

from *Aora typica*, is, however, so very like *Microdentopus maculatus* in every part except the gnathopoda that I have little doubt that it, and not *Aora typica*, is really the male. This is also confirmed by the fact that the two were found together.

DESCRIPTION OF PLATE VIII.

- Fig. 1. *Hymenicus marmoratus*.
 a. Third (external) maxillipede $\times 22$.
 b. Second maxillipede $\times 22$.
 c. Abdomen of male $\times 5$.
- Fig. 2. *Anthura (?) flagellata*.
 a. Antennæ $\times 22$.
 b. Third thoracic leg $\times 22$.
 c. Sixth thoracic leg $\times 22$.
 d. Abdomen and telson $\times 22$.
- Fig. 3. *Microdentopus maculatus*.
 a. First gnathopod of male $\times 22$.
 b. Second gnathopod of male $\times 22$.
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ART. XXV.—*On some Subterranean Crustacea*. By CHARLES CHILTON, B.A.

[Read before the Philosophical Institute of Canterbury, 3rd November, 1881.]

Plates IX. and X.

THE existence of blind Amphipodous Crustacea in wells and caves of England and Europe, has been long known; in this paper I record the existence of similar animals in New Zealand. The Crustacea which form the subject of this paper were obtained from a well at Eyreton, about six miles from Kaiapoi, North Canterbury. The well was made about seventeen years ago, it is not more than twenty-five feet deep, and it is fitted with a common suction pump, through the medium of which these interesting animals were obtained.

From this well I got three species of Amphipoda and one of Isopoda. In none of these have I seen any trace of eyes, though I have examined living as well as preserved specimens. The most interesting species is the Isopod; the only other blind Isopod inhabiting wells or caves that I know of is the genus *Cacidolea*, a species of which is found in the Mammoth Cave of Kentucky, and another in the Wyandotte Cave.*

* See "Nature," 1872, pp. 11, 445, and 484.

The Isopod that I have to describe is remarkable from the fact that it has only six pairs of legs, whilst the normal number is seven pairs. In many Isopoda the young have at first only six pairs of legs, the last thoracic segment being but slightly developed and destitute of appendages,* and hence it might, at first sight, be thought that the animal I have is only an immature form. This, however, I think can hardly be the case, for there is nothing embryonic about the appearance of the animal, and moreover, I have examined altogether twenty-two specimens, varying in length from .16 of an inch to .46 of an inch, and these all agree in wanting the last pair of thoracic legs. These specimens were obtained at various times from January up to October, 1881, and I think it is hardly possible that these can all be immature forms, and that during the whole time not one mature form should have been obtained. If it is, therefore, a mature form, the absence of the last pair of thoracic legs must I suppose be due to arrested development.

ISOPODA.

Cruregens, (nov. gen.)

Generic characters:—Body sub-cylindrical. Head small. First six thoracic segments sub-equal, the seventh *small and without appendages*. Antennæ sub-equal, neither having a flagellum. First pair of thoracic legs large and sub-chelate, the second and third sub-chelate but smaller, the three posterior pairs simple. First pair of abdominal appendages forming an operculum enclosing the branchial plates; last pair biramous. Telson squamiform.

In the antennæ, the shape of the body and of the thoracic legs, this genus resembles *Paranthura*, Spence Bate, and in the shape of the telson and the last pair of abdominal appendages, it is like the closely allied genus *Haliophasma*, Haswell, but it differs from both in the absence of the last pair of thoracic legs.

Cruregens fontanus, sp. nov. Pl. X. figs. 1 to 12.

