small circular wall, and are not prominent in this species.

The maxillipeds are relatively large, each consisting of three joints. The basal joint is large and swollen, with two ridged patches and a short spine in between on their medial margin. The second joint is about half as long as the basal joint and, combined with a prolongation of the third joint, takes the form of a sub-chela having only a slightly curved, strong claw. On the distal half of the medial margin of the second joint there is a comb of cross-ridged teeth which fits into the distal pad on the basal joint. The tip of the terminal claw reaches the proximal pad on the same joint, an arrangement which clearly improves the grasp of the maxilliped.

The specimens examined varied much in size, but the following measurements apply approximately to a well-grown female: Length of cephalothorax, 4 mm. Width of cephalothorax, 0.6 mm. Length of carapace, 1 mm. Length of trunk, 2 mm. Width of trunk, 2.5 mm. Depth of trunk, about 1 mm. Length of posterior processes, about 2 mm. Length of egg-strings, 2-3, 5 mm. Width of same, 0.8 mm.

Male: The head is placed at an angle of nearly 90 degrees to the body axis. It is covered with a distinct dorsal carapace, which is extended anteriorly into a small rostrum. The trunk is ovate, and ends in a pair of well-shaped anal laminae, which are conical and at right angles to the trunk axis.

The first antenna is slender and three-jointed, the first joint being about twice as long as the following ones. The distal joint is tipped with four setae as in the female, but those of the male are conical in shape and definitely sensory. The second antenna is a much larger appendage, and biramose. The protopod consists of two joints (coxa and basis) of about equal size, followed by a one-jointed, smoothly-rounded endopod and a three-jointed exopod. The second joint of the exopod is furnished with a spiny sensory bulb on its distal posterior margin. This sensory bulb is underneath the claw which tips the exopod, and forms the third joint. If the male exopod is compared with that of the female, the claw on the male appendage must be homologous with the single, large, most lateral spine and the tuft of setae found in the female.

The mouth-cone is large and the upper lip is divided into two parts; there is a proximal larger part and a distal smaller one, divided from each other by a dorsal groove crossing transversely the upper surface of the upper lip. The frontal opening of the mouth-cone is strongly fringed with setae. The first maxilla is large, and reaches the distal tip of the mouth-cone. Its protopod is spindle-shaped, comprising an original two joints, and is tipped with three fingers—exopod, endopod, and an endit from the basis—all of which are one-jointed and tipped with a claw. The second maxilla is two-jointed, sub-chelate, and is the largest of the appendages. It consists of a large swollen basal joint, and a claw-shaped finger which is bent backwards towards the basal joint. The maxilliped is also two-jointed, more slender than the maxilla, and chelate. The chela, however, is not of the ordinary kind, for the basal joint is furnished with a forwardly-directed lobe on its medial margin, against which the claw of the distal joint clasps.

Length of carapace, 0.6 mm. Length of rostrum, 0.07 mm. Length of trunk, 0.6 mm. Length of mouth-cone, 0.27 mm. Length of first antenna, 0.14 mm. Length of second antenna, 0.18 mm. Length of first maxilla, 0.16 mm. Length of second maxilla, 0.25 mm. Length of maxilliped, 0.3 mm.

Brachiella cirrata sp. n.

(Figs. 237-245)

Locality, Host and Record of specimens: 17 females (some with males), including the holotype, from the skin and inside the mouth of a Red Rock Cod (*Physiculus barbatus*); D'Entrecasteaux Channel, Tasmania. Collected by A. M. Olsen, 4.11.1948.

Female: The cephalothorax is especially stout towards the trunk, conical, and tapers towards the tip. The head is pointed towards the tip and covered with a large carapace reaching far down on each side. Dorsally, the axis of the cephalothorax is bent towards the axis of the trunk where the two meet. The trunk is strongly flattened dorso-ventrally, with the side wings bent a little ventrally, much wider than long, and extending forwards like a pair of shoulders along the sides of the cephalothorax. Only two small posterior ventral processes are present, and placed between their bases is a small triangular genital process. Dorso-laterally from the posterior processes there extends a pair of very long egg-strings—longer than the whole copepod, and containing a great number of eggs in from 10 to 12 longitudinal rows.

The first antenna is small, three-jointed, and not swollen at the base as in *B. cirrocauda*. Of the three joints the distal joint is the smallest, and is tipped with some short setae. The second antenna is biramose and, as in most species, is turned down across the frontal margin. Its protopod is two-jointed, although the basal joint is not clearly marked off from the head. The same structure is also tipped with a blunt, swollen but smooth one-jointed endopod, and a small exopod extends from the second joint of the protopod. This exopod is two-jointed, the basal joint being much the larger. The distal joint of the exopod is tipped with a small, tiny claw. The mouth-tube is small, conical, neatly-rounded at the tip, and provided with a very thin upper lip. The mandibles are of the usual shape.

The first maxilla consists of a two-jointed shaft which is considered characteristic, as it has not been seen in other species known to the author. Further, the second joint is furnished with four fingers—exopod, endopod, and two endits from the basis. Each of the fingers is one-jointed, and tipped with a claw. The second maxillae are separated throughout their full length and are of very remarkable build. Each of them consists of four bulbs connected with one another through a thin string. Although not clearly seen, it does appear that the maxillary glands open on the tip of the lower bulbs at the point marked *g*. on figure 239. The largest and most distal of the bulbs of each arm clasp a trumpet-shaped bulla. The marked difference from normal structure exhibited by both the first and second maxillae might tempt some future investigators to establish a new genus for the accommodation of this species. The author, however, feels that this is not absolutely necessary because of the present limited knowledge of the genus *Brachiella*.

The maxillipeds have a very elongated basal joint and, in the female, the claw tipping the second joint is coalesced with that joint. Ventrally from the claw the joint extends into a second smaller claw which, in the male, clasps the chela.

Length of cephalothorax, a little less than 3 mm. Length of trunk, about 2 mm. Width of trunk, 3 mm. Length of posterior processes, 1.2 mm. Length of egg-strings, about 5 mm.

Male: The male is relatively large and clumsy in appearance. The head is at right angles to the body axis, and covered with a distinct dorsal carapace which reaches down aganist the thorax beyond the bend of the neck; no rostrum was present. The trunk is large and oval-shaped, ending in a pair of small anal laminae which are conical and at an angle of 45 degrees to the body axis.

The first antenna is longer than usual, slender and three-jointed. It has a swollen basal joint, and a conical second joint with the tip of the cone cut off from the third joint. The third joint is long and cylindrical, with five thick sensory hairs at the tip. The second antenna is biramose, with a two-jointed protopod of which the coxa, as in the female, is short and with no suture showing its separation from the head. The endopod of the same appendage is a smooth-surfaced, rounded bulb, while the exopod is two-jointed and tipped with a claw. The basal joint is half the diameter of the endopod, but of the same length. The second joint is only one-third the length of the endopod, and the claw is sickle-shaped but relatively delicate. The male mouth-cone is short and the first maxilla reaches to its tip. The maxillae have, as in the female, a two-jointed protopod and four long claw-tipped fingers. The second maxillae are short, stout and three-jointed, with the first two joints shaped into a cone tipped with a sickle-shaped claw.

The male maxilliped is of a special shape. It is long and three-jointed, but between the first and second joints there is found a soft-skinned girdle functioning as a globular joint which enables the distal part to move with the chela in all directions. The second joint is shaped so as to function as the basal part of the sub-chela, against which the margin of the finger of the third joint clasps and fits into a groove on the second joint.

Length of carapace, 0.4 mm. Length of trunk, 0.5 mm. Width of trunk, 0.35 mm.

Brachiella stellifera sp. n.

(Figs. 246-250)

Locality, Host and Record of specimens: Four specimens of both sexes, including the holotype, from the gills of a Toado Fish, *Sphaeroides*; Rockingham, Western Australia. Collected by A. G. Nicholls, 1.2.1943.

Female: The cephalothorax of this relatively large species is stout, cylindrical and of about the same length as the trunk. The head is a little enlarged, with a straight-cut front, and is covered with a carapace. Dorsally the cephalothorax is bent backwards from the trunk, which is elliptical and somewhat elongated. Two short ventral posterior processes are found on the trunk, and between them is a very small genital process. The egg-strings are long—longer than the whole copepod, and contain several rows of eggs.

The first antenna is slender, three-jointed and tipped with a single long seta. The second antenna is stout and bent in front of the head. Its protopod contains a short coxa and a basis which is three times longer. The endopod is a bulb with a diameter greater than that of the protopod, and the shape is somewhat like the cap of a mushroom. The exopod is smaller and two-jointed, with the basal joint much thicker than the distal one. The latter joint is short and cut at the tip, where there is a tuft of long and short setae. The mouth-cone is large and fleshy, with the usual ring of hairs at its tip. The first maxillae are furnished with three fingers, each of them terminating in a claw. The second maxillae are rather short, wrinkled, and bifurcate at their tips. They are separated along their entire length, and at their bases is a semi-globular bulb, the maxillary gland, which opens with two thin tubes leading on to the dorsal side of the cephalothorax close up towards the trunk. The bulla is of very artistic build, somewhat like a flattened cup, with its free margin produced into a circle of radiating rays.

The maxillipeds are large and three-jointed, featuring a big basal joint with a little spine in the middle of its medial margin, and a second joint tipped with a claw. The second joint has ridges on its medial margin behind the claw, which are used for clasping against the basal joint to form a sub-chela.

Length of cephalothorax, 3.5 mm. Length of trunk, 3.5 mm. Length of posterior processes, 2 mm. Length of egg-strings, 7-8 mm.

Male: The head is at right-angles to the body axis, and covered with a large dorsal carapace furnished with a rostrum. The anterior part of the trunk is in the form of a narrow neck or waist, while the posterior part is strongly elongated into an elliptical shape. Anal laminae are absent. The first antenna is long and slender, three-jointed as in the female, and tipped with a single seta. The second antenna has a two-jointed protopod, a smooth bulbous one-jointed endopod, and a two-jointed exopod tipped with three fleshy setae. The mouth-cone has a fleshy upper lip, and on the side of the lower lip the first maxilla is found. The latter has three fingers tipped with claws, of which the exopodal and endopodal claws reach a little in front of the mouth-cone. The second maxilla is small when compared with the maxilliped. It is conical in shape and tipped with a medially-pointing, sickle-shaped claw. The maxilliped is the prehensile organ and is three-jointed, with the two distal joints forming a chela.

Length of cephalothorax, 0.5 mm. Length of trunk, 0.8 mm. Greatest width of trunk, 0.2 mm.

Family Sphyriidae

Genus Sphyrion Cuvier, 1830

Sphyrion laevigatum Guerin

Sphyrion laevigatus Guerin, 1840, p. 11, pl. 9.
Lesteira kroyeri Thomson, 1890, p. 370, pl. 28, figs. 4, 4a.
Sphyrion laevigatum, Stebbing, 1900, p. 60, pl. 4.
Sphyrion australicus Thor, 1900, p. 280.
Sphyrion laevigatum, Wilson, 1919, p. 575.

Locality, Host and Record of specimens: One specimen from a fish (species unknown) caught in the Tasman Sea, east of New South Wales. Presented by D. G. Stead, New South Wales State Fisheries. Australian Museum Reg. No. P. 4,899. One specimen from a Ling Fish, *Genypterus*; Great Australian Bight, South Australia. Australian Museum Reg. No. E. 4,760.

Remarks: This large copepod has a cosmopolitan distribution. It is very closely related to *S. lumpi* Kröyer—so closely that if sufficient young material became available for examination it is likely that the two would prove to be one species. This question of possible synonymy must remain a problem for future investigators.

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EXPLANATION OF FIGURES

Abbreviations

CA — Cephalic area
ECA — Eucephalic area
PCA — Post cephalic area
TA — Thoracic area
LA — Lateral area or lateral wings
FP — Frontal plates
FL — Frontal lunules
PL — Posterior lunules
FS — Free fourth thoracic segment
GS — Genital segment
A — Abdomen
AL — Abdominal or anal lamina
AF — Abdominal furca
C — Coxa
B — Basis
Bu — Bulla
Pe_{1-6} — Pereiopod$_{1-6}$ or first to sixth thoracopods
F — Sternal furca
ES — Egg-strings
A_1 — Antennule or first antenna
A_2 — Second antenna
MD — Mandible
L — Labium or upper lip
LB — Labrum or lower lip
MC — Mouth cone
MX_1 — First maxilla or maxillule
MX_2 — Second maxilla
MXP_1 — First maxillipede
MXP_2 — Second maxillipede
R — Rostrum
MG — Maxillary gland
g — Maxillary gland opening
CT — Cephalothorax
T — Trunk

Figs. 1-3. *Argulus macropterus* sp. n. Fig. 1, dorsal view. Fig. 2, ventral view. Fig. 3, first and second antennae.

Figs. 4-7. *Argulus japonicus* Thiele. Fig. 4, dorsal view. Fig. 5, ventral view. Fig. 6, first and second antennae. Fig. 7, maxilliped.

Figs. 8-13. *Pseudoblias lyrifera*, gen. and sp. n. Fig. 8, dorsal view of female. Fig. 9, same viewed partly from lateral. Figs. 10-11, frontal part of female from dorsal and ventral.

Fig. 12, posterior part of trunk with abdomen and part of egg-string of female. Fig. 13, first antenna.

Figs. 14-19. *Acanthochondria gemina* sp. n. Fig. 14, dorsal view of female. Fig. 15, ventral view of frontal part of female. Fig. 16 abdomen of female with anal laminae. Fig. 17, frontal part of male from dorsal, showing rostrum and first and second antennae. Fig. 18, mouth parts of female. Fig. 19, pygmy male.

Figs. 20-26. *Acanthochondria tasmaniae* sp. n. Fig. 20, dorsal view of female. Fig. 21, ventral view of anterior part of female. Fig. 22, ventral view of posterior part of trunk and abdomen of female. Fig. 23, mouth appendages of female. Fig. 24, first antenna of female. Fig. 25, rostrum and second antenna of male. Fig. 26, male in lateral view.

Figs. 27-36. *Alimeda orientalis* gen. and sp. n. Fig. 27, dorsal view of female. Fig. 28, first antenna. Fig. 29, second antenna. Fig. 30, Labium with mouth-appendages. Fig. 31, detail of mandible, maxilla and first maxilliped. Figs. 32-36, first to sixth pereiopods.

Figs. 37-44. *Caligus alveolaris* sp. n. Fig. 37, dorsal view of female. Fig. 38, dorsal view of male. Fig. 39A, frontal part of male from ventral, showing frontal appendages. Fig. 39B, same of female. Fig. 40, second maxilliped of female. Figs. 41-44, first to fourth thoracopods of female.

Figs. 45-53. *Caligus maculatus* sp. n. Fig. 45, Dorsal view of female. Fig. 46, same of male. Fig. 47, posterior part of young female from dorsal. Fig. 48, frontal part of female with appendages from ventral. Figs. 49-51, second to fourth thoracopods of female. Fig. 52, frontal appendages of male. Fig. 53, posterior part of young male from dorsal.

Figs. 54-61. *Caligus lucidus* sp. n. Fig. 54, dorsal view of female. Fig. 55, frontal section of female from ventral, with appendages. Figs. 56-58, second to fourth thoracopods. Fig. 59, posterior part of male from dorsal. Fig. 60, section of same from ventral, showing fifth and sixth pairs of thoracopods. Fig. 61, Posterior part of young female.

Figs. 62-67. *Caligus dentatus* sp. n. Fig. 62, dorsal view of female. Fig. 63, ventral view of anterior section, showing mouth appendages. Fig. 64, first antenna, with sucking disc enlarged. Figs. 65-67, second to fourth thoracopods.

Figs. 68-74. *Caligus probosci* sp. n. Fig. 68, dorsal view of male. Fig. 69, section of same from ventral, showing mouth appendages. Fig. 70, second maxilliped. Figs. 71-74, first to fourth thoracopods.

Figs. 75-82. *Caligus cincabdominalis* sp. n. Fig. 75, female from dorsal. Fig. 76, section of same from ventral, showing frontal appendages. Figs. 77-78, first and second maxilliped. Figs. 79-82, first to fourth thoracopods.

Figs. 83-91. *Caligus sensoris* sp. n. Fig. 83, dorsal view of female. Fig. 84, mouth appendages, seen from ventral. Figs. 85-88, first to fourth thoracopods. Fig. 89A, male from dorsal. Fig. 89B, posterior part of same. Fig. 90, second antenna of male. Fig. 91, second maxilliped of male.

Figs. 92-98. *Caligus cornutus* sp. n. Fig. 92, dorsal view of male. Fig. 93, dorsal view of young female. Fig. 94, genital segment of male, from ventral. Fig. 95, mouth appendages, from ventral. Figs. 96-98, second to fourth thoracopods.

Figs 99-105 *Caligus obovatus* sp. n. Fig. 99, dorsal view of male. Fig. 100, section of male from ventral, showing mouth-appendages. Fig. 101, second antenna. Figs. 102-105, first to fourth thoracopods.

Figs. 106-115. *Caligus longirostris* sp. n. Fig. 106, dorsal view of female. Fig. 107, same of male. Fig. 108, second antenna and first maxilla of male. Fig. 109, second maxilliped of female. Fig. 110, mouth appendages of female from ventral. Fig. 111, second maxilliped of male. Figs. 112-115, first to fourth thoracopods.

Figs. 116-123. *Lepeophtheirus elongatus* sp. n. Fig. 116, female from dorsal. Fig. 117, first antenna. Fig. 118, mouth appendages. Fig. 119, second maxilliped. Figs. 120-123, first to fourth thoracopods.

Figs. 124-134. *Lepeoptheirus molae* sp. n. Fig. 124, dorsal view of female. Fig. 125, ventral view of frontal section of female, showing mouth-appendages in natural placement. Figs. 126-130, first to sixth thoracopod. Fig. 131, male from dorsal and genital segments, from ventral. Fig. 132, first maxilla of male. Fig. 133, second maxilliped of male. Fig. 134, posterior part of young female.

Figs. 135-144. *Caligulus longispinosus* gen. and sp. n. Fig. 135, dorsal view of female. Fig. 136, dorsal view of male. Fig. 137, mouth-appendages of male. Fig. 138, mouth-appendages of female. Figs. 139-140, first and second maxillipeds. Figs. 141-144, first to fourth thoracopods.

Figs. 145-150. *Tuxophorus cervicornis* sp. n. Fig. 145, dorsal view of female. Fig. 146, mouth-appendages from ventral. Figs. 147-150, first to fourth thoracopods.

Figs. 151-153. *Gloiopotes longicaudatus* (Maricawa). Fig. 151, female from dorsal. Fig. 152, ventral view of frontal section with appendages. Fig. 153, fourth thoracopod.

Figs. 154-161. *Perissopus serratus* sp. n. Fig. 154, female from dorsal. Fig. 155, frontal part from ventral showing appendages. Fig. 156, part of genital segment and abdomen from ventral. Fig. 157, first maxilliped. Figs. 158-161, first to fourth thoracopod.

Figs. 162-172. *Nesippus australis* sp. n. Fig. 162, female from dorsal. Fig. 163, ventral view, with frontal appendages. Fig. 164, first antenna. Fig. 165, first maxilla. Figs. 166-167, first and second maxilliped. Figs. 168-171, first to fourth thoracopods. Fig. 172, abdomen from ventral.

Figs. 173-181. *Nesippus incisus* sp. n. Fig. 173A, female from dorsal. Fig. 173B, young undeveloped female. Fig. 175, frontal appendages. Fig. 176, second antenna. Fig. 177, first maxilliped. Figs. 178-181, first to fourth thoracopods.

