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The Phreatoicoidea

By

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(Read 16th November, 1943)

PART II.—The PHREATOICIDAE

Family **Phreatoicidae**

Right mandible without *lacinia mobilis*. Body sub-cylindrical, pleon compressed; head relatively long, generally with posterior process; cervical groove usually well developed; first peraeon segment normally not fused to the head; the telson as a rule produced into terminal projection. Maxillula usually with few setospines on apex of proximal endite; coxae of peraeopods generally free from pleura of related segments; bases of hinder peraeopods moderately, or scarcely, expanded.

As has already been noted (Part I, p. 25), the essential distinction between the Amphisopidae and the Phreatoicidae is found in the retention or the loss of the secondary cutting edge of the right mandible.

Since a similar reduction in that appendage has also taken place independently in some Amphipoda as well as in several groups of the Isopoda, that modification might be attributable to difference in dietary or mode of life, but such an explanation will not avail for the Phreatoicidae, all of which seem to be humus feeders.

Within the sub-order, the degradation or complete disappearance of this *lacinia* could, of course, have occurred independently in more genera than one and, thus, forms which lack the right *lacinia mobilis* need not necessarily be near akin, but, on the other hand, its occurrence must have a phyletic significance, since its retention can only be interpreted as an inheritance from a common ancestor. Further, the absence of this cutting edge is generally associated with a more reduced condition of some of the other mouth parts; but, to that rule, the genus *Phreatoicus* (s.s.) proves a notable exception, the maxillula, at least, being as well, or even better, developed than it is in any Amphisopid form.

Moreover, the retention of the more primitive condition of the mouth parts is usually accompanied by a greater development of the antennule, and the possession of large and prominent eyes, both features doubtless the attributes of the more active swimming mode of life.

Part I, dealing with the Amphisopidae, was published in the 1942 volume of this Journal, and the literature referred to in Part II is given on pp. 4-5 of the 1942 volume. For explanation of lettering see Part I of this paper. *Pap. and Proc. Roy. Soc. Tas.*, 1942, p. 5.

Related to this, in the Amphisopidae, seems to be the condition of an apparently shortened head, on which the cervical groove can, in many species, no longer be traced, the process of cephalization having progressed so far that, in most members of that family, the first peraeon segment appears to have undergone considerable forward shifting, with the result that its appendage (the gnathopod) lies external to, instead of behind, the maxilliped.⁽¹⁾ In most of the Phreatoicidae, however, the cervical groove persists and in many members of that family the forward shifting of the first peraeon segment seems to have been less marked, so that a visible gap may still exist between the attachments of maxilliped and gnathopod.

But whether the head be short or long, a character which may perhaps be important is the *relative length* of the post-mandibular part of the head; associated with this is the forward production at its anterior angle into a 'posterior process'. In *Paramphisopus palustris*, although the head appears short, the post-mandibular region is relatively long and is produced into a well-marked process. *Mesamphisopus depressus*, another species which retains many primitive features, also conforms to this type. All subterranean forms, whether Amphisopid or Phreatoicid, show, strongly marked, the opposite tendency (i.e., to head elongation), the lengthening being particularly noticeable in the region behind the mandible. *Hyperoedesipus* has no posterior process, but this is well developed in the species of *Phreatoicoides*. In general, the head in Amphisopidae is short, and the reduction in length appears to have been effected mostly at the expense of the post-mandibular region, while a posterior process is variable. It is well developed in *Amphisopus* spp., but absent in *Phreatoicopsis*.

From these facts, one may perhaps draw the inferences that (1) the primitive condition was one in which the post-mandibular region was moderately long, this condition tending to become exaggerated in many subterranean species; (2) that a posterior process, moderately developed, was probably present in the ancestral form.

Such a primitive condition of the head is characteristic of the majority of forms included in the second family of the sub-order—the *Phreatoicidae*. This includes some thirty-odd species and sub-species (more than twenty of which are new) and which are here referred to ten genera. In previous accounts, the eleven species known were all recorded under the name *Phreatoicus*.

As noted in Part I, the Amphisopidae have a pan-Australian range and occur also in South Africa, whereas the members of the *Phreatoicidae* are restricted to New Zealand and the Bassian region of Australia. They fall, as will be seen from the key to genera given below, into three distinct groups, most readily separated by the form of the telson, and it is of interest that the species occurring on the periphery of the area (New Zealand and the northern fringe of the Bassian) probably most nearly resemble, in condition of telson and mouth parts, the typical Amphisopids from West Australia. A few species, found only in the Great Lake of Tasmania, retain what may well be the primitive condition of the telson, and, seemingly, a comparatively slight reduction of the condition recorded for the Carboniferous fossil, *Acanthotelson*.

But the largest group of the species of the Phreatoicids cluster round *australis* or *joyneri*, and these are strictly confined to the Australian Alps and Tasmania, being in the latter country, quite widespread and abundantly occurring forms. This probably represents the latest efflorescence of the sub-order, all its repre-

(¹) Part I, figs 1 and 2B.

sentatives being forms retaining what must be assumed to be the docked stump only of a primarily elongate telson, reduced mouth parts, and uropods but slightly armed.

This stump of the telson bears a terminal fringe of spines, in the great majority *four* in number. Such an armature characterizes the telsonic apex, not only of the species of *Paraphreatoicus*, but also of a very wide range of members of this sub-order, and it may well have been the number originally preserved on this telsonic stump. A few, however (constituting the genus *Metaphreatoicus*), have six spines, an arrangement which might represent either an intermediate condition in the reduction of the telson, or be due to a secondary acquisition of a third pair of these spines developing upon the lateral border of the stump. In the present account it is regarded as secondary,⁽¹⁾ and the more general armature of four spines is considered as the earlier condition in this family.

KEY TO GENERA MICROSCOPIC

- A. Eyes large, prominent; telson with terminal projection well developed, its pleura slightly produced; gnathopod with spines on palm denticulate; spine beneath insertion of rami of uropods stout, toothed.
 - B. Telsonic projection cylindrical, backwardly directed.
 - C. Telsonic projection relatively long, segments of peraeon deeper than long; bases of hinder peraeopods not expanded Subf. Mesacanthotelsoninae *Mesacanthotelson* 61 Tas.
 - C¹. Telsonic projection shortened; peraeon segments as long as deep; bases of hinder peraeopods slightly expanded *Colacanthotelson* 99 Mt Kos NSW
 - B¹. Telsonic projection slightly flattened, sharply upturned; segments of peraeon deeper than long *Onchotelson* 86 Tas.
- A¹. Eyes small or wanting; telsonic projection reduced to small upturned stump; pleura of telson well developed; gnathopod with spines on palm denticulate; spine beneath insertion of rami of uropod stout, toothed.
 - B. Apex of telsonic projection armed with two pairs of spines. Subf. Paraphreatoicinae
 - C. Endopodite of first pleopod setose *Paraphreatoicus* 134 Tas
 - C¹. Endopodite of first pleopod without setae ... mostly TAS, some VIC *Colubotelson* 128 Tas/VIC
 - B¹. Apex of telsonic projection with three pairs of spines *Metaphreatoicus* 147
- A². Eyes wanting; telson scarcely produced or upturned, its hinder dorsal border having an outline ranging from sub-triangular to a flattened convex; gnathopod with palm armed with stout sub-conical spines.
 - B. Body vermiform, telson with flattened posterior surface; spine beneath insertion of rami of uropods stout, simple.
 - C. Gnathopod practically chelate; bases of hinder peraeopods not expanded *Phreatoicus* 5 NZ.
 - C¹. Gnathopod sub-chelate; bases of hinder peraeopods moderately expanded *Neophreatoicus* 16 NZ.
 - B¹. Body sub-cylindrical, fusiform; bases of hinder peraeopods scarcely expanded.
 - C. First pleopod with endopodite bearing plumose setae; penial stylet cylindrical with several terminal spines; spine beneath insertion of rami toothed Subf. Phreatoicinae *Notamphisopus* 31 NZ
 - C¹. First pleopod with endopodite unarmed; penial stylet curved, tapering, armed with a stout spatulate spine; spine beneath insertion of rami of uropod toothed or absent *Crenoicus* 21 NSW, VIC

(¹) There are six spines on the tapering apex of *Mesamphisopus capensis* (an undoubtedly primitive species), but only four on the similar apex of *Crenoicus mixtus*; the condition of *Paraphreatoicus relictus*, which retains the setosity of the first pleopod endopodite, is, however, almost certainly primitive and in that species only four terminal spines are present.

The family Phreatoicidae has been subdivided as follows:—

- Sub-family VI.—PHREATOICINAE
 Genus—*Phreatoicus*
 Genus—*Neophreatoicus*
 Genus—*Crenoicus*
 Genus—*Notamphisopus*
- Sub-family VII.—MESACANTHOTELSONINAE
 Genus—*Mesacanthotelson*
 Genus—*Onchotelson*
 Genus—*Colacanthotelson*
- Sub-family VIII.—PARAPHREATOICINAE
 Genus—*Paraphreatoicus*
 Genus—*Colubotelson*
 Genus—*Metaphreatoicus*

Sub-family VI. PHREATOICINAE

Head generally without posterior process, cervical groove absent or slight, eyes obsolete; antennule short; palm of gnathopod with conical teeth which are not denticulated; suture between sixth pleon segment and telson reduced, being marked by a slight ridge; telsonic projection wanting or developed only as a small flattened, rounded or sub-triangular ledge; uropod long, spine on peduncle beneath insertion of rami, stout, simple or toothed.

The question of the appropriate place for this sub-family⁽¹⁾ and of the genera which should (or should not) be included has proved unexpectedly difficult. The retention of the obviously primitive condition of the maxilla in the genus *Phreatoicus* (s.s.) is associated with a moderately well-developed condition of the antennule; the reduction of the cervical groove and the occurrence of a stout, simple spine at the end of the peduncle of the uropod in that genus are, also, features generally characteristic of members of the Amphisopidae, as, too, is the flattened and reduced telsonic projection. On the other hand, the right *lacinia mobilis* is wanting; a gap between maxilliped and gnathopod is indicated, and the telson retains a projection which is perhaps the stump of an original spine.

Again, in the genus *Phreatoicus* (s.s.) the loss of the eye, the elongation of the body and of the antenna, the slender, unexpanded bases of the peraeopods, and the reduction of the setae on the pleopods may, perhaps, be attributable to a long-continued subterranean habit, but must not all be summarily dismissed as without significance, for some of these features are equally developed in *M. tasmaniae*, in which species a past history of subterranean life is not indicated.

Chilton's species *assimilis* has to be assigned to a new genus (*Neophreatoicus*), but obviously belongs to the sub-family. The newly discovered New Zealand surface-living forms clustering around *kirkii* constitute a second new genus (*Notamphisopus*) showing affinities with both Amphisopid and Phreatoicid genera and, of the latter, chiefly with certain Great Lake species, but from these they are separated by the suppression of the telsonic spine. Finally, several blind species from the highlands of New South Wales and Victoria, also with Amphisopid affinities, seem most satisfactorily grouped with the New Zealand species. They constitute the new genus *Crenoicus*.

⁽¹⁾ Reference to such groups of genera as 'sub-families' may seem doubtfully warranted, the more so that a definition of the sub-family is not easy to formulate. Monod found a similar difficulty with the Cirolanidae and prefers to speak merely of 'groups of genera', noting that Racovitza had earlier named these groups as sub-families without attempting a definition. Since, in the ultimate issue, classification is merely a matter of convenience, it seems preferable to use the term sub-family for such subdivisions of a family.

Genus *Phreatoicus* Chilton

Chilton, Chas. (*Phreatoicus*), 1882, p. 89.

Chilton, Chas. (*Phreatoicus*), 1894, p. 185 (part).

Body vermiform with sparse, fine setae; head long, without posterior process, post-mandibular region long; eyes wanting; peraeon shallow, first segment short, free; pleon scarcely compressed, its pleura about as deep as the related segments, lower border setose; tailpiece long, telson produced into small, flattened, triangular projection as wide as long. Antenna long, mandible with first joint of palp long; maxillula with inner endite broad, wider than outer, with numerous setospines, maxilla with distal lobe of proximal endite somewhat distinct from basal lobe; gnathopods, attached behind head, practically chelate, unlike in the two sexes; oostegites differ, in immature females, from other *Phreatoicids*, in that at least two pairs stand erect, only two being applied to the sternum; peraeopods slender, without armature of spines, bases not expanded; pleopods reduced, exopodite with few setae, endopodite bare; uropod with peduncle styliform, rami slender and setose, spines below insertion of rami stout and simple.

Genotype. *Phreatoicus typicus* (Chilton).

Shorn of its many later accretions, the genus *Phreatoicus* is, here, restricted to *typicus* and one other, recently discovered, subterranean form, *orarii*. It would seem that it represents a very early shoot from that branch of the *Phreatoicid* stock which had already lost its right *lacinia mobilis* and (although this reduction has not extended to other mouth parts) had started upon the later specialization of the head, having practically lost the cervical groove and the posterior process; shortening of the head, if any had occurred, has been compensated by subsequent general elongation of the animal, consequent on long, sustained, subterranean mode of life, which is associated with the creeping habit, the development of slender peraeopods and the reduction of pleopods.

Of the many other species which have been assigned to the genus *Phreatoicus*, the sub-alpine forms, of which *australis* (Chilton) is typical, belong, in the opinion of the writer, to a wholly distinct branch, and are referred below to a genus *Metaphreatoicus*, closely related to which are two other genera *Paraphreatoicus* and *Colubotelson* with numerous species and some sub-species. The Tasmanian Great Lake species *tasmaniae* G.M.T. and some related forms appear quite distinct and constitute the new genus *Mesacanthotelson*; it is these latter which appear to link up with the surface New Zealand forms (*Notamphisopus*), differing noticeably, however, in that in the latter the telsonic projection has been suppressed. Geoffrey Smith's species, *brevicaudatus*, is made the type of a somewhat isolated genus *Onchotelson*, gen. n.

Phreatoicus typicus Chilton

Chilton, 1882, (1), p. 279 (*Phreatoicus typicus*); 1882, (2), p. 87, pl. 4; and 1894, p. 196, pl. 18.

Thomson and Chilton, 1886, p. 151 (part) (*Phreatoicus typicus*).

Stebbing, 1888, pp. 543 and 687 (*Phreatoicus typicus*); 1893, pp. 388-391.

Sheppard, 1927, p. 109 (*Phreatoicus typicus*).

Male, not known. *Female*, body long, sub-cylindrical, although in the pleon it appears slightly compressed; its surface is set with very short setae (1882, pl. 4, fig. 15), said to be arranged more or less regularly in interrupted rows (l.c. p. 89). The figure does not support this suggestion, nor do the setae appear in the habitus figure (1884, pl. 18, fig. 1), which was, however, drawn from a dried, mounted specimen.

The *head* is not described, but, in that figure, Chilton has represented it as being as long as the first two peraeon segments, shallow anteriorly, sloping upward posteriorly to attain a depth nearly twice that at the anterior end; no trace of eyes. The ventro-lateral border of the head appears sinuous, but almost horizontal. In that figure, too, there is no hint of a cervical groove running from the postero-ventral border of the head.

Peraeon. The first segment is short, less than half the length of the second segment; it is practically as deep as the head and lengthens ventrally, its antero-inferior angle being produced towards the head. The second, third, and fourth segments are sub-equal, the latter two being longer than deep; they are described as quite rectangular, with inferior margins almost straight; the fifth, sixth, and seventh are progressively shorter than the preceding segments and deeply emarginate below. In all, the terga are sufficiently shallow to expose the ventral surface in side view.

Pleon. The first segment is shorter than the last peraeon or second pleon segment; the second to fourth are sub-equal; the fifth, which is nearly as long as the combined length of second, third, and fourth, meets its pleuron in a wide angle; while the tailpiece (including the telsonic projection) is shown as being at least as long as the preceding three segments. The terminal projection is short and slightly upturned, and the piece, in profile, has a shape rather like that of a helmet, described by Chilton as sub-conical. It is likely, however, that it gapes widely below, as it does in *orarii*.

The first pleuron is very shallow, but the pleura of the second to fifth segments are almost as deep as their related segment; all are fringed ventrally with setae. On the tailpiece, the pleuron appears as a narrow, ventro-posterior border only, fringed with very fine setae. Anterior to the uropods, the ventral margin of the pleuron of the sixth pleon segment is figured as armed with four stout, curved spines.

The projection at the end of the telson is narrow, longer than broad, and projects slightly upward, the truncate end tipped with a few setae, with a stout seta below at its base.

Appendages. The *antennule* is short, being less than half the length of the peduncle of the antenna. It consists, in the female, of eight joints, with little distinction between those of peduncle and flagellum; the last three or four joints are swollen and bear olfactory cylinders. The *antenna* is long, being about three-fourths of the length of the body; its peduncle is relatively long, the fifth joint longer than the combined length of the third and fourth; the flagellum has about thirty-five joints.

Mouth parts. The *labrum* is said not to differ in any important respect from that of *P. assimilis*. The *mandibles*, also, are said to agree essentially with those of *assimilis*, but there are three teeth only on the cutting edge of the left mandible and three on the *lacinia mobilis*. There are, presumably, three teeth on the dentate edge of the right mandible. One difference, not referred to in the text, but to be made out in the figure (1882, fig. 5) is the relatively long first joint of the mandibular palp; in *assimilis* that joint is represented as short (1894, pl. 16, fig. 5).

Lower lip. It is evident that it was this structure which was referred to as the labrum in Chilton's earlier paper, the related figure (1882, pl. 4, fig. 6) suggesting a quite peculiar condition for this organ. Later, the *labium*, correctly named, is described and, although the figure has been redrawn, it is not essentially modified. Its condition, as figured, suggests that while it may have suffered some distortion in preparation, it is, nevertheless, quite unusual in this sub-order.

Maxillula. This is remarkable for the width of the inner endite and the number (nine or ten) of its setospines. Two slender, simple, sub-terminal spines apparently constitute the remnant of the second rank of plumose setae which still persists in *Phreatoicopsis*. The outer endite has about fourteen spine-teeth arranged in two rows, while sub-marginally upon the posterior face of the lamella there are probably three or more slender, plumed setae which are not, however, mentioned or figured by Chilton.

Maxilla. In this appendage, also, the condition is quite unusual. In the basal part of the proximal endite the border is convex, while its distal portion is directed sharply mesially and a wide gap separates the apical group of setae from the proximal part of this fringe. The inner plate of the distal endite is exceptionally long and is represented in shape as sub-triangular instead of the usually obliquely-truncated oblong.

Maxilliped. This is said by Chilton to resemble the appendage of *assimilis*, except for the condition of the 'grappling setae' which are long, curved, and slightly hooked, two and three in number, whereas in *assimilis* there are said to be, on either side, two straight coupling spines slightly hooked at the end.

There is possibly, however, another detail in which *typicus* shows a resemblance to *assimilis*, to which attention has not been directed. Chilton's figure of the latter species (1894, pl. 16, fig. 10) shows a stout spine at the outer distal angle of the basis. Actually, in that species there are two stout, plumose setae at this point, obviously the homologues of the stout plumose spines so well developed in *Eophreatoicus* and in *A. lintoni*, although placed somewhat more distally; one is present in *P. orarii*, and such a spine is probably present in *typicus*, also.

Peraeopods. These appendages are known only from Chilton's description of the female. All are relatively long and slender and but sparsely setose, the coxa small and shallow, probably ankylosed⁽¹⁾ to the body segment (1894, p. 199) and armed *posteriorly* with a small spine; on the dactyl a small secondary unguis is indicated.

The gnathopod is slightly developed,⁽²⁾ and is remarkable for the sub-triangular propod with its concave palm and practically chelate condition. The second, third, and fourth peraeopods are sub-equal and longer than the gnathopod. The fifth leg is comparatively short, while the sixth and seventh are considerably longer; in these three the basis is stouter than in the limbs of the anterior group, but is scarcely expanded. Of one specimen, it is recorded that incipient brood lamellae were present.

The *pleopoda*. Only a very brief and rather vague account of these appendages was provided in Chilton's earlier paper (1882, p. 91), but the figures (pleopods 1 and 2) are serviceable. Later (1894, p. 194), that author called attention to the fact that his earlier interpretation was mistaken, but by an unfortunate oversight he still neglected these appendages, dismissing them with the statement (l.c., p. 200) that they 'appear to be similar to those of *P. assimilis*, but are rather more slender; the fifth pleopods are very short and small'. Actually, if the figures (1882, pl. 4, figs 12 and 13) are correct, they differ from the pleopods of *Neophreatoicus assimilis* in shape, proportions, and setation. Indeed, in the notable reduction of the setal fringe, they come near to the condition, presumably developed independently, in species of the genus *Phreatoicoides*.

(¹) Miss Sheppard (1927, p. 109) says *all are free*.

(²) It may be confidently predicted that the gnathopod of the male will prove to be large and chelate.

Uropoda. These are relatively long, slender, and but feebly spinose. The peduncle appears slight, curved, and gently concave dorsally, reaching back to the level of the telsonic apex. Its inner border is high and ends in two prominent spines; the outer border is figured as unarmed, but is stated to resemble (except for its proportions and the setation of the lower border of the peduncle) the uropod of *N. assimilis*, which (described as having a few fine setae along this border) is figured (1894, pl. 17, fig. 13) as quite setose. The two rami are short, the inner and longer being but two-thirds of the length of the peduncle; the terminal claws are immovably part of the rami. Ventral to the insertion of the rami on the peduncle is a single, slender spine, apparently without pectination.

The above account has been compiled from various references in Chilton's published papers. The species was evidently rare, for in the dozen years preceding 1894, Chilton had received only about ten specimens, *all female*, obtained from several distinct sources. The most southerly of these records is Ashburton, which is but thirty miles from Winchester, which latter is the only region to yield *N. assimilis*.

Since no descriptions, other than Chilton's, of any New Zealand species have been published, and because the writer was anxious for more information on certain details, there passed in 1925-6 some correspondence with Dr. Chilton, who very kindly sent examples of all the then known New Zealand forms, including one specimen stated to be *typicus*, coming from Ashburton. On examination, this proved to be a male, but, most unexpectedly, it differed in so many characters (other than sex differences) that there arose the question of the correctness of its reference to *typicus*, of which the male was unknown.

Almost exactly ten years later, the writer was able to spend some months (December, 1935, to February, 1936) in New Zealand engaged in the search for surface-living members of this family, this search extending to the extreme south of the South Island, and beyond, to Stewart Island. At the end of this trip, while in Canterbury on the return journey, the kindness of Professor Perceval made possible the examination of Chilton's collections and records, preserved at Canterbury College. Chance directed attention to a stray letter from Mr. Hinckney, received in 1925 at the Canterbury Museum, indicating that a packet had been despatched from the Post Office of Rangitati in South Canterbury. It had contained, as Chilton subsequently noted, some ten specimens, which were referred to *P. typicus*, but the tube had broken and the specimens for the most part dried and broken. A hasty examination, without dissection, of the balance of this small collection, suggested that the Ashburton male was probably referable, not to *typicus*, but to a new species to which Hinckney's specimens also belonged. An attempt to discover the actual place of origin of these latter took a couple of weeks and led the writer over much of South Canterbury, but eventually the locality was identified as a well, in the valley of the Orari River. Arrived there, it was found that the original well had been filled up. It had been on the property of a Mr. Scully, who stated that this 'well-shrimp' still came up in water pumped from other wells in the neighbourhood. More than a year later, this gentleman sent a tube containing close upon eighty specimens, accompanied by examples of *Cruregens*, *Paracalliope*, and *Apocrangonyx*. *Phreatogammarus* was unrepresented in this particular collection, but, as it happened, this had been secured by the writer with *N. assimilis* at Winchester the previous year. It is upon the material in this collection received from Mr. Scully and, also, the specimen sent by Dr. Chilton, that the description which follows, of the new species *P. ovarii*, has been based.

Phreatoicus orarii, sp. n.

(Figs 35 and 36)

Apparently very near to *P. typicus*, from which it may be distinguished as follows:—

Body elongated, vermiform (fig. 35, *1d, 1s*), its length nearly eleven times its width, scarcely wider than deep; surface free from ridges or wrinkling, but set with fine setae, which, on some segments at least, suggest an arrangement in incomplete anterior and posterior double rows. In the pleon, the setae form conspicuous pleural fringes ventrally and posteriorly.

Head (fig. 35, *2s♂*) rounded, almost quarter-spherical, as long only as the second peraeon segment, its anterior border slightly concave. Antero-ventrally, there is a distinct sub-ocular notch. In side view a cervical groove is ill-defined, but from above there may be made out a constriction which seems to be the vestige of the suture between the maxilliped segment and the primary head.

Eyes are not developed, but a tiny paired oval depression might mark their place.

The ventro-lateral border of the head is sinuous and against it abuts the mandible. Anteriorly, there is a rounded fulcral prominence on the mandible which moves freely against the corresponding hollow in the head. There is no 'posterior process', but behind the mandible the ventral part of the head is deepened and produced downwardly to bear the maxilliped, in which development there appears to be a marked difference from the condition figured for *typicus*. The head can move freely upon the first peraeon segment; as noted above, this is probably true of *typicus*, also.

In the *peraeon*, the segments are sub-cylindrical. The first segment is very short; in the male, measured in the mid-dorsal line, it is only half the length of the second, but is widely expanded below; in the female, the ventral expansion is less marked. The second, third, and fourth segments are of almost equal width and practically uniform depth, but the third is slightly the longest; thence the segments decrease regularly in length but increase in depth to the seventh which, in the male, has a length once and a half as great as the first segment and a depth nearly double that segment; in the female, however, the seventh segment is actually shorter than the first. The antero-ventral corner of the second to fourth segments is produced into a quite definite process, armed each with a group of setae. In the third and fourth segments, the antero-ventral border is slightly excavated and the tergum deepens behind; in the fifth to seventh segments it is the postero-ventral border which is excavated by the coxa.

The *pleon* is comparatively long, the ratio of its length to that of the head and peraeon combined being 60 : 100. The pleura are but moderately developed, and the difference in depth between this region and the peraeon is accordingly much less marked than is the case in surface-living forms. The sixth pleon segment is, as usual, united with the telson, and almost all trace of the original suture has disappeared, a short, curved ridge running upwards from the insertion of the uropod, representing the last vestige of this boundary. It runs dorsally, parallel to the antero-ventral border of the segment, but lacks the usual series of setae or spines.

The actual telsonic projection, as seen in side view (fig. 35, *3s*), does not differ appreciably from that of *typicus*, as figured by Chilton, but viewed from above it appears *sub-triangular*, its length equalling its greatest width; it is armed apically with four short setae; laterally it is extended in narrow downturned

flanges on either side, each bearing, sub-marginally, a short, stout spine. This crescentic area, with its median projection, is separated dorsally from the rest of the tailpiece by a short, *curved* crevice. While it may be that it actually represents the true telsonic area, it seems probable that that region is more extensive and includes a larger area as far back as the insertion of the uropods, as appears from the ventral view (fig. 35, 3*v*).

Anterior to the attachment of the uropod, the ventral border of the tailpiece is armed with four stout, curved, simple spines; the postero-ventral border bears a fringe of short setae, a few of which are stouter than the rest. Viewed from below, these latter borders gape widely, exposing a concave sternal region, the oval anal aperture occupying the hinder two-thirds of its length. A faint sinuous line joining the posterior border of the uropodal insertions seems to mark off the sternite of the sixth pleon segment from that of the telson.

Appendages. The *antennule* (fig. 36, 4) has nine joints in the male (ten in the Ashburton specimen); the sixth to eighth are swollen, the ninth a mere knob (only eight occur in the female). It reaches beyond the end of the fourth joint of the peduncle of the *antenna*. This latter is nearly three-fourths of the length of the animal; in the male, the fifth peduncular joint is once and a half the length of the fourth joint but less than the combined length of third and fourth; the flagellum has forty-two joints.

The *labrum* (fig. 36, 5) appears strongly convex, nearly as deep as wide and notched on either side near its base, thus differing considerably from the condition in *N. assimilis*, to which Chilton has likened (1894, p. 194) the upper lip of *typicus*.

Mandibles. In the male, the left mandible (fig. 35, 6*l*) bears a cutting edge of three teeth; the slighter *lacinia mobilis* also has three, while near its base is a small, spined lobe; the spine row has a rounded surface fringed with doubly serrate spines arranged in horseshoe fashion. Immediately proximal to its base lie several close-set plumose setae; the molar is long and stout. The mandibular palp is robust and arises from a slight elevation bearing one stiff seta; the first joint is unusually long, being two-thirds of the length of the second. The setae arming the third joint bear a double row of setules; one, at least, of those on the first joint is minutely denticulate.

Upon the opposite appendage (fig. 35, 6*r*), the cutting edge has four teeth; the *lacinia mobilis* is wanting. The spine row has a concave surface edged with numerous spiniform setae and, in life, underlies the short row of plumose setae. The molar is long with its grinding surface lozenge-shaped and placed obliquely.

The *lower lip* (fig. 36, 7) consists of a basal region, cleft almost to its attachment, but with the two halves opposed when at rest. Each of these is produced distally into an outer lobe, strongly convex laterally, the mesial border almost straight. In the mounted preparation, these are rather widely separated, but near their proximal end, the inner border turns mesially at an angle of about 120° to pass into the distal end of the basal region. The lip closely resembles the condition figured by Chilton for *typicus*.

Overhanging (antero-dorsal to) the basal region is a paired structure which does not seem a normal inner lobe, and its relations to the basal portion are somewhat obscure. Probably it is a fold which permits of a wide divarication of the two halves, when it would form a median gutter leading directly to the mouth. On the anterior aspect of the lip, the apical region is set closely with fine setae in addition to the normal dense apical fringe.

The *maxillula* (fig. 35, 8) closely resembles that of *typicus*, and differs from that of other members of this sub-order in the unusual breadth of the inner endite

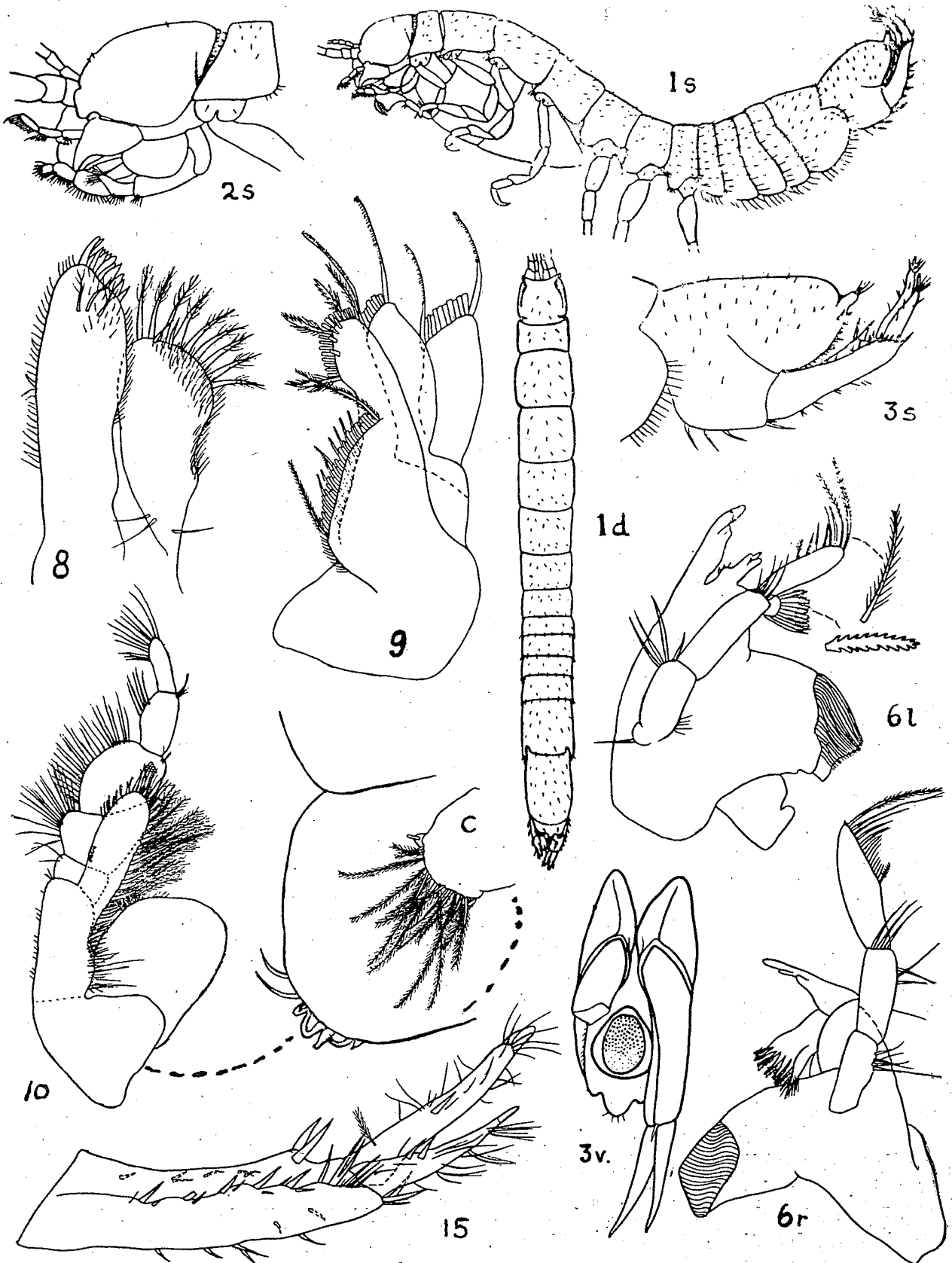


FIG. 35.—*Phreatoicus orarii*, sp. n.

(which exceeds that of the outer); it broadens distally and upon its slightly convex apex bears eight (Ashburton), nine, or ten (Orari R.) setospines.

Against the third and fourth of these (counting from the outer edge) rises, in the Orari specimens, a stiff, simple spine exactly as in *typicus*. In the Ashburton specimen, spines lie against the second and third setospines. It would seem, therefore, that the diminution in the number of setospines in the Ashburton specimen may have resulted from the disappearance of the outermost. In other species, where the number is still further reduced, the loss apparently occurs from both inner and outer ends of the row.

The outer endite bears short, simple spines arranged along its oblique distal margin in a double line, about sixteen in all. In both endites, the mesial border is rather less setose than in *typicus*, while the posterior surface of both is clothed distally with a dense fur of fine setae. Upon the posterior face of the outer endite is a sub-marginal cluster of three ciliated setae near the lateral border, these being more slender in the Ashburton specimen; they are not recorded for *typicus*.

In the *maxilla* (fig. 35, 9) the inner endite is clearly divisible into basal and distal lobes (recalling the condition in *Mysis*), with a fringe of fine setae at the extreme proximal end followed by a row of filtratory setae, which at its distal end passes round onto the anterior face of the endite, bounding the proximal part of the lobe; posterior to the filtratory setae is a series of six to eight pectinate (biting) setae, set in a nearly straight line, along an edge which is continued as the mesial edge of the distal part of this endite. There is a gap, devoid of setae, following the pectinate series, and the apex is crowned with a dense fringe of setae, mostly plumose. The two plates of the distal endite are fringed with pectinate (biting) setae; the posterior face of the whole of this appendage is clothed with fine, hair-like setae.

Maxilliped. In this species, the coxa is unusually large, the sub-rectangular epipodite has a wide attachment, is as long as the basis and has, disto-mesially, a few short, fringing setae. In its general proportions the appendage (fig. 35, 10), though rather less robust, agrees fairly closely with the condition figured for *N. assimilis* (1894, pl. 16, figs 10 and 11). There are about thirteen stiff brush setae along the dorsal free edge of the endite, and the inner dorsal edge of this endite is setose to its proximal end. It has three coupling hooks on one side, two on the other, which are strongly curved as in *typicus*. The dactyl is unusual in that it lacks setae on its outer border. In a spent female, the coxal lobe has the appearance of a small oostegite (fig. 35, 10c); in the adult, but non-ovigerous animal, the lobe is much like that of other mature female Phreatoicids (cf. Sheppard, 1927, fig. 2(i)). There is, however, an important difference, for, in this earlier stage, in *orarii*, the lobe is fringed with numerous stiff setae which are hook-like (fig. 35, c). In the ovigerous stage, these have been replaced by long, plumose, entangling setae.⁽¹⁾

The presence of such plumose setae suggests that they are respiratory, but it is possible that they may function, also, in hindering the entrance of small organisms into the brood-pouch.

The large development of these coxal lobes suggests that they retain more nearly a generalised Isopodan condition; in many members of the family they have become reduced in size.

In the female, the *peraeopods* appear to resemble closely those of *typicus* in slenderness, length, and setation. Nor, in the male of *orarii* (with the exception

⁽¹⁾ Such a replacement is of interest in connection with the analogous occurrence of coupling hooks and their replacement by entangling setae in the pleopods.

of the first and the fourth), do the peraeopods seem to differ noticeably from those of the female, except that they are rather more setose, as setose perhaps as in the male of *N. assimilis*, as figured by Chilton (1894, pl. 17).

First peraeopod (gnathopod), ♀ (fig. 36, 11 ♀). It is principally in the hand that this appendage differs from that of *typicus*. The propod is rather stouter, its anterior border more convex, its posterior border shorter and straight and the palm sinuous, swelling convexly at the postero-distal corner into a short blunt 'thumb', thus producing practically a chelate condition; this convex bulge bears a number of slender spines. The dactyl is as long as the palm, its outer border less convex than that of *typicus*, the palmar border nearly straight, fringed with short setae and minutely denticulate near its distal end.

In the remaining peraeopods of the female there are no noteworthy differences from the condition recorded for these limbs in *typicus* (female).

The *oostegites* in the latter species were seen (by Chilton) only in the stage preceding maturity. In *orarii*, this stage and the succeeding have both been examined; in the earlier stage they exhibit an arrangement which has been recorded for no other species (although probably occurring in *typicus*), the *oostegites* on the first and fourth peraeopods being borne erect, while they lie flat against the sternites and meet mesially on second and third. In the ovigerous stage the condition is practically that of other Phreatoicid species.

There is, however, in the mature female, one important detail to note. Lying immediately mesial to the fifth leg is a sub-triangular plate, which is flattened upon the related sternite. It is apparently an incompletely developed *oostegite* and overlies what appears to be the opening of the oviduct. In the presence of this structure, we have the nearest approach, in a New Zealand species, to the condition recorded for *Mesamphisopus*, in which a small, free *oostegite* on the fifth peraeon segment is present.

In the male, the gnathopod develops a very powerful hand, which, perhaps, just misses the chelate condition. In the 15 mm. specimen supplied by Dr. Chilton (fig. 36, 11 ♂) the anterior border is strongly convex, the hinder border short and straight, the sinuous palm produced into dentations which increase in size as the base of the dactyl is approached. The tip of the dactyl just over-rides the hinder angle of the palm. In one of the specimens collected by Mr. Scully (in 1937), some differences appear, probably attributable to complete maturity. In one feature, this species is peculiar, the carpus appearing capable of so considerable a rotation that the hand is carried horizontally, and turned forwardly at right angles to the proximal part of the limb, so that the palm lies in the transverse plane. Both propod and dactyl are more setose, the hinder angle of the palm has become slightly developed as a small thumb and the palmar margin here is transverse and convex, while the serrations of the more anterior part of the palmar edge are replaced by rounded prominences bearing stout conical spines. Chilton figures a rather similar condition in *N. assimilis* (1894, pl. 17, fig. 2), but the palm in that species is oblique. The dactyl is stouter and more curved, its apex not over-reaching the palm, and this distal end shows a finely denticulate condition, but a secondary unguis is not present.

Such powerful development of the gnathopod is found in many subterranean forms and probably indicates that they live in strongly flowing currents which might sweep the animal into open water. It has been pointed out (1926, p. 199) that in *Hyperoedesipus*, where this development is extreme, the gnathopod is presumably of use only in maintaining an 'earth-hold'; it is not used in catching

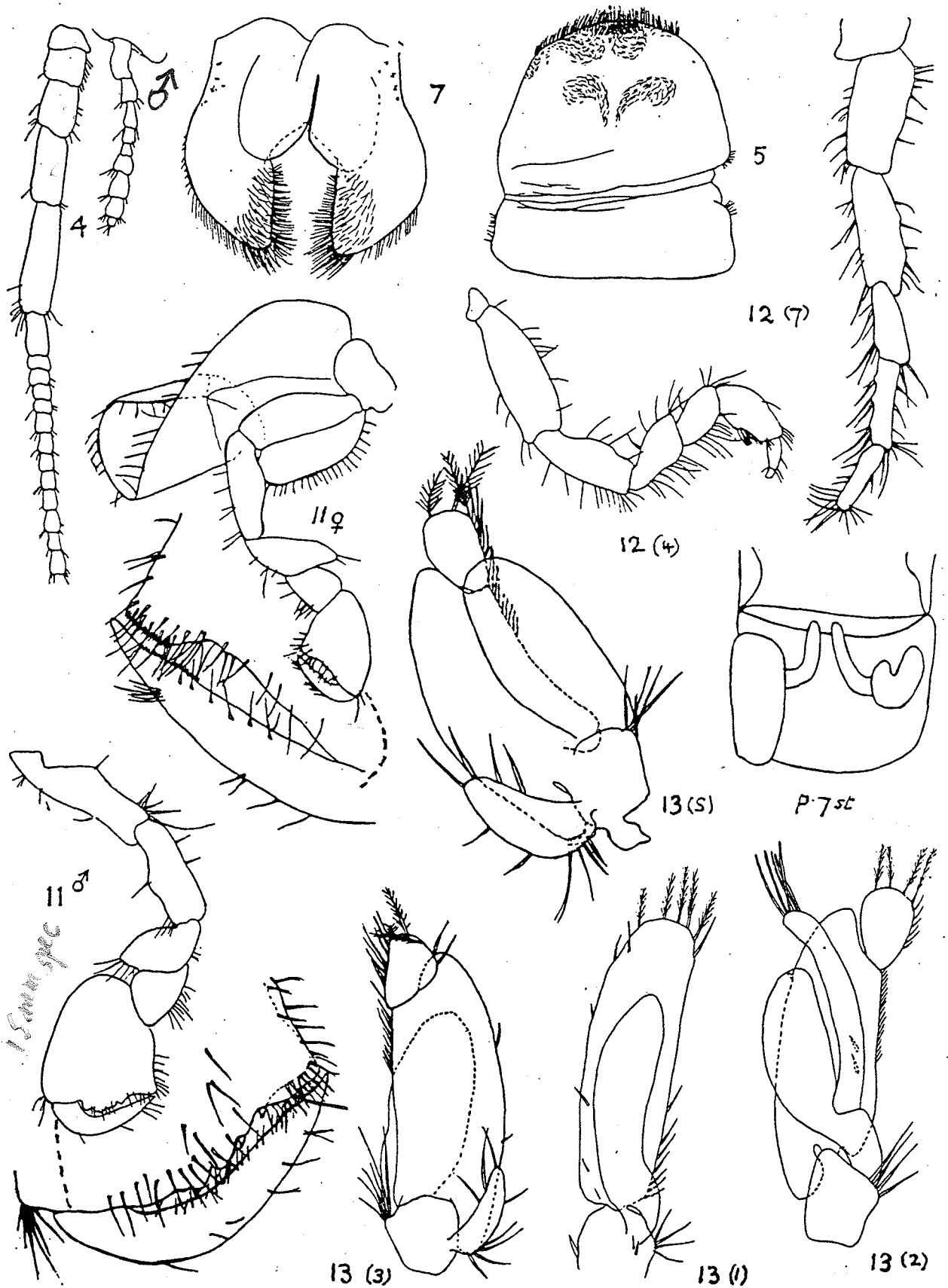


FIG. 36.—*Phreatoicus orarii*, sp. n.

prey, for the animal is a humus-feeder, not a predator; nor is it used in holding the female. The latter purpose is served by the fourth peraeopod, which is specially modified in varying degree in different genera.

The condition of the hand in this appendage (fig. 36, 12(4)) in *orarii* suggests that the dactyl shuts down on to the propod as in *N. assimilis*, *M. australis*, etc., but the spines on the propod which should encounter the dactyl are rather feeble, and it is possible that the propod⁽¹⁾ itself may be bent upon the merus, the musculature of this joint being quite strongly developed. On the dactyl of this appendage (in the male) there is a fairly stout secondary unguis; on the fifth peraeopod this is present but smaller, and in the other peraeopods it was not to be distinguished.

Seventh peraeopod. One other detail should be noted, connected with the thoracic limbs of the male. The area of attachment of the seventh limb is shown in fig. 36, p. 7, st., and it will be seen that the penis appears to spring from its mesial border. In removing the limb, it is usual to find that this structure, which contains the exerted vas deferens, will come away with the coxa. It thus has a relation comparable to that of the oostegite in the more anterior limbs of the female. The penes in this species are backwardly bent, short, and unarmed.

The pleopods. Of *typicus*, only the first and second pleopods were figured by Chilton (1882, pl. 4, figs 12 and 13); these agree fairly closely with the corresponding appendages of *orarii*.

First pleopod (fig. 36, 13(1)). Apically, the exopodite carries but four or five weak plumose setae, with a few (eight to twelve) simple setae proximally on its mesial border, and one or two upon the lateral border rather more distally, one of these being practically a spine; although the endopodite appears relatively longer than in *typicus*, it is still distinctly shorter than the exopodite; the large sympodite bears fewer entangling setae and only a single spine laterally, the outer edge of the sympodite being produced into a thin membranous flange, much more marked in some other species and which, as has been suggested in Part I, p. 21, may be the remnant of an epipodite fused with the sympodite.

The *second pleopod*, in the female, except for the separation of a distal joint to the exopodite, differs little from the first; there is, however, a single short spine on the outer border of the exopodite, and there are few terminal plumose setae. In the male (fig. 36, 13(2)), the penial stylet is little curved, but is unusually long, passing beyond the endopodite and reaching almost to the distal end of the exopodite (cf. *O. brevicaudatus*), a condition quite unlike that of *N. assimilis* as figured by Chilton. Apically, it is furnished with five stiff setae, while the inner border bears a couple of spines (not seen in the Ashburton specimen). The endopodite resembles that figured for *typicus*, but in the male the distal part seems to arise independently from a basal region, from which the penial stylet also springs—giving the effect of a two-jointed endopodite. In this appendage, also, the sympodite is well developed, the mesial 'entangling setae' sprouting in a bunch just proximal to the endopodite.

Upon the three remaining pleopods (fig. 36, 13) are borne epipodites, arising quite near to the basal attachment of the sympodite. They are narrow, rather long, sub-oval plates fringed with few (six to eight) long plumose setae. The endopodite reaches its greatest length in the fourth pleopod, while in the fifth, which is shorter and broader than the preceding appendages, the endopodite attains its greatest width. In this last pleopod the exopodite bears more setae on

(1) In *Amphisopus*, three joints are clearly involved, dactyl and propod shutting down together on to the merus to secure a grip on the pleuron or coxa of the female.

the second joint as well as retaining a cluster at its proximal end, while the entangling setae are now found springing from a moderately projecting lobe.

Uropod (fig. 35, 15). The peduncle is long and slender. It is widest at its dorsal surface, which is slightly concave and highest along its inner side, which ends in two stout spines; the outer edge, armed with a few spines, runs obliquely and, distally, bears two spines; thence a series of spines passes aslant to the ventral border, the last spine of this outer series springing immediately below the insertion of the rami. As in *typicus*, the spine is simple and not very stout and is flanked by a second and much smaller, simple spine. Along the inner surface of the peduncle, there are scattered setae; its undersurface has several tufts of fine setae, thus differing from *typicus* in which, according to Chilton, these setae form a continuous series. The inner ramus, as always in this sub-order, is longer and stouter than the outer; near its attachment a single sensory (auditory?), plumose seta arises from this edge; from the peduncle nearby there projects one long, slender, bifid spine, the forerunner, perhaps, of the multifid spine of other subterranean species. In *orarii*, both rami are slender, apparently laminar, tapering to a point, being capped with a spine which is fixed; along their upper surfaces are a few slender, movable spines and associated tufts of setae.

Neophreatoicus, gen. n.

Body vermiform, head and tailpiece elongate; telsonic apex abruptly truncate; eyes obsolete; a short cervical groove present, post-mandibular region long; maxillula with proximal endite narrow, armed with but three or four setospines; bases of peraeopods of hinder group moderately expanded; pleura of second to fifth pleon segments deeper than related segments, pleopods not notably reduced in size, but setal fringes on lamellae are relatively little developed; uropods moderately long.

Genotype. *Neophreatoicus assimilis*, sp. n.

The second of Chilton's New Zealand subterranean species, *assimilis*, is, without doubt, most closely related, among extant forms, to *P. typicus* and *P. orarii*, with which it has many features in common. Some, however, of these must be recognised as due to long-continued adaptation to a similar, subterranean, mode of life, any or all of which could have been independently acquired and are not, therefore, necessarily evidence of near kinship.

Such are (a) the eyeless condition, and the possession of long antennae; (b) the vermiform elongation of the body affecting noticeably the head and tail-piece; (c) the proportions of the peraeon segments; (d) the relative shortness of the pleon, and the shallowness of the pleura in this region; (e) the slight expansion of the bases of the peraeopods; (f) the reduction of setosity of the pleopods; and, perhaps, (g) the elongation and slenderness of the uropods.

If the elongate condition of the head in these three species is correctly interpreted as a feature secondarily acquired in relation to the subterranean habit, then the unusual length (and shallowness) of the post-mandibular region, the obsolescence of a posterior process of the head, and perhaps of the cervical groove, also, may be consequential changes. It may well be, however, that the two latter occurred before the adoption of the subterranean mode of life.

The same elongation could have brought about a small relative displacement of the appendages in this post-cephalic region, and so account for the existence of a small gap between the attachment of the maxilliped and the coxa of the

gnathopod, as seen in lateral view. This latter joint, it should be noted, is relatively small, which is surprising in view of the fact that in this, as in most subterranean forms, the gnathopod attains an exaggerated development.

Of significant characters common to all three species, which do not seem to be in any way related to the mode of life, might be noted—

- (1) The persistence of the telson only as an abruptly truncated and upturned apex, with a small *posterior* surface;
- (2) The occurrence of a stout, *simple* spine on the end of the peduncle of the uropod beneath the origin of the rami.

But *assimilis* differs from *P. typicus* and *P. orarii* in several notable features: the reduction in some of the mouth parts has gone much further, while the bases of the hinder peraeopods are expanded, the pleon pleura are relatively deeper and the pleopods less reduced; rather surprisingly, however, its body is much less setose than that of *P. orarii*. Moreover, according to Chilton, a cervical groove is present and arises from the ventro-lateral border of the head, a primitive condition and one practically lost in *P. typicus*; the proportions of the body, too, cannot be derivable from those of *P. typicus*.

It seems probable, therefore, that this form became adapted to underground life at a more recent date than *P. typicus*. If so, it could have arisen from a surface-living form in which modification of the mouth parts had already gone far beyond that of the form from which *typicus* was derived, while the expansion of the bases of the hinder peraeopods was less reduced. This phyletic difference must be expressed by referring *assimilis* to a separate genus.

Neophreatoicus assimilis (Chilton)

(Fig. 37)

Chilton, 1884, p. 89 (*Phreatoicus typicus*); 1894, p. 186, pls. 16 and 17 (*Phreatoicus assimilis*); and 1924, p. 8, fig. 1.

Thomson and Chilton, 1886 (*Phreatoicus typicus*) (part).

Sheppard, 1927, p. 111 (*Phreatoicus assimilis*).

Of the four New Zealand species recorded by Chilton, this was the most fully described and figured. Material available for this re-examination consisted of one specimen sent by Dr. Chilton, a second (slightly damaged) collected by the writer at the end of January, 1936, and a third sent by Mr. Pellatt of the Fish Hatchery at Temuka (near Winchester, New Zealand), taken a few weeks later. All three were males, the two more recent specimens being somewhat longer than Chilton's record. At the time of publication of his later paper (1894), Chilton seems to have had but three specimens, and it appears from an examination of his collection made in 1936, that he received subsequently very few additional specimens. It is thus one of the rarest of known subterranean forms.

Chilton has given a *habitus* figure of the female which shows many differences from the condition here recorded for the male. Chilton's original sketch was made, however, from a dried, mounted specimen, and the apparent differences between the two sexes in the proportion of segments, coxa, etc., may in part be attributed to shrinkage, etc., and are not, perhaps, as great as the figures would suggest.

Seen from above, the body is elongate, almost vermiform (fig. 37, *1d*), being of nearly uniform width, the head narrowing a little anteriorly; the length is almost exactly ten times as great as the width. Chilton has stated that, in the female, the body is of uniform breadth throughout its whole length.

In the peraeon, the depth of the segments is less than the width, but posteriorly the pleura of the pleon are downwardly produced (suggesting a compression of the body) and reach a maximum depth twice as great as the width of the pleon.

The body is smooth, with few short setae, distributed generally in small tufts. It is noteworthy that the arrangement of these suggests the remnants of two parallel transverse rows of setae in the peraeon segments and of a single row in the pleon segments.

Head. The head is as long, approximately, as the third peraeon segment; it is longer than wide and as wide as deep; its anterior border is emarginate; there is a well-marked sub-ocular notch; ventro-laterally the mandibular border is shorter than the post-mandibular. The cervical groove is said by Chilton to rise from the ventral border rather than the hind border of the head, an undoubtedly primitive condition which it would share with *Mesamphisopus*; in the specimen figured, however, this groove is not strongly developed.

Peraeon. In the male (fig. 37, 1s), the first segment, seen from the side, appears rather more than half the length of the second. In the mid-dorsal line, however, it proves to be little more than one-third of the length of that segment (or sub-equal to the seventh), due to the fact that both its anterior and posterior margins are strongly concave,⁽¹⁾ this condition being much more strikingly developed than in *P. orarii*. Below, it widens considerably, just touching the posterior margin of the head from which, however, it is quite free. Chilton records for the female the length of this segment as half the length of the second.

Pleon. The first to the fourth segments are all short, sub-equal; but in Chilton's figure (pl. 16, fig. 1) there is a noticeable difference in the pleura. The first pleon segment is practically not produced, while the pleura of the second to fifth segments are practically as deep as their segments and unusually long antero-posteriorly; the fifth is as long as the combined length of the first three, while the *tailpiece* is as long as the fourth and fifth combined. It ends in a slight projection, thus differing from the more or less gently convex apex of the surface-water forms from Otago, but approaching the condition found in *P. typicus* and *P. orarii*.

Below this projection, the telson is flattened posteriorly and down-turned, this area being bounded laterally by almost rectangular corners; thence it slopes sharply forward and ventrally in slightly developed pleura, which are fringed with spinules or setae. Antero-ventrally, the pleura of the sixth segment bears four or five curved, simple spines, the last being stoutest. From the ventral border of the telsonic pleura there runs upward and forwardly a very short ridge marking a vanishing suture between the sixth pleon segment and telson. It bears two spinules, its postero-ventral end being some little distance dorsal to the upper end of the insertion of the uropods.

Appendages. These have been described in considerable detail (Chilton, 1894, p. 188), so that it will be necessary here to note a few differences observed, and to record some features previously overlooked.

Antennule. Chilton records nine or ten joints in this appendage; the present specimen show but nine, the penultimate joint being long and slender as figured by Chilton. In the female, Chilton shows five flagellar joints. The condition of the *antenna* agrees substantially with Chilton's account.

⁽¹⁾ This condition is not very common in Phreatoicoids, but is frequently seen in other Isopods and in Amphipods, particularly where the animal habitually curls up completely. Related to this may be the retention of an unusual degree of development of the pleura in the pleon.

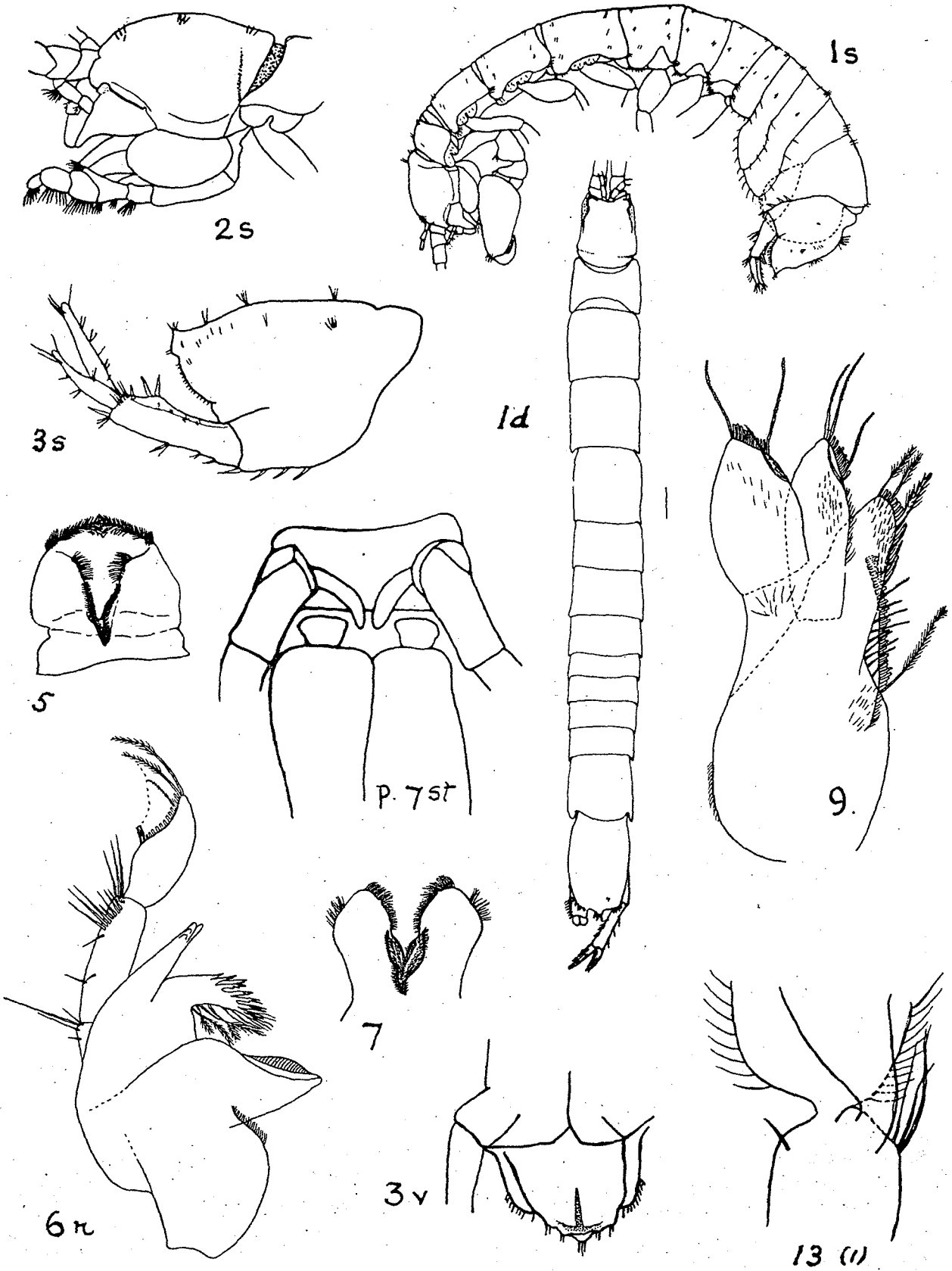


FIG. 37.--*Neophreatoicus assimilis* (Chilton).

Upper lip. Chilton has figured part only of this structure; actually, there is found an upper hinged portion, the epistome, and sutured to this, usually very firmly, in a lower portion—the labrum proper. It is this which Chilton has described. It is usually the composite structure which is figured, and in this species it is as deep as broad (fig. 37, 5).

The *mandibles* are as described by Chilton, except that there are found four teeth in the dentate edge of the right mandible (fig. 37, 6r) and the first joint of the palp is short. The articulation of this appendage with the head differs, however, in that its sinuous upper margin fits upon a *concave* articulation, well above the level of the post-mandibular border of the head.

Labium. Chilton's figure shows the two lobes adpressed. They can readily be separated and then have the appearance (fig. 37, 7) more usual for this structure, the inner border of the rounded outer lobes springing from a convex surface which represents, presumably, the rudiments of an inner lobe.

The *maxillula* is as figured (1894, pl. 16, fig. 8), the proximal endite being practically as wide as the outer. Chilton's figure, although clearly a posterior view, omits the ciliated seta on the hinder face of the distal endite. The *maxilla* (fig. 37, 9) has a rather short inner endite, but in the specimen examined, the distal portion is not bent at the angle suggested by Chilton's figure and the proximal row of filtratory setae passes well onto the face of the endite; the posterior row consists of about nine biting setae. The outermost endite is quite broad, the setae on both the outer endites being pectinate. The *maxillipeds* agree essentially with Chilton's description.

The *peraeopods* agree very closely with Chilton's figure, although both the gnathopod and the fourth peraeopod given the impression of greater stoutness; the specimen examined was a male of 14 mm. and rather larger than that figured by Chilton.

The *pleopods*, too, appear to agree quite closely with the account given by Chilton for his specimen, excepting for the details of the plumose setae on the apex of the several exopodites which were more numerous than were found in the specimen examined—in some cases twice as many. There are details, however, to which attention should be called—(i) the narrowness of the attachment of the two lamellae, so that the endopodite arises entirely mesial to the exopodite, and (ii) the production distally of the first joint of the exopodite in the hinder pleopods, so that the distal lobe is partly overlapped by the more proximal.

The penial stylet is figured as rather short; in the specimens under examination, it was strongly curved and long enough to reach the end of the proximal lobe of the exopodite; it is, also, distinctly stouter, this being probably a matter of age. It is armed apically in one specimen with four strong setae; in a second there are six or seven. Chilton mentions 'four or five' but figures seven.

In this connexion, it is to be noted that in all three examples the penes have been found to be as well developed as in other species. Chilton stated (1894, p. 196) that these were not to be seen in his specimen. It might have been supposed that his specimen was not fully mature, were it not expressly stated that the vas defrens was found packed with spermatozoa.

As regards the pleopods, it is to be noted that the condition of *assimilis* with regard to these appendages is intermediate between the condition seen in *P. typicus* (and *orarii*) on the one hand and the more nearly surface-living forms on the other.

They are long, particularly the first, second, and third, so that, although the pleura are well-developed, in life they hang partly exposed below. Not only are the actual lamellae long, but they have each a distinct stalk, notably in the second;

these are widely displaced, so that a gap between their bases is readily observed. In the first pleopod, the basal part of the endopodite is particularly noticeable, recalling the condition in *O. brevicaudatus*. In addition, the sympodite is relatively long. The exopodite of the first pair retains very nearly the primitive long-lanceolate shape which characterizes all of the Southland species, but they are less setose, bluntly rounded terminally and the plumose setae much less abundant, while the endopodite is both narrower and shorter, as well as being completely bare of setae and tending to be lobed apically.

In the sympodite, the outer distal spine is present, but is very slender. Since it is apparently a character of no value, its retention in these subterranean forms is of interest. Elsewhere it occurs, well developed, in *Mesacanthotelson* and *Onchotelson*. The lack of entangling lobes (the setae arising directly from the sympodite) is of interest as presumably a condition due to subterranean life and the desuetude of the swimming habit.

In the succeeding appendages, the endopodite is relatively smaller, oval or sub-oval in shape, while upon the exopodites the plumose setae become fewer and are persistent only apically. The epipodites, too, are relatively smaller than in the surface-water forms.

The *uropod* is noteworthy, for in its length and in its considerable extension behind the telson it resembles the condition of *M. tasmaniae*. The peduncle is long, the inner ramus sub-equal to it in length, lanceolate and laminar (rather than styliform as in most Phreatoicids), in these details strongly resembling *Mesamphisopus* and *Eophreatoicus*.

The sudden sub-terminal narrowing of the rami, to which Chilton refers, is very noticeable in this species (as it is in *H. plumosus*) and suggests the fusion of a blunt-ended joint with a primitively free spine. In the Amphisopine forms, this freedom of terminal spine (or perhaps second joint) still obtains. Beneath the insertion of the rami is a stout, simple spine flanked by a smaller spine.

Owing to the development of an actual posterior surface of the telson, the anal opening is not observed in dorsal view. Actually, it lies only just anterior to the end of the telson, the slit-like opening being set obliquely.

Colour. In life, a translucent bluish-white, becoming opaque and cream-coloured in spirit.

Size. Up to 15 mm.

Occurrence. Known from wells at Winchester, South Canterbury, New Zealand, and from a spring discharging into the Trout Hatchery at Temuka nearby.

Crenoicus, gen. n.

Body sub-cylindrical, fusiform, smooth; head of moderate length with slight sub-ocular incisure, cervical groove short, frontal slope not very steep; eyes wanting; peraeon segments deeper than long, the first short, expanded ventrally; pleon moderately long, pleura much deeper than depth of related segments, lower margin fringed with long setae, which are continued only as a sparse fringe along the hinder border; telsonic projection short, tapering to a bluntly pointed end, armed by one pair of spines laterally and a second paired spine latero-terminally;⁽¹⁾ telsonic pleura sparsely spined, sixth pleon pleura fringed ventrally with stout, simple spines.