Eyes none. Short blunt rostrum between the bases of the upper antennæ. Upper antennæ slightly shorter than the lower, formed of four joints; first joint of lower antennæ long, second short, third and fourth about as long as the first, the fourth being followed by a short terminal joint. First pair of thoracic limbs strong and sub-chelate; hand large, broadest at the proximal end, narrowing distally, the palm armed with stout spines, the finger strong and slightly curved; the wrist about twice as long as broad. Last pair of abdominal appendages two-branched, first branch consisting of a single long narrow joint, the other of two joints, the

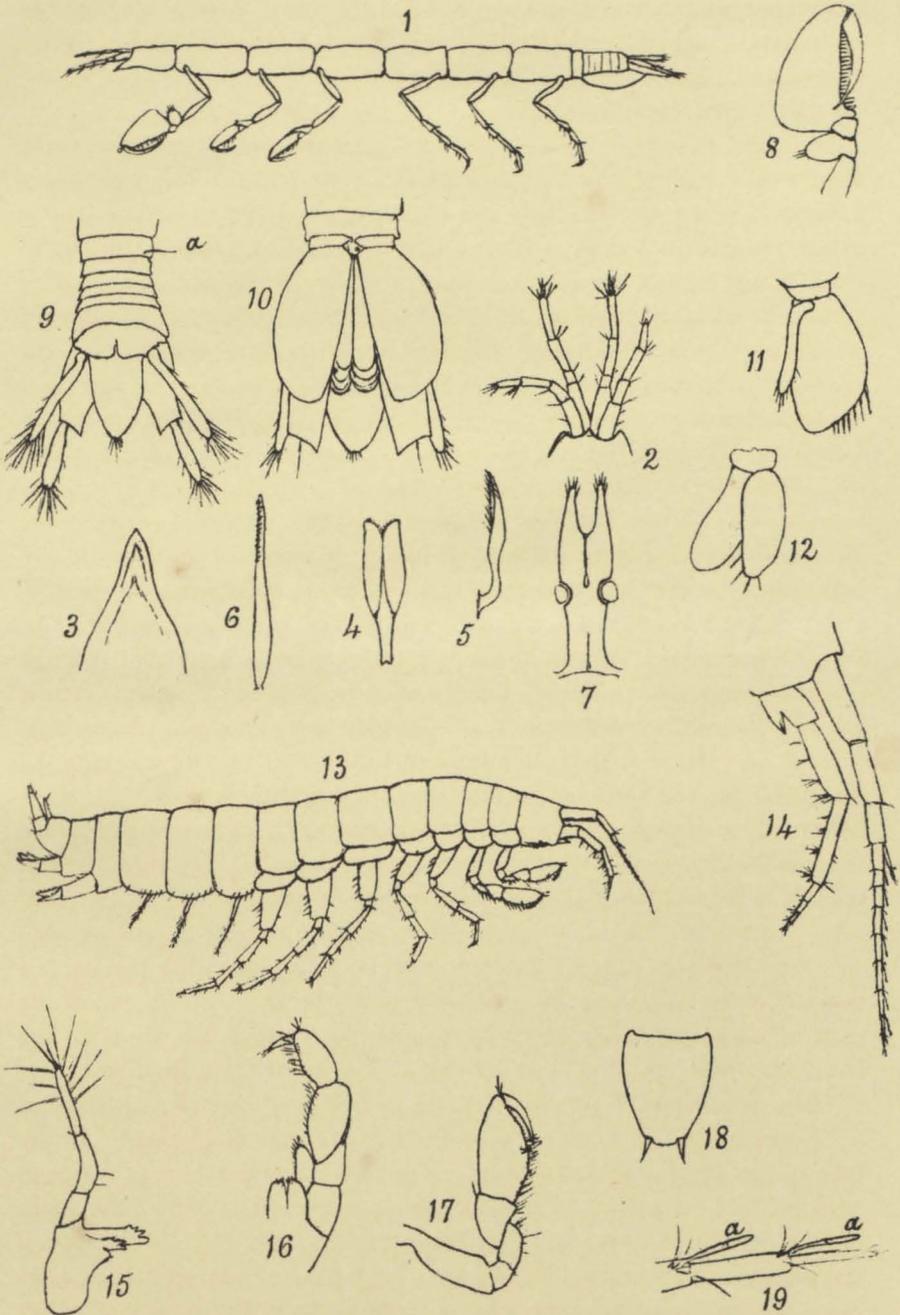
* "Facts and Arguments for Darwin," Fritz Müller, pp. 70-72.

basal one broader and longer than the terminal one. The ends of both branches supplied with numerous rather long setæ. Telson squamiform, sides arched, ending in a blunt point tipped with a few short setæ. Colour transparent. Length of largest specimen .46 inch.