Figs. 182-190. *Paracycnus lobosus* gen. and sp. n. Fig. 182, dorsal view of female. Figs. 183-185, ventral, dorsal and lateral views of head. Fig. 186, posterior part from ventral. Figs. 187-188, first and second antennae. Fig. 189, second maxilliped. Fig. 190, first thoracopod.

Figs. 191-200. *Hyponeo australis* gen. and sp. n. Fig. 191, female from dorsal. Fig. 192, female from ventral. Fig. 193, ventral view of frontal part, showing appendages. Fig. 194, first antenna. Fig. 195, second antenna. Fig. 196, mouth tube with mandibles. Fig. 197, maxilla. Figs. 198-199, first maxilliped. Fig. 200, second maxilliped.

Fig. 201. *Nemesis lamna* Risso. Female from dorsal.

Figs. 202-206. *Hatschekia elongata* sp. n. Fig. 202, female from dorsal. Fig. 203, first antenna. Fig. 204, second antenna. Fig. 205, maxilla. Fig. 206, maxilliped.

Figs. 207-208. *Lernaeenicus hemiramphi* Kirtisinghe. Fig. 207, female from lateral.

Fig. 208, ventral view of head and anterior part of neck.

Fig. 209. *Lernaeolophus sultanus* Nordman, head of female.

Figs. 210-213. *Pennella remorae* Murray. Fig. 210, female. Fig. 211, frontal part from ventral. Fig. 212, rostrum and second antenna. Fig. 213, first to fourth thoracopods.

Figs. 214-220. *Trifur physiculi* sp. n. Fig. 214, female in total. Figs. 215-218, head with horns and anterior part of neck from different angles. Figs. 219, dorsal view of rostrum, first and second antennae. Fig. 220, third and fourth thoracopods.

Figs. 221-224. *Lernaeopodella major* gen. and sp. n. Fig. 221, female from lateral.

Fig. 222, frontal part of head from ventral. Fig. 223, maxillipeds. Fig. 224, ventral view of posterior part of trunk, with genital process, beginning of posterior processes, and egg-strings.

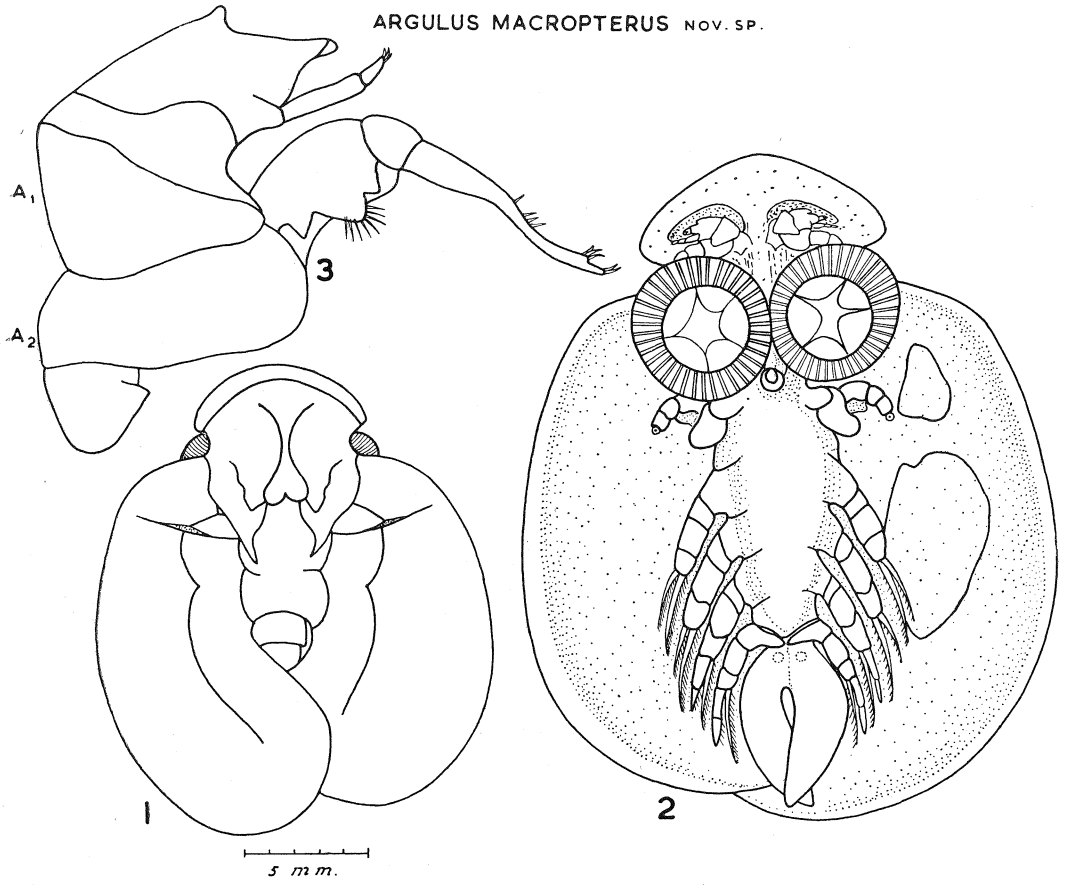
Figs. 225-232. *Tracheliastes chimaerae* sp. n. Fig. 225, female from dorsal. Fig. 226, tip of mouth cone. Fig. 227, young female. Fig. 228, head of young female. Fig. 229, second antenna of same. Fig. 230, maxilliped of female. Fig. 231, male in lateral view. Fig. 232, second antenna of male.

Figs. 233-236. *Brachiella cirrocauda* sp. n. Fig. 233, female. Fig. 234, frontal part of head from ventral. Fig. 235, male. Fig. 236, frontal part of male.

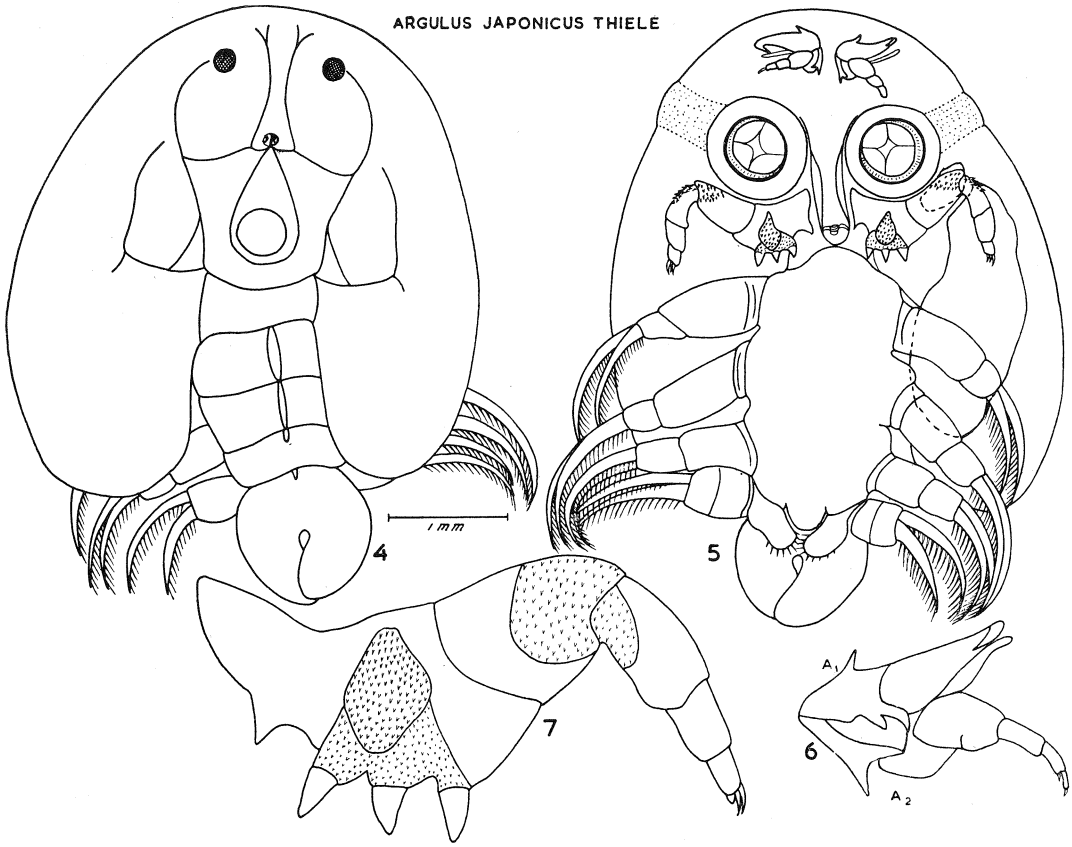
Figs. 237-245. *Brachiella cirrata* sp. n. Fig. 237, female. Fig. 238, frontal part of head from ventral. Fig. 239, detail of second maxilla. Fig. 240, posterior part of trunk, with genital process and posterior processes from dorsal. Fig. 241, male from lateral. Fig. 242, first antenna of male. Fig. 243, second antenna of male. Fig. 244, maxilla of male. Fig. 245, maxilliped of male.

Figs. 246-250. *Brachiella stellifera* sp. n. Fig. 246, female. Fig. 247, frontal part of head from ventral. Fig. 248, detail of second maxilla with bulla and maxillary gland. Fig. 249, male. Fig. 250, frontal part of head of male.

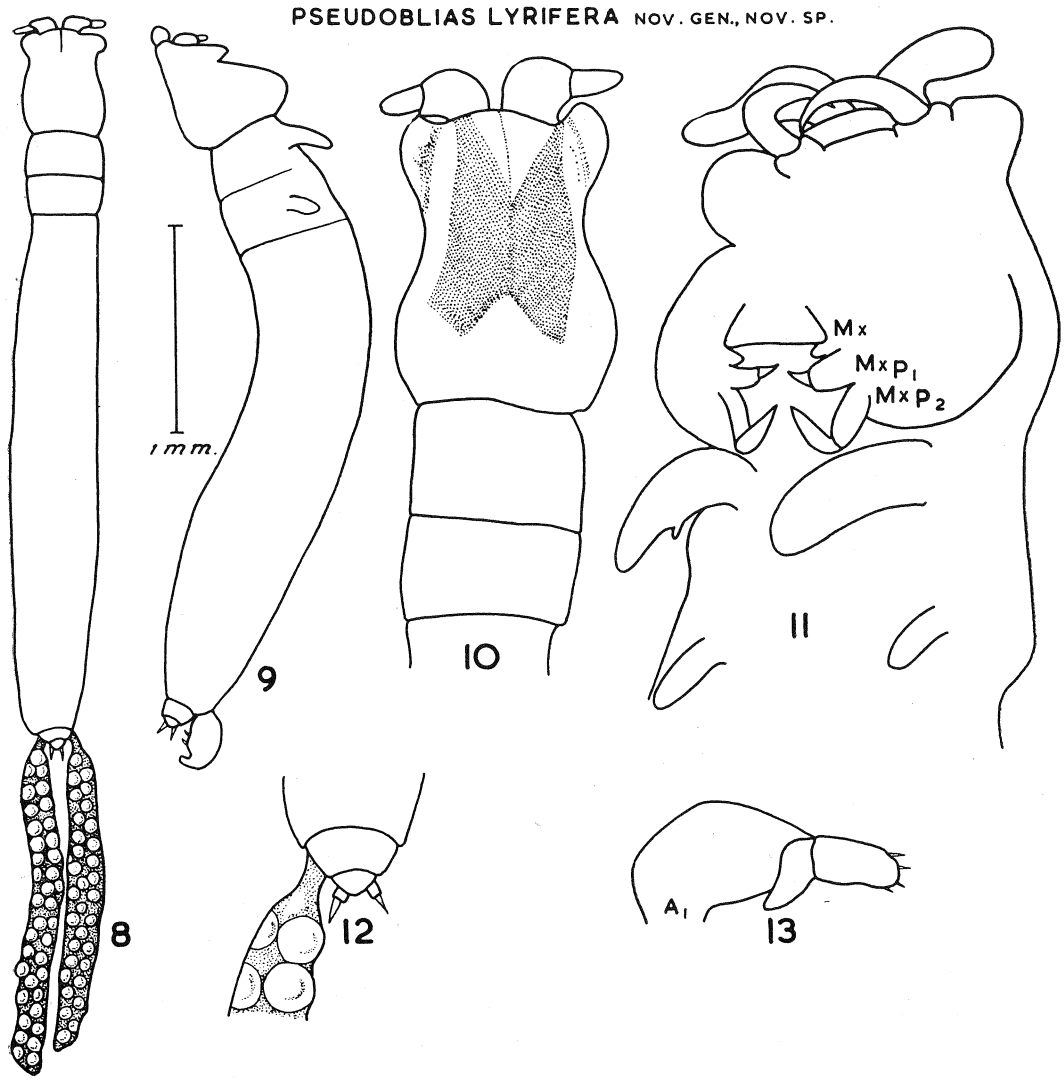
Sydney: V. C. N. Blight, Government Printer—1962