⁽¹⁾ Sayce records but a single spine terminally in *shephardi*, and states that the toothed spine normally present below the origin of the rami is here absent.

Antennule ^{NO} ten-segmented, scarcely swollen apically. Maxilliped with propod broadly expanded; gnathopod of male with palm armed with a few low conical teeth; dactyl on hinder peraeopods long. First pleopod with exopodite narrow basally, widening at its mid-length and narrowing to a point apically; second pleopod, in male, with penial stylet produced distally into a stout, curved, spatulate process; uropod with but a single, toothed spine⁽¹⁾ beneath insertion of rami.

Genotype. *Crenoicus mixtus*, sp. n.

This genus has been placed in this sub-family only after much deliberation. For, while in a few respects it is peculiar, in most of the details of its structure it shows resemblances to a wide range of genera. Such a condition as that of the first pleopod of *C. mixtus* is met with in no other genus, although the proximal narrowing of the exopodite is reminiscent of the condition in the modified first pleopod of *Amphisopus* or *Synamphisopus*, while a similarly pointed apex is seen only in *Phreatoicopsis*. A comparable scattering of abundant setae on the anterior face of this lamella is seen in some species of *Paramphisopus* and *Amphisopus*, and the relatively reduced state of the endopodite is, also, paralleled in *A. annectens*.

The structure of the penial stylet is of particular interest in that it seems to provide the link between the two forms which this organ has assumed. It is unfortunate that Sayce has not recorded its condition in *shephardi*.

^{NO!} In the sub-triangular shape of its telsonic apex, members of this genus present a likeness to the condition of *Mesamphisopus* spp.; it might be considered as intermediate between that and the more rounded condition of *Paramphisopus* and *Notamphisopus* spp. as well as approaching that of *Neophreatoicus assimilis* and of *Metaphreatoicus affinis*. The number of terminal spines (four in both *C. mixtus* and *C. harrisoni*) is that widely occurring in many species, but the condition of *C. shephardi*, if correctly recorded, seems to be unique. The presence of but a single toothed spine beneath the origin of the uropodal rami in those same two species brings it into line with *Notamphisopus flavius*, *Uramphisopus pearsoni*, *Mesacanthotelson tasmaniae*, and *Onchotelson brevicaudatus*, but the simple (untoothed) condition of the relatively few and stout spines on the sixth pleon pleuron is characteristic of *Amphisopine* genera and of *Phreatoicus* (s.s.).

In the condition of yet another structure—the gnathopod—there is a rather different grouping; the palm on the propod is armed with a few stout, but low, conical teeth, resembling the armature found in the hand of species of *Phreatoicus*, *Neophreatoicus*, and *Notamphisopus* (amongst the *Phreatoicids*) and also in some *Paramphisopus* spp., although in the latter, the teeth are more strongly developed and more numerous. In members of the sub-families *Mesacanthotelsoninae* and *Paraphreatoicinae*, on the other hand, the teeth are numerous and strongly denticulated along the posterior convex border. In some *Amphisopidae* similar teeth occur on the propod. Comparable is the distribution of denticulation or slitting on the palmar edge of the dactyl.

Yet another example of this intermediateness is found in the way in which setospines and simple spines are grouped on the apex of the inner endite of the maxillula. In *Crenoicus* spp., of the two simple spines, one is placed outermost on the endite and the other between second and third setospine, an arrangement which occurs in the *Phreatoicidae* only in the two sub-families *Mesacanthotelsoninae* and *Paraphreatoicinae* (where it is constant) and amongst the *Amphisopidae* in *Eophreatoicus* and *Mesamphisopus depressus*. Since the loss of one setospine (the outermost) in other genera (*Amphisopus*, *Paramphisopus*, etc.) would bring about

⁽¹⁾ Sayce records but a single spine terminally in *shephardi*, and states that the toothed spine normally present below the origin of the rami is here absent.

a similar arrangement, it is probable that this was a condition acquired very early in the evolution of the sub-order. It is of interest, therefore, that in the remaining genera of the Phreatoicinae, this arrangement does not obtain.

One other generic feature may be considered, viz., that which concerns the comparative lengths of pleon and peraeon. In *C. mixtus*, the proportional length of pleo-telson to cephalo-peraeon (62 : 100) is much the same as in *australis* (58 : 100), there being relatively a slightly longer pleon; the condition is still more marked in *C. shephardi*, in which, according to Sayce, the proportions are 66 : 100. Chilton, however, differs from Sayce on this point and says that, although this may be true of the female, in the male the relative lengths of the two regions are much the same as those found in *Metaphreatoicus australis*. It should be noted, however, that Sayce's statement was based on the measurement of a male. The discrepancy may perhaps be explained by the fact that the specimens examined by Chilton came from Barrington Tops, and are specifically distinct from Sayce's example, being referred below to a new species *C. harrisoni*. Moreover, as Chilton himself recognized, differences in degree of contraction or telescoping of segments, may result in discrepant results. Thus in the specimen of *mixtus* the measurement quoted above as 62 : 100 was made along the dorsal surface with the segments in normal position; if viewed from above with the dorsal surface of the segments brought into a straight line the measurement would be 47 : 100. It will be obvious that measurements made in the position assumed by the animal at rest should give, more nearly, the correct proportions.

This feature has a certain interest, since all three of the species included in this genus are eyeless and well on the way to becoming subterranean. Now, as is well known, all modern Isopoda display a marked tendency towards the production of a shortened pleon; only in the Phreatoicoidea (particularly in the Amphisopidae) does the pleon retain a relatively considerable length, and, even in this sub-order, adaption to the subterranean mode of life is, as a general rule, associated with a further shortening of the pleon segments. It may well be, therefore, that in this rather less shortened pleon of *Crenoicus* spp. we have (notwithstanding a probable reduction due to subterranean habit) the partial retention of a condition more primitive than that displayed by *Metaphreatoicus* spp.

Crenoicus mixtus, sp. n.

(Figs 38 and 39)

Body (fig. 38, 1, s, d) slender, smooth, short scattered setae fairly plentiful, a few longer setae being distributed sparsely on the tailpiece. Head (fig. 38, 2s) short, little longer than the second peraeon segment; cervical groove nearly obsolete; the first segment of the peraeon short above, greatly expanded below; the second, third, and fourth segments sub-equal, longer than deep; the fifth and sixth segments sub-equal, but the sixth is deeper and the seventh slightly shorter and deeper still, its depth being almost twice that of the first segment. The ventral margins of the pleon segments are fringed with long setae, the hinder borders with less abundant and shorter setae; the first two pleon segments are sub-equal in length, but the second is abruptly deepened; third and fourth are longer and sub-equal; the fifth is as long as the tailpiece and nearly equal to the combined length of the second and third. The tailpiece (fig. 38, 3s) is, in side view, not greatly convex dorsally, but behind dips steeply to rise abruptly in a short telsonic projection. This process, while agreeing with species of *Paraphreatoicus* in

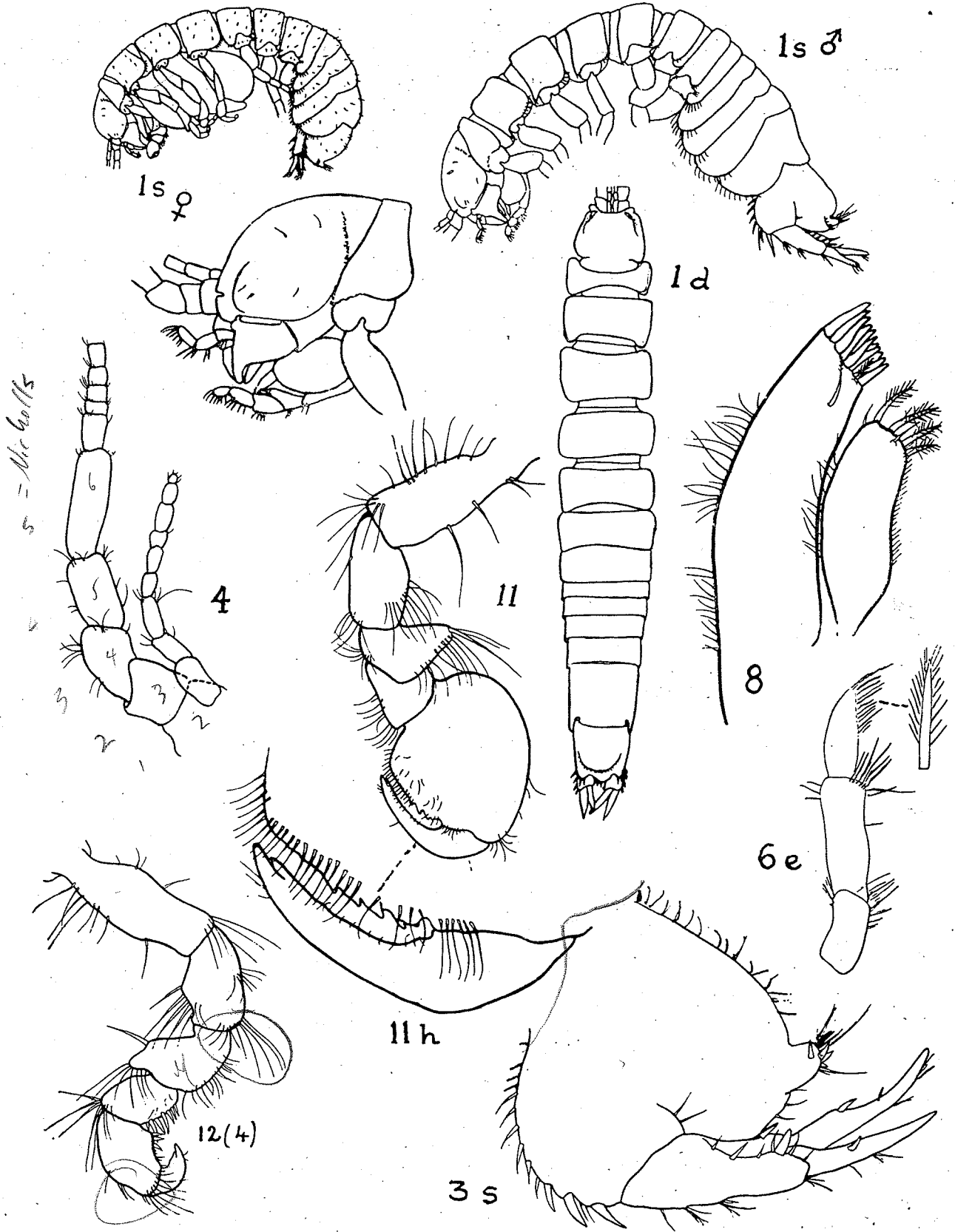


FIG. 38.—*Crenoicus mixtus*, sp. n.

bearing four spines, differs from those in the fact that it is bluntly sub-triangular in shape, and its spines are arranged in two pairs along its lateral surfaces (fig. 39, *t.a.*). In the rest of its armature, also, the tailpiece is distinctive; the anterior border of the piece slopes gradually to a rounded ventral region, armed with about seven spines of which the three hindmost are much the stoutest—*none* are toothed; flanking the last are three or four simple setae. The telsonic pleuron is defined above by a strong dorso-lateral ridge which bears a stout spine anteriorly, followed by another, and there is a third spine at the point where the ridge reaches the free border; the pleuron flares outwards and backwards much as in *Colubotelson* spp., its hinder extremity is produced into a spine and its free border bears a few setae variable in number; the suture at its lower boundary, which ends posteriorly just above the insertion of the uropod, is armed usually by two stout spinules, preceded in some by a third more slender spinule or seta.

Appendages. The antennule (fig. 38, 4) reaches to the end of the peduncle of the antenna, and its flagellum may have as many as seven joints. The *antenna* has a length equalling that of the head and first three peraeon segments. In the peduncle the first joint is short and the second and third sub-equal and nearly twice as long as the first, the fourth slightly, and the fifth considerably, longer than the third, but the last is not as long as the combined length of the second and third joints. The *labrum* is considerably broader than long and shows a quite evident asymmetry.

The right *mandible* has four teeth constituting the biting edge; the molar is elongate; the mandibular palp (fig. 38, 6e) has a moderately long first joint, the second only once and a half as long, and the third intermediate in length; this latter is slender and bears a single row of about eight sub-equal and doubly pectinate spine-setae, followed by an apical series of four much longer setae, also pectinate along both edges. On the inner endite of the *maxillula* (fig. 38, 8), the usual simple spines persist, one lateral and one (the central) between the second and third setospine, but on the outer endite only one plumose seta occurs on the posterior face. 13

The *maxilla* (fig. 39, 9) has the end of the proximal endite broadly rounded; the fringe of setae upon the free edge of the distal endite is relatively long; the outer endite seems folded over lengthwise upon itself.

The *maxilliped* (fig. 39, 10) has the coxa large; the endite on the basis has about nine brush-setae and apparently only three coupling hooks; the propod is expanded; the epipodite, rounded distally, is almost as broad as long, its proximo-lateral edge fringed with setules.

The *gnathopod* (male) (fig. 38, 11) has a fair number of setae on the basis; the ischium is relatively long for this appendage, the merus well produced anteriorly, the propod sub-globose with a long convex palm, armed only with four stout, conical teeth at the end nearer the dactyl; the free posterior border of the propod is convex and about as long as the unarmed part of the palm.

The fourth peraeopod (fig. 38, 12(4)) has the merus rather long, the posterior border of the carpus well provided with spines, a quite definite and very spinous palm on the propod and a stout dactyl. The bases of the hinder peraeopods are scarcely expanded; the seventh peraeopod is slender and its basis is fringed with setae along both anterior and posterior borders.

The first pleopod (fig. 39, 13(1)) has an exopodite of quite unusual shape, narrow proximally, widening sharply at its mid-length and tapering to a rounded point distally, with about fifteen plumose setae at the apex and latero-proximal to that. Its mesial border is fringed proximally with stiff spine-setae and its

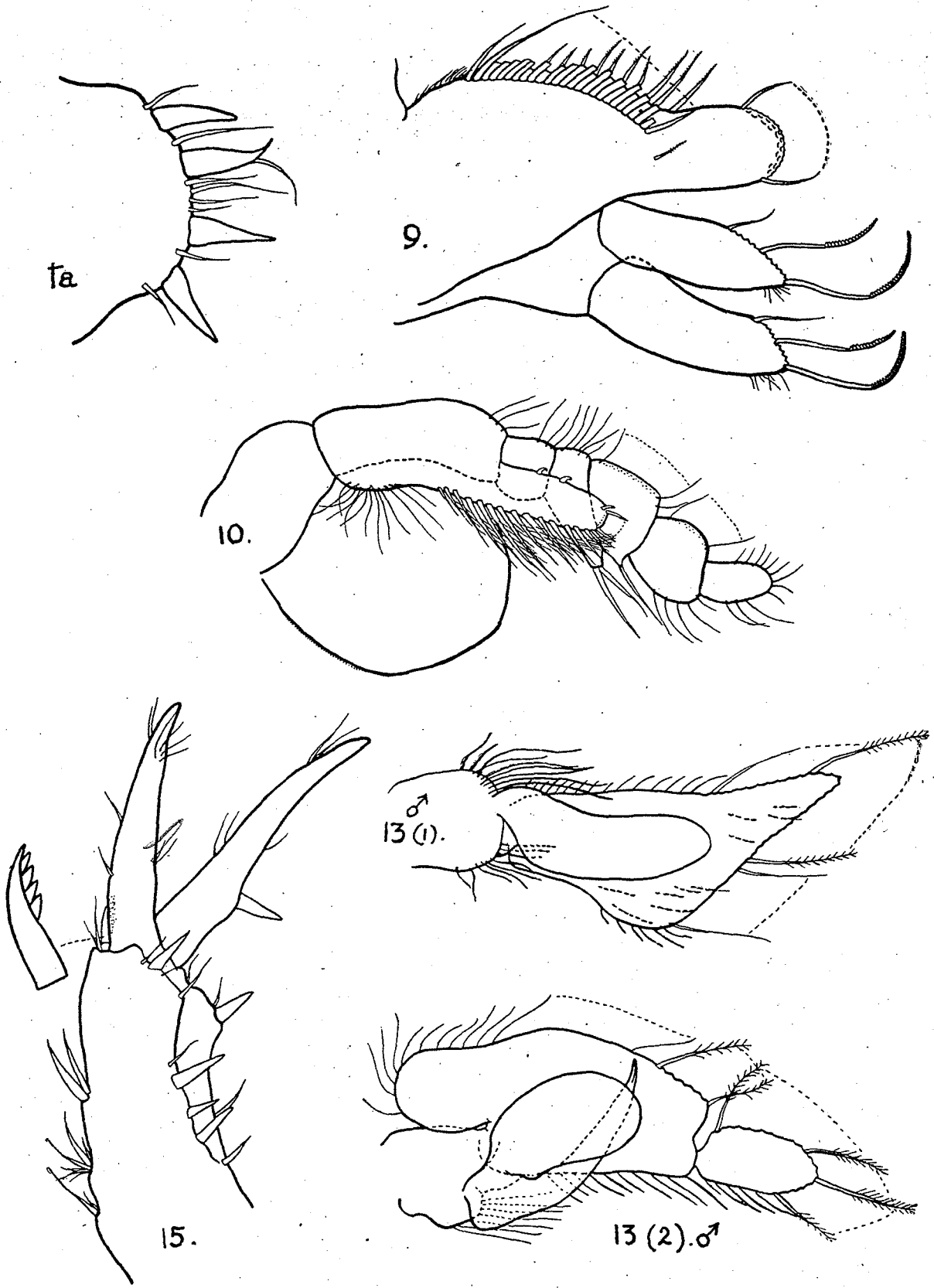


FIG. 39.—*Crenoicus mixtus*, sp. n.

hinder face has a scattered covering of setae. The second pleopod of the male (fig. 39, 13(2♂)) also shows the unusual narrowing at the proximal end of the exopodite, which is produced into a long, proximo-lateral lobe, as long, practically, as the sympodite. The endopodite is small and the penial stylet, unarmed terminally, curved and tapering in a fashion recalling that of some of the Amphisopine forms. The third pleopod shows a long proximo-lateral lobe, but there is little trace of the sinuous outer margin of the two preceding pleopods.

Uropods (fig. 39, 15). Moderately short, peduncle stout, its inner border rising apically, its depth at that point being almost equal to half its length; there are usually two apical spines, both very stout, but one is sometimes wanting, while the outer border, which is lower than the inner, bears usually three strong spines; the lower edge bears three tufts of mixed spines and setae, relatively long and strong; below the insertion of the rami is the characteristic stout spine with well-developed teeth; this is flanked by a couple of stiff setae. The terminal spine may be readily overlooked, since it is almost hidden by the wide base of the outer ramus. Both rami are stout, each bearing one stout spine and variable setae; the inner is almost as long as the peduncle.

Size. A large male measured 14 mm.

Colour. Pale yellowish-brown in life, fading to straw colour in alcohol.

Occurrence. Some thirty specimens, mostly small, were taken (9/1/28) on the Dividing Range near Ballarat, in springs and soaks at the source of that city's water supply. About eight of these were females, four having a brood-pouch, and three with brood lamellae. One specimen had the gnathopod of the male combined with the broadened peraeon of the female. The brood-pouch of one contained about a dozen embryos.

Crenoicus shephardi (Sayce)

Sayce, O. A., 1900, p. 25, pl. 3 (*Phreatoicus shephardi*).

Sheppard, E. M., 1927, p. 112 (*Phreatoicus shephardi*).

nec Chilton, 1917, p. 91, figs 13-17 (*Phreatoicus shephardi*).

This species was described by Sayce from a single specimen, a male of 10 mm. A comparison of the account given by Sayce with the condition found in *C. mixtus* reveals the following differences:—

The body is stout, and if Sayce's *habitus* figure is accurate, there are differences in the peraeon, for the first segment is shown as not greatly expanded below, the fifth segment shorter than either the sixth or seventh. It may well be that this quite unusual shortness of that segment (and a consequent shortening of the total peraeon length) would account for the relatively greater length of the pleon, for the proportions of the segments of the pleon are found to agree closely with those of *mixtus*.

The ventral armature of the sixth pleon pleura consists of six large, curved, simple spines, increasing in size distally and, near the base of the uropod, eight finer, simple spinules; telsonic pleuron rounded but, according to Sayce's figure (1900, pl. 3, fig. 1) projecting scarcely at all backwardly; the telsonic projection, also, is very short and, if the specimen described was normal, is quite unusual in that it has one large *median* spine and a pair of smaller lateral spines associated with some longish setae.

The *antennule* is relatively shorter, 'not reaching to the extremity of the peduncle' of the antenna. The joints of the peduncle of the *antenna* differ in relative length, the third being practically twice as long as the second, the fifth as long as the combined length of the first three joints.

The left *mandible* is figured (Sayce, 1900, pl. 3, fig. 4), but not described; the principal dentate edge shows four teeth; the spine row is not, apparently, followed by free plumed setae; the palp agrees fairly well with that of *mixtus*, but the first joint appears shorter, the second more setose and the third relatively longer. The description of the *maxillula* suggests nothing different from that of *mixtus*, but the figure indicates two plumed setae sub-apically on the hinder face of the outer endite; in both *mixtus* and *harrisoni* only one of these is found. The figure (Sayce, 1900, pl. 3, fig. 5) of the *maxilla*, if it correctly depicts the setal armature, suggests a very reduced condition of the filtratory setae, a condition, indeed, that is found otherwise only in vermiform species greatly modified for subterranean life.

Sayce's account (1900) of the *maxilliped*, which agrees quite well with his figure (pl. 3, fig. 7), indicates that this appendage is somewhat unusual; the epipodite is particularly long and produced almost to a point apically, and all of the terminal four joints of the palp unlike those of *mixtus*.

The *gnathopod* is in general agreement with that of *mixtus*, hand and palm seemingly very similar; the basis is shown as less setose. No mention is made of the sexual modification of the fourth peraeopod, which in the two species examined is a little unusual in that there is a suggestion in the spinose armature of the carpus that three joints may be involved in the clasp as is the case in *Amphisopus* spp.

Pleopods are dismissed as 'normal', but it seems altogether likely that they were not markedly dissimilar from the condition described for those appendages of *C. harrisoni*; if so, they will have differed distinctly from those of *Metaphreatoicus australis*.

In the *uropods*, differences are recorded; the outer upper margin of the peduncle is described as 'very spinose', and Sayce stresses the fact that the strong, toothed spine which is present in *M. australis* at the end of the peduncle and beneath the insertion of the rami is here not represented, apparently a unique condition, for in all other Phreatoicids there seems to be at least one spine (either toothed or simple) present in this position.

Size. Male 10 mm.

Colour. Light brown with indefinite markings of darker brown.

Occurrence. Collected (1899) by J. Shephard under moss at the source of a spring running into Wallaby Creek, Plenty Ranges, Victoria.

An unsuccessful attempt was made in January, 1928, to rediscover the locality and obtain further examples of this species; in the meantime, specimens, assigned by Chilton to *shephardi*, had been taken by C. Hedley (Jan., 1916) ^{or before} at Barrington Tops in N.S.W. These, however, differ in numerous characters from Sayce's species and are described below under the name *C. harrisoni*.

Crenoicus harrisoni, sp. n.

(Fig. 40)

Chilton, 1917, p. 91, figs 13-17 (*Phreatoicus shephardi*).

This species seems to be quite nearly related to *mixtus*, with which it agrees in several particulars, some of which were not recorded by Sayce for *C. shephardi*.

The *body* is sub-cylindrical; head short, first peraeon segment short and parallel-sided; second, third, and fourth sub-equal, deep as long; fifth, sixth, and seventh progressively shorter. In the pleon, the first to fourth segments, though short, are rather longer than is usual amongst Phreatoicids, the fifth segment not being as long as second and third combined.

A. M. Specimens
Dec, 1915.

Appendages. The *antennule* (fig. 40, 4) has the ten joints usual in this genus, but in this species there is shown a tendency to widen distally, in the fourth, fifth, and sixth joints. The *antenna* differs from that of *shephardi* as figured by Sayce (1900, pl. 3, fig. 3) in that the three more distal joints of the peduncle, while increasing progressively in length, decrease scarcely at all in width; these joints, too, are much less setose; the flagellum, almost complete, shows twenty-five joints.

The *labrum* is, as usual, asymmetrical, there being a relatively deep incisure for the right mandibular palp. The *mandible* (fig. 40, 6r) agrees, in general, with *mixtus*, as also, with the figure of *shephardi* given by Sayce. On the right appendage, the second joint of the palp is long, the third joint shows a setal fringe, arranged, for the most part, in a single row of thirteen setae, which are all finely pectinate, but none show the denticulate condition found in *mixtus*. The spine row is strong, the individual teeth doubtfully denticulate.

The setal fringe upon the mesial aspect of the labium is very dense, but seems to include some spines of which one, a slender spine, stands out distally, not, however, a setospine.

Upon the inner endite of the maxillula there is the usual Phreatoicid apical fringe of four setospines, but the two flanking (sub-terminal) spines are here slightly ciliated. The outer endite has but ten stout apical spines, some being denticulate. On its hinder face, the place of one spine is taken by a relatively long and slender setospine, while more proximally are two feebly plumose setae, indicated, also, in Sayce's figure (1900, pl. 3, fig. 6) of *shephardi*—only one being found in *mixtus*.

The row of filtratory setae which partly constitutes the mesial fringe of the proximal endite of the maxilla appears much better developed than in *shephardi* (Sayce, 1900, pl. 3, fig. 5). Lateral to it is a slender, simple spine, while behind it is a supporting row of about nine to ten biting setae; the terminal lobe of this endite is somewhat expanded, but narrows apically and bears a sparse fringe of stout, biting spines and half-plumed setae; the two outer endites have a fringe of but few doubly-pectinate spines and setae, relatively shorter than in *mixtus*.

The *maxilliped* differs little from that of *shephardi*; there is the same widely expanded propod, while the epipodite is long, pointed distally, and without bordering spinules; a short fringe of setules proximo-laterally, as in *mixtus*; four coupling hooks are found upon the endite of the right appendage.

Chilton (1917, p. 93, figs 13, 15) has called attention to differences between gnathopods of male and female, and has stressed the enlarged condition of the propod in the male. Actually the propod is not especially developed, although large development of this joint is a fairly constant feature in species which have adopted the subterranean or burrowing habit. The palm (fig. 40, 11h) of this species differs slightly in its armature from that of *mixtus*, but probably resembles quite nearly that of *shephardi*; the free posterior border of the joint is concave. The fourth peraeopod (fig. 40, 12(4)) of the male is unusually stout and differs in some details from Chilton's account, the propod being widely expanded, without evident palm and without spines, suggesting that the tip of the dactyl shuts down on the abundant spines on the carpus.

The basis of the seventh peraeopod (fig. 40, 12(7)) appears to be less expanded than is suggested by Sayce's figure (1900, pl. 3, fig. 9) for these limbs in *shephardi*, its anterior border is free from setae; the male appendage, arising from the coxa, is quite unusually long and armed by one stout spine at about its mid-length.

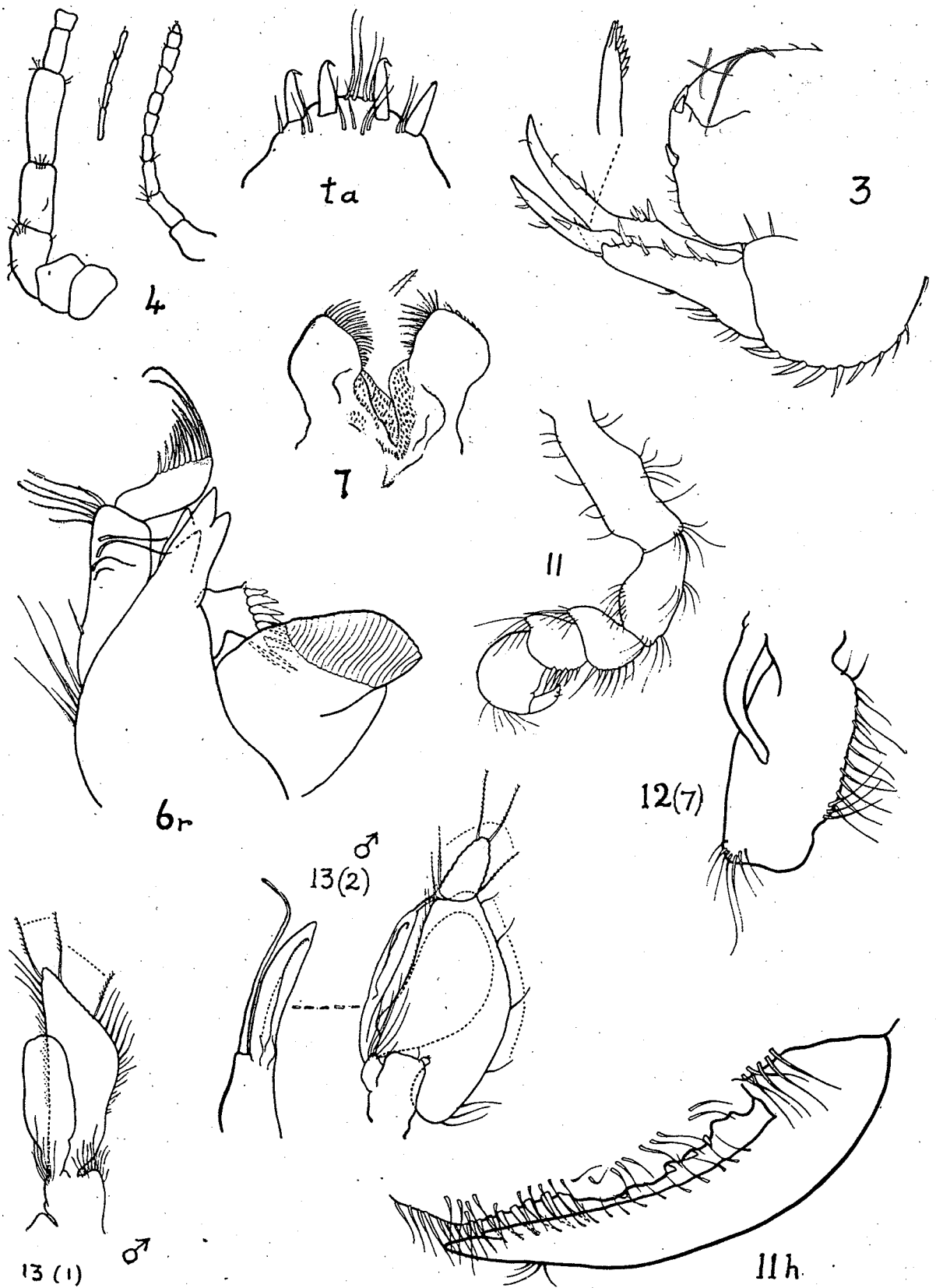


FIG. 40.—*Crenoicus harrisoni*, sp. n.

Concerning the pleopods of *shephardi*, Sayce says merely 'pleopods normal'; Chilton makes no reference to them, and yet both in this species as in *mixtus*, the shape of the first pleopod of the male is quite unusual (fig. 40, 13(1)). Indeed, insofar as outline goes, it can compare only with that of some *Amphisopus* spp., although the proximo-lateral emargination seems to be unrelated to any transverse fold across the exopodite, such as found in *Amphisopus*. The endopodite is oval, much longer than in *mixtus* with a distinct basal region and emarginate distally.

The second pleopod (fig. 40, 13(2)) of the male is remarkable chiefly for the condition of the penial stylet which, outside of this genus, has no close parallel within the sub-order. It is long, with its mesial border curved, and its lateral margin straight, and is armed terminally by a stout spine in addition to the longer structure of hollowed spatulate shape, which alone completes the stylet of *mixtus*.

The uropod conforms quite nearly to the figure of this appendage given by Sayce (1900, pl. 3, fig. 10), but it differs in that, in *harrisoni*, there is developed an unusually long and strong denticulated spine at the end of the peduncle. Since the presence of at least one spine here is such a constant feature in Phreatoicids, it might have been supposed that this spine was present in *shephardi*, obscured by the outer ramus, were it not that Sayce twice insisted that it was wanting.

Size. 13.5 mm. (male).

Colour. In preserved specimens, palely straw-coloured.

Occurrence. Collected by the late Professor Harrison at Mount Royal (Barrington Tops); presumably identical with that collected nearby some years earlier (Jan., 1916) by C. Hedley.

NOTE.—Two or three specimens in the collection of the Australian Museum taken at 'Crystal Springs' near Armidale (New England), N.S.W., should probably be referred to another species.

Notamphisopus, gen. n.

Body sub-cylindrical and fusiform, setae moderately abundant; the head short, the mandibular region usually longer than the post-mandibular; the 'posterior process' reduced or absent; the peraeon deep; the pleon with pleura well developed, tailpiece practically not produced into a telsonic projection, and the telsonic pleura may actually project behind the telsonic apex. The antennae short; the maxillula with inner endite narrower than outer with few setospines; the maxilla with distal part of proximal endite not sharply marked off from basal part; the peraeopods stout, spinose, bases more or less expanded; the fourth peraeopod sexually modified; the first pleopod with exopodite and endopodite fringed with plumose setae; the uropod with inner border of peduncle raised, rami lamellar, spinose; spine beneath insertion of rami, toothed.

Genotype. *Notamphisopus littoralis*, sp. n.

but note p. 58 *N. dunedinensis*
without edge

Notamphisopus littoralis, sp. n.

(Figs 41 and 42)

The body (fig. 41 (1)), seen from above, appears widest at the fourth peraeon segment, the length in the male being six times the greatest width; the sub-cylindrical peraeon has a width once and a quarter its depth; in the pleon the greatest depth is slightly greater than the maximum width of the body. The surface, which shows no wrinkling or sculpturing, is sparsely set with fine setae,

whose arrangement in the peraeon, at least, suggests incomplete double rows. In the female, the peraeon is rather wider, the body length being only five times the greatest width, which latter is sub-equal to the greatest depth of the pleon, these being proportions which agree closely with those of *Eophreaticus kershawi*.

These measurements, however, depend to some extent upon the state of preservation of the individual. Commonly (as in the male figured) the terga in the peraeon appear to be separated by wide inter-segmental gaps. In this species, at least, these gaps are more apparent than real, for an unusually wide posterior border of each of these terga seems bevelled and is apparently capable of sliding beneath the anterior border of the succeeding tergum. Related to this telescoping, the postero-ventral fringe of setae, normally marginal, is here sub-marginal. In the female figured (in which the setae are not represented) the terga are seen in the closely approximated overlapping condition.

The head (fig. 41, 2) is short and rounded, depth and length being approximately equal, the width slightly greater; in front it rises steeply from the transverse anterior border which is only shallowly concave. In the male, the head is scarcely longer than the second peraeon segment, but in the female it appears nearly equal to the combined length of first and second peraeon segments. A minute oval depression, near the anterior border of the head, may mark the original position of an eye—now entirely obsolete. The sub-ocular incisure is well marked, while behind the mandible is a vestige of the posterior process. From the hinder border of the head, at about half its depth, rises a short but quite definite cervical groove, widely interrupted dorsally. The post-mandibular region is deep but short, its length about half that of the mandibular border.

Peraeon. The first segment is short, being, in the mid-dorsal line, approximately half the length of the second segment; the third is a trifle the longest; the fourth is sub-equal to the second; the fifth, sixth, and seventh are progressively shorter. In all of these the antero-ventral angle is produced downwardly, in front of the coxa, into a process armed with setae. Postero-ventrally, the first segment is rounded off considerably; in the succeeding three, the corner is less truncated, and on each there is a short, setal fringe. This shaping of the terga would appear to be related to the ability of the animal to roll up more or less completely.

Pleon. The first segment is very short; the second, third, and fourth are slightly longer and, in the female, sub-equal; the fifth is longer than the combined length of the third and fourth; the pleura of the second to fifth segments are deeper than their related segments, a notch generally marking the junction. The ventral borders of the pleura are fringed with long setae, and, in the male, much of the posterior borders as well.

The tailpiece (fig. 41, 3) is scarcely as long, in the mid-dorsal line, as the fifth pleon segment and practically equals the head in length. The telson is not produced apically and practically not upturned; seen from above, its transverse hinder border is very gently convex and fringed with setae, while the telsonic pleura project strongly backwardly, giving to the tailpiece, in dorsal view, an outline little different from that of the preceding (fifth) pleon segment. The antero-ventral border has a fringe of about twelve or thirteen curved, slender spines (only eight in the female), increasing in length posteriorly. The postero-ventral border bears a fringe of short setae, which are replaced, dorsally by spines, three or four in number. The suture separating the telsonic pleuron from that of the sixth pleon segment is short, but quite definite and bears two or three stout

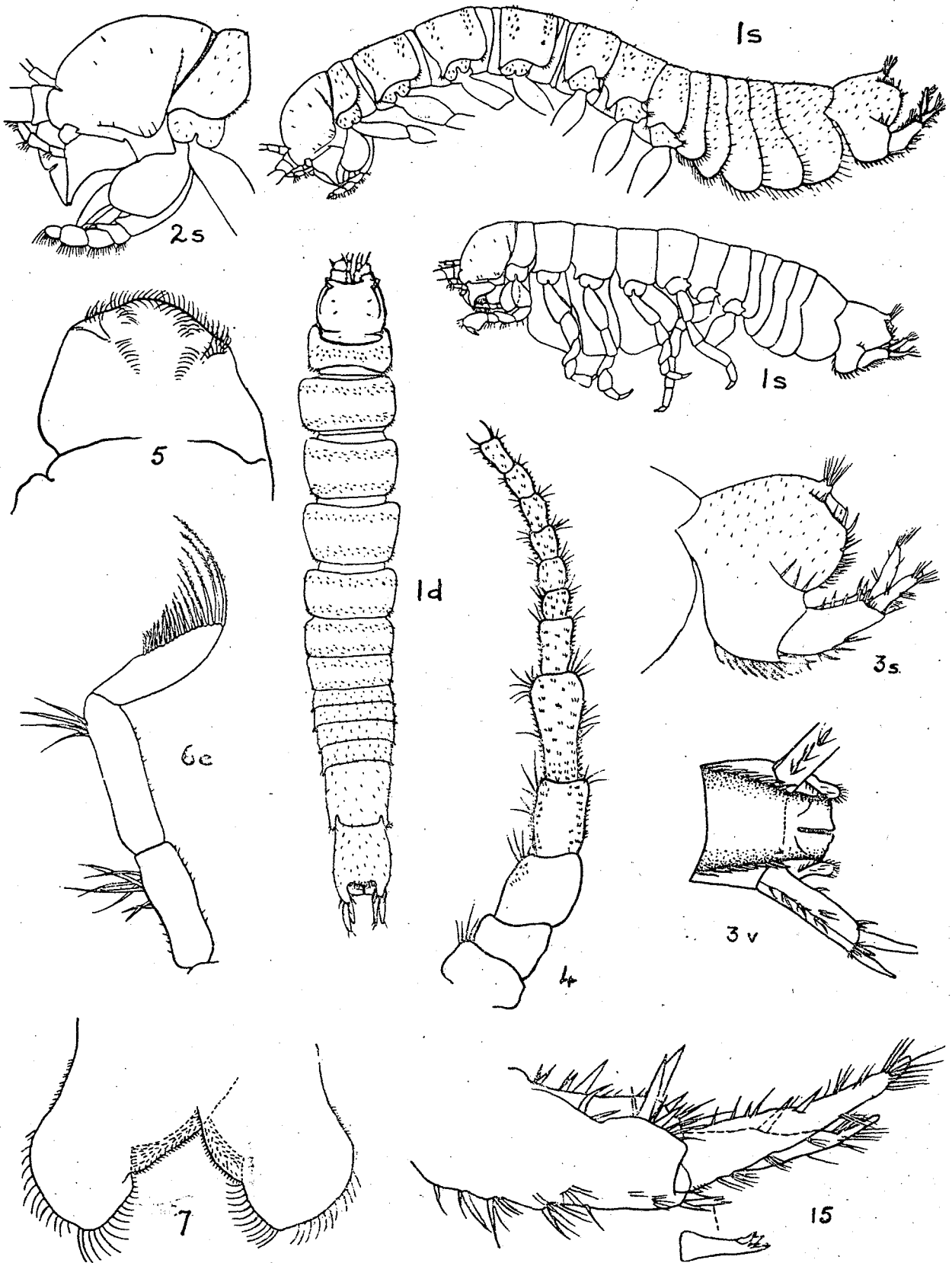


FIG. 41.—*Notamphisopus littoralis*, sp. n.

spines. It meets the ventral border some distance above the insertion of the uropod, leaving a distinct gap between that appendage and the telsonic pleuron.

Owing to the absence of any backward projection of the telson, the anal opening, which is strictly terminal (fig. 41, 3v) may be visible on the rounded posterior end of the body, viewed from above (fig. 41, 1d). This condition is found in several New Zealand surface forms, and a comparable vertical opening, terminally situate, occurs in *Phreatoicopsis*. In the majority of Phreatoicids, however, the anus is found to open postero-ventrally or even ventrally into a concavity, well forward of the base of the telsonic spine. Thus, while its terminal position in *Notamphisopus* may be due simply to the reduction of the telsonic area and spine, it may equally be the retention of a primitive condition.

Appendages. The antennule consists of eight joints in the male, fewer in the female, with little distinction between those of peduncle and flagellum, except for size and that some of the more distal (flagellar) joints are swollen and bear olfactory cylinders.

The *antenna* (fig. 41, 4) is short, less than one-third of the length of the body, and moderately robust. Its condition is unusually primitive, inasmuch as, apart from decreasing thickness, the several joints of the peduncle are not strikingly different; in length, the third and fourth are equal, the fifth only two-thirds of the combined lengths of third and fourth; there are seventeen joints in the flagellum. Many of the joints, both in peduncle and flagellum, show well-marked fringed scales.

Labrum (fig. 41, 5). This is stout, attached above to a well-developed epistome; the convex outline of its ventral border is uneven and is edged by an irregular fringe of longish setae; the structure is unusually asymmetrical, being irregularly excavated where the mandibular palps rest upon its lateral borders, that of the right side lying in a deep notch.

The *right mandible*. Examined, in position, this is seen as a sub-triangular body with a short, straight, nearly horizontal, hinge-like articulation with the ventro-lateral margin of the head, this articular line appearing less than, or about, one-half of the length of the appendage. In front of this hinge, the large, rounded fulcral process is stout and is directed upwards and forwards to rest against a hollow on the ventro-lateral border of the head. Behind the hinge, the dorsal border of the mandible curves away to bulge into the rounded acetabular process, which fits upon a convexity at the forward end of the post-mandibular region. The anterior border of the triangle is nearly vertical, its apex—the dentate cutting edge (with four teeth)—being incurved mesially; the palp springs from the anterior border within its upper third. The posterior side of the triangle is sinuous, being at first concave and then convex.

If the mandible be rotated outwards until it is loosened sufficiently to be turned completely upwards against the side of the head, the mesial surface is exposed. The spine row is long, lying immediately proximal and internal to the *pars incisiva*, the massive molar presents its truncated end as a ridged oval surface; in side view this surface appears somewhat saddle-like; the large, sub-quadrangular opening of the adductor muscle occupies much of the inner surface.

If the left mandible be similarly examined, several differences will appear. The fulcral projection is more remote from the hinge-like articular edge, which is less noticeably distinct from the acetabular process. The fulcral process seems to spring from the anterior surface of the base of the molar, and this latter has an altogether different shape, the grinding surface appearing an irregular long oval in surface view. The adductor muscle is presumably more powerful, as the

opening on the inner face of the mandible is larger, and differs, too, in shape from that of the opposite side. There is present, of course, in addition, a *lacinia mobilis*, which is not very strong and has but two small teeth; the spine row differs in shape. The principal dentate edge bears four teeth. Free plumose setae between spine-row and molar were not seen, but the inner surface of the spine row and its base is heavily setose.

Differences were not observed in the two palps, but it should be noted that accurately to determine differences in proportions in the lengths of the three joints, measurements must be taken when the palp lies wholly in one plane. As it is carried in life, the palp is usually bent so that the terminal joint is carried in front of the labrum or epistome, and measurements made from sketches of the entire appendage with the palp attached are liable to be misleading. Reliable measurements are to be obtained only if the palp be removed for examination.

In one specimen, the first and third joints were sub-equal, the second exceeding them by one-fifth only of its length, but in others the second was relatively considerably longer. There is some slight variation in the number and disposition of the setae; it is to be noted, however, that on the terminal joint the setae are set *in a single row*, except at the apex, where two stout, additional setae are present, forming a second rank. These setae (fig. 41, 6e) are finely pectinate along two edges.

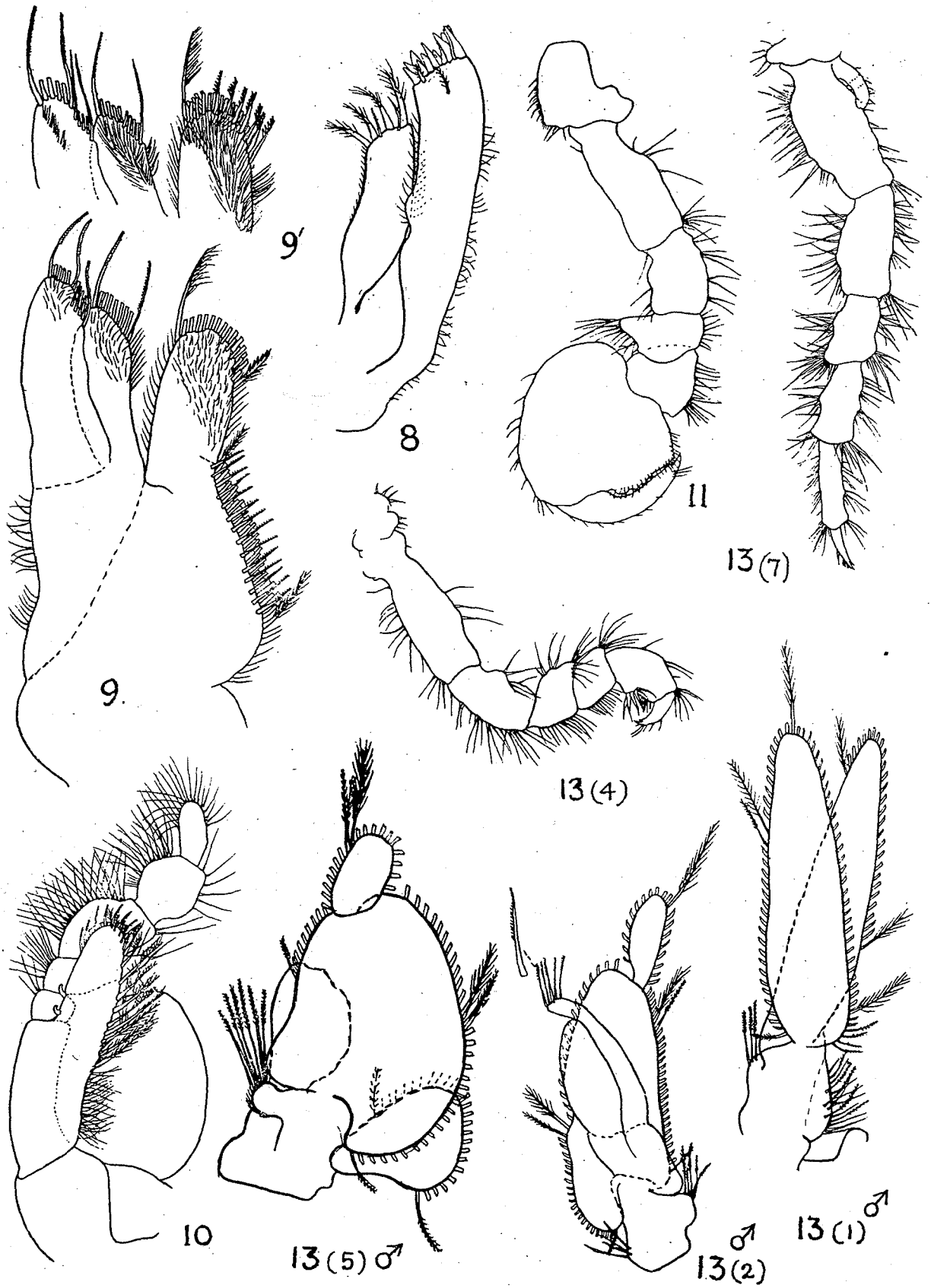
The *labium* (fig. 41, 7) is markedly different from that of *typicus*, and shows a condition approaching that seen in the great majority of Phreatoicids. In the figure, the setae on the mesial borders are merely indicated; they are, in fact, more abundant, although the fringe is less dense than in Australian Phreatoicids.

Maxillula (fig. 42, 8). The inner endite is short but moderately wide so that the four setospines borne on its free end are widely spaced. The sub-marginal row consists of two slender spines, one against the outermost and the other between the second and third of the setospines; this inner spine is finely pectinate; the outer (on both appendages) bears but a single cilium. If these two sub-marginal spines are the homologues of those found in *P. orarii*, then two setospines have disappeared apparently from the outer border and three from within.

The outer endite has about thirteen stout spines apically (some of which are toothed) and, almost mesially, one small setospine; there is but one plumose seta on the posterior face of this endite.

The *maxilla* (fig. 42, 9) retains in the inner endite the bent condition noted for *P. typicus*, though to a lesser degree. There is a smaller gap between proximal and distal setae, the distal fringes ranging from stoutly denticulate to feebly plumose and forming a double row. In the proximal portion there is the usual close-set row of filter setae anteriorly and, behind, a row of about fourteen biting setae. The two outer endites are relatively narrow and not very long. Both have a truncate apex closely fringed with long, pectinate spines. The distal part of the posterior surface of all three endites is clothed with fine setae, which may be very dense (fig. 42, 9').

Maxilliped (fig. 42, 10). As in *P. orarii*, the coxa is very large and the epipodite long, sub-ovate and unarmed. The basis (not including the endite) is little longer than the coxa and shorter than the epipodite, the endite being nearly as long as the proximal part of the basis. It is fringed proximally with fine setae, continued on its distal two-thirds with eight to ten brush setae, many of which are chiefly or entirely ciliate on the distal side only and bare at the tip; these pass at the summit of the plate, without transition into shorter and relatively stouter



F.g. 42.—*Notamphisopus littoralis*, sp. n.

setae which have minute pectinations only in the apical part; on its ventro-mesial border are two coupling hooks. The palp is long, heavily setose, the merus and propod both reaching an unusually large size; the dactyl has setae on its lateral border.

In the female, the oostegal plate borne on the gnathopod had a relatively large anterior portion folded forward, in the usual manner, against the base of the maxilliped. The other plates were in no way remarkable. All were bordered along their free edge with a close fringe of long setae.

The *gnathopod*, in the female, has the propod small, sub-triangular in shape with a concave palm. The palmar edge of the dactyl has a series of parallel slits, giving the effect of a rank of square-ended, closely-fitting teeth.

In the male (fig. 42, 11) it is short and stout; the coxa is large, fused with its segment, usually breaking in removal, its anterior border bearing setae and a fine fur of very short setules. The several joints are but moderately setose, the basis nearly as long as the succeeding three joints, the ischium stout, the hand, in the male, very strong and sub-globose in shape. The length of the propod is greater than that of the basis, its width almost equalling its length. The posterior border is about two-thirds the length of the palm, which is short, nearly transverse, and armed with stout teeth, rising in an increasing elevation from an almost straight border. The dactyl is a stout, strongly curved joint, almost as long as the basis, its unguis slightly overlapping the palm.

The second and third *peraeopods*, in the male, are stout and setose, the ischia long, the condition of the third propod resembling, though less strongly developed, the condition found in that joint in the fourth, which is sexually modified in the male; the fourth (fig. 42, 13(4)) is the shortest of the *peraeopods*. The propod appears to be concave on its posterior border, but actually the excavation is developed principally on the inner surface.

The fifth shows a very slight development of a flange upon the hinder edge of the basis and bears some spines as well as stout setae; the sixth and seventh (fig. 42, 13(7)) are progressively longer and stouter; the expansion on the basis is longer but not greatly wider than on the fifth, and more heavily spinose. The penis, which comes away with the limb, is armed laterally with a few short, stiff setae, and is strongly curved and rounded apically.

Pleopods. In the pleon appendages, this and its nearly related species has retained a strikingly primitive condition. The sympodite of the first pleopod (fig. 42, 13(1)) is stout, squarish in outline but narrowing distally, its outer margin produced laterally (from its anterior surface) into a thin membranous lamina closely fringed with strong, finely pectinate setae—highly suggestive of a reduced and fixed epipodite. In addition to the marginal setae, there is one bunch of stout sub-marginal setae of unusual length. Sub-marginally, from the inner distal angle of the sympodite, arise, close together, three or four long and stout entangling setae, some being pectinate; there may be a few related but slighter marginal setae. These collectively interlock with those of the opposite appendage so that the pair move as one.

The exopodite and endopodite are long-lanceolate in shape and *practically equal in size*, for, although the exopodite may extend slightly beyond the endopodite, the latter arises rather more proximally from the sympodite. *Both are fringed heavily with setae.* In the exopodite, this fringe extends uninterruptedly around its entire border and for the most part the setae are long and plumose. In the

endopodite there are mesially and sub-apically only four or five plumose setae, but along the lateral border this series extends about two-thirds of its length, then giving place to long, flexible, simple setae. A comparable setose condition of the endopodite is seen, beyond this genus, only in *Mesamphisopus*.

In the middle line between these pleopods there is a bulbous process rising from the sternite, recalling that seen in *Eophreaticus*.

The *second pleopod* (fig. 42, 13(2)) is the only one, in this genus, which shows differences associated with sex. The sympodite is large, but the lateral membrane is wanting and three or four setae only are found on this border; mesially, pectinate entangling setae arise in a tuft from a distal prominence.

The exopodite, although little longer than that of the first pleopod, is the longest of the series. It is divided into two joints, in the usual Phreaticid fashion; the proximal is long, the distal is short and sub-oval; in addition, on both the lateral and mesial borders of the first joint, there is a proximal extension into a lobe, that on the lateral border reaching upwards almost to the sternite.

Two-thirds of the outer border (including much of the distal joint) is fringed with plumose setae; the setae along almost all the inner border are finely pectinate, as, too, are many of the setae on the lateral proximal lobe of the first joint.

In the female, the *endopodite* is long, oval, rather shorter than the first joint of the exopodite and bears no fringing setae. In the male, the inner border of the endopodite is separated, almost to the base, as the penial stylet, a scroll-like structure which curves outward at the distal end, around the free end of the endopodite. It is armed apically with five stiff setae, some or all of which may bear short pectinations; proximally, on its mesial border, are four curved, pectinate setae not shown in the figure. It is jointed at its attachment to the endopodite, the proximal region being strongly muscular, the endopodite, too, appearing divided at this level.

The *third, fourth, and fifth pleopods* are all alike, except for a progressive decrease in length and a corresponding increase in width; they differ markedly from the second pleopod in the possession of an epipodite which is a thin, sub-oval plate, attached narrowly to the sympodite, very near to its junction with the sternite. For about two-thirds of its perimeter, the epipodite is fringed with long, flexible setae, some of which are shortly pectinate.

The increasing width of the lamellae in these hinder peraeopods is associated with a lateral displacement of the distal process (from which arises the tuft of entangling setae), which becomes more and more elongated until, in the fifth pleopod, it appears as a strongly projecting outgrowth, directed mesially and bearing a large group of long entangling setae, some with a double row of short pectinations.

Upon the exopodites, the plumose setae show a progressive decrease in abundance, more of the fringe being made up of long pectinate, or even simple, setae.

In the fourth and fifth, part of the proximal mesial border of the first joint of the exopodite is bare of setae. The endopodite, relative to the exopodite, becomes smaller and wholly lacks setae.

Uropods (fig. 41, 15). These are comparatively short and stout. The peduncle has a broad and deep base, its length being barely twice its greatest depth, and it is twice as broad distally as at its base. Along its ventral edge are several clumps of spines and setae, and some ventro-mesial in position, not seen in external view. Its dorsal surface is unusual in that it appears rounded instead of concave and the inner border little higher than the outer, its distal apex having two particularly

stout spines, only one being mesial, the outer rising about the middle of the width (cf. *Phreatoicoides*); right and left marginally are a few spines and, in some specimens, the outer row may scatter on the outer surface. The inner ramus, scarcely shorter than the peduncle, is setose (some setae being plumed sensory) and capped with a terminal fixed spine, the outer ramus about three-fourths the length of the inner, smaller and less setose, but bearing one spine about its mid-length. Beneath the insertion of the rami is one stout, toothed spine and a smaller simple spine.

Colour. In life, scarcely translucent, dull greenish-yellow to grey, harmonizing well with the mud in which it occurs. In spirit, it fades to pale straw-yellow.

Size. The largest males measure nearly 14 mm.

Locality. The Reserve at Pounaweia, a tiny hamlet near the mouth of the Catlins Estuary, some ten miles only from the extreme southern end of the South Island of New Zealand. Taken 8-9/12/1935 in springs (and the ditches draining from them) within a hundred yards of the shore and practically at sea level. Associated with it, in the drains, were abundant *Paracalliope* and a few *Apocron-gonyx*.

Notwithstanding the many evidences of the adaptation of this species to subterranean life, it retains to an unusual degree the armature of spines and setae normally associated with the free living habitat. In many features (as, for example, the shape of the head as seen in dorsal view) it shows a strong likeness to *M. setosus*. In the occurrence of plumose setae on the endopodite of the first pleopod, and, perhaps, in the sub-equality of the joints of the mandibular palp, there is a retention of features more primitive than those of *P. typicus*, but in the condition of the mouth parts generally there has been considerable simplification by loss. In the presence of a toothed spine below the insertion of the rami of the uropod—the species of this genus differ from those of *Phreatoicus* and *Neophreatoicus* and agree with *Mesacanthotelson*, etc.

Notamphisopus flavius, sp. n.

(Figs 43 and 44)

Very near to *N. littoralis*.

Body sub-cylindrical (fig. 43, *1s*, *1d*) fusiform as seen from above, narrowing rather less than *N. littoralis* at head and tailpiece.

The greatest width, attained in the fourth peraeon segment, is rather more in the female and less in the male than one-sixth of the entire length of the body and is scarcely less than the greatest depth of the pleon. The surface is smooth and there are rather fewer setae than in *littoralis*, and there is a more evident arrangement of these setae in two bands in each segment, the bands consisting of a single or, occasionally, a double row of setae. As in *littoralis*, the terga of the peraeon, in lateral view, display a raised region considerably less than the area of the segment, bounded before and behind by a wide bevelled margin.

The *head* (fig. 43, *2*) is short, rounded, high in front, rather longer relatively in the female, the extra length (as compared with the female of *littoralis*) being chiefly in the post-mandibular region. Otherwise, the head agrees closely with the condition described for *N. littoralis*, but the shape of the mandible (in its natural position) seems to differ in the two species.

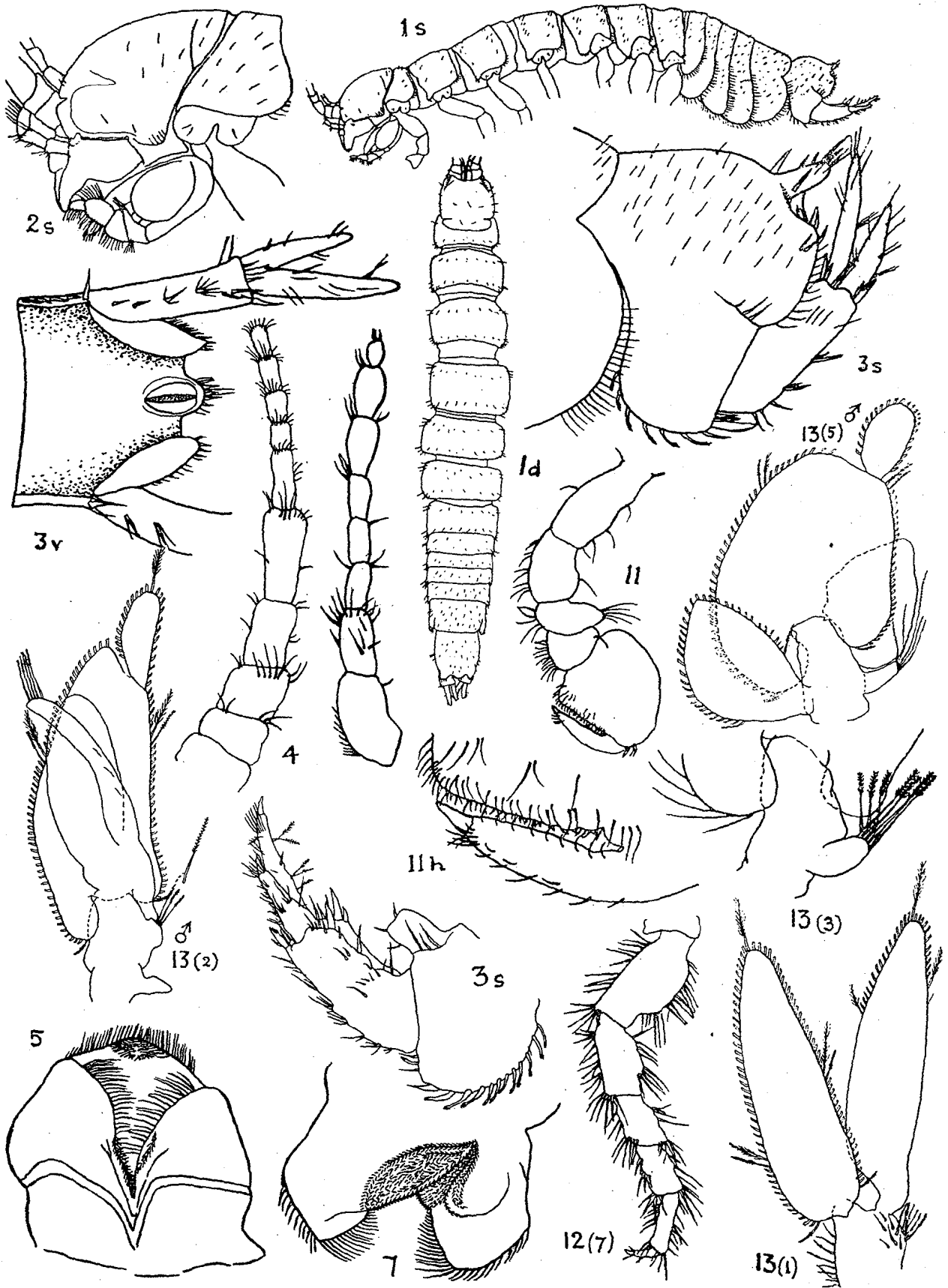


FIG. 43.—*Notamphisopus flavius*, sp. n.

In the *peraeon*, the first segment appears rather shorter, and more expanded ventrally, than in that species, perhaps because its hinder angle is less cut away; generally, setae are fewer and shorter, but in other respects the condition is very nearly that found in *littoralis*.

The pleon is, relatively, rather shorter in *N. flavius*, and its depth slightly greater; a comparison of the *habitus* figures of the two species will reveal other differences, the more noticeable of which are the relative greater length of the first pleon segment, the greater difference in depth between the first and third pleon segments, and in the shape of the several pleura. As seen from the side, the *tailpiece* (fig. 43, 3) is rather more convex dorsally; the terminal projection appears rather longer and hides the anal prominence, but examined from above it is found that the terminal convexity is relatively less developed and that it is really the short and wide telsonic pleura which conceal the anal prominence; the spines fringing the ventral border of the pleura of the sixth pleon segment vary from twelve to nine in the male and are as few as six in the female; they are stouter and more widely spaced than in *littoralis*. The suture between the sixth pleon segment and the telson forms a distinct ridge armed with three spiniform setae.

Appendages. The *antennule* (fig. 43, 4) consists, in the male, of eight joints and reaches to a point rather more than halfway along the fifth joint of the peduncle of the antenna. The first joint is large, the second much more slender and quite setose, and the remainder decrease slightly in thickness, except the fourth and fifth, but the appendage is not markedly club-shaped; in the female, there are but four joints in the flagellum. The *antenna* is robust but very short, not reaching to the hinder border of the third peraeon segment. The peduncle is stout, and as in *littoralis*, the joints differ unusually little in relative length; the first and second combined are longer as well as stouter than the fourth; the third and fourth are sub-equal, while the fifth is barely three-fourths of the combined length of the third and fourth joints. The flagellum has but sixteen joints.

The *labrum* (fig. 43, 5) differs little from that of *littoralis*; it appears narrower, relatively deeper; its lower contour is more regular, but, as in the latter species, the lip has a suggestion of right and left thickened areas. Upon its hinder face a deep V-shaped area is present, the surface of which is covered with setae.

The *left mandible* (fig. 44, 6l) appears somewhat intermediate in character between that of *littoralis* and *N. benhami*. The *pars incisiva* seems stouter, even, than in the latter, a fourth tooth is barely indicated, while the *lacinia* has but three teeth; the spine row is rather shorter and oval in shape. The hinder border of the appendage is setose, as in *benhami*, but the third joint of the palp has fewer setae.