Hab. Pump at Eyreton.

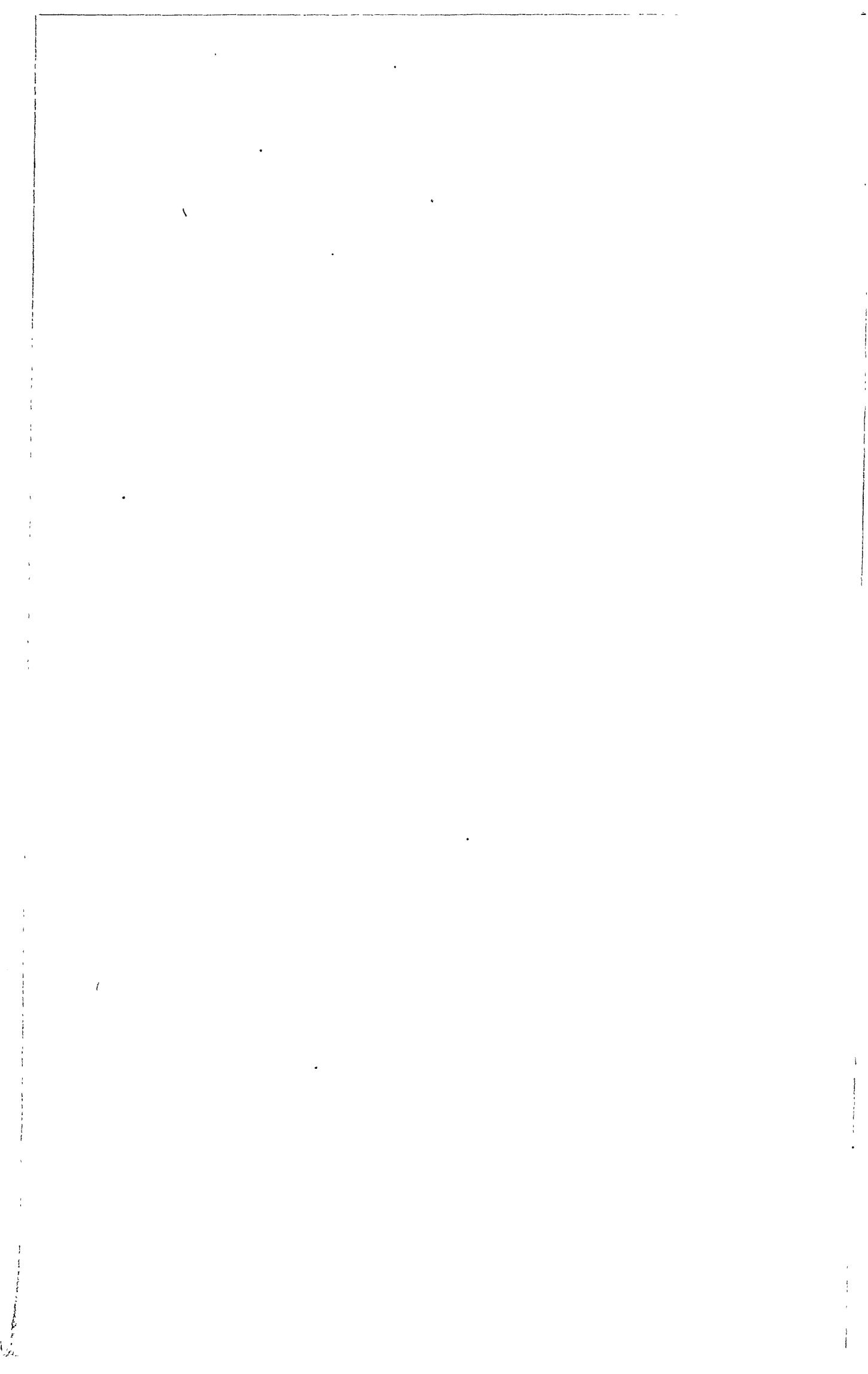
As this Isopod is exceedingly interesting, I have endeavoured to describe and figure it in some detail. The mouth parts are all small and exceedingly difficult to make out, owing to the various parts being to a considerable extent anchylosed together; and I have to thank Professor Hutton for valuable aid in their dissection. Though I have by his aid succeeded in making out the various parts which form the mouth, I cannot, in the absence of sufficient books of reference, be quite certain of their homologies. All the parts of the mouth project forwards; just below the antennæ there is a strong moderately sharp labrum or upper lip (pl. X., fig. 3). The appendage which, by its position, should correspond to the mandibles does not appear to perform the function of mandibles. The two parts, right and left, appear to be here anchylosed together, and no trace of any palp is to be seen; the distal ends are fringed with very short indistinct setæ, and the opposite end is notched (fig. 4). The first maxilla is simple, spoon-shaped at the end, which is fringed with setæ (fig. 5). The second maxilla is also simple, straight, and towards the end it is supplied with short teeth (fig. 6). Though this appendage, by its position, appears to correspond to the second maxilla, yet it is the only one that looks at all like a masticatory organ. If the right and left halves were rubbed longitudinally together they would, owing to the short teeth at their ends, form a most efficient triturating organ. The most posterior of the mouth organs, the maxillipedes (fig. 7), are somewhat concave and operculiform, enclosing the rest of the mouth parts. The basal parts of the two halves on the two sides are anchylosed together, and to the head itself, but the terminal portions are free, and the ends, which are at some distance apart, are tipped with setæ. On each side, near the middle, is a peculiar looking small round piece, which is articulated to the rest of the limb. This may possibly represent a rudimentary exopodite, while the free terminal portion may be the endopodite of the typical Crustacean limb.