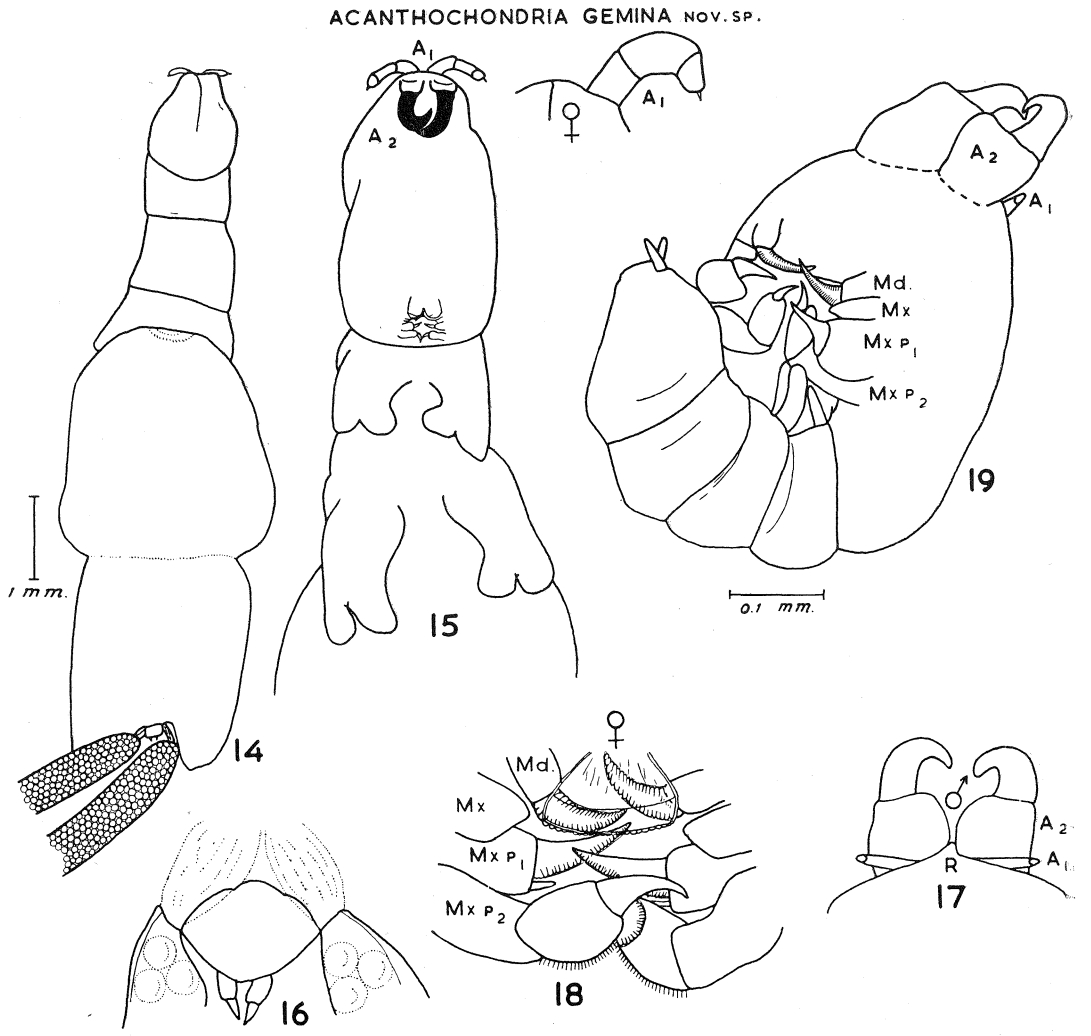
Figs. 1-3



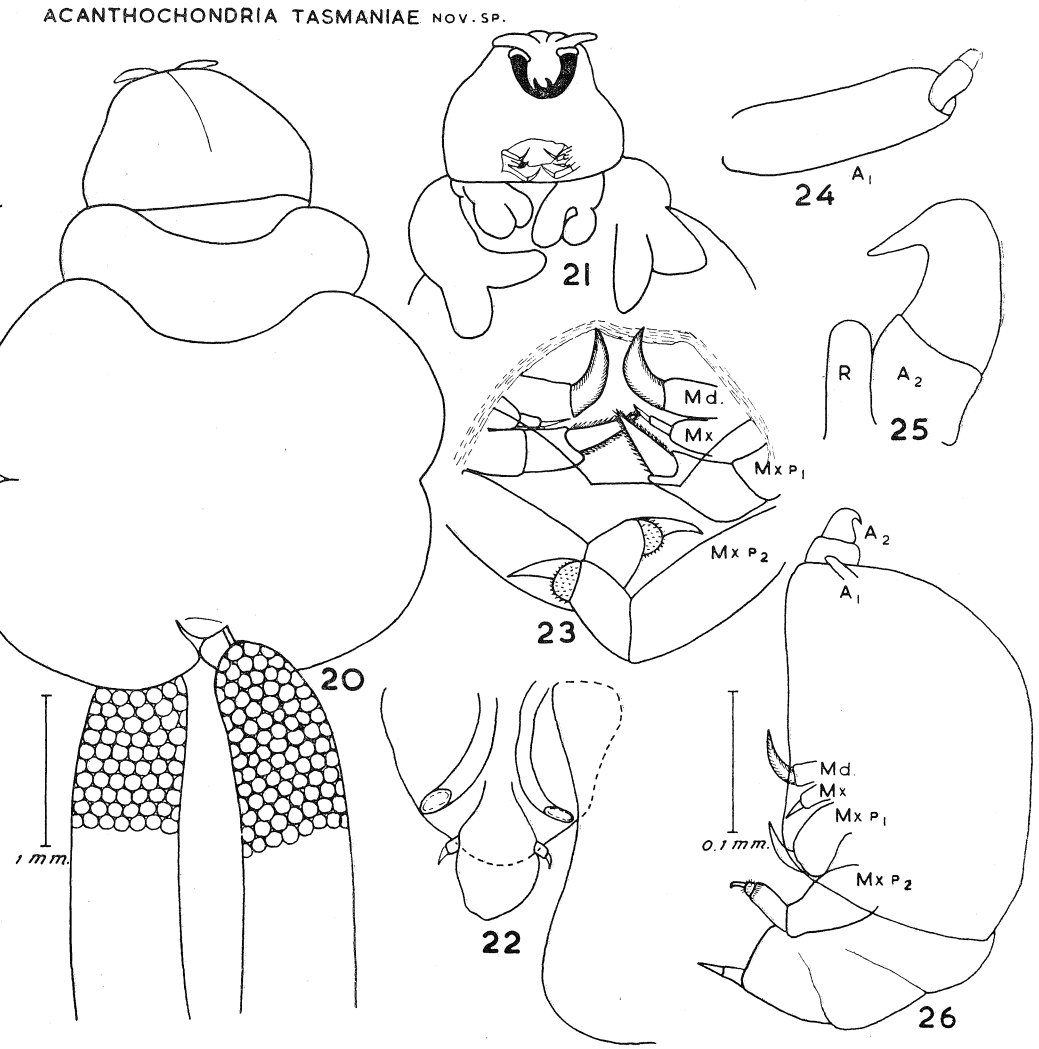
Figs. 4-7


PSEUDOBLIAS LYRIFERA NOV. GEN., NOV. SP.
1 mm.
8
9
10
Mx
MxP1
MxP2
11
12
A1
13

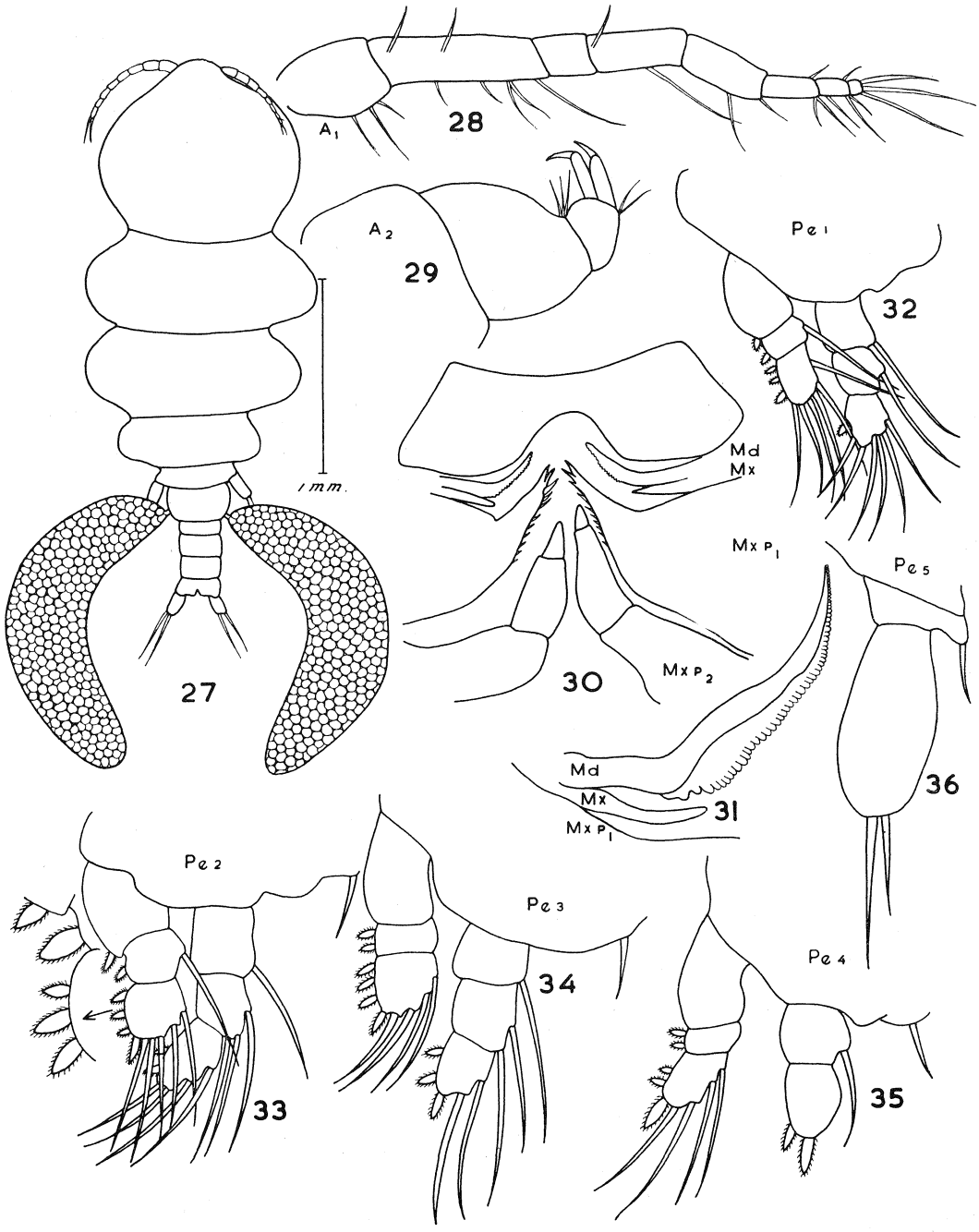
Figs. 8-13


ACANTHOCHONDRIA GEMINA NOV. SP.
A1
A2
A1
♀
A2
A1
Md.
Mx
Mx P1
Mx P2
19
0.1 mm.
1 mm.
15
14
♀
Md.
Mx
Mx P1
Mx P2
18
♂
A2
A1
R
17
16

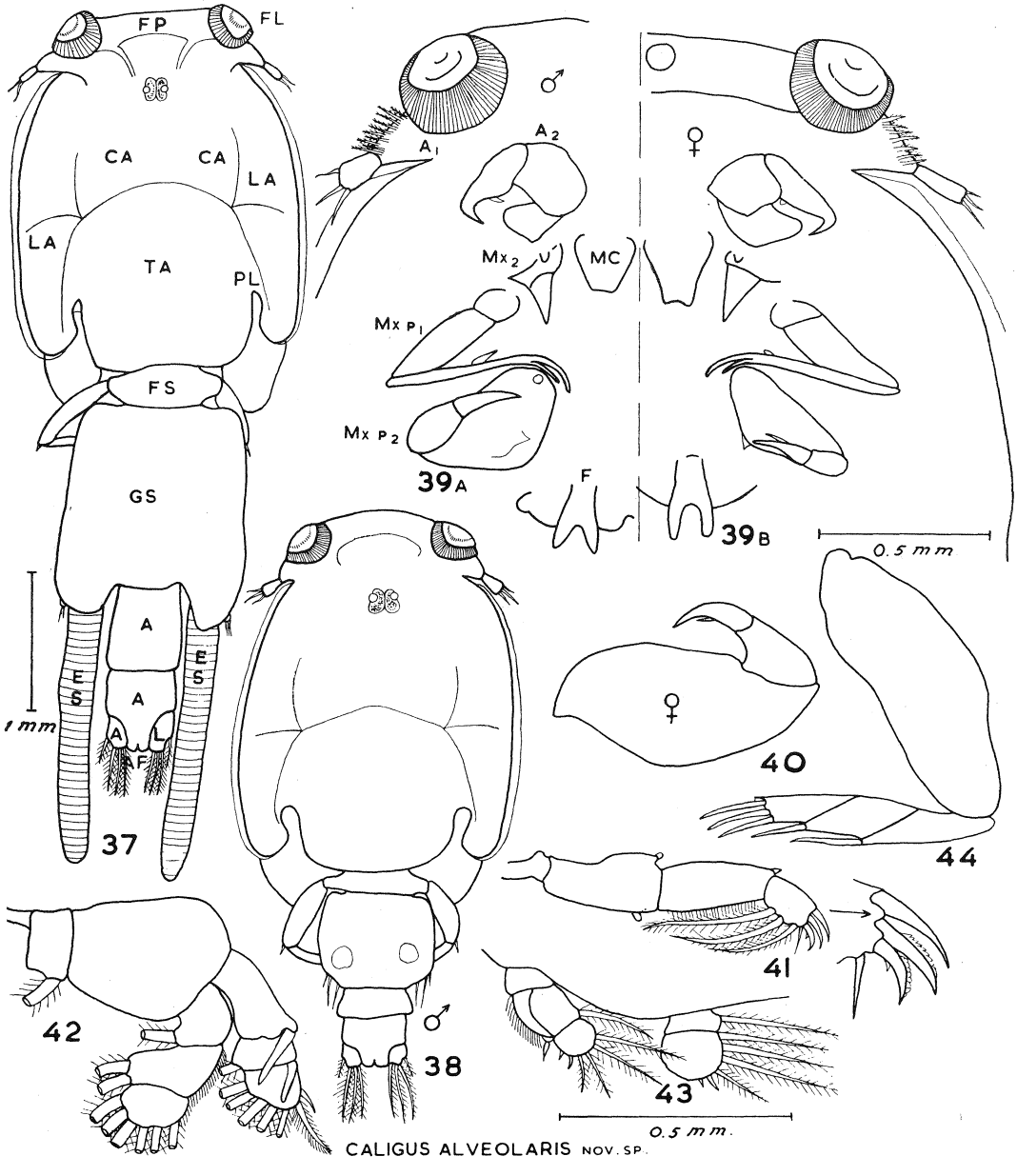
Figs. 14-19


ACANTHOCHONDRIA TASMANIAE NOV. SP.
20
1 mm.
21
22
23
Md.
Mx
Mx P1
Mx P2
24
A1
25
R
A2
26
A2
A1
Md.
Mx
Mx P1
Mx P2
0.1 mm.

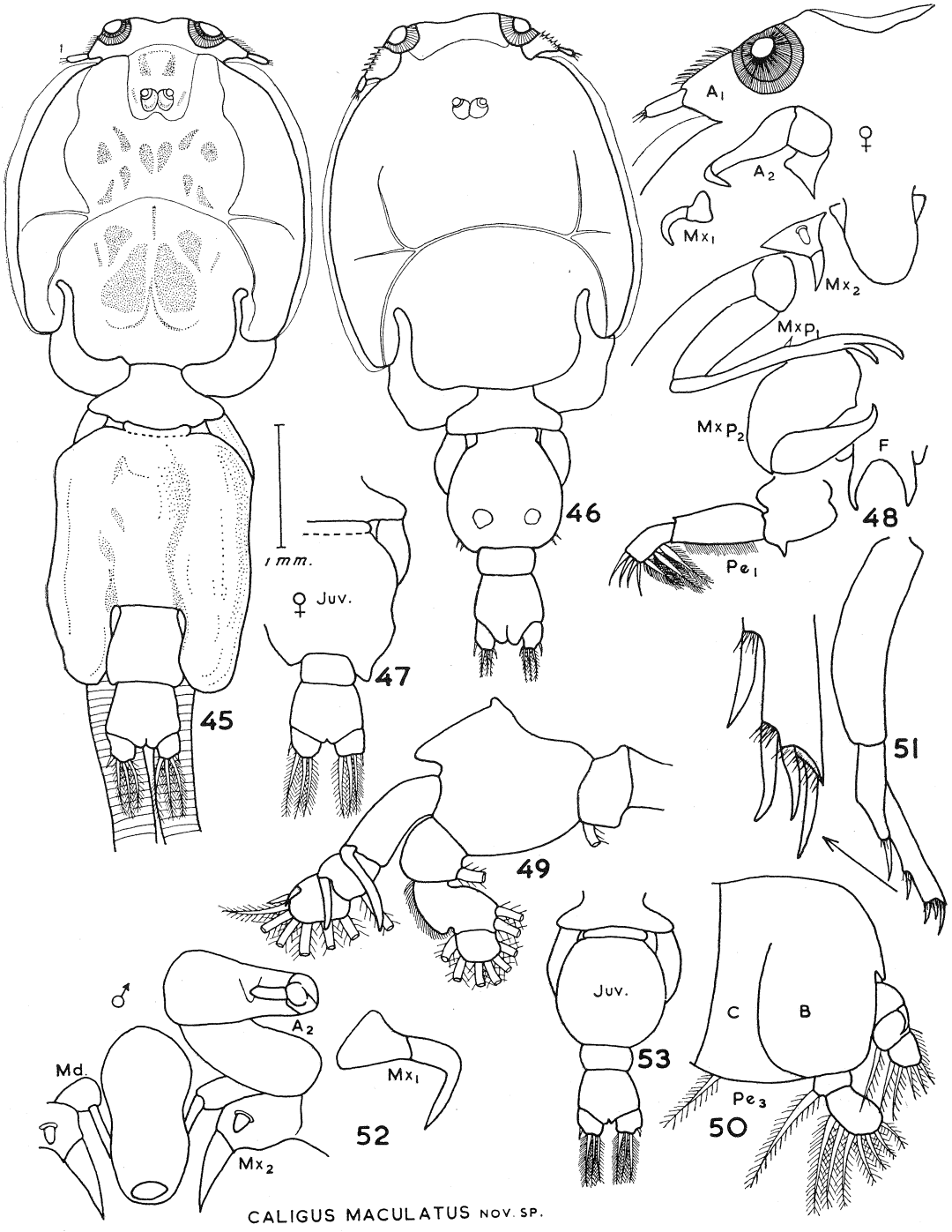
Figs. 20-26


A1
28
A2
29
Pe1
32
1 mm.
Md
Mx
MxP1
Pe5
27
30
MxP2
Md
Mx
MxP1
31
36
Pe2
Pe3
34
Pe4
33
35

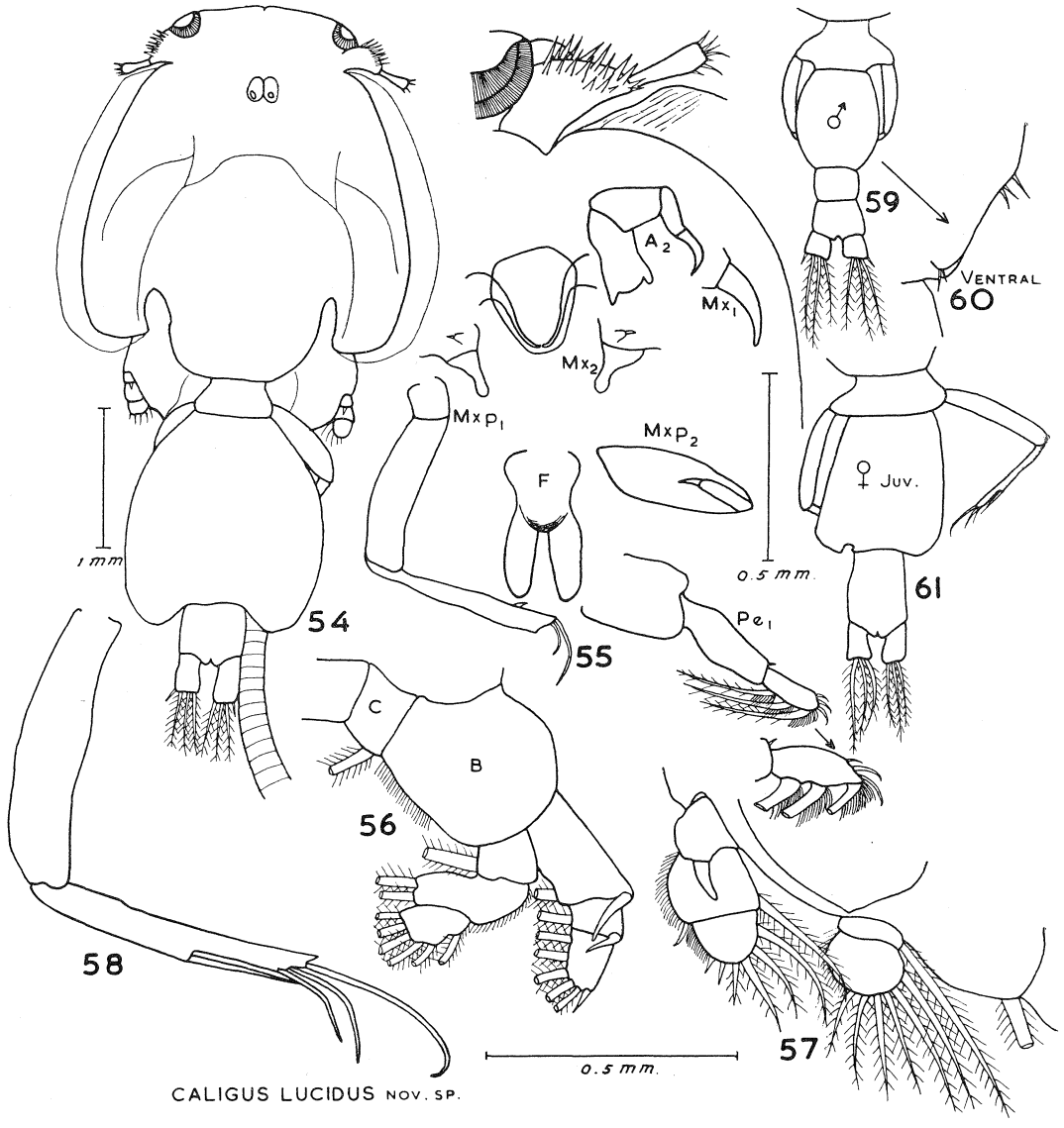
Figs. 27-36


FP
FL
CA
CA
LA
LA
TA
PL
FS
GS
A
ES
ES
A
A
L
F
1 mm
37
A1
A2
Mx2
U
MC
Mx P1
Mx P2
39A
F
39B
0.5 mm
40
44
41
42
38
43
0.5 mm.
CALIGUS ALVEOLARIS NOV. SP.

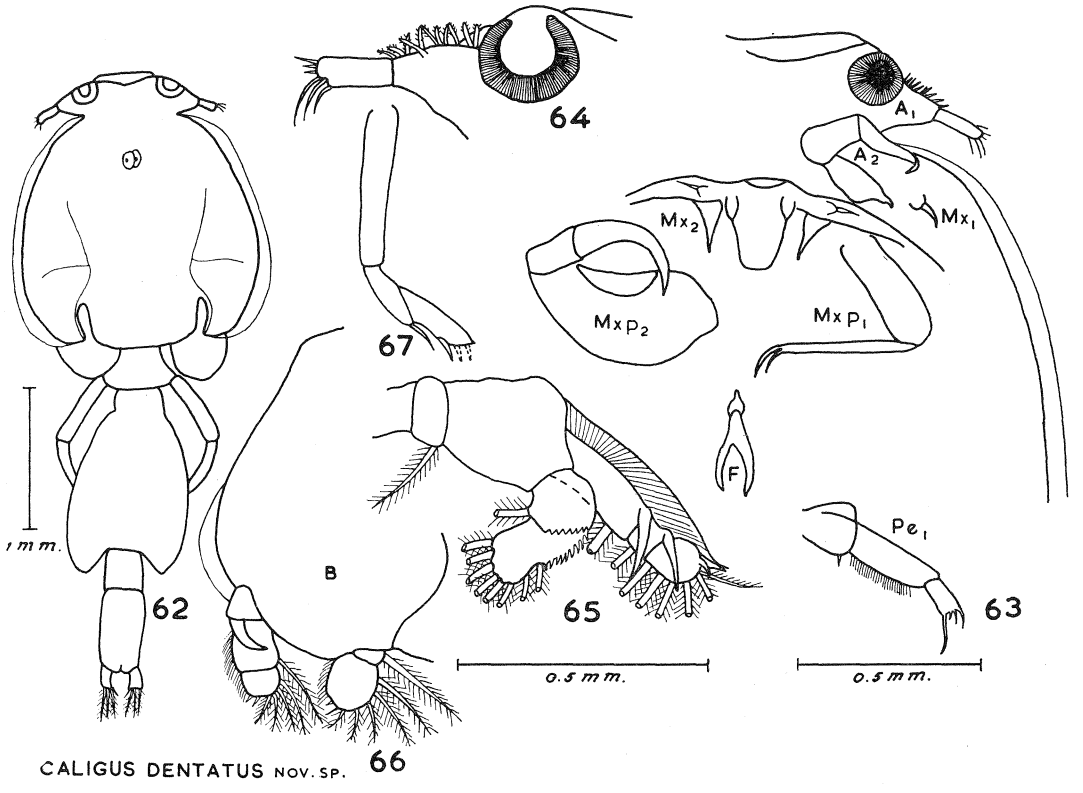
Figs. 37-44


A1
A2
♀
Mx1
Mx2
MxP1
MxP2
F
Pe1
46
48
1 mm.
♀ Juv.
47
45
49
51
Juv.
53
C
B
Pe3
50
♂
A2
Md.
Mx1
52
Mx2
CALIGUS MACULATUS NOV. SP.