In the *right mandible* (fig. 44, 6r) neither fulcral nor acetabular process seems to be as well defined; the primary dentate edge has four stout teeth; at the distal end of the spine row is a small bi-dentate structure which may well be the last vestige of the *lacinia*; its edges are minutely denticulate; the spine row is shorter and narrow, and is followed by a couple of plumose spines, while a more slender, plumose seta springs from the base of the pedicel of the spine row. The third joint of the palp has setae along its whole length set in a double rank. In both palps, the basal joint rises from a rounded elevation.

The *labium* (fig. 43, 7) differs in no essential from that of *littoralis*.

Maxillula (fig. 44, 8). The proximal endite is relatively shorter and narrower than that of *littoralis* and, as in that species, there may be but four setospines and two stiff flanking setae. Of four specimens examined for this feature, one

showed an interesting variation in the appendage of one side, there being five setospines in one row and two setose and two slightly pectinate spines in the sub-terminal parallel row, making a total of nine, thus agreeing with the condition observed in some Amphisopine forms and approaching that of *P. orarii*. The third and fourth specimens showed five setospines and two simply pectinated on the proximal endite of one side.

On the distal endite, the stumpy setospine is regularly found but outwardly displaced⁽¹⁾ (i.e., it is nearer to the middle of the row of spines) and, in the more variable specimen, a feebly ciliated seta springs from the posterior face of the inner endite; in other examples, this seta was apparently wanting, but the whole face of the endite is setose, thus agreeing with the condition found in *N. littoralis* and *benhami*.

Maxilla (fig. 44, 9). The proximal endite is much less incurved mesially than in *littoralis*. The basal lobe projects mesially scarcely at all beyond the edge of the distal part of the endite; its mesial fringe consists of the usual row of filter setae and behind this a rank of about nine pectinate setae. The filter setae end upon the anterior face of the lamella and at that level there is a single isolated spine. The apical setae are loosely pectinate rather than plumose (fig. 44, 9); upon the outer endite the stiff setae are denticulate, the toothing long and comparatively slender. The anterior face of all of the endites are more or less abundantly setose.

Maxilliped (fig. 44, 10). This differs in several respects from that of *littoralis*; the epipodite is shorter and rounded, its margin sparsely setose; carpus and propod are less expanded; the coupling setae in *N. flavius* are short, stiff, and barbed—two or three in number and passing by gradual transition into the longer pectinate setae which crown the endite of the basis; the dorsal mesial border of this endite is fringed with plumose (brush) setae which, although restricted to its distal half, are more numerous than in *littoralis*. Moreover, they pass by transition through about three setae into the pectinate spines on the summit of the plate.

Gnathopod (male) (fig. 43, 11). The ischium is rather longer and distinctly more slender than in *littoralis*, coming nearest in its proportions to that of *P. orarii*. The merus is strongly produced; the propod is sub-triangular, less strong even than in *benhami*, but with palm toothed as in *littoralis*, the dactyl longer and less curved.

The coxae of the *peraeopods* are better furnished with setae than in other New Zealand forms, while the *peraeopods* are rather less setose than in *littoralis*, except for the bases of the first three which have abundant fringing setae. The propod of the fourth, in the male, is distinctly concave on its posterior border. On the sixth and seventh *peraeopods*, the flange-like expansion of the bases are, relatively, slightly more pronounced; the penes are long and armed terminally with setae.

Pleopods. The pleopods resemble fairly closely those of *littoralis*; the chief differences are:—

The first pleopod (fig. 43, 13(1)) has the sympodite less setose; on the endopodite, plumose setae are fewer and along the lateral border of the exopodite there are a few sub-marginal simple setae.

⁽¹⁾ It may be that in this species, this setospine is the homologue of the outer of the two occasionally found in *tasmaniae* (see p. 72 below).

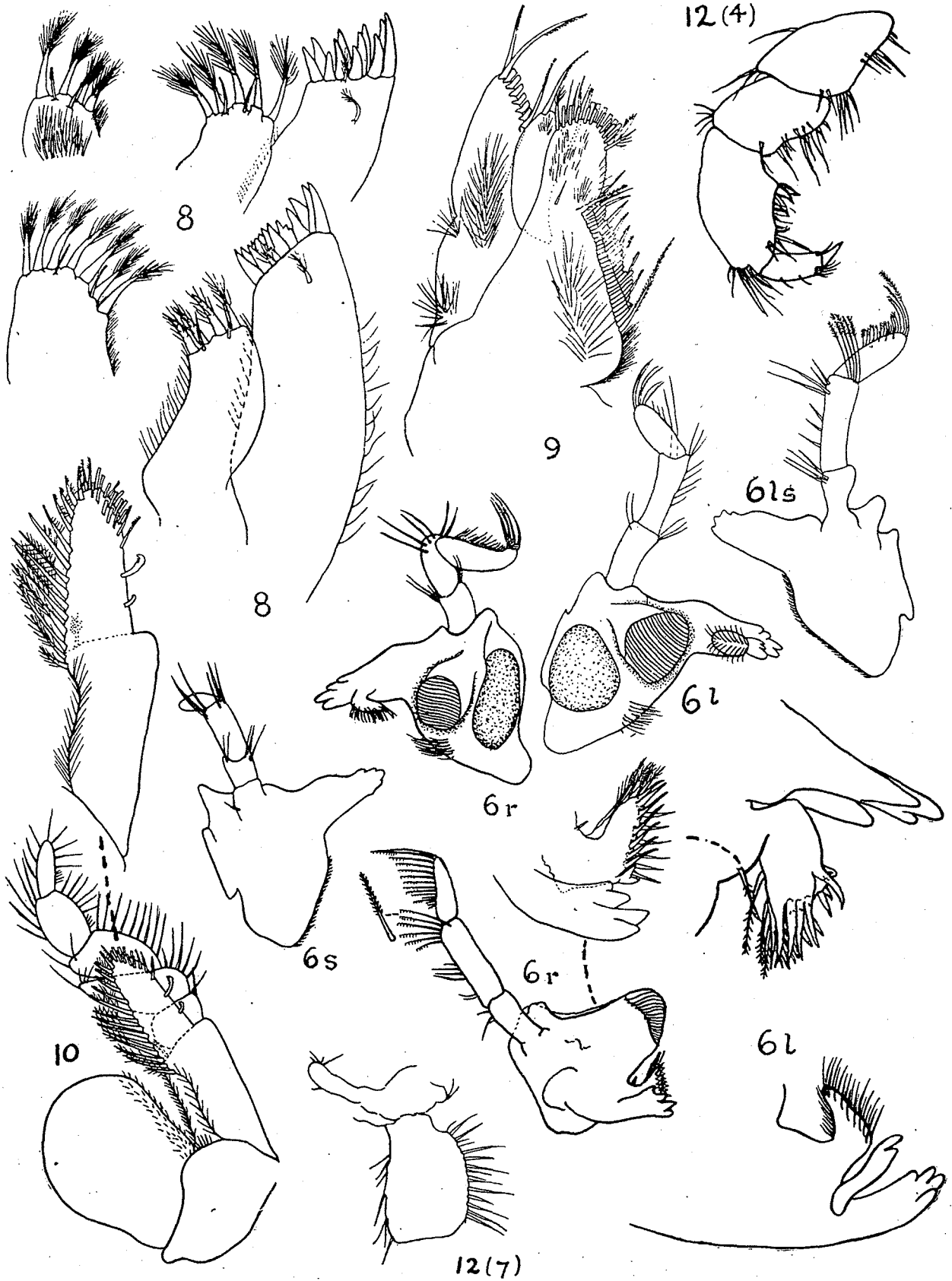


FIG. 44.—*Notamphisopus flavius* (8'—apices of maxillulae from other specimens).

In the second pleopod (fig. 43, 13(2)), the exopodite is relatively wider and the proximal lateral lobe is not nearly so well defined; the penial stylet in one specimen bore only four terminal setae on one side and five on the other, these being minutely pectinate as in *littoralis*. On its inrolled mesial border are three spinules.

The exopodite of the third pleopod is as long as that of the second and distinctly wider, and its fringe of plumose setae extends farther proximally. The third, fourth, and fifth (fig. 43, 13(5)) are (as in *littoralis*) generally alike, except that the exopodites become progressively wider and shorter; the lobes bearing the entangling setae lengthen and the endopodite of the fifth is much smaller.

The uropod (fig. 43, 3s) differs from that of *littoralis* in several details. The peduncle is, relatively, longer and more slender, and seems less setose along its ventral and lateral surfaces, while its dorsal surface has the inner and outer edges very little raised and with few bordering spines; the inner distal end is produced into a comparatively short process capped by the usual two spines, one equally stout on the distal end of the outer border. The outer ramus is little more than half as long as the peduncle, the inner shorter than the peduncle by one-fourth only of its length. The inner ramus is unusual, however, in bearing half a dozen short plumose setae strikingly like the 'sensory' setae so frequently found on the dactyl of the peraeopods of many Gammarids; these are present, but fewer, in *littoralis*. Beneath the insertion of the rami there is a stout spine, toothed apically, and a much smaller simple spine, in this agreeing exactly with *littoralis*.

Colour. In life, the specimens varied from a uniform golden yellow to reddish orange; in spirit, they quickly changed to a creamy tint while the preserving fluid became bright yellow. This is the only Phreatoicid so far known, whose colouring matter is discharged in alcohol, although the small cadmium-yellow patches on the bodies of living *P. terricola* and *P. longicollis* fade after a few days' storage in spirit.

Size. The largest specimen (male), fully extended, measured 15 mm.

Locality. These were first taken in a tiny creek crossing a road by the Railway Station of Lumsden near the 'Elbow'. The creek was followed northwards through paddocks, and, everywhere, springs were found issuing from a high bank (which seemed to be the face of a river terrace), forming small puddles, from all of which specimens were obtained. Some four weeks later, another visit was made to Lumsden, and the collecting extended to backwaters of the Oreti River, several miles to the north. Here, too, specimens were found, rather paler in colour, but otherwise indistinguishable from those taken in the township.

* New Zealand: 45° 45' S, 168° 27' E
(Far South of South Island) *Notamphisopus benhami*, sp. n.

(Figs 45 and 46)

Body (male) compact, sub-cylindrical, distinctly tapering posteriorly, but anteriorly scarcely narrowing. In the peraeon the width is practically uniform, greatest, perhaps, at the seventh peraeon segment where it is approximately one-sixth of the total length; the depth in the peraeon is about four-fifths of the width, the setation much as in *N. littoralis*.

The head (fig. 45, 2) is deeper than long and longer (measured in the mid-dorsal line) than the combined length of the first and second peraeon segments. In both *littoralis* and *flavius* it is slightly less. Its anterior border is shallowly emarginate; it rises in a steep 'forehead' above the well-marked sub-ocular incisure,

the head bulging convexly in the region where, normally, eyes are situated. In this species that area is, most unusually, sparsely set with a cluster of short setae (cf. *M. decipiens* and *Mesamphisopus depressus*). There is a distinct cervical groove and behind this, upon the 'maxilliped segment', is a transverse row of setae, reminiscent of the condition seen in *Mesacanthotelson setosus* and *M. tasmaniae*.

Peraeon. The first segment is exceptionally short, widening below to embrace the head. The second and third segments are sub-equal; the fourth is slightly longer and deeper, its postero-ventral corner produced; the fifth, sixth, and seventh with antero-ventral corner rounded and produced downwardly.

Pleon. The first to third segments are sub-equal in length, with the pleura progressively wider and deeper; the fourth is but slightly longer than the third, but the fifth is nearly as long as the combined length of the first to third; its widened pleuron meets its segment at a sharp angle; the ventral and posterior margin of all the pleura fringed with long, flexible setae.

The tailpiece is a little longer than the fifth pleon segment, dorsally scarcely convex in profile and with no projecting telsonic apex. Examined from above or below, the body is seen to end in a slightly convex border, fringed with setae, behind which the vertical anal opening may be visible (as in *littoralis*). Antero-ventrally, the free border bears eight curved spines (seven in the female); postero-laterally the telsonic pleuron is fringed with plumose setae, while sub-marginally are a spine and a couple of setae. As compared with *littoralis*, this posterior region appears relatively narrower (cf. figs 43 and 45, 3v).

Appendages. *Antennule* (fig. 45, 4). The first joint of the flagellum is quite small, so that it is marked off from the peduncle. The flagellum has five joints (in one specimen only four), the penultimate joint long and swollen.

Antenna (fig. 45, 4). This appendage, removed, frequently comes away with the corner of the head below the sub-ocular incisure, so that the peduncle seems to have six joints—an appearance frequently suggested in the undissected specimens. The first to third peduncle joints are equally wide, but the third is as long as the first and second combined and as long as, but stouter than, the fourth. The fifth joint is half as long again as the fourth (or three-fourths the combined length of third and fourth), and distinctly more slender; the flagellum, in a male 15 mm. in length, has twenty-six joints and is twice as long as the peduncle.

The *labrum* (fig. 45, la.) is robust, as wide as deep; is markedly asymmetrical; the fringing setae are shorter and more uniformly distributed than in *littoralis*. There is a similar depressed V-shaped area bounded by long setae on its hinder face.

Left mandible. As a whole, the body of the mandible, as well as the hinge-like articulation, appears longer than in *littoralis*, the fulcral process more conical, the molar surface more nearly quadrangular and the spine row longer. The opening for the adductor muscle is differently shaped; three or four teeth on the primary dentate edge and three on the *lacinia*.

The *right mandible*, as compared with that of *littoralis*, has the hinged articulation more nearly central, the fulcral process more distinct, bluntly rounded, the hinder (acetabular) region less developed; the *pars incisiva* seems stouter, with three terminal teeth, the fourth antero-lateral and reduced; the spine row long and wider.

In both mandibles, the hinder border of the appendage is fringed with setae and the palps seem stouter and more abundantly setose, the proportion of the joints differing slightly; in the left, both first and third joints are unusually long; the apical fringe of setae in several rows.

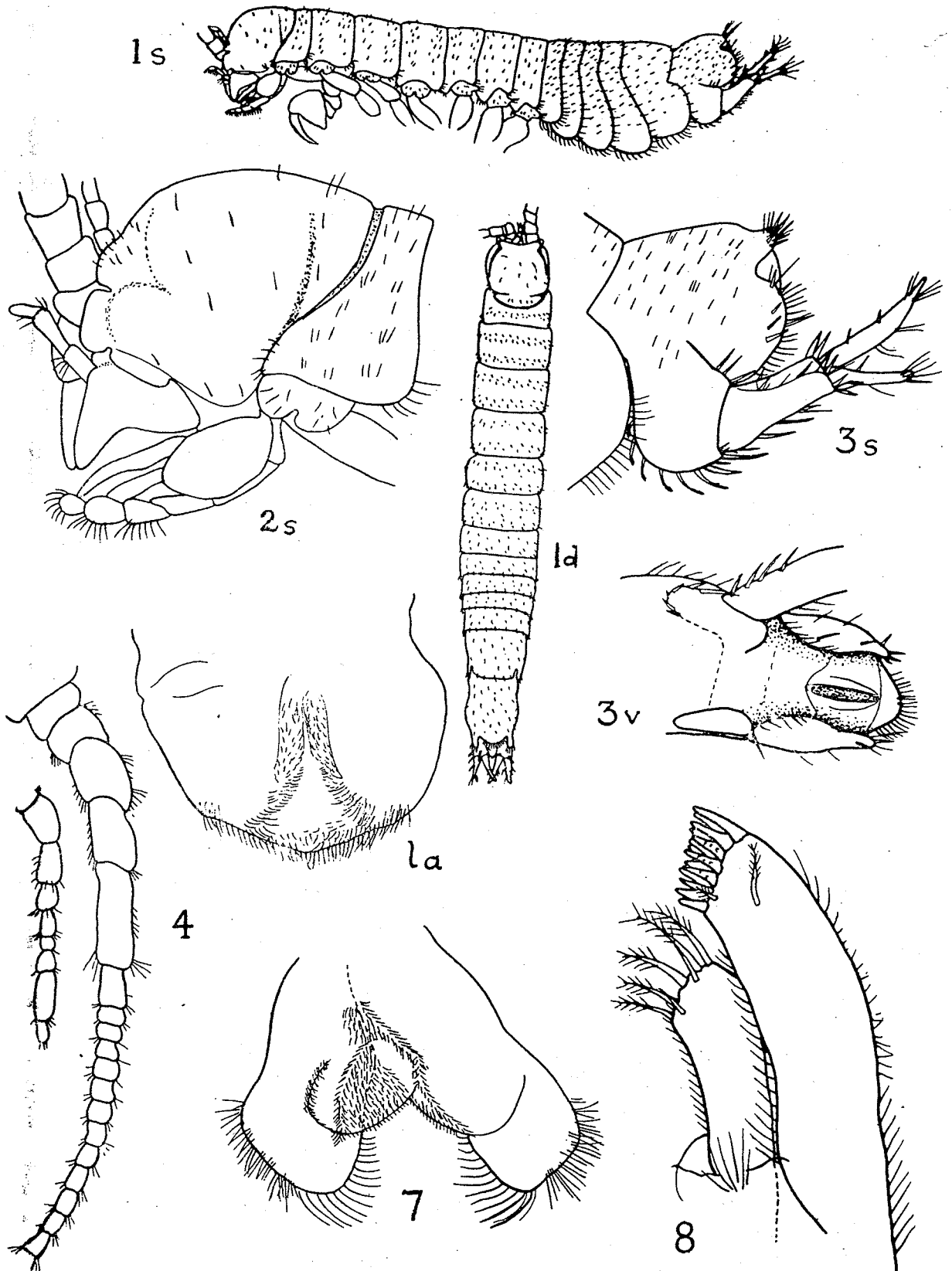


FIG. 45.—*Notamphisopus benhami*, sp. n.

The *labium* (fig. 45, 7) much as in *littoralis* and *flavius*, but the inner lobe is covered by setules only.

The *maxillula* (fig. 45, 8) differs from that of most of the other surface-living New Zealand species in normally retaining *five* setospines on the inner endite, the two simple spines lying against the second and fourth setospines; the endite itself being longer and narrower than in *littoralis*. The outer endite has one plumose seta and the usual setospine in the normal position.

The *maxilla* (fig. 46, 9) resembles closely that of *littoralis*, but the row of filter setae bends more strongly, laterally, onto the face of the inner endite, and an irregular row of stout setae continues this line, while the outer distal endite seems wider and even shorter; the biting setae on both of the distal endites are as numerous as in *flavius*.

The *maxilliped* (fig. 46, 10) has essentially the condition described for *littoralis*, although there are minor differences in the shape of the epipodite, the relative proportions of coxa and basis; brush setae are more numerous and extend farther proximally along the endite.

In the female, the coxal lobe is large and simple, fringed with fine setae, but bearing, also, about eight very long, flexible setae.

In all the *peraeopods*, the coxa is particularly setose. The *gnathopod* (fig. 46, 11) (male) differs slightly from that of *littoralis*. The basis is practically bare of setae; the ischium is nearly cylindrical, almost lacking an enlargement of its anterior border; the propod is longer than wide, the palm more oblique, with a gently rounded elevation, not produced into conical teeth at the posterior end of the palm. The dactyl (only about two-thirds the length of the basis) is more curved and bears a series of small setae on its anterior border. The second and third *peraeopods* are alike.

The fourth *peraeopod* (fig. 46, 12(4)) in the male, as compared with that of *littoralis*, is more slender and its propod less widened; the palmar border of the dactyl is minutely denticulate. The remaining *peraeopods* seem to differ only in minor details of setation from those of *littoralis*; the expansion of the basis in the seventh is perhaps slightly less developed; the hinder border of the dactyl has a fringe of setules; the penis is shorter and does not taper apically.

The *pleopods* resemble fairly closely those of *littoralis*. In the first (fig. 46, 13(1)), the sympodite has the fringed lateral flange much less developed and less setose; the inner distal entangling setae are few; exopodite and endopodite are sub-equal, lanceolate, but more tapering; the exopodite has very few of the proximal setae simple, almost all being plumose; in the endopodite the setae (nearly all plumose) are fewer, being restricted largely to the distal end, its proximal region being bare of setae.

The outer border of the sympodite of the second pleopod (fig. 46, 13(2)) lacks setae. The plumose setae on the lateral border of the exopodite extend proximally nearly to the proximal lobe, while the mesial border is thickly fringed with marginal and sub-marginal finely pectinate setae, which are separated distally from the plumose series by a few curiously-jointed setae. The endopodite resembles that of *littoralis*, except that it is rather more reduced; the penial stylet bears three long and two short pectinate setae terminally. The third to fifth pleopods are in general agreement with the corresponding appendages of *littoralis*, the mesial border of the exopodite being free from setae for the proximal half of its length, while more distally the border is thickened and set sub-marginally with simple setae, replaced, near the distal end of the proximal lobe, by a few plumose setae.

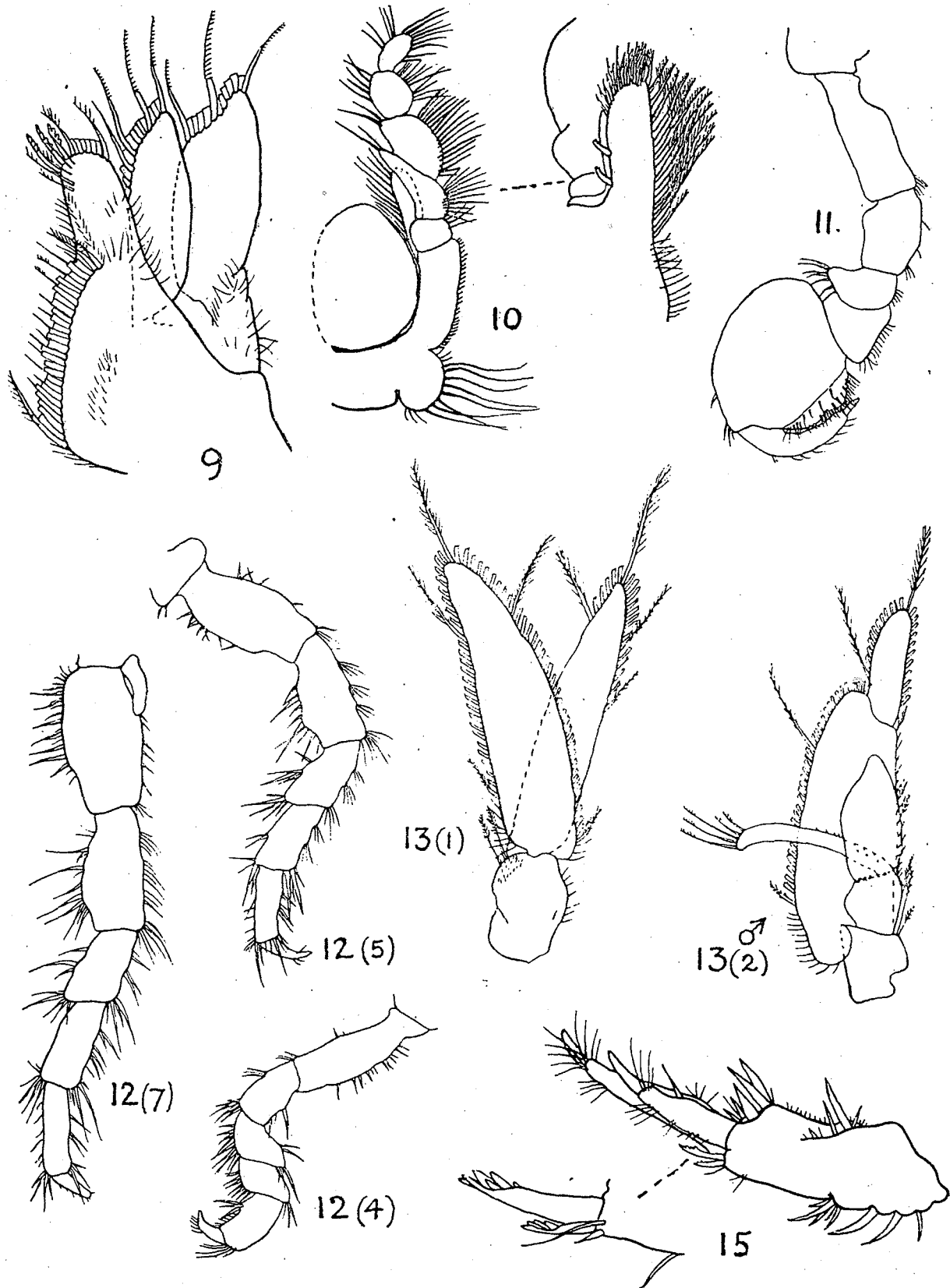


FIG. 46.—*Notamphisopus benhami*, sp. n.

Apart from the minor differences in setation, *benhami* shows differences in the development of the lobes from which arise the entangling setae; and the fourth and fifth pleopods have undergone more reduction in size. In both species the endopodite of the fifth pleopod has an irregular shape.

The uropods (fig. 46, 15) agree generally with those of *littoralis*, but they are rather less spinose. The peduncle shows the dorsal inner edge fringed with short setae but not greatly elevated and ending in a tuft of three stout spines. The outer edge is defined only for about half the length of the peduncle.

The rami are nearly devoid of spines along their length, these being replaced by tufts of setae, but the terminal spines of the rami are relatively much larger and, although fixed, they are clearly marked off from the rami. There are two toothed spines, one much stronger than the other, beneath the insertion of the rami, differing in this from both *littoralis* and *flavius*, but agreeing with *N. dunedinensis*.

Colour. In life, a pale yellowish or greenish grey; in spirit, fading to straw colour.

Size. The largest males about 15 mm.

Locality. Under moss and debris along the bed of a tiny creek, flowing through extremely dense tree-fern scrub and discharging into Horseshoe Bay on the eastern shore of Stewart Island. Several specimens were taken at the actual outlet, a few feet only above high-water mark, where the creek opens out to discharge across the sand into the sea. They were associated with a freshwater Idotheid *Austridotea* sp.

Notamphisopus kirkii (Chilton)

(Fig. 47)

Chilton, 1906, p. 274 (*Phreatoicus kirkii*).

Sheppard, 1927, p. 110 (*Phreatoicus kirkii*).

Chilton's description of this species is very brief and vague, being limited to an incomplete comparison with *Neophreatoicus assimilis* which is, itself, the least typical of Southland (New Zealand) forms.

Of specimens from the type locality (a lagoon in the Island of Ruapuke) no specimens were available until quite recently. Indeed, Part I of this paper had been sent to press when there were received from Professor Perceval some half-dozen specimens. Previously Dr. Chilton had supplied two specimens (male and female) taken at Drummond, tentatively referred to *kirkii*.

A comparison of preparations made from these with others dissected from the Ruapuke material revealed numerous differences, sufficiently marked to make it necessary to refer the Drummond material to a new species, which is described later under the name *N. percevali* sp. n.

The accompanying description of *kirkii* is an amplification of Chilton's account.

Body sub-cylindrical (fig. 47, 1, s.), scarcely fusiform, appearing more robust than *benhami*; it is widest at the third peraeon segment. In the male, the body tapers slightly in the pleon, the tailpiece being barely two-thirds of the width of the peraeon; the total length is approximately seven times the width. In the mature female these proportions are rather different, the width of the tailpiece being less than three-fifths of that of the third peraeon segment, and the total length scarcely five times as great as the width. The surface is smooth except for short and sparsely scattered fine setae.⁽¹⁾

(¹) Not represented in the figures of the female, (47, 1s ♀, 1d♀).

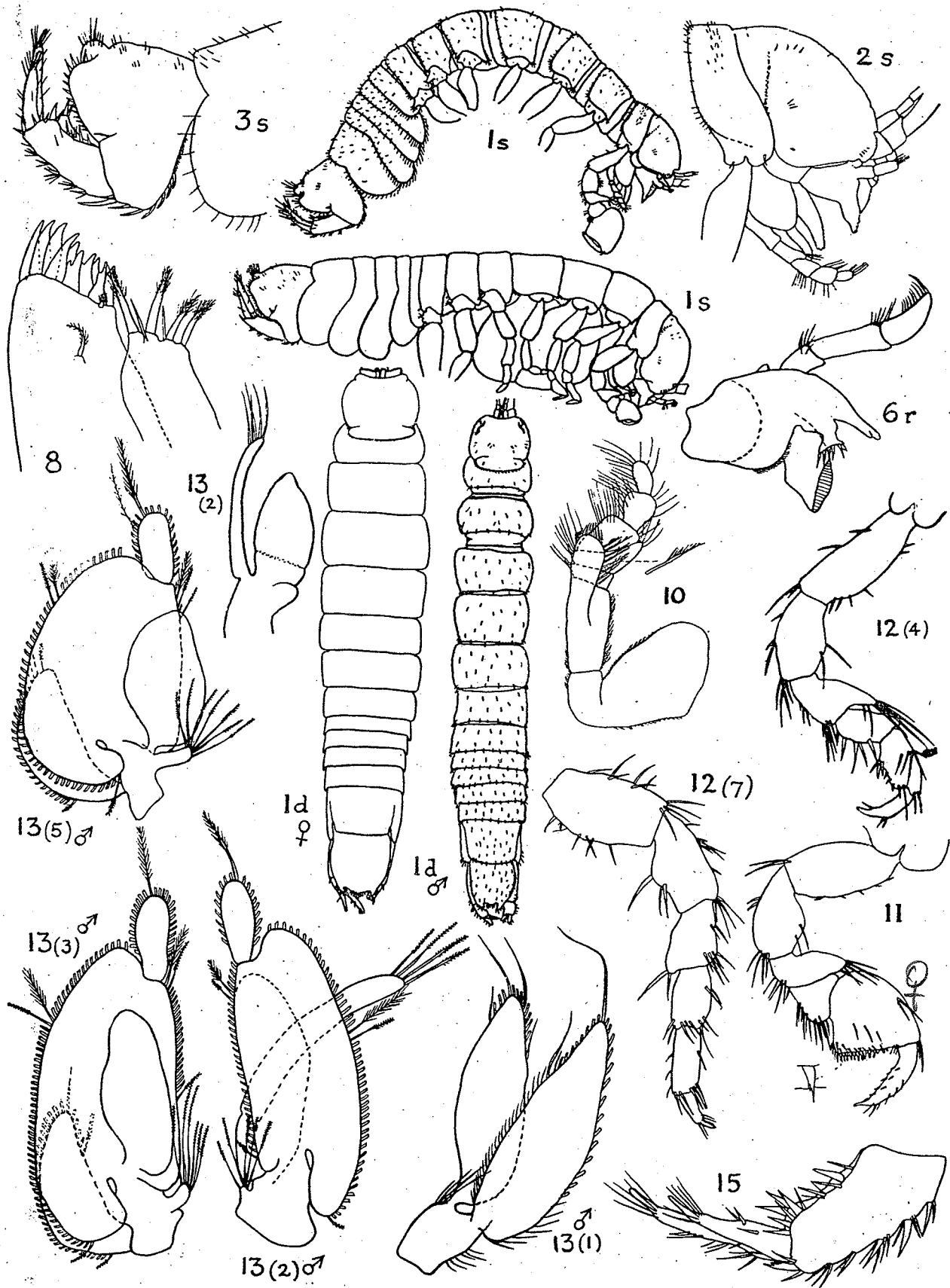


FIG. 47.—*Notamphisopus kirkii* (Chilton).

The *head* (fig. 47, 2) agrees quite closely with that of *littoralis*, the frontal slope perhaps a little less steep, and there seems to be no trace of a 'posterior process'; the shape of the mandible as seen in position, also, differs slightly.

In the *peraeon* the first segment is deeper and, although directed forwardly, is not notably expanded ventrally; the related coxa is ill-defined. All of the peraeon segments are fringed along the entire posterior margins with fine setae. Chilton's note that the segments of the peraeon fit closely to one another refers to the contracted state. As is shown in the figure (fig. 47, 1s, 1d♂) of a partly relaxed specimen, the segments may separate in this as in other New Zealand species.

In the *pleon*, the pleura appear less widened than in *littoralis* or *benhami*, and the posterior margins are more setose. The *tailpiece* is scarcely longer than the fifth pleon segment; the terminal convexity is narrower than in *benhami*, and the telsonic pleura are less developed.

The ventral border of the pleura of the sixth pleon segment (anterior to the insertion of the uropod) seems narrower and the armature of spines more close-set and may bear six or seven spine-setae; the suture, above the uropod, between the telson and the sixth segment, is short and bears but a single spine. The anal opening is directed postero-ventrally. Chilton states that, in side view, the telsonic projection is narrower than in *N. assimilis*. Actually, as seen in dorsal view, the two tailpieces are quite unlike.

Appendages. *Antennule* and *antenna* do not differ in any noteworthy respect from those of *littoralis*. The *mandibles* (fig. 47, 6) are in general agreement with those of *benhami*; the inner surface behind the molar, on the right mandible at least, is unusually setose.

The *maxillula* (fig. 47, 8) has but four setospines on the inner endite; the sub-marginal spines are slender and simple, standing against the second and third setospines; the outer endite is normal, with about ten spines, some denticulate, and one small setospine; there is, also, one plumose seta on the posterior face of the endite.

The *maxilla* appears to be normal, excepting, perhaps, that the number of spine-setae upon the apex of the proximal endite is small and the setae (which are coarsely denticulate on the lateral border) are rather unusually stout.

The *maxilliped* (fig. 47, 10) differs in several details; the coxa is relatively shorter; the endite on the basis is less produced and has relatively few (seven to eight) brush setae which are ciliated on the distal side only, and are restricted to the distal half of the endite.

The *gnathopod* (fig. 47, 11) differs from that of *littoralis* in shape and armature of its joints, notably in the shape of the propod; the fourth peraeopod of the male (fig. 47, 12(4)), also, differs in some of the joints, the merus being strongly produced antero-distally, the propod with its posterior border convex; the succeeding limbs are less setose than those of *littoralis*.

The *pleopods*, too, show several differences. The first pleopod of the male (fig. 47, 13(1)) has the lamellae ovate rather than lanceolate; on the exopodite the plumose setae are much less numerous, extending on the mesial border only along the distal third of its length. Both lamellae rise from narrow stalks, particularly the endopodite, which retains a few plumose setae apically.⁽¹⁾ The second pleopod, too, bears upon the exopodite comparatively few plumose setae

(1) Nevertheless, in the occurrence of setae upon the endopodite of this pleopod there was a marked difference, not only from *dunedinensis*, but from all Phreatoicids known at that time (with the exception of *Hypsimetopus*), and it is surprising that Chilton did not call attention to this character.

(fig. 47, 13(2)); its endopodite as compared with its related exopodite appears much shorter; it is clearly marked into two regions; the rather long penial filament has four (or five) terminal setae.

In the remaining pleopods the exopodite becomes increasingly longer relatively to the endopodite, which is, however, less reduced than in *littoralis*; the epipodites are longer and narrower. The lobes bearing the entangling setae are well developed.

The *uropods* (fig. 47, 15) do not differ essentially from those of *littoralis*, but they appear rather more spinose; beneath the insertion of the rami there is, beside the stout toothed spine, a smaller spine, also toothed, this apparently replacing the small simple spine found in this situation on *littoralis* and *flavius*.

Colour. Whitish (in spirit).

Length. 17.5 mm. (Chilton, 1906, p. 275).

Habitat. A fresh-water lagoon on Ruapuke Island. New Zealand.

($\approx 47^{\circ}\text{S}, 168^{\circ}35'\text{E}$; in Foveaux Strait - between South Island & Stewart Is.)

Notamphisopus percevali, sp. n.

(Fig. 48)

The material available for study consisted of two specimens (male and female), collected by Professor Chilton at Drummond, and as noted above, tentatively assigned by him to *kirkii*. They prove, however, to be distinct from that species, and are apparently intermediate between *dunedinensis* and *benhami*. Unfortunately, both of the two specimens were temporarily mislaid, so that the description is limited to appendages which had been removed and mounted, and to notes made at the time of dissection, when the specimens were accepted as examples of *N. kirkii*.

Antennule (fig. 48, 4). In the female this is short, seven-jointed, with practically no distinction between peduncle and flagellum; in the male there are eight joints and the appendage is longer than the peduncle of the antenna. This latter appendage is about three times the length of the antennule, its peduncle robust, the flagellum with sixteen joints.

The *labrum* is stout, slightly asymmetrical.

Left mandible. Dentate edge with four teeth, *lacinia mobilis* with three. On the right mandible, also, there are four teeth on the primary dentate edge; the spine row is markedly setose; the molar notably oblique, the palp with long second joint, setae on the third joint are restricted to the distal half, as in other species of *Notamphisopus*. The *lower lip* (fig. 48, 7) shows but one setospine in the dense fringe of simple setae.

The *maxillula* (fig. 48, 8) resembles that of *dunedinensis* and differs from that of *assimilis* in that the simple spines on the inner endite lie against the second and third setospines instead of the rather unusual condition occurring in *assimilis*, where the simple spines lie mesially against the third and fourth of these. In all three of these species, there is but one sub-terminal plumose seta (in this species almost a simple seta) on the posterior face of the outer endite, which bears twelve apical spines, some denticulate, and a short setospine.

In the *maxilla* (fig. 48, 9), the inner of the two endites of the third segment is shorter than the proximal endite. The basal part of this latter appears as a wide triangular region fringed, as usual, anteriorly by close-set filter setae and a posterior row of biting setae, of which, however, there are only about eight (much as in *kirkii*); the distal part of the endite is short and fringed its whole length with simple hair-like setae. The apex bears mixed plumose and pectinate setae.

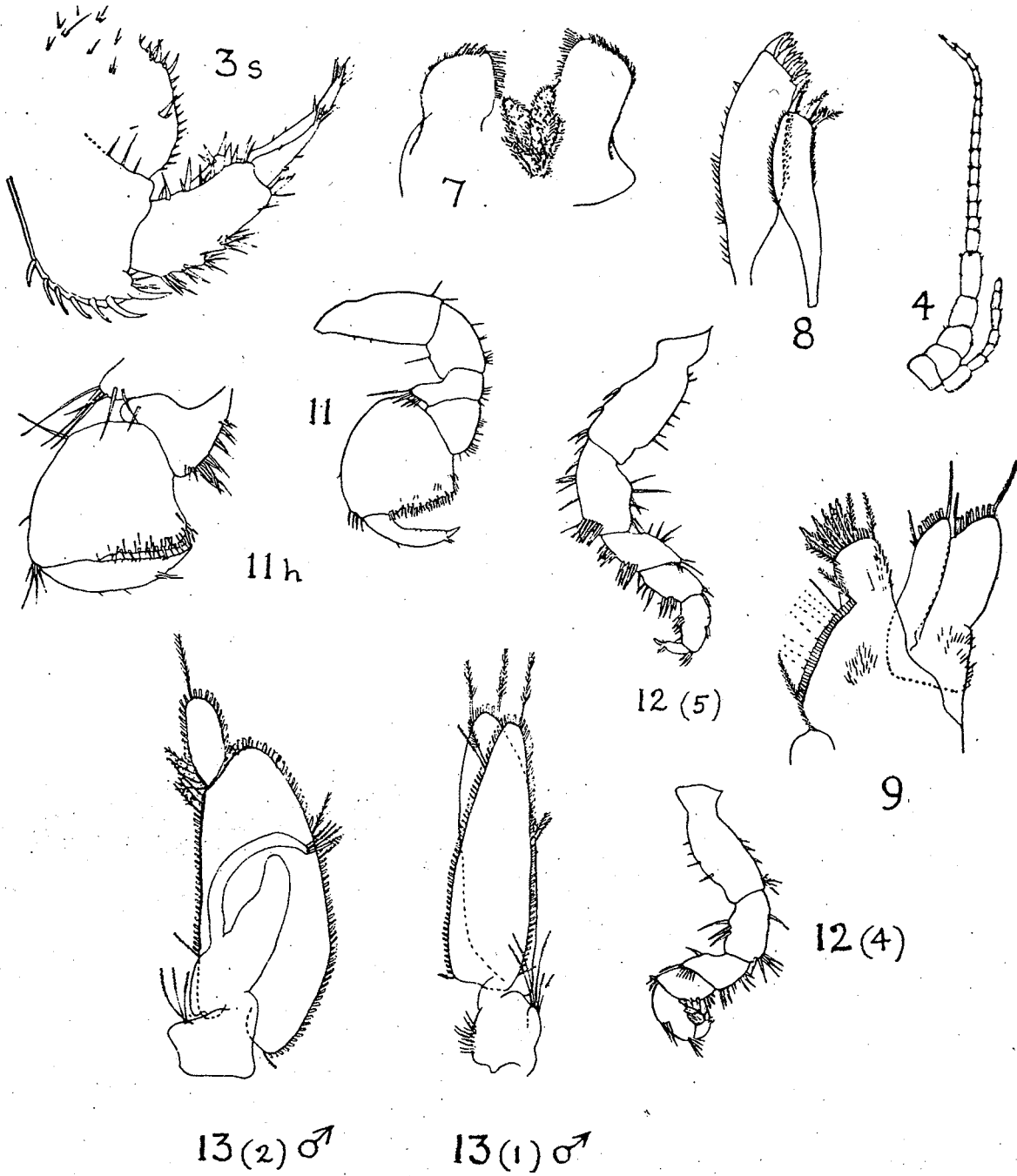


FIG. 48.—*Notamphisopus percevali*, sp. n.

The *maxilliped* has a very elongated coxa, the sub-oval epipodite being setose mesio-proximally. The endite is armed apically with a short row of stout biting setae and its dorso-mesial border bears some seven or eight brush setae; the propod is sub-circular, the moderately long dactyl bearing setae only on its mesial edge. In the female, which shows immature brood lamellae, the coxal lobe of the maxilliped is very feebly developed; the epipodite is sub-ovate.

The *gnathopod* of the male (fig. 48, 11♂) seems to differ slightly from that of *dunedinensis* in the armature of the palm. In the female (fig. 48, 11h) the merus is produced anteriorly and bears a tuft of setae as recorded by Chilton for *assimilis*; the whole limb is much less robust than that of the male.

The *fourth peraeopod* (fig. 48, 12(4)) is sexually modified in the male, but is not appreciably shorter than the third, whereas in *assimilis* this appendage is distinctly shortened; the armature of the palm differs in minor details from that of *dunedinensis*.

In the degree of expansion of the bases of the fifth to seventh peraeopods, there is also a small difference from the condition of *dunedinensis*.

It is in the condition of the *pleopods*, however, that this species, like *kirkii*, differs markedly from *dunedinensis*. The first pleopod (fig. 48, 13(1)) has an endopodite sub-equal and similar to the exopodite, both lamellae being setose. The endopodite has an apical series of about eight feebly plumed setae. It has thus the least setose condition of any of the Southland forms, excepting *dunedinensis*. The sympodite has about five entangling setae (fewer in the female), while upon the lateral border are six or seven setae.

In the succeeding pleopods, the mesial border of the exopodite is armed along almost its entire length with short, pectinate setae. In the male, the penial stylet on the second pleopod (fig. 48, 13(2)) is very strongly curved and armed with a terminal series of six or seven stout setae.

The sixth pleon segment has the ventral border armed with seven spines, the last, immediately beneath the insertion of the uropod, being very stout, the six preceding curved, apically toothed, and much more slender.

The telsonic pleuron is fringed with spinules with one or two much stouter spines. One spine is just sub-marginal, while three slender spines arm the suture between the sixth pleon segment and the telson.

The *uropod* is short and stout, its inner dorsal border slightly raised distally to end in a stout spine. Both inner and outer borders are spinose and the ventral edge has four tufts of mixed spines and setae. Apically beneath the insertion of the outer ramus is a stout spine, toothed at its end. The inner ramus is slender and gently tapering, rather shorter than the peduncle, with a few spines and setae, the outer ramus, only half the length of the peduncle, very slightly setose.

Colour. Whitish, in spirit.

Occurrence. At Drummond, in Southern Otago.

Among Chilton's notes were found records of the distribution, etc., of this species. Numerous specimens were said to have been taken (Jan., 1907) in a pond at Drummond in mud at roots of rushes, etc.; white in colour, blind and rather sluggish. A little later a few small specimens were taken in cleaner water on Elodea, Microphyllum, etc., presumably also at Drummond. Another collection (23.12.22) of about 8-10 specimens is recorded from 'Ringway', Drummond. A single male was found (5.1.14) on roots of rushes in the creek at Redfern 'Otautau'; specimens were also noted from a creek near Invercargill. This is presumably the collection found in a tube labelled 'Creek, Otatava Rd., Invercargill' and comprising five small, compact animals, dark in colour.

Notamphisopus dunedinensis (Chilton)

(Figs 49 and 50)

Chilton, 1906, p. 275 (*Phreatoicus kirkii*, var. *dunedinensis*).
Sheppard, 1927, p. 111 (*Phreatoicus kirkii*, var. *dunedinensis*).

This form which was originally recorded as a variety only of *Phreatoicus kirkii*, actually differs very markedly not only from that species, but from all other Southland forms; it is undoubtedly a distinct species. Chilton's account is so very brief and chiefly in terms of comparison with *kirkii* that a full description is necessary.

Body fusiform, sub-cylindrical (fig. 49, 1); the width, which equals the greatest depth in the pleon, remains practically uniform from the third peraeon to the third pleon segment, narrowing slightly at both ends. Its length is six times its maximum width.

Head (male). Seen from above (fig. 49, 1d), it is sub-circular, width and length being equal, and its length being equal to that of the second peraeon segment which is, also, that of the greatest depth of the head. In the female, the width, relatively, is slightly greater than the length of the second or even of the third peraeon segment. The anterior border is very shallowly emarginate; a short but quite definite cervical groove rises, rather high up, from the posterior border of the head.

Peraeon. This region appears rather longer than in most surface-living New Zealand forms, being practically twice the length of the pleon. All the segments have the bevelled margin, and all are fringed with sub-marginal setae along their entire posterior border. The first segment is short, less than half the length of the second and shorter even than the seventh. In the male, it widens markedly below, while in the female, though less expanded, it still overlaps the hinder border of the head, to which it appears immovably attached. The second to fifth segments are sub-equal, the third being just a little the longest; the sixth and seventh are each considerably shorter than the segments preceding them. The first four segments are scarcely hollowed ventrally for the coxa, but the fifth, sixth, and seventh are deeply excavate and each is strongly downwardly produced in front. In a female, with brood-pouch, the coxae of the anterior group of legs actually project slightly outwardly.

Pleon. The first four segments are sub-equal, the fifth as long as (female) or a little longer than (male) the combined length of the third and fourth. The pleura are fringed ventrally and posteriorly with long, flexible setae, the pleopods hanging well below them. The *tailpiece* is a little longer than the fifth segment. The telsonic apex—broad and strongly convex, armed with several (about eight) spines dorsally and a fringe of several setae terminally—is scarcely upturned; the pleura, which do not project behind the telsonic apex, are separated by an incisure on either side and quite distinctly developed, and are fringed with spinules or stout setae and one sub-marginal spine. In dorsal view, this shows far greater resemblance to the condition seen in *Paramphisopus* spp. than it does to that of *N. assimilis*. Antero-ventrally, the border of the sixth pleon pleuron bears five to seven curved spines, the last one or two stout and simple, the more anterior finely toothed apically. The ventral suture between the sixth pleon segment and the telson rises some little distance dorsally to the uropod and bears three or four fine curved setae. The anal opening lies anterior to the telsonic apex and is presented postero-ventrally.

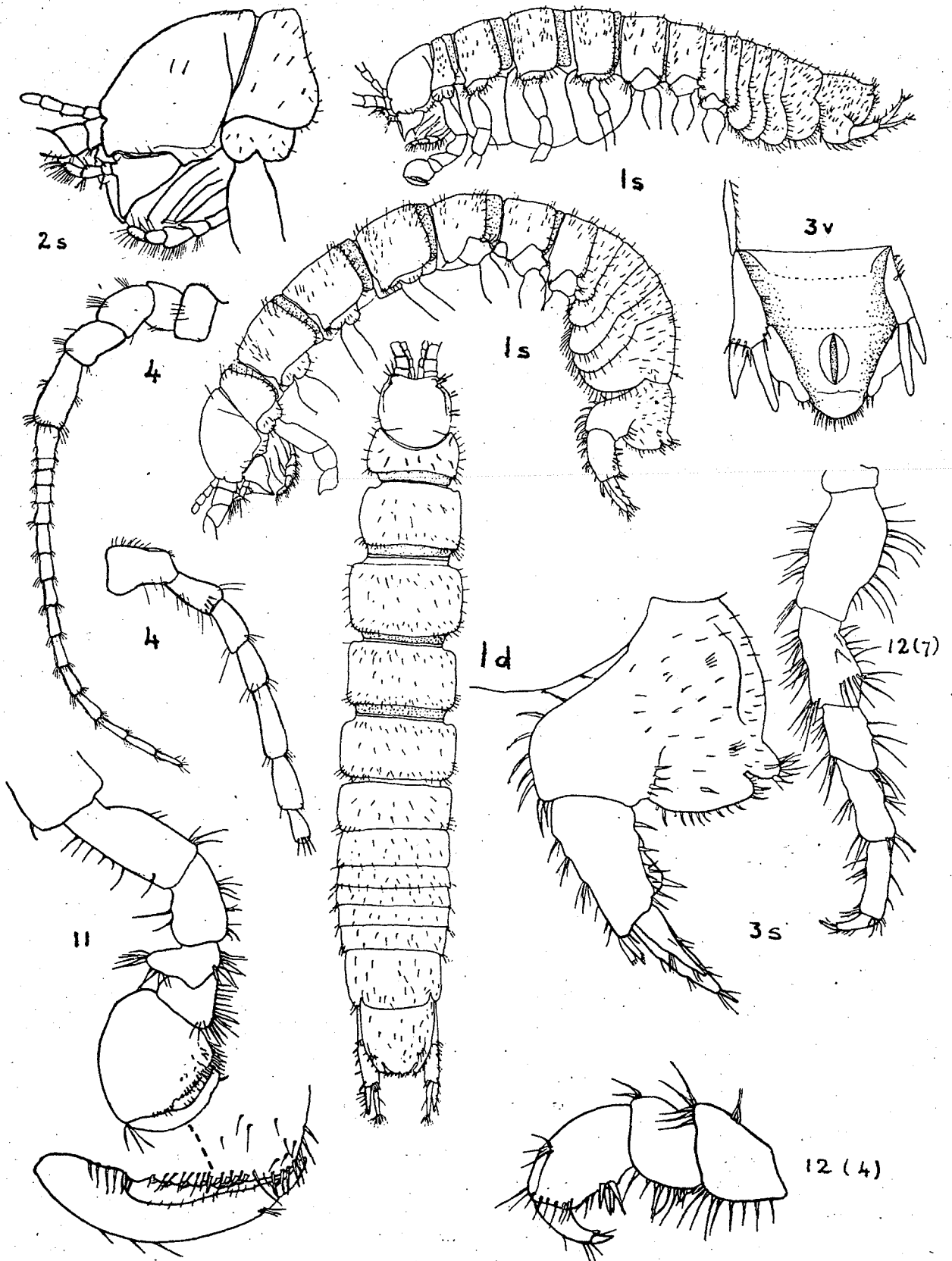


FIG. 49.—*Notamphisopus dunedinensis* (Chilton).

Appendages. The *antennule* (fig. 49, 4) is as long as the peduncle of the antenna, with seven joints in the male and six in the female; there is little distinction between peduncle and flagellum, the first and second joints of the flagellum being long and scarcely swollen. The *antenna* is short, peduncle joints decreasing in stoutness but not increasing greatly in length, except the fifth which is once and a half the length of the fourth. The flagellum, with fifteen to eighteen joints, is not twice as long as the peduncle.

Mouth parts. *Labrum* (fig. 50, 5) very wide and shallow, strongly asymmetrical, only the middle third of its border fringed with setae; its hinder surface with a V-shaped setose area.

Mandibles. *Right* (fig. 50, 6r). Dentate edge with four strong teeth, spine row strong, molar stout, oblique; palp short and stout; second joint twice as long as first, third joint three-quarters of the length of the second, fringed on the distal part of the upper border with curved, finely pectinate setae; these in the apical half appear to lie in at least two rows (cf. *Mesacanthotelson*). In the left *mandible*, the principal cutting edge has the usual four teeth, the *lacinia* is strong and bears three teeth; there is a dense fringe of setae at the base of the molar; in the palp the setal armature of the third joint is less developed.

Labium, as in *littoralis*.

Maxillula (fig. 50, 8). Inner endite short, narrow, truncate apically, bearing four setospines and two slender simple spines, feebly ciliated, lying between first and second, and second and third. The outer endite has eleven spines and one setospine; there is a single plumose seta on its posterior face.

Maxilla (fig. 50, 9). The basal and distal mesial edges of the proximal endite meet at an angle, but the distal lobe is not curved mesially inwards as in some Southland species. The row of filter setae is carried round onto the anterior face of the joint, and, as in *percevali* and *kirkii*, there is a stout spine external to its upper outer end. The pectinate setae are few (eight) in number. The two outer endites, though short, are relatively long as compared with the proximal endite and the outermost is much wider. The setae arming the lobes are as in *littoralis*.

Maxilliped (fig. 50, 10). The coxa is shorter (relatively to the basis), the epipodite long. The two coupling hooks which stand out very distinctly from the other setae on the endite are stout, curved, and apically toothed; on the mesio-dorsal border of the endite, the proximal part is occupied by a close fringe of simple setae; distally there are about eight or nine brush setae; these, as in all species of *Notamphisopus* are ciliate on the distal side only.

In all the *peraeopods*, the coxae are setose. The *gnathopod* (fig. 49, 11) has a stout propod, with the anterior border very convex, the greatest width and length sub-equal, the posterior border short, the slightly convex palm armed with stout conical teeth and an outer fringe of spiniform setae which are continued from the palm onto the posterior border; the condition of the palm differs from that of *kirkii* in both female and male.

The second to fourth *peraeopods* are much alike, the last being shortest and more evidently sub-chelate (fig. 49, 12(4)), a group of four spines being placed to receive the tip of the curved and shortened dactyl; it is even less modified than in the case in *kirkii*. The fifth, sixth, and seventh are progressively longer and stouter and increasingly setose (almost spinose), the basis little expanded but, nevertheless, stouter and wider relatively than in specimens of *percevali*. Chilton has noted that the basis is less expanded in *dunedinensis* than in *kirkii*.

It is in the condition of the *pleopods*, however, that *dunedinensis* is most sharply marked off from all other Southland species, the endopodite being without setae and generally unlike the exopodite in shape and markedly smaller.

The *first pleopod* (fig. 50, 13(1)) has the sympodite stout and squarish with a few short setae laterally but no expanded lateral flange; from its inner border arise numerous entangling setae; the exopodite broadly lanceolate, blunt-ended; three-fourths of its outer margin bearing plumose setae, the proximal fourth fringed with simple setae; the proximal half of the inner border is edged with stiff pectinate setae, both marginal and slightly sub-marginal; the apical half is for the most part composed of plumose setae. The endopodite is sub-oval, much shorter than the exopodite, but its basal region is unusually long, suggesting an oblong proximal joint; it may be notched apically.

Upon the sympodite of the *second pleopod* (fig. 50, 13(2)), the entangling setae spring from a projecting lobe; on the exopodite plumose setae are restricted to the distal lobe and the outer half of the proximal lobe, while on the inner border simple (some pectinate) setae fringe almost the entire length of the proximal lobe. The endopodite is longer, reaching to the base of the distal lobe; the penial stylet is long and curved, armed terminally with four stout setae.

The *third pleopod* (fig. 50, 13(3)) differs from the second (apart from the sexual modification of the latter) in a much increased width, and, of course, in the presence of an epipodite; the inner fringe of setae on the exopodite arms only the distal two-thirds and tends to spread considerably inward from the margin; the fourth and fifth show a decrease in length, and the fifth is markedly wider; the endopodites, too, are relatively smaller, while the lobe on the sympodite bearing the entangling setae becomes more elongated mesially. The pleuron of the fifth pleon segment differs from that of *percevali* (and of *kirkii*) in that it has setae scattered over its surface as well as forming a fringe.

The *uropod* is comparatively stout and short. The length of the peduncle is less than twice its depth at its insertion; its inner dorsal edge is markedly raised, its ventral border less strongly armed and there are but one or two spines on its lateral surface. The joint is markedly less spinose than in *kirkii*. The rami are short and feebly setose, while beneath their insertion are two almost equally strong spines, toothed apically.

Size. Up to 22.5 mm., female with brood-pouch 13 mm.

Colour. Whitish.

Occurrence. From streams at Mosgiel and at Woodhaugh (near Dunedin).

It would be tempting to suppose that we have in these southern New Zealand species a series of surface-water forms passing into subterranean forms with progressive reduction of the pleopods. In *Notamphisopus* these retain a more nearly primitive condition, but showing a steady decrease in setosity (or in increasing departure from the natatory condition) from *littoralis* (through *benhami*, *flavius*, *kirkii*) to *dunedinensis*. In the lastnamed the endopodite of the first pleopod has become seta-less and the exopodite shows a marked diminution in the number of plumose setae. In *assimilis*, the difference in size of the exopodite and endopodite is still more marked, and the exopodites also nearly devoid of plumose setae, the reduction reaching a climax in *P. typicus* and *P. orarii* with the pleopods short and oval (rather than lanceolate) and still less setose (or even bare), and the obsolescence of the endopodite a stage more advanced.

But, in the condition of its mouth parts, particularly the maxillulae and maxillae, *typicus* is so much the more primitive, that its derivation from known surface-water New Zealand forms is precluded. The fact that in *littoralis* and in

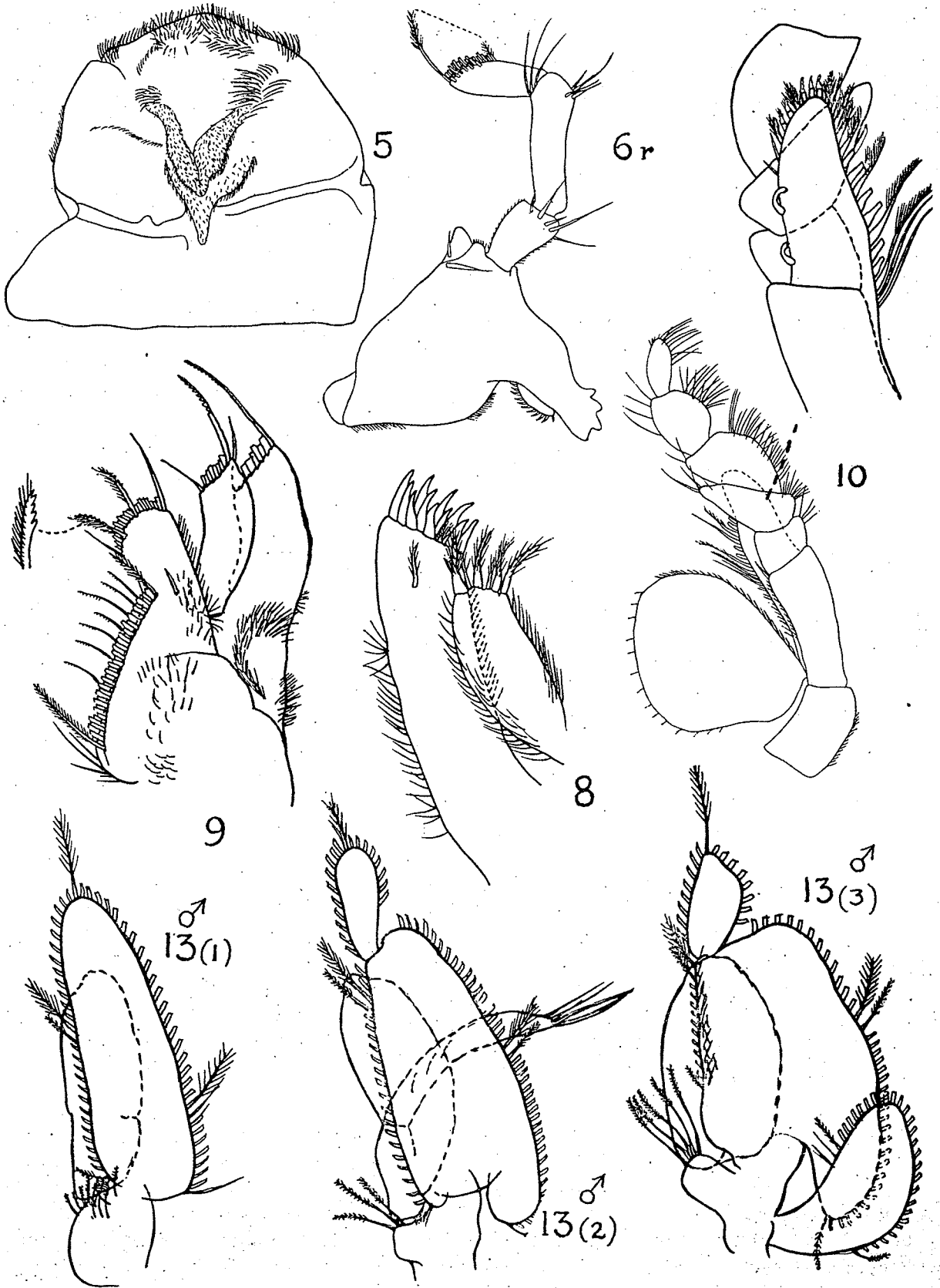


FIG. 50.—*Notamphisopus dunedinensis* (Chilton).

flavius, however, the condition in the maxillula may variably approach that of *typicus* suggests that they had a not-too-remote common ancestor with both mouth parts and pleopods unreduced.

The small bifid structure at the ventral end of the spine row of the right mandible of *flavius* may be a persisting vestige in this genus of that *lacinia mobilis*. A similar structure has been seen in one specimen of *P. orarii*.

The obsolescence or the absence of the posterior process of the head is another feature common to all New Zealand species.

The *Notamphisopus* species show, in certain features, a strong likeness to *M. setosus*—a likeness perhaps most evident in *dunedinensis*, although in the latter species the head is narrower, probably due to the decreased size of the brain, resulting from the loss of the eyes in the New Zealand forms. A resemblance to *assimilis*, which Chilton stresses, is much less evident, the vermiform body of the latter pointing to a prolonged subterranean existence.

On the tailpiece, the telsonic apex has spines dorsally—instead of posteriorly as in *Paraphreaticoicus* and *Metaphreaticoicus*. The shape of the apex is reminiscent of that found in some Amphisopine forms, like that, too, in the shortened condition, and because of that shortening the telsonic pleura appear similarly more produced backwardly.

The sixth pleon pleuron agrees with that of *Onchotelson* and *Metaphreaticoicus* in its armature of relatively numerous spines, many of them terminally toothed; the suture above the uropod insertion resembles that of the Tasmanian species, *setosus*, but the uropod of *dunedinensis*, like that of *tasmaniae*, shows the end of the peduncle armed with two stout, toothed spines, in this agreeing, also, with *benhami* and *kirkii*; in *littoralis*, *flavius*, *setosus*, and *brevicaudatus*, there is but a single, toothed spine accompanied by a smaller simple spine, while in the species of *Phreaticoicus* and *Neophreaticoicus* both of these spines are simple.

Sub-family VII. MESACANTHOTELSONINAE

Body fusiform, rugose; head with well-marked cervical groove; eyes prominent, with many facets; first peraeon segment free or fused with head; peraeon sub-cylindrical, segments generally deeper than long, with transverse bands of spines or setae; pleon slightly compressed, the incomplete suture between sixth pleon segment and telson marked by a short line of spines or stiff setae; tailpiece with well developed telsonic projection.

Antennule of moderate length, not swollen apically; *lacinia mobilis* on left mandible only; maxillula usually with five or fewer setospines on inner endite; coxae of sixth and seventh peraeopods produced posteriorly; basis and ischium of peraeopods not expanded, ischium relatively long; fourth peraeopod of male sub-chelate; sympodite of pleopods with numerous entangling setae; epipodites moderately large; penial stylet curved, elongate, strongly armed terminally; spine beneath the insertion of the rami at the end of the peduncle of the uropod toothed; apex of rami sharply-pointed.

Three genera, *Mesacanthotelson* gen. n., *Onchotelson* gen. n., and *Colacanthotelson* gen. n.

Mesacanthotelson, gen. n.

Body with segments strongly rugose; head with shallow anterior emargination and with the cervical groove complete or interrupted dorsally; eyes large, prominent, not forming part of the profile of head; pleura of sixth pleon segment armed with a few spines; telson long with sub-cylindrical projection, little upturned, armed along its length and terminally with spines and setae; the third joint of the mandibular palp armed with a brush of setae; median process between maxillipeds; uropods long.

Genotype. *Mesacanthotelson setosus*, sp. n.

This genus has been instituted for four (or possibly five) species, all from the Great Lake, Tasmania; in normal circumstances G. M. Thomson's species, *tasmaniae*, which was the first to be recorded, would have been named as type species. From a comparison of the figures, it could well be identical with Geoffrey Smith's form *spinusus*. But both Smith's and Thomson's descriptions are sadly inadequate; they are, for instance, useless in discriminating between *tasmaniae* and *fallax*. Miss Sheppard, who examined specimens collected by Smith, is satisfied of the identity of that author's '*spinusus*' with Thomson's *tasmaniae*. The present writer, also, has had two specimens (both half-grown) of Smith's material for examination, and these agreed sufficiently well with Thomson's figures to justify acceptance of Miss Sheppard's conclusion.