The appendages of the abdomen on each side consist of a short basal joint supporting two more or less oval branchial plates (fig. 12). In the appendages of the first abdominal segment the outer branch is much enlarged and forms an operculum over the branchial plates; the inner branch, which lies under the operculum, is narrow (fig. 11). In the view of the abdomen from below (fig. 10), the two halves of the operculum have been slightly separated from one another to show the branchial plates underneath.



SUBTERRANEAN CRUSTACEA.

C.C. del.



AMPHIPODA.

Genus *Crangonyx*.

(Brit. Mus. Cat. Amphip. Crust., p. 178).

Crangonyx compactus, sp. nov. Plate X., figs. 13 to 19.

Eyes not visible. Upper antennæ rather more than one-fourth the length of the body; peduncle with the first joint longer than the second, and the second longer than the third; flagellum rather longer than the peduncle; secondary appendage small and slender, consisting of one long and one short joint. Peduncle of lower antenna longer than that of the upper, the "olfactory denticle" large and prominent, last two joints of the peduncle equal in length, with their posterior edges fringed with several tufts of setæ; flagellum short, rather more than half the length of the last joint of the peduncle. Appendage of the mandible with three joints increasing in length distally, the last bearing several long setæ. Gnathopoda subequal, propodos only slightly broader than the carpus, palm about one half the length of its inferior edge, defined by a stout spine on each side. Pereiopoda subequal. Pleon having the inferior edge of the three anterior segments furnished with five or six small setæ. Three posterior pairs of pleopoda short and broad; first two biramous, third unbranched, the branch longer than the peduncle and composed of one rather long joint followed by a very small one. Telson half as long as the posterior pair of pleopoda, narrowing slightly towards the extremity which bears two short stout spines. Colour—transparent.