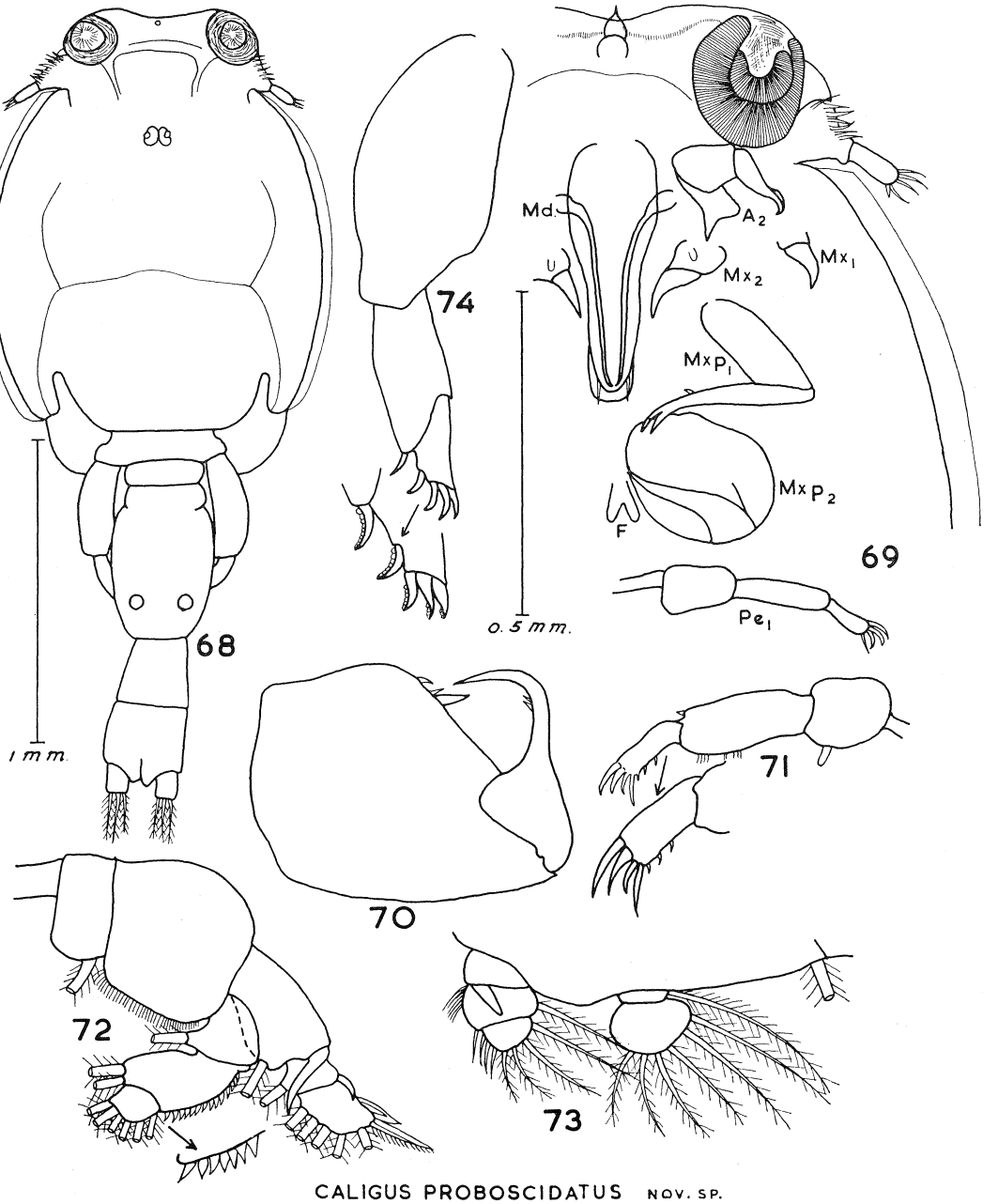
Figs. 45-53


1 mm
54
55
56
57
58
59
60
61
A2
Mx1
Mx2
MxP1
MxP2
F
Pe1
C
B
♂
♀ Juv.
VENTRAL
0.5 mm.
0.5 mm.
CALIGUS LUCIDUS NOV. SP.

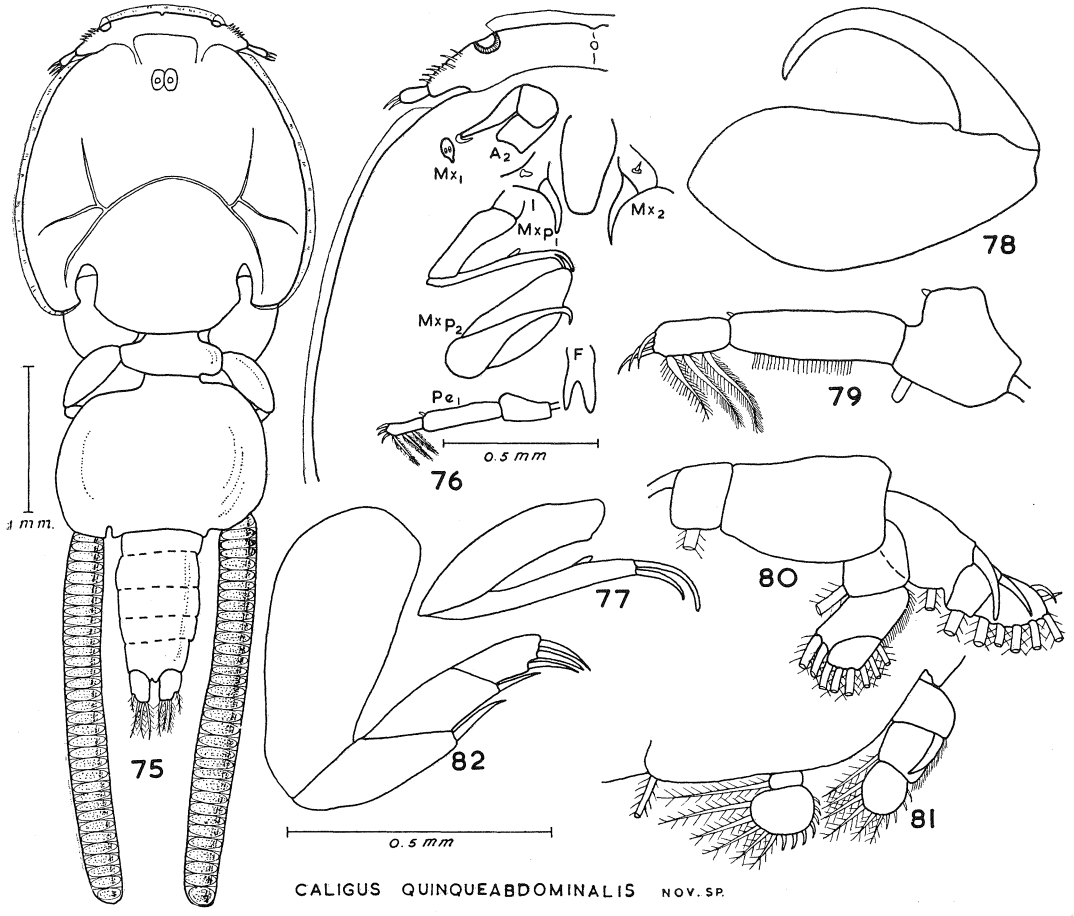
Figs. 54-61


64
A1
A2
Mx2
Mx1
MxP2
MxP1
67
F
1 mm.
62
B
65
Pe1
63
0.5 mm.
0.5 mm.
66
CALIGUS DENTATUS NOV. SP.

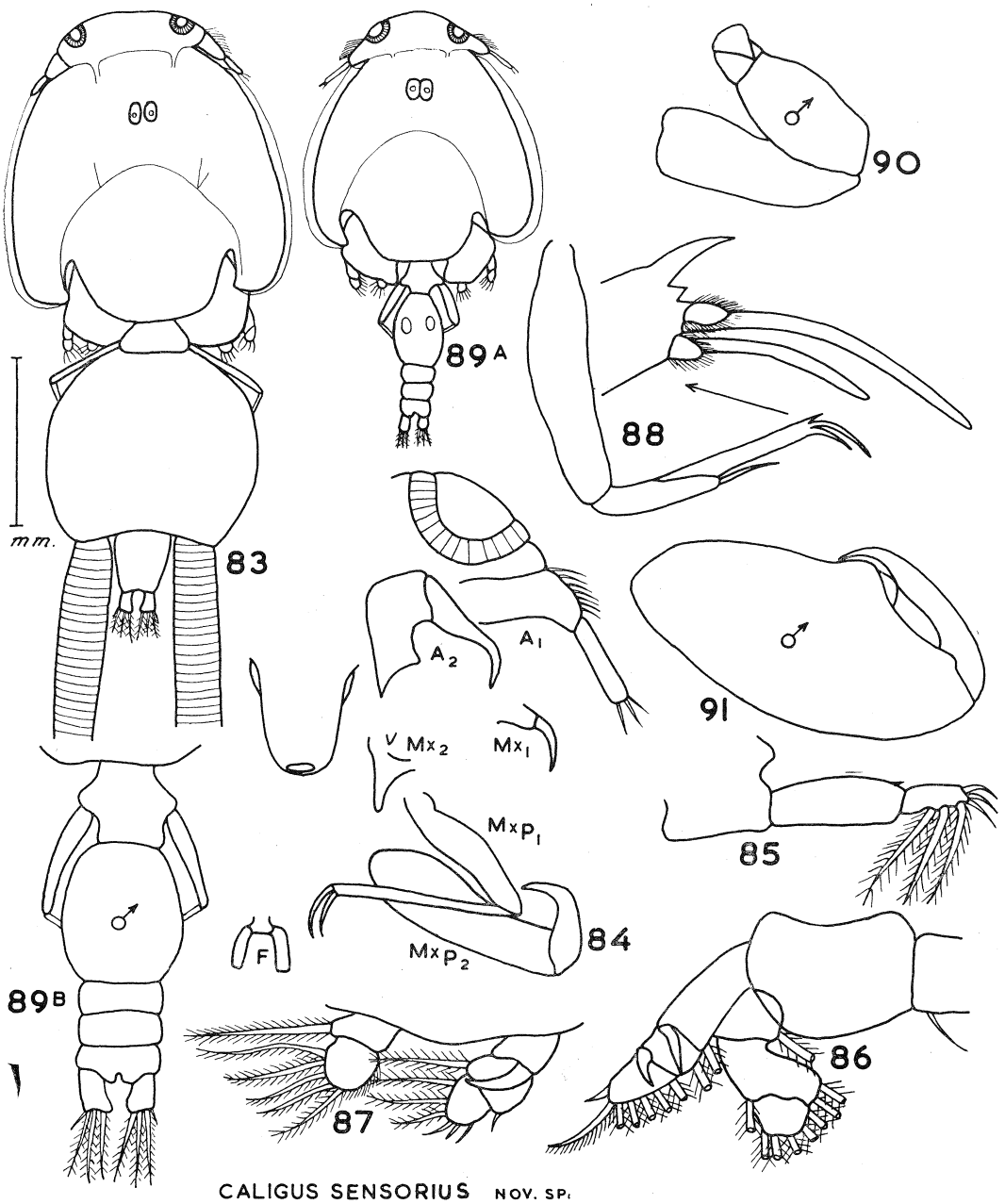
Figs. 62-67


Md
A2
Mx1
Mx2
MxP1
MxP2
F
69
Pe1
74
0.5 mm.
68
1 mm.
70
71
72
73
CALIGUS PROBOSCIDATUS NOV. SP.

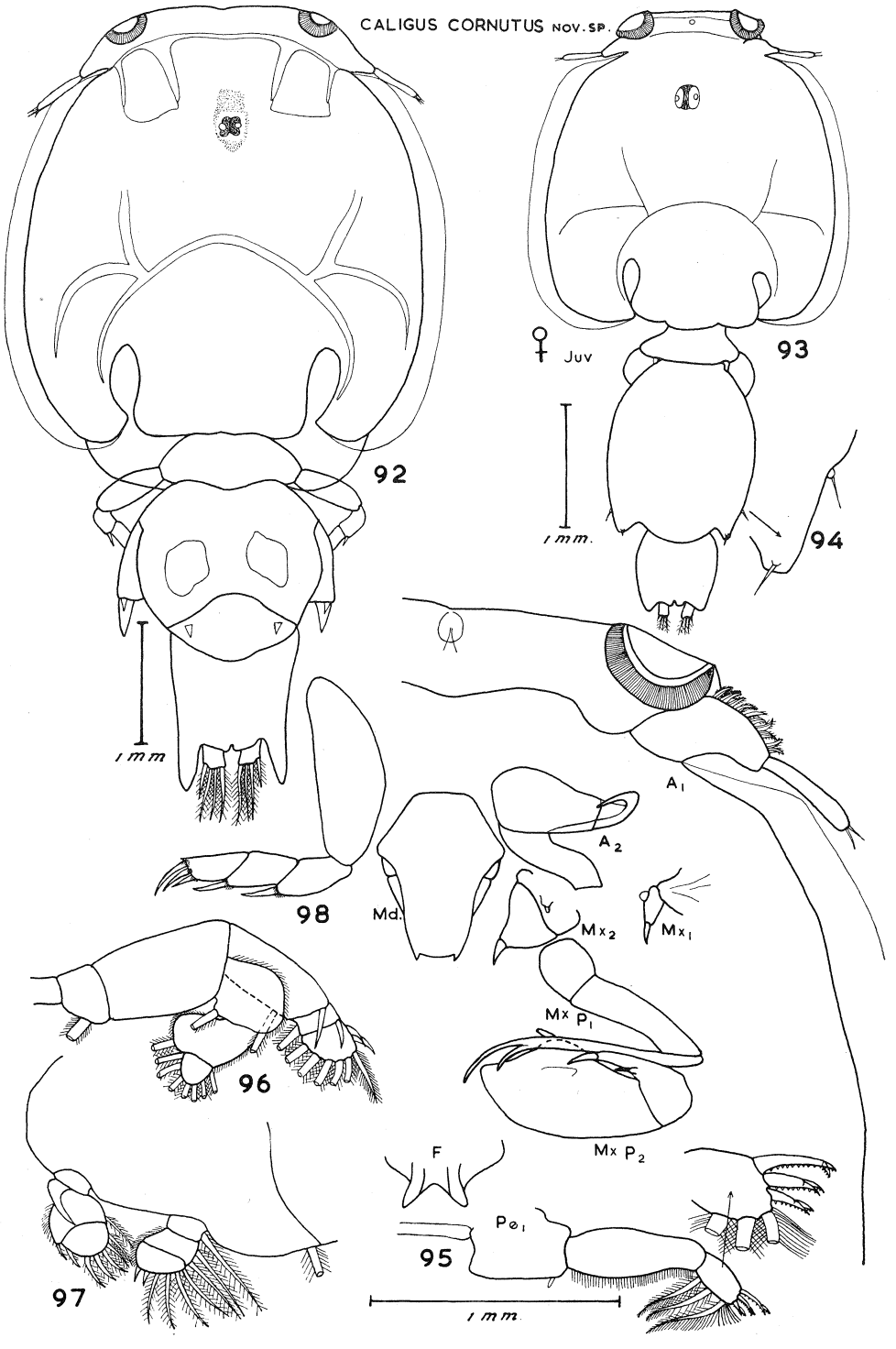
Figs. 68-74


1 mm.
75
Mx1
A2
Mx2
Mxp1
Mxp2
F
Pe1
0.5 mm
76
78
79
77
80
82
81
0.5 mm
CALIGUS QUINQUEABDOMINALIS NOV. SP.

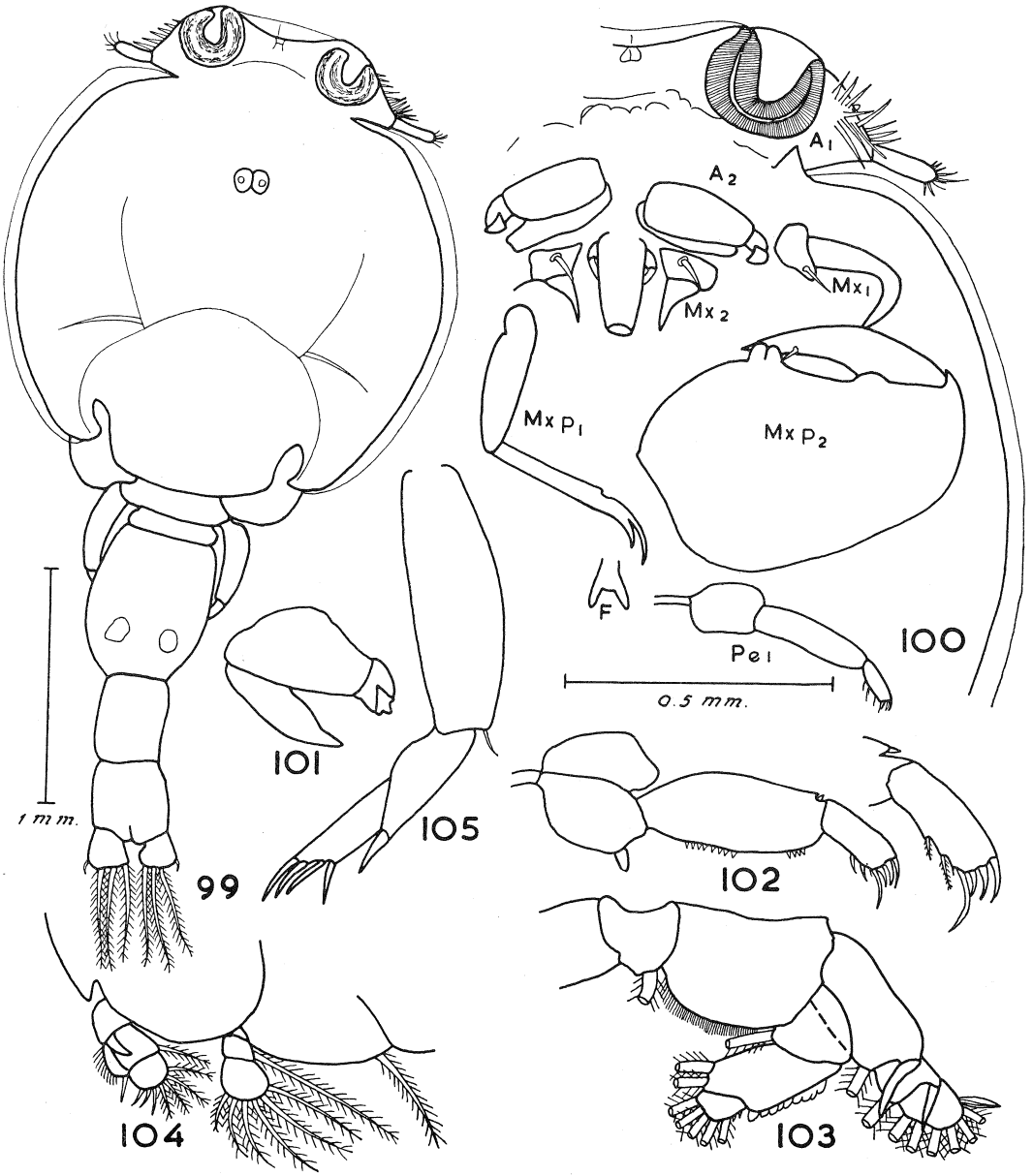
Figs. 75-82


mm.
83
89A
88
90
A2
A1
MxP1
MxP2
84
F
87
91
85
86
89B
CALIGUS SENSORIUS NOV. SP.