Thomson had, however, but a few examples, preserved dry, and said to be mutilated, and apparently his type is not now available. Also, it seems certain that his material from the Great Lake included at least two different species, for he notes⁽¹⁾ that 'the young (small specimens presumably) of *P. tasmaniae* resemble the adult form of *P. australis*', a statement which is, in fact, quite incorrect. It seems entirely probable that these 'young' were immature specimens of another species, perhaps *chiltoni* Sheppard (= *australis* G. Smith), for in this same paper Thomson transfers to *tasmaniae* specimens taken earlier on Mt. Wellington (Jan., 1892) which he had originally assigned to *australis* Chilton. These latter may be confidently accepted as examples of the species *thomsoni* described below, for *tasmaniae* is not known from any waters other than those of the Great Lake, nor is any Phreatoicid other than *thomsoni* known from Mt. Wellington.

As to Smith's material, it seems not at all improbable that his collection of '*spinusus*' may likewise have been a mixed one in which two species were represented. With regard to the size of their species, the two authors differ markedly, Thomson's specimen being recorded as a little over half an inch, while Smith's specimens attained almost to an inch. At the present time several species are known, of which both *fallax* and *decipiens* are relatively small; *setosus* approaches *tasmaniae* in size, but it largely lacks *spines*. While, therefore, Miss Sheppard's identification of *spinusus* with *tasmaniae* (G.M.T.) may be accepted as probably correct, it is not completely convincing.⁽²⁾ Accordingly, with the desire of avoiding, if possible, further nomenclatorial confusion, the new species *setosus* has been selected as the type of this genus, although in as far as the telsonic projection is concerned, it is perhaps not the most primitive, for it seems possible that that structure in *setosus* has been derived by reduction from the condition still retained by *tasmaniae*. It occupies, however, in many respects a rather central position in the genus, and in many of its characters it links up with the surface-water New Zealand forms and possibly, also, with *Onchotelson*.

(¹) 1894, p. 349.

(²) Barnard (1914, p. 232) had previously pointed out that *spinusus* might be a 'larger form of *P. tasmaniae*, though the fifth pleon segments differ'.

Mesacanthotelson setosus, sp. n.

(Figs 51 and 52)

Near to *M. tasmaniae*, which, except for its lesser spininess, it resembles so closely that a superficial examination might confuse the two. Like *tasmaniae*, its length is six and a half times its greatest width. Under close scrutiny it is found to differ from the Great Lake species in numerous details.

The surface of the body is strongly ridged, but stout setae for the most part take, somewhat variably, the place of spines; upon the head, however, even setae are almost wanting, and in both the 'maxilliped segment' and the first peraeon segment, the single transverse row of spines, found in *tasmaniae*, is, as seen in side view, represented, if at all, by but a few setae, sometimes only two or three; in the second and the sixth peraeon segments the anterior row is less complete, while in the latter segment the second row, too, may be feebly developed; in the last peraeon segment both rows may be reduced. In the pleon, the posterior fringes are often restricted to setae along the more dorsal part of the segment, but the short anterior (mid-segmental) row consists of *spines*, sometimes very few in number. On the tailpiece, too, spines are present, mingled with setae, and, here, appear less irregular than in *tasmaniae*, their grouping suggesting two or even three short and incomplete double rows.

Compared with that of *tasmaniae*, the *head* appears less sloping, the forehead rising from the prominence above the eyes; its depth, length, and width are practically equal, there being no appreciable widening behind. The anterior border is rather shallowly emarginate, but is raised, between the eyes, into a short ridge, which is produced variably into a pair of mesial processes, frequently developed strongly as tubercles, which project visibly above the eyes when the animal is viewed from the side; in an immature specimen they may be very much less obvious.

Below the eye is a deep, sub-ocular incisure, from near which a 'genal' groove runs backward as in *tasmaniae*, but it is much shorter in this species, not reaching nearly to the hinder border of the head. From near the inner end of the sub-ocular incisure, a strong groove, bounding the gena in front, runs almost to the ventral surface, marking off a sub-oblong area below the eye, strikingly suggestive of a proximal antennary segment incorporated in the head. From this groove runs backward a ridge which constitutes the ventro-lateral boundary of the head. In almost every specimen this ridge bears an armature of setae (five to seven), these in some cases springing from an upward extension of the ridge towards the sub-ocular incisure. In this it differs from *tasmaniae*, in which, too, the other setae are replaced by spines. The ridge runs above the mandibular articulation (with which in some species it is confluent) and, behind that, in a sinuous course, turning slightly upward, to disappear beneath the antero-ventral extension of the coxa of the gnathopod, reappearing above to define a conspicuous cervical groove. In this posterior part of the head, a considerable area is exposed below the ventro-lateral border, and is variably overlaid ventro-mesially by the lateral border of the epipodite of the maxilliped; it is produced forwardly into a distinct 'posterior' process'. Behind the cervical groove is the maxilliped 'segment' which lacks, in this species, the strong, transverse, spine-bearing ridge so well developed in *tasmaniae*.

The proportions, etc., of the *peraeon* segments are much as in *tasmaniae*, except that they are rather less deep; a bevelling of the terga is seen here as in the surface-living New Zealand forms, to which this species shows many points of resemblance. The first peraeon segment, in dorsal view, shows very markedly

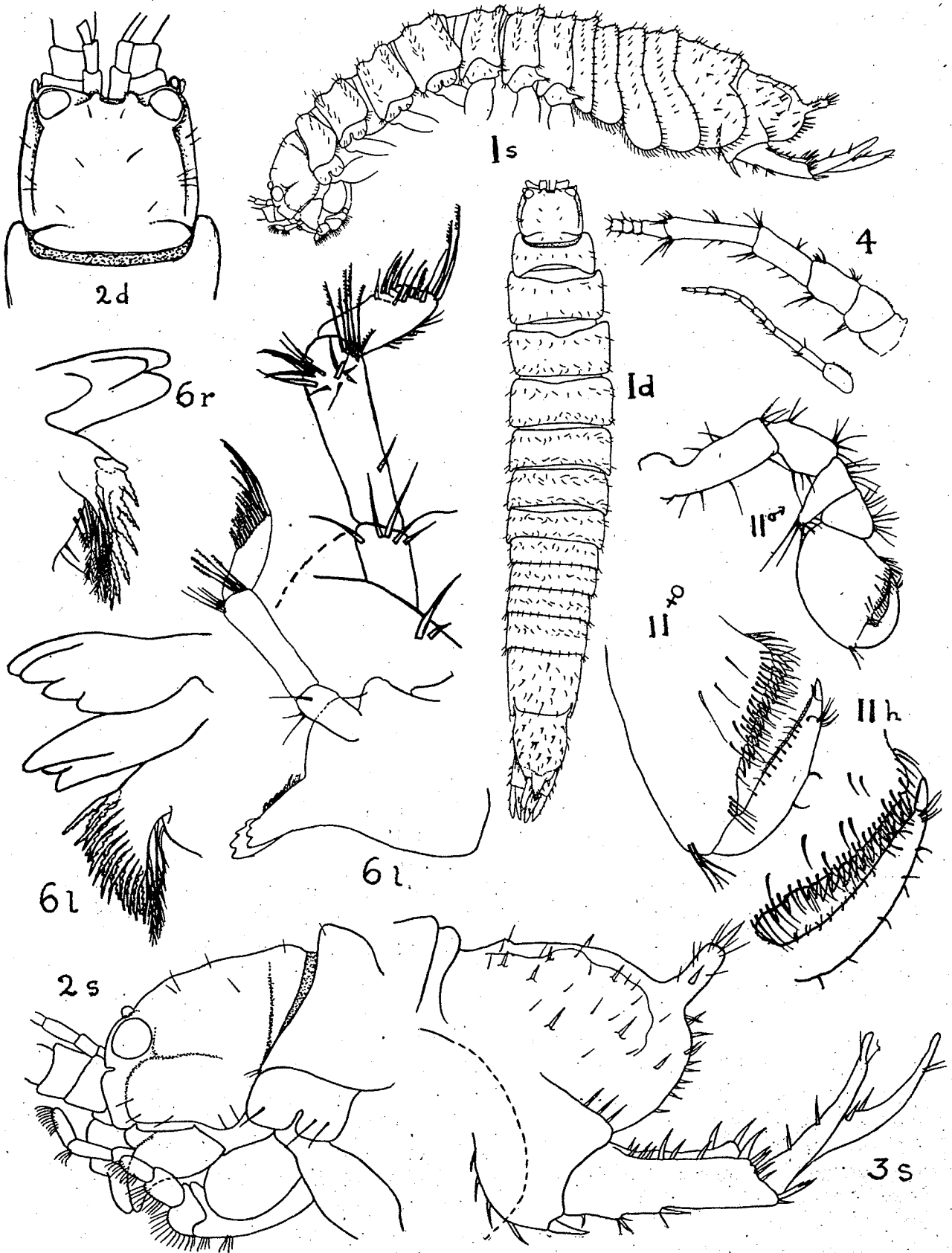


FIG. 51.—*Mesacanthotelson setosus*, sp. n.

the concave margin to both anterior and posterior borders, to which attention has been called in *N. assimilis*. The seventh peraeon segment is less sharply produced antero-ventrally, while fifth, sixth, and seventh are produced postero-ventrally into a seta-armed process. The outer faces of the coxae are comparatively free from spines and setae; the three hindmost are produced into strong processes.

In length, the first three *pleon* segments are sub-equal, the fourth slightly longer, the fifth as long as the combined length of the first three, and, as in *tasmaniae*, equal to the length of the tailpiece not including the telsonic spine.

As compared with the peraeon, the pleon is deeper than that of *tasmaniae*. The pleuron of the first segment is shallow, while those of second, third, and fourth increase progressively in depth. The ventral borders of these pleura are fringed with long, flexible setae, as in *tasmaniae*.

The telsonic spine is distinctly shorter than that of *tasmaniae*, both relatively and actually, slightly upturned, with a distinct dorsal concavity at its base, and, as a comparison of the figures will show, it is differently armed. The related pleuron is slightly more convex and meets the suture defining the sixth pleon segment and the telson closely above the insertion of the uropod. The sutural ridge has three or four setae and may stretch variably from a quarter to half-way across the tailpiece (fig. 51, 3). The antero-ventral border of the tailpiece (i.e., the free margin of the pleuron of the sixth pleon segment) is armed with from five to seven stout, slightly curved spines, three or four of the shorter (more anterior) of these bearing two or three pectinations terminally, in this agreeing with some *Notamphisopus* spp. (e.g., *dunedinensis*). The hindmost of these spines is particularly stout.

Appendages. The *antennule* (fig. 51, 4) is shorter than the peduncle of the antenna; the flagellum, which is sub-equal to the three-jointed peduncle, has apparently a maximum of seven joints.⁽¹⁾ On the first peduncle joint there is a fine fur of setules. In a female (with immature brood lamellae) there are, in the flagellum, only four joints, of which the second and third are disproportionately long.

The *antenna* (male) is, relatively, very much shorter and seems more robust than that of *tasmaniae*; in the peduncle, the third joint is as long as the first two, these having a width equal to the length of the third; the fourth is slightly longer than the third, the fifth once and a half times the length of the fourth, but rather less than the third and fourth combined. The flagellum, nearly twice the length of the peduncle, has thirty-two joints. In a female, the flagellum (practically complete) had but fifteen joints.

The mouth parts generally differ little from those of *tasmaniae*. The *labrum* (fig. 52, 5) is deeper and differs somewhat in shape; the right mandible (fig. 51, 6r) has a spine-row less well developed and there are differences in the armature of the palp—the setae arming the third joint are disposed, in *setosus*, in three or four sub-terminal transverse rows, some being coarsely denticulate, others finely pectinate, but in either case on one side of the setae only. Further, although there are numerous setae at the end of the second joint, only a few are pectinate.

Labium (fig. 52, 7). The mesio-ventral angles of the outer lobes appear more angular and the mesial and lateral fringes of setae are practically continuous. It is on an example of this species that the occurrence of setospines in the mesial marginal brush is most evident, their presence indicated by the retraction of the protoplasm of the actual setospines.

(1) Seven on one side and six on the other, in one specimen.

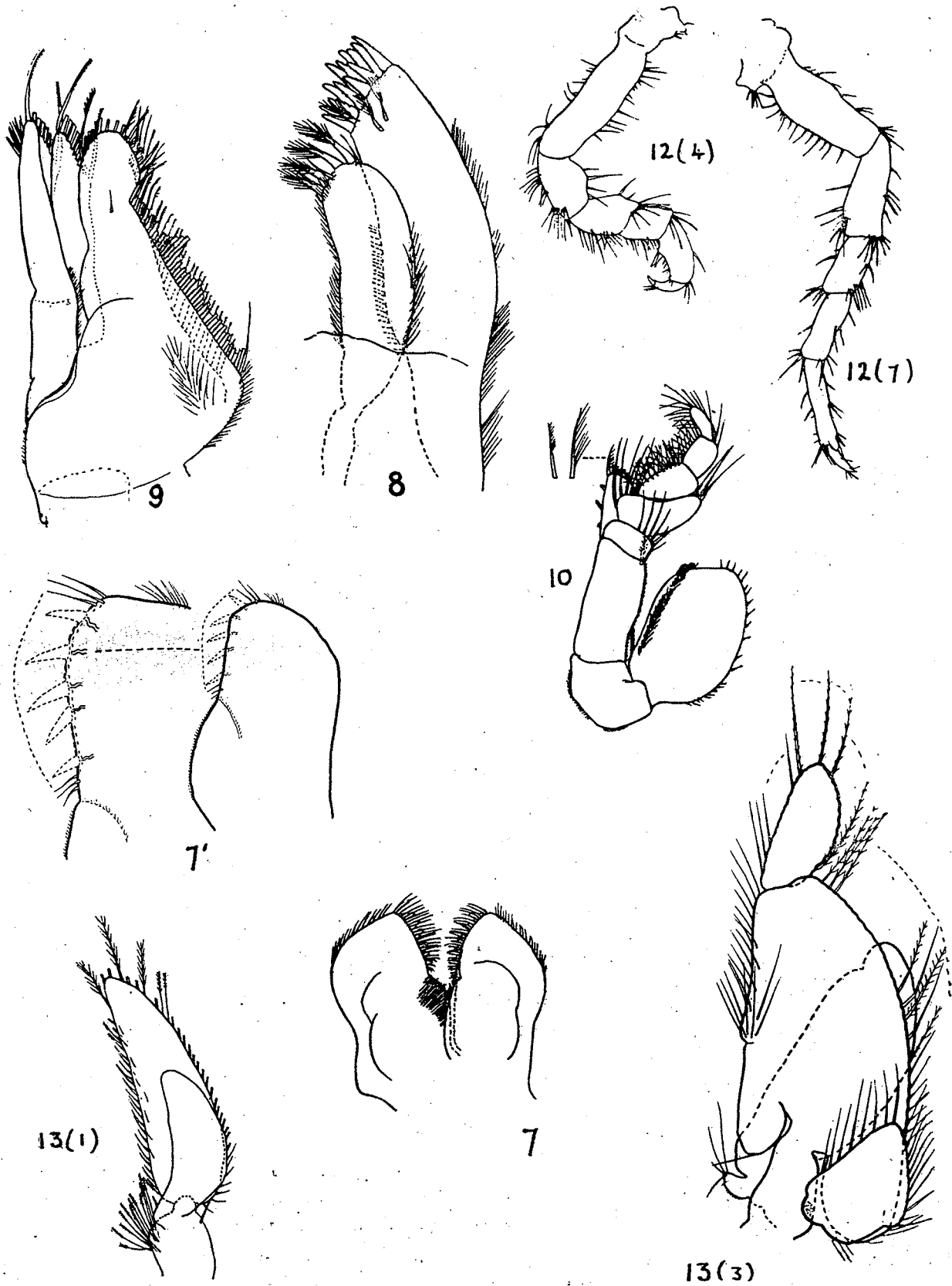


FIG. 52.—*Mesacanthotelson setosus* (7'—lobe of labium more highly magnified).

In the *maxillula* (fig. 52, 8), the principal differences are seen in the distal endite which is less noticeably narrowed apically (and its spines, therefore, less crowded); the sub-terminal plumose setae on the posterior face are reduced to two, and never more than one setospine is found in the apical series of spines.

Maxilla (fig. 52, 9). In this appendage, the outer endite appears narrower and the characteristic tuft of setae on the outer border, near its base, is wanting. On the proximal endite, the filter setae are arranged in the usual single row; on the anterior face of this endite there is a short basal tuft of simple setae instead of the long rank running the whole length of the endite.

On the posterior face there is the normal single rank of pectinate setae, and this begins more proximally and springs from a ridge which is farther from the mesial edge; the setae are less numerous, about thirty in all. In the *maxilliped* (fig. 52, 10) there are fewer coupling hooks (three instead of four) set far more distally, the appendage as a whole being less setose; on the endite there were found only about fourteen brush setae, all of which seem to carry cilia on the distal face only. At the outer distal end of the basis are two spines, apparently not plumed. The epipodite has the whole of its outer margin crenate and set with spinules.

The *gnathopod*, in the male (fig. 51, 11♂), differs from that of *tasmaniae* in the proportions and the shape of the hand. The propod has a width barely three-fourths of its greatest length; moderately convex anteriorly, it is quite definitely concave on its posterior border, which is barely half the length of the palm; the palm is sinuous, convex for three-fourths of its length, concave near the base of the dactyl; its armature of about fourteen denticulate spines is like that of *tasmaniae*, but the spines are less stout and are followed distally by four or five simple spines; the slotting on the palmar border of the dactyl is undeveloped. In the female (fig. 51, 11♀) the propod is more narrowly sub-triangular (as in *tasmaniae*); the slotting of the dactyl is strongly marked, and there are twelve to fourteen spines on the palm of the propod.

The peraeopods (fig. 52, 12(4), (7)) are to be distinguished from those of *tasmaniae* principally in that they are armed mainly with longish flexible setae, this difference being particularly noticeable in the more proximal joints of the fourth to seventh peraeopods, whereas in *tasmaniae* there are close-set ranks of short, stout spines. In the fourth peraeopod of the male, the ischium is shorter, being barely half the length of the basis, and the dactyl is without the apical (palmar) tuft of setae. In the hinder group of legs, the more distal joints of the peraeopods of *setosus* are, perhaps, relatively less elongate and more robust than in *tasmaniae*, but in both species spines are here present; in addition there are several small sensory (plumose) setae on the bases.

The penes are alike in the two species, excepting that those of *tasmaniae* are armed with spinules, those of *setosus* unarmed.

Females are not abundant and there are none mature in the collection examined. One (16 mm. in length) shows the brood lamellae as small leathery flaps; a well-defined triangular area just internal to the coxa of the fifth peraeopods apparently include the future oviducal opening; springing from the coxa of its seventh peraeopod, on the left side only, is a slender penis

The *pleopods* show minor differences in the setation of the exopodite and in the processes bearing the entangling setae. There are also differences in the shape of the attachment of the epipodites. On the sternite in the mid-line between the first pair is a rounded boss in the male, a low hump in the female.

First pleopod (fig. 52, 13(1)). The exopodite is narrow, lanceolate, with about nine or ten plumose setae borne on the distal margin. Along the nearly straight inner border are long slender setae, mostly finely pectinate, in the distal half some arising sub-marginally on the lateral border, the rank of plumose setae is extended interruptedly rather more proximally than on the inner border; pectinate setae extending almost to the proximal end; some setae, mostly simple, are borne sub-marginally. The endopodite, which arises on a narrow, curved stalk, is scarcely two-thirds of the length of the outer lamella, is narrower, more rounded apically, and quite devoid of setae. The entangling setae are numerous and pectinate, and arise in two or three tufts.

The second pleopod in the male is longer than the first, by the extent of the second exopodite joint; the mesial border of the basal joint of the exopodite has a thick fringe of short, pectinate setae, only two or three terminal setae being plumose; on the second joint, also, the greater part of the mesial border has pectinate setae, but near the apex, plumose setae appear, and these continue along the outer border for its distal half; there are a few interspersed simple setae, and these constitute the fringe along the proximal half of the outer border. The endopodite is as long as the proximal joint of the exopodite and is recognizably divided into a common basal region and two distal portions, an outer respiratory lamella and a longer mesial scroll-like stylet, curved, its hollow directed mesially, the free edges armed with a fringe of short setae. Apically the stylet is armed with three or four stiff spine-setae. The sympodite is irregularly four-sided, its mesial border shorter than the lateral, and its distal half occupied by a short entangling lobe carrying a dozen or so long pectinate setae; its lateral border appears unarmed.

Succeeding pleopods differ in several details; the endopodite in the third is slightly longer than that of the second; only the distal half of the mesial border is setose; upon the rest of the joint plumose setae are present much as in the second, but the simple setae proximo-laterally are fewer. On the sympodite the entangling lobe becomes increasingly conspicuous.

Uropod. As in *tasmaniae*, this is very elongate, but differs in its armature, the peduncle bearing two spines on its ventral border; scattered spines on the inner dorsal edge are few, but rather more plentiful on the outer edge; the rami are stout; the inner may be a little longer or not quite as long as the peduncle; the outer ramus is armed with two spines, one at its mid-length, the other more proximally; usually three spines arm the inner ramus. The spine beneath the insertion of the rami is stout and multi-toothed. In the female, the uropods seem relatively shorter.

Size. Largest male about 19 mm.; largest female (immature) 16 mm.

Colour. Uniformly dull grey (in spirit).

Occurrence. Dredged along the old shore line at the north end of the Great Lake (D. Spargo, 22.12.33). Also from the collection made by J. W. Evans, obtained from the stomach of trout.

Mesacanthotelson tasmaniae (G. M. Thomson)

(Figs 53 and 54)

Thomson, G. M., 1894, p. 349, pl. 11 (part) (*Phreatoicus tasmaniae*).

Sheppard, 1927, p. 94, figs 2(2)-(5), 3, and 4 (*Phreatoicus tasmaniae*).

Smith, Geoffrey, 1909, p. 73, pl. 12, figs 7, 8, and 11 (*Phreatoicus spinosus*).

The body is sub-cylindrical, being flattened ventrally, maintaining in the male, between the third and seventh pereiopod segments, an almost uniform width, which

is rather greater than the depth in this region. The head and first peraeon segments are, however, distinctly narrower than the peraeon, while, posteriorly, the pleon segments and tailpiece taper, at first gently and then sharply, to pass abruptly into the long spinous telsonic process, so that viewed from above, the animal appears of an elongate fusiform shape. Actually the length of the body is about six and one-half times the greatest width.

The surface is produced into stout spines, distributed somewhat irregularly upon head and tailpiece, but more regularly on the body. On the first peraeon segment, they are arranged in a single, short, wide band, which consists of a double rank of spines, while on the second to the seventh, there are two more extensive bands in each segment, the second, which is separated from the first by a deep groove, lying close to the hind border. In the first four pleon segments there is a single row of these spines situated posteriorly and forming a backwardly-directed fringe, but in the second to the fifth, there may frequently be found a feeble development of a mid-segmental row on a slightly elevated ridge.

The *head*, long, shallow in front, slopes upward irregularly to its hinder border. Its length equals its greatest depth, but is rather less than its width; the anterior border is very shallowly emarginate. The eyes, long-oval in shape, are prominent, placed laterally and obliquely, each having about sixty facets; the width of the interocular region is between once-and-a-half and twice the longest diameter of the eyes; is slightly concave and practically free from tubercles; in front it is raised into a well-marked ridge which becomes slightly sinuous just in front of the eyes, and may be produced into a pair of small elevations, or may bear one or two pairs of slender spines. Below the eye there is a short, wide sub-ocular incisure from which a shallow groove curves towards the hinder border of the head, forming the upper boundary of a wide gena or cheek and fading out behind at the level of the suture of the coxa of the gnathopod with its segment. The sub-ocular area is fairly well defined; a spine-bearing ridge marks off the ventro-lateral border of the head, the anterior half of which appears as a smooth band of variable width, part of its lower edge providing the mandibular articulation, this latter being at first practically horizontal, and then strongly inclined ventrally (fig. 53, 2s). Below the mandible there is a very small 'posterior process' clothed with fine setae, which are present also on the adjoining surface of the mandible. Behind, this ventro-lateral border widens into the post-mandibular region (the lower part of the maxilliped segment) and is normally overlapped below by the epipodite of the maxilliped (displaced in the figure), while its upper limit is indicated by the spine-bearing ridge which, turning dorsally, seems to define the lower end of the cervical groove. At this point it is hidden by the coxa of the gnathopod, but, above, the cervical groove is particularly well-defined; dorsally (fig. 53, 2d) it is incomplete. The maxilliped segment bears a slight transverse elevation with two or three spines (obviously comparable with the row on the first peraeon segment) and its posterior margin forms the depressed articular area of the head.

The *peraeon* segments all have a depth greater than their length. The first is but half the length of the head, with which it appears fused⁽¹⁾, below it widens distinctly. The second and fourth segments each almost equals the head in length; the third is slightly the longest; the fifth and sixth are shorter, while the seventh is barely two-thirds of the length of the third. The antero-ventral angle of the first peraeon segment is sub-quadrangle, armed with a couple of short spines, a variable cluster of spines springing from both lobes of the large coxa of the

(1) There seems a slight mobility here in some specimens.

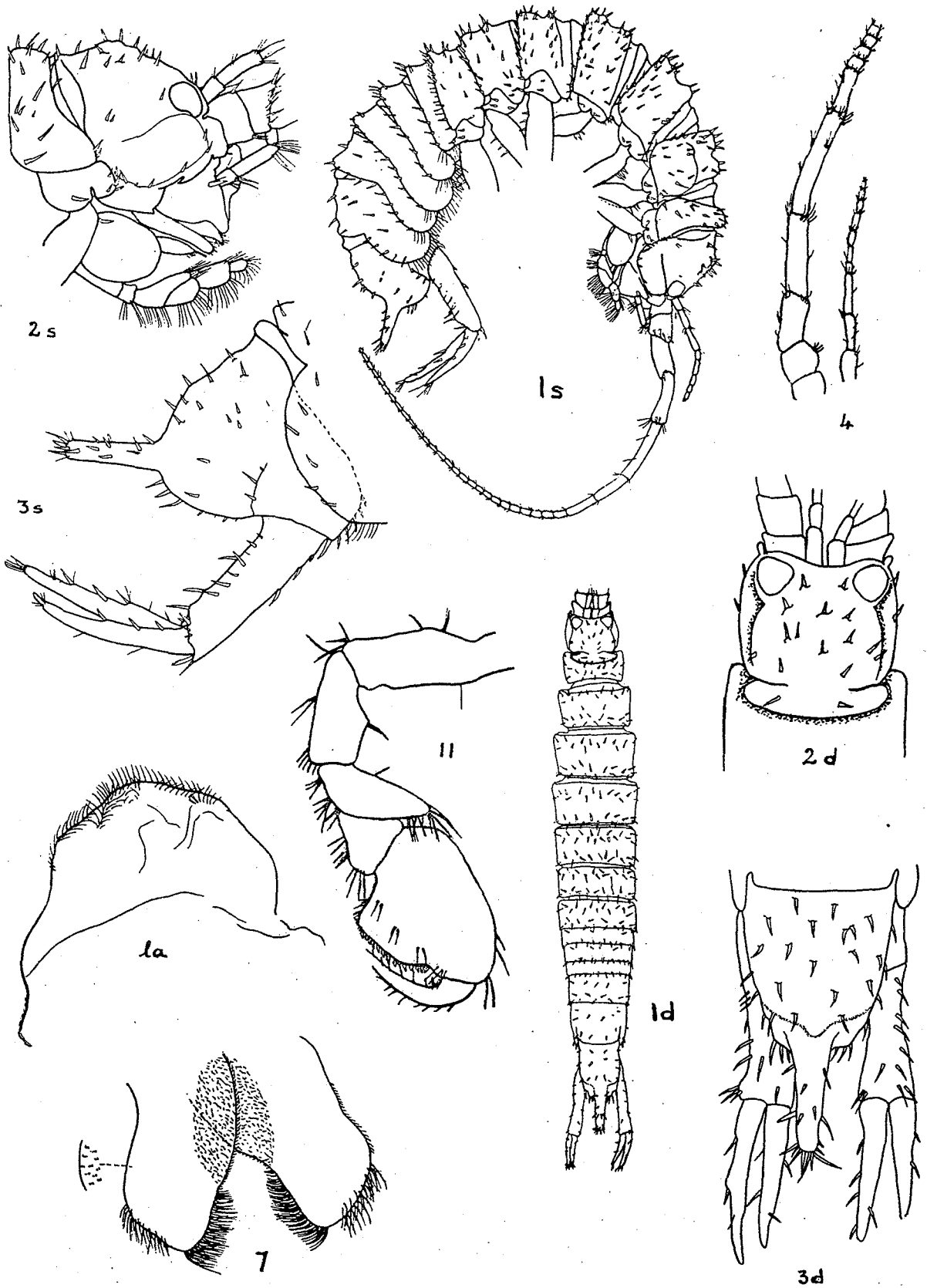


FIG. 53.—*Mesacanthotelson tasmaniae* (G. M. Thomson).

gnathopod. The next three segments have the antero-ventral angle downwardly produced in front of the respective coxae into an angular process, armed with a small group of spines. The fifth to seventh peraeon segments, also, are produced antero-ventrally, but the corners are more rounded and spines occur along the ventral borders. The postero-ventral angle in the first three segments is rounded; in the fourth it appears more angular, while in the posterior three segments, the ventral border is deeply excavated and the hinder margin shortened to accommodate the coxa of the related limb; the actual coxae are produced backwardly in a strong process which is armed with one or more spines. All the coxae are large (only the fourth somewhat reduced), and may bear sparsely-scattered spines.

The *pleon* segments increase progressively in length from the first to the fifth, the first being about half as long as the seventh peraeon (or the fourth pleon) segment; the fifth has a length sub-equal to the combined length of the first three, and is as long as the tailpiece, not including the telsonic projection; there is, also, in each a progressive increase in depth from the first to the fourth pleon segment. The ventral border of the second to fifth pleura is fringed with curved, slender, flexible setae, the first pleuron having a less complete fringe.⁽¹⁾

The tailpiece is unique among extant forms, in the extreme elongation of the telsonic spine (cf. *Acanthotelson*). This is armed, a little variably, with some setae and one or two pairs of stout spines terminally, and with paired spines at one or two nodes along its length. The telsonic pleura are slightly convex below the base of the projection and armed marginally, each with a few (six to eight) moderately strong spines of variable length. The incomplete suture between telson and sixth pleon segment is to be seen extending antero-dorsally from the insertion of the uropods, and bears two, rarely three, spines. Between this and the uropod the border is fringed with setules.

Anterior to the insertion of the uropod, the pleuron of the sixth pleon segment is relatively deep and narrow, its ventral border having five close-set, strong, curved spines, some being toothed apically, while immediately beneath the uropod insertion there is a much stouter, simple spine flanked by two smaller spines (cf. *Eophreatoicus*).

In the specimen figured, the pleon has scarcely two-thirds the length of combined head and peraeon, the latter region being shown fully extended. In the figures given by Geoffrey Smith and Miss Sheppard, the pleon appears longer relatively.

Appendages. Some of these have been figured by Thomson and by Sheppard. There is, apparently, considerable variability for, in several instances, my preparations show marked divergence from the condition recorded by the latter author.

Antennule (fig. 53, 4). The peduncle is sub-equal to the flagellum; the first joint is expanded and covered with scale-setae; the second and third are slender; the third is longest. There may be as many as nine joints in the flagellum,⁽²⁾ the last four or five of which (fifth to end) bear two or three characteristic sensory setae apiece, the 'olfactory cylinders' of Chilton's descriptions; the end joint has unusually but a single olfactory cylinder.

(1) The development here, of flexible setae, is probably related to the habit of rolling up. Stiffer spines might make this operation more difficult.

(2) The number will naturally vary in growing specimens, but even in mature specimens there can be considerable variation in the number of joints of the flagellum of the antennule. Thus, males are found with seven and nine joints, or seven and eight, in flagella of opposite sides; or with seven on both sides; three females examined showed seven on both sides, a fourth (with immature brood lamella) had six joints on both, while a fifth had seven flagellar joints in one, with eight on the opposite appendage.

The *antenna* is stout and attains to a greater length than in any other Phreatoicid. The peduncle is very strong (fig. 53, 4), but owing to the proportions of the several joints which diminish relatively slightly in thickness, this robustness is not so obvious in the figures of the isolated appendage. In one detail it differs markedly from Sheppard's account, for the fourth joint of the peduncle is half as long again as the third joint instead of shorter as stated by Sheppard (l.c., p. 96), while the fifth is only about one-third longer than the fourth, thus agreeing with the condition figured by Thomson. In the male, the flagellum may have at least as many as thirty-nine joints and the entire appendage is, in some examples, practically as long as the body of the animal, the flagellum thrice the length of the peduncle; an unusual, but not invariable, feature is the length of the first two joints of the flagellum. In the female, twenty-six joints seem to be normally present, but in one female, with developing brood lamellae, forty-five joints were counted.

In immature specimens, the appendage is shorter; thus Thomson (1894, p. 350, pl. II, figs 1, 2) described the flagellum as 'somewhat exceeding the peduncle in length' and figures the antenna as about 4 mm. in length, noting that his largest male had a length of 'a little over half an inch'. Sheppard, with specimens from '15 mm. to 23 mm.' in length, finds the antenna 'rather more than half the length of the body'.

In view of the facts that the three closely-related species, *tasmaniae*, *decipiens*, and *setosus* show a marked difference in the length of their antennae, and that Smith's figure of '*spinosus*' and his description record the antennae as very long, also, that Sheppard's figure differs from those of Thomson, it may be (i) that the material collected by Geoffrey Smith contained examples of at least the first two of these species, and (ii) that the specimens from G. Smith's collection examined by Sheppard were not specifically identical with those selected and figured by Smith as the types of his species *spinosus*. Sheppard's identification of *spinosus* with *tasmaniae* is thus open to question, and it is possible (i) that *tasmaniae* G.M.T. is actually distinct from *spinosus* and (ii) that it is the species *decipiens*, described below, which is identical with *tasmaniae* G.M.T.; (iii) that *tasmaniae* of the present account should be assigned to *spinosus* Geoffrey Smith.

Alternatively, if Sheppard's identification of *spinosus* G. Smith with *tasmaniae* is really correct, the discrepancies in descriptions and figures must be attributed to the recording of conditions in immature specimens, or perhaps to variation in the specimens examined.

Labrum (fig. 53, *la*). The upper lip is very stout and prominent, although in outline it appears long and narrow. It is movably attached, along a markedly asymmetrical hinge-line, to a well-developed epistome. Upon the external face there is a median ridge, which projects in a well-developed prominence, on either side of which the surface is concave, a condition suggestive of a reduced or under-developed, sub-rostral spine.

Mandibles. The left differs from the right (fig. 54, *6r*), as is usual in this family, in the condition of the molar, as well as in the possession of a *lacinia mobilis*. The joints of the palp retain the relative proportions commonly found in the Phreatoicidae. The palp as a whole is quite long and its armature of spines and setae is exceptionally well developed. Near its attachment there is one stout spine; the distal end of the first joint bears a group of three stoutish spines and some setae; not only does the distal end of the second joint carry the usual terminal, rather comb-like, series, consisting here of nine long, slender, pectinate setae, but there is also a rank (varying in number in the two palps) of slender setae along the distal fourth of its upper border, and a fringe of setules on the opposite border; the third joint is of the usual sub-crescentic shape but the

concave setae-bearing part of the edge is very long (nearly two-thirds of the length of the joint), with numerous setae carried in a triple rank, some simple and others finely pectinate, a few coarsely denticulate. They are more abundant on the left appendage; in both, the apical setae are doubly pectinate. As compared with *setosus*, the setae in this region are more plentiful in *tasmaniae*. In one specimen, there was retained a condition which has been observed in no other Phreatoicid—one exceptionally long seta, normally appearing terminal in this series, arising in a well-marked notch on the convex border of the joint. Fine setae partly cover the inner surface of the joint.

Just dorsal to the insertion of the palp, the fulcral process projects as a rounded knob which fits into a corresponding hollow near the antero-lateral corner of the head.

The spine row is a highly flexible structure, but, unlike the lacinia mobilis, does not appear to be articulated with the primary dentate piece. In both mandibles, the spine row consists of a narrow flange, its free edge slightly flattened into a plate almost at right angles to its axis. From the borders of this plate, the paired spines diverge slightly and are denticulate on their mesial surface. In both mandibles, the spine row is followed by two or three (occasionally four or five) slender plumose spines which have presumably escaped incorporation in the row.

Labium (fig. 53, 7). There is practically no differentiation into outer and inner lobes. The ventral ends of the lobes are sub-rectangular, the corners gently rounded; mesially it passes into a flexible median fold, the paired surfaces of which are densely setose and form an inverted trough leading to the mouth. The mesial surface of the outer lobe is densely furred with long setae; the outer distal surface is more sparsely setose, the two setal tracts being separated by a short gap; the outer distal fringe passes gradually into a sub-marginal fur of short setae, which decrease continually in length proximally, until they are replaced by short scales whose free edges are dissected into a short, curved line of setules. Such a scale-like condition probably forms the covering over nearly the whole of the outer surface of the body, but can probably be seen nowhere more readily than on the outer edges of the proximal part of the labium or on the corresponding region of the maxillula and maxilla.

Maxillula (fig. 54, 8). Miss Sheppard has devoted considerable attention to the structure of this and the succeeding appendage of this species (1927, pp. 85 and 96/97), and while she has, it seems, entirely missed certain essential features of the maxilla, there is little to be added to her account of the maxillula. It must be noted, however, that here, as elsewhere in this species, there is a rather unexpected variability.

Thus, on the *inner endite*, the number of apical setospines, normally four, may sometimes be increased to five, in which case the two stout spine-setae lie against the first and third (counting from the outer edge); normally, these two spine-setae lie well external to the first and between the second and third. Again, the inner half of the apex of this endite may be thickly furred with slender setae shorter than, but otherwise resembling, the setae which cover the mesial border of the endite.

On the *outer endite*, the terminal short, stout spines are arranged in two rather uneven rows; the number seems to be inconstant (eleven to fourteen) but of them, one (in several specimens, two) near the inner edge of the posterior row is a setospine very like, but smaller than, those normally present on the inner endite. The stouter (outermost) spines may be simple, but most of the series are coarsely denticulate.

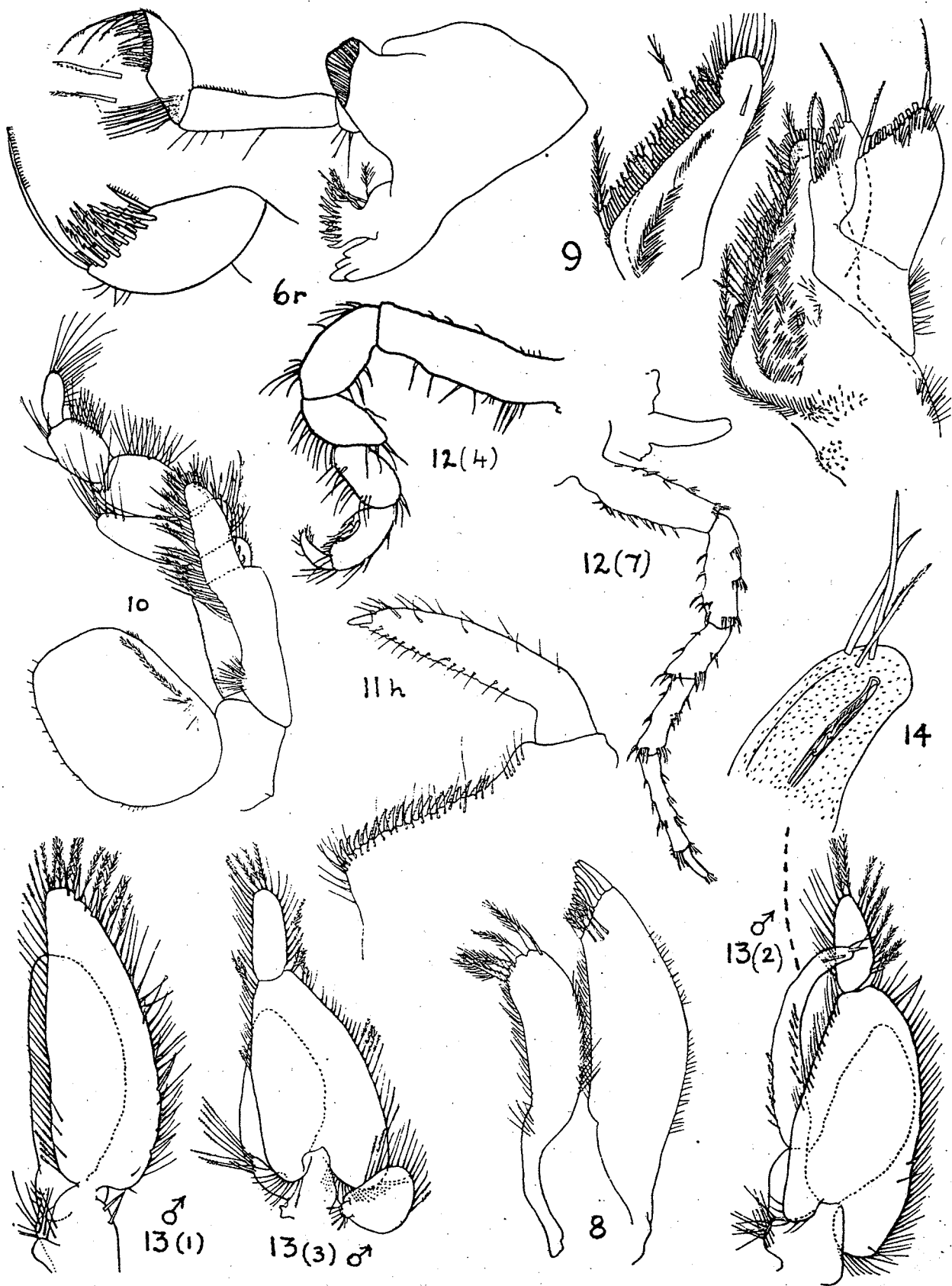


FIG. 54.—*Mesacanthotelson tasmaniae* (G. M. Thomson).

On the *posterior* face of the endite, near its distal end, is a broken rank of slender, plumose setae. Sheppard records only two setae here, but in large specimens there are usually three, scantily ciliated and occasionally one (the innermost) may be almost simple. In one example (the largest male examined), four⁽¹⁾ of these setae were found on both right and left appendage; the additional seta (more mesial in position) being more strongly ciliated than the others.⁽²⁾

Maxilla (fig. 54, 9). The structure, and particularly the armature, of this appendage is much more complicated than would appear from existing accounts and, up to a point, displays a striking likeness to the condition in *Apsuedes* and *Mysis*! The three endites are set somewhat obliquely; the innermost (fixed) lobe or proximal endite is wholly anterior, the inner free lobe (inner distal endite) lying partly concealed behind it and, in its turn, it partly covers the outer distal endite.

The proximal endite has its inner border broadened to constitute a mesial surface; from the anterior border of this mesial surface springs a rank of about fifty slender filter setae forming a close palisade, the apices of the setae being plumed with two ranks of fine cilia.

Towards the distal end, this row of setae is found to pass laterally a little onto the anterior face of the lobe where it stops abruptly, short of the apex; lateral to it lies one stout spine. Laterally to the row of filter setae along the anterior surface is a ridge armed with short setae. Much of the posterior surface is clothed with a dense fur of shortish setae; at the proximal end of the innermost ranks there is a thick band of simple setae which passes laterally on the hinder face.

Upon the posterior edge of the mesial surface, sub-marginally, lies a confused series of much more loosely-grouped setae, as many as thirty-five in some specimens. Proximally, they appear simple, but as they are traced distally they become stouter and show a pectinate condition, or, variably, are feebly plumose; finally this series is merged in the terminal cluster of stout setae, predominantly plumose but including some slender, simple setae and others spinous and with stout denticulations. The latter are more in evidence when the posterior surface of the apex of the endite is examined; the occurrence of plumose setae here is of interest, since such setae are, also, found in *M. capensis* and in some New Zealand species.

The inner of the two distal endites projects apically very little, if at all, beyond the free end of the proximal endite; the outermost is wider and extends slightly more distally. The apices of both are obliquely truncated and bear a row of long, curved, pectinate, or even serrate, setae. The denticulations vary from coarse to fine, the finest being practically pectinations; just sub-terminal are short rows of simple setae.

On the lateral border of the appendage, on the outer aspect of the second and third segment (Sheppard, text-fig. 3 (2)) are two clusters of slender setae directed distally; the more proximal is sometimes whorled.

The *maxilliped* (fig. 54, 10) has been described in detail by Sheppard. In many particulars, however, there was found a departure from the condition recorded, and it would seem that in this appendage, also, there is considerable inconstancy in setation and perhaps even in proportions.

⁽¹⁾ Cf. *Synamphisopus* and *Colubotelson setiferus*, where there may be five.

⁽²⁾ In her figure of this appendage (fig. 3, (4)), Sheppard indicates the presence of similar plumose setae sub-terminally on the inner endite, also. No reference is made in the text to this detail, however, nor could there be found any trace of such setae. It can only be supposed that the structures figured are protoplasmic retractions from the setospines.

It should be noted that, even when allowance is made for the relatively large size attained by this species, the maxillipeds are unusually large and stout, and the palp long, extending in front of the anterior surface of the labrum. Perhaps the most unusual feature is the large development of the coxa which may have a length more than three-fourths of that of the basis (not including the endite), while the width and length of the basis measured in a 12 mm. specimen is approximately three-fourths of similar measurements of the basis of the gnathopod.⁽¹⁾

The outer distal angle of the basis bears two stout, plumose spines. The endite of the basis is long—on its ventral edge is a series of four coupling hooks, which is continued to the apex of the endite by a short row of thick, curved and barbed spinules, these giving place to the terminal pectinate setae. The dorsal edge of the endite bears a long fringe of about twenty brush setae; proximally, and separated from these by a short gap, is a cluster of long stiff setae. The epipodite is large, its outer border armed with spaced setules, with an occasional spine; the inner surface bearing the usual sub-marginal series of setae, which are longest near its base. In an immature female the ventro-mesial corner of the coxa is scarcely produced but bears a serried rank of short setae.

Gnathopod. In the male, the basis, which bears a few spines, appears relatively rather shorter and wider than figured by Sheppard; the ischium bears one or two stout spines anteriorly; the merus is strongly produced, the apex of the process armed with a very stout spine with flanking setae on either side; the propod, at its greatest width, is three-quarters as wide as long, its anterior border convex with a couple of tufts of setae distally. The posterior border, which is half the length of the palm, is almost straight but slightly concave proximally; the palm, straight for more than half its length, becomes concave near the attachment of the dactyl; it is armed with fifteen to sixteen stout spines, strongly denticulate on their posterior edge, the dactyl scarcely reaching the end of the palm, the inner border serrated, the outer with sparse setae. In the female, the limb is shorter and more slender, the propod sub-triangular with steeply oblique palm, notably setose. The denticulate spines are fewer and more slender; the inner border of the dactyl slotted apically so as to cut it into a series of incisor-like teeth, but these tend to become short, sub-conical spinules nearer the base of the dactyl. In the three succeeding peraeopods, the ischia and merus are very slightly expanded, the dactyls of second and third have a small secondary unguis; the propod of the fourth is elongated but appears rather less angular than represented in Sheppard's figure. In a large immature female, 18 mm. in length, the sternite of the fifth peraeon segment showed a pair of small flexible flaps—obviously vestiges of a fifth pair of oostegites. Usually the sternite of this segment has two well-marked triangular regions, the nearly mesial apices apparently marking the oviducal aperture.

The fifth, sixth, and seventh *peraeopods* show progressive increase in length; on the basis of the sixth and seventh there is found a trace only of a flattened flange along part of the hinder border. Upon this hinder margin may be found one or more small ciliated (sensory) setae.⁽²⁾ Ischium and merus, too, are slightly flattened, but all are relatively very much less expanded than figured by

⁽¹⁾ The maxilliped of this small (12 mm.) *tasmaniae* is rather longer than that of a fully-grown *orarii* (15 mm.) and as long as that of a large *pearsoni* (18 mm.); in the fully-grown *tasmaniae* (23.5 mm.) its size is almost doubled.

⁽²⁾ A small cluster of such setae occurs distally on the propod just above the insertion of the dactyl.

Chilton for *australis*; the dactyl is elongate. These limbs are notable for their armature which consists of numerous stout, but short, spines, the spininess reaching a greater development than in any other Phreatoicid species, and is scarcely rivalled even by *Eophreatoicus* or *Synamphisopus* among the Amphisopidae. In the male, the penes are strongly curved, and so long that their apices meet in the middle line. There seem to be spines related to this structure, but these may be actually borne on the sternite, for there is a transverse row of spines on each peraeon sternite, a feature peculiar to this species. In one female, a single penis was present, on the left side.

Pleopods. The pleopods in this species have received scant notice. Geoffrey Smith omits all mention of them, while Sheppard dismisses them in three lines, as being of the usual *Phreatoicus* type and bearing a close resemblance to those of *M. australis*. In actual fact, in the first pleopod, at least, there is a marked difference from that of all other Phreatoicids, in that on both exopodite and sympodite, it bears stout sub-marginal spines. In this first pleopod (fig. 54, 13(1)), the sympodite, seen in anterior view, has the usual sub-quadrangular shape; on its inner aspect, it is produced into a large lobe which bears mesially a tuft of long entangling setae, while upon its outer distal angle is a powerful spine (sometimes two) in the male, these being less developed in the female.

The endopodite is scarcely oval as figured (1927, fig. 4 (8), (9), (10)), but has a practically straight inner border and is nearly four-fifths of the length of the exopodite. The exopodite bears the usual fringe of plumose and simple setae; a number of long, simple setae provides a complete fringe along the mesial border and proximally there are a few sub-marginal setae, also. Upon the outer aspect, at several points, the setal fringe is irregularly interrupted by the presence of stout spines, and there are a few (mostly apical) simple setae sub-marginally (cf. *flavius*).

The second pleopod, in the female, differs from the first (apart, of course, from the subdivision of exopodite into proximal and distal lobes) chiefly in the absence of spines from the exopodite and the larger development of the mesial plate upon the sympodite which bears the entangling setae. These setae are very numerous, long and stiffly pectinate or serrate.

In the male, however, there are certain details in which the appendage is marked off from that of other Phreatoicids. The endopodite is relatively shorter than that of the first pleopod, the basal lobe unusually strong, the penial stylet strong and tending to taper slightly towards its apex, which is curved. There is well developed an armature of slender spines along both free edges of the stylet, and there is an apical and sub-apical cluster of stouter spines, some of which may be serrated. One of these—which is sub-apical and springs from the inner surface of the scroll-like stylet and appears to be introverted, but is apparently capable of eversion—is only variably present. In the specimen figured it is seen to arise a little short of the apex and to lie rather crumpled in a tubular cavity. A second specimen shows it half everted. It is distinctly stouter than the other spines in this region and strongly serrated. The apical cluster differs, also, from that of *Mesamphisopus*, *Eophreatoicus*, *Uramphisopus*, and *Onchotelson* in that the number of terminal spines is quite small, probably not exceeding three.

Between the pleopods of both the first and second pair of the male is a distinct median sternal boss. It doubtless represents in a much reduced condition the structure figured as occurring on the second pleon segment of *Eophreatoicus*

kershawi.⁽¹⁾ In the immature female it is more rounded and, in the preparation, strongly wrinkled; indeed, the folding suggests the presence of an irregular slit-like orifice, but no mature female is available for study, and it may well be that the apparent opening is an artifact.

In the succeeding pleopods, there is to be noted a progressive decrease in the size of the endopodite, an increase in the development of the coupling lobe which may bear not only the usual group of long entangling setae but also, more proximally, a fur of short setules.

In the exopodites, the plumose setae on the outer border may extend farther proximally than in the first and second pleopods, but the mesial setal fringe is restricted to the distal half of the proximal plate. On the distal lobe, most of the mesial setae are pectinate.

The epipodites, which are sub-oval in shape, may bear a small basal lobe just proximal to the insertion of the narrow stalk, but this, like so many features in *tasmaniae*, is of variable occurrence.

Uropods (fig. 53, *la*). These are slender and longer, both absolutely and relatively, than in any other species, projecting well beyond the elongate telsonic spine. The peduncle is long, broadens posteriorly on its dorsal (concave) surface, the two diverging edges being armed with regularly spaced spines. The inner ramus, which is very long and may actually exceed the peduncle in length, bears two or three stout spines and is sharply pointed terminally. The outer ramus is distinctly shorter, and bears no fewer than three spines on its proximal half. Beneath the insertion of the rami is one, stout, and a second, smaller, toothed spine, flanked by several slender simple spines.

Colour. The body generally is greyish, sometimes quite dark but, in life, is relieved on antennae and legs by bars of orange or reddish chestnut.

Size. Up to 23.5 mm.

Occurrence. Great Lake, Tasmania.

Mesacanthotelson decipiens, sp. n.

(Figs 55 and 56)

A small form, very near to *M. tasmaniae*, but perhaps with affinities to *Colubotelson tattersalli*; from both of these, however, it may be at once distinguished by the condition and armature of the terminal telsonic projection. It has, also, much in common with *O. brevicaudatus*, from which it is readily separated by the condition of the head and the lesser degree of ridging and setosity, as well as by that of the telson.

Body sculptured and with slight ridges, sparsely setose, the setae long and flexible. The *head* is as long as the combined length of the first and second peraeon segments; its maximum depth is greater than either its length or width. In front it is moderately excavate, its anterior border raised, and there are some

⁽¹⁾ Reference was made in Part I of this paper (1943, p. 108) to this structure which, by some slip, for which the writer is utterly unable to account, was compared with a 'petasma'. Obviously it had no sort of likeness at all to any petasma, but a much more evident resemblance to a Penaeid 'thelycum'. The point which was to have been made was that in the male of *Eophreatoicus* there was perhaps a structure of the character of a *receptaculum seminis*, on a segment normally modified, if at all, only in relation to the male; if so, it would furnish yet another instance of the existence of male and female characters in a member, and a particularly primitive one, of this sub-order. It must be remembered that the adult female of this species has not been observed and that this structure may prove to be a normally functional female organ at the ovigerous stage.

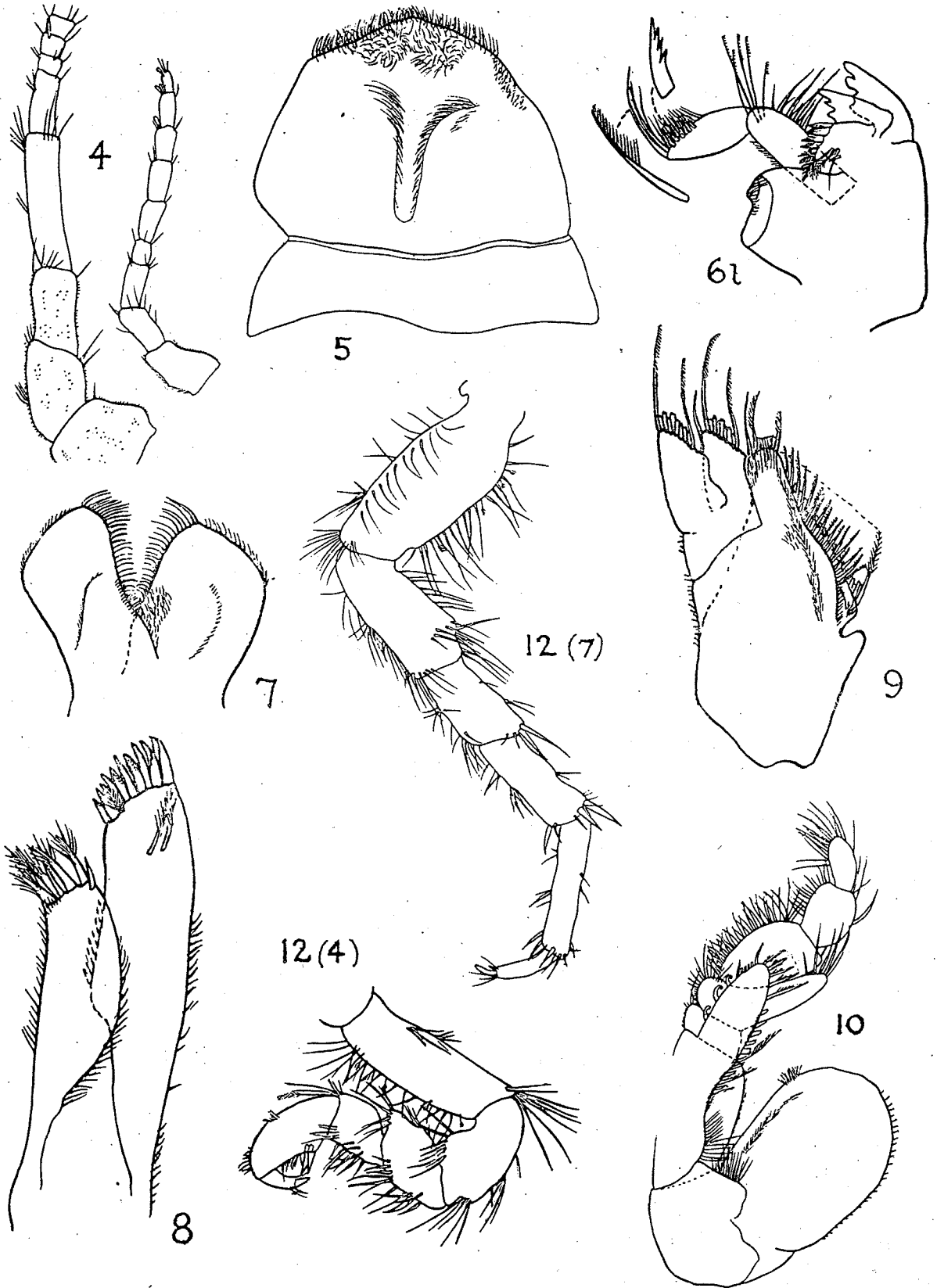


FIG. 55.—*Mesacanthotelson decipiens*, sp. n.

irregular elevations in the slightly concave inter-orbital area, which has a width about twice that of the greatest diameter of the eye. The oval eyes, with approximately 40 facets, are only moderately prominent, and the hollow behind the eye is accordingly much less marked than in *brevicaudatus*. Unlike that species, too, the genal groove is long, almost completely separating the cheek from the more dorsal part of the head. The sub-ocular incisure is a wide and shallow notch above the pre-antennary area which is well defined. The ventro-lateral border of the head appears as an almost straight and nearly horizontal line; the pre-mandibular portion is short, and is followed by a moderately long mandibular articulation behind which the border is sharply bent near the middle of its length to outline, as usual, the anterior limit of the post-mandibular region of the head. In this species, this is short and shallow; the removal of the gnathopod with its coxa uncovers the lower end of the cervical groove which clearly arises from this postero-ventral corner of the head. As in *brevicaudatus*, the transverse groove is complete dorsally, so that a maxilliped segment is well defined; the groove is, however, much weaker than in that species.

Peraeon. Again, as in *brevicaudatus*, the first peraeon segment is fused on to the head, of which it is less than one-half the length; the second to fifth segments are sub-equal, the sixth slightly, and the seventh decidedly, shorter; the width throughout the peraeon is fairly uniform.

Pleon. The first and second segments are both shorter than the seventh peraeon segment; the third is sub-equal to that; the fourth is almost as long as the sixth peraeon segment. The pleuron of the first is short, of the second longer (sub-equal to the depth of its segment), of the third and fourth deeper than the related segment, each of them meeting its related tergum in a nearly straight line behind. In the fifth, which is longer than the combined length of the third and fourth, the pleuron is deepest, its depth measuring nearly twice (?) that of its segment. The ventral borders of all these pleura are fringed with long, flexible setae which are continued up the hinder border of the fifth.

The pleopods hang down well below the lower ends of these pleura, the penial stylet of the adult male noticeable, being forwardly curved at the level of the endopodite, instead of hanging down almost vertically below the ends of the pleopods, as in *brevicaudatus*.

The *tailpiece* is barely as long as the fifth pleon segment, the terminal projection short and sharply upturned.

The telsonic pleuron has a slightly convex border, armed with a number of stout setae or slender spinules. These are usually eight in number and one of these, the fourth counting from above, is always stouter than the rest, thus agreeing exactly with Sheppard's description of this region in *C. tattersalli*.

The suture marking the junction of the sixth pleon segment with the telson, at the dorsal end of the articulation of the uropod, is short but distinct, and bears two long, stiff setae, agreeing with Sheppard's figure (1927, fig. 6 (11)) of *tattersalli*.

In front of the uropod, the pleuron of the sixth pleon segment has one stout distal simple spine, preceded by one similar but more slender, and this by four curved spinules, shorter and with a terminal toothed condition. There may be a slight variation here, some specimens showing *five* slender, toothed setae on one or both sides, but, apart from the slight numerical difference, they are markedly different from the condition described in *tattersalli* in that the curved toothed spines of *M. decipiens* are shorter (generally much shorter) than the stout distal spines, whereas of *tattersalli*, Sheppard states explicitly that they are longer. Finally, the telsonic apex differs from that of *tattersalli* and agrees with the

condition found in several of the Great Lake species (including *brevicaudatus*) in that the upturned end is armed with two pairs of spines and some eight to twelve scattered setae. It differs from *brevicaudatus*, however, in the angle at which it is upturned and in its shape. In *decipiens*, though slightly longer than broad, the projection is widest at its origin, whereas in *brevicaudatus* it is markedly longer and narrower relatively and its width decreases slightly near its origin.

Appendages. The *antennule* (fig. 55, 4), in many examples, conforms almost exactly to the description given for *tattersalli*, but in some specimens six joints are found in the flagellum and the proportions of the several joints may then be quite different. Its length is nearly that of the peduncle of the antenna. In the female it is long, but there are only four joints in the flagellum.

The *antenna*, too, agrees sufficiently nearly with that of *tattersalli* so far as the peduncle and first joint of the flagellum are concerned; the number of joints in the flagellum is, however, somewhat variable (fourteen in the female; twenty-four in the male). The terminal joints scarcely exceed half the length of the first flagellar joint, whereas in *tattersalli* the terminal joints are said to be long, the penultimate being as long as the first. The appendage reaches a length slightly less than half that of the body.

The *upper lip* and *epistome* show the usual asymmetry, the notch for the right mandible palp being strongly developed (fig. 55, 5).

The *mandibles* show the usual features, the principal and secondary dentate edges on the left bearing four and three teeth respectively, on the right mandible four; all are strong and heavily chitinised. In the palp, the second joint is by no means three times the length of the first, and upon this joint setae are present not only as a distal fringe, recorded for *tattersalli*, but also as a bordering fringe. Too much importance must not be attached, however, to the apparent absence or lack of record of such setae, as they are often to be seen only when the appendages are suitably mounted. Actually the arrangement of the setae in this species agrees closely with that of *tasmaniae*, although in previous accounts of that species, the bordering setal fringe has been neither recorded nor figured. Upon the distal half of the concave surface of the third joint of the palp is borne a row of short, simple setae, parallel to which is a row of shorter denticulate spinules. The apex is crowned by two or three longer, finely pectinate setae.

The *labium* (fig. 55, 7) resembles rather closely that of *setosus*.

The *maxillula* (fig. 55, 8) shows the condition characteristic of this genus, except that the outer endite is unusually long, but it differs from that described for *tattersalli* in a couple of minor details; the apex of the outer endite bears twelve spines and one small setospine and the marginal setae on both borders of the two endites are quite short. Two plumose setae spring from the posterior face of the outer endite.

In the *maxilla* (fig. 55, 9), the only detail calling for special note is the number (eighteen) of the pectinate setae in the posterior row of setae fringing the mesial border of the proximal lobe, a similar number being found in *fallax*, whereas in *tasmaniae* there are about twenty-one and in *setosus* twenty-six.

The *maxilliped* (fig. 55, 10) resembles closely that of *tasmaniae*, excepting that there are fewer (twelve only) brush setae on the dorsal margin of the endite.

