No. VIII.—ON THE PONTONIINÆ.

By L. A. Borradaile, M.A.

(*Lecturer in Zoology in the University of Cambridge, Fellow, Dean, and Lecturer of Selwyn College.*)

(Communicated by Prof. J. Stanley Gardiner, M.A., F.R.S., F.L.S.)

(Plates **52**—**57**.)

Read 2nd November, 1916.

FOREWORD.

The collections made during Professor Stanley Gardiner's two expeditions to the Western Indian Ocean are particularly rich in Pontoniinæ, and contain many new species, some of which are of peculiar interest. In view of these facts, and of the large additions to our knowledge of the group that have been made since my revision of it in 1898, I have thought well again to revise it as a whole*. The results of my labours are embodied in the present paper.

The following is a list of the species collected, with a statement of the localities in which they were taken:

1. *Urocaridella gracilis* Borradaile, 1915. Suvadiva, Kolumadulu, and Haddumati Atolls.
2. *Urocaris* sp., ? *U. longicaudata* Stimpson, 1860. N. Malé Atoll, Amirante.
3. *Urocaris psamathe* de Man, 1902. N. Malé Atoll, Diego Garcia.
4. *Palæmonella tridentata* Borradaile, 1899. Goidu, Goifurfchendu Atoll, S. Nilandu Atoll, Salomon, Coin, Peros Banhos.
5. *Palæmonella elegans* Borradaile, 1915. Salomon Is.
6. *Palæmonella longirostris* Borradaile, 1915. Reef, Naifaro, Fadiffolu Atoll.

* The present article was finished towards the end of the year 1914. Since then there have been described the following new species which probably or certainly belong to the Pontoniinæ.

(1) *Paratypton siebenrocki* Balss, 1915 (Zool. Anz. xlv. p. 83), Red Sea and Samoa. A remarkable coral commensal, superficially resembles *Conchodytes*. As neither the telson nor the gill formula are described it is not certain that this is a member of the Pontoniinæ.

(2) *Urocaris indica* Kemp, 1915 (Mem. Ind. Mus. v. p. 279), Chilka Lake, India. Perhaps accounts for Pearson's report of *U. longicaudata* from Ceylon. Lives in water whose salinity varies, and which is at times nearly fresh.

(3) *Periclimenes demani* Kemp, 1915 (*loc. cit.* p. 275). A member of the subgenus *Falciger*. From the same waters as *U. indica*.

(4) *Periclimenes* (*Hamiger*) *novæ-zealandiæ* Borradaile, 1916 (Brit. Antarct. ("Terra Nova") Exp. Rep., Zool., III, 2, p. 87, 1916), New Zealand. Representative of a new subgenus and possibly of a new genus. First chela has fingers fringed with long curled hairs, second pair unequal, one very large and of abnormal shape. Hepatic spine absent. Ischiomeropodite of third maxilliped somewhat broadened.