Figs. 83-91

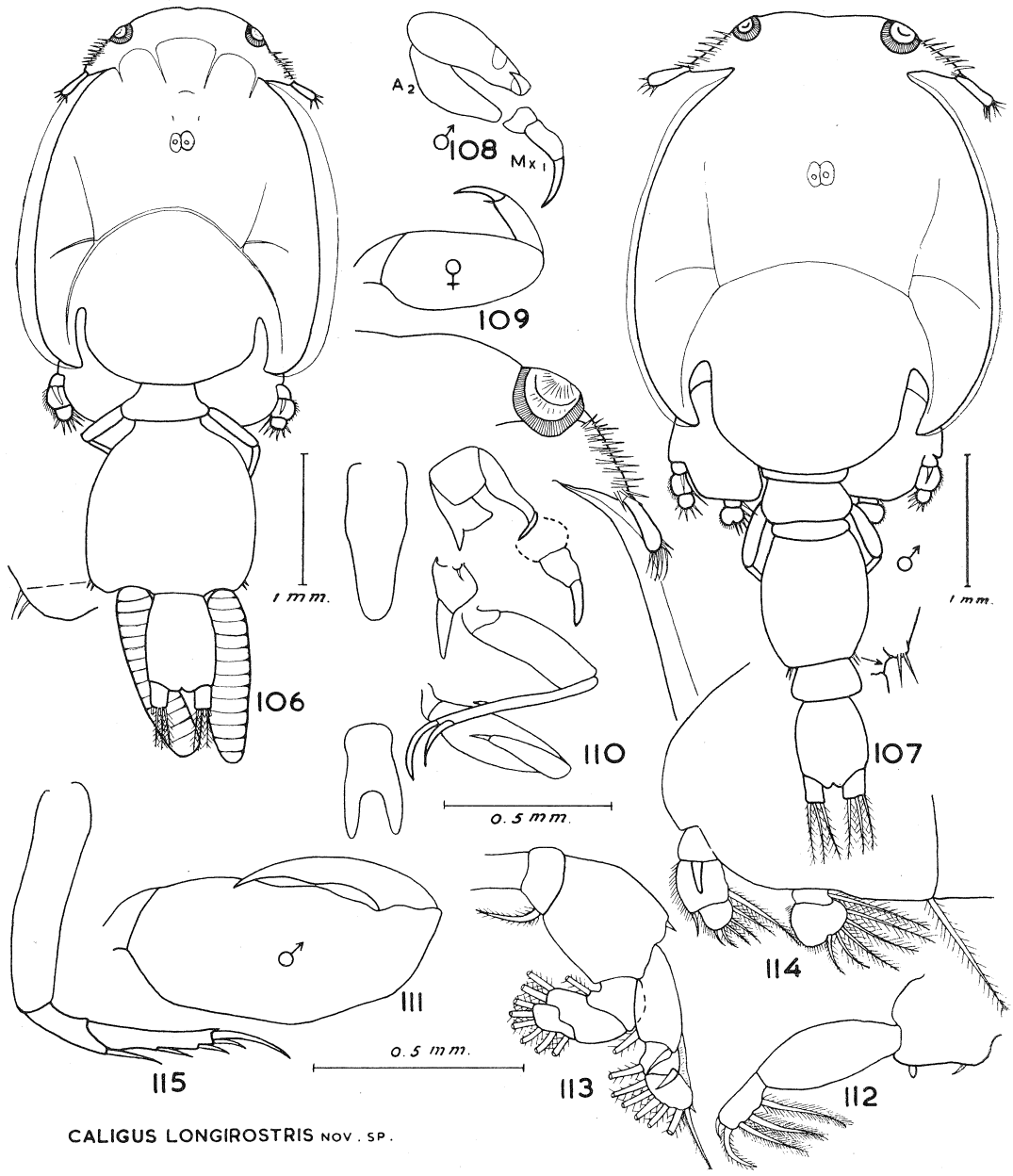

CALIGUS CORNUTUS NOV. SP.
92
♀ Juv
93
1 mm.
94
1 mm
98
A1
A2
Md.
Mx2
Mx1
Mx P1
Mx P2
96
F
Pe1
95
97
1 mm.

Figs. 92-98

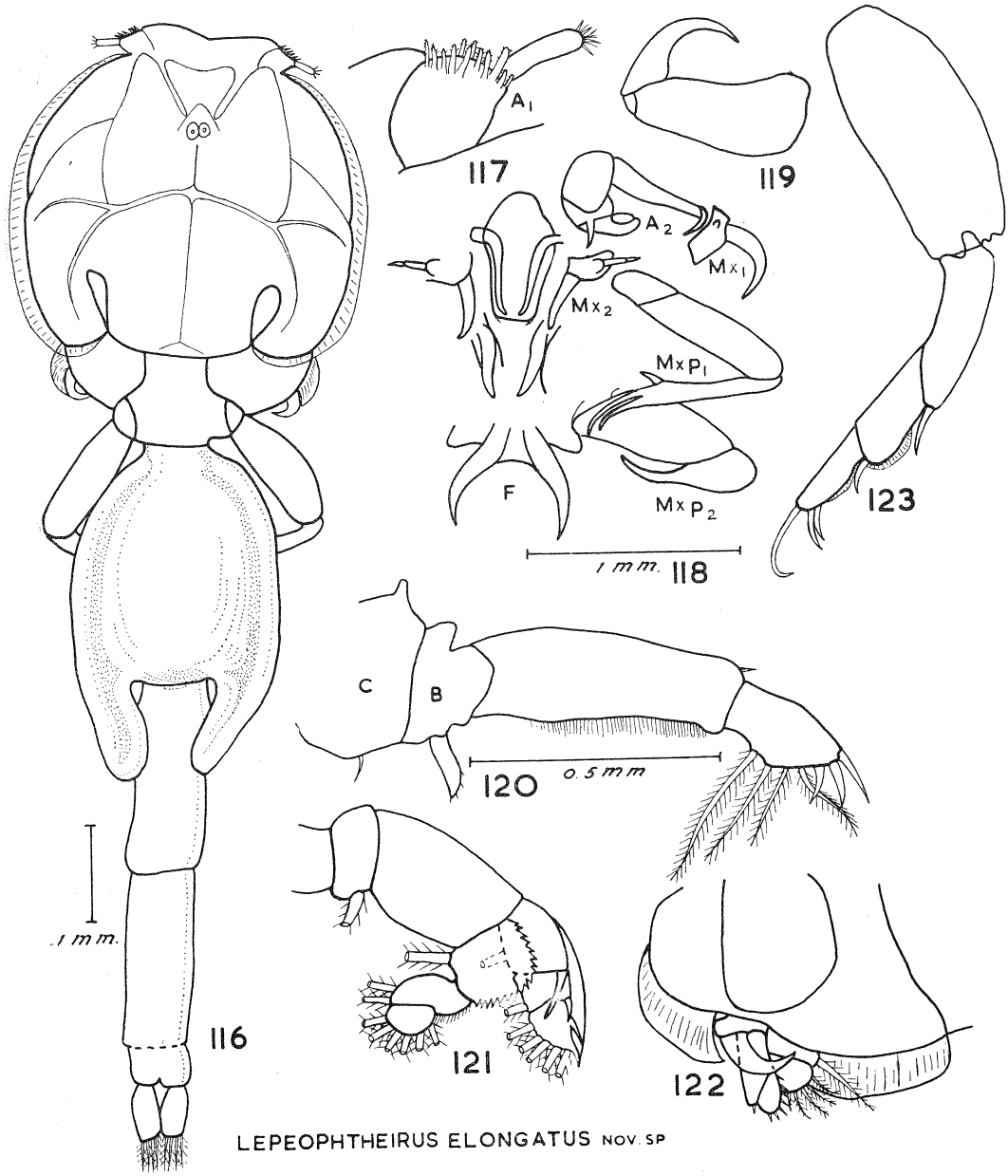


CALIGUS OBOVATUS NOV. SP.

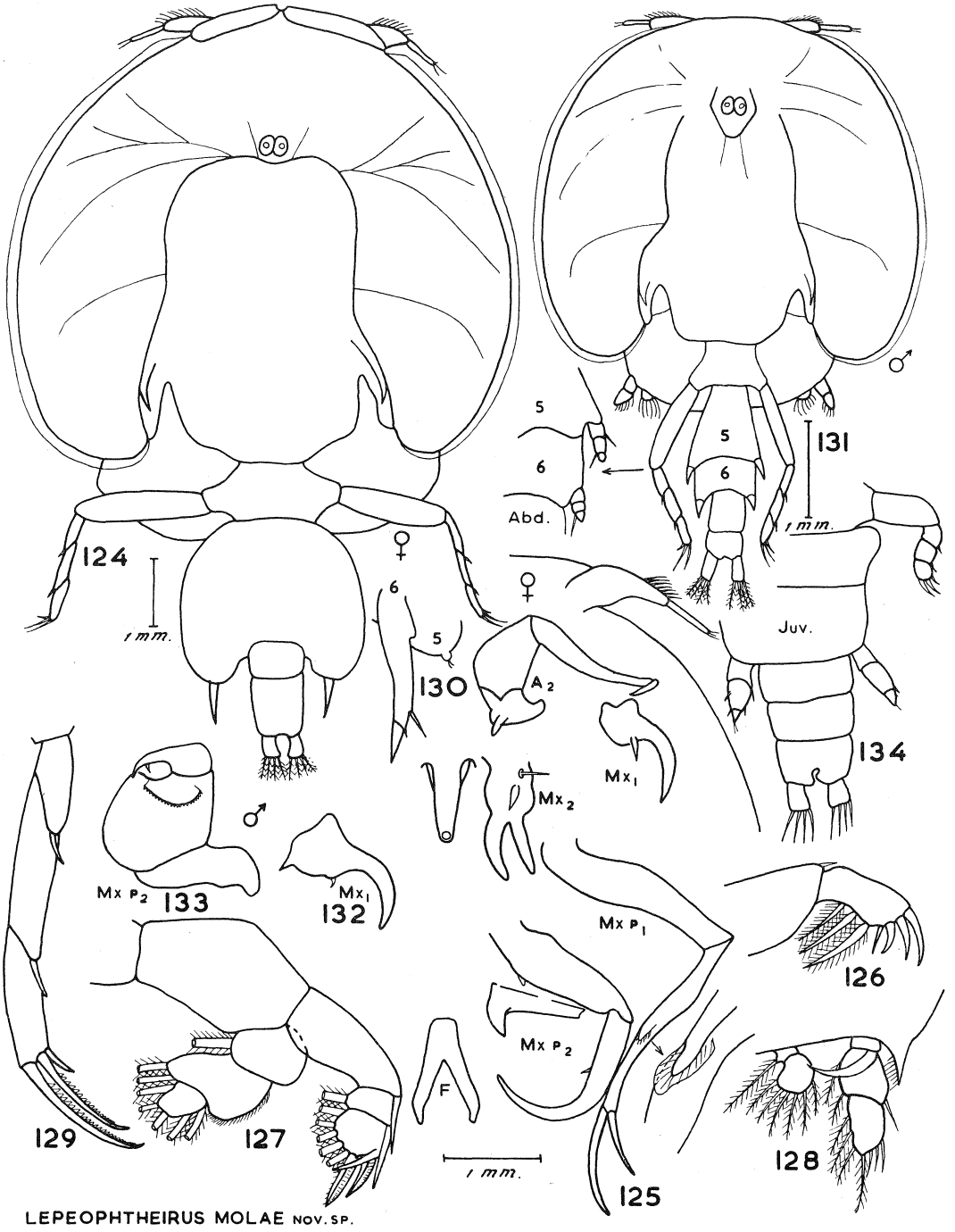
Figs. 99-105


A2
♂108
Mx1
♀
109
1 mm.
106
110
0.5 mm.
♂
107
1 mm.
111
0.5 mm.
115
113
114
112
CALIGUS LONGIROSTRIS NOV. SP.

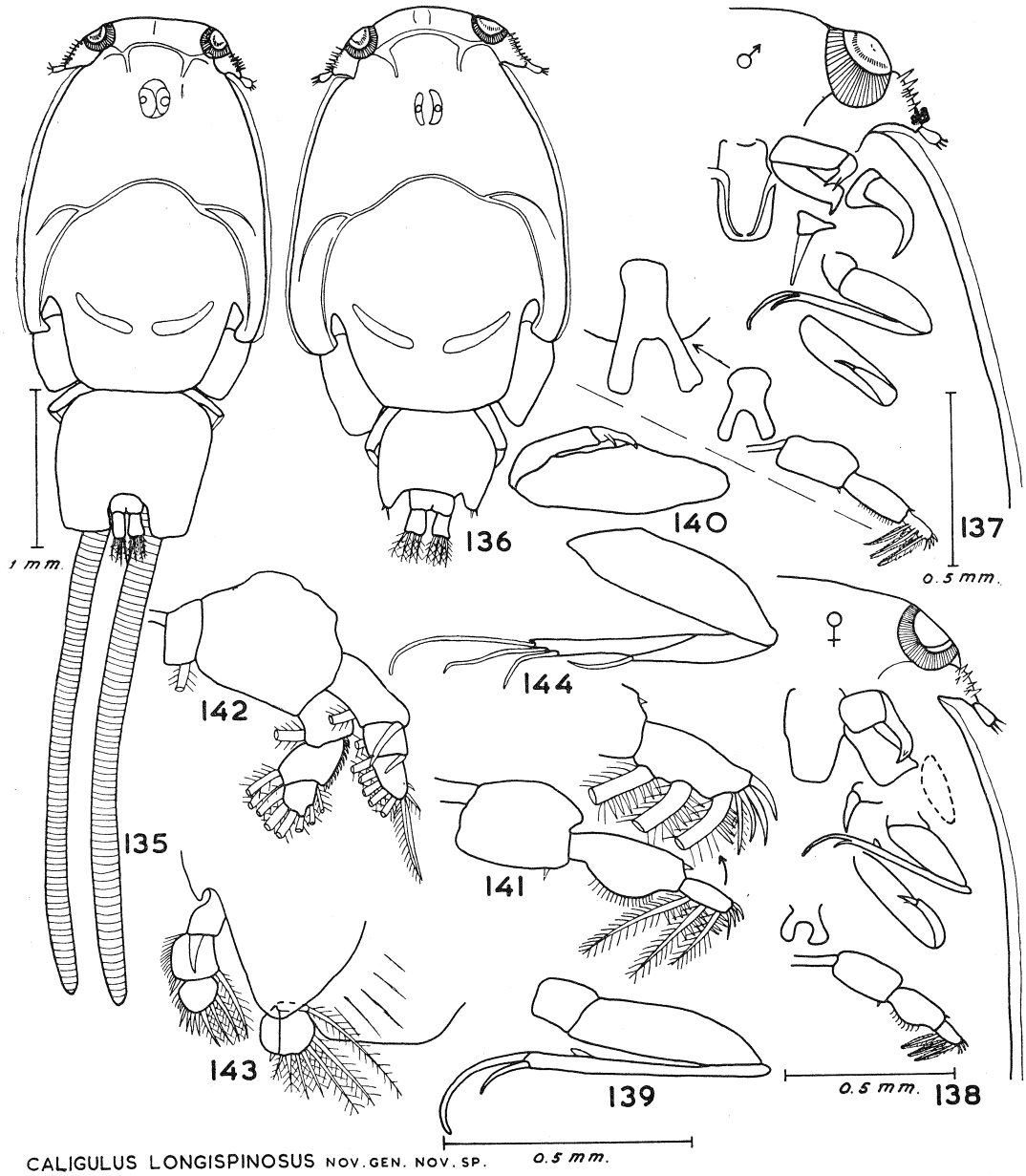
Figs. 106-115


A1
117
119
A2
MX1
MX2
MXP1
MXP2
F
123
1 mm. 118
C
B
120
0.5 mm
1 mm.
116
121
122
LEPEOPHTHEIRUS ELONGATUS NOV. SP

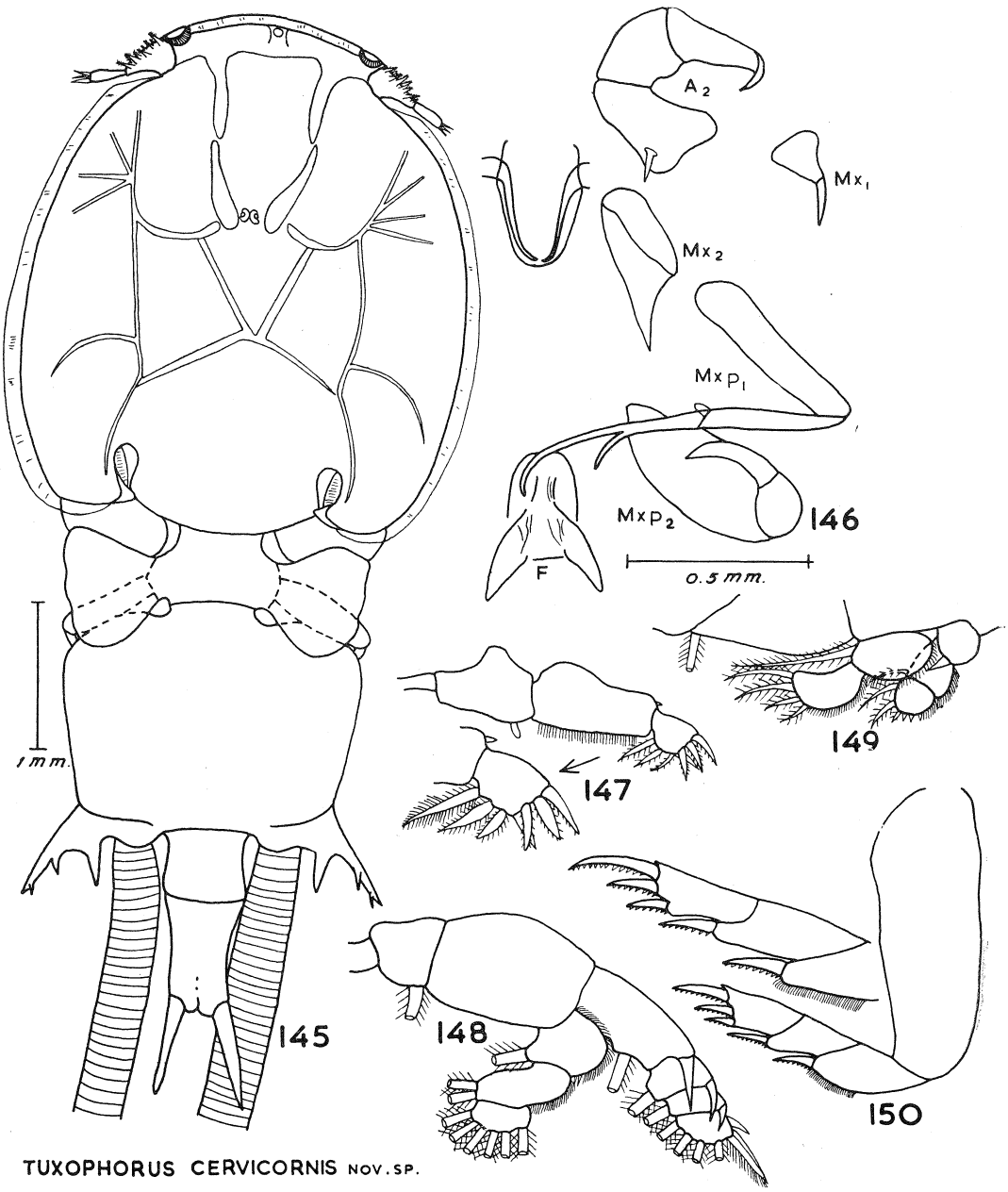
Figs. 116-123


124
1 mm.
♀
6
5
130
A2
Mx1
Mx2
♂
Mx P2
133
Mx1
132
129
127
F
1 mm.
Mx P1
Mx P2
125
126
128
5
6
Abd.
♂
5
6
131
1 mm.
♀
Juv.
134
LEPEOPHTHEIRUS MOLAE NOV. SP.