The *gnathopod* of the male (fig. 56, 11 ♂) is, also, in close agreement with that of *tasmaniae*; the joints, however, are in general more setose and lack spines. In the female, too, there is a similar resemblance even to the narrow slots upon the palmar edge of the dactyl (fig. 56, 11 ♀), a feature which is absent in the male. Of the *peraeopods* generally the same is true. The fourth *peraeopod* of the male is stout, its joints heavily setose, the propod without strongly concave

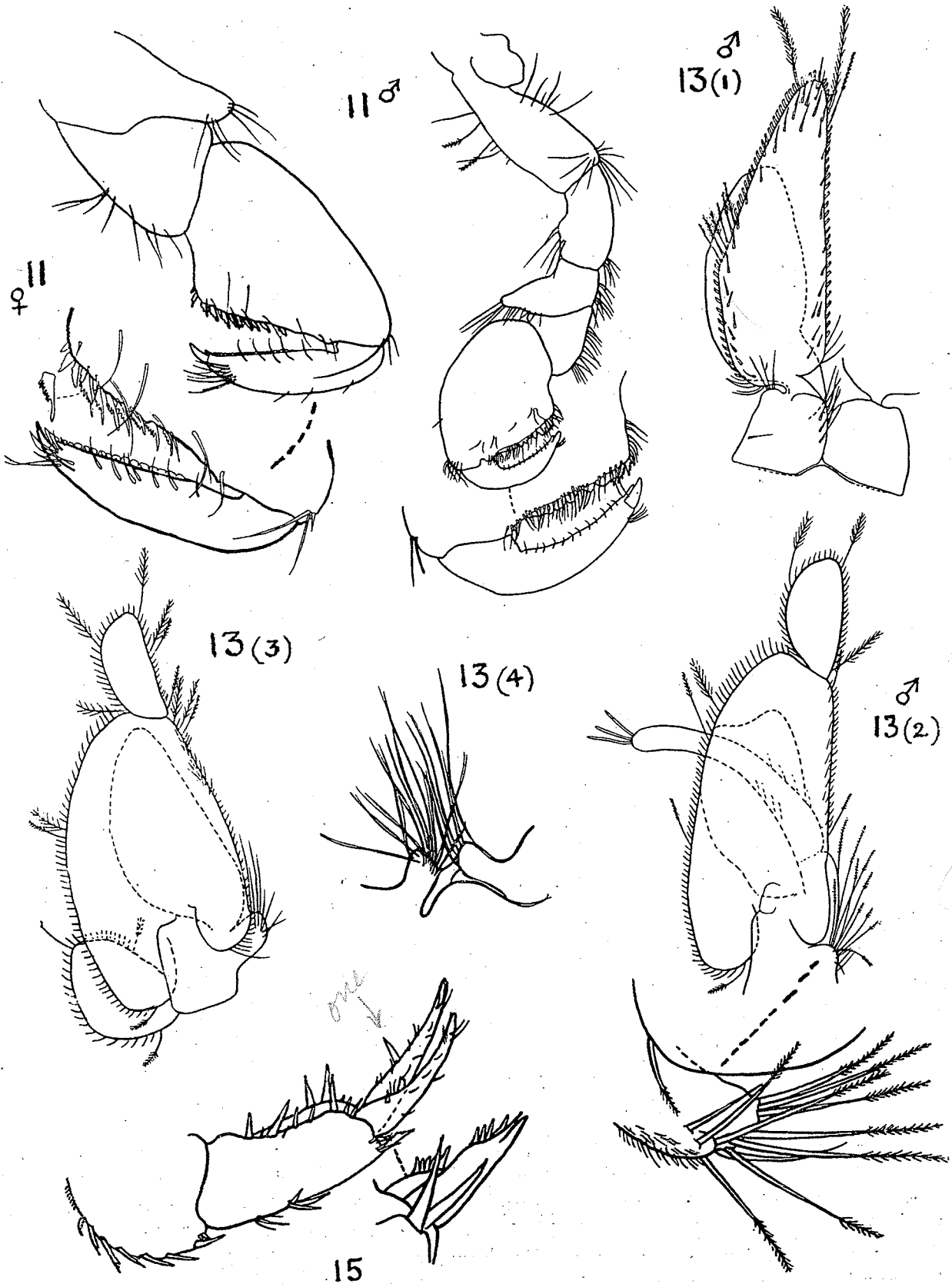


FIG. 56.—*Mesacanthotelson decipiens*, sp. n.

posterior margin (fig. 55, 12(4)). The seventh (fig. 55, 12(7)) seems to show an incipient flange on the posterior border of the basis, the enlargement making the maximum width nearly two-fifths of the length; in *tasmaniae* this is less developed.

The first *pleopod* (fig. 56, 13(1)) is somewhat unusual in this genus, for there are numerous setae arising sub-marginally and sub-apically from the anterior face of the exopodite, in this resembling *brevicaudatus* and *Paraphreatoicus relictus*; the endopodite, though relatively rather shorter than in *tasmaniae*, is, nevertheless, longer than in the remaining species of this genus. The second pleopod has numerous entangling setae springing from the mesio-distal angle of the sympodite, the setae being doubly pectinate apically; proximal to these the surface of the sympodite is furred with short setules. In the male, the penial stylet is strongly curved and has three stiff setae apically, while its lateral border bears a few short setae or slender spines. In the succeeding pleopods the entangling setae are borne on strongly projecting lobes, and as these pleopods become more widely separated these lobes are increasingly elongated, the respective sternites being raised in a rounded boss in the middle line between the two entangling lobes. The epipodites are short, oval lamellae attached by moderately wide bases.

The *uropod* (fig. 56, 15) is relatively short, its peduncle deep and longer than the rami, beneath the insertion of which are two stout, toothed spines of unequal length, flanked by two slender simple spines; the outer ramus has one spine.

Colour. In spirit, faded to a dull greyish brown.

Size. About 10 mm.

Occurrence. Great Lake, Tasmania; from stomach of trout.

This species seems to be nearest to *tasmaniae*, intermediate between that species and *fallax*, but in its lack of spines and the possession of abundant setae, approaching *setosus*.

Mesacanthotelson fallax, sp. n.

(Figs 57 and 58)

♀ only
probably = *M. setosus*

This species, also, is in appearance very like *M. tasmaniae*, from which it differs in the following respects; it is a much smaller animal, the body having the ridges less marked; spinose, but the spines considerably fewer and more widely spaced than in *tasmaniae*, and the rows tending to consist of a single, instead of a double, rank.

In the pleon, where mid-segmental ridges are scarcely developed, there are two rows of spines on the third, fourth, and fifth segments, the hinder sub-marginal, unlike the characteristic marginal fringe of *tasmaniae*.

The *head*—almost smooth and sub-equal to the combined length of the first and second peraeon segments—is longer than deep; the eyes, though prominent, do not appear in the profile of the head, so that the rather steep frontal slope starts directly from the anterior border of the head, which is but slightly emarginate.

The interocular area is little concave and not greatly wider than the longest diameter of the eye; it bears neither spines nor tubercles. The sub-ocular incisure is wide and shallow. The ventro-lateral border of the head appears as a smooth band, which runs above the mandibular articulation and widens into the lower (post-mandibular) part of the maxilliped segment from the hinder corner of which the cervical groove runs upward. This fails to meet its counterpart dorsally, so that the maxilliped segment is not there completely marked off from the rest of the cephalon, in this agreeing with *tasmaniae* and differing from *decipiens*.

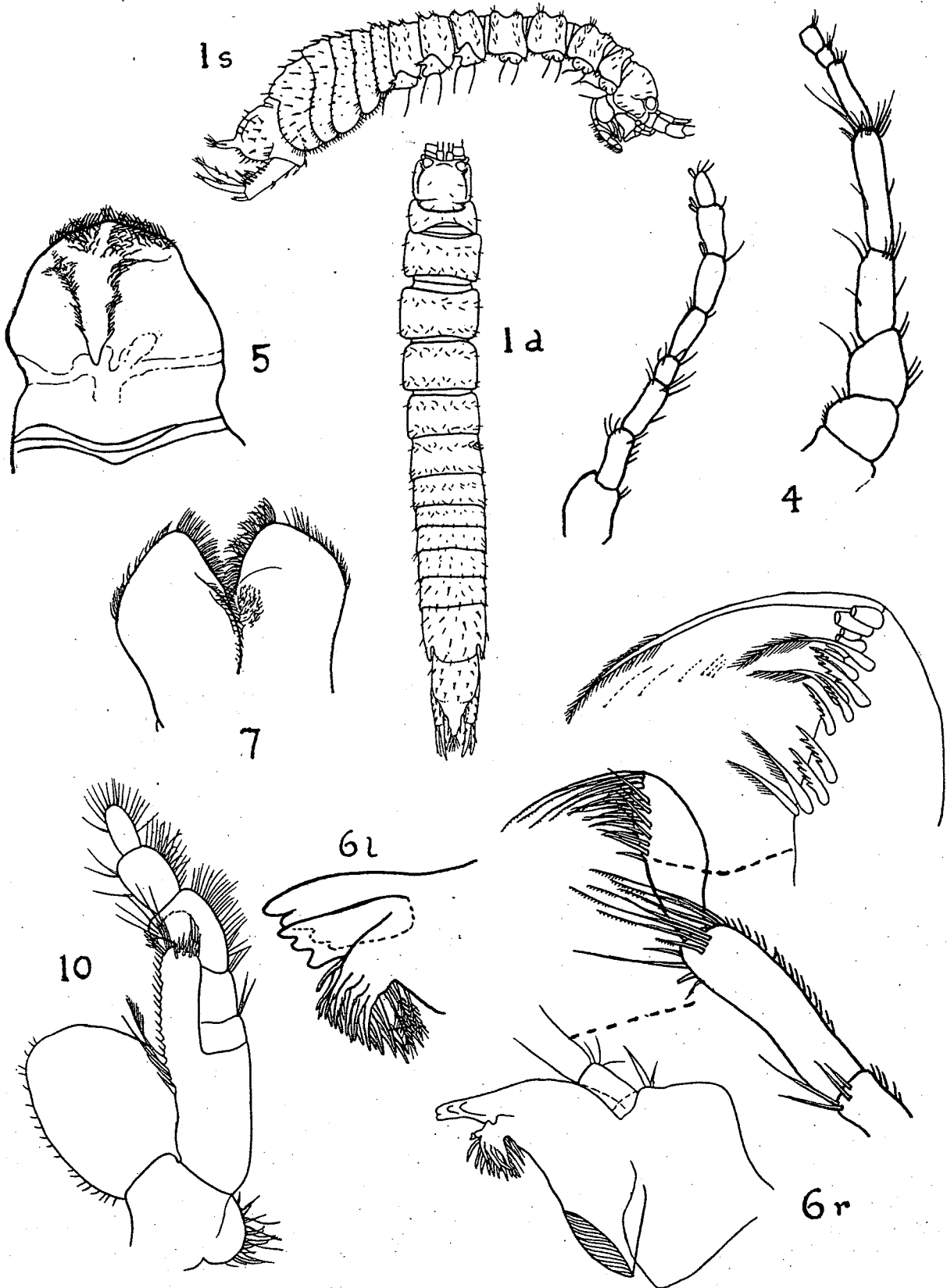


FIG. 57.—*Mesacanthotelson fallax*, sp. n.

In the peraeon, the anterior segments have a length sub-equal to the depth, except the first segment, which, although moderately long in the mid-dorsal line, appears short owing to the elevation of the tergum into a ridge which is preceded and followed by bevelled marginal areas. Ventro-laterally the segment seems to widen out, both anteriorly and posteriorly, slightly more than does the corresponding segment in *tasmaniae*. The second, third, and fourth segments are sub-equal; they are emarginate below for the articulation of the related coxae, in front of which they are angularly produced and bear one or two spines sub-marginally; the fifth to seventh peraeon segments are deeply incised postero-ventrally (as in *tasmaniae*) for the reception of unusually large coxae, so that the hinder border of the fifth and sixth segments are considerably shorter than the anterior; these anterior angles are unarmed; the posterior bear one or two spines.

The *pleon* generally differs very little from that of *tasmaniae*; the fifth segment, however, meets its pleura in a marked angle and—a more notable difference—the telsonic process is not only distinctly shorter, but when examined from above is seen to taper away evenly instead of standing out abruptly from the rest of the tailpiece. It thus appears sub-triangular when examined from above, recalling the shape of the projection in *Mesamphisopus* spp. It bears one pair of lateral spines sub-terminally and a second pair at the apex—these latter associated with a scattered tuft of long, slender setae. The telsonic pleura are slightly more convex than in *tasmaniae* and agree closely with the description and figure of *tattersalli*. In front of the insertion of the uropod the ventral margin of the sixth pleon pleuron is armed with four stout spines.

Appendages. *Antennule* and *antenna* (fig. 57, 4) agree sufficiently well with Sheppard's description of *tattersalli*, making allowance for variation in number and size of the flagellar joints. The *second* flagellar joint of the antennule is *not* longer but is slightly shorter than the third peduncular joint; the antenna is distinctly less than half the length of the body, although the joints (twenty) are more numerous than in *tattersalli*, and the terminal flagellar joints, though long, fall considerably short of the length of the first joint of the flagellum while, in the peduncle, the fifth joint is shorter than the combined length of the third and fourth.

The *labrum* (fig. 57, 5) appears longer and narrower than that of *tasmaniae*, and seems rather less asymmetrical.

The *right mandible* (fig. 57, 6r) differs in several particulars; among these may be noted (i) the cutting edge shows the fourth tooth only in an incipient condition; (ii) the third joint of the palp appears more slender and is longer, relatively to the second joint; and (iii) its apical cluster of setae are arranged in rows of three or sometimes four; of the setae some are finely pectinate, others denticulate; there are more elongate setae apically and these are feathered. It thus differs considerably from the condition recorded for *tattersalli*. In *tasmaniae*, these setae are so closely bunched that it is difficult to discover their arrangement, and the terminal elongate seta of that species is finely denticulate. Fourthly, the spine row appears shorter and bears distally a couple of very short spines (or one bifid spine) which recalls the vestigial *lacinia mobilis* of *Uramphisopus pearsoni*; and lastly, there are more setae immediately proximal to the spine row than were found in *tasmaniae*.

The *left mandible* (fig. 57, 6l) has four well-developed teeth in the primary cutting edge and three, almost equally stout, on the *lacinia*.

In the *lower lip* (fig. 57, 7) there is no noticeable difference; the scales, so abundant on this structure in *tasmaniae*, are here almost as well developed.

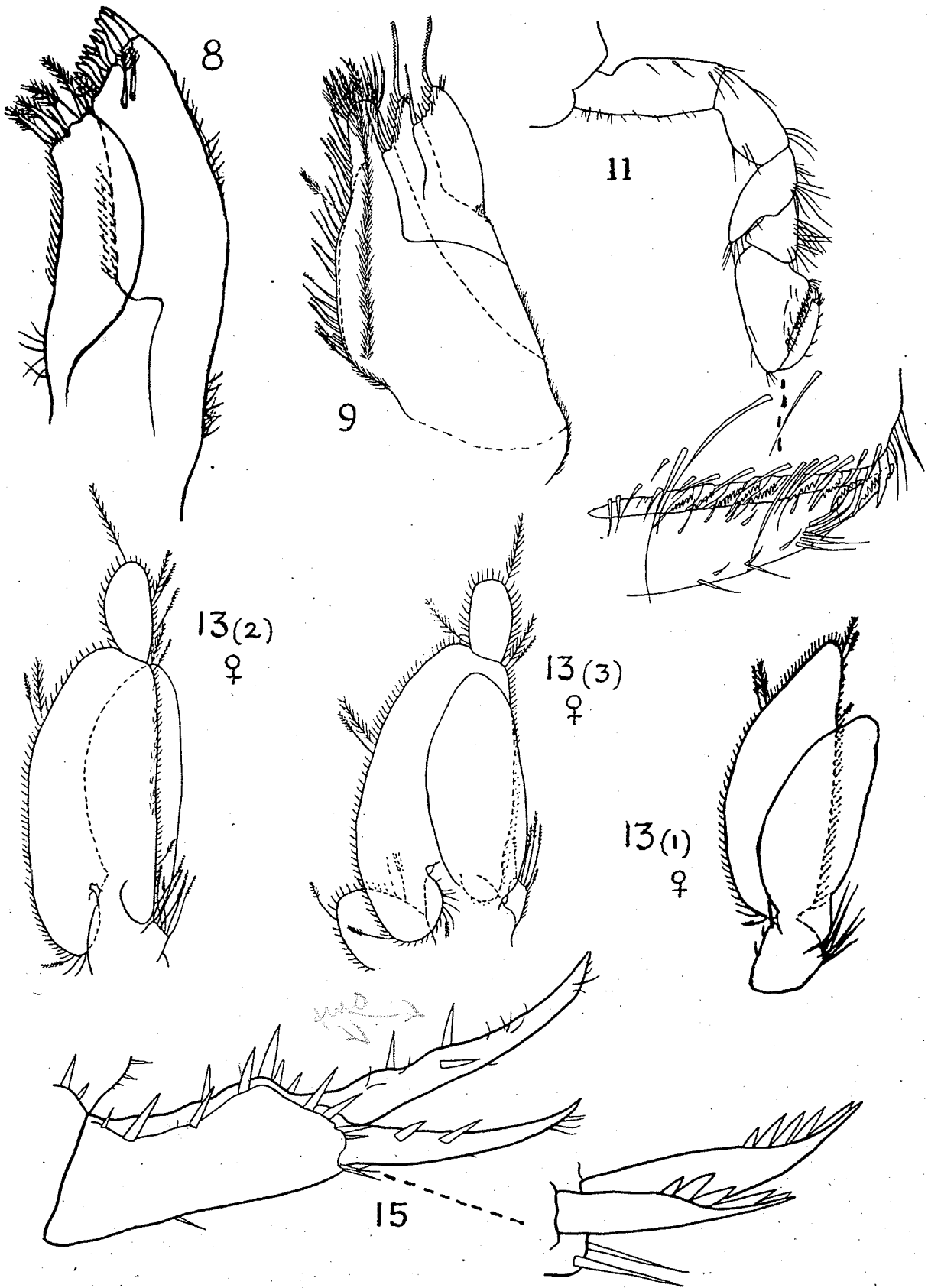


FIG. 58.—*Mesacanthotelson fallax*, sp. n.

The *maxillula* (fig. 58, 8) differs from that of *tasmaniae* only in one minor detail of the armature of the outer endite. This is the presence of only two (instead of three) sub-apical plumed setae on the posterior face of this endite (in this apparently agreeing with *tattersalli*). There appear to be twelve simple or denticulate spines on the apex of this endite.

The *maxilla* (fig. 58, 9) has an unusually long proximal endite, while the two outer endites are distinctly shorter than in other species of this genus. A continuous rank of short, simple setae on the anterior face of the proximal endite runs parallel to the filter setae.

The *maxilliped* (fig. 57, 10), too, is relatively shorter and stouter, and generally rather less setose. The endite on the basis is more rounded apically and bears but fourteen or fifteen brush setae on its dorsal edge, while the more proximal fringe of simple setae appears to be wanting.

In the female, the coxal lobe is a semi-circular flap, edged by about twenty long, sparsely plumed setae, and rather fewer and more widely spaced stiff, simple setae.

The *gnathopod* is setose (in *tasmaniae* this appendage is armed with spines), but otherwise the various joints differ little except in the propod and dactyl (fig. 58, 11). The former in the female is very nearly triangular in shape and the nearly straight palm more oblique and armed with fewer serrated spines. The dactyl is more setose but lacks on its palmar margin the notches or corrugations found in *tasmaniae*, *decipiens*, and *setosus*.

The *pleopods* (fig. 58, 13, (1), (2), (3)) differ little from those of *decipiens*, except, perhaps, that in the second the endopodite is unusually long, extending to the base of the distal lobe of the exopodite. In the third, simple setae fringe the entire mesial border of the exopodite in both these species, whereas in *tasmaniae* such setae are restricted to the distal half of this border.

The *uropod* (fig. 58, 15) is long and slender; the length of the peduncle is more than twice its greatest depth, the inner upper border little raised and with two distal spines on a low elevation; the outer border spinous along its entire length; the ventral edge is armed with two tufts, each including one spine and two or three setules, these restricted to the proximal half. The inner ramus is longer than the peduncle, with three stout spines; the outer ramus shorter by one-fourth its length and with but a single stout spine at its mid-length. Beneath the insertion of the rami are two stout, terminally digitate, spines.

Onchotelson, gen. n.

Body fusiform, tapering from the seventh peraeon segment; all segments with transverse ridges; head with deep anterior emargination, the interorbital space narrow, separating large and very prominent eyes; the cervical groove arises from the ventro-lateral border of the head and is complete dorsally, thus marking off a definite maxilliped (first thoracic) segment, while the second thoracic (first peraeon) segment is immovably united to the head; pleon segments little deeper than those of the hinder peraeon, narrow notch at junction of tergum and pleuron of the fifth pleon; telson short, sharply upturned; first and second pleopods modified in the male; the second endopodite two-jointed; uropods short, rami sub-equal with a single toothed spine below their insertion.

The rugose condition of the body is probably primitive; it occurs elsewhere in this sub-order in *Mesacanthotelson* and in a much reduced condition in *Eophreatoicus*, but in the former the ridges bear parallel rows of spines or stout setae,

while in *Eophreaticoicus* neither spines nor setae are retained.⁽¹⁾ In the Phreaticinae ridges are lost, but the arrangement of the setae persists. Prominent eyes, too, are found in *Mesacanthotelson*, but the retention of a complete cervical groove, and therefore of a recognizably distinct maxilliped segment, is almost peculiar to this genus. Among Phreaticoids it is found only in *M. decipiens*, but it is of interest that the development of a similarly well defined wedge-shaped first thoracic segment seems to have been characteristic of certain Carboniferous Syncarids (*Pleurocaris*, *Gamponyx*?). The condition of the first and second pleopods in the male, likewise, is distinctive, the unusually elongated sympodite of the first pleopod recalling the condition of the pleopods in *Acanthotelson* in which, judging from Packard's restoration, the sympodite was sub-equal in length to the lamellae. The shape of the telsonic apex is reminiscent of that recorded for *Uramphisopus* and is quite unlike that of *Mesacanthotelson*; the sub-equality of the uropodal rami is unusual.

Genotype. *Onchotelson brevicaudatus* (G. Smith).

A second and quite remarkable species is recorded here under the name of *O. spatulatus*.

Onchotelson brevicaudatus (G. Smith)

(Figs 59 and 60)

Smith, 1909, p. 73, pl. 12, figs 5 and 6 (*Phreaticoicus brevicaudatus*).
Sheppard, 1927, p. 100, fig. 5 (*Phreaticoicus brevicaudatus*).

Smith's description was, as Sheppard notes, extremely brief; at that time, however, when but three Phreaticoids from the Great Lake were known, it was, with one correction, amply sufficient for the purpose of identification, and even now, his figures remain quite adequate for the recognition of this very distinct species. Sheppard, in attempting to remedy the deficiencies of Smith's description, has, unfortunately, allowed this mistake to pass uncorrected. Both authors have included in the first peraeon segment that of the maxilliped, which should be attributed to the head. With the discovery of many new Phreaticoids, however, a more complete description has become desirable, particularly for purposes of comparison.

The ridging and sculpturing of the *body* is practically as well-developed as in *M. tasmaniae* and *M. setosus*. In figure (59, 1s.) an extreme condition is shown, the ridges on the peraeon segments attaining the maximum development. In the majority of specimens these ridges do not extend so far ventro-laterally and the areas beyond these are variably raised into tubercles or irregular, antero-posterior ridges. The existence of such irregular folding is suggested in Smith's figure (1909, pl. 12, fig. 5) and a more pronounced sculpturing is shown by Sheppard (1927, text-fig. 5 (1)). But this sculpturing can be even more strongly developed, so that at one stage in the preparation of this description a new variety ('*sculptus*') was proposed for forms in which the setose ridges were limited to the dorsal surface and the whole of the lateral areas were raised into tubercles and folds and were almost free from setae. Such setae as were present were unusually long and slender, while in the pleon the lateral surfaces were practically smooth. Some support for the idea that this was a genuine variety was derived from the fact that when such extremely sculptured examples were taken, they were usually found to the exclusion of more highly ridged and setose specimens. A careful examination of a very large series, however, showed that there existed no definable

⁽¹⁾ *Protamphisopus* seems to have had much the condition found in *Eophreaticoicus*.

boundary for the variety. The existence of the highly sculptured condition is, however, of interest in connection with the new species, *spatulatus*. The segments, with but two exceptions (the first peraeon and the sixth pleon), are raised into two well-marked ridges. It differs, however, from the two *Mesacanthotelson* species in that the armature is made up entirely of short setae which are set in double rows, and that spines are wholly wanting. It differs in shape, also, for, although the body of this animal is sub-cylindrical and (as in most members of this sub-order, when seen from above) fusiform, in the male it begins to taper posteriorly at a point unusually far forward (recalling *Amphisopus*). The body is widest in the second to fifth peraeon segments, then contracts markedly, so that the end of this region and the whole of the pleon is relatively slender, the width of the tailpiece not exceeding one-half of the greatest width of the body. Thus, although the depth of the pleon (i.e., the maximum depth of the body) is not apparently great⁽¹⁾ and only equals the greatest width of the body, it is nevertheless twice as great as the width of this region, a condition found in no other genus. It thus presents, to an unusual degree, the appearance of lateral compression.

The head (fig. 59, 2s, d, v) is notable for several features: (i) in its proportions, its maximum width being greater than its length (again resembling *Amphisopus*) and equalling its greatest depth.

(ii) The eyes are very large and oval with many facets (fifty-eight to sixty) and are so prominent that they form part of the dorsal profile of the head. The ocular region is bounded by a conspicuous transverse frontal groove, behind which the convex dorsal surface of the head rises steeply, its profile with small irregular corrugations. The anterior border of the head is deeply emarginate (practically angular), its edge raised in a pronounced ridge. The interocular surface is concave but is commonly produced into a couple of short elliptical prominences, comparable to those found in *setosus*. The frontal part of the head is peculiarly narrow but somewhat variable, the interocular region ranging from a width little more than that of the longest diameter of the eye to one which approaches twice that diameter.

(iii) The sub-ocular incisure is a shallow notch, wide but short, below which the sub-ocular area, though strongly projecting, is not well defined nor is the 'genal' groove complete. The mandibular portion of the ventro-lateral border is relatively well marked and the mandibular articulation long, while the post-post-mandibular region is shorter and deepened; the ventro-lateral border is indicated by a slight ridge bearing a marginal rank of setae.

(iv) The head is almost unique in this sub-order in that the cervical groove is *completed dorsally* so that the maxilliped segment is visibly distinct from the more anterior part of the head. Behind, a wider intertagmal groove marks off the cephalon from the peraeon. These two grooves approach closely at a point beneath the forwardly projecting coxa of the gnathopod (fig. 59, 2s) the maxilliped segment then widening out below into the post-mandibular region of the head. It would seem that Miss Sheppard (1927) has followed Smith in misinterpreting this region, the dorsal part of the maxilliped segment being represented as constituting part of the *first peraeon segment*. The first peraeon segment is so firmly fused with the head that there is no mobility here, but there can be no doubt that the boundary between primary head and peraeon lies *posterior* to the

⁽¹⁾ The pleon segments are little deeper than the hinder peraeon segments and the pleopods are often exposed to an unusual degree. In the figure (fig. 59, 1s.) these have been omitted, but their length can be judged by that of the penial stylet which only exceeds by a little that of the second pleopod.

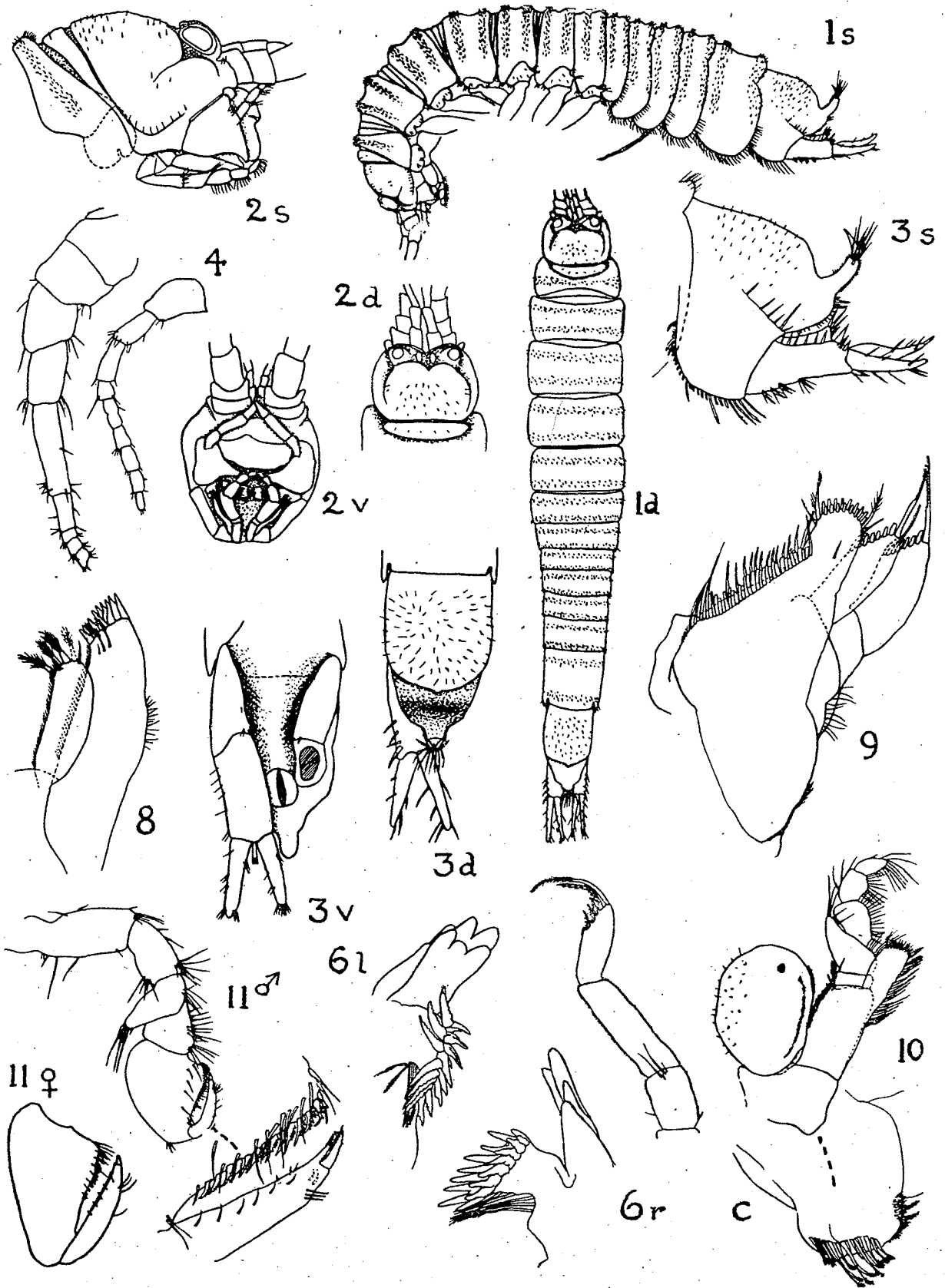


FIG. 59.—*Onchotelson brevicaudatus* (G. Smith).

first of the two ridges shown on the first peraeon segment of Miss Sheppard's figure (i.e., fig. 5 (i)). In actual specimens, this boundary is unmistakable, the groove being much wider than represented in that figure, and presenting an appearance of the usual bevelled edge of a free segment. In the male figured (fig. 59, 2s, d) the two grooves (cervical and post-cephalic) appear relatively wide.

It seems probable that this transference of the maxilliped segment from the head to the first peraeon segment is responsible for the mis-measurement recorded in the statement 'the cephalon is shorter than the following segments'. Actually the head (measured in the mid-dorsal line), notwithstanding its considerable shortening by the exceptional depth of its anterior emargination, is *longer than any one of the peraeon segments*. It is more than three times as long as the first peraeon segment and is little less than the combined length of first and second peraeon segments.

Peraeon. The first peraeon segment is immovably united with the head; it is very short dorsally and bears but a *single ridge*, but ventrally it is widely expanded and extends forwardly to embrace the hinder angle of the head. In its strongly concave anterior and posterior borders (fig. 59, 1d.), this segment has a condition like that of *N. assimilis*. On the ventral surface, the sternite is slightly raised along its anterior border into a ridge, against which abuts the coxa of the maxilliped.

Of the succeeding segments, the second to sixth are sub-equal; the seventh is considerably shorter.

Pleon. Not only is this much narrower than the peraeon, but the downward extension of the pleura is relatively slight, so that there is an unusually small increase in the depth of the body in this region. The fifth pleon segment is notable, not being as greatly elongated as is usual in this sub-order; it has a length scarcely equal to the combined length of the third and fourth, and its hinder border meets its pleuron in a sharp notch. In all the pleon segments the pleura are fringed ventrally by long, flexible setae, but these are continued well up the hinder margin in the fifth pleon segment alone.

The *tailpiece* (fig. 59, 1s, 1d, and 3s), distinctly longer than the fifth segment, has a convex dorsal surface, the terminal projection being sharply upturned, the telson thus appearing hook-like. Its apex is armed (fig. 59, 3s, d) with a tuft of long setae and two pairs of spines, but, behind, it presents a flat postero-ventral surface. In side view it passes almost imperceptibly into the telsonic pleura which bear marginally a few short setae or spinules. The antero-ventral border of the tailpiece, that is, the pleuron of the sixth pleon segment, bears a series (twenty to twenty-five or more) of long, curved and close-set setae, of which a variable number, mostly shorter setae *at the anterior end of the fringe*, are toothed apically. Such a long rank of setae is peculiar to this genus—this condition being most nearly approached in *N. littoralis* and *M. australis*, where, however, the setae are replaced by spinules and are less numerous.

Appendages. The *antennule* (fig. 59, 4) in the males examined had usually but five joints in the flagellum, only one agreeing with Sheppard's record of six, but that specimen showed an approaching division of the second flagellar joint to give an incipient seventh article. In the mature female, there were but four, of which the second and third were long. In the *antenna*, also, fewer joints were found in the flagellum than are recorded by Sheppard.⁽¹⁾ There is probably, as in

⁽¹⁾ Thirteen to twenty, with an average of sixteen (male) and fifteen (female) respectively; the specimens examined may not, however, have reached full growth.

M. tasmaniae, a considerable range of variability in the number of flagellar joints and no diagnostic value can be attached to this character. The peduncle is robust and very little shorter than the flagellum, in this retaining what may, perhaps, be a primitive condition; the proximal four joints are relatively short and sub-equal, the fifth, alone, being elongated.

The 'serration' in both antennule and antenna, of the joints of the peduncle and of more or fewer joints of the flagellum, to which Smith referred, and which Miss Sheppard more correctly records as a covering of 'short, thick hair', has already been recorded in *Eophreatoicus*. In this species it occurs not only in the antennae but forms a clothing for practically the whole of the body and the appendages.

Upper lip (fig. 59, 2v, fig. 60, 5). The epistome is very strongly projecting, the whole structure stout and the hinge of labrum on epistome noticeably asymmetrical. The labrum is wide and shallow; upon its under (posterior) surface the ventral fringe of setae is extended upward, in two converging bands, to meet nearly at the level of the suture with the epistome.

In the *left mandible* (fig. 59, 6.l.) the secondary dentate piece (*lacinia mobilis*) bears three teeth almost as strong and as darkly chitinized as the three large teeth of the primary cutting edge, on which a small fourth tooth is indicated. The spine row is unusual in its structure and is followed by a short rank of five slender, plumose setae. As in *Eophreatoicus* and some New Zealand species, the palp arises from a slight elevation which is armed with setae, its second joint being nearly twice as long as the first or third. The latter is obliquely truncated and bears a terminal finely-plumed seta preceded by a short row of five strongly denticulated setae decreasing in length proximally; there is here, probably, the maximum reduction of this setal armature of the mandibular palp.

The *right mandible* (fig. 59, 6.r.) differs slightly in having four stout teeth on its dentate edge, in the absence of the *lacinia mobilis* and in the disposition of the spine row.

The *labium* (fig. 60, 7) bears setules on the outer border, as well as the usual heavy fringe of setae on the inner border of the terminal lobe. There is a small indication of an inner lobe.

The *maxillula* (fig. 59, 8) has nearly attained the maximum reduction in the number of apical setospines on the inner endite. Only four are present and the two accompanying simple spines are very slender, one outermost, the second lying against the third setospine; while the endite itself is both short and narrow. The outer endite bears the usual double (partly triple) rank of stout spines; mesially some of these are strongly denticulate and there is the usual small setospine near the mesial edge of the posterior surface. There are three slender setae, also, on the same face, two plumose, the innermost small and simple. The fringe of short setae may be greatly reduced or even absent on the outer aspect of this endite, but the inner mesial border of both endites has a continuous fringe of setules.

Maxilla (fig. 59, 9). In this appendage, the mesial surface is narrow; the posterior row of about nine finely pectinate setae appears to be marginal and the anterior close-set row of long, filter setae is borne slightly sub-marginally. The latter series comes to an end, distally, on the anterior face of the proximal endite, the usual single spine lying lateral to this point. A short unarmed region separates the distal end of these two mesial rows from a double apical row of setae which are biting or plumose, or may be intermediate in character.

The two distal endites are short, their end obliquely truncated, and armed with few (six to eight) biting setae, which on each endite become increasingly stouter laterally. There are a few setae on the outer (lateral) border.

Maxilliped (fig. 59, 10). This agrees generally with Miss Sheppard's description. The coxa is wide and, in the ovigerous female, its mesial process is indistinctly bi-lobed and bears sub-marginally a number (fifteen to seventeen) of stout, strongly-curved setae, scantily plumed apically, mixed with which proximally are a few more slender, simple setae, while distally, there are one or two short, densely-plumed spines, buried in a tuft of short setae which are continued after a brief gap by a dense fringe of setae at the proximo-mesial end of the basis. Its condition would appear to be closely comparable to that recorded by Sheppard for *tasmaniae* (1927, p. 90), but of that species no ovigerous female was available for examination. The latero-distal angle of the basis bears two stout, plumed spines; the endite of the basis is rather long and carries, on the distal half of its free edge, a rank of twelve brush setae; these pass into an apical border of shorter, more sparsely feathered setae. The length and the number (eleven to nineteen) of the setae fringing the epipodite is somewhat variable.

The *peraeopods* are all relatively shorter and stouter than in *tasmaniae*, but unlike that species, they are almost devoid of spines, so that, in this particular, *setosus* offers an intermediate condition.

The *gnathopod* of the male (fig. 59, 11♂) is strongly built; the basis is short and the ischium is moderately long; the propod is stout, sub-triangular in shape, its anterior border convex, the posterior short, the slightly sinuous palm disposed obliquely and armed with about a dozen stout, curved spines (strongly toothed on the convex surface) and with a parallel row of setae. The dactyl is long, strongly curved and bears apically a stout claw supported by a small secondary unguis; its palmar surface bears a few short, curved setae.

In the female, the limb is relatively short, the basis being shorter and rounder than in the male, the propod (fig. 59, 11♀) sub-triangular, not strongly developed, its palmar border appearing so thin as to be almost knife-edged, but produced into a few spines which resemble those in the male; the dactyl is less strongly curved, its inner distal border minutely denticulate.

The brood lamellae are fringed with a fairly close-set rank of setae, some of which, at least at the proximal and anterior end of the lamellae, are feebly plumed apically. The functional lamellae are very long, being, with the exception of the first pair, considerably longer than the related limbs.

In the male, the strong, curved dactyl and small concave and spine-bearing palm on the propod of the fourth leg suggests that this limb is sexually modified and strongly prehensile.

Of the hinder group of *peraeopods*, the fifth is short and relatively weak, the sixth and seventh sub-equal. The basis in these hinder appendages (fig. 60, 12(7)) is stout but not appreciably expanded; the ischium about as long as the slender propod. In the female, if the coxa of the fifth be removed with the limb, a long, ridge-like strip may tear away from the sternite, perhaps representing a vestigial and fused oostegite. The oviducts seem to open below this ridge near to its lateral end. In the male, the penes are related similarly to the coxa of the seventh *peraeopod*; they are apparently wholly unarmed, relatively long, meeting in the middle line near the distal end of the sympodite of the first pleopod (fig. 60, 12(7)).

Pleopods. In the condition of the first pleopod (fig. 60, 13(1)) this species has no parallel in the family. The sympodite, sub-quadrangular in shape, is a massive-looking structure, much longer than those of the succeeding appendages,

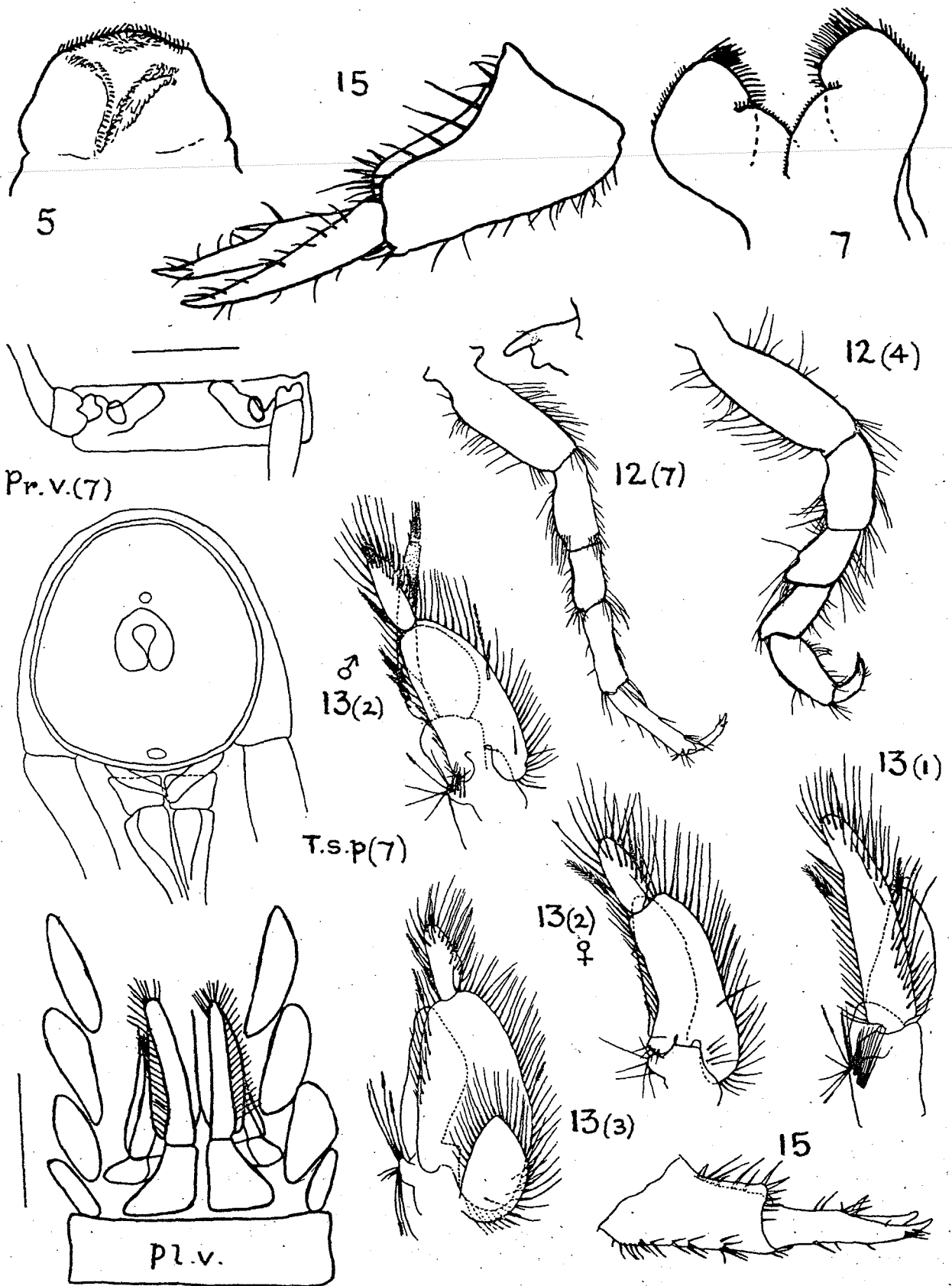


FIG. 60.—*Oncholaelon brevicaudatus* (G. Smith).

and thick from front to back, and, in front of the exopodite, is produced distally into a small flap. The appearance of solidity is increased by a large, thickened proximo-mesial portion of the exopodite (fig. 60, *pl.v., t.s.p.(7)*); further, the two lamellae seem to be borne obliquely so that both exopodite and endopodite appear when viewed from in front. These lamellae arise from the sympodite at different levels. The endopodite springs from its inner border, about midway along the length of that piece, whereas the exopodite has its origin practically from the apex of the sympodite.

The entangling setae arise in three steps, the most distal being almost marginal; the setae are numerous and some at least are minutely denticulate.

The exopodite is moderately well developed but, owing to the unusual length of the sympodite, appears relatively short, being in some specimens (male) little more than twice the length of the basal region. In shape, it is narrow, lanceolate; the apical portion is almost brush-like and may represent the distal lobe of succeeding limbs, being bent at an angle to the more proximal part. This condition is found in nearly all specimens examined, of both sexes, and cannot therefore be regarded as a distortion due to the position and unusual length of the penial stylet. It is fringed around its entire border with long setae which are plumose in the distal third of the mesial, and the distal half of the external border. Under close scrutiny, the densely setose or brush-like condition of the free end is discovered to be due to the fact that two, in places three, ranks of plumose setae arise in steps marginally and from the anterior face of this lamella, and this step-like arrangement is continued along almost the entire lateral border. A somewhat similar condition is found in *U. pearsoni*, while in West and South Australian species, and also in South African forms, there is a similar sprouting of setae from the anterior surface, but in those other species the setae seem to be scattered irregularly, are usually fewer and generally are simple only.

The *second pleopod* is longer than the first by half the length of the distal joint of the exopodite. In the male, the sympodite is moderately long, its inner distal angle being produced mesially into a stout process bearing the entangling setae, which are numerous and spring both from the inner border and, much more proximally, from the hinder face of the sympodite. These setae are fewer in the female.

The endopodite is distinctly two-jointed; the basal lobe is very muscular and nearly as large as the respiratory portion of the lamella; from its disto-mesial angle arises the penial stylet, while laterally it is expanded into a sub-oval, rather swollen, respiratory lamella, which extends distally to the base of the distal lobe of the exopodite. The stylet is exceptionally long, hanging ventrally quite freely below the general level of the pleopods, in which elongate condition it resembles *orarii*. Proximally, on its mesial border, it bears six or seven short spinules, while, sub-apically, there is a graduated series of seven long stiff setae, some minutely denticulate or pectinate; its surface is clothed with minute setules. In the female, the endopodite is longer, relatively, but a basal lobe is not differentiated. The exopodite is similar in both sexes, the basal part being produced *proximally* into a small inner and a larger outer lobe lying partly behind the sympodite. There is a difference, however, in the setation. In the male, the marginal plumose setae are found with the distribution generally like that of the first pleopod. In the female, the inner border of the proximal lobe has no plumose setae, their place being taken by setae which are pectinate terminally.

In this and the succeeding appendages, the condition of the distal joint of the exopodite is again without parallel in other Phreatoicidae, the apex of the distal joint being brush-like, bearing a number of long plumose setae arising from the anterior face of the lamella, as well as furnished with bordering setae. There are here, too, delicate sub-marginal, simple setae laterally along the distal part of the proximal joint, and a few longer setae arising from the face of the proximo-lateral lobe.

In the *third pleopod*, the pectinate entangling setae are seen springing from the inner border of a large process projecting mesially from the distal end of the sympodite, and both the exopodite and the endopodite of the third are longer and wider than those of the second pleopod. In the hinder pleopods, the lamellae are shorter and only relatively wider. The epipodites are large, sub-ovate, and closely fringed with long, simple setae. The entangling setae become fewer, the projection from which they arise being quite long. A few setae are found on the anterior face of the proximo-lateral lobe.

In the pleopods generally, the whole or part of the mesial border of the exopodite is thickened and stiff setae arise, not only marginally but in a dense sub-marginal fringe. Such a mesial sub-marginal fringe extends along the whole length of the inner border of the first and second pleopods, but in the succeeding limbs the setae are restricted to the distal part of this border. Along the curved outer border and around the distal lobe, the lamella is fringed with uniformly-spaced, long, flexible setae, some of which (the more apical only) are plumose, the remainder pectinate or simple.

Uropod. This is unusually short⁽¹⁾; the length of the peduncle measured along its upper border is scarcely greater than its depth at its oblique insertion. In dorsal view, the peduncle broadens distally; this appearance is enhanced by the fact that ventrally the tailpiece is inturned,⁽¹⁾ so that the two uropods are somewhat approximated; in the ventral view (fig. 59, *3v.*) it may be seen that when the limb is removed its attachment is comparatively narrow and long, though foreshortened in this view. The dorso-mesial edge of the peduncle is raised very slightly above the level of the outer edge and bears only two or three apical spines, but from these a short row of spines (fig. 60, *15*) runs downwards towards its lower mesial edge. The outer edge has a series of setae and one stout distal spine; the ventral border appears to have a nearly continuous line of setae, but actually these arise chiefly in short rows on the mesial surface and project mesially. The rami are styliform, tapering and sub-equal and each bears one spine and a few setae only; beneath their insertion is one relatively long and stout spine, toothed apically. In the female, the peduncle is shorter and thus appears deeper and there is less difference in the length of upper and lower borders.

The telsonic projection is short and smoothly upturned, and is rather longer than broad. Its actual extremity is dorsal in position and bears a pair of terminal spines and a second pair latero-terminally, as well as numerous fine setae. The margins of the projection bear a fringe of fine setules. Postero-ventrally there is a smooth surface which lies behind the last sternite. The telsonic pleura, though slightly developed, nevertheless extend almost as far back as the projection when viewed from above. On the last sternite, the anal opening is directed ventrally. A typhlosole is present (fig. 60, *T.s.p.(?)*), and may be traced forward from the fifth pleon to the first peraeon segment. At that level it is enlarged and is seen as a paired structure, apparently part of the gastric mill.

⁽¹⁾ The uropod is even shorter in *Phreatoicopsis* and *Protamphisopus* and the telsonic pleura are even more inturned in *Phreatoicopsis*.

Colour. Geoffrey Smith records this as straw-yellow in life, which is the usual colour of spirit-preserved material, although in time, this may become greyish or greyish-brown.

Size. The largest specimens may reach 15 mm.

Occurrence. Great Lake, Tasmania, 'in the deeper littoral where the bottom is chiefly composed of a fine yellowish mud'. (G. Smith.)

This species has, hitherto, been the only one recorded from the bottom of the Great Lake. It is of interest that *U. pearsoni* which resembles *brevicaudatus* in the shape of the telsonic projection, is also, in all probability, a dweller in this same muddy floor of the lake. Specimens of this latter, however, have never apparently been taken in the dredge, and only rarely in the stomach of trout, where they are generally covered with yellow-brown or reddish-brown mud. The capture by Dr. Pearson of a second and quite distinct species of *Onchotelson* provides, therefore, a notable addition to our knowledge of this part of the fauna of the Great Lake.

Onchotelson spatulatus, sp. n.

(Fig. 60A)

This new species, while indisputably referable to *Onchotelson*, differs not only from *brevicaudatus*, but from all known Phreatoicids in the development of strong processes from the coxae of all the peraeon appendages, strikingly suggestive of epaulettes. It is this condition which has led to the choice of name.

Apart from this striking feature, it differs from *brevicaudatus* in other external characters, only in degree. As seen in fig. 60A. 1s, the head (which is shown without appendages) is rather more corrugated and tuberculate; its cervical groove is clearly defined and the maxilliped segment thus retains its distinctness from the primary head. In the peraeon, transverse tergal shields are raised above the level of the general surface of the body, leaving smooth and bevelled strips anteriorly or posteriorly. The segments, moreover, have well-developed ridges, comparable to those setae-covered elevations characteristic of *brevicaudatus*, except that here they are short and restricted to the dorsal surface, being in this respect closely like the condition noted above for the variety which is referred to as '*sculptus*'; on the lateral surfaces these ridges are obsolete and are replaced by tubercles and irregular folds; even the ridges appear to be made up of a series of coarse tubercles. On these surfaces the sparsely scattered setae are long and slender.

Only four specimens were available and all of these were in a greatly relaxed condition, so that the intersegmental membranes are unusually conspicuous. In general, the proportionate length of tagmata and of individual peraeon segments are much as in *brevicaudatus*, but the segments are relatively shallower.

In the pleon, however, the terga appear somewhat deeper, and the pleura therefore are by comparison less deep; the fifth segment, too, is relatively shorter, while on the tailpiece the telsonic apex seems rather more sharply upturned, and, as in *brevicaudatus*, this is armed apically with two pairs of spines and numerous setae, for the most part long and flexible. The armature of the ventral border of the sixth pleon segment, too, resembles that of *brevicaudatus*, with a number (twenty or so) of slender, curved setae, while the junction of the sixth pleuron with that of the telson is indicated by the usual short ridge bearing three or four setae.

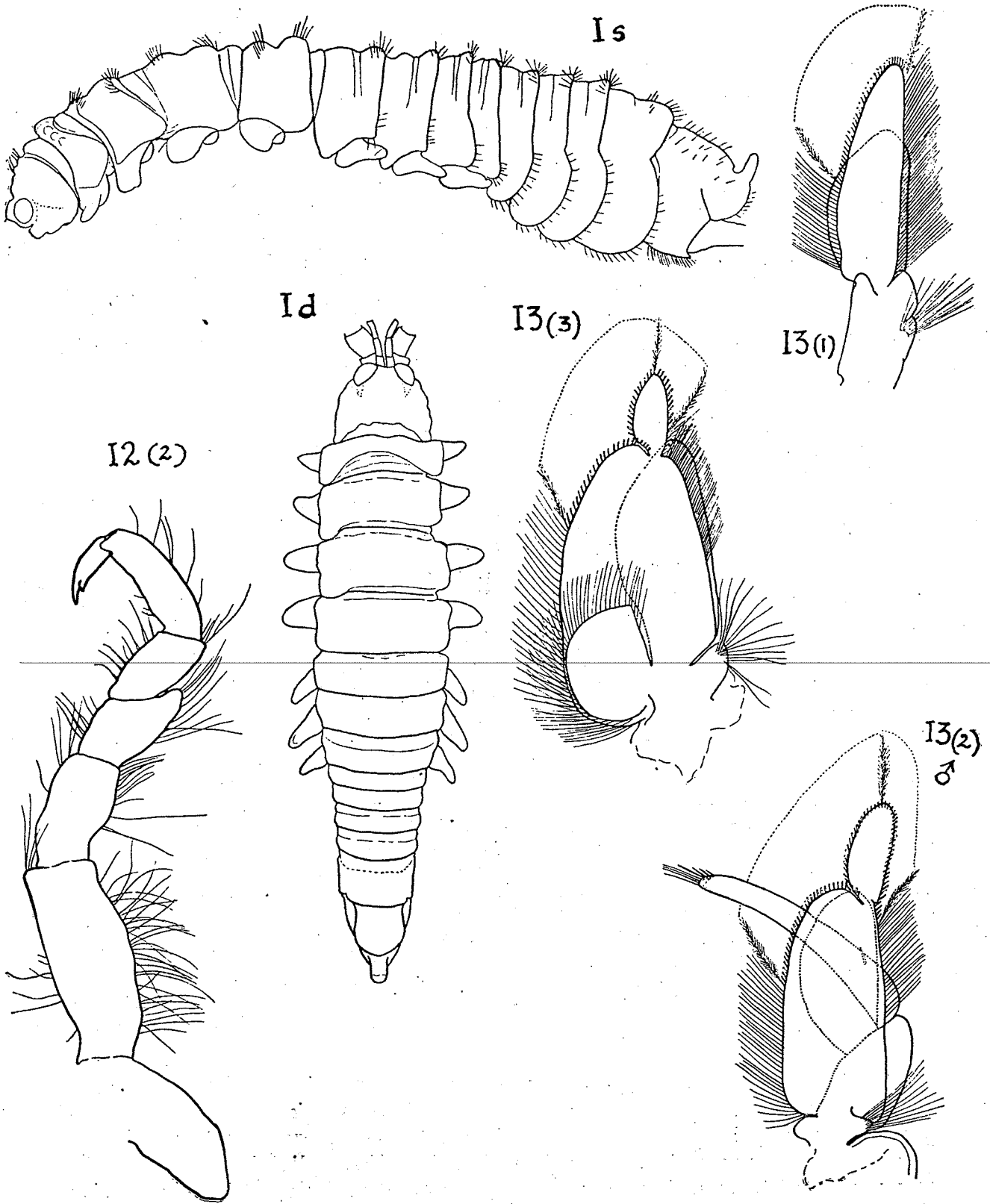


FIG. 60A.—*Onchotelson spatulatus*, sp. n.

As figured in dorsal view (fig. 60A, 1d) the fusiform shape is evident, but that outline is broken by the seven pairs of coxal processes. It should be noted that in this figure the relative lengths of the segments are not quite accurately shown, the body of the animal being strongly curved, the head and part of the pleon being shortened; the width is greatest in the third and fourth peraeon segments, where it attains to almost exactly one-sixth of the total length.

Appendages. Of the four specimens, all male, which were taken, but a single example was dissected. In structure the several appendages showed generally a very close resemblance to the typical condition of a male *brevicaudatus* of about the same size. A few, comparatively trivial, differences are noted.

The *antennule* seems more slender, particularly the second peduncular joint; there are, also, small differences in the proportions of the five joints of the flagellum.⁽¹⁾ As in *brevicaudatus*, the condition of the second joint of the peduncle of the *antenna* suggests that it may have arisen from the fusion of two articles, and the proportions of the peduncular joints differ slightly from those of *brevicaudatus*. The actual end of the flagellum was lost, but the appendage appeared nearly complete, with fourteen joints, of which some (from the eighth onwards) are distinctly longer and rather slender.

In both *mandibles*, the terminal joint of the palp shows a similar paucity of setal armature, but on the first and second joints setae are rather more abundant. The inner endite of the *maxillula* is in close agreement with that of *brevicaudatus*, a strong, simple spine being present,⁽²⁾ as usual, against the third setospine; on the outer endite of one side, however, a rather unusual condition is found, the sub-terminal plumose setae on the posterior face being two in number, unusually long and arising close to the mesial border; upon the opposite appendage these were apparently wanting. Among the terminal group of spine-teeth there is, as usual, one setospine which, in the specimen examined, was exceptionally well developed, but setae were restricted to its mesial face. The *maxilla* shows the mesial rank of filtratory setae extending very far distally, while the setae which make up the rank are relatively short as compared with the pectinate setae which support it. The usual single spine on the face of this endite could not be discovered. The *maxilliped* is short, but shows the same relatively long coxa seen in *brevicaudatus*, and an unusually stout and conspicuous plumose spine at the latero-distal angle of the basis, which is considered as representing a vanished exopodite.

On the peraeon, as already noted, all the appendages show the coxa produced outwardly into a flattened spatulate process. Under the microscope the process is seen fringed with, presumably covered by, a dense fur of setules, while stray hair-like setae spring from the free surface. Otherwise, these appendages seem to resemble closely those of *brevicaudatus*, excepting that the anterior border of the basis of the first four and the posterior border in the case of the hinder three is more heavily fringed with setae, which are, as usual in this species, long and hair-like.

In the *gnathopod* the palm is armed with about thirteen slender denticulate spines and numerous other setae and spinules; the merus is strongly produced and bears a dense rank of stiff setae. In the next three *peraeopods* the basis differs somewhat in its proportions and the ischium is perhaps slightly longer, relatively. The propod of the fourth peraeopod is stouter and its palm rather more spinose; the seventh peraeopod displays a different arrangement of the setae upon the ischium.

(¹) Six in some examples.

(²) Not shown in figure 59, 3.

Upon the seventh sternite a stout, doubly-curved ridge is developed, against which lie the paired male appendages. This is present in *brevicaudatus* also, although attention was not called to it in the description of that species. Such a ridge is developed on no other sternite, and it is probably related to the functioning of these appendages, the free ends of which lie normally against the apices of the sympodites of the first pleopods.

The pleopods, too, differ little from those of *brevicaudatus*. In the first, the sympodite is relatively rather less stout; the flap arising from it latero-distally, which may well be a reduced epipodite, is much smaller than in *brevicaudatus*, but its occurrence seems to be a generic character. Mesially, on the exopodite of the second pleopod, the setal fringe appears even more dense, extending in from the margin well onto the lamella, but apically the brush-like condition is less strongly developed; the penial stylet carries eight terminal stiff setae, graduated in length, but only one of the proximal spines, near the mesial border of the stylet, could be made out. A large swelling on the sternite separates the paired sympodites of the second pleopods. On the third pleopod, the principal difference appeared in the shape of the coupling lobe.

In the *uropod* differences were few and slight. Upon the inner border of the peduncle the apical projection is rather higher; a stout spine marks the end of the outer border; the outer ramus is slightly shorter than the inner, both rami bearing a single spine at or near mid-length.

Size. About 13 mm.

Colour. Pale straw colour, becoming greyish in parts.

Occurrence. Taken in April, 1939, in the Great Lake by Dr. Pearson.

Colacanthotelson, gen. n.

Body fusiform, segments with setose transverse ridges moderately developed; eyes fairly large and prominent; telson scarcely upturned, rounded, relatively short with four (or two?) spines apically; the sixth pleon pleura with few (five or six) slender, curved spines; pleura of telsonic region with seven to ten spines or spinules, of which one (third or fourth) below the telson is longer and stronger than the others.

The genus was proposed in the first place for the reception of the Kosciusko species. From a consideration of Miss Sheppard's figures (1927, fig. 6) as well as her description of *tattersalli* from the Great Lake, it appeared that this Tasmanian species, also, ought to be included here. In the absence, however, of actual material of that species, it has seemed desirable to include it in the genus *Colubotelson*, with the species of which it has perhaps still more in common.

Genotype. *Colacanthotelson rugosus*, sp. n.

Colacanthotelson rugosus, sp. n.

(Figs 61 and 61A)

Amongst the Phreatoicid material provided by Prof. Chilton were several examples of *M. australis*, one of which differed quite noticeably from the rest. Later, in generous response to a request for additional material of *M. australis* (Chilton), about a dozen specimens were sent by Dr. Anderson, then Director of the Australian Museum, Sydney, and included in this material were two other

specimens resembling the stray example in Chilton's material. A detailed study proved it necessary to institute for these, not only a new species, but also a new genus, exhibiting affinities with *Mesacanthotelson*.

The body is characterized by a marked rugosity, the ridges being set with setae in a fashion recalling the condition of *O. brevicaudatus*, though less extreme.

The *head* (fig. 61, 2s) is long and narrow, the eyes oval, large and prominent, their dorsal border modifying the profile of the head; there is a shallow sub-ocular incisure and a strong cervical groove which is incomplete dorsally.

The first *peraeon* segment appears short and greatly expanded ventrally; the third peraeon segment is longest, as long as its greatest depth; the fifth to seventh segments become progressively shorter; the seventh is deepest.

The first *pleon* segment is about two-thirds of the length of the last peraeon segment and slightly deeper; the second, third, and fourth are sub-equal, the fifth as long, nearly, as the combined length of the first three pleon segments, but rather shallower. In the peraeon, both antero-ventral and postero-ventral angles bear a few setae, while the pleon segments have a ventral fringe of long setae which is continued half way up the posterior border. The *tailpiece* is as long as the combined length of second, third, and fourth pleon segments, and is produced into a moderately long and narrow telsonic apex, armed with a pair of spines and a tuft of setae terminally, and a second pair at a node some way back from the end, in a manner reminiscent of *M. tasmaniae*. Apart from the telsonic apex, the tailpiece is quite distinctive. Its anterior border dips steeply to a narrow ventral edge which bears five slender, curved spines, terminally digitate, these spines becoming progressively stouter posteriorly; at the end of this border are two stout, simple spines, and immediately dorsal to the last, two short furcate spinules. The free posterior border of the telsonic pleuron is armed with seven evenly-spaced spines, of which the third from the top is stoutest; immediately sub-marginal (anterior) to it is a second stout spine. There is a distinct ridge running antero-dorsally from just above the insertion of the uropod, and this, again closely paralleling the condition of *M. tasmaniae*, bears two spines (three on one side in one specimen).

The *antennule*, in the one complete appendage, had a flagellum in length sub-equal to peduncle, with six joints, which are slender and not swollen.

The *labrum* (fig. 61, 5) shows a marked asymmetry, the incisure occupied by the right mandibular palp being relatively deep.

The *right mandible* (fig. 61, 6r) is noteworthy for several features; the four teeth of the principal cutting edge are stout and seem unusually short, the spine row arising just proximally, and at the outer edge of this there are two minute spines, differing from all the remainder and highly suggestive of a reduced lacinia, such as is seen in *Phreatoicoides* or *Uramphisopus*; several plumed setae spring from the base of this spine row and the molar is curiously produced mesially. The palp rises from a short, broad elevation which bears two setae; its first joint is as wide as long and has an apical tuft of setae; the second joint, nearly three times as long, has a sub-terminal rank of five long and stiff, doubly-pectinate setae, arranged almost transversely, proximal to which are a few variable, simple setae; the third joint, almost equalling the second in length, has a long series of setae for the most part arranged in three rows, one of these rows including a set of seven stout spine-setae, denticulate on one edge and finely pectinate on the other; apically, and seeming to rise at a different level, are three long, finely feathered setae; the whole face of this joint is covered with tufts of fine setules.

The *lower lip* (fig. 61, 7) shows little indication of division into inner and outer lobes; its mesial fringe of setae is very dense and seems to include several setospines, including one, unusually stout, which is borne apically.

The *maxillula* (fig. 61, 8) calls for little comment; the outer endite has apically about fifteen spine-teeth, one, at least, of which is a characteristic setospine, and this seems to spring a little sub-apically; there are the usual two plumed setae. On the inner endite are only four setospines, but one of the two spines normally simple in this family is here feebly ciliate.