Length, .3 of an inch.

Hab. Pump at Eyreton.

This species is readily recognized by the short stumpy appearance of the three posterior pairs of pleopoda. The secondary appendage on the upper antenna is small and very easily overlooked. On the flagellum of the upper antenna there are some "sensory setæ." These are small and cylindrical, not quite as long as the joint they are on, and they are divided by a transverse septum about the middle. On the basal portion of the flagellum there are two of these setæ on each joint, but towards the distal end there is only one on each joint.

This species is rather rare.

Genus *Calliope*.

(Brit. Mus., Cat. Amphip. Crust., p. 148.)

Calliope subterranea, sp. nov. Plate IX., figs. 1 to 10.

Female.—Cephalon without a rostrum. Eyes absent. Upper antenna longer than the lower, about two-thirds the length of the body. The joints of the peduncle decreasing in length and breadth distally. There

is a rudimentary secondary appendage only about half as long as the first joint of the flagellum. Peduncle of lower antenna equal in length to that of the upper, the last two joints equal in length. Appendage of the mandible three-jointed, the second joint larger than the first, the third short and curved. Second gnathopoda more slender than the first. Last three pairs of pereopoda increasing in size from before backwards, the various joints being pretty abundantly supplied with stout setæ. Last three pairs of pleopoda slender, biramous, the penultimate the smallest and having the rami slightly unequal, the rami in the other two being equal. Telson short, as long as broad, the posterior border slightly concave.

Male.—Differs in having sensory capsules and setæ on both pairs of antennæ, and in having the gnathopoda much larger than those of the female. First pair of gnathopoda much larger than the second, propodus very large; palm broad, defined by one long and two short spines, the long one being about two-thirds the length of the finger. Second pair much smaller, palm defined by a short, stout spine. Colour—transparent.