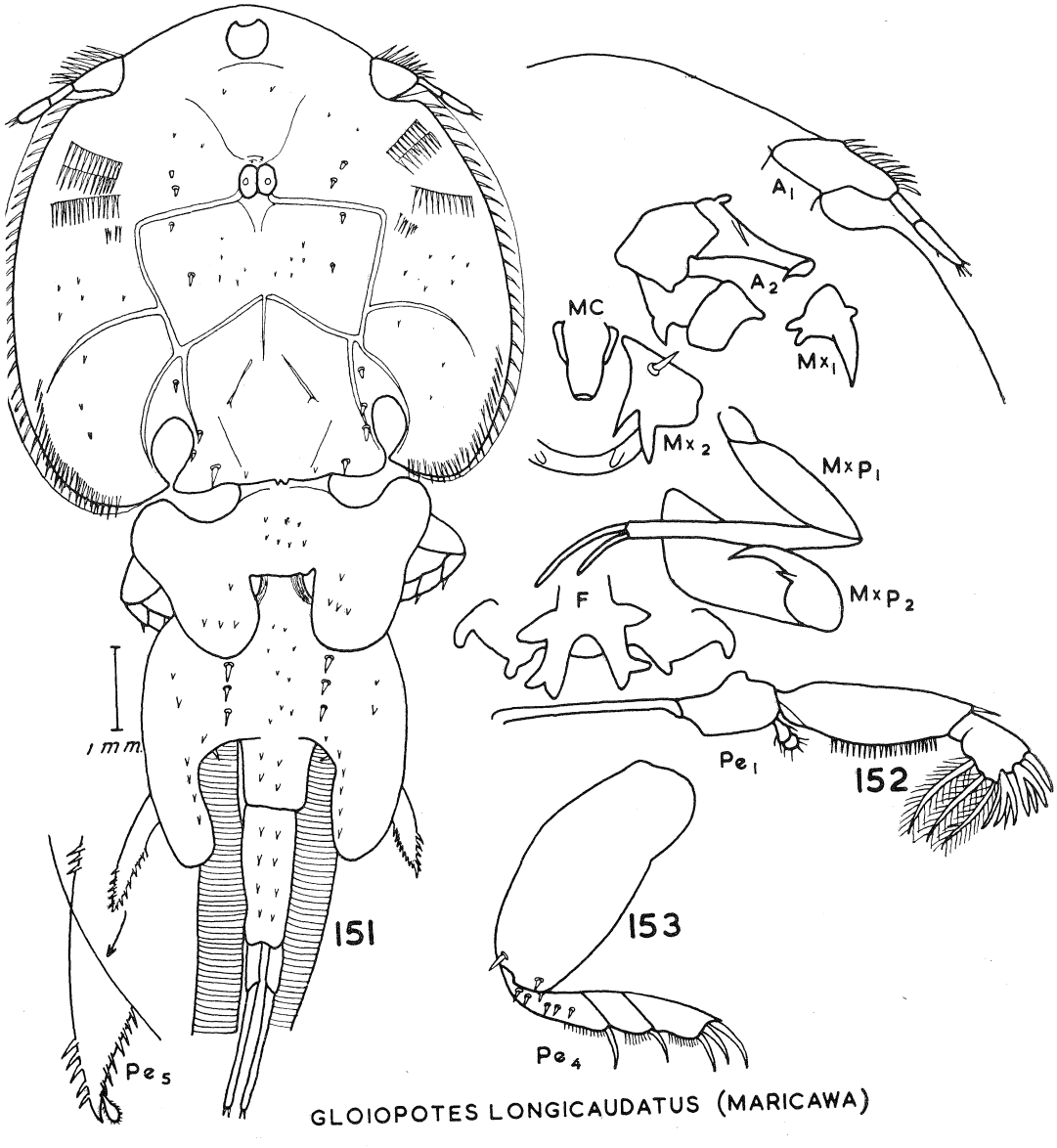
Figs. 124-134


♂
♀
136
137
138
139
140
141
142
143
144
135
1 mm.
0.5 mm.
0.5 mm.
0.5 mm.
CALIGULUS LONGISPINOSUS NOV. GEN. NOV. SP.

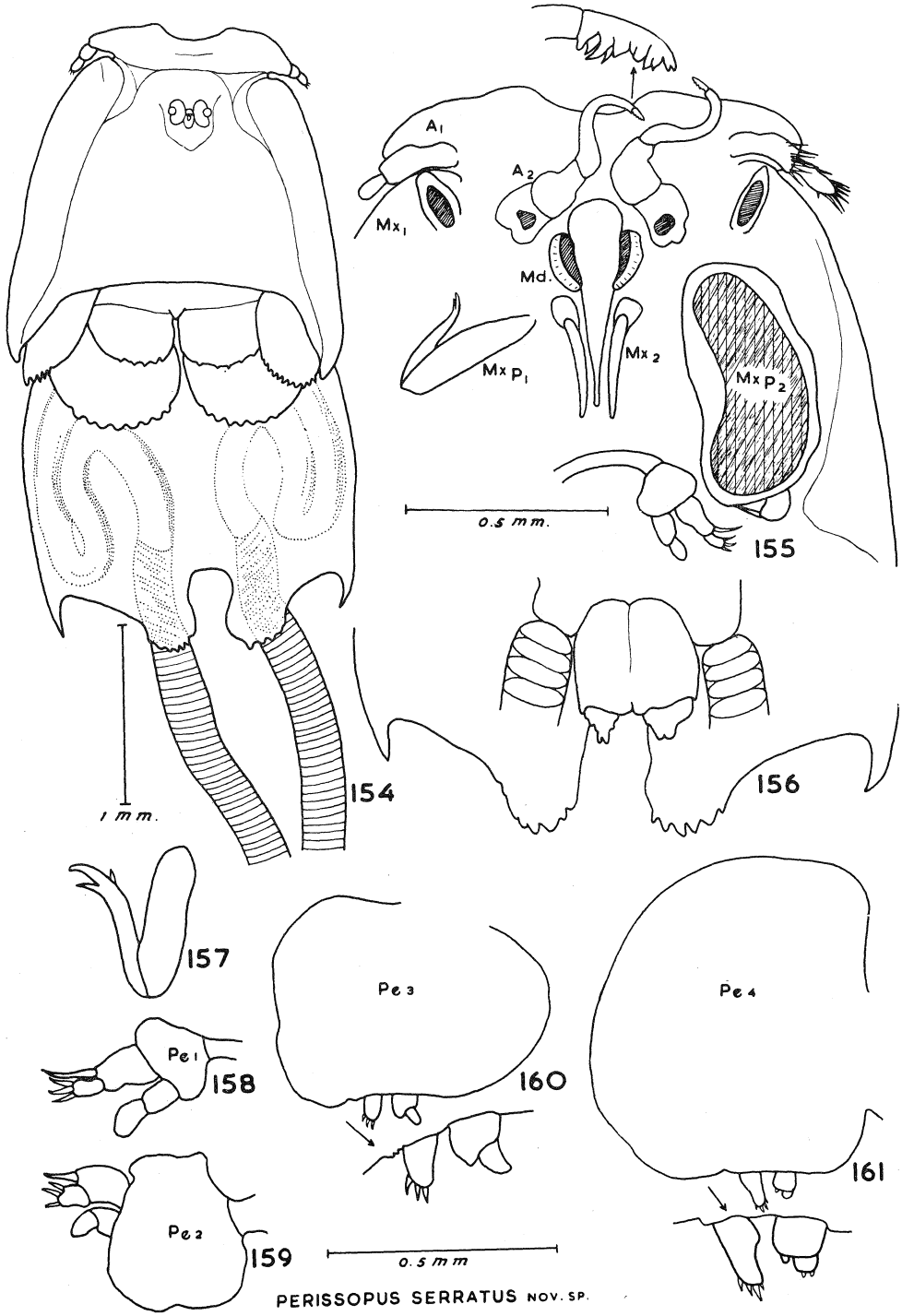
Figs. 135-144


A2
Mx1
Mx2
MxP1
MxP2
146
F
0.5 mm.
1 mm.
149
147
145
148
150
TUXOPHORUS CERVICORNIS NOV. SP.

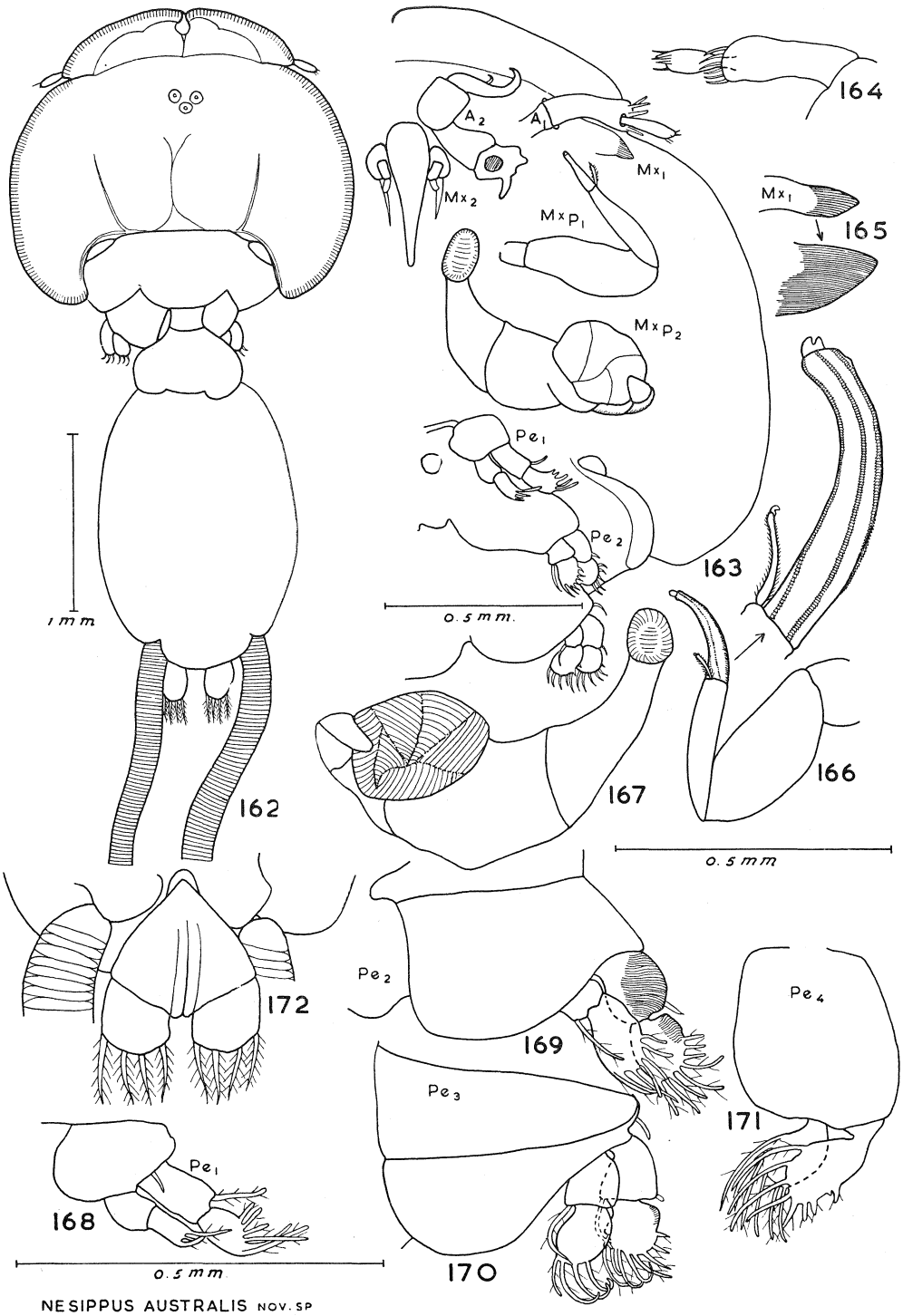
Figs. 145-150


A1
A2
MC
Mx1
Mx2
MxP1
MxP2
F
Pe1
152
153
Pe4
1 mm.
151
Pe5
GLOIOPOTES LONGICAUDATUS (MARICAWA)

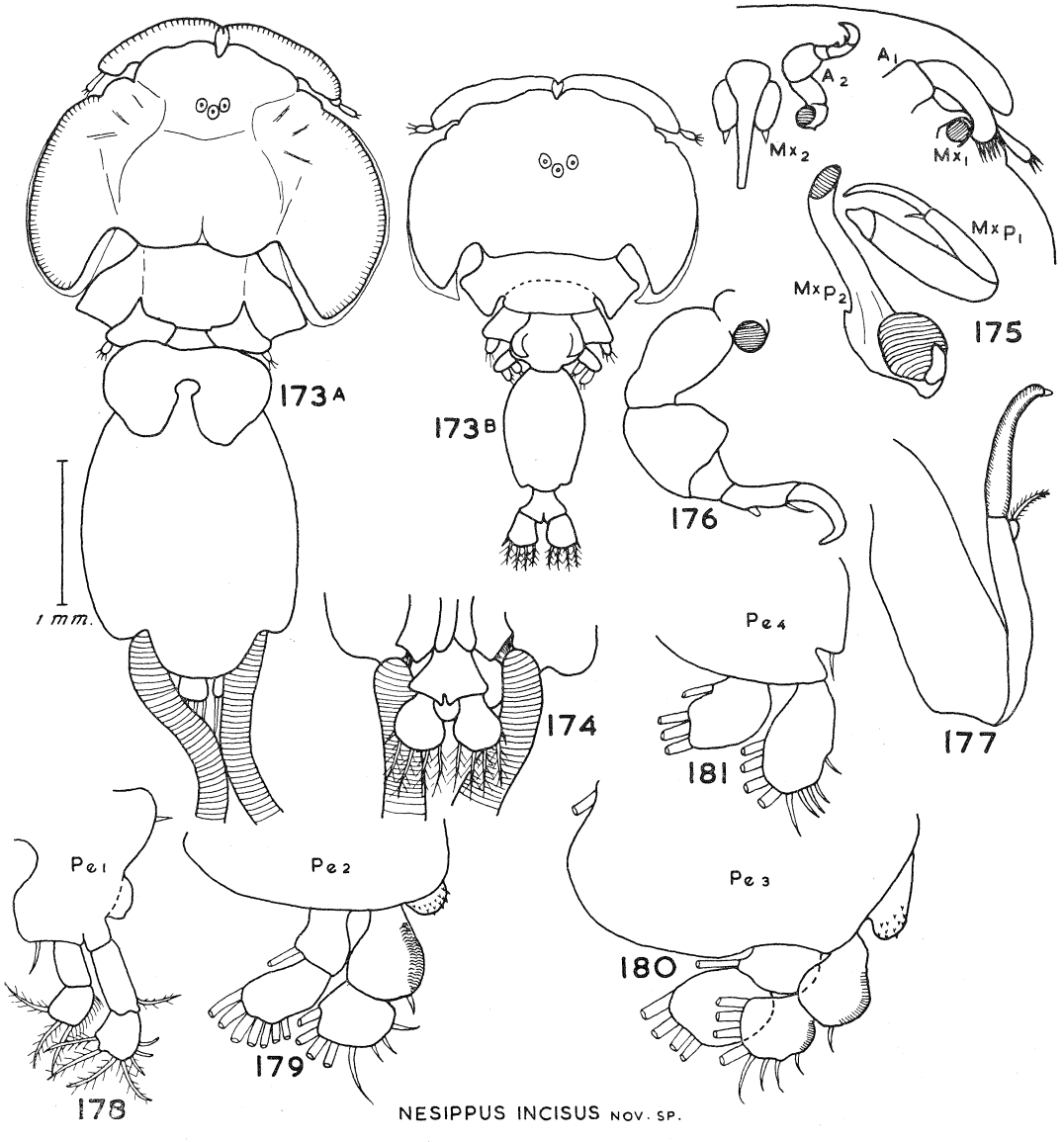
Figs. 151-153


A1
A2
Mx1
Md.
Mx 2
Mx P1
Mx P2
0.5 mm.
155
1 mm.
154
156
157
Pe 3
Pe 4
Pe 1
158
160
161
Pe 2
159
0.5 mm
PERISSOPUS SERRATUS NOV. SP.