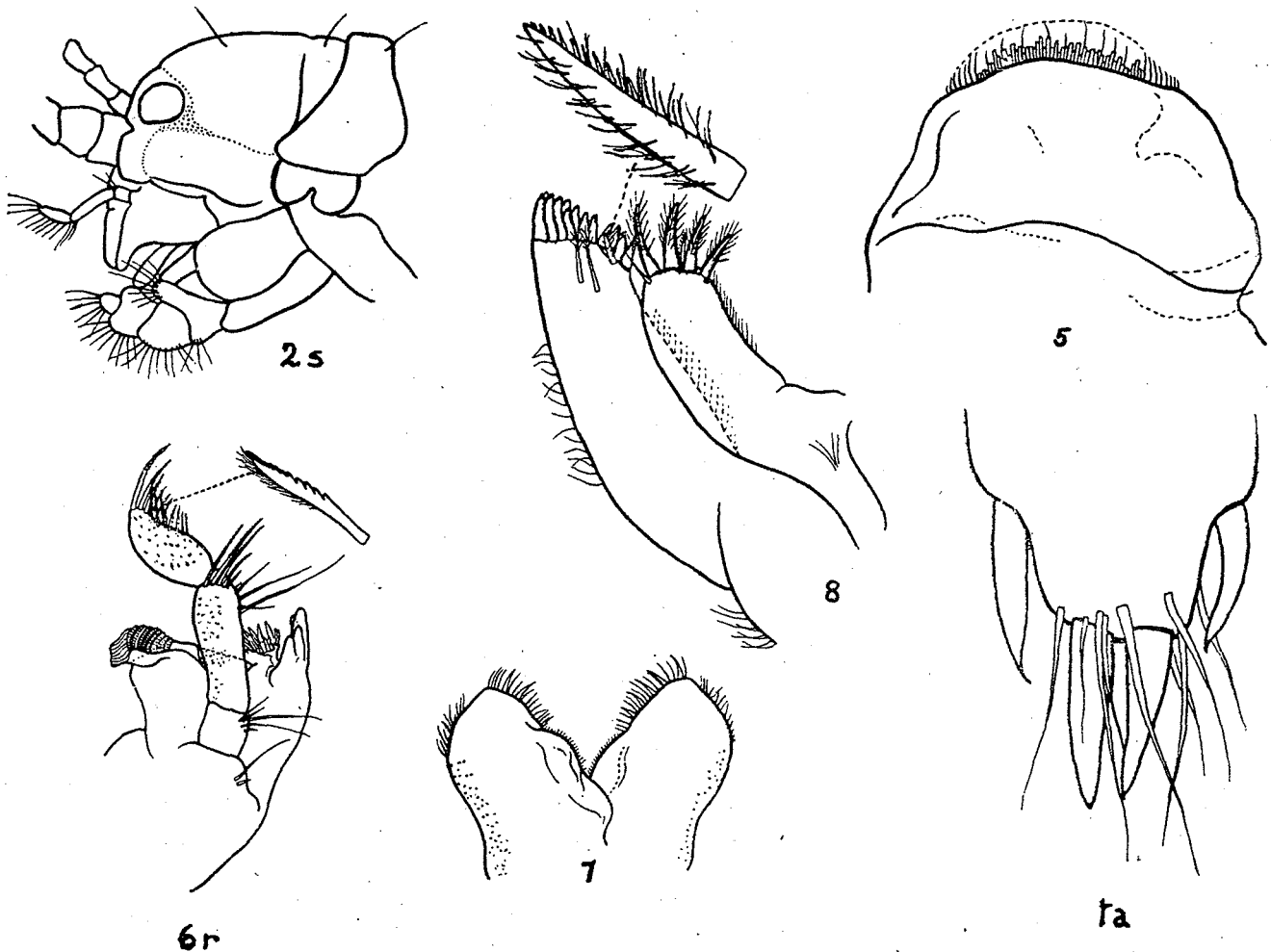


FIG. 61.—*Colacanthotelson rugosus*, sp. n.

The *maxilla* (fig. 61A, 9), too, seems normal, except perhaps that the endites are shorter, relatively.

The *maxilliped* (fig. 61A, 10) bears twelve brush setae on the dorso-mesial edge of the endite, the setae at the proximal end of that structure being long and some, at least, pectinate; the epipodite has a half-circlet of setules fringing its outer (upper) border.

The *gnathopod* (fig. 61A, 11) differs from that of *M. australis* in several details; the basis is devoid of setae and there are very few on the ischium; the merus seems rather unusually produced; the propod is not greatly enlarged and

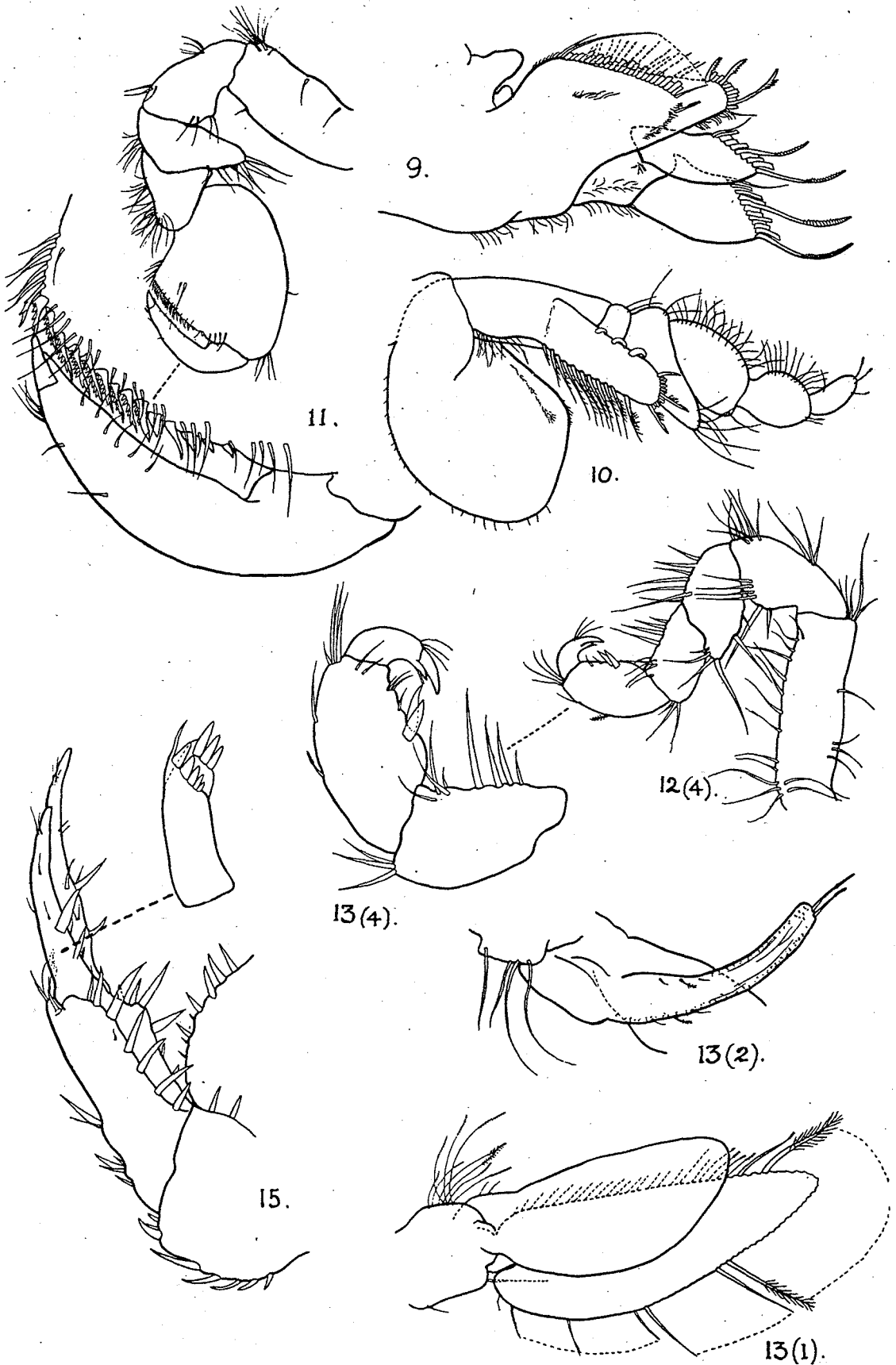


FIG. 61A.—*Colacanthotelson rugosus*, sp. n.

its whole distal (palmar) end is fringed with long, slender setae; about ten denticulated spines, so usual on the palm, are present, but there is, also, a series of simple spine-teeth which makes this appendage quite distinctive.

The *fourth peraeopod* (fig. 61A, 12(4)), in its armature of setae and in the proportions of basis and ischium, comes near to that of *M. decipiens*, from which however, it differs in the shape of the propod. The hinder peraeopods are slender and less setose than those of *M. australis*, but they differ most markedly in the absence of any expansion of the basis, in this most nearly resembling *tasmaniae*.

The *pleopods* generally seem normal, but the endopodites of the first and second lack the terminal emargination seen in *M. australis*, *C. chiltoni*, etc. In the first pleopod (fig. 61A, 13(1)) the endopodite seems unusually widely based; the exopodite is, as usual, fringed with long setae which in the distal third are mostly plumose; an unusual feature, however, is the presence (between the bases of the longer setae) of short, stiff setae, which are reminiscent of the short spines occurring in this position in the corresponding appendage in *tasmaniae*.

Upon the second pleopod, the penial stylet differs from *M. australis* in that there are (as in *M. tasmaniae*) but two terminal setae which are doubly pectinate; both free inrolled borders of the stylet bear short, stiff setae, some of which are pectinate.

The *uropods* (fig. 61A, 15) are slender and rather long, projecting behind the telsonic apex; the inner upper edge of the peduncle is well raised distally and bears one stout and two lesser spines; the outer edge has a series of about six spines, all moderately stout; along the ventral edge are two tufts of setae, each with an accompanying spine. At the lower distal end of the peduncle are one stout, but quite short, digitate spine and two slender, simple spines.

The inner ramus is as long as the peduncle and bears one or more spines at nodes about one-third and two-thirds of its length. The outer ramus is similar, but slightly shorter, with a single spine at mid-length and a second more proximally.

A second specimen shows some scattered setae as well as spines upon these rami.

Size. About 13 mm.

Occurrence. Thomson's Flat, Mt. Kosciusko, 5700 ft. (collected by C. Hedley, 15/2/01) and (?) at Piper's Creek.

This material from both sources had been preserved in alcohol for many years, and had, doubtless, undergone some bleaching. The specimens were brown in colour and noticeably different from the *australis* with which they were associated; the rugosity of the body, too, and the telsonic projection, though not so greatly longer than that of *australis*, were both distinctive. In the case of the first example observed, it seemed possible that it was a Tasmanian specimen which had accidentally become included, but detailed comparison showed it to be assignable to no known Tasmanian species.

It is of interest that Chilton had noted (1891, p. 151) that specimens of *australis* had the body 'wrinkled into irregular depressions', this suggesting that some examples of this species were probably present in the first batch of specimens⁽¹⁾ examined by him, for, as noted below (p. 145), the body of *M. australis* (Chilton) cannot be described as wrinkled.

(1) Taken at 'Piper's Creek, Mt. Kosciusko, 6000 ft.'

The association, on or near the summit of this isolated peak, of two distinct species which seem to find their nearest kinship in the similarly isolated Tasmanian Plateau, is of considerable interest. It is to be noted that Phreatoicids, with the possible exception of subterranean forms, have practically disappeared from the lower levels of the mainland portion of the Bassian region. Such surface-water survivors as there are occur only on isolated mountain tops, whereas, in Tasmania, forms akin to *australis* are found practically at sea-level.

Sub-family VIII. PARAPHREATOICINAE

Body slightly wrinkled or smooth, sparsely setose, never spinose; eyes rarely prominent, generally small, approaching obsolescence or entirely wanting; peraeon sub-cylindrical, segments usually not deeper than long, without transverse bands of setae; the incomplete suture between sixth pleon segment and telson marked by a line of stiff setae; tailpiece sharply upturned, short, and slightly tapering or truncated.

Antennule usually short, club-shaped. Maxillula, with four setospines on inner endite; coxae of sixth and seventh peraeopods little produced posteriorly, bases of hinder peraeopods expanded; spine beneath insertion of the rami of the peduncle toothed.

Three genera, *Paraphreatoicus*, *Colubotelson*, and *Metaphreatoicus*.

This sub-family is the largest of any of the Phreatoicidae, containing, as it does, nearly one-third of the known forms.

Paraphreatoicus relictus is of particular interest, for it retains the primitively fringed condition of the endopodite of the first pleopod. A comparable condition is seen in one New Zealand genus, while in the South African *Mesamphisopus* all of the five endopodites bear a fringe, variably incomplete, of such plumed setae, and in some restricted to the apex of the lamella. The only Tasmanian species hitherto known, which has setae on this lamella is *Hypsimetopus intrusor*, and in this case the fringe is very sparse, a reduction related doubtless to the generally degenerate condition of the pleopods following the adaptation to life in underground waters.

The condition of the tailpiece, and particularly of the telsonic process, suggests that the members of this sub-family have been derived from a Mescanthotelsonine ancestor, which must, however, have been more primitive than any extant form, since none of these retain the setal fringe upon both lamellae of the first pleopod.

The shape of the telsonic process in *P. relictus* suggests that in this process of reduction, it has passed through a phase still retained in *Onchotelson brevicaudatus*. To this latter species, *P. relictus* shows a likeness, also, in the marked setosity of both lamellar faces of the exopodite of the first pleopod, as well as in the strongly armed condition of the free border of the sixth pleon pleura.

From a condition like that of *P. relictus*, that of members of the genus *Colubotelson* is readily derivable by loss of the setose condition of the endopodites of the first pair of pleopods and progressive modification of the tailpiece.

Paraphreatoicus, gen. n.

Telsonic process sharply upturned and abruptly truncated; armed terminally with four stout spines. The endopodite of the first pleopod almost completely fringed with setae, some of which are plumose.

Genotype. *Paraphreatoicus relictus*, sp. n.

Paraphreatoicus relictus, sp. n.

(Fig. 62)

A species of medium size, in general appearance much like *australis*, but differing from all known Australian species in that the first pleopod retains the setose condition of the endopodite.

Body smooth, with few setae. *Head* shallow in front; eyes small; sub-ocular incisure shallow; cervical groove incomplete; post-mandibular region moderately developed with small posterior process.

Peraeon. First segment short, widening ventrally; second, third, and fourth sub-equal in length, but increasing in depth; fifth, sixth, and seventh decreasing progressively in length; seventh about one-and-a-half as long as the first.

In the *pleon*, the first and second segments are short and sub-equal, third and fourth much longer, fifth as long as the second and third combined.

Tailpiece barely as long as the fifth segment; telsonic apex upturned and very short, behind a broad, shallow depression.

The *antennule* (fig. 62, 4) is about as long as the peduncle of the antenna; its flagellum is six-jointed, the penultimate being long. The *antenna* has short first and second joints, third and fourth sub-equal, fifth more slender and less than the combined length of the third and fourth joints; in the flagellum there are sixteen joints, the more distal being long and slender.

The *mandible* (fig. 62, 6) has a stout palp, the third joint little shorter than the second, the terminal tuft of pectinate setae in two or three rows, while the setae forming a row half-circling the apex of the second joint are long and pectinate. The cutting edge with four stout teeth; the molar produced.

The *maxillula* is normal, the outer endite with ten spines and one setospine, with the usual two plumose setae on the posterior face.

The *maxilla* (fig. 62, 9) shows the inner endite widened basally, the filtratory setae passing onto its anterior face and ending distally in a shorter seta with a short, double pectination apically; the anterior spine is short, a little proximal to the end of the row of filtratory setae and is pectinate on one side; the filtratory setae are backed by about nine biting setae, rather widely spaced.

On the *maxilliped* (fig. 62, 10) the inner border of ischium and merus is slightly produced mesially, the epipodite narrow, its lateral border with a fringe of setae; the brush setae on the upper border of the endite about fifteen in number; the dactyl narrow, lanceolate.

The *gnathopod* (fig. 62, 11) of the male is short, rather robust, its basis slightly widened, little longer than the ischium, the propod with anterior border convex, palm oblique, nearly straight, armed with about fifteen spine-teeth, the eleven more posterior being denticulate, while the four nearer the dactyl are reduced progressively in size and are simple; the free posterior border of the joint is nearly two-thirds of the length of the palm. The fourth *peraeopod* (fig. 62, 12(4)) shows some modification, the slightly concave palm occupying three-fourths of the posterior border of the propod. The *peraeopods* of the hinder group are elongate, the basis slightly expanded; the ischium is long, the propod slightly longer and slender. In the seventh (fig. 62, 12(7)) the dactyl is three-fourths of the length of the propod. As a whole the limb is setose, approaching spinose.

It is in the first *pleopod* (fig. 62, 13(1)), however, that this species is distinctive. The appendage is well developed and slender, but the sympodite is wide, its mesial border with a number of pectinate entangling setae, its outer border produced and fringed with long setae, some of which are feebly ciliated. The

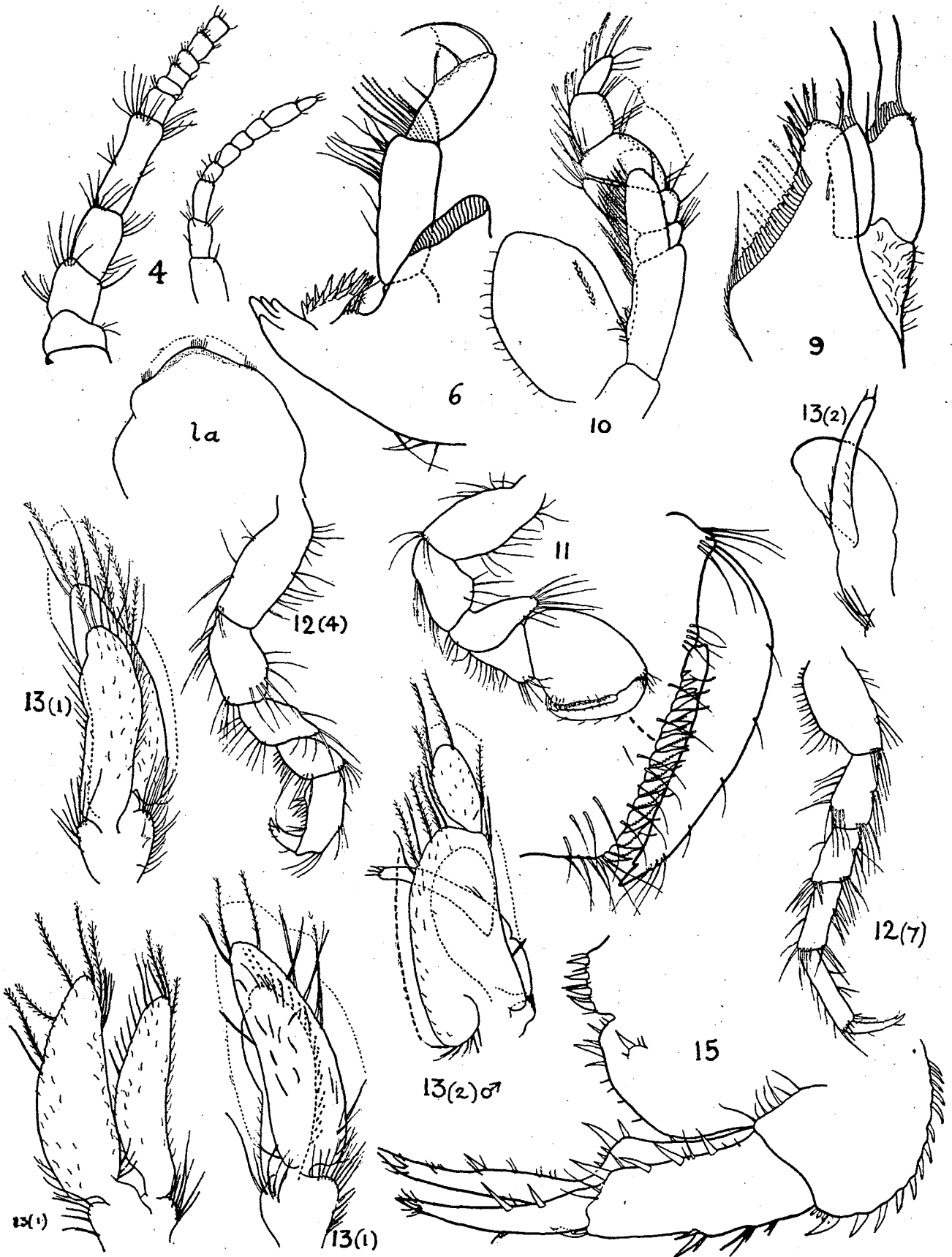


FIG. 62.—*Paraphreatoicus relictus*, sp. n.

exopodite is long-lanceolate in shape, with apex rounded and bearing a few plumose setae, extending for a short distance laterally; the rest of the lateral border has a sparse fringe of long, flexible, simple setae. On the mesial border of the exopodite the terminal third bears pectinate setae; the rest are long, simple setae. The whole anterior face and a wide outer margin of the posterior face bear numerous stout, simple setae. The endopodite is narrow basally, then widens, and finally narrows near the apex; it is fringed along most of its inner border with setae, short proximally, longer and some pectinate distally, with a few plumose apically, and laterally a fringe of longish, simple setae. The posterior face of the endopodite is remarkable for a sprinkling of short setae like those on both faces of the exopodite. In a second specimen there is some variation in the setae, although the general condition is much the same.

On the second pleopod of the male (fig. 62, 13(2)) the entangling lobe bears four stout setae, the exopodite with relatively few plumose setae near the end of the proximal joint and around the distal lobe; the greater part of the lateral and distal borders being fringed with long, simple setae; the anterior surface of both lobes carrying scattered, short setae. The endopodite, nearly as long as the basal lobe of the exopodite, is subdivided indistinctly at the level of the base of the penial stylet; this stylet is long and cylindrical, armed mesially with four or five setae, laterally with rather fewer and terminally with four stiff setae (in one specimen, two only).

The *tailpiece* is figured with the telsonic apex displaced to appear in the side view. It is short, much wider than long, and armed only with four stout spines; the telsonic pleura are little produced and fringed with a spine and several spinules or setae, with one stout, sub-marginal spine; the suture with the sixth pleon pleuron is marked by a short ridge bearing six or seven setae. The antero-ventral border of the pleuron bears an unusually extensive fringe of spinules, twelve or thirteen, apically denticulate; the hindmost, which may be simple, is flanked by four furcate spinules.

The *uropod* is long, extending well behind the telson; the inner, upper border of the peduncle is well raised and bears one particularly stout spine apically. The two rami are long, the inner a little the longer, sub-equal to the peduncle; the outer ramus shows the more primitive condition with two spines—one at mid-length and one more proximally; in some specimens the two are quite close.

Beneath the insertion of the rami are two spines of unequal size, both toothed apically.

Size. About 12 mm.

Colour. In life, dark grey, some nearly black, abundantly marbled on the sides with chestnut-brown; after long preservation in spirit they fade to a pale straw colour.

Occurrence. Under stones and amongst roots of water plants in Stringy-bark Creek at Woodbury, Tasmania. It occurs, but less plentifully, in several adjacent creeks, from St. Peter's Pass and down through Antill Ponds.

In the retention of a well-developed fringe of setae, the condition of the endopodite of the first pleopod approaches that seen in the blind New Zealand surface forms; actually, the plumose setae are not very numerous, but other setae make the fringe almost complete. The endopodite is smaller than the exopodite, in this resembling the South African species of *Mesamphisopus*, but in that genus this setose condition of the endopodite is not restricted, as here, to the first pleopod.

It is undoubtedly the retention of a primitive condition which has disappeared in all other of the known species of this sub-family. On the telsonic process four

spines constitute the sole armature, and it seems probable that this number, found in so many species, is nearer to the earlier condition, and that the occurrence of three pairs of spines in *Metaphreaticus* is due to the development of an additional pair of spines, stages of which are seen, perhaps, in *M. magistri* and *M. affinis*. The extensive fringe of spines upon the sixth pleon pleuron is paralleled in *O. brevicaudatus*, *N. littoralis*, and *M. australis*, and while it, too, may represent an early condition in the Phreatoicidae, it should be noted that other primitive species, such as *M. tasmaniae*, *P. typicus*, and *C. mixtus*, show few spines on this border.

Colubotelson, gen. n.

Telsonic process sharply upturned, very short, and bearing but two pairs of stout, apical spines; endopodite of first pleopod lacking any setal fringe.

Genotype. *Colubotelson joyneri*.

Colubotelson joyneri (Nicholls)

(Fig. 63)

Nicholls, 1926, p. 183, pl. 25, 26, and 29 (*Phreatoicus joyneri*).

Sayce, 1904, p. 151 (*Phreatoicus australis*).

This species having been described in considerable detail, there will be little need to do more than consider those characters in which it differs from *M. australis* (Chilton) or other alpine species.

The *body* (fig. 6, 1) is smooth and only sparsely setose; the length of pleon to that of cephalon and peraeon combined is as 62 : 100. The head seems relatively short and deep. The eye has undergone greater reduction, there being only twelve to fourteen ommatidia. The *antennule* is short; the *antenna* is nearly half the length of the body; the fifth joint of the peduncle is rather long; the flagellum of about twenty joints, is little more than twice the length of the peduncle.

The first *peraeon* segment is expanded noticeably ventrally.

The *gnathopod* of the male shows the propod very robust; upon the palm is a raised convex edge bearing about a dozen spines, of which some nearer the dactyl are tooth-like; traced posteriorly they become elongate and four are denticulate; at the limit of the palm they are continued posteriorly in a close-set rank of four or five slender spines; the hinder border of the propod is straight, about two-thirds of the length of the palm.

All four of the *peraeopods* of the anterior group seem to possess some degree of prehensility, the propod having a rudimentary palm and a couple of stout spines. In the male the fourth *peraeopod* shows this condition quite well developed. The bases of the hinder *peraeopods* are rather more widely expanded. The male appendage widens apically and is armed with three stiff setae; there is, also, a row of setae along its length.

The *pleon* is shorter, but its maximum depth is relatively rather greater than in *australis*. Of the pleopods, it may be noted that the endopodite of the first is produced into a small proximal lobe; the second in the male shows the penial stylet long and slender, armed terminally with four or five stiff spine-setae. The entangling setae on the sympodite are long, stout, and doubly pectinate.

It is in the *tailpiece*, however (fig. 63, 3), that this species differs most evidently from *australis*. As seen in the *habitus* figure (Nicholls, 1926, pl. 25, fig. 1), the tailpiece is nearly as long as the combined length of fourth and fifth

pleon segments. Seen in profile the dorsal surface appears not markedly convex and the tip-tilted telsonic apex projects little, if at all, behind the telsonic pleura. The actual apex bears four equidistant spines, interspersed with which are a dozen to fifteen short, flexible setae. The antero-ventral margin of the tailpiece (the free border of the sixth pleon segment) is armed with spines and spinules. These are usually eight in number; the six more anteriorly situated are denticulate apically and, at first quite short, increase progressively in size as they are traced posteriorly; they are followed by two much stouter, simple spines; flanking the last is a short series of three or four small spinules, which may be simple or digitate.

The telsonic pleura which flare out behind and below the apex are unusual, for, except for one posteriorly placed marginal spine and a small sub-marginal, this border is bare of setae. The junction of this telsonic pleuron with that of the preceding segment is marked by a slight ridge situated just above the insertion of the uropod; it is shorter and less distinct than in *australis* and is armed with a few short setae, irregularly spaced, differing markedly from the comb-like row seen in *australis*.

The *uropod* is stout and of moderate length; upon the peduncle, the inner border is raised terminally and armed with the usual two stout spines with one or more supporting spinules; the outer border is armed along its length with a series of six or seven stout spines. The ventral border bears, in its anterior half, three tufts of setae, each usually with one stout spine. The end of the peduncle, beneath the insertion of the rami, bears one unusually large denticulate spine with a similar, but smaller, spine mesially and a slender simple spine laterally.

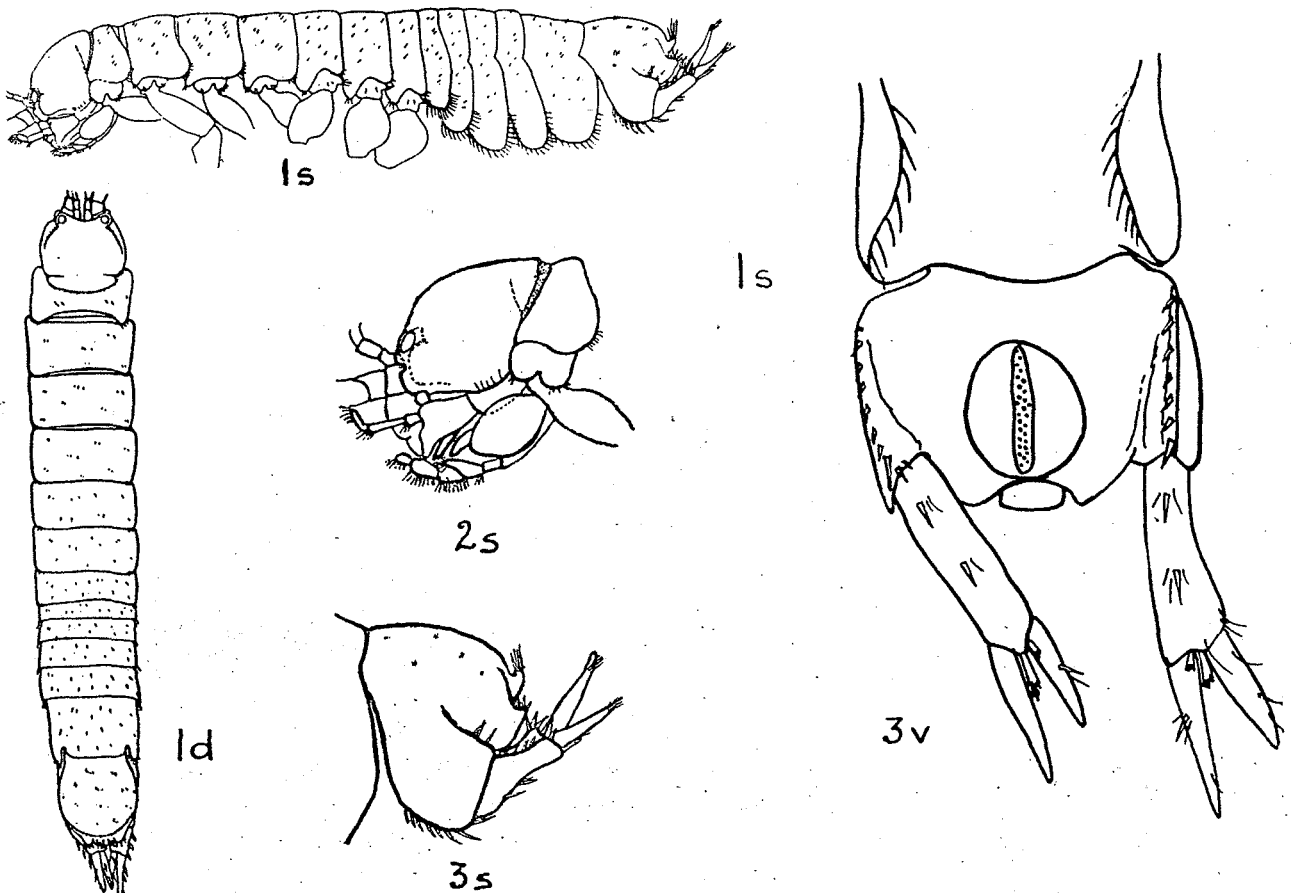


FIG. 63.—*Colubotelson joyneri* (Nicholls).

The inner and longer ramus is rather shorter than the peduncle, the outer ramus only about two-thirds of that, or about four times the length of the denticulated spine. The rami are practically unarmed; each bears two small tufts of setae and, rarely, there may be a single slender spine associated with the more proximal tuft.

Size. The largest male obtained measured 14 mm.

Colour. Varying with habitat from very dark to pale brown.

Occurrence. This species has been taken twice by the writer (in 1925 and 1934) in several localities on and near the summit of Mt. Buffalo, Victoria. Although prolonged search was made, it was not found at or near the base of the mountain. It occurs in black ooze in shallow ditches and puddles, beneath sphagnum in several boggy areas and, in one or two cases, in fairly fast-flowing creeks. Specimens were also taken sparingly along the banks of Lake Catani, but not in the reservoir. It would seem that it requires a sheltered situation, and the reduced condition of the eye supports this view, but it may be that food is not so readily available on the gravelly bottom of the lake.⁽¹⁾

Recently, Phreatoicids from the Great Lake, Tasmania (presumably a mixed collection), have been introduced into Lake Catani⁽²⁾ as a source of trout food, and it will be of interest to discover whether conditions in the lake are unfavourable only to the local species, or unsuitable for Phreatoicids generally. It is, of course, possible that the scarcity of the animal in the lake was due to the presence of trout!

Colubotelson joyneri searlei, sub-sp. n.

(Figs 64 and 80, a)

In general, agreeing quite closely with the Mt. Buffalo species, but differing in the following details:

The eye is slightly less reduced, having about twenty ommatidia; but the antennule is shorter and retains only four joints in the flagellum. The gnathopod is less robust, and upon its palm about six of the more posterior spines are stout and denticulate, while the remaining six, which stretch to the base of the dactyl, become small, conical, and simple (fig. 64, 11*h*). The hinder border of the propod is short, about one-third of the length of the palm; the fourth peraeopod of the male (fig. 64, 12(4)), which is sexually modified, is robust, propod stout with short concave palm; the ischium on this appendage is little more than half the length of the basis, the latter bearing only three or four setae. The seventh peraeopod (fig. 64, 12(7)), although bearing a distinct plate-like expansion posteriorly, is relatively slightly longer and narrower than in *joyneri*; the male appendage short and unarmed.

The specimens had been collected and allowed to dry, so that the pleopods were in a poor state of preservation. The tailpiece showed a telsonic apex very closely like that of *joyneri*, but in dorsal view this is found to project directly from the anterior part of the piece, whereas, in *joyneri*, it is separated by a shallow gap from the flanking telsonic pleura (1926, pl. 29, fig. 40). The latter differ in armature scarcely at all from *joyneri*, and the same is true for the sixth pleon pleura, but the suture, above the insertion of the uropod separating these two pleura, is marked by a line of eight or nine slender setae.

⁽¹⁾ Among Chilton's notes, there was found a reference to the taking of '*P. australis*'. (Sayce, Victorian Naturalist, v. 20, March, 1904) at the 'Haunted Gorge' on the summit of Mt. Buffalo.

⁽²⁾ *vide* J. W. Evans, in litt. 7/4/41.

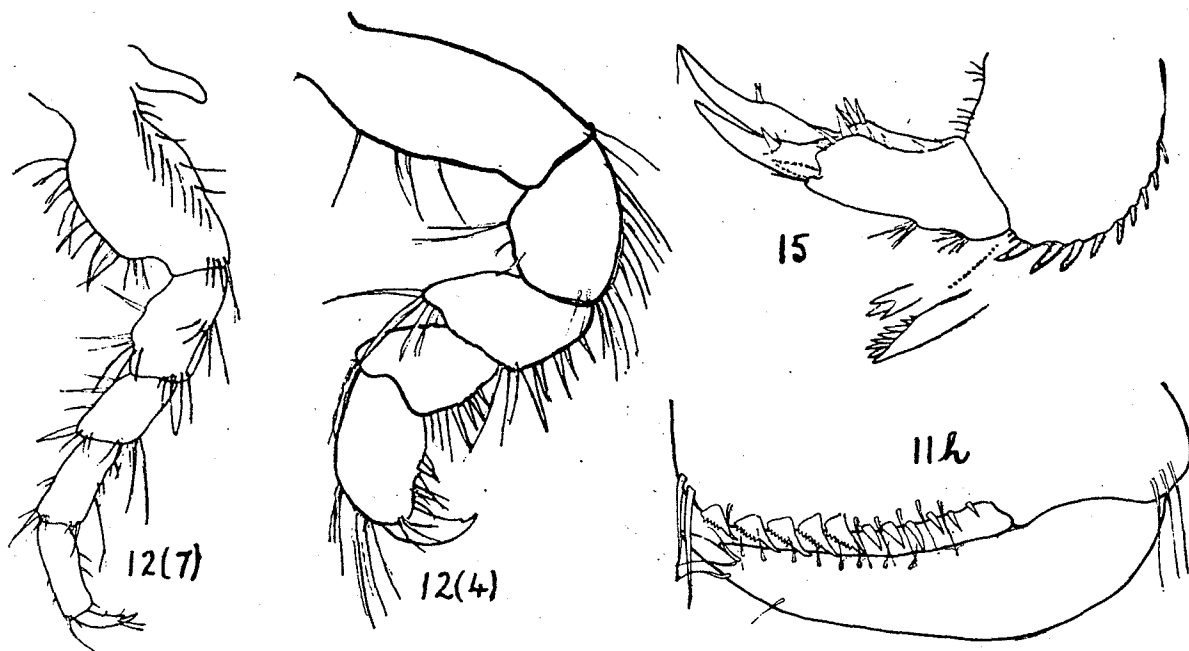


FIG. 64.—*Colubotelson joyneri searlei*, sub-sp. n.

The uropods, too, are closely alike (fig. 64, 15), but both rami bear a particularly stout spine at about their mid-length, whereas, in *joyneri*, the sole armature frequently consists of a few setae.

Size. ♂ 14-15 mm.; ♀ 11 mm.

Colour. Dark brown with lighter marbling.

Occurrence. Collected on Mt. Baw Baw by Mr. Jas. Searle (26/1/14).

Vic. 37°50'S, 146°17'E

Colubotelson thomsoni, sp. n.

(Figs 65 and 80, d)

Thomson, 1893, p. 76 (*Phreatoicus australis*).

Thomson, 1894, p. 349 (*Phreatoicus tasmaniae* juv.).

Smith, G. M., 1909, p. 72, pl. 12, fig. 4 (*Phreatoicus australis* part).

Barnard, K., 1914, pp. 233 and 239; 1927, p. 160 (*Phreatoicus australis*).

This species, which was apparently first recorded by G. M. Thomson in 1892, closely resembles *C. joyneri*, but in the condition of the tailpiece seems intermediate between that species and *M. magistri*.

The eyes are small, not prominent, and do not appear in the profile of the head, the front rising even more steeply than in *magistri*; the post-mandibular region is small; the cervical groove is relatively well developed.

In the peraeopods it is to be noted that the antero-posterior axis of the basis is disposed nearly parallel to the long axis of the body, so that the anterior border of the limb is scarcely visible. Only in an occasional specimen does there appear that partial torsion of the limb which is normal for many species.

In the pleon the ventral and hinder margins of the first to fifth segments are fringed with long setae, interspersed in a dense fringe of short setules. The tailpiece shows the telsonic projection more tip-tilted, and distinctly shorter, so that the preceding dorsal concavity is relatively slight. The actual hinder margin is smoothly rounded, armed with four short spinules and a few long setae; on either side near its base are a couple of longer, stiff spine-setae which represent, possibly in a rudimentary condition, the outermost pair of spines of *Metaphreatoicus* spp.

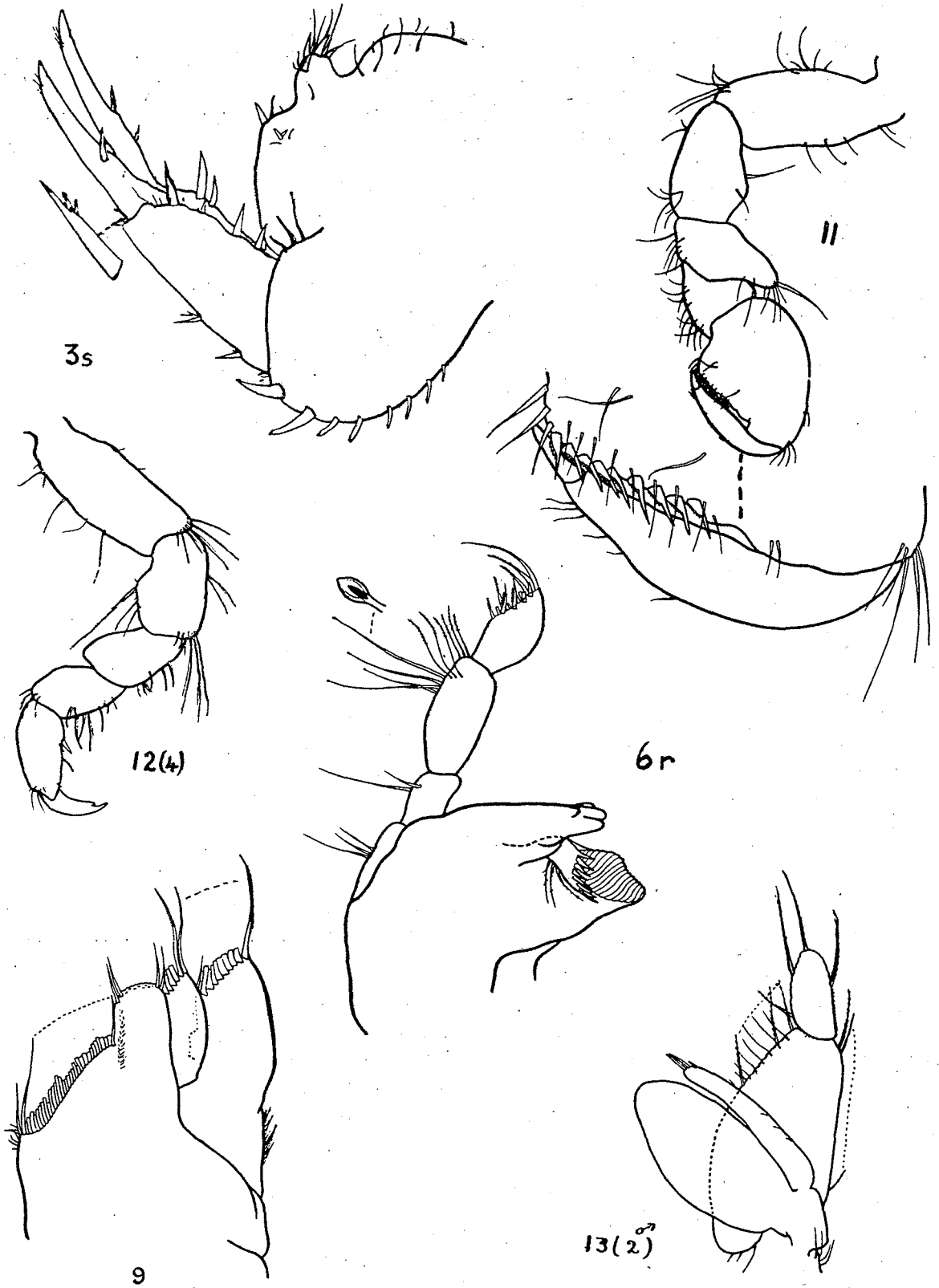


FIG. 65.—*Colubotelson thomsoni*, sp. n.

The telsonic pleura are rounded and project very little, if at all, behind the telsonic apex; in their upper part, these pleura bear two marginal spines and, below, two setae; anteriorly is the usual sub-marginal spine. The pleura of the sixth pleon segment are broad, armed antero-ventrally and ventrally with six or seven toothed spines and one particularly stout, simple spine (which may, variably, bear traces of apical denticles); flanking this last spine may be one or two spinules, which may be simple or furcate. The suture between sixth pleon and telsonic pleura is indicated by a short ridge with two, three, or four long, stiff setae.

Appendages. The *antennule* is short, with but five joints in the flagellum. The *antenna* seems less robust than that of *australis*; it has fewer (not exceeding twenty-one) flagellar joints, but these are fairly long, so that the appendage as a whole is relatively longer. The *labrum* is asymmetrical; the incisures on either side for the reception of the mandibular palps are unevenly developed. On the mandible (fig. 65, 6) there are two or three plumed setae just proximal to the spine row; the third joint of the palp is stout, the setae being disposed in two or three rows. On the second joint, which in length does not greatly exceed the third, there is an apical tuft of pectinate setae, while upon its outer margin are longer, simple setae, some with small spatulate or knob-like apices.

The *maxillula* seems normal, but in the *maxilla* (fig. 65, 9) the inner endite seems of quite unusual width, the row of filtratory setae disposed in a line at a very wide angle to the apical lobe. It is backed by about sixteen biting setae. The usual spine on the anterior face of the endite was not observed; all three endites are short and wide.

The *gnathopod* (fig. 65, 11) of the male is much less robust than that of *joyneri*; the palm, which is very obliquely set, is nearly straight and bears nine denticulate spines; upon the dactyl the unguis is simple, the secondary unguis wanting.

In the fourth *peraeopod* of the male (fig. 65, 12(4)) the propod is scarcely widened, the dactyl very slightly curved. Upon the basis setae occur more sparsely even than in *joyneri*. The basis of the hinder *peraeopods* is rather less expanded than in *australis*.

The first *pleopod* differs from that of *australis* in a couple of details: the sympodite is practically bare of setae and the exopodite has, in addition to its apical series of plumose setae, a subsidiary fringe of simple setae, projecting at a different angle; the second pleopod in the male shows the penial stylet with a few marginal setae mesially, and three stiffer spine-setae apically; in the exopodite, the mesial aspect of the distal lobe bears a fringe of short setae (fig. 65, 13(2)).

The uropod (fig. 65, 3s.) has an unusually short peduncle, which in length is sub-equal to, or even shorter than, the inner ramus; the terminal spine on the peduncle is somewhat variable, being in one case a slender tridentate spine; usually there are either one or two more typical toothed spines, relatively short and stout. Each ramus bears several setae and one slender spine.

Size. About 12.5 mm.

Colour. Closely resembles *australis*.

Occurrence. Found abundantly on the summit of Mt. Wellington, on wet slabs of rock, covered by moss or liverwort; also in puddles on the 'plains', and in runnels upon the higher slopes of the mountain. It may be found in the Ridgeway reservoir and, in the overflow from that, at a level of a few hundred feet only above sea-level, and is thus the only species known to have a considerable vertical range.

TAS: 42° 54' S, 147° 14' E

town
42° 56' S,
147° 17' E

Colubotelson evansi, sp. n.

(Figs 66 and 80, e)

A species of small size with affinities to *C. joyneri*.

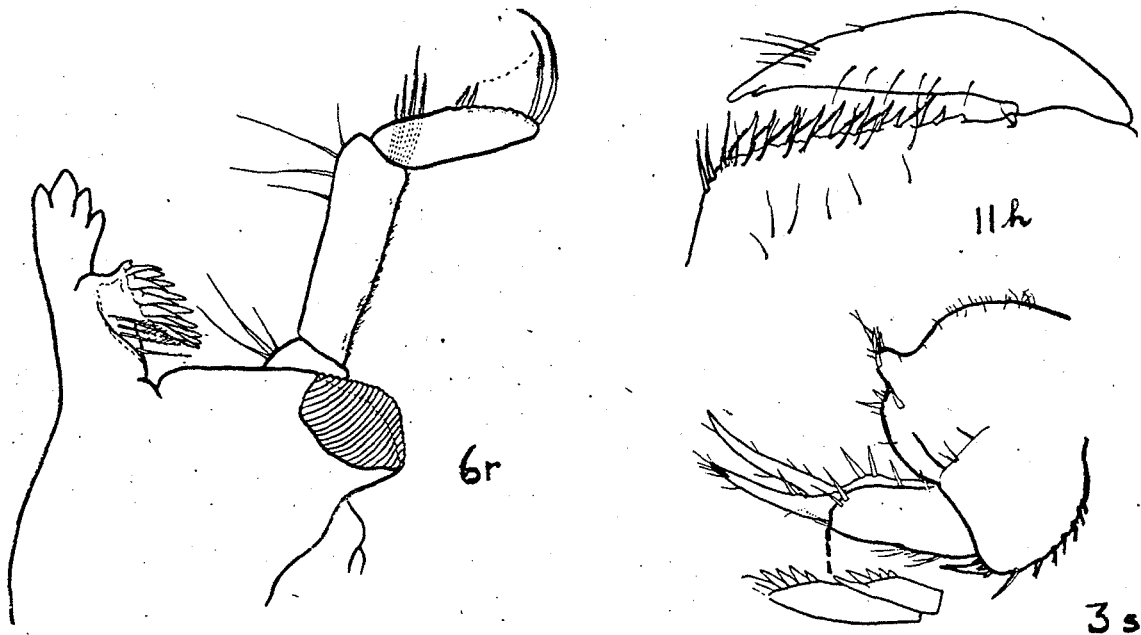
The body is somewhat slender, with a very sparse covering of short, fine setae; the head is as long as the combined length of the first two peraeon segments, with moderately large eyes (about 32 ommatidia); the cervical groove is deep and traceable almost to the ventro-lateral border of the head. In the peraeon the first segment is short and widens below, but instead of embracing the head seems to project backward postero-ventrally over the second segment. Third and fourth segments sub-equal and longest, fifth as long as second, seventh distinctly longer than first; the segments are relatively deep; from the third backward the depth is greater than the length. In the pleon the first four segments lengthen and deepen progressively; the fifth is long, as long as the tailpiece. The tailpiece, as viewed from the side, is convex and produced into a telsonic projection which is short and much less tip-tilted than is the rule in species of this genus, so that there is but a shallow, rounded concavity preceding the apex. The projection, too, examined from above (fig. 80, e), is unusually long, its shape semi-circular, and its four spines evenly spaced around its hinder curvature; completing the terminal armature are four longish setae. Below, the telsonic pleuron, which projects little, slopes away smoothly, the border of the pleuron bearing two spines and two or three spinules in a little dorso-posterior group; sub-marginally is a single, stout spine. Ventrally to the group of spinules the border is fringed with fine setules. From immediately above the insertion of the uropod there is a slight ridge, armed with three or four fine setae, marking the feeble boundary between the telsonic and the sixth pleon pleuron. The antero-ventral border of the latter bears a fringe of six or seven curved spinules and spines toothed apically and one much stouter spine, hindmost in position; flanking this latter are, variably, one or two furcate spinelets.

Appendages. The *antennule* is as long as the peduncle of the antenna, although the flagellum has but five joints; the *antenna* is short; the peduncle has the third and fourth joints sub-equal, the fifth barely one-third longer than the fourth; its flagellum has only about fourteen joints, but the first is long, practically as long as the fourth joint of the peduncle.

The *right mandible* (fig. 66, 6r) bears four plumose setae proximal to the spine row; both second and third joints of the palp are relatively long, the final joint having very few (about eight) slender spines (most being finely denticulated), which seem to be arranged in but a single row.

The *labium* has an inner lobe indicated and at least one setospine seems present apically in the mesial tuft of setae. The *maxillula* appears normal, the setospine on the outer endite being well developed. On the *maxilla* the tuft of pectinate setae arming the apex of the proximal endite are relatively numerous, and both this apical lobe and the outermost endite are comparatively wide; the biting setae on the latter are unusually stout.

Possibly related to the small size of this species, the propod of the *gnathopod* is not particularly robust. The palm is straight and bears a series of the characteristic denticulated spines (fig. 66, 11h). In this species, there is an interrupted rank of eight, beginning at the extreme border of the palm and passing, near the origin of the dactyl, into lower irregular teeth. The fourth *peraeopod* is obviously prehensile, but the propod is scarcely modified and the dactyl is little curved.

FIG. 66.—*Colubotelson evansi*, sp. n.

The basis in this and the following appendages is not very setose and in the hinder group the expansion of that joint is very slight. In the seventh peraeopod the dactyl is noticeable for its length, which is about three-quarters of that of the propod.

The pleopods are not remarkable; the epipodites, however, differ somewhat in shape from *australis* in being a broad oval, rounded apically. In the male the penial stylet is unusual in that it bears but a single apical spine; at its mid-length there is a short mesial seta (as in *Crenoicus* spp.), and at the base of the endopodite are a few stiff setae, not observed in other species.

The pleura are rather sparsely set with long sub-marginal setae, both on the ventral and posterior borders; the actual margin is bordered by a close fringe of short, hair-like setae.

The uropods (fig. 66, 3s) are of moderate length, the peduncle extending slightly beyond the end of the telson. It is slender, but widens distally, its dorsal surface being distinctly concave, both margins being raised and set with spines; the two rami are slight, the inner sub-equal in length to the peduncle; both bear stiff setae and the outer ramus has one slender spine at its mid-length. There is one stout, strongly-toothed spine beneath the insertion of the rami, and this may be accompanied by a smaller and similar spine or by a slender simple spine.

Size. About 10 mm.

Colour. In life, a dull yellowish-brown, in some cases fading in alcohol to a pale straw colour.

Occurrence. These were taken by the writer (9/2/28) at Waratah, West Tasmania, in ditches in a piece of vacant ground adjoining the hotel.

The species is named in compliment to Dr. J. W. Evans, from whom the writer has received much valuable material.

Colubotelson campestris, sp. n.

(Figs 67 and 80, b)

Geoffrey Smith, 1909, p. 72 (*Phreatoicus australis* var.)

A smallish species, body length rather more than six times the width, practically smooth and free from setae. The *head* is narrow, as long as the combined length of first and second peraeon segments, shallow in front, becoming much deeper behind; eyes moderately prominent; cervical groove well developed, not complete dorsally. First six *peraeon* segments longer than deep, with the first segment strongly widening ventrally; second to sixth segments sub-equal, the fourth rather the longest; seventh noticeably shorter and much deeper than the sixth. Pleon rather deep, greatest depth sub-equal to length of first four pleon segments, the pleura being much deeper than the related segments. The tailpiece is longer, by the length of the telsonic process, than the fifth pleon segment, moderately convex dorsally, dipping smoothly into a small concavity in front of the very short telsonic projection, which is short, nearly twice as wide as deep, its transverse hinder border scarcely convex, armed with four very stout spines and a few stiff setae; the telsonic pleura project sharply, armed above by one stout marginal and one sub-marginal spine, followed by five or six spinules; the sixth pleon segment having six or seven slender, curved spines, toothed apically, with one much stouter terminal spine and a couple of furcate spinules just anterior to the lower border of the uropod; suture between sixth and telsonic pleura marked by a short, slight ridge, bearing four or five setae.

The *antennule* short, reaching, nevertheless, nearly to the end of the peduncle of the antenna, with eight joints, of which the penultimate is long. The *antenna* has an unusually short second peduncular joint; third sub-equal to first, fourth longer than third, and fifth rather slender and sub-equal to the combined length of the third and fourth; flagellum with sixteen joints, slender, whip-like (fig. 67, 4).

Upper lip, rather less asymmetrical than in related species; *mandible* unremarkable, excepting for the shortening of the *pars incisiva*, a feature observed in some other species of this genus.

The *maxillula* (fig. 67, 8) is small, apparently undergoing reduction; upon the outer endite there seem to be but nine or ten spine-teeth and the small setospine is only doubtfully present; there are two feeble plumose setae; the inner endite shows but one (the outer) simple spine; the setospines are four, but the innermost is quite slight. The *maxilliped* (fig. 67, 10) is remarkable chiefly for the rather unusual size of the epipodite, which is armed along its dorso-lateral border with about half a dozen fine, short setae.

The *gnathopod* is slight, the basis with very few setae, ischium three-fourths the length of the basis, propod sub-triangular, anterior border only gently convex, palm (fig. 67, 11h) very oblique with ten or eleven slender, denticulate teeth, the free posterior border sinuous, about two-thirds the length of the palm; dactyl moderately long, slender, its palmar border smooth.

The *fourth peraeopod* (fig. 67, 12(4)) is slight, its more proximal joints agreeing closely with those of the gnathopod, but the propod is slight, a palm is barely indicated and the spines for the reception of the dactyl are short and slender. The hinder peraeopods show a small expansion of the basis, the greatest width of that joint being half its length; setae are few, but on the more distal joint they

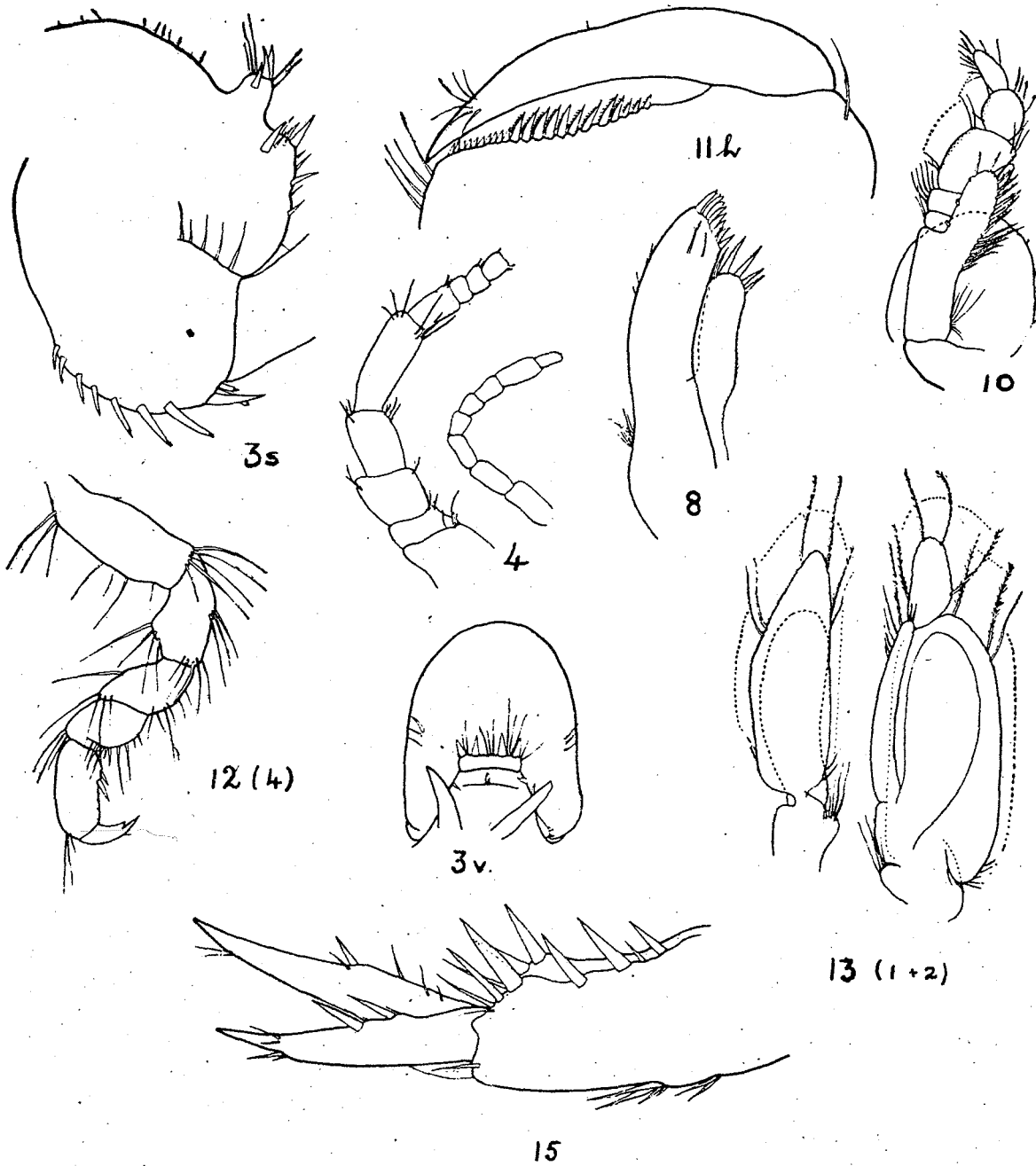


FIG. 67.—*Colubotelson campestris*, sp. n.
The tailpiece (3v) is shown in posterior view.

are plentiful and are, in parts, replaced by slender spines. The male appendage is slender and fairly long, its length equalling the maximum width of the basis; it is armed with a terminal seta.

The *pleopods* (fig. 67, 13 (1), (2)) are unremarkable, although they differ from those of *australis* in the relative proportions of exopodite and endopodite. In the male, the penial stylet upon the second pleopod is much more like that of *magistri* or *chiltoni* than *australis*. In the latter, this stylet is well armed terminally. In this species it is long (as is the related endopodite), bears one longish and one short terminal spine, but otherwise appears unarmed. On the pleura of the pleon segments, the fringe of setae is comparatively feebly developed.

The *uropod* is robust (fig. 67, 15); its peduncle has a couple of tufts on its ventral margin; dorsally its inner border is armed only apically by two stout spines and smaller flanking spinules; the outer border bears spines along its whole length; both rami are stout, the inner as long as the peduncle and with one stout spine at its mid-length, while the outer ramus retains the more primitive condition with one spine at that point and another more proximally. Beneath the insertion of the rami is one stout, toothed spine, a second similar but smaller, and a slender, simple spine.

Size. 10.5 mm.

Colour. In colour and marking this species retains the condition characteristic of *australis*.

Occurrence. In a paddock at Huntingfield, close to the west shore of the estuary of the Derwent, some miles south of Hobart. This is evidently not quite the same locality as that referred to (1909, p. 72) by Geoffrey Smith (that author speaks of a small stream at sea-level, but it was the only water found by the writer in that vicinity (22/1/1928)). It formed a small pond, receiving the drainage from an adjoining cow-barn and stable-yard. From its very evil-smelling mud nearly a hundred specimens were taken, collecting being precarious and intermittent owing to the activity of a bull which was the other occupant of the paddock.

Geoffrey Smith's reference indicates that he regarded specimens from Mt. Wellington, Bruni Island, and Huntingfield as all referable to the same (third) variety of *australis* and, indeed, it might have been expected that at least those from Huntingfield (almost at the foot of Mt. Wellington) would prove to be identical with that (*thomsoni*) from the summit, the more so that the latter occurs at the reservoir only 800 ft. from the sea.⁽¹⁾ That the forms from Bruni Island might prove distinct was more likely, for that island is separated from the mainland by the deep⁽²⁾ D'Entrecasteaux Channel.

Colubotelson huonensis, sp. n.

(Figs 68 and 80, c)

Body sparsely setose, setae being a little more plentiful on the tailpiece; the head almost as long as the combined length of the first two peraeon segments; it is shallow in front, much deeper behind; eye moderately large (about thirty

⁽¹⁾ It should be noted, however, that *thomsoni* has elsewhere not been recorded from the slopes of Mt. Wellington. (It does not occur in the New Town Creek, for example, although *Anaspides* is found thriving there at less than 1000 ft. above sea-level.) Its occurrence at the reservoir is probably unnatural.

⁽²⁾ Information is not available as to the probable antiquity of this channel separating Bruni Island from the adjoining Tasmanian coast. It is, however, quite deep, and lodges those living fossils *Neotrigonia margaretacea*.

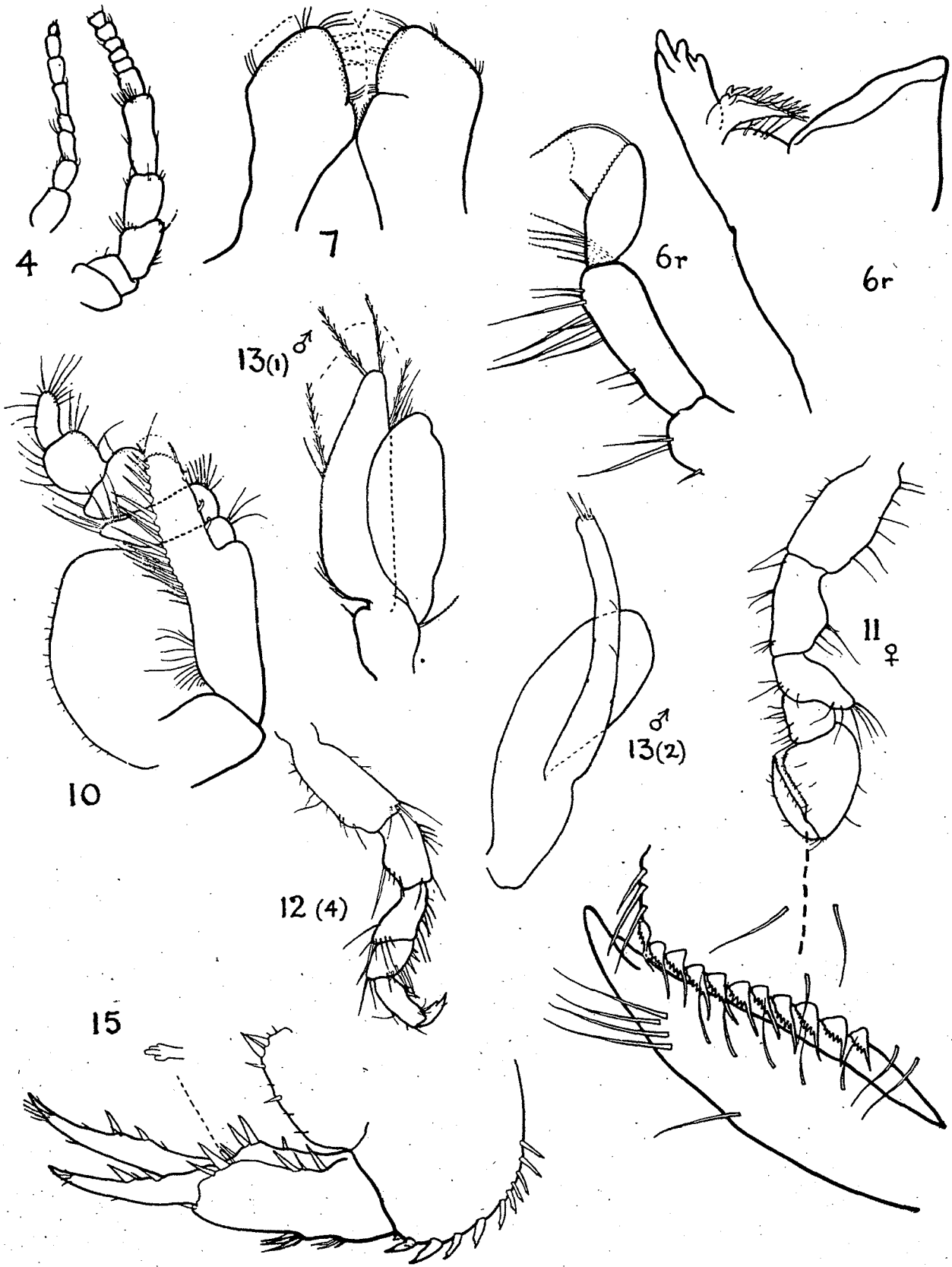


FIG. 68.—*Colubotelson huonensis*, sp. n.

ommatidia) sub-ocular incisure distinct, cervical groove well developed. All the peraeon segments are deep, the first segment short, not greatly widened below, downwardly produced in front of large coxa; third segment longest, fifth and sixth sub-equal, seventh about as long as the first. First four pleon segments increasing progressively in length, the fifth nearly as long as the first three; the tailpiece strongly convex dorsally, ending with a very short, terminal projection armed with four short upturned spines; telsonic pleura are produced behind the telsonic apex, the margin armed with two or three stout spines and about ten spinules and setae; the sixth pleon pleuron fringed anteriorly and ventrally by about nine curved spines, toothed apically, and two, more posteriorly situated, stout and simple; against the hindermost are three short furcate spinules; this armature apparently increases with age, since in a smaller specimen only six curved spines (all toothed) were present, and the telsonic pleural fringe, too, was less complete.