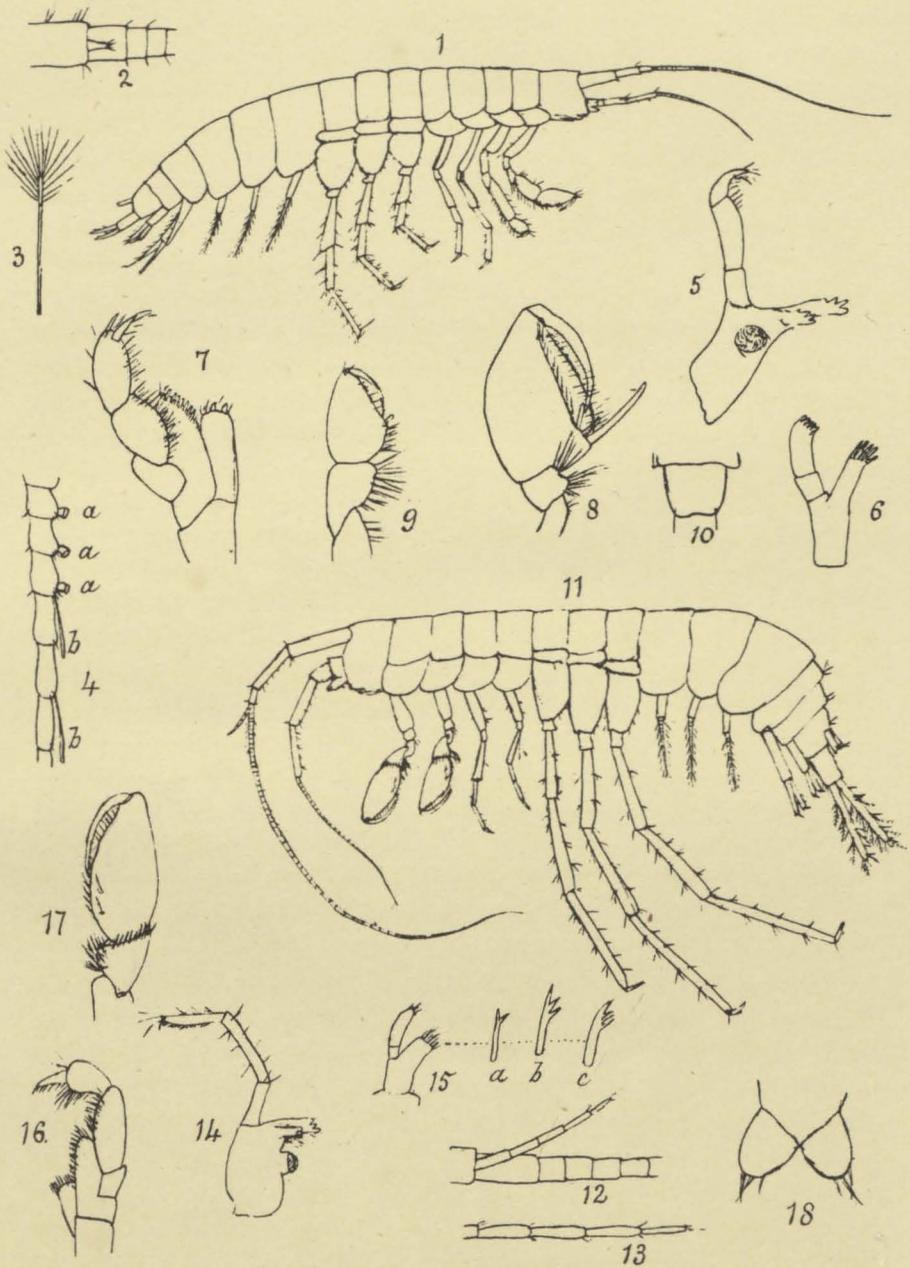
Length of female (with eggs), .3 inch. Male (largest specimen), .5 inch.

Hab. Pump at Eyreton.

This species differs from the other species of *Calliope* in the absence of eyes and in the presence of a rudimentary secondary appendage on the upper antenna, but I have not considered this sufficient to warrant its removal from the genus. The female is very abundant, but the male is rarely obtained.