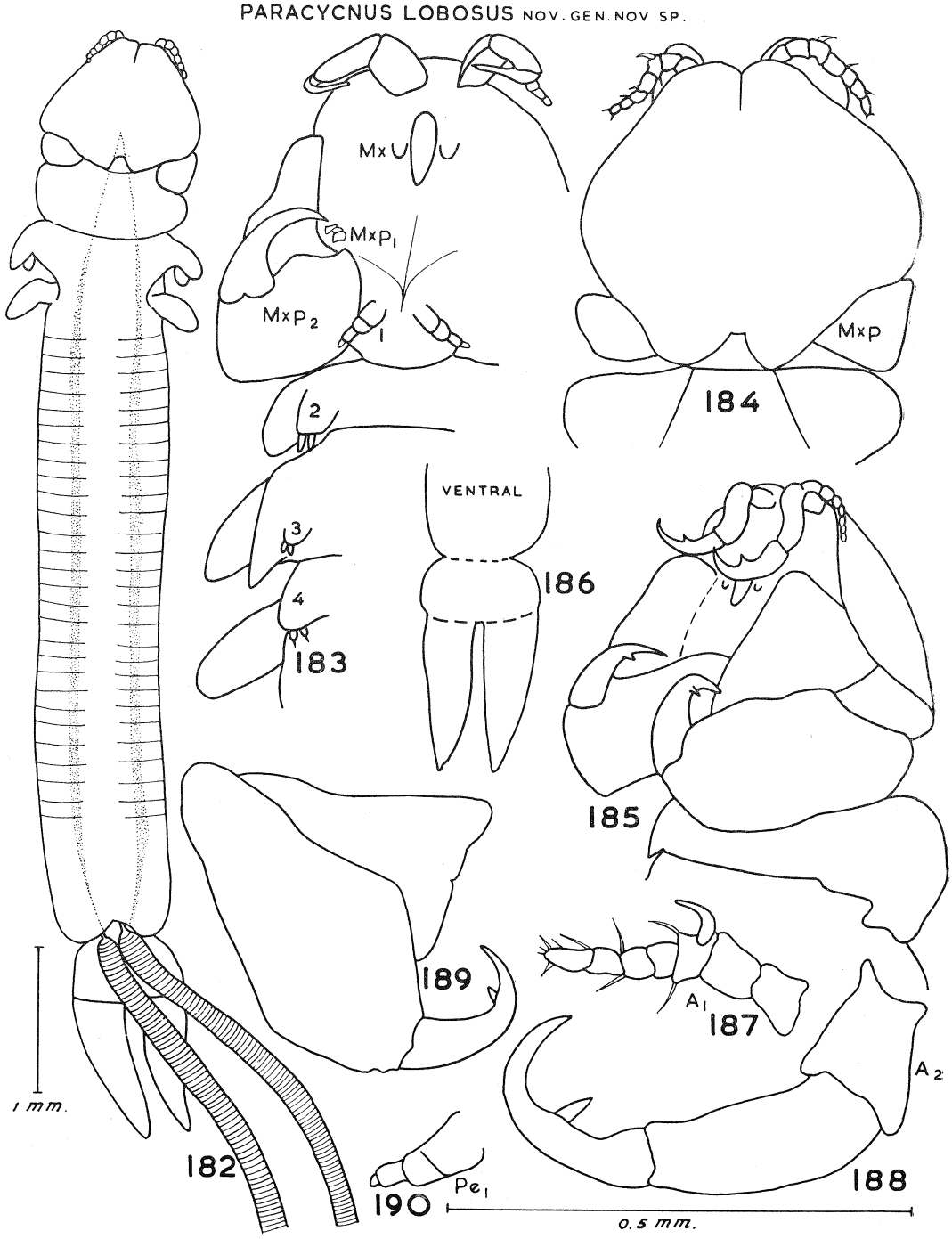
Figs. 154-161


1 mm
162
A2
A1
Mx2
Mx1
MxP1
MxP2
Pe1
Pe2
0.5 mm.
163
164
Mx1
165
167
166
0.5 mm
172
Pe2
169
Pe4
Pe3
171
Pe1
168
0.5 mm
170
NESIPPUS AUSTRALIS NOV. SP

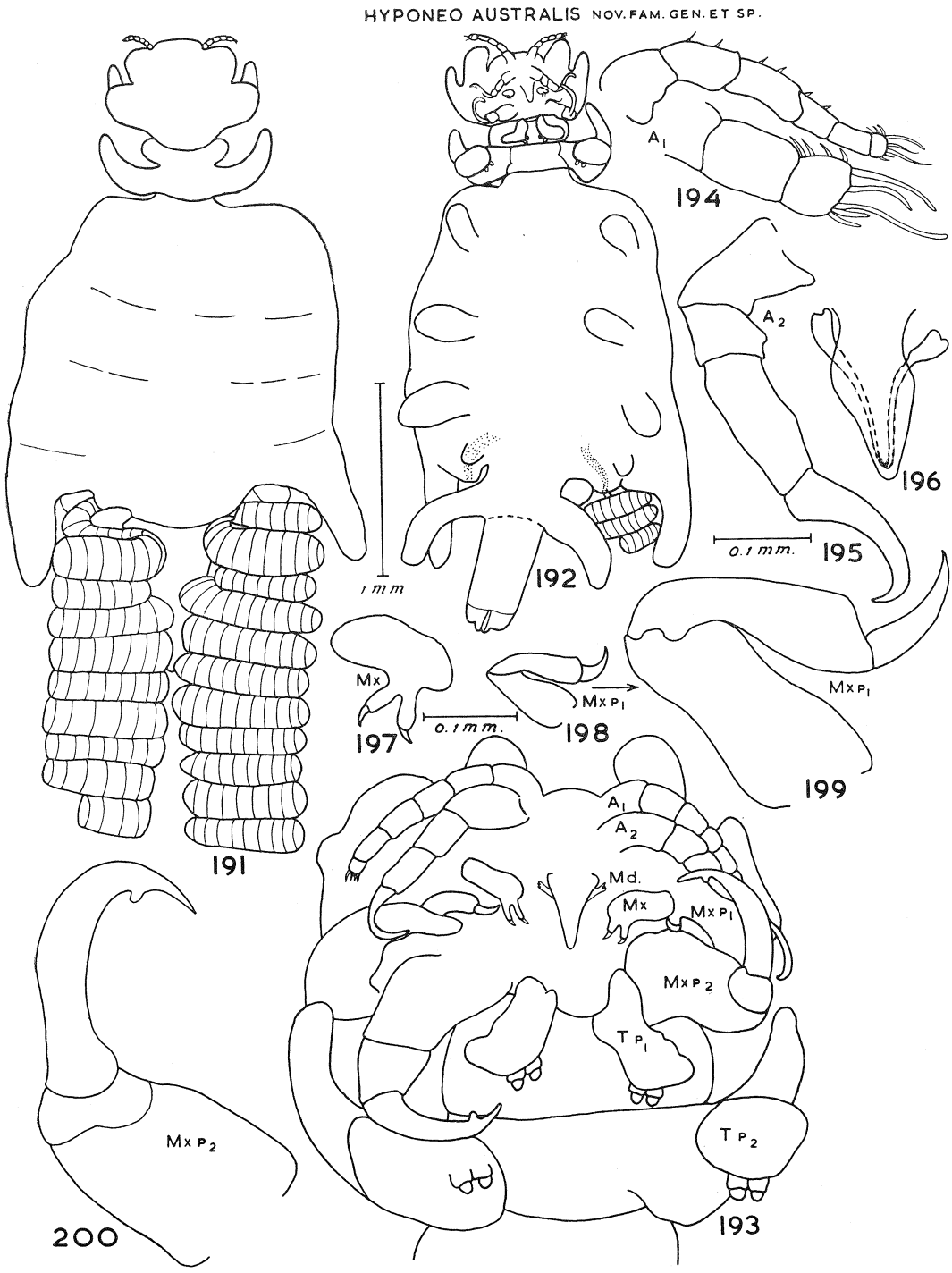
Figs. 162-172



Figs. 173A-181


PARACYCNUS LOBOSUS NOV. GEN. NOV SP.
Mx
MxP1
MxP2
1
2
3
4
183
VENTRAL
186
184
MxP
185
189
A1
187
A2
188
182
1 mm.
190
Pe1
0.5 mm.

Figs. 182-190


HYPONEO AUSTRALIS NOV. FAM. GEN. ET SP.
A1
194
A2
196
0.1 mm.
195
1 mm
192
Mx
197
0.1 mm.
MxP1
198
MxP1
199
191
A1
A2
Md.
Mx
MxP1
MxP2
TP1
TP2
MxP2
200
193

Figs. 191-200

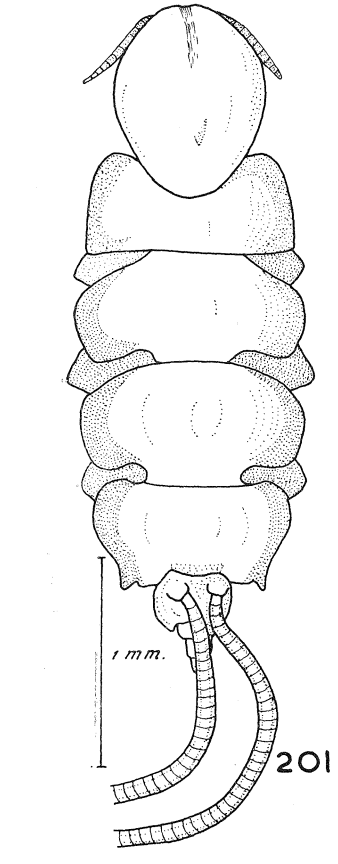
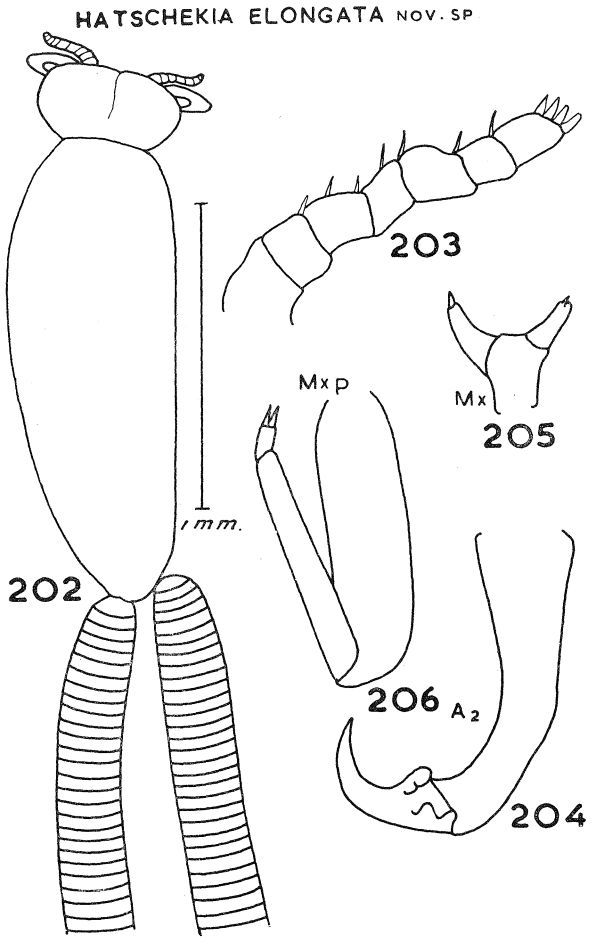
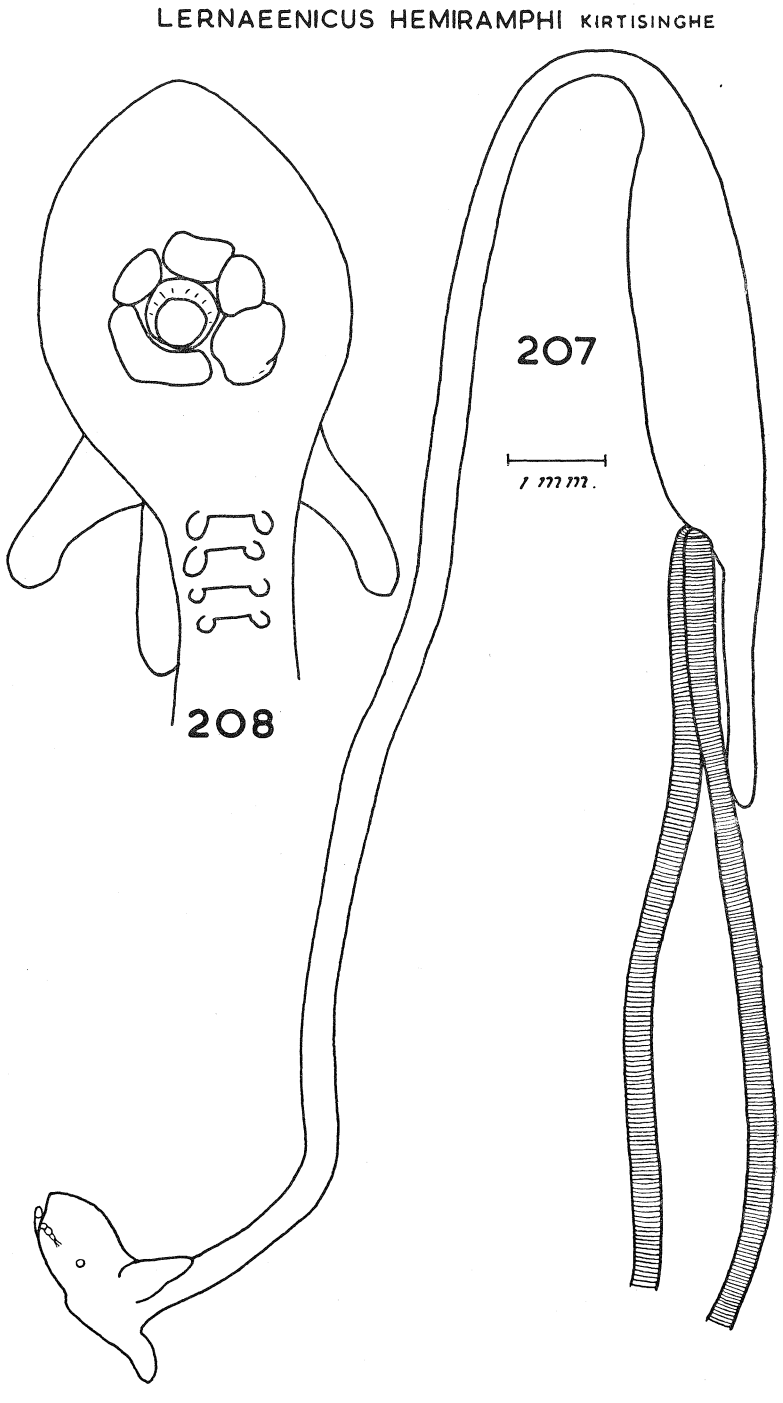