The *antennule* (fig. 68, 4) extends to the end of the peduncle of the antenna, the flagellum having five joints, of which the first and last are short. The *antenna* is of moderate length and has, in the male, a flagellum of about twenty-four joints.

The *right mandible* (fig. 68, 6r), as in several species of this genus, has a small mesial bifurcate piece (suggestive of a much reduced lacinia) at the distal end of the spine row; the third joint of the palp is little shorter than the second and carries about eighteen finely pectinate setae on the distal half of the joint. The *maxillula* appears normal, with about ten spine-teeth and one small setospine on the apex of the outer endite and with two sub-terminal plumed setae; the inner endite with four setospines, but there is only one (the outermost) simple spine present.

The *maxilliped* (fig. 68, 10), as compared with that of *campestris*, has more brush setae (about fifteen) on the endite of the basis and the endite is rather longer and narrower; the epipodite more setose; the dactyl bears setae on both outer and inner borders.

The palm of the *gnathopod* is armed with about eleven spines, all denticulate (fig. 68, 11); in the fourth peraeopod, the ischium is relatively shorter, the propod slender, and the palm indistinct (fig. 68, 12(4)).

The first *pleopod* (fig. 68, 13(1)) shows a distinct lateral flange on the sympodite, bearing only a single seta; the exopodite not very setose, only about fifteen of the more distal setae being plumed; the endopodite, which rises from a quite narrow base and shows a sub-apical indentation, is little shorter than the exopodite.

The second pleopod of the male is moderately large; its endopodite shows a distinct narrowing at the level of the base of the penial stylet, this latter being long, sparsely setose along its borders, and armed terminally with three stiff setae.

The *uropod* (fig. 68, 15) is short; the ventral edge of the peduncle has two strong tufts of spines and setae; the inner dorsal edge scarcely armed, except for the two stout spines crowning the low apical elevation; the outer border is rather more spinose, one of the spines, near the end of the peduncle, appearing short and digitate. The rami are unequal in length, the inner nearly as long as the peduncle; both bear two spines in the proximal half of their length; beneath their insertion is an unusually well-developed toothed spine, almost one-third of the length of the outer ramus.

Size. About 11 mm.

Colour. Light brown.

Occurrence. In ditches near sea-level in the neighbourhood of Port Huon, Tasmania.

Very few were taken, and these doubtfully mature. Since they occur on the southern flanks of Mt. Wellington, it might be expected that they would most nearly resemble *campestris* or *thomsoni*; they occur, however, in a different river system, both the Huon and Franklin discharging at Port Huon, and they seem to be quite distinct from *campestris*.

Colubotelson huonensis flynni, sub-sp. n.

(Fig. 69)

Two or three juveniles were taken in January, 1928, by Prof. T. Flynn, from a roadside puddle on Eaglehawk Neck. These, in several features, come near to *huonensis*, of which it is here ranked as a sub-species. The possession (i) of two spines on the proximal half of the outer ramus of the uropod (fig. 69, 15), and (ii) of a complete series of denticulated spines on the palm of the gnathopod (fig. 69, 11h) link them with that species, but they differ in that they possess a short and slight penial stylet with but a single apical seta, while the spine beneath the rami of the uropod is relatively much longer, even, than that of *huonensis*.

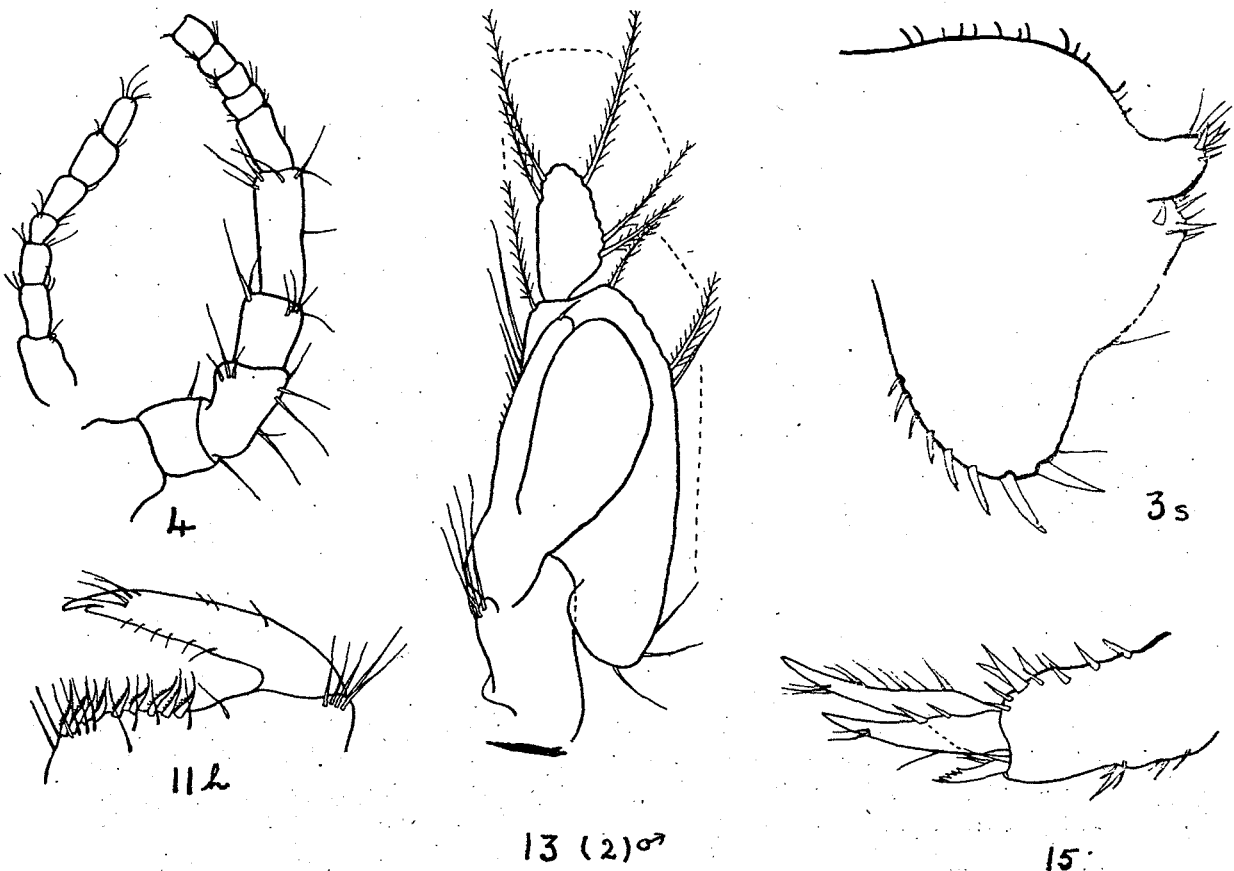


FIG. 69.—*Colubotelson huonensis flynni*, sub-sp. n.

Colubotelson gesmithi, sp. n.

(Figs 70 and 80, f)

This species from Mt. Field shows a close likeness to *C. joyneri*, from which, however, it differs recognizably in that it is practically eyeless.

The specific name was chosen to recall the association of Geoffrey Smith with this region, for it was Smith's record of the occurrence of *Anaspides* upon Mt. Field (1909, p. 559) that led the writer to make a search there for Phreatoicids.⁽¹⁾

In a mounted specimen, an irregular pigmented area can be made out, which obviously represented the eye, and some nine or ten lenses dispersed upon and around the pigmented area could be counted, but the organ was obviously undergoing degeneration. The *antennule*, with its four-jointed flagellum, is even shorter than in *joyneri*, reaching little beyond the end of the fourth joint of the peduncle of the antenna. Only its penultimate joint is swollen. The *antenna* differs slightly from that of other species of this genus in that the proximal three joints are of approximately equal width, the second and third sub-equal in length; the fourth is distinctly more slender than the third and little stouter than the fifth, though shorter than the latter by half its own length. The flagellum has sixteen to eighteen joints, the first nearly as long as the fourth peduncle joint, the terminal joints rather more than half the length of the first joint of the flagellum.

The *upper lip* is rather more than usually asymmetrical, the V-shaped hollow on its posterior face exceptionally long.

The *right mandible* has the usual four teeth on its cutting edge, while the spine-row has a mesial lamina at its distal end particularly well developed; it is minutely denticulated and suggests a vestigial *lacinia mobilis*. The palp, too, is rather generalized, the first and third joints sub-equal, the third having a short brush of setae, finely pectinate and arranged in two parallel rows.

The *labium* has the shape normal for this genus and shows in its mesial fringe of setae at least one setospine in a much reduced condition. In the *maxillula*, the proximal endite has a slightly convex mesial border; the outer endite bears about eleven spine-teeth, and one small setospine apically and two feebly plumed setae on the posterior face. The *maxilla* appears to differ in no noteworthy detail from that of *joyneri* and the *maxillipeds* of the two species are scarcely distinguishable, except that in *gesmithi* the epipodite is more rounded and has about three setules disto-laterally; there are three coupling hooks on the endite of the basis and the propod seems a little less broadened.

No fully-grown male was taken, but in a specimen not quite 11 mm. long the *gnathopod* has a narrow propod, sub-triangular in shape, the very oblique palm nearly thrice the length of the free posterior border. The distal half of the palm is armed with a close-set series of relatively slender, denticulate spine-teeth, twelve to fourteen in number, that half of the palm nearer the dactyl being unarmed. The distal end of the palmar edge of the dactyl is narrowly slotted to give about fourteen close-ranked square-ended teeth (fig. 70, 11h).

A spent female, about 9 mm. long, bore a gnathopod in which the hand scarcely differed from that described for the male, except that the teeth on propod and dactyl might have been rather fewer in number. The basis of this appendage in the female was practically bare of setae; in the male, on the anterior border, was a sparse fringe of long, slender setae.

⁽¹⁾ Actually the credit for the discovery that *Anaspides* existed elsewhere than on the summit of Mt. Wellington should go to G. M. Thomson, *vide* Calman, 1896, p. 802.

The fourth *peraeopod* of the male shows the propod shorter and stouter than that of the preceding appendage, a short, scarcely concave palm defined proximally by two stout spines (fig. 70, 12(4)); but neither gnathopod nor fourth *peraeopod* is nearly as well developed as are those limbs in *joyneri*.

In the female the second, third, and fourth *peraeopods* are stouter and a little longer than the gnathopod; in the fourth the basis is widened, and appears practically without setae, and is little longer than the ischium. The oostegites are large and bordered by a close fringe of long setae.

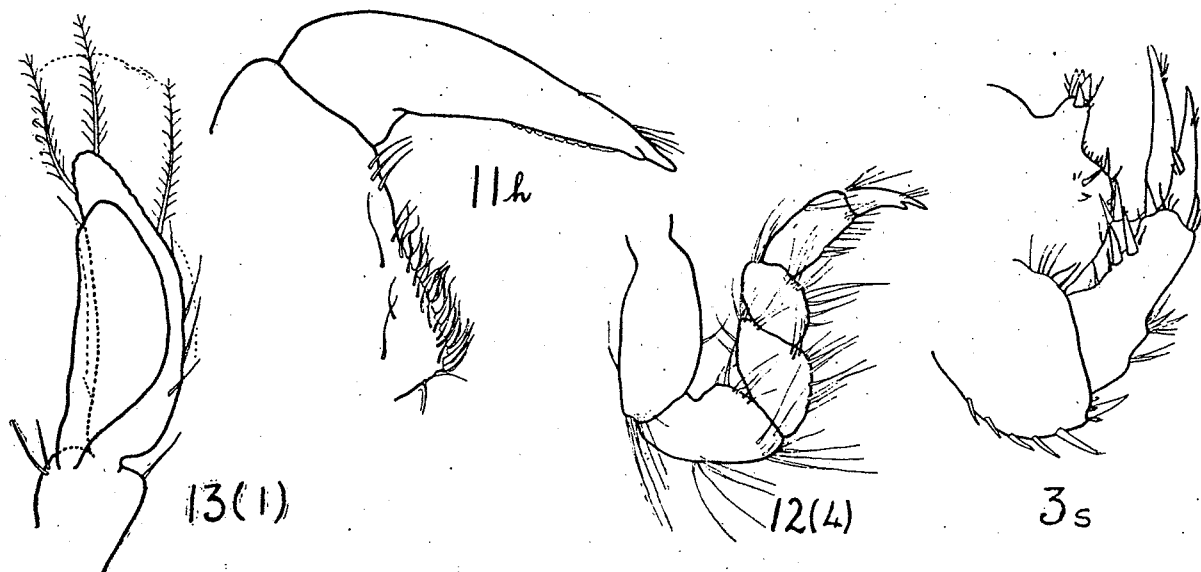


FIG. 70.—*Colubotelson gesmithi*, sp. n.

In the condition of the remaining *peraeopods* there seem to be no discoverable differences from that of the corresponding limbs of *joyneri*, apart from trifling differences in setal armature.

The male appendage is a short, stout tube, not shaped as in *joyneri*, and bears two or three setae sub-apically.

The first *pleopod* (fig. 70, 13(1)) lacks the lateral fringe of setae upon the symphodite, but has, instead, one or a couple of spine-setae distally; the appendage is relatively short, the exopodite only sparsely setose, about a dozen of the more distal setae being plumose; both lamellae are quite narrow at their insertion; the endopodite little shorter than the exopodite. In the second *pleopod* of the male there are sparse setae scattered over the hinder surface of the exopodite; the penial stylet appears much more strongly curved than in *joyneri*, but like that species has three stiff, apical spine-setae.

In the pleon, the pleura of the first to fifth segments are nearly identical in the two species, the setae, perhaps, rather fewer in *gesmithi*, but in the tailpiece there are some differences.

The pleuron of the sixth pleon segment has no more than six spines, of which four (sometimes five) are curved, toothed spines, followed by one (or two) hindmost stout and simple; about the last are grouped four furcate spinules. The apex of the telson is less tip-tilted than in *joyneri*, and is preceded by a wide concavity. The telsonic pleuron projects abruptly and bears two stout spines

dorso-posteriorly, one being sub-marginal; associated with these are two or three spinules, but for the most part the border of the pleuron is unarmed; in one specimen there were several stiff setae on this border.

The vestigial suture between sixth and telsonic pleura is marked in this species by a short rank of four to seven setae.

The *uropod* is short and stout, the depth of the peduncle nearly half its length, its upper, outer border with three or four stout spines; on the inner border two strong spines rise from the apex. Both rami are stout, the outer short, less than two-thirds of the length of the peduncle, with one stout spine at its mid-length; the inner, nearly as long as the peduncle, bears several sensory setae near its end. Beneath the origin of the rami is one stout spine and a second quite slender, both toothed apically.

Size. Largest male barely 11 mm.; female 9 mm.

Colour. Pale greyish-brown.

Occurrence. Taken (January, 1928) from under moss and liverwort in slowly flowing water in ditches crossing the trail up Mt. Field, associated with small examples of *Anaspides*. No specimens were secured in the tarns on the summit.

Colubotelson chiltoni (Sheppard)

(Figs 71 and 80, *g*)

Sheppard, E. M., 1927, p. 105, fig. 7 (*Phreatoicus chiltoni*).

Smith, G. M., 1909, p. 71, pl. XII, fig. 2 (*Phreatoicus australis*).

This species was discovered by G. M. Smith in the Great Lake, Tasmania, and, although assigned by him to *P. australis*, was considered as a distinct variety which, however, he neglected to name. Since it has been described by Miss Sheppard in some detail, in the following account only those features will be noted which appear to be distinctive, or of use in instituting comparison with other species.

The *body* is wrinkled slightly and somewhat irregularly; setae are sparse, except as fringing the margins of the pleon segments and, of course, upon the appendages. The *eyes* are moderately large with as many as forty ommatidia. *Antennule* relatively short with, according to Sheppard, a maximum of seven joints, the penultimate not swollen; actually there are frequently five joints in the flagellum and the proportions of the joints then differ from the description given. The *antenna* is nearly one-third of the length of the body; the last three joints of the peduncle are said to be sub-equal; commonly, however, they show progressive increase in length, the fifth being almost twice as long as the third; the flagellum is twice as long as the peduncle and has from fourteen to eighteen joints.

Mouth parts. The *labrum* is quite markedly asymmetrical; the third joint of the *mandible* palp is described as having a double row of setae, one row of simple setae, the other of setae pectinate along one border; actually, in the specimens examined, three rows could be made out, one of which was of short denticulate spinules; there seem to be several setospines in the mesial fringe of setae upon the *labium*. Upon the inner endite of the *maxillula* there is the usual arrangement of two simple, slender spines and four setospines; apically these latter are swollen and unarmed; upon the outer endite there appear to be twelve stout spines and one setospine; sub-marginally on the posterior face are the two slender, plumose setae found in all species of this genus. The *maxilla* has the usual row of filtratory setae ending distally upon the anterior face of the endite, just lateral

to which is a stout, pectinate spine. Posteriorly to the filtratory setae, the row of biting setae are about fifteen in number, and distally these are paralleled by a thick fringe of fine setae; upon the inner of the two distal endites there is a similar short, bushy row of setae. The *maxilliped* is normal, with about thirteen brush setae upon the mesio-dorsal edge of the endite; the epipodite, more elongate than in *australis*, has a lateral fringe of about eighteen setae continued mesially by a fine fur of setules.

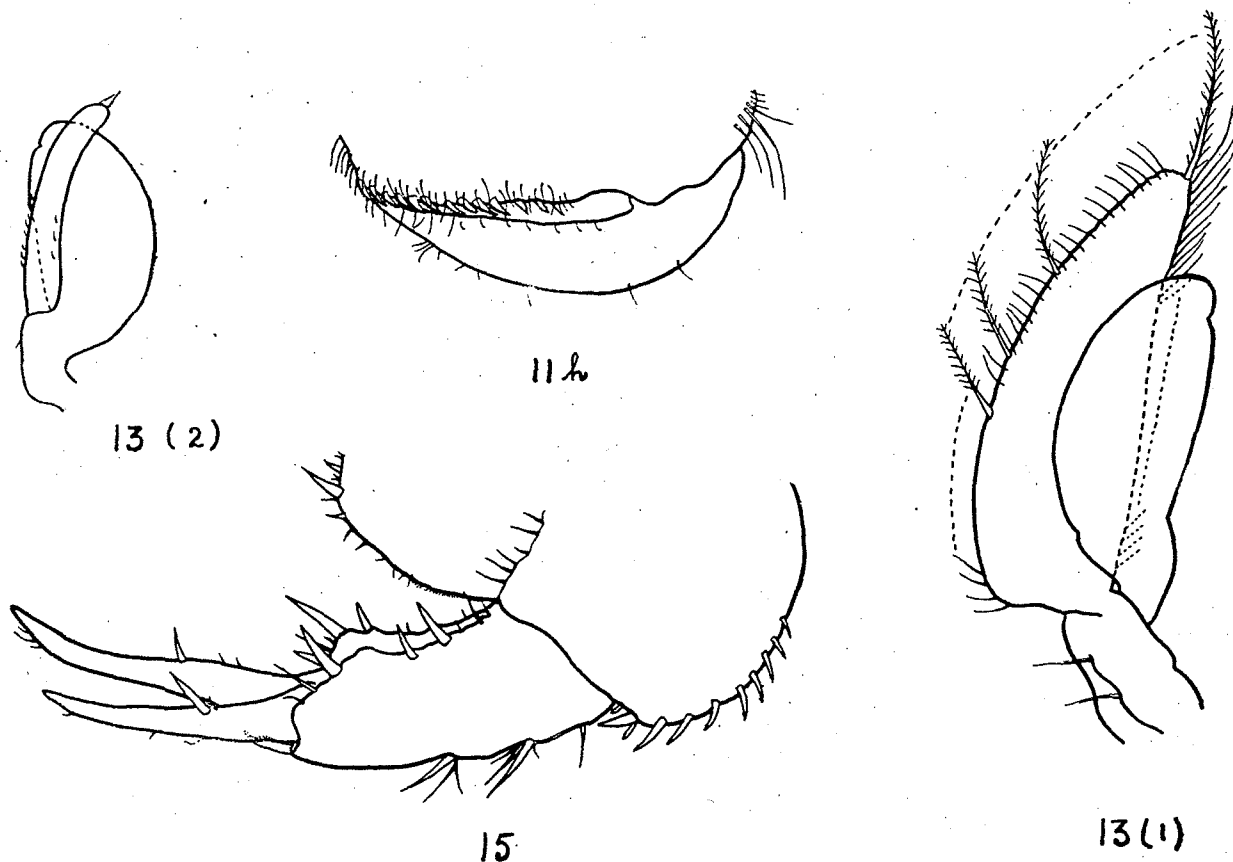


FIG. 71.—*Colubotelson chiltoni* (Sheppard).

Peraeon and peraeopods. The first peraeon segments appear to be more expanded ventrally in the male than in the female. As in *australis*, the postero-ventral corners of the second, third, and fourth peraeon segments are fringed with setae. The *gnathopod* bears upon the palmar border of the propod a row of ten to thirteen short, curved, denticulate spines, these spines extending to the posterior limit of the palm (fig. 71, 11h), whereas in *joyneri* they are fewer and are replaced near that end of the palm by more slender and non-denticulate spines. The propod of this appendage and of the fourth peraeopod of the male appears less massive than those of the corresponding limbs in *joyneri*.

The condition of the seventh peraeopod approaches more nearly to that figured for *australis*, its basis being little expanded and markedly setose. The male appendage is short and apparently unarmed.

The pleura in the *pleon* are fringed with setae, but differ from those of *australis* in their arrangement and abundance. On the first pleon segment there are few (three to four) setae ventrally, and about as few sub-marginally on the

posterior border; rather more plentiful on the second segment, they become abundant on the third, where they appear both marginal and sub-marginal. The fourth shows a loose fringe ventrally, but they are sparse on the posterior border, while on the fifth pleuron they are represented along the hinder margin by short, fine setae, widely spaced. On all but the first there is a complete fringe of setules interspersed with the setae.

The first *pleopod* (fig. 71, 13(1)) differs from that of *australis* in that plumose setae are practically absent from the mesial border of the exopodite, but extend more than half-way along the outer border and are much more numerous (about twenty-five) as compared with ten to twelve in *australis*. The endopodites of both first and second pleopods show a terminal emargination like that figured by Chilton for *australis*. In the male, the penial stylet has a short row of spines upon the lateral edge of the scroll-like structure, and a longer row of shorter setae upon its mesial edge; apically, there are but two terminal spine-setae.

The *tailpiece* is relatively longer than that of *australis* and differs from that of both *australis* and *joyneri* in several details. Its apical process seems to differ from the condition described by Sheppard; it is rather wider than long, armed with four longish spines of equal size and a few slender setae. Beneath the apex the backwardly-projecting telsonic pleura are armed with a single, stout spine, two or three spinules, and a few setae and setules.

The sixth pleon pleura are a little variable in their armature; the general arrangement of the spines and spinules is fairly constant, but the number varies from eleven to eight. The spines are, in one specimen, ten, all toothed; in others there are nine or eight of these, but there are stouter spines, simple in character, varying in number from one to three; these latter, as in *australis*, are flanked by two to four short, digitate spinules. The short ridge marking the line of junction between the sixth pleon segment and the telson resembles that of *joyneri* (as also the spines beneath the insertion of the rami). The *uropod* (fig. 71, 15) is relatively more slender than that of *joyneri*; the armature of the dorsal border of the peduncle is less strong, there being but one long, apical spine; of the rami, the inner is as long as the peduncle. On each ramus there is a stoutish spine at about mid-length, but the associated setae are fewer.

Size. Largest specimen about 14 mm.

Colour. Dark brown with marbling and markings of a lighter brown.

Occurrence. In the Great Lake, Tasmania. Taken by G. Smith (1908/9) and by Tattersall (1914). The species is also plentiful in the Shannon Lagoon, through which passes the overflow from the Great Lake.

Colubotelson chiltoni minor, sub-sp. n.

(Figs 72 and 80, h)

A small form, obviously near to *chiltoni*, from which it differs in the following details:—

The *eye* has fewer ommatidia (about sixteen). The *antennule* examined, is short, reaching only to the end of the fourth joint of the peduncle of the antenna, and is unusual in that the first joint of the peduncle apparently represents first and second united—probably a teratological condition—the flagellum with but four joints, the third quite long. The peduncle of the *antenna* is like that of *chiltoni*, but the flagellum has only twelve or thirteen joints.

The *lower lip* shows a rather long setal fringe. The innermost of the seto-spines upon the inner endite of the *maxillula* is somewhat reduced. The proportions of the epipodite of the *maxilliped* differ and the dorso-lateral setal fringe is reduced to about three setae.

The palm of the *gnathopod* has but seven denticulated spines. On the seventh *peraeopod* setae are almost wanting from the propod. The *pleopods* are in too poor a condition to provide much information, but the penial stylet has two terminal stiff setae as in *chiltoni*.

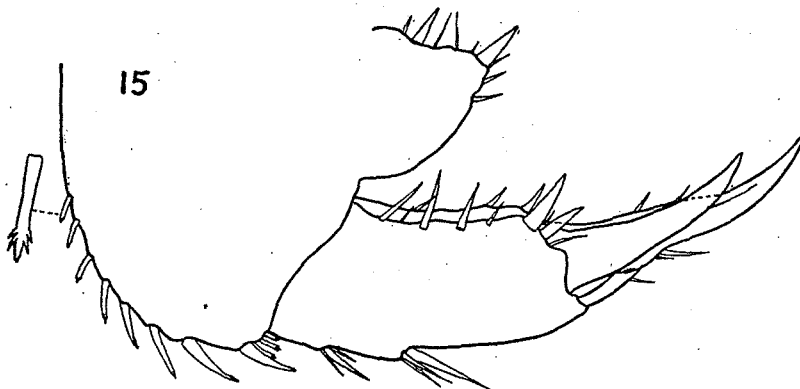


FIG. 72.—*Colubotelson chiltoni minor*, sub-sp. n.

The *tailpiece*, too, is in fairly close agreement with that of *chiltoni*, the telsonic process, wider than long, having four short spines and few (six to eight) setae; below the process, the pleura have each a stout spine dorso-posteriorly and four small flanking spine-setae; the sixth pleon pleura bear eight pectinate spines, the more anterior short and slender, the two hindermost much stouter, and with three small furcate spinules; the junction between sixth pleon and telsonic pleura is marked by a quite short ridge, bearing a single spine. The *uropods* are stout (fig. 72, 15), the inner border of the peduncle little elevated, and with but a single spine of moderate size situate apically; the outer edge with several spines, one, particularly stout, distally; both rami are stout; of the spines beneath their insertion, one is stout and toothed, the other slender and simple.

Size. Male 10.5 mm. Female (spent) 10 mm.

Colour. Resembling *chiltoni*.

Occurrence. Only a few specimens were seen, these being collected by Miss N. Hutchinson, in February, 1928, from Pine Lake, a small sheet of water on the Plateau, north of the Great Lake. Possibly this should be ranked as a distinct species, but the material was too limited to permit of a satisfactory study.

Colubotelson chiltoni saycei, sub-sp. n.

(Figs 73 and 73A)

This form, taken on the Tasmanian Plateau, seems to be intermediate between *chiltoni* and the North Coast species, *fontinalis*. Unlike the latter, however, it does not show any tendency to degeneration of the eyes. Some half dozen specimens were collected, according to Sayce, by Prof. Baldwin Spencer (probably in 1900) from the waters of a small lake (Petrarch) at an altitude of 2900 ft.

By the kindness of Mr. Kershaw (then Director of the National Museum, Melbourne) the writer was provided with a copy of several pages of typescript, which formed part of the Sayce collection; from this it appears that Sayce had referred these to a new species under the name *Phreatoicus spenceri*, but this description was never published. However, in a note 'On the Crustacean, *Phreatoicus australis*, from Tasmania' ⁽¹⁾ Sayce wrote 'Of those received from Professor Spencer, from Lake Petrarch, ⁽²⁾ . . . At first I was inclined to regard them as a new species, principally in consequence of the shape of the hand and the armature of the terminal segment, but after examining some specimens of *Phreatoicus australis* from Mt. Kosciusko, sent through the kindness of the Trustees of the Australian Museum, I regard the differences from that species as slight and varietal.'

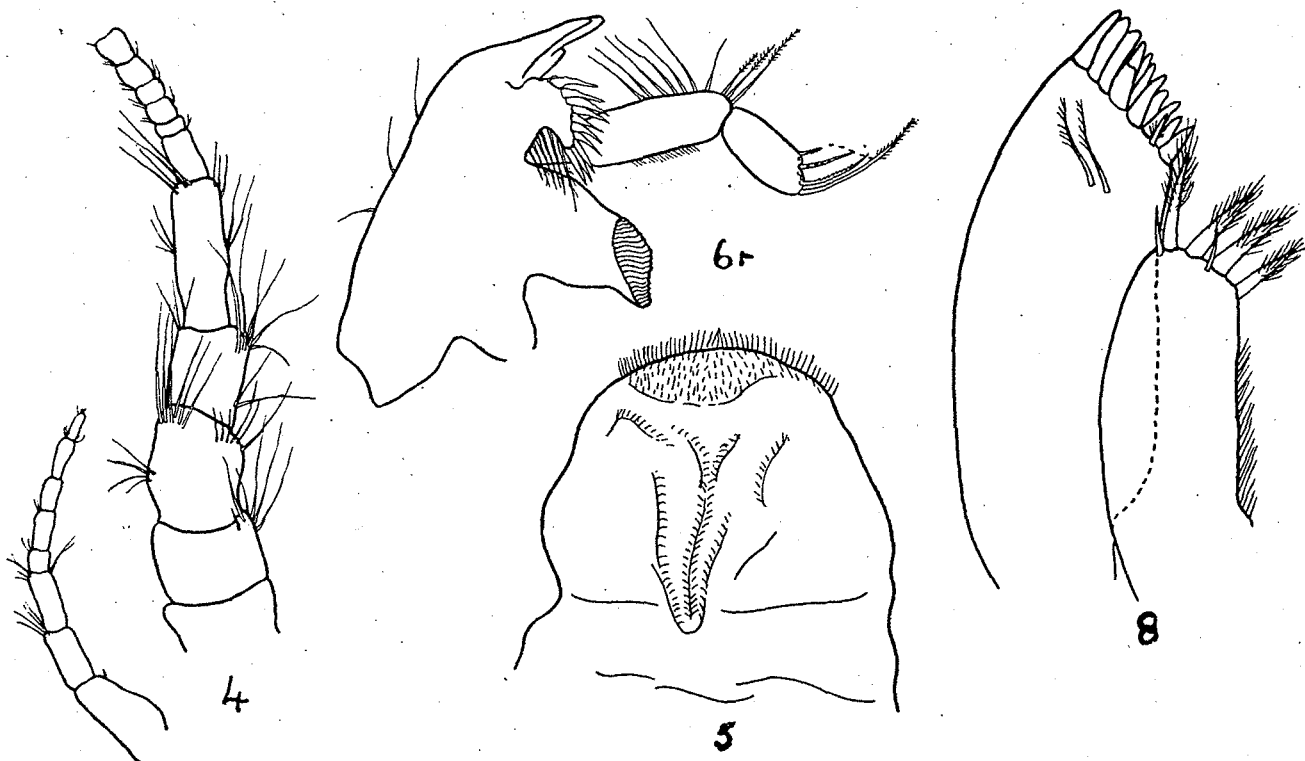


FIG. 73.—*Colubotelson chiltoni saycei*, sub-sp. n.

Sayce's original description was as follows:—'Body stout, sparsely setose. Eyes somewhat large, round. Pleura of first segment of pleon produced to slightly below the coxae of last peraeopod, succeeding four segments with pleura deeply produced, their inferior margins evenly rounded, and fringed with long flexuose setae which extend somewhat along the posterior margins. Terminal segment deeply convex above, and covered with a fur of short setae, the inferior margin possessing nine pectinated spinules that increase in length posteriorly, these, with the exception of the last two, are strongly pectinated at their tips, also at the extreme distal angle there is a bunch of three small pectinated spinules. Projection at extremity of telson prominent, its distal upper margin spinulose.

(¹) *Victorian Naturalist*, Vol. 17, No. 6, Oct., 1900, pp. 108-111.

(²) Sayce has misspelt this name in his paper. It should be Petrarch—Ed.

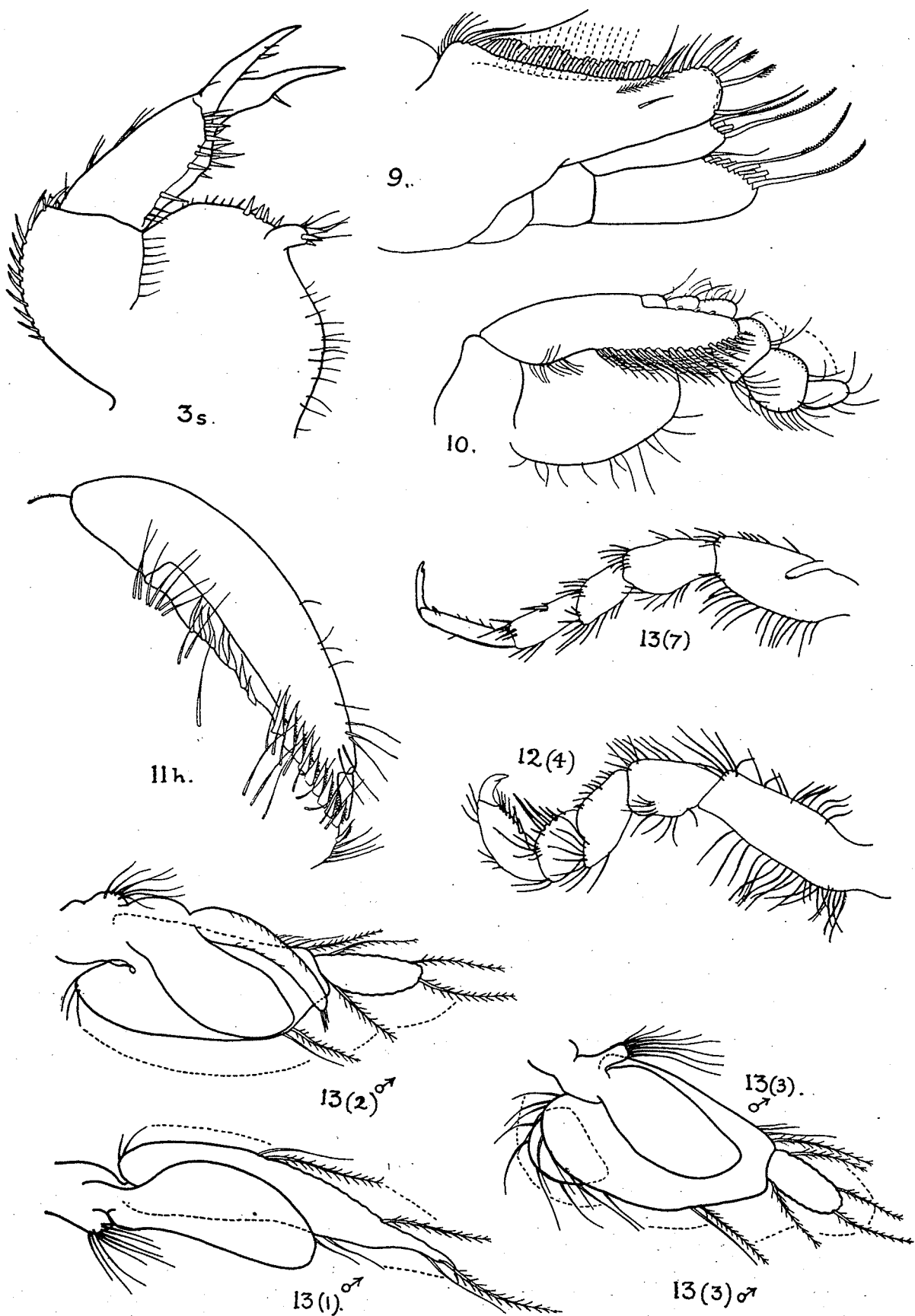


FIG. 73A.—*Colubotelson chiltoni saycei*, sub-sp. n.

'Upper antennae scarcely reaching to extremity of peduncle of lower. Lower antennae less than one-third the length of the body, peduncle scarcely so long as the lower margin of the cephalon, flagellum of about fourteen articuli. First peraeopod with palm oblique, very slightly convex, posterior distal angle slightly rounded off, with thirteen more or less pectinated spine-teeth along the margin, and also a parallel row of simple setae which extend a short distance beyond the palm. Dactyli of all peraeopods furnished on the inner margin with a small secondary unguis. Infero-distal angle of peduncle of uropods with one large broad apically pectinated spine, and two smaller lateral ones.

'*Colour.* Pale yellow with dendroid markings of chocolate brown on body and appendages.

'*Size.* 14 mm. in length.

'*Habitat.* Lake Petrarch (Fresh-water) Tasmania. Elevation 2900 ft.'

In his notes in the *Victorian Naturalist*, Sayce remarks: 'The following differences may be mentioned as observed in the Lake Petrarch specimens compared with those from Mt. Kosciusko:—Firstly, the gnathopods of the male have the palm oblique, almost straight, with a notch near the articulation of the dactylus, and the margin is defined by a fringe of 13 triangular spines, that commence just beyond the notch and extend to the postero-distal angle; these spines are strongly denticulated on the edge that faces posteriorly, and the denticulations become more numerous, and also the spines longer and more acuminate, toward the posterior angle. Parallel with this row is a row of simple setae that extend for a short distance beyond the angle along the posterior border. In the Mt. Kosciusko specimens the palm is strongly convex, and, in addition to the row of simple setae, instead of 13 denticulated teeth there are only nine and these are of similar form, but not toothed. This character was constant in each of the specimens examined. Secondly, the terminal segment had the inferior margin fringed with nine spinules (not 15 or 16 as mentioned by Chilton), which gradually increase in length hindwards, and all are more or less pectinated at the tips, with the exception of the last one, which is simple; also, in addition to these, there is distally a sub-marginal cluster of three little pectinated spinules. The uropoda are similar to Chilton's drawing, with the addition of having a very conspicuous long spine at about half-way along the upper margin of each ramus. In other respects of form they essentially agree.'

Actually, there are a number of other differences which serve to distinguish it from the Tasmanian Great Lake species, *chiltoni*, as well as from *australis*. If, however, as is probable, Sayce's description was accurate for the specimens dissected by him, the form must be somewhat variable.

Thus, in the gnathopod, there were found in the specimens examined only ten denticulated spines followed, in the anterior part of the palm, by seven more reduced spine-teeth, lacking denticulation (fig. 73A, 11h). Sayce's reference to the condition in *australis* is, however, in error, for the teeth upon the palm on that species, though fewer (eight to nine), are all very strongly denticulated. Again, the pleura of the sixth pleon segment may bear as many as thirteen curved spines, terminally toothed, instead of nine, as stated by Sayce.

These and other details are shown in the several figures. In the telsonic apex this sub-species agrees with other *Colubotelson* forms and differs from those of *Metaphreatoicus* in that only four terminal spines are present.

Colubotelson fontinalis, sp. n.(Figs 74 and 80, *i*)

This Phreatoicid, which is found abundantly on the central part of the North Coast of Tasmania, at levels little above that of the sea, is superficially so like *chiltoni* that it was originally considered a sub-species only. A closer examination, however, has revealed a number of differences.

Many examples are practically eyeless, the eye being small in some, while in others it appears, in life, as a chalky white area, a condition which is associated in many Crustacea with the obsolescence of this organ.

The antennule normally has only five joints in the flagellum; the antenna resembles that of *chiltoni* in peduncle and in the elongation of the more distal joints of the flagellum, but the proximal joint is quite short; there may be as many as twenty-five joints in the flagellum. Asymmetry in the labrum is well marked.

The mandibular palp is relatively long; the setae in the distal half of the third joint are set in three rows; those in one row are denticulate; in the others they are finely pectinate on one side. Proximal to the spine row are four plumed setae; the molar on the right mandible is elongate (fig. 74, *br*).

Sheppard's figure (1927, fig. 3 (6)) of the labium of *tasmaniae* would serve equally for this species.

The maxillula (fig. 74, 8) is a little unusual in that the inner endite widens at about the middle of its length, its mesial border there being convex, and then contracts, becoming concave distally. The outer endite has about ten apical spines, the accompanying setospine being very small; the two plumed setae on its posterior face lie near the mesial border; in some species (e.g., *affinis*) they are much more laterally placed.

The maxilla shows the middle endite as the shortest. In the maxilliped the propod appears much more expanded than is figured by Sheppard (1927, fig. 7 (5)) for *chiltoni*, and the epipodite has a more extensive fringe of setae.

Sheppard's figure (1927, fig. 7 (6)) for the gnathopod of *chiltoni* omits details of the hand, but a comparison of the actual appendages of the two forms show differences in the shape of the propod and in the armature of the palm. In the specimen figured (fig. 74, *11h*) it was found that in *fontinalis* the propod is more sub-triangular in shape, the maximum length and width sub-equal, the palm convex (it is straight in *chiltoni*) and sharply marked off from the posterior border, which is short; the denticulate teeth become simple, conical spines as the dactyl is neared, and they extend (unlike the condition in *chiltoni*) almost to the base of the dactyl.

The fourth peraeopod in the male bears a propod almost unmodified in shape, showing no recognizable palm, but an exceptionally stout spine evidently receives the strongly curved dactyl (fig. 74, *12(4)*).

The pleon pleura generally are fringed with shorter and far fewer marginal setae than are found in *chiltoni*; except in the case of the fifth in which the posterior border has this fringe better developed.

The first pleopod bears on the outer border of the exopodite a sparse fringe of simple setae as well as the normal rank of plumose and pectinate setae; it differs from other species, however, in that it bears one stiff spine near its outer distal end, recalling, in this, a condition found in *tasmaniae*. The penial stylet differs, too, from that of *chiltoni* in bearing three stiff, terminal spine-setae.

In the tailpiece several differences are to be noted: the free border of the sixth pleuron bears the same number of spines as in *chiltoni*, but the two hindmost are usually stouter and shorter and generally free from terminal teeth; there is a rounded junction of the pleuron with the telson beneath the apex instead of the usual angular one; the normal sub-marginal spine is closely approximated to the marginal, and both are stouter than in *chiltoni*. The uropod is unusual in that its outer ramus retains two spines well separated (fig. 74, 15), a feature which characterizes some species of *Mesacanthotelson*, and is seen also in *Crenoicus*.

Size. 12.5 mm.

Colour. In life rather paler brown than *chiltoni*.

Occurrence. First taken (1928) in ditches in a field adjoining the railway station at Lemana Junction. Subsequently (1929) found in various nearby localities, including springs in the hillside and, also, abundantly in almost every ditch for some miles around Deloraine.

The occurrence of this Isopod on the North Coast of Tasmania is of considerable interest. G. Smith stated (1909) that Phreatoicids were apparently entirely absent from the North and West coastal regions of the island. It would seem likely that a generalized *Paraphreatoicus* was once widespread on the island, south of and including the Plateau; that in the Great Lake and adjacent lakelets it underwent some modification, giving rise to *intermedius*, *chiltoni*, etc., and that some of these, reaching the North Coast by way of the Mole, gave rise to the present species. The occurrence of many blind or purblind examples seems to lend support to this view.

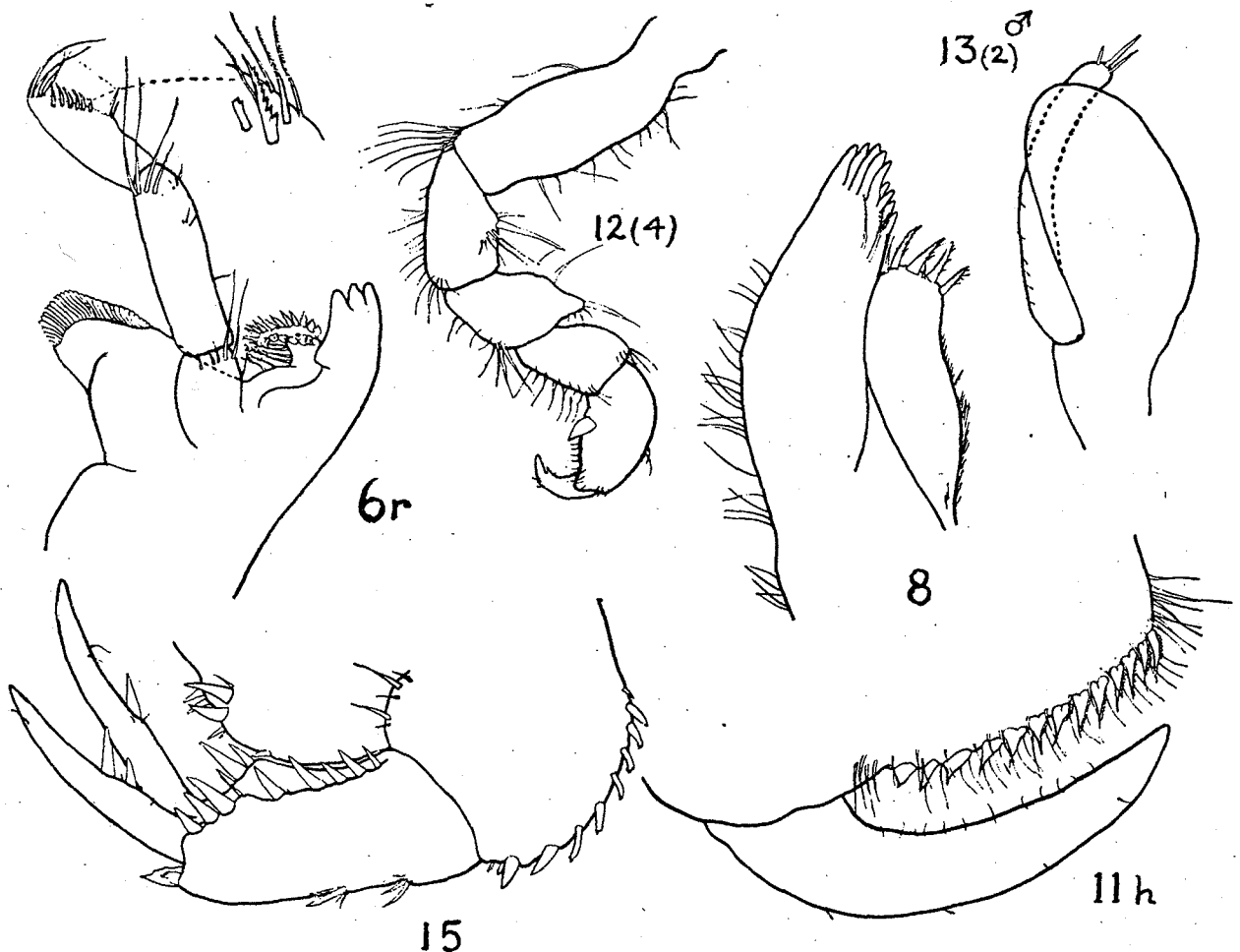


FIG. 74.—*Colubotelson fontinalis*, sp. n.

Colubotelson tattersalli (Sheppard)

Sheppard, 1927, p. 102, text-fig. 6 (*Phreatoicus tattersalli*).

From the outset, all attempts to recognize this species proved unsuccessful, and although, eventually, several thousands of Great Lake specimens were examined, not one was found which has conformed to the description given, nor which could, with reasonable certainty, be referred to it.

From correspondence between the author and Miss Sheppard shortly after the appearance of her paper, it would appear that there must have been very few of this species represented in the collection made in 1914 and upon which the description was based. It seemed possible that it was never an abundant form and that the changes brought about in the Great Lake consequent upon the damming effected by the Hydro-Electric Commission had resulted in the practical extinction of the species. It was not recorded by Geoffrey Smith in the summer of 1907/8, nor was it found by the writer in the considerable collection made by Professor Flynn in 1917 when the construction of the dam had been but recently completed.⁽¹⁾

The task of identification was rendered more difficult by the incompleteness as well as a certain vagueness of the description. Precise statements were largely limited to such details as the numbers of joints in appendages (e.g., antenna) which, as already repeatedly noted, are commonly liable to a wide range of variation, or the proportions of the joints of the peduncle which are frequently not distinctive. Moreover, the apparently characteristic feature in the second antenna, viz., the sub-equality of a long first joint of the flagellum with its penultimate joint is one which, frequently, cannot be made use of, for not only are the terminal joints commonly lost in preserved specimens, but the first joint may subsequently undergo further segmentation. Information on diagnostic features, such as the condition of the mouth parts, peraeopods, and pleopods is, in the main, limited to statements that they bear a resemblance to those of *tasmaniae* or are similar to those of *P. australis*—general statements which could be made for many Phreatoicids and which are of even less use when some of these parts (e.g., maxillipeds) have not been fully or correctly described. Finally, a description of the pleopods and uropod has been completely omitted, the figures providing little useful information.

Thus from Sheppard's description there proved to be available for identification only the following details:—*Body* slightly sculptured or ridged; the surface covered with tufts of short hairs and scattered setae.

Head sub-equal in length to the combined length of the first and second peraeon segments; eyes lateral, with thirty to forty facets. The first *peraeon* segment half the length of the second, which is sub-equal to the third and fourth; fifth, sixth, and seventh might be presumed sub-equal, being described as slightly shorter than the fourth. The first pleon segment is but half as long as the seventh peraeon segment; second, third, and fourth segments show a slight progressive increase in length, while the fifth is twice as long as the fourth. The pleura of the second, third, and fourth pleon segments have a depth greater than that of their segments.

The *tailpiece* (sixth pleon segment and telson) is slightly convex above; the terminal projection, a little longer than broad, is tipped with two spines placed laterally, and eight longer setae; the telsonic pleuron is rounded and bears eight

(¹) The outflow of water from the Great Lake passes through a grid which prevents the escape of fish. Periodically this is raised for cleaning, and Flynn's collection was made by scraping its surface. It should, therefore, have been a fair sample of the free-living Phreatoicid fauna.

see p. 140, Nicholls
 examined types of
 C. tattersalli in BMNH.

spines, of which the fourth is larger than the others; the pleuron of the sixth pleon segment bears a large spine distally and, preceding this, five *longer* spines, each of which bears two minute, sub-terminal teeth.

Appendages. *Antennule* with flagellum of five joints, nearly as long as the peduncle of the *antenna*. This latter has first to third joints short, the third being produced slightly on the inner side, the fourth equalling the combined length of the second and third, the fifth once and a half as long as the fourth; its flagellum has sixteen joints, of which the first is long, being half the length of the fifth (i.e., the longest) joint of the peduncle, the second shorter (only one-third of the length of the first), subsequent flagellar joints increasingly long till the penultimate joint is practically as long as the first; the appendage is nearly one-half of the length of the body.

In the *mandible*, the third joint of the palp is said to bear a double rank of setae, the first rank made up of simple setae, the second of setae pectinate along one border, a condition recalling that of *M. decipiens*, where, however, the second row consists of short, toothed spinules.

The outer endite of the *maxillula* has only nine spiniform setae, some minutely denticulate, while the distal part of the fringe of setae on both inner and outer margins is noted as long. The occurrence of two sub-apical plumose setae is recorded; this is, however, not a feature peculiar to this species but one found in very many Phreatoicids.

In the *maxilla*, the proportion of the lobes is not unusual, but the exceptionally thick teeth on the pectinate setae of the outer lobes may have value as a distinctive character.

There are no details of gnathopods or of sex differences, except for a passing reference to modification of the fourth peraeopod in the male.

Some other details might, perhaps, be gleaned from the figures. Thus the *habitus* figure shows the peraeon segments deeper than long, which is an important feature, and characteristic of *Mesacanthotelson*; the figure is very small and perhaps it should not be relied upon for detail, for it shows the seventh segment not only longer than the sixth, but actually as long as the third segment, which not only seems quite improbable but is, indeed, contradicted by the text.

The same figure suggests, too, that the transverse ridges are really very slight indeed, and setae appear to be practically wanting, a suggestion which is borne out by the more highly magnified figure of the tailpiece; but in the text there are said to be scattered setae, which are most abundant on the dorsal surface of the telson. The *habitus* figure shows the telsonic projection sharply upturned, and this would be a highly distinctive feature. It is, however, in sharp conflict with the enlarged figure of the tailpiece, which indicates the projection more backwardly directed, rather as in *Colacanthotelson*.

Another important feature, and one which should perhaps be sufficient to exclude *tattersalli* from that genus, is the marked degree of expansion of the basis of the seventh peraeopod. This joint appears narrow in the *habitus* figure, but in the enlargement drawn by Miss Sheppard (1927, fig. 6 (4)) from the appendage removed, its real width is shown as almost exactly one-half of its length, and those are the proportions shown by Chilton for *australis*, to which species Sheppard likens *tattersalli*.

As regards the sculpturing and, more particularly, the transverse ridging of the segments, the description of this species suggests a kinship with *tasmaniae*, *setosus*, and *decipiens*, from all of which, however, it should be readily distinguished

by the condition of the tailpiece and especially of the terminal projection, which is said to have but a single pair of latero-terminal spines. As already stated, these details are not confirmed by the figures.

An armature of spines, such as that recorded for the terminal projection of *tattersalli*, has been found elsewhere only in *pearsoni*; but that species differs in its smooth body, in other details of the tailpiece and in the proportions of the joints of the antenna, palp of mandible, etc.; notably, too, *pearsoni* differs from all other recorded Great Lake species in the condition of its uropod with its huge dorso-mesial projection, and while it is most unfortunate that a description of this appendage was omitted from the description of *tattersalli*, it is, nevertheless, scarcely credible that Miss Sheppard would have overlooked such a significant character had it been present; her figure (1927, text fig. 6 (11)) shows no suggestion of such a structure. Moreover, as already pointed out, such a condition of the uropods seems to be invariably associated with a burrowing mode of life, and *tattersalli* is said to be a shore-haunting form living under stones. The small size recorded for *tattersalli* suggests that Tattersall's specimens may have been immature. Of *pearsoni*, my smallest examples are about 11 mm. in length, but apart from increase in size and developments related to sex, there is found neither significant change that could be attributed to growth, nor distinctive characters absent in the half-grown. The possibility, therefore, that *tattersalli* could be the immature condition of *pearsoni*, may be entirely dismissed.

In the collection made by Dr. J. W. Evans and deposited in the Tasmanian Museum there were a few specimens which Dr. J. Pearson provisionally had attributed to *tattersalli* and, if one could substitute the word 'spines' for 'setae', could regard the ridges referred to as much more strongly developed than is indicated in the *habitus* figure (1927, fig. 6 (i)) and, further, could suppose that, in the specimens originally examined, two of the telsonic spines were either incompletely developed or had been lost—then these specimens come nearest to fitting into Sheppard's description. As it is, they more nearly resemble *tasmaniae*, and they differ, further, from *tattersalli* in other details of antenna, mouth parts, the slenderness of the basis of the hinder peraeopods, and the length of the telsonic process. They have been described in this account under the name of *M. fallax*.

Size. 10 mm.; pleon long, equalling combined length of head and peraeon.

Colour. Dark brown in spirit material.

Occurrence. Todd's Corner, Great Lake (under stones along the shore).

Colubotelson tattersalli dubius, sub-sp. n.

(Fig. 74A)

The specimens recorded under this name were collected by the writer from beneath stones in the bed of an almost dried-out creek draining into the Great Lake at Todd's Corner, the type locality for Miss Sheppard's species *tattersalli*. In some particulars these seem to agree well with that author's account of *tattersalli*, but in others they depart quite markedly from that description and, in these latter characters, they approach the condition found in the Great Lake species *chiltoni* and *intermedius*.

It may prove that certain features recorded by Miss Sheppard for *tattersalli*, particularly those which seem to distinguish it from the variety under consideration,

are not constant. In that event the new varietal name will be redundant and the details furnished here will then serve to supplement the rather nebulous original description of the species.⁽¹⁾

The length of the body is approximately six times the width, the pleon being about as long as the combined length of the second to seventh peraeon segments. It is practically devoid of ridges but is setose, the setae being generally slender and rather long; they form a fringe, sub-marginal in position, on all the segments, but since they are stiffly upstanding they are liable to be overlooked. In the peraeon segments there is an anterior as well as a posterior fringe, the two being linked by a ventro-lateral series. Upon the fifth pleon segment there is, at its mid-length, an additional transverse row, while upon the tailpiece there may be two short ranks of setae limited to the lateral surfaces; in profile this region appears to have a sparse covering of setae. The pleura in the pleon have a close-set free marginal edging of quite long setae; shorter setae, in an interrupted rank, stretch along the antero-posterior axis of the coxae of the peraeopods, this series being continued forward as a short ventro-lateral rank on the head.

The head, which is about as long as the combined length of first and second peraeon segments, has a moderately convex dorsal profile, of which the fairly prominent eyes do not form part; a small pre-ocular lobe projects in front of the eye, bounded below by a fairly long sub-ocular incisure which practically reaches the lower border of the eye; behind the latter is a well-marked depression, from which arises a short genal groove. The anterior (transverse) border of the head is moderately shallow, the inter-ocular space being about twice the longest diameter of the eye, which has probably rather fewer than forty ommatidia. The cervical groove is well marked; it is incomplete dorsally, while its ventral end is obscured by the forwardly projecting coxa of the gnathopod.

The first peraeon segment is scarcely half the length of the second; the second and third are sub-equal, the fourth a trifle shorter, while the fifth, sixth, and seventh show a progressive decrease in length. From the first to the sixth there is a steady increase in depth, but the seventh deepens abruptly.

The first pleon segment has a length about two-thirds that of the last peraeon segment; the second, third, and fourth are progressively longer, the fifth being rather less than the combined length of the third and fourth and rather less deep than those segments. A slight excavation, distinctively coloured, marks the junction posteriorly of the pleura and terga of the first four of these segments; in the case of the fifth there is a quite deep notch; the pleura of the second to the fifth are wider and nearly twice as deep as the related terga.

In profile, the tailpiece is scarcely convex dorsally, but sub-terminally it is sharply downturned (almost incurved) and is then produced abruptly into the upturned telsonic apex. In its inclination to the long axis of the body this process agrees much more nearly with the condition shown in the *habitus* figure given by Miss Sheppard (1927, fig. 6 (i)) than with the enlargement (i.e., fig. 6 (11)) of the tailpiece. The actual apical projection examined from below is found to present a convex postero-ventral surface which is as wide as long. Its terminal free border is almost semi-circular and bears four stout spines about equally spaced,

⁽¹⁾ But in the comparative fewness of the spine-setae constituting the armature of the free (ventral) border of the sixth pleon segment of *tattersalli* there is a condition which, while it is met with in no other species of this genus, is characteristic of *Mesacanthotelson* and *Colacanthotelson*; and in the two-spined condition of the telsonic apex, a feature peculiar, amongst Phreatoicidae, to *tattersalli*. It may be, therefore, that the writer is wholly in error in associating this variety with Miss Sheppard's species.

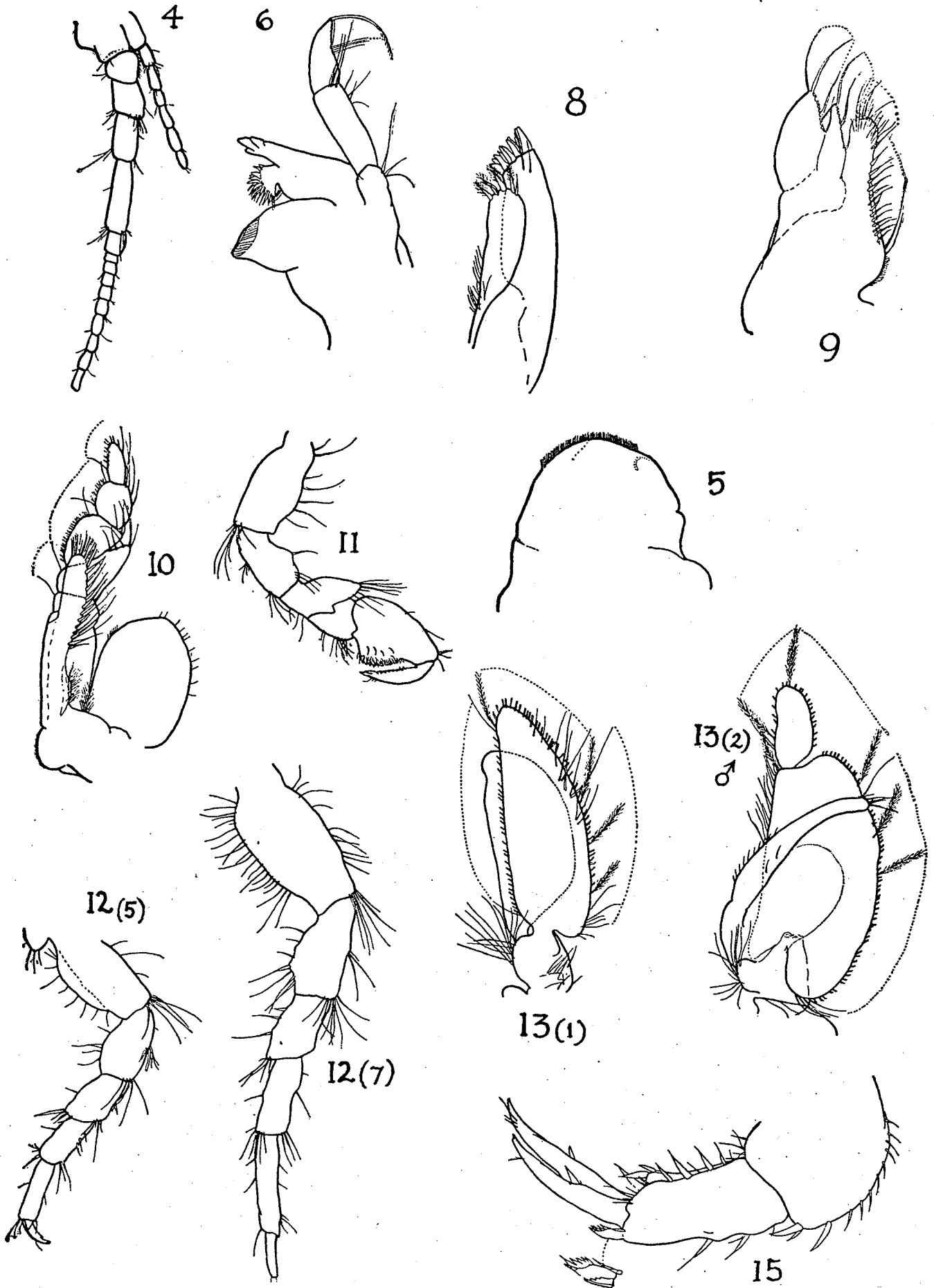


FIG. 74A.—*Calubotelson tattersalli dubius*. sub-sp. n.

interspersed with some stiff setae. In this particular, therefore, these specimens differ markedly from those described by Miss Sheppard, and approach much more nearly to the condition seen in *intermedius*.