7. *Periclimenes* (*Cristiger*) *frater* Borradaile, 1915. Reef, Egmont.
8. *Periclimenes* (*Cristiger*) *incertus* Borradaile, 1915. S. Nilandu Atoll.
9. *Periclimenes* (*Cristiger*) *brocki* (de Man), 1887. Suvadiva Atoll.
10. *Periclimenes* (*Corniger*) *ceratophthalmus* Borradaile, 1915. Hulule, Malé Atoll.
11. *Periclimenes* (*Corniger*) *cornutus* Borradaile, 1915. Hulule, Malé Atoll.
12. *Periclimenes* (*Falciger*) *vitiensis* Borradaile, 1898. Coetivy, Seychelles.
13. *Periclimenes* (*Falciger*) *affinis* Borradaile, 1915. Salomon Is.
14. *Periclimenes* (*Falciger*) *dubius* Borradaile, 1915. Minikoi.
15. *Periclimenes* (*Falciger*) *nilandensis* Borradaile, 1915. S. Nilandu Atoll.
16. *Periclimenes* (*Falciger*) *seychellensis* Borradaile, 1915. Praslin, Seychelles.
17. *Periclimenes* (*Falciger*) *brocketti* Borradaile, 1915. N. Malé Atoll.
18. *Periclimenes* (*Falciger*) *suvadivensis* Borradaile, 1915. Suvadiva Atoll.
19. *Periclimenes* (*Falciger*) *borradailei* Rathbun, 1904 Haddumati Atoll.
20. *Periclimenes* (*Falciger*) *kolumadulensis* Borradaile, 1915. Kolumadulu Atoll.
21. *Periclimenes* (*Falciger*) *compressus* Borradaile, 1915. Saya de Malha, 145 fms.
22. *Periclimenes* (*Falciger*) *spiniferus* de Man, 1902. Goidu, Goifurfchendu Atoll, Hulule, Malé Atoll, Coetivy, Seychelles, Salomon Is., Diego Garcia.
23. *Periclimenæus fimbriatus* Borradaile, 1915. Mulaku Atoll, Providence, 39—50 fms.
24. *Periclimenæus robustus* Borradaile, 1915. Amirante, 29—39 fms.
25. *Harpiliopsis beaupresi* (Audoin), 1825. Goidu, Goifurfchendu Atoll, Hulule, Malé Atoll, Barachois, Diego Garcia.
26. *Harpiliopsis depressus* (Stimpson), 1860. Goidu, Goifurfchendu Atoll, Hulule, Malé Atoll. Reef, Naifaro, Fadiffolu Atoll. Minikoi. Coetivy, Seychelles. Coin, Peros Banhos. Salomon Is.
27. *Coralliocaris graminia* (Dana), 1852. Coetivy, Seychelles.
28. *Coralliocaris nudirostris* (Heller), 1862. Goifurfchendu Atoll, Coetivy, Seychelles.
29. *Coralliocaris macrophthalma* (H. M.-Edwards), 1837. Saya de Malha, 26 fms.
30. *Coralliocaris japonica* Ortmann, 1891. Hulule, Malé Atoll. Coin, Peros Banhos. Coetivy, Seychelles. Salomon Is. Saya de Malha, 26 fms.
31. *Anchistus miersi* (de Man), 1888. Hulule, Malé Atoll. Egmont, Seychelles.
32. *Pontonides maldivensis* (Borradaile), 1915. Fadiffolu Atoll.
33. *Conchodytes tridacnæ* Peters, 1851. Hulule, Malé Atoll. Minikoi.
34. *Conchodytes meleagrinæ* Peters, 1851. Salomon, Farquhar, N.W. Cheval.

Rather more than half the species in the above list were new, and among these are representatives of three genera previously unrecognized. I have established a fourth genus for two of the species that were already known to science.

It is unfortunately not at present possible to reach any faunistic conclusions concerning the Carides of the Western Indian Ocean.

My revision is not based solely upon the specimens placed in my hands by Professor Gardiner. By the kindness of Mr F. A. Potts I am enabled to include in

it the results of the examination of a small but interesting collection made by him in the Torres Straits, which contained three species new to science, one of them the representative of a new genus. I have also re-examined the material in the Cambridge University Museum of Zoology, and am under much obligation to Dr W. T. Calman for enabling me to do the same with the Pontoniinæ of the British Museum.

I have not restricted myself to the systematics of the subfamily. The unfortunate destruction in transit of a great part of the crustaceans collected by myself in the Island of Minikoi has deprived me of the numbered specimens to which my field notes applied, and thereby rendered it impossible for me to give information upon the natural history of various prawns, but I have endeavoured to elucidate to some extent the conditions under which Pontoniinæ live, and the connection between their structure and their habits. It has seemed to me advisable also to discuss briefly certain questions of morphology and genetics, and impossible to omit consideration of the relationship of the genera of Pontoniinæ with one another and with other prawns.

Short definitions of the new species and of three of the new genera have already appeared in the Annals and Magazine of Natural History for February, 1915. Fuller diagnoses, with notes on some other species, will be found in the course of the present article.

A Monograph of the Pontoniinæ.

It is one of the paradoxes of Marine Natural History that the Decapod Crustacea, the most active and nervous of the invertebrates of the sea, are also among the most prone to avail themselves of opportunities of shelter and concealment, and make use of the most subtle adaptations to this habit. In describing the collection of crabs made by Professor Gardiner and myself in the Maldive Islands and Minikoi*, I found occasion for some remarks upon this phenomenon with regard to the various groups of Brachyura. Among the prawns, two families are pre-eminent in the same respect. Professor Coutière's fine researches upon the Alpheidæ have illuminated one of these cases. The other is that of the Pontoniinæ. Although the members of this group have not so rich an originality as have the Alpheidæ in the production of bizarre modifications of structure, they are in one way even more interesting, for they show a more complete series of stages in the transformation of the primitive caridoid facies, ranging from wholly free-living forms such as *Urocaris* to commensal and very considerably degenerate genera such as *Conchodytes*. The success which has attended their strategy of retreat makes them so abundant that they bulk largely in any well-made collection of prawns from the Tropics, and their species are numerous and often closely related, though generally perfectly distinct. Moreover, the assembling of the species into genera and other groups is a matter of great difficulty, partly because they present an almost unbroken series of degrees of modification, associated, no doubt, with a gradually increasing dependence upon the host, and partly because among species of similar habits similar features reappear with bewildering frequency. They are therefore of as much importance to the systematist as to the naturalist.