Fig. 201

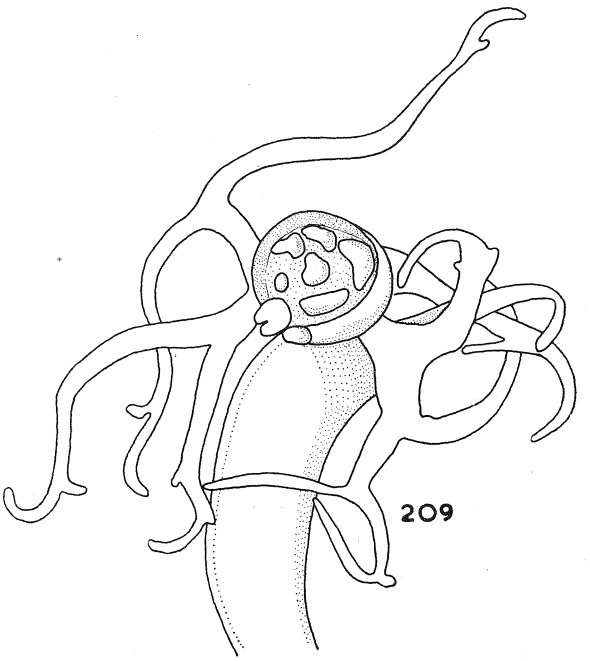


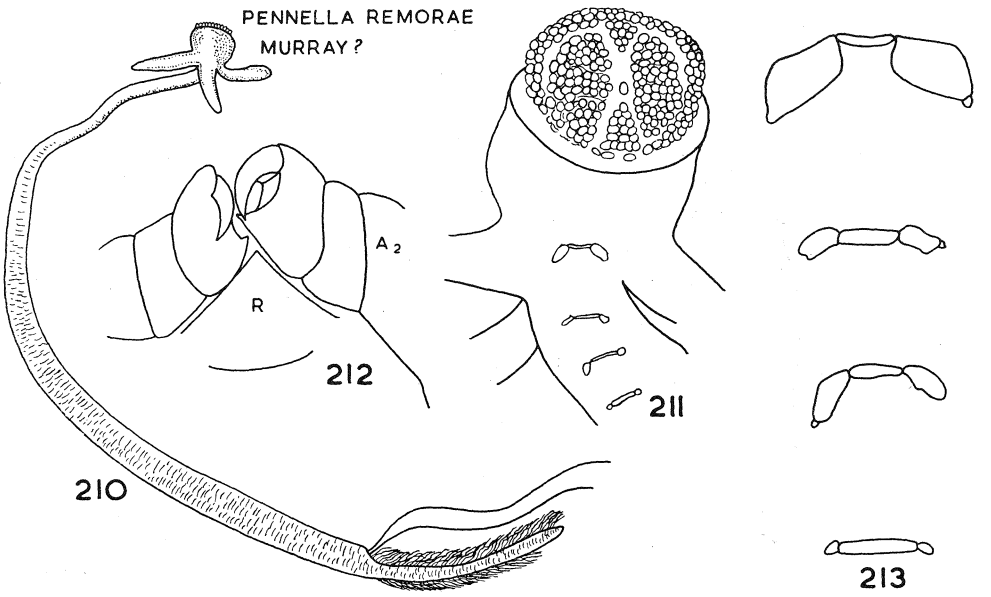
Figs. 202-206



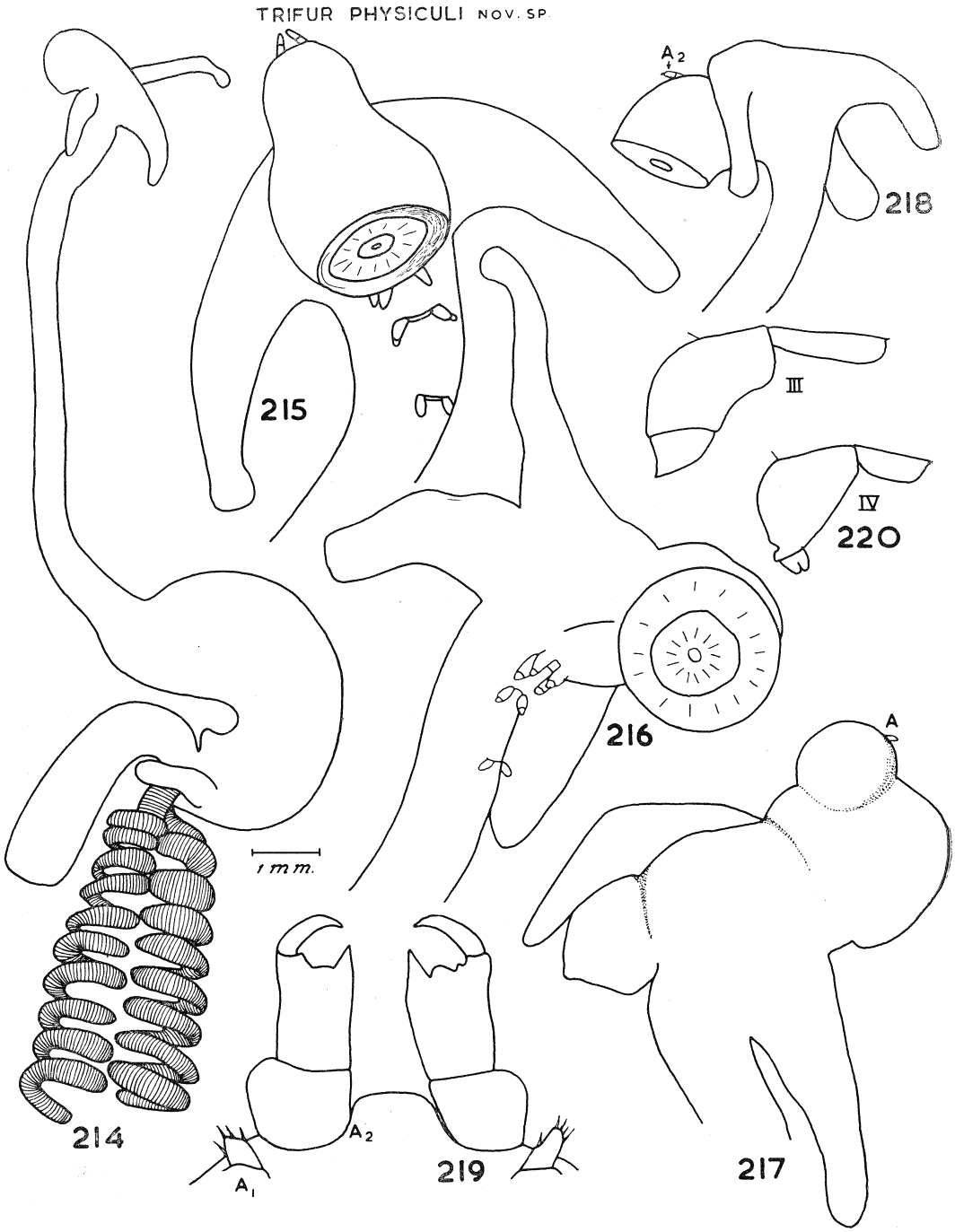
Figs. 207, 208

LERNAEOLOPHUS SULTANUS NORDMANN

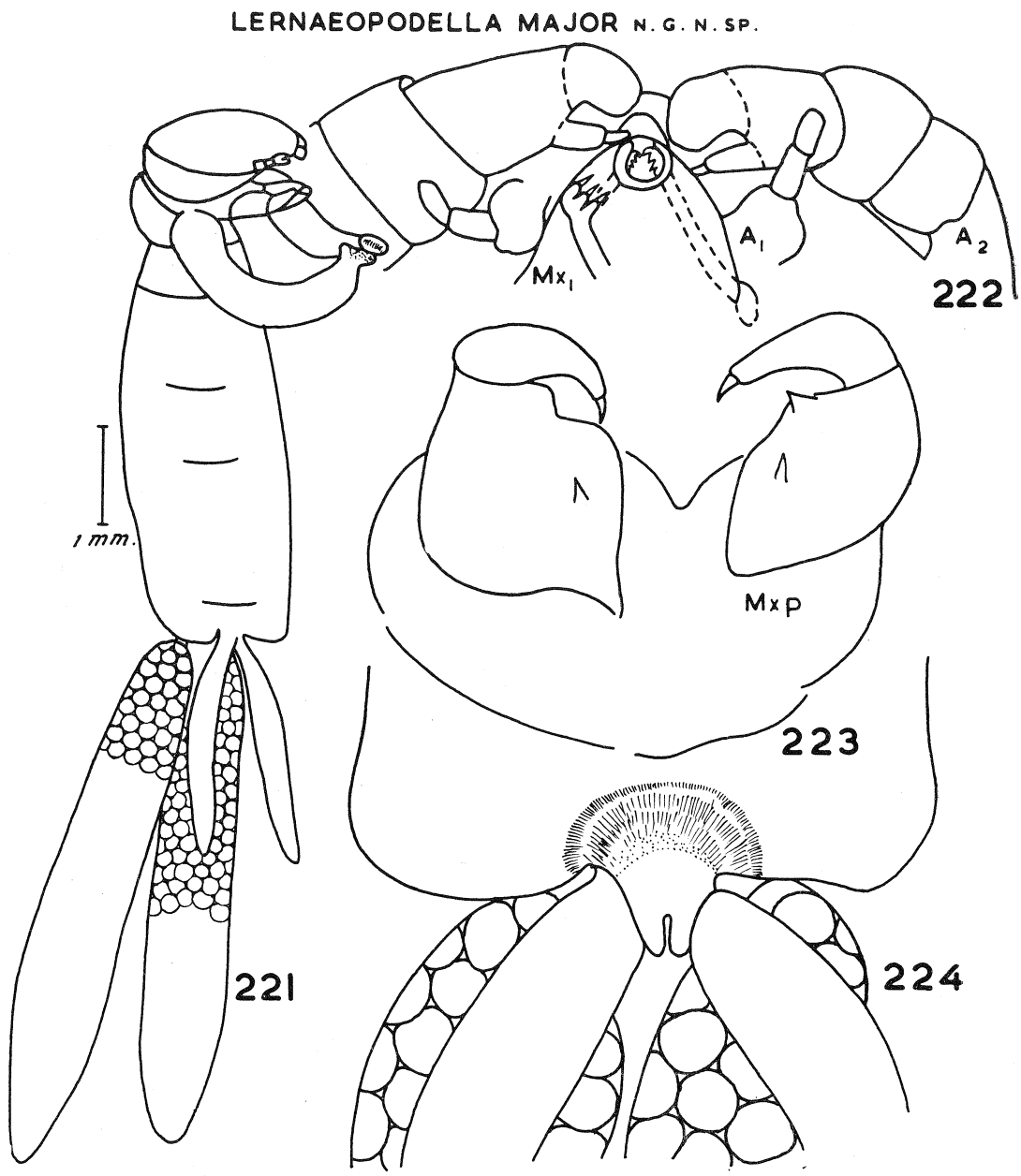




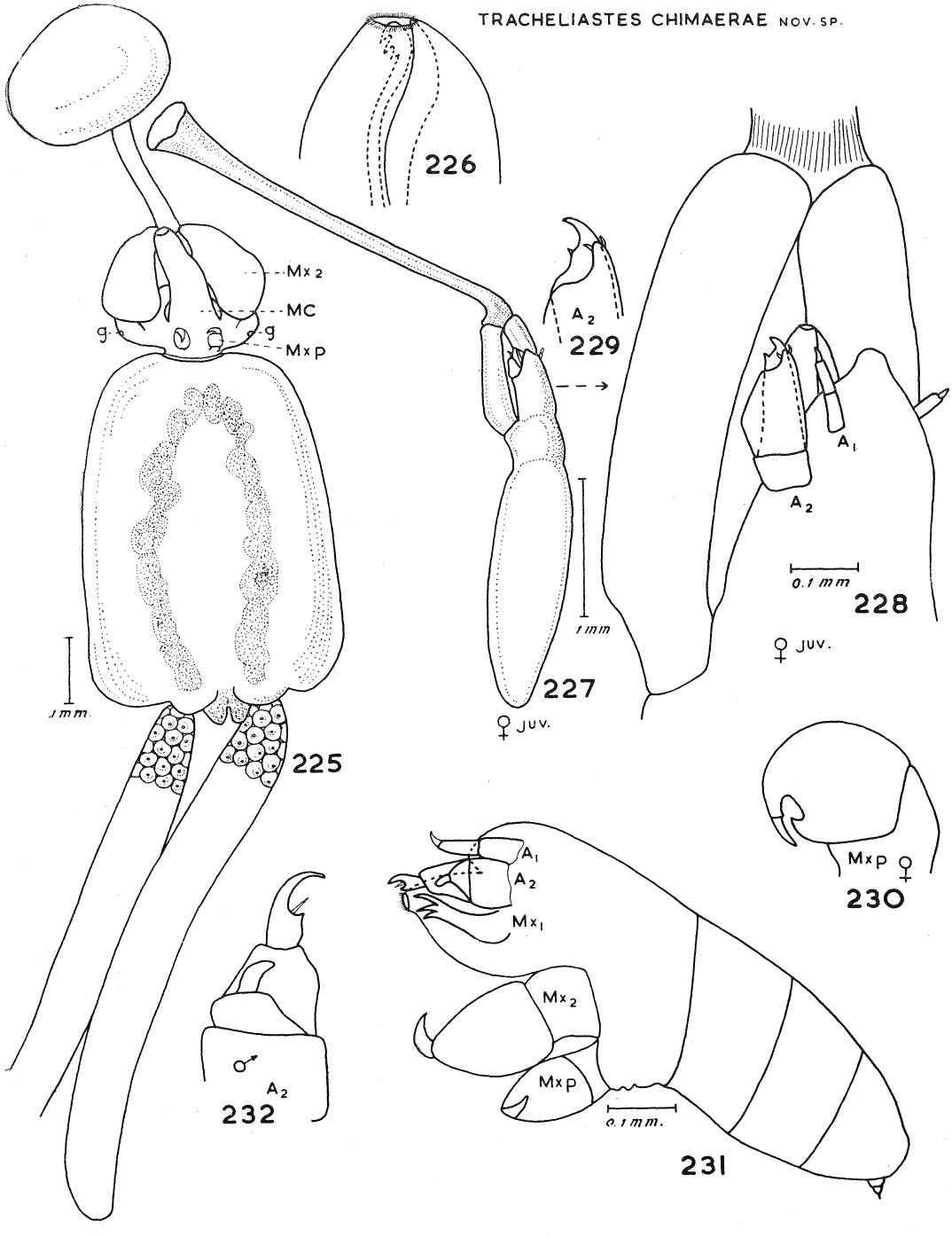
Figs. 209-213


TRIFUR PHYSICULI NOV. SP.
A2
218
215
III
IV
220
216
A
1 mm.
214
A2
A1
219
217

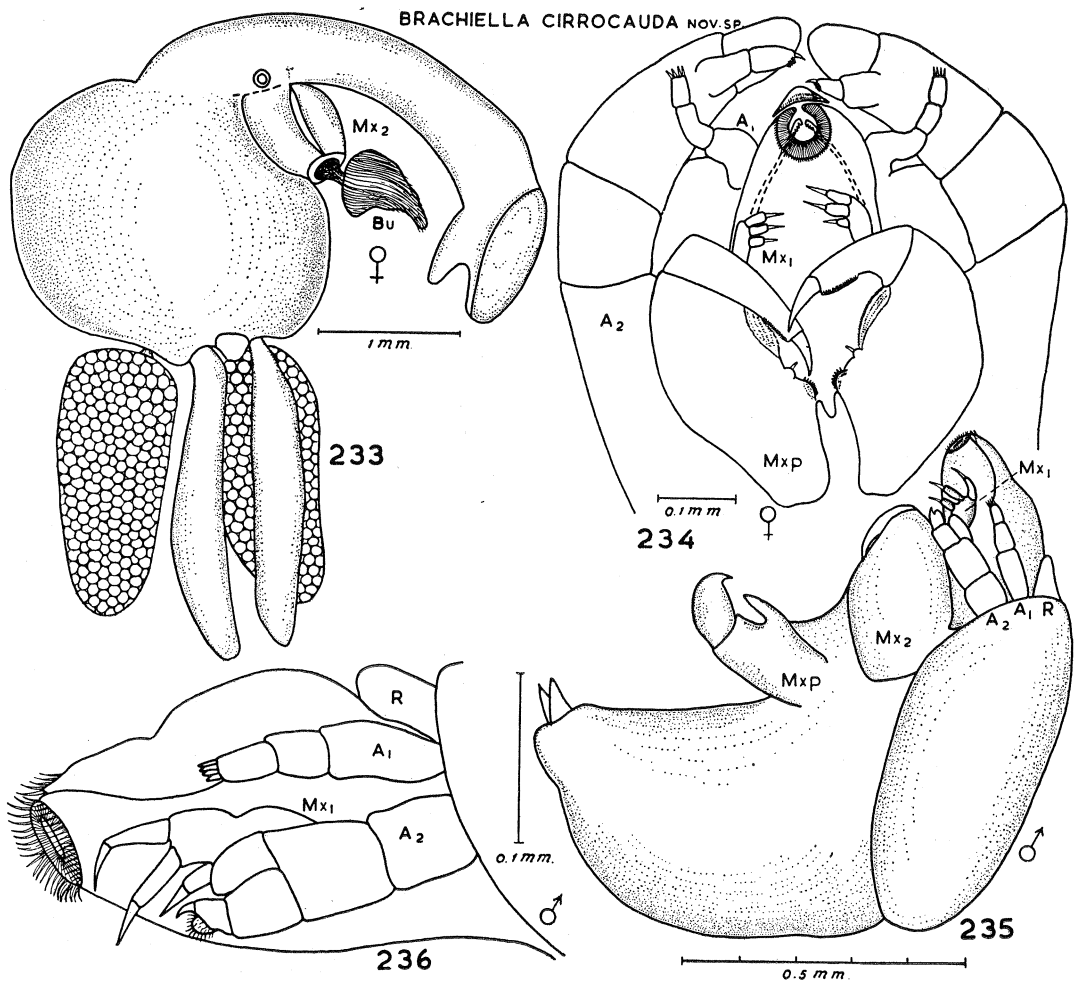
Figs. 214-220



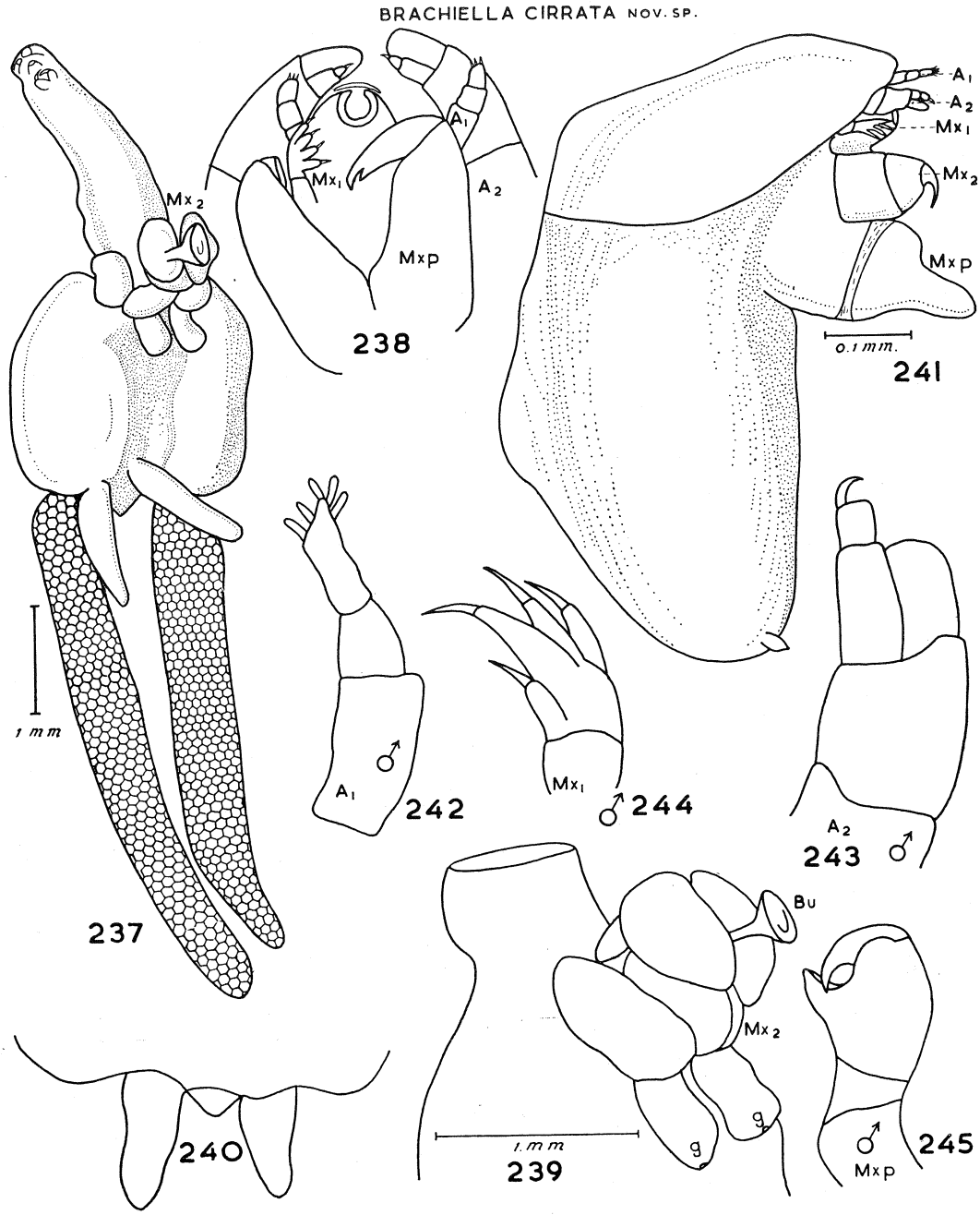
Figs. 221-224


TRACHELIASTES CHIMAERAE NOV. SP.
226
Mx 2
MC
Mx P
g
g
1mm
225
A 2
229
1mm
227
♀ JUV.
A 1
A 2
0.1 mm
228
♀ JUV.
Mx P ♀
230
A 2
232
A 1
A 2
Mx 1
Mx 2
Mx P
0.1 mm.
231

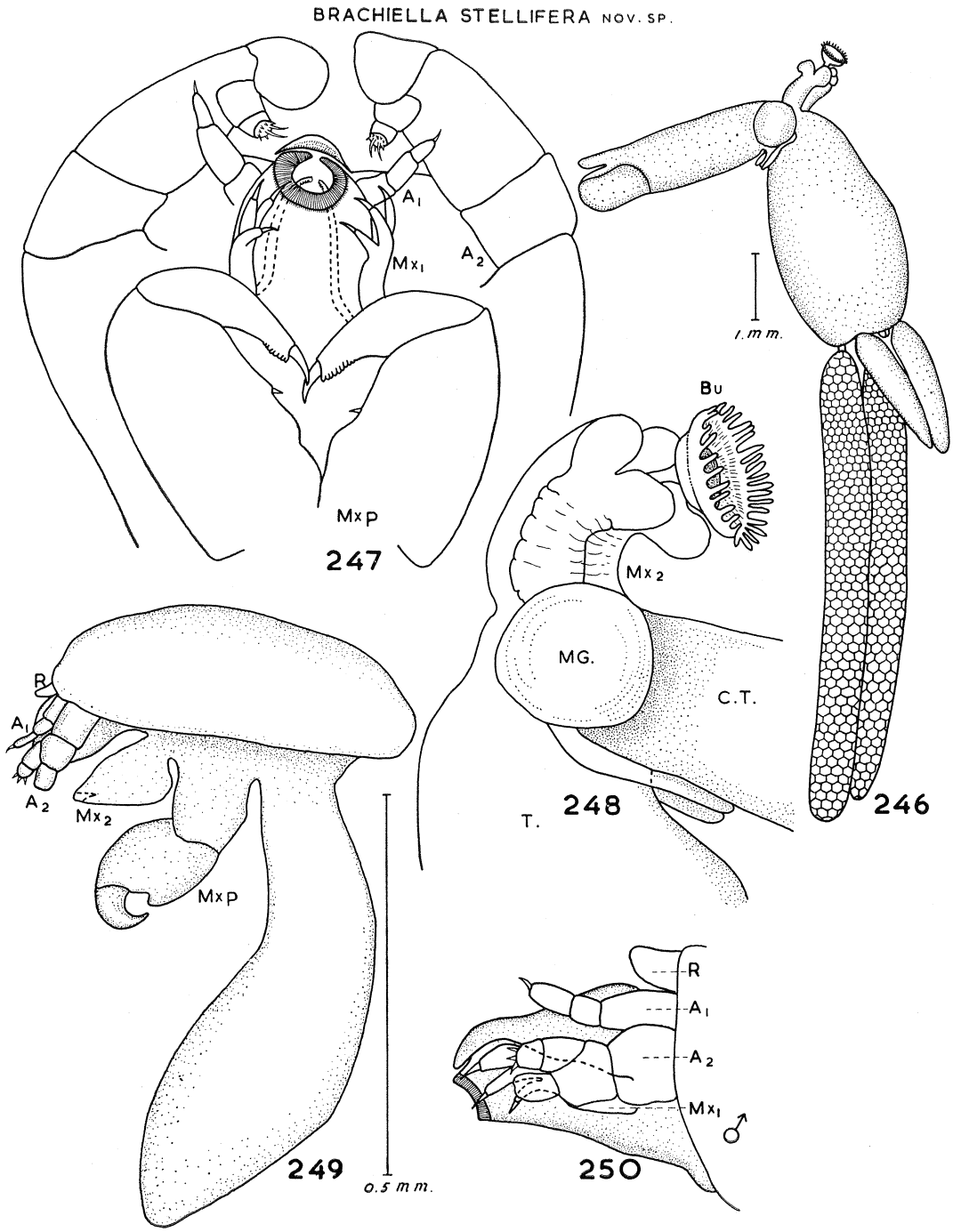
Figs. 225-232


BRACHIELLA CIRROCAUDA NOV. SP.
Mx2
Bu
♀
1 mm
233
A1
Mx1
A2
MxP
0.1 mm
♀
234
Mx1
A1 R
A2
Mx2
MxP
♂
235
0.5 mm
R
A1
Mx1
A2
0.1 mm.
♂
236

Figs. 233–236


BRACHIELLA CIRRATA NOV. SP.
Mx2
1 mm
237
A1
Mx1
A2
Mxp
238
A1
A2
Mx1
Mx2
Mxp
0.1 mm.
241
A1
242
Mx1
244
A2
243
Bu
Mx2
g
g
1 mm
239
Mxp
245
240

Figs. 237-245


BRACHIELLA STELLIFERA NOV. SP.
A1
Mx1
A2
MxP
247
1. mm.
Bu
Mx2
MG.
C.T.
T.
248
246
R
A1
A2
Mx2
MxP
249
0.5 mm.
R
A1
A2
Mx1
♂
250

Figs. 246-250