The crevice separating the anterior mass of the tailpiece from this apical process appears almost U-shaped, but widens above. On either side it is continued downwards as a shallow groove marking the junction of telsonic pleura with the axial region. These pleura have a distinctly convex posterior border bearing a stout spine at about one-third of its length from its dorsal end; this spine and another which rises sub-marginally both spring from a longitudinal ridge which crosses the shallow lateral extension of the crevice. Dorsal to the stout spine there are usually three slighter spines upon the pleural border, ventrally there are five or six short, stiff setae.

The suture between sixth pleon segment and telson runs antero-dorsally from the hinder border and bears a short, broken, comb-like row of from five to seven stiff but slender setae. The dorsal limit of the insertion of the uropod lies a little ventral to this suture. The armature on the ventral border of the sixth pleon pleuron is slightly variable. It may bear ten to twelve stiff, curved spines, of which the hindmost is the strongest, but is shorter than the three immediately preceding it, in this agreeing with the condition described for *tattersalli*, in which, however, not more than six of such spines are present.

Appendages. The *antennule* is short, extending little beyond the fourth joint of the peduncle of the antenna; its flagellum may have four or five joints. Where but four are found the first and last are short, the second and third as long as the third peduncle joint. The *antenna*, too, is moderately short; the first three joints of the peduncle are sub-equal, the fourth a little longer than the third, the fifth practically equal to the combined length of third and fourth; the flagellum has twenty or more joints, but the first is short, little more than a quarter of the length of the fifth joint of the peduncle, and the succeeding articles are squarish, beginning to lengthen at about the tenth, the terminal joints elongated.

The *labrum* is strongly asymmetrical. The right mandible bears the usual four cutting teeth; the spine row shows a stout, short, double spine at its distal end; the strong molar seems to lack the bushy setae found in *intermedius*; the palp is short, the first joint with a small tuft of setae, the second rather long with a few setae distally, the terminal joint two-thirds the length of the second, with setae in a single row confined to its distal half, and with a terminal seta of unusual length.

The *maxillula* displays the normal condition for species of this genus; the inner endite bears but four apical setospines with short, stiff, simple spines against the first and third; the outer endite has a double row of conical spines, twelve in number, set in a double row; the setospine usually associated with these is unusually large. In the *maxilla* the row of pectinate setae (backing the row of filter setae) is well developed, consisting of thirteen or fourteen setae; a single spine with few pectinations is present on the hinder face of the endite; the apex of this inner endite is rounded and its posterior face is setose sub-terminally; the middle lobe is narrow, the outermost broad; both are armed with an oblique rank of biting setae; setae are apparently absent from the outer border of the appendage, but are plentifully developed just within the margin along the entire hinder surface of the third joint.

On the *maxilliped* the epipodite has but few (nine to ten) setae on its latero-distal border. The *gnathopod* of the male has the basis expanded anteriorly, the width of this joint being more than half its length, its anterior border armed with

a half-dozen long, slender setae; the sub-triangular propod with sinuous palm has ten to a dozen slender, denticulate spine-teeth in a close-set series, while the stout dactyl has a nearly straight, distinctly toothed, palmar edge, its claw supported by a strong secondary unguis. It is quite distinct from that of *intermedius*.

In the posterior group of *peraeopods* the basis is produced into a thin expansion, rising from its posterior border, the width of the joint being rather more than half its length; both borders are set with long, slender setae.

In the first *pleopod* the exopodite is strongly setose, the inner border being fringed with long setae, those situated sub-apically being plumed, and plumose setae extend along most of the outer margin, interspersing the numerous simple setae, a few of which arise sub-marginally; the endopodite is well developed, four-fifths as long as the outer lamella, in this differing markedly from *intermedius*.

In the male the second pleopod bears a rather long penial stylet, narrowing somewhat apically and armed terminally with four stout spines; its mesial border has a short series of curved setae; the sympodite has a well-developed coupling lobe with a strong tuft of entangling setae.

The *uropod* is stout, not greatly produced into a vertical mesial border which is armed apically by one stout and one smallish spine. The outer border is nearly parallel with five or six stout spines; beneath the insertion of the rami is one strong denticulate spine and a second rather small but otherwise similiar; the ventral edge of the peduncle bears two groups of spines and setae. The inner ramus is sub-equal in length to the peduncle; the outer shorter by one-fifth of its length; both bear a single spine at approximately mid-length.

Size. The largest specimen (δ) had a length of nearly 14 mm.

Colour. Very dark brown, appearing, when collected, almost black; the bases of *peraeopods* heavily pigmented.

Occurrence. Found only under stones in a creek draining into the Great Lake at Todd's Corner.

It should perhaps be noted that when Tattersall's collection was made, the Great Lake had not been dammed. According to recent information, very much of the large bay now known as Todd's Corner was, in 1914, swampy land traversed by the abovementioned creek. The original shoreline was, thus, some distance from that existing to-day. The only part of the habitat of this species which was unaffected by the changes resulting from the damming of the Great Lake would be the persistent part of this creek, in which the variety *dubius* was secured. The present shoreline is practically free from stones, etc., and no Phreatoicids were taken in such situations along the water's edge; dredging, too, in shallow waters gave no material, excepting that of an Amphipod, yellowish green in colour, apparently not hitherto observed.

Colubotelson intermedius, sp. n.

(Figs 75 and 80, *k*)

In 1923 the writer received a collection of Phreatoicid material from the Great Lake. This collection, which was secured by Professor Flynn in 1917, contained some examples of an unrecorded form which was provisionally labelled *intermedius*. In 1927, after the publication of Miss Sheppard's 'revision', this material was re-examined and the form *intermedius* was doubtfully identified as Miss Sheppard's species *tattersalli*. In later collections made by the writer (in

1928 and again in 1929) along the shore of the Great Lake and also in the Shannon Lagoon, this new form was found relatively abundant. A visit to London in 1929 permitted of a comparison of this with the types of *tattersalli* in the British Museum collection. The examination was necessarily superficial, since it did not include a dissection of *tattersalli*, but it seemed to establish the distinctness of the new form. In further material collected by Miss Spargo from the Great Lake between 1932 and 1934, and still later, in material from the Great Lake brought together by the Biological Survey in 1939, this new form had become preponderant.

The following is a description of the new species—*Body* smooth, or with very slight sculpturing, fine setae scattered generally over the body. The eyes are as large as, or even larger than, those of *chiltoni* (about fifty ommatidia). The proportions of the several peraeon segments are a little variable, but, in general, they conform to Miss Sheppard's account of those of *chiltoni*. As already noted, the seventh peraeon segment is shorter than the sixth or fifth and not sub-equal or longer as figured for *tattersalli*. It is, however, in the tailpiece that an intermediate condition of the characters of *chiltoni* and *tattersalli* is apparent. Setae are scattered generally but not in tufts. The telsonic process is rather longer than that of *chiltoni* and tends to project rather more backwardly as figured for *tattersalli* (1927, fig. 6 (11)), but is wider at the base than it is long. Its apex

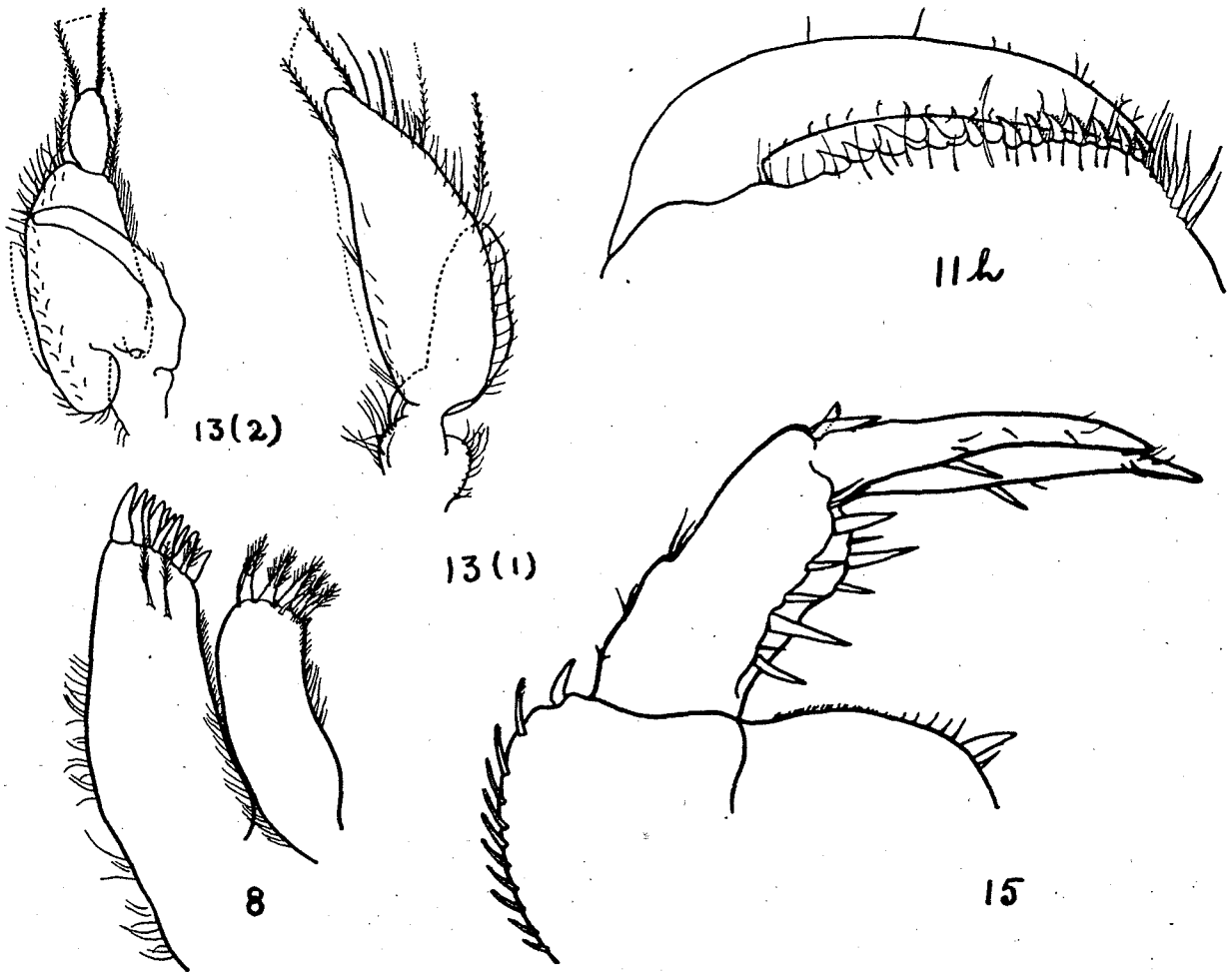


FIG. 75.—*Colubotelson intermedius*, sp. n.

is distinctly convex and furnished normally with four quite long, stout spines and a few setae of variable length. Rarely three spines are found, but never two, the number recorded by Miss Sheppard for *tattersalli*. Beneath the process, the telsonic pleura project evenly rounded (instead of an angular outgrowth following an intervening gap as in *chiltoni* (l.c., fig. 7 (8))). Its armature is a fairly even fringe of seven or eight spines or stout setae with interspersed fine setae. Of this series usually one, the fourth (rarely fifth or sixth), is stouter than the rest and, at the same level, is a stout sub-marginal spine. The arrangement of the antero-ventral fringe of spines comes near to that of *chiltoni* but is variable, frequently differing on opposite sides of the same specimen. There are, as a rule, eleven of these curved, toothed spines, increasing progressively in length and stoutness from before backwards. The last member of the series is frequently markedly stouter than the rest and may be simple.

Appendages. The *antennule*, like that of *chiltoni*, has peduncle and flagellum sub-equal; it is eight-jointed and bears olfactory cylinders on the distal four. The *antenna*, too, agrees rather closely with that of *chiltoni*, the fourth joint of the peduncle a trifle longer than the third; the fifth slender, but not as long as the combined length of the third and fourth; the flagellar joints (there are twenty-five) decrease steadily in thickness without any noticeable increase in length. The *labrum* is distinctly asymmetrical.

In the *mandible* (right) the second joint of the palp is rather long, the third agreeing generally with that of *chiltoni*. From the surface of the molar a short brush-like seta projects.

The *maxillula* (fig. 75, 8) is unusual in that there are frequently five terminal setospines on the apex of the inner endite, with the usual two stiff, simple spines against the first and third setospines. The outer endite shows ten spine-teeth and a rather long setospine and the normal two sub-terminal plumose setae.

The *maxilla* is normal, but the single spine on the anterior face of the proximal endite is quite long and, as usual in this genus, shortly pectinate. There is an unusual development of the setae at the base of the third segment. The *maxilliped*, like both that of *chiltoni* and of *tattersalli*, bears a series of setae completely round the lateral border of the epipodite. In the male, upon the palm of the *gnathopod* (fig. 75, 11h), of the row of spine-teeth, only seven (sometimes eight) are denticulated, and there are substituted for the more distal members of this series in *chiltoni* four or five particularly stout, sub-triangular, simple teeth.⁽¹⁾ The shape of the propod is quite nearly that figured for *tattersalli* (1927, fig. 6 (6)), but the free posterior border is concave. Upon the anterior border of the basis of this limb, as, also, upon that of the succeeding limbs, a sensory seta is found, and in the case of the fourth *peraeopod* there are at least three of these. The propod of the latter limb is stout, with a well-marked palm and the usual two spines, the dactyl stout and curved strongly with a well-developed secondary unguis.

In the hinder group of *peraeopods* the basis shows a slight expansion; in the seventh limb the length of the joint is just twice the greatest width; the appendage is rather more spinose than in *dubius*. The male appendage is short, curved, and bears several setae.

The first and second pleopods (male) display a marked contrast in size between exopodite and endopodite (fig. 75, 13 (1), (2)). In this they differ from *tattersalli*, at least as far as the first pleopod is concerned, this alone being figured by Sheppard

(¹) The condition and armature of the palm of the *gnathopod* of *tattersalli* is not recorded.

(1927, fig. 6 (7)). It might be inferred that they differ, also, from those of *chiltoni*, Sheppard stating that in that species they are rather narrow, but otherwise like those of *P. australis*, in which species Chilton shows first pleopod with exopodite and endopodite almost equally long. The endopodites lack, also, the terminal emargination of *australis* or *chiltoni*.

The exopodite in both these pleopods bears a heavy marginal fringe of setae, many being plumose, with a sparser sub-marginal series of simple setae, not seen in *dubius*; there are, also, short setae scattered on the face of the lamella near its outer (lateral) border. The sympodite is long, expanded laterally and fringed with long setae upon both inner and outer borders.

In the second pleopod, the penial stylet is long and curved, with a few setae proximally and mesially; as in *chiltoni*, it usually bears but two terminal spine-setae, although there may be a short third spine.

The peduncle of the *uropod* is stout (fig. 75, 15), its length more than twice its depth; at the distal end of the inner border both apical spines appear, but only one of the two is strong; the outer border bears five or six spines of variable length. Of the two rami the outer is practically as long as the peduncle, the inner distinctly longer; both bear scattered tufts of setae and a single spine near the mid-length; beneath the insertion of the rami are two strongly toothed spines.

Size. Largest male about 15 mm.

Colour. In life, brownish or greyish brown. Upon the bases of the *peraeopods* pigment is distributed only in fine veinings. After prolonged preservation in spirit, fading to pale yellowish brown.

Occurrence. Abundant in the Great Lake and in the Shannon Lagoon.

Colubotelson setiferus, sp. n.

(Figs 76 and 80, j)

This, although showing marked resemblances to *C. joyneri*, is, nevertheless, a quite distinct species.

The body is very slender, almost vermiform, free from wrinkles and but sparsely setose; the head short, the front steep, with well-marked sub-ocular incisure and cervical groove. The eyes are small, the ommatidia being represented by a few small and scattered black-pigmented spots. The peraeon has the first segment short but considerably expanded below, the large first coxa overlapping the hinder angle of the head; succeeding peraeon segments are relatively long and deep. In the pleon, the segments have much the same relative lengths as those of *joyneri*, but appear somewhat deeper, and long, flexible setae are continued sub-marginally high up on the hinder borders of the pleura. The tailpiece is more setose; the telsonic process, gently rounded behind, is as long as broad, with a terminal armature of four stout spines and numerous setae; the telsonic pleura project prominently and bear three spines dorsally and a sparse fringe of setae posteriorly, this series including one spine; the sixth pleon segment has an edging of setules antero-dorsally, which gives place ventrally to a rank of nine toothed spines, the hindermost three stout and much the longest; flanking the last are one or two furcate spinules. The junction of the sixth pleon pleuron with that of the telsonic is marked by a slight ridge bearing only five or six stiff setae.

Appendages. The *antennule* (fig. 76, 4) is short, with a flagellum reduced to four joints, the terminal two elongate; the *antenna* shows the first two peduncular joints short and wide, the following three increasing steadily in length and becoming

increasingly slender; the flagellum of twenty joints, also, shows the distal joints slender, but not noticeably longer than the proximal. The *labrum* is distinctly asymmetrical and at its base much wider than its depth. The *mandible*, except that it appears unusually bulky, does not differ noticeably from that of related species; the third joint of the palp bears two rows of doubly pectinate setae. The *labium*, also, is normal, but the *maxillula* is unique in this sub-family in that on the hinder face of its outer endite there are *five* feebly plumed setae, all in its mesial half, while the proximal endite is narrowed and its innermost apical setospine is obviously undergoing degeneration; it is smaller than the rest and slipping down onto the mesial border; the final stage of this change is seen in the species of *Phreatoicoides*, where this setospine has been lost altogether. The *maxilla* calls for little comment, except perhaps to note that the row of biting setae behind the filtratory is represented by but nine pectinate setae.

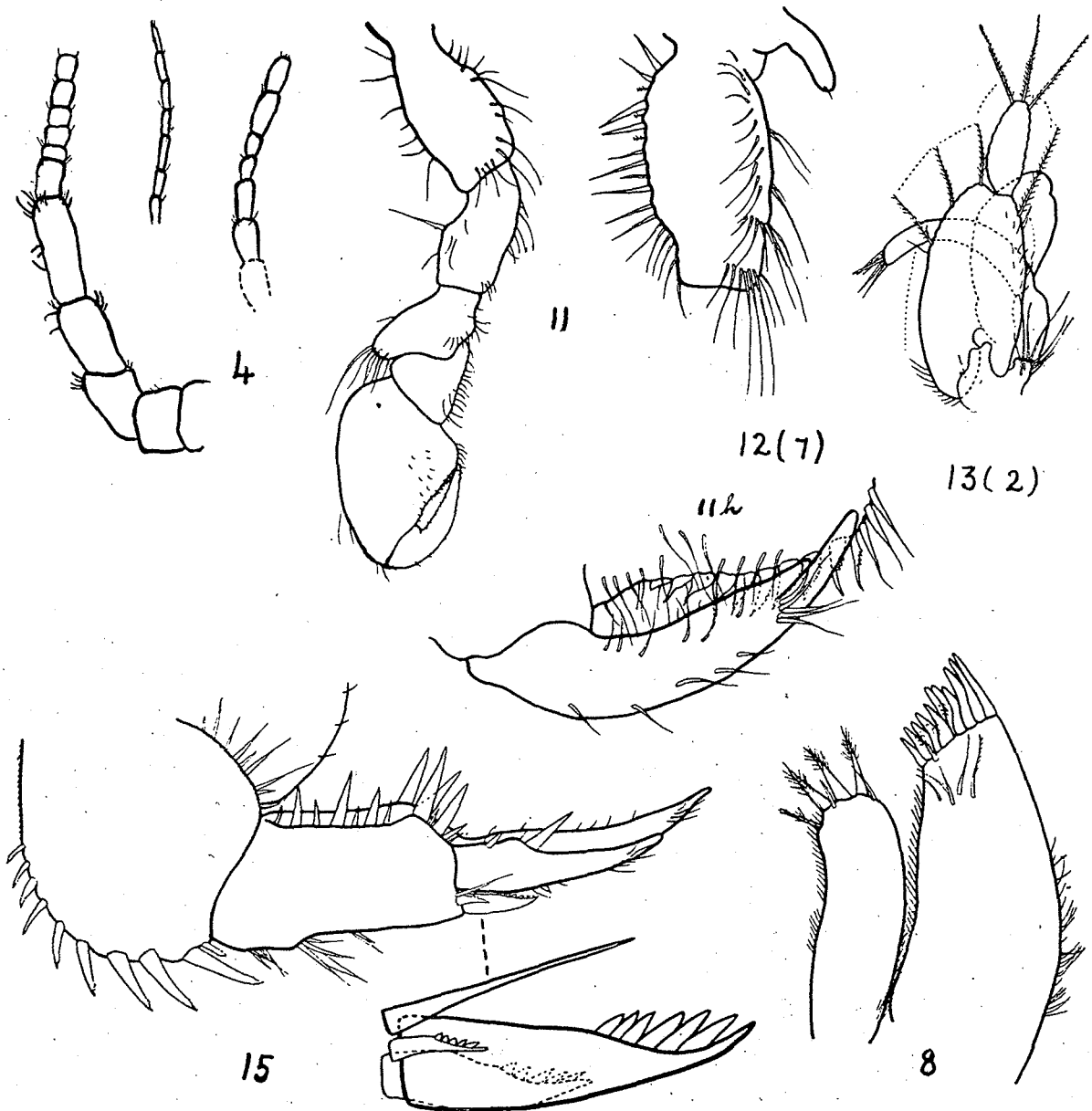


FIG. 76.—*Colubotelson setiferus*, sp. n.

The *gnathopod* (fig. 76, 11) is rather unusually setose, the propod robust, the palm concave distally, becoming convex where it passes into the hinder border, and is unusual in that the denticulated spines are reduced to five, followed by four or five simple teeth. The setal armature of the remaining *peraeopods* is quite noticeable, and the small ciliate (sensory) setae seen on the basis of most Phreatoicid *peraeopods* are here peculiarly abundant. Thus on the fourth *peraeopod* there are at least five on the anterior border of the basis and there is one on the anterior end of the propod; this joint (in the male) has a distinct palm defined by two spines for the reception of a stout, strongly curved dactyl. It is of interest, as a detail confirming the torsion that the *peraeopods* have undergone, that in the hinder group these sensory setae are found on the posterior border of the basis and others occur at the posterior extremity of carpus and propod. The bases in these limbs are little expanded, there being but a quite narrow plate even on the seventh leg (fig. 76, 12(7)). The male appendage is short, with a small terminal seta.

The *pleopods* call for little comment; it is perhaps indicative of the relative recency of the acquirement of a semi-subterranean habit that the endopodites are well developed and the exopodites still heavily setose with abundant plumose setae and a secondary fringe of simple setae. The first pleopod has both lamellae narrow; in the second (in the male) the endopodite and penial stylet are both long, the latter bearing terminally no fewer than five stiff spine-setae (fig. 76, 13(2)).

The *uropod* (fig. 76, 15) is of only moderate length and is comparatively stout. In the peduncle, the greatest depth is more than half of the length; the inner upper border is raised slightly, and bears but the two usual stout spines distally; the outer border nearly equals the height of the inner and bears a rank of spines, of which two are particularly strong. The inner ramus is sub-equal in length to the peduncle and, except for a few setae, appears unarmed; the outer ramus is three-fourths of the length of the inner and bears a quite stout spine at its mid-length. Beneath the rami are two toothed spines, one being strong and having a length equal to one-third of that of the outer ramus.

Size. 11 mm. (male).

Colour. In spirit, a pale cream tint.

Occurrence. The two or three specimens examined were found at (or near) Scottsdale in the north-east corner of Tasmania, in a wooden pipe-line leading from the local reservoir. These were supposed (obviously erroneously) to be responsible for considerable damage (to the extent of perforation) of the pipe-line. When examined, there was found in the same tube three or four specimens of *Hyperoedesipus*, in no discoverable detail differing from the Western Australian species *plumosus*. It is scarcely credible that these were other than an accidental, though quite inexplicable, inclusion of local material after the receipt of the Tasmanian specimens. No more material could be made available and the nature of the creature responsible for the damage to the pipe remains an unsolved problem.

Metaphreatoicus, gen. n.

Telsonic process sharply upturned, abruptly truncated, shorter than wide; armed terminally with three pairs of stout spines.

Genotype. *Metaphreatoicus australis* (Chilton).

NOT USED

NO

Metaphreatoicus australis (Chilton)

(Fig 77)

- Chilton, 1891, pp. 149-171, pl. 22-26 (*Phreatoicus australis*); 1894, p. 200; 1918, p. 381, fig. 13, a.b.c.
 Spencer and Hall, 1897, pp. 12-21 (*Phreatoicus australis*).
 nec. Smith, G., 1909, p. 72, pl. 12, figs 1-4 and 9 (*Phreatoicus australis*).
 Barnard, K., 1914, p. 231; nec. 1927, pp. 159, 160 (*Phreatoicus australis*).
 Nicholls and Milner, 1923, pp. 24 and 34 (*Phreatoicus australis*)
 Glauert, L., 1924, p. 50 (*Phreatoicus australis*).
 Nicholls, G. E., 1926, p. 185 (*Phreatoicus australis*).
 Sheppard, E. M., 1927, pp. 81 and 108 (*Phreatoicus australis*).

Body sub-cylindrical, fusiform, tapering from the third peraeon segment; surface smooth, scarcely wrinkled, with a few fine setae in scattered tufts on the peraeon; in the pleon a fur-like covering of setules interspersed with sparse, longish setae; the length in the male barely six times the width, and the depth (in mid-peraeon) scarcely two-thirds of the width.⁽¹⁾ The *head* has a moderately deep anterior emargination; it is shallow in front, but slopes upwardly from the well-developed, sub-ocular incisure, to attain a much greater depth posteriorly; the genal groove is well defined; the deep cervical groove which rises from the posterior border of the head is incomplete above and does not, as stated by Chilton, 'run across the dorsal surface'; the ventro-lateral border is nearly horizontal, but dips steeply, behind the short mandibular articulation, to include a deep post-mandibular region, from which arises a vestigial posterior process; the pre-mandibular region is relatively long and the mandible accordingly lies far back. The eyes are variable; small, round, or rounded-oval with longer axis obliquely vertical, more prominent than is suggested by Chilton's figure, with few ommatidia (about twenty, according to Chilton).

Peraeon. The first segment, which is free from the head, is short, moderately expanded ventrally, with anterior and posterior borders both concave; the third and fourth segments widest and sub-equal; the second and fifth shorter; the sixth and seventh progressively decreasing in length and increasing in depth. The postero-ventral corners of the second, third, and fourth segments are smoothly rounded and fringed with setae; on the fifth and sixth segments these corners bear but a few setae, while upon the seventh, in which setae in this region were not seen, there was a well-developed sub-marginal rank of setae stiffly outstanding from the hinder border of the segment.

All the coxae are distinct, but it is difficult to be sure that those of the second, third, and fourth are really freely movable as Sheppard states (1927, p. 93, 'the last six pairs'). In the specimens examined (which have been in preserving fluid for forty years) the chitin is quite limp and flexible, but the actual joints seem obsolete. In the female it is possible that these joints had some degree of mobility.

In the *pleon*, the first segment is distinctly shorter than the seventh peraeon segment, the succeeding segments progressively increasing in length, the lower borders rounded and fringed with long, flexible setae, which are continued some way up the posterior border, where they stand stiffly erect, and are thus liable to be overlooked; between them is a close edging of setules which, traced onto the free surface, pass into the fringes of scale-like areas which cover the body. The fifth segment, as Chilton has noted, has the junction of pleuron with tergum marked

⁽¹⁾ The depth is stated by Chilton (1891, p. 153), to be *about equal* to the width; if that were so, the length of the specimen figured, which is moderately relaxed, would be approximately ten times the width—a vermiform condition which is not found in this genus, but is most nearly approached in *setiferus*.

by a distinct depression; as figured by Chilton (1893, pl. 23, fig. 1), it is almost as long as the tailpiece, and the hinder margins of pleuron and tergum meet in a wide angle.

The anterior border of the pleuron of the second to fifth segments normally underlies the posterior border of the pleuron of the preceding segment for a distance varying from one-fifth to one-third of the full width of the pleuron. The extent of the overlap is clearly indicated by a line parallel to the anterior edge of each pleuron, this line, under high magnification, being set with a fine fringe of setules, giving the effect of striation. The actual anterior margin of these pleura is armed with widely-spaced, stiff, slender setae, projecting forwardly in the plane of the pleuron, whereas those on its hinder margin may project at a sharp angle from the surface. Near the dorsal end of the free posterior border there is a dense fringe of short, simple setae, best developed on the fifth segment.

The *tailpiece*, slightly longer than the fifth pleon segment, is sharply upturned in a telsonic projection which is short (wider than long) and abruptly truncated, its apex armed with six short, stout spines and several setae; the median pair of spines are occasionally rather more slender than the outer pairs. Ventral to the apex, the telsonic pleura are sharply produced posteriorly, the margin set with two spines and setae (or spinules), these latter somewhat variable in number and arrangement; there are usually two spines sub-marginally. Running antero-dorsally from the insertion of the uropod is a long, well-defined ridge, from which spring twelve to fifteen stiffly upstanding setae. It marks, apparently, the ventral border of the telsonic pleuron. Dorsally to this ridge is an interrupted parallel row of eight or more setae ending in the two sub-marginal spines already mentioned.

The antero-ventral margin of the tailpiece (the sixth pleuron) bears a close-set fringe of nine to eleven curved spines, spaced fairly evenly, and increasing in size progressively from before backwards. The end of each of these, except the hindmost, is obliquely hollowed and, in this part, pectinate. The hindmost spine is stouter than those preceding and is generally, but not invariably, simple; it is flanked by a small series of three or four short and slender spinules which are digitate terminally. Chilton, describing this region, records fifteen or sixteen spines, and in his figure (1891, pl. 25, fig. 6) represents seventeen, all apparently alike. This was presumably the condition in the specimen examined,⁽¹⁾ perhaps an unusually large example, but, even so, it is surprising to find so considerable a variation.

The appendages have, fortunately, been described by Chilton in very considerable detail, and comparison with other material has confirmed in almost every case these descriptions; there will be, therefore, little need here to do more than mention some points to which attention was not called.

The *antennule*, in position, reaches nearly to the end of the peduncle of the antenna, its flagellum being stated to have from five to seven joints, of which the penultimate and ante-penultimate joints are swollen; the last joint is usually minute and knob-like; there are olfactory cylinders on at least the distal three or four.

The *antennae* are short, about one-third the length of the body, the peduncle unusual in that the third and fourth joints are short and sub-equal (the third perhaps a little the longer), the fifth one-third longer than the fourth; the

⁽¹⁾ Chilton's original material was obtained on Mt. Kosciusko, at Piper's Creek (6000 ft. altitude). The specimens examined by the writer were determined by Chilton as *australis*, but came from Thomson's Flat at 5700 ft., also on Kosciusko. The several small discrepancies observed may be explained by this fact.

flagellum has from seventeen to twenty-two joints, and is considerably longer than the peduncle, the more distal joints becoming increasingly longer and more slender.

Chilton describes the *upper lip* as long and strong, regularly rounded distally, the centre slightly produced. Actually it is somewhat asymmetrical, though perhaps less noticeably so than in species of other genera.

There is little to add to the account of the *mandibles*; the setae on the third joint of the palp are disposed in a double row, as stated by Chilton, but those in one row are coarsely denticulate, and in the other very finely pectinate; the fulcral process of the mandible is very slightly developed.

In the *labium*, apparently the setal fringe consists in this species wholly of densely clustered, simple setae.

On the *maxillula* Chilton has recorded the occurrence of a couple of plumose setae on the posterior face of the outer endite, a feature which, though of quite general occurrence in this sub-order, has been generally overlooked; there is also one, nearly mesial, setospine on the apex of the joint among the terminal spines. Upon the summit of the inner endite there are the usual two slender, simple spines, but none of the specimens examined shows more than four setospines. Chilton records 'four or five'.

In the *maxilla*, that author has described the row of filtratory setae upon the mesial face of the inner endite as continuing for a short distance on to the (anterior) surface of this endite, a condition which is usual for the majority of Phreatoicids; it is of interest, therefore, that in one specimen examined, this fringe actually ended upon the mesial border. Lateral to the distal end of this row of filtratory setae, and situate on the anterior face of the endite at a point about one-third of the width of the endite from its inner border, is a stout spine. It is of common occurrence in this sub-order and it has been interpreted (Part I, p. 15) as the vestige of the series of spines so well developed upon the anterior face of this endite in *Mysis oculata*. It seems unusual, however, in that in this species it is finely pectinate. Running parallel to the filtratory setae on the anterior face is a bushy row of simple setae; on the posterior edge of the mesial face is the usual row of biting setae, about fifteen in number, rather unusually stout and spiniform. The posterior face of the endite is, in its distal part at least, clothed with simple setae.

Slightly behind the maxillae, in the middle line, is a small and flimsy *median process*, almost semi-circular in shape.

An error, obviously typographical, in the original account of the *maxilliped*, makes the endite of the basis project slightly beyond the inner end of the ischium—it should, of course, be *merus*, as is seen by reference to the figure (1891, pl. 23, fig. 4). The epipodite, which is quite distinctive in its shape and in that its outer margin is crenate, has a sparse fringe of eight short, curved setae, springing from the deeper crenations. Within the inner aspect of its mesial border is a thick fringe of setae. Upon the dorsal border of the endite, and restricted to its distal half, is a rank of nine or ten brush setae; these change somewhat in character near the free end, having the cilia restricted to the distal surface of the setae, which become shorter and apically denticulate or finely pectinate. Proximally to these brush setae the dorsal border is bare of setae for some distance, until near its base there is a dense tuft of simple setae.

The account of the remaining thoracic appendages calls for little amplification. In the *gnathopod*, it should be noted that the palm is armed with eight curved

spines, sub-triangular in outline, with the outer (posterior) edge coarsely denticulate⁽¹⁾ basally, but drawn out into a fine terminal thread. The dactyl has, in addition to the apical cluster of setae, two or three smaller tufts projecting from its anterior surface. The fourth peraeopod in the male has a quite rudimentary palm on the propod defined by three stout spines and some spinules (fig. 77, 12(4)). The hinder borders of the peraeopods, particularly of the fifth, sixth, and seventh, are armed with setae which are in most cases almost stout enough to be described as spines. The male appendage in specimens from the type locality is generally heavily pigmented.

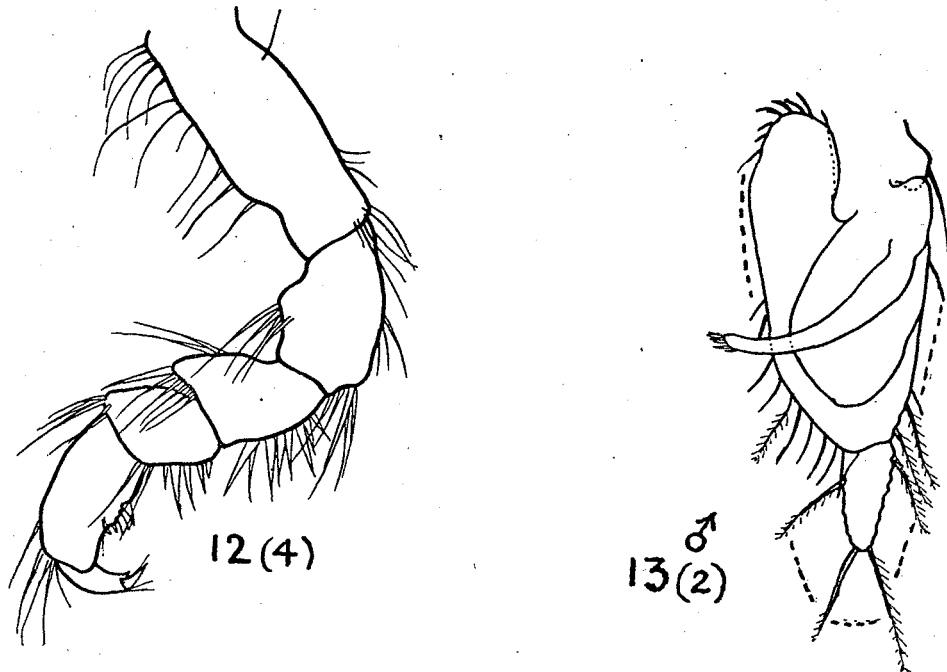


FIG. 77.—*Metaphreaticoicus australis* (Chilton).

The pleopods are fully described by Chilton; the emargination of the apices of the endopodite is apparently a constant feature; it occurs in many species of this genus and *Colubotelson*.

In the second pleopod of the male (fig. 77, 13(♂)) the penial stylet is armed apically with four stiff spine-setae.

The uropods are stout, the depth of the peduncle being equal to half its length; the inner, upper border slightly raised and bearing two stout spines apically; the outer margin armed with five to seven strong spines. The rami are strong, the inner almost as long as the peduncle, the outer slightly shorter; both bear scattered setae, with a sub-terminal circlet, and each has one stout spine at about half its length. Beneath the insertion of the rami is one stout, curved spine, apically denticulate. In some cases there is a slender, simple spine flanking the toothed spine.

Habitat. Mt. Kosciusko. Piper's Creek (6000 ft.) and Thomson's Flat (5700 ft.).

Colour. In spirit, light brown with marbled dark-brown markings over much of the surface.

Size. About 13 mm.

(¹) Sayce states that these are all simple!

Metaphreatoicus australis lacustris, sub-sp. n.

In many minor features these specimens from Blue Lake seem to differ from those taken from the Plateau on Kosciusko.

The *eye* seems to have fewer (nineteen to twenty-three) ommatidia.

The *antennule* is variable, in some specimens reaching only to the beginning of the fifth joint of the antenna; there are usually five or six joints in the flagellum; the swelling of the terminal joint is not simply a development of the chitin, as stated for *australis*.

The *antenna* shows difference in proportions of the joints of the peduncle.

The palp of the *mandible* lacks setae from the proximal end of the third joint. (Those figured by Chilton are on the distal end of the second joint.)

The first *maxilla* normally resembles that of typical *australis*, with four setospines on the inner endite, but in one specimen the inner endite is broad and bears *nine* setospines!

Setae are present on the coxa of the *gnathopod* and the second *peraeopod*—Chilton says that in *australis* setae are absent from the coxa of the first four peraeon appendages. The basis of the gnathopod is rounded; that of the fourth peraeopod is rounded, but an expanded plate springs from its anterior border. There is a fur of fine setules on the fifth and sixth joints of the seventh peraeopod, and the male appendage is unpigmented.

There is a difference in the armature of the sixth pleon pleura; the two hindmost spines are generally not pectinate and the total number may be as low as eight; the digitate spinules two or three only. The ridge above the insertion of the uropod, and marking the ventral border of the telsonic pleura, may bear from six to eight flexible setae. The truncated telson tends to be slightly longer and the apical spines are disposed differently, four being terminal, the median pair sub-terminal. The uropods seem to bear fewer spines on the dorsal borders of the peduncle.

This material was collected by Hedley from the Blue Lake, some miles from Kosciusko. The specimens apparently reach a slightly greater size, one male measuring 15 mm.

Metaphreatoicus magistri, sp. n.

(Figs 78 and 80, 1)

This species seems to come near to *M. australis*.

The *head* is as broad as long and, in profile, appears to rise more steeply than figured for *australis* (Chilton, 1891, pl. 23, fig. 1). The eyes are larger and more prominent than in any other member of this sub-family, so that they appear in the profile of the head. There is a narrow sub-ocular incisure; the cervical groove is strongly developed, but is not complete dorsally. The post-mandibular region is rather more evident, and there is a small posterior process.

The *antennule* (fig. 78, 4) extends beyond the end of the peduncle of the antenna and has seven joints⁽¹⁾ in the flagellum, the last not merely knob-like. The *antenna* is slightly longer, relatively, with about nineteen flagellar joints.

In the *peraeon* the postero-ventral corners of the segments are rounded, and in the second, third, and fourth these are fringed with setae, in this agreeing with *australis*. In the fifth and sixth segments there are fewer setae in this region; in the seventh, setae were not found here, but, instead, there is a conspicuous rank of setae along the hinder border of the segment.

⁽¹⁾ Only five shown in specimen figured.

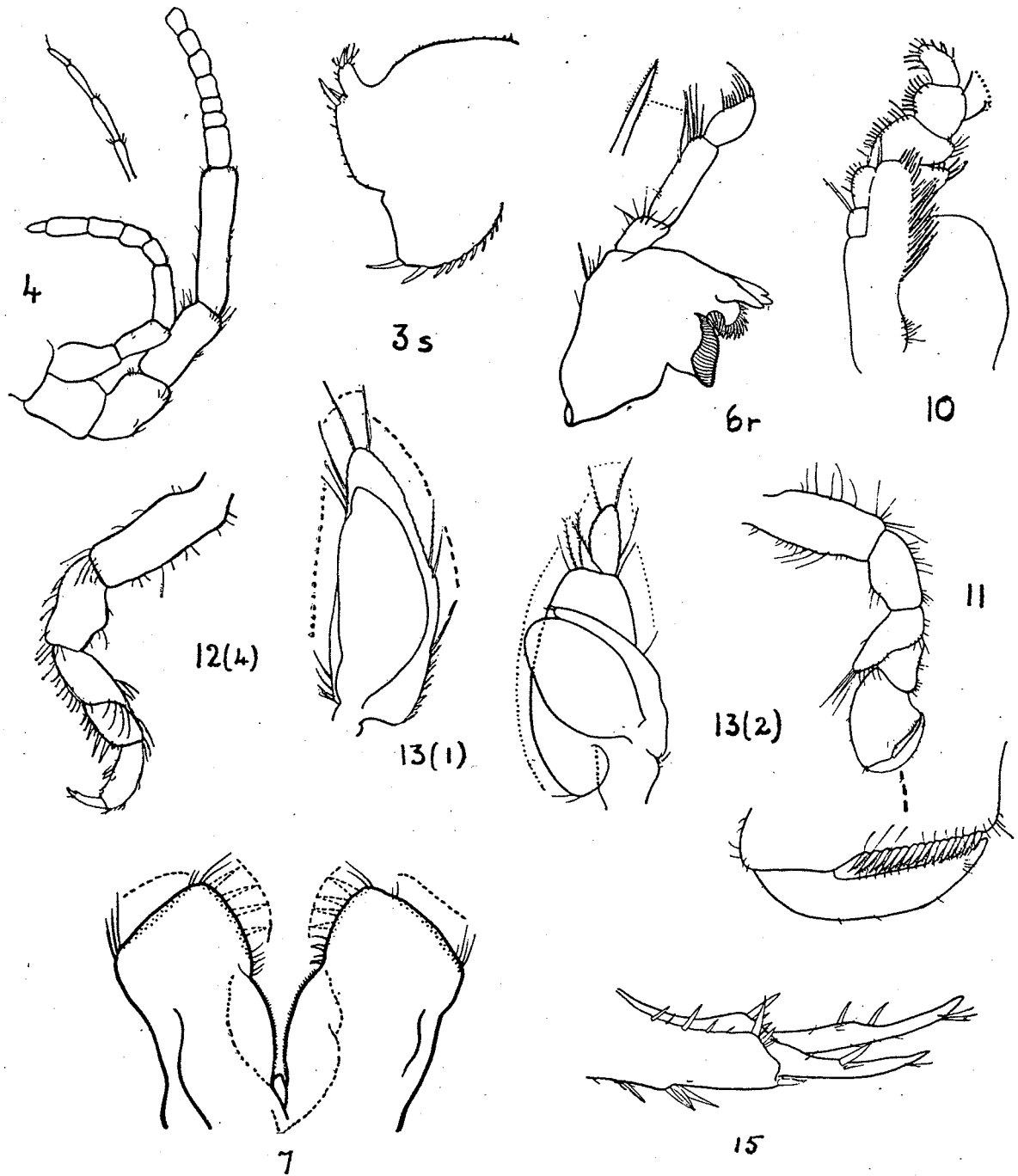


FIG. 78.—*Metaphreatoicus magistri*, sp. n.

The palm of the *gnathopod* is straight (♀) and armed with no fewer than sixteen denticulate spines; in *australis* the palm (♂) is noticeably convex.

In the hinder peraeopods the proportions of the bases differ, the setal armature is less developed and the limb appears relatively longer.

In the *tailpiece*, too (fig. 78, 3s), this species, while distinctive, nevertheless shows affinities with *australis*.

The telsonic projection (fig. 80, l) is short (much wider than long), its hinder border evenly rounded with four short, equidistant spines, with a dozen or more interspersed setae; dorsally, nearer the base of the projection and slightly sub-marginal, there is a third pair of spines, smaller than the others.

The telsonic pleuron has a slightly sinuous margin and bears at its dorsal end one stout and two slighter spines, while sub-marginally is another stout spine; below this there are four or five fringing spinules and six or more setae. The ventral suture of the sixth and telsonic pleura is marked by a long ridge set with but few (four to five) stiff setae.

The antero-ventral border of the tailpiece agrees closely with that of *australis*, there being eleven fringing spines, the hindmost two stouter, and all are toothed apically. There are three posterior digitate spinules.

The *uropods* (fig. 78, 15) are relatively longer and more slender, the dorsal border of the peduncle less spinose, the ventral edge with three tufts of setae, each with one spine. The rami are slender, the inner sub-equal in length to the peduncle, and both with more feeble armature of spines and setae.

Size. Largest male 15 mm.

Colour. Practically indistinguishable from *M. australis*.

Occurrence. Adventure Bay, Bruni Island, Tasmania. Specimens were first taken by G. M. Smith, in 1908/9, and later by the writer (28/1/28). The locality is of interest, since it lies practically at sea level; the ditch draining a small swamp, flows very sluggishly across the sandspit that joints the northern and southern parts of the island, and empties into Adventure Bay. The name proposed for this species is intended to commemorate the association of Captain Cook with the locality, the bay being named for one of his ships, the *Adventure*.

43° 22' 147° 19'
43° 18' 147° 21'

Metaphreatoicus affinis, sp. n.

(Figs 79 and 80, m)

This is a quite distinct form which seems to show resemblance to several different species.

The *body* is irregularly wrinkled and the exoskeleton over the body generally is excavated into numerous large ovoid or elliptical pits. The head of the male, in profile, appears almost a quadrant of a circle; it is short, about as long as the second peraeon segment; in the female, the frontal slope is more oblique. The eye is small, rounded-oval in shape; sub-ocular incisure well developed, cervical groove rising from the hinder border of the head. In the peraeon the first segment is of moderate length, well expanded ventrally, particularly in the female; the four following segments about as long as deep; fifth and sixth, though shorter, are still relatively long; the seventh, longer than the first, has depth twice its length. In all but the first, the antero-ventral corner of the tergum is produced downwardly in front of the related coxa.

The first three pleon segments are sub-equal in length, but increase progressively in depth, the first being quite appreciably longer than the last peraeon segment; the fourth is rather longer and the fifth half as long again as the fourth, and both are deeper than the third; the pleura in these hinder segments are nearly twice as deep as the related segments and in the fifth meets its segment at a sharp angle; all carry a heavy fringe of long setae.

The *tailpiece* (fig. 79, 3) is slightly longer than the fifth segment, its dorsal surface, in profile, little convex, but dipping steeply into a concavity in front of the tip-tilted telsonic process. Seen in dorsal view, this projection appears sub-triangular in shape (approaching that found in *Crenoicus* spp.), its apex truncated or rounded, and bearing four stout, apical spines, set in a brush of short, stiff setae, twenty or more in number; laterally at the base of the projection are two rather more slender spines. Its postero-ventral aspect shows a comparatively broad, flattened, post-anal surface, reminiscent of the condition of *brevicaudatus*. Beneath the projection, the telsonic pleuron is very pronounced, its dorsal border straight, and springing, as in *australis*, from the tailpiece at a sharp angle, but armed with three stout spines, the hinder border with four or five setules; its junction with the sixth pleon is marked by a short ridge with two, or at most three, short, stiff setae.

The pleuron of the sixth pleon segment resembles that of *thomsoni*, armed with eight curved and toothed spines, increasing in length and stoutness as they are traced posteriorly; the upper anterior border of this segment is closely fringed with setules.

Appendages. The *antennule* (fig. 79, 4) is ten-jointed, but relatively short, reaching barely to the mid-length of the last peduncular joint of the antenna. The three joints of the peduncle are sub-equal in length, and are followed by the seven-jointed flagellum, the terminal four joints bearing olfactory cylinders. The *antenna* (fig. 79, 4) is long, with a flagellum of about thirty joints. In the peduncle, the first, second, and third joints are of nearly equal length, but the third is more slender, the fourth rather longer, the fifth equalling the combined length of the second and third and longer than the first four joints of the flagellum.

The asymmetry of the *labrum* is not very marked, and (including the epistome) it is as broad as deep.

The left *mandible* has the usual four teeth on the principal cutting edge, three on the *lacinia mobilis*; in both, the palp has a long second joint, with a dense setal fringe along its length; the third joint appears quite short and bears a double rank of pectinate setae (fig. 79, 6r).

The *lower lip* has quite moderately well-developed inner lobes. The *maxillula* is normal, with four setospines and two simple spines on the apex of the inner endite, but these latter are rather unusually feeble; ten spine-teeth and one short setospine constitute the armature of the outer endite.

The *maxilla* (fig. 79, 9) is quite unusual in that there may be either three or four spines (singly-pectinate) on the anterior face of the inner endite. In no other Phreatoicid⁽¹⁾ has more than one of these spines been observed, although, as noted earlier (Part I, p. 15, fig. 5A, *a.s.*) they are better represented in Mysids.

The *maxilliped* (fig. 79, 10) has a long and rather narrow epipodite, its outer border bearing a dozen or so setae, rather longer than is usual on this structure.

⁽¹⁾ In the Amphisopid, *Eophreatoicus kershawi*, there is normally a group of three spines in this position.

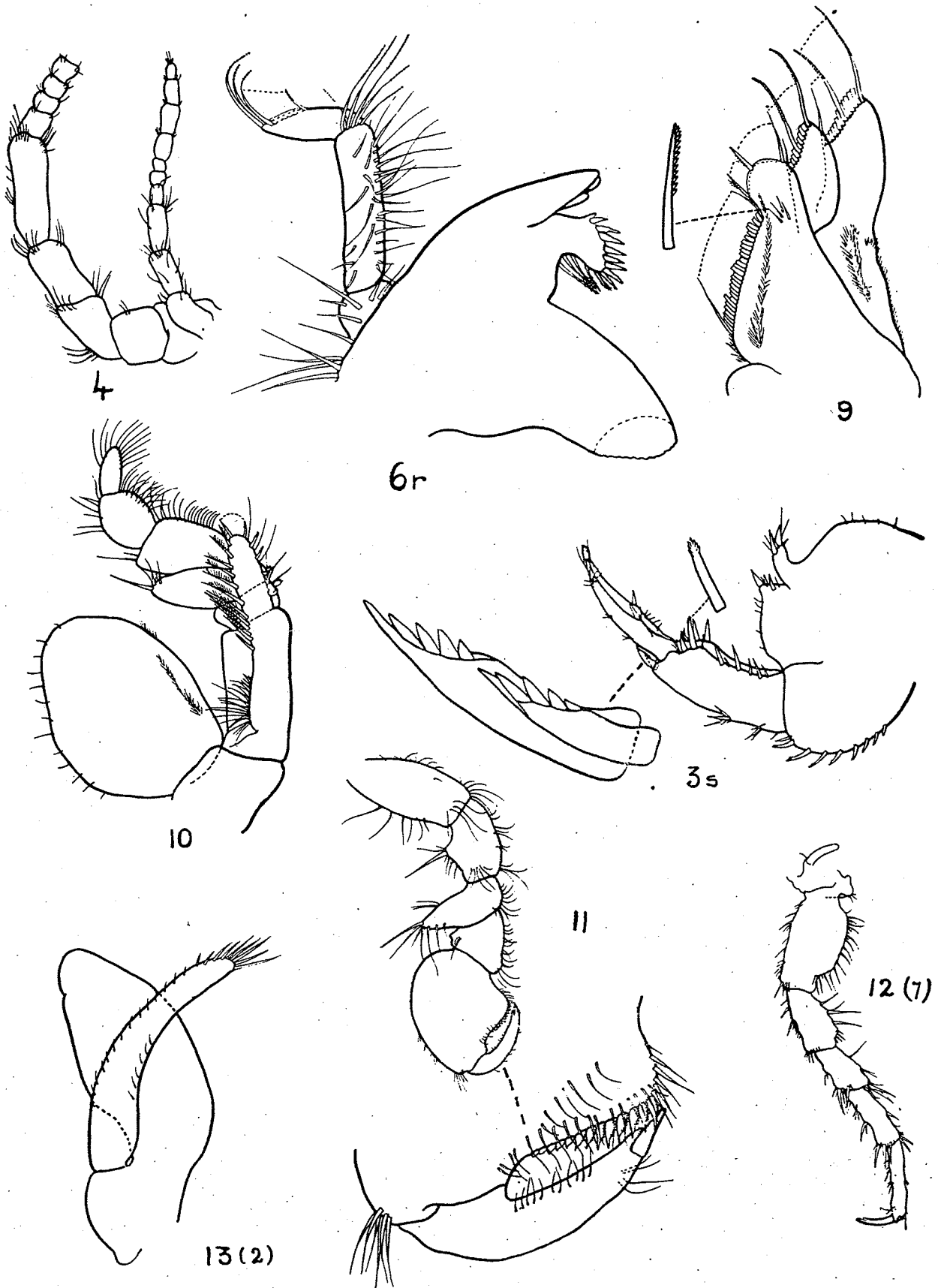


FIG. 79.—*Metaphreatoicus affinis*, sp. n.

The endite is narrow and relatively rather short, with eight to ten brush setae; coupling spines, two or three in number, are stout and little curved; the joints of the palp differ somewhat in shape from those of nearly related species.

In the male, the *gnathopod* is exceptionally setose (fig. 79, 11); the merus is short and much produced anteriorly, the propod very convex anteriorly; its hinder border is modified into a short, convexo-concave palm, six or seven denticulated spines being followed by about five short, close-set conical teeth, an arrangement closely paralleling that of *intermedius*; the free posterior border of the propod is relatively long, about two-thirds of the length of the palm. The fourth peraeopod is setose, the basis long, ischium little more than half the length of the basis, propod stout with concave palm, defined by three spines; dactyl short and stout.

In the hinder group of *peraeopods*, the basis of the fifth and sixth are less expanded, relatively, than those of *australis*; the seventh (fig. 79, 12(7)) has a quite distinct expansion on this joint and the leg as a whole is setose with spines on ischium and merus; the propod and dactyl are long.

In the *pleopods*, the endopodites are well developed; in the first, the sympodite has a number of setae on its lateral border; the exopodite is setose, some of these setae arising from the posterior face, and there is a sub-marginal series of long setae. In the second of the male (fig. 79, 13(2)) the endopodite is longer than the proximal joint of the exopodite; the penial stylet is quite unusual in that it bears a series of about seven stiff, terminal setae, these passing into a mesial fringe of shorter setae. Such a well-developed armature is not known in any other species of *Metaphreaticus*, although most closely approached in *M. australis* (Chilton). It agrees, however, with the condition in *Onchotelson brevicaudatus*, and is approached in *Uramphisopus pearsoni* and some species of *Notamphisopus*. It is surpassed only by *Eophreaticus kershawi*.

The *uropod* is slender, the two rami practically sub-equal, and the inner (slightly the longer) is as long as the peduncle; each ramus is armed with one spine at its mid-length. The peduncle bears the usual two stout spines distally on its inner border, and on the outer border is a series of spines, the most distal being unusually stout and digitate. Beneath the insertion of the rami are two stout, toothed spines.

Size. The largest specimen (♂) measured 13 mm.

Colour. In spirit, a light brown.

Occurrence. A few specimens were collected (13/3/34) by Miss D. Spargo, on Wombat Moor, in South-Central Tasmania.

Wombat Creek 92° 49' 147° 43'

between 42° - 43°
146° 21' 147° 30'

In addition to the species of *Paraphreaticus* and *Metaphreaticus* described in the present paper, a few specimens from other localities have been examined. These have been either too few or immature (in one case fragmentary) to permit of a satisfactory description. A list of these is attached.

1. From Lake Sorell a few specimens were taken, generally resembling *intermedius*. As Geoffrey Smith notes, no Phreaticoids were found in the water of that lake in 1907/8 and, as the writer similarly failed to find Phreaticoids there twenty years later, it is possible that specimens from the Great Lake have since been introduced.

2. A single specimen from Table Mountain.

3. Some fragments, taken in shore collecting (marine material) at Wynyard, in North-West Tasmania, were seen in the collection of the South Australian Museum. They are unidentifiable and a visit made to this locality in February,

1939, failed to discover the presence of Phreatoicids in nearby fresh water, either standing or emptying into the harbour. It was, however, a period of exceptional dryness and it is probable that under more favourable conditions specimens might have been found.

Lastly, Geoffrey Smith records a distinct variety (unnamed) from Ben Lomond, but specimens from this locality have not been available for examination. There can be little doubt that many more Phreatoicids still remain to be discovered in Tasmania.

Supplementary Note

Family *Acanthotelsonidae* Meek and Worthen 1865.

It appears probable that the above family should be placed in the Phreatoicoidea rather than in the Syncarida, as proposed by Packard (1886). Considered originally to be closely akin to the Amphipoda, the only genus *Acanthotelson* was finally referred by those authors to the Tetracapoda, but to no previously recognized family, presumably occupying a position intermediate to the Amphipoda and Isopoda.⁽¹⁾

As in the case of *Protamphisopus*, the characters which would determine its position within the Phreatoicoidea are unfortunately not known. In the possession of an elongate spinous telsonic projection it differs from the Syncarida and is most nearly approached by the Great Lake members of the Mesacanthotelsoninae, all of which lack the *lacinia mobilis* from the right mandible.

There are, however, several characters which mark off *Acanthotelson* from all existing Phreatoicids and link it with the Syncarida. The first to be noted is the distinctness of the sixth abdominal segment from the telson. The failure to develop these as distinct regions (or their complete fusion) in Phreatoicids is obviously a change which has occurred in most Malacostraca. Only in a few, for example, *Mysis*, is there a sixth segment which is lost only in later developmental stages. Were it not for the fact that the anal opening is accepted as marking the sternal face of the telson, it might be supposed that, in the Phreatoicinae, the whole of that terminal region had disappeared, leaving only the rounded hinder border of the sixth pleon segment with the anal opening presented posteriorly instead of ventrally; a half-way condition, perhaps persisting in *Phreatoicopsis*, in which a terminal rim seems to constitute the residue of this (seventh) telsonic area.

Secondly, the maxillipeds seem⁽²⁾ to have been large and well developed and definitely of the Syncaridan type; therefore, it is interesting to note in this connection that this appendage reaches relatively its strongest development in *Mesacanthotelson*, the Phreatoicid which most nearly resembles *Acanthotelson*. But the second thoracic legs were clearly much larger and stronger than the succeeding thoracic appendages, a condition which is found in Phreatoicids but not in extant Syncarids.

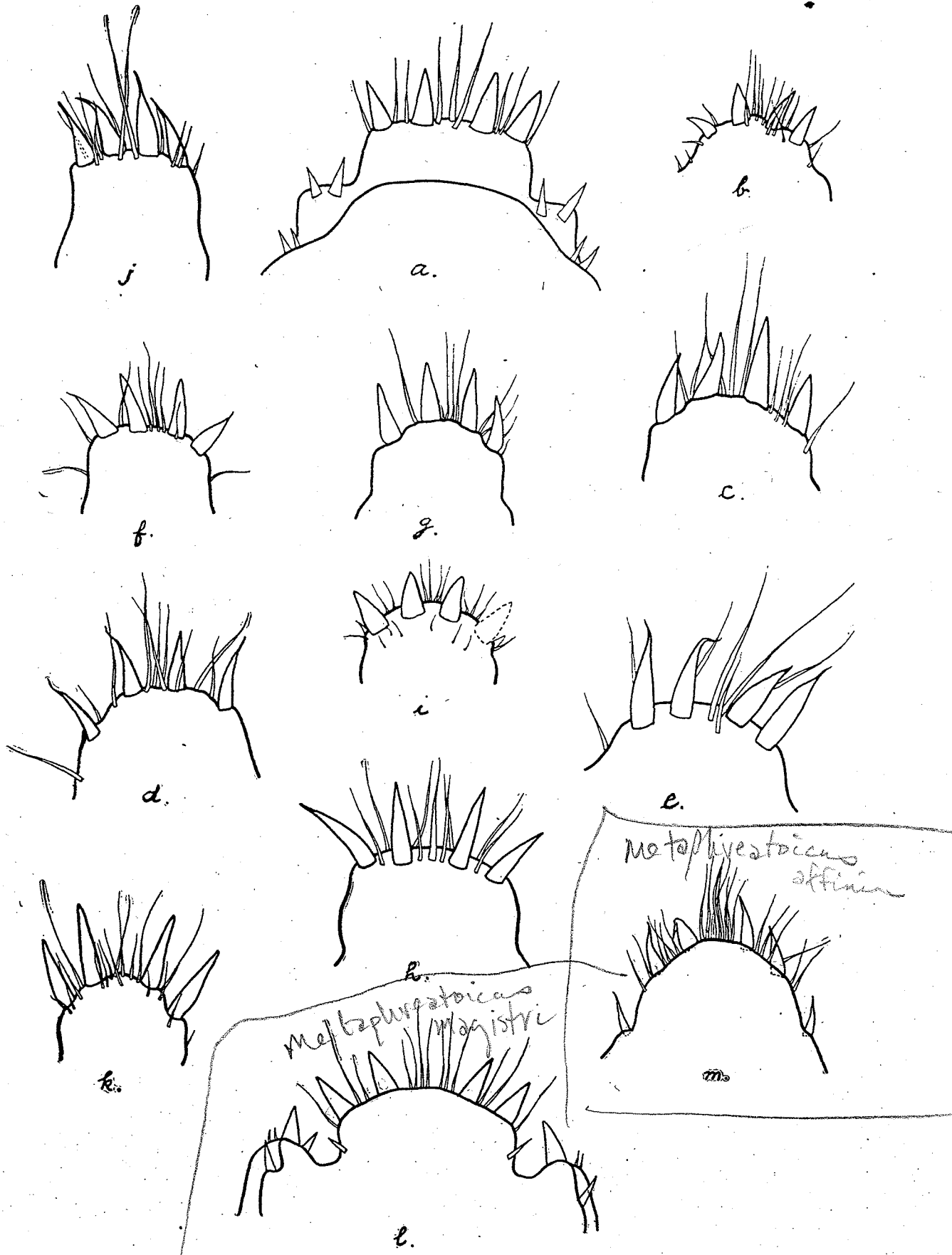
The third character which may distinguish *Acanthotelson* from all extant Phreatoicids is the alleged two-branched condition of its antennule, a feature which is normal for Syncarida. Actually, however, Meek and Worthen's reconstruction

(1) G. Smith, 1909 (Q.J.M.S., vol. 53, p. 500), has suggested that *Acanthotelson* should be considered as a generalized Amphipod.

(2) It should be noted, however, that only in Meek and Worthen's paper, (1868, p. 551, fig. B) is there a suggestion of a stout appendage anterior to the second thoracic and fig. D suggests that this appendage is really the second thoracic of the opposite side: if that is the correct interpretation, then the maxilliped of this form remains unknown but was probably not as large as it is in Syncarida.

of *A. stimpsoni* is not convincing, for it is noteworthy that the double flagellum (with both rami equal!) is apparently not represented in any specimen which is seen in dorsal view. It is true that it is shown quite convincingly as a biflagellate structure in a later figure of *A. eveni* (Meek and Worthen, 1868, p. 551, fig. D), but it is noted that this is a *diagram* made from a specimen preserved on its side, one in which the two flagella are not seen. Indeed, it seems to have been only once figured, and that in a specimen seen from the side, this showing a condition that could very well be brought about by the superposition of the base of one antennule upon that of the other. It is noteworthy that Packard does not figure it in his reconstruction.

For the rest, in most of its features *Acanthotelson* seems to resemble more closely the Phreatoicoidea than the Syncarida; the eyes were probably sessile; the antennae devoid of a scape; the peraeon has but seven recognizable segments, all sub-equal; exopodites do not appear on the peraeopods; the pleopods appear to have been biramous and lamellar, with a well developed sympodite. Cockerell (1916, p. 235) has suggested that the styliform rami of the uropods distinguish the *Acanthotelsonidae* from the other Syncarid families. Actually the single pair of uropods resemble those of Phreatoicids in that (i) they do not form part of a tail fan, (ii) the exopodite is not notched, suggesting an unequal division into two joints, as is the case in the extant Syncarida, (iii) the outer ramus is fringed with spines and setae and *is shorter than the inner*, this being an invariable feature in Phreatoicids, while the reverse is true of Syncarids, and (iv) they could well have been used (as they are in Phreatoicids) as an aid in walking. *Pleurocaris annulatus*, which is regarded by Calman as very little removed from *Acanthotelson*, shows much the same departure from the *Acanthotelsonid* condition as does *Onchotelson spatulatus mihi* from that of *Mesacanthotelson* spp.



a—searlei
b—campestris
c—hounensis

d—thomsoni
e—evansi
f—gesmithi

g—chiltoni
h—minor
i—fontinalis

j—setiferus
k—intermedius
l—magistri
m—affinis

FIG. 80.—Telsonic apices of various species of *Colubotelson* and *Metaphreatoicus*.