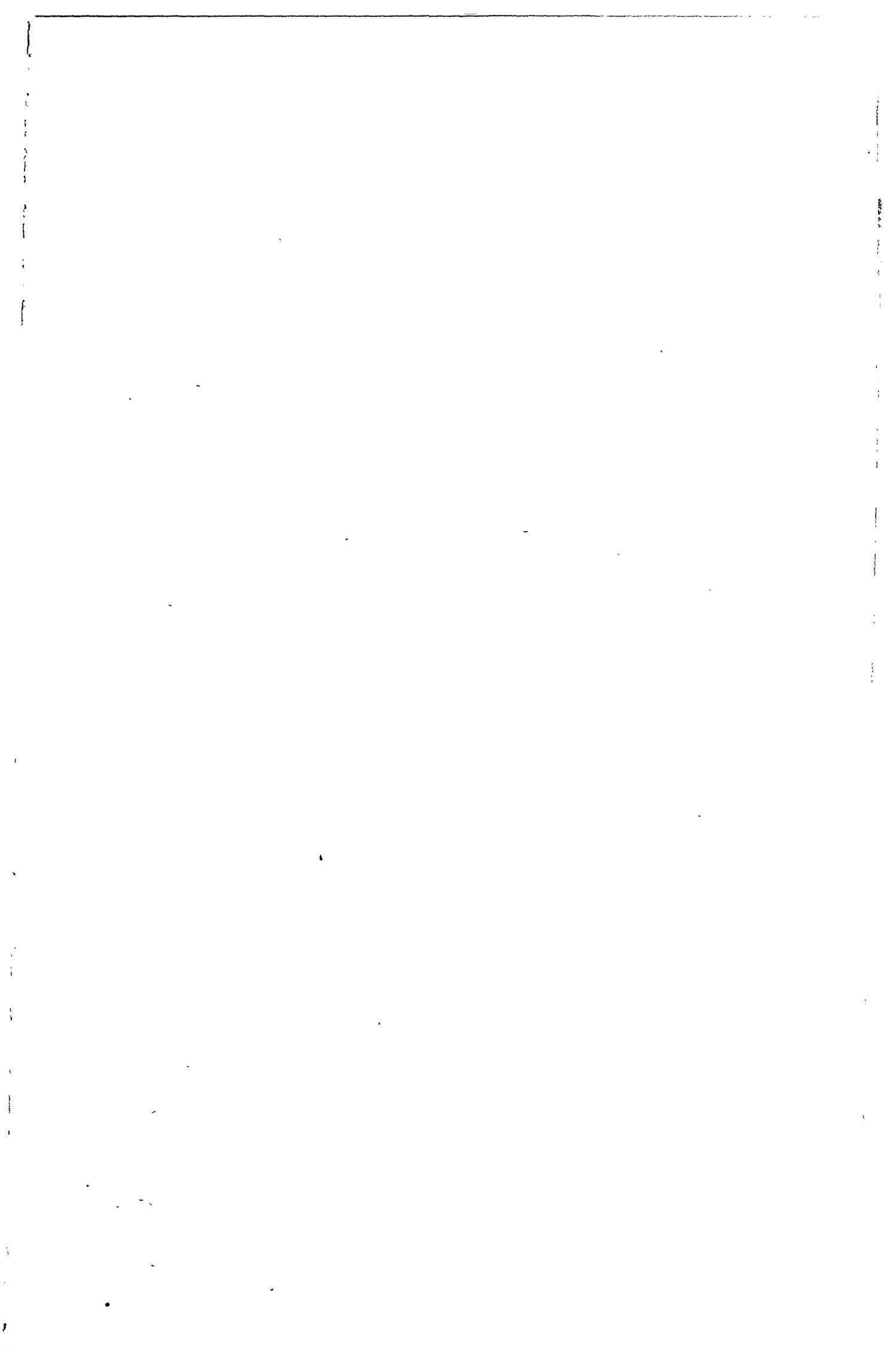
The number of joints in the flagella of the two antennæ varies very much (in the female) according to the size and therefore presumably according to the age of the animal. Thus in very small specimens I found 15 joints in the flagellum of the upper antenna and 7 in the lower, while in full-sized specimens there were about 55 in the upper and 21 in the lower.

In the male, peculiar "sensory capsules" are found on both antennæ. They are to be found on the last two joints of the peduncle and on the proximal half of the flagellum of the upper antenna; on the distal half simple sensory setæ (fig. 4 *b*) are found on every other joint. The sensory capsules are also present on all the joints of the flagellum of the lower antenna except the last two or three. They are cup-shaped and slightly constricted towards the middle, and they are situated on a slight protuberance of the joint of the flagellum (fig. 4 *a*). On the peduncle of the upper antenna of the male there are other peculiar-looking setæ which are evidently sensory. They are long and slender, with several very fine divergent filaments at the distal end (fig. 3). Similar capsules and setæ



C.C. del.

SUBTERRANEAN CRUSTACEA.



appear to have been found in *Niphargus puteanus* by M. Alois Humbert.* The form of the mandibles, second maxilla and maxillipedes will be readily understood from the figures given.

Genus **Gammarus**.

(Brit. Mus. Cat. Amphip. Crust., p. 203.)

Gammarus fragilis, sp. nov. Plate IX., figs. 11 to 18.

Eyes none. Superior antennæ about as long as the body; first joint of the peduncle about as long as the next two together, the third joint being only one-third the length of the second; secondary appendage with about five joints, the joints of the flagellum increasing considerably in length distally. Peduncle of inferior antennæ about as long as that of the upper, the last two joints equal in length with their inferior edges setose; flagellum longer than the peduncle. Appendage of the mandible with three joints, the second being longer than the other two. Gnathopoda subequal, propodos long ovate, finger curved. Last three pairs of pereopoda very long, increasing in length from before backwards, the last pair reaching as far as the last pair of pleopoda. Last three segments of the pleon with stout setæ on their posterior dorsal margins. Of the three posterior pairs of pleopoda the first reaches as far as the end of the second, but the third is very long; its two branches are equal in length and supplied with numerous stout setæ and a number of delicate plumose setæ. Telson double, each part having the posterior end rounded and tipped with two or three setæ.

Colour—transparent.

Length (largest specimen), .65 inch.

Hab. Pump at Eyreton.

This species is readily recognized by the great length of the last pair of pleopoda and of the last three pairs of pereopoda. It is not very common, but it is larger than any of the other species.

DESCRIPTION OF PLATE IX.

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| Fig. 1. | <i>Calliope subterranea</i> , female, × 9. |
| Fig. 2. | „ „ Base of flagellum of upper antenna showing the rudimentary secondary appendage. |
| Fig. 3. | „ „ Sensory seta from peduncle of upper antenna of male. |
| Fig. 4. | „ „ Portion of flagellum of upper antenna of male showing sensory capsules <i>a</i> , and sensory setæ <i>b</i> . |
| Fig. 5. | „ „ Mandible. |
| Fig. 6. | „ „ Second maxilla. |
| Fig. 7. | „ „ Maxillipede. |
| Fig. 8. | „ „ First gnathopod of male. |
| Fig. 9. | „ „ Second gnathopod of male. |
| Fig. 10. | „ „ Telson. |

* See Ann and Mag. Nat. Hist., ser. 4, vol. xix., 1877, p. 243.

- Fig. 11. *Gammarus fragilis* × 7.
 Fig. 12. " " Base of flagellum of upper antenna, with the secondary appendage.
 Fig. 13. " " Extremity of upper antenna.
 Fig. 14. " " Mandible.
 Fig. 15. " " Second maxilla; *a b c*, different forms of setæ from the same.
 Fig. 16. " " Maxillipede.
 Fig. 17. " " First gnathopod.
 Fig. 18. " " Telson.

DESCRIPTION OF PLATE X.

- Fig. 1. *Cruregens fontanus* × 7½.
 Fig. 2. " " Antennæ, from above.
 Fig. 3. " " Labrum.
 Fig. 4. " " Mandibles.
 Fig. 5. " " First maxilla.
 Fig. 6. " " Second maxilla.
 Fig. 7. " " Maxillipedes.
 Fig. 8. " " First thoracic leg.
 Fig. 9. " " Abdomen and telson, from above; *a*, last thoracic segment.
 Fig. 10. " " Abdomen, seen from below.
 Fig. 11. " " Appendage of first abdominal segment.
 Fig. 12. " " Branchial plates.
 Fig. 13. *Crangonyx compactus* × 9.
 Fig. 14. " " Antennæ.
 Fig. 15. " " Mandibles.
 Fig. 16. " " Maxillipede.
 Fig. 17. " " First gnathopod.
 Fig. 18. " " Telson.
 Fig. 19. " " Extremity of upper antenna showing sensory setæ *a*.

ART. XXVI.—*History of Fish Culture in New Zealand.*

By W. ARTHUR, C.E.

[Read before the Otago Institute, 18th February, 1881.]

Plates XII.—XIV.

THE experience of other countries, as France, Germany, England, and America, has demonstrated the fact, that the cultivation of *water*, acre for acre, can be made more profitable to a community than the cultivation of the *land*. Fish culture, begun as a scientific experiment in natural history, has expanded into a great national industry—and, with the exception of