* Gardiner's Fauna of the Maldives.

The Pontoniinæ are members of the Palæmonidæ, the central and typical family of the Carides. By the loss of exopodites and mastigobranchs from the legs, the reduction of the gill formula, and the position of the last joint of the second maxilliped at the side of the preceding joint, this family has discarded the primitive organization which still prevails in such groups as the Pasiphæoida and the Hoplophoroida. In the well-marked cleft of the mandible, the retention of the distal "lacinia" of the maxilla, the shape of the legs of the first two pairs, with their undivided carpopodites and relatively unspecialized chelæ, and in a certain absence of exaggeration in all the features of the body, they appear more conservative than the remaining members of the tribe, to some of which, indeed, and in particular to the Crangonoida, it seems possible that their near ancestors may have given rise.

The Subfamilies of the Palæmonidæ.

The members of the Palæmonidæ fall into four groups, which we may rank as subfamilies, defining them briefly by means of the following key:

I. None of the bristles at the end of the larval telson become in the adult transposed on to the anterior part of that organ, which is therefore unarmed on its back and sides. The surface of the molar process of the mandible is closely ridged. [There is a pleurobranch on the third maxilliped.]

Desmocaridinæ Borradaile, 1915.

II. Two pairs of the bristles at the end of the larval telson become in the adult transposed on to the back of that organ. The surface of the molar process of the mandible bears some half-dozen large knobs or crests.

A. The end of the telson bears six spines. [There is no pleurobranch to the third maxilliped.]

Pontoniinæ Kingsley, 1878.

B. The end of the telson bears four spines and a varying number of feathered bristles.

1. The side of the carapace is traversed by a suture. The outer flagellum of the antennule is but slightly cleft. There is no pleurobranch to the third maxilliped.

Typhlocaridinæ Annandale and Kemp, 1913.

2. The side of the carapace has no suture. The outer flagellum of the antennule is deeply cleft. There is a pleurobranch to the third maxilliped.

Palæmoninæ Kingsley, 1878.

The peculiarities set forth in this key belong to all members of the subfamilies, which by their means can be absolutely separated. In elucidating the relations of the subfamilies to one another, however, account must also be taken of certain universal characteristics by which the affinities of the groups are indicated.

Of the four subfamilies, that of the Desmocaridinæ is the most primitive, as has been well shown by M. Sollaud, the describer of its only genus, *Desmocaris**. Among

* C. R. Ac. Sci. clii. p. 913 (1911).

other features, M. Sollaud finds the following to indicate its nearness to the ancestral form of the family: (1) the condition of the telson, (2) the retention of the larval supraorbital spine, (3) the armature of the molar process*, which recalls that of the primitive *Acanthephhyra* (Hoplophoridæ), (4) the simple form of the epipodite of the first maxilliped, which in most other Palæmonidæ is bilobed, (5) the relation of the propodite of the second maxilliped to the dactylopodite, which is here largely free, instead of lying wholly alongside the propodite, (6) the armature of the fingers of the chelæ, which consists of fine spines arranged comb-wise, as in many Hoplophoridæ and Penæidæ, and not of a cutting edge or coarse teeth, as in most Carides, (7) the gill-formula, which comprises a pleurobranch for each leg and one for the third maxilliped, one arthrobranch for the latter limb, and a podobranch on the second maxilliped. At the same time, *Desmocaris* is not without features which constitute a departure from the primitive state. As such may be cited (8) the loss of the mandibular palp, (9) the disappearance of the cleft between the two divisions of the outer "lacinia" of the maxilla, and (10) great reduction of the podobranch of the second maxilla.

The Palæmoninæ are less primitive than *Desmocaris* in respect of the characters numbered (1), (2), (3), (5), and (6) above, and most of them have a bilobed epipodite on the first maxilliped, though in regard to (9), (10), and generally also to (8), they are more primitive. The Typhlocaridinæ are an aberrant branch of the Palæmonine stock.

On the other hand, the less specialized of the Pontoniinæ are in many respects near to the ancestral type. It is true that in the condition of the telson and of the molar process†, and in the loss of the pleurobranch of the third maxilliped, all Pontoniinæ are unprimitive, but (*a*) many keep the supraorbital spine, (*b*) while nearly all have lost the mandibular palp, *Urocaridella* and *Palæmonella* keep this structure, though it is here of two joints, and not of three as in the Palæmoninæ, (*c*) nearly all have a double lacinia on the maxilla, (*d*) some have a simple epipodite to the first maxilliped, and in many cases it is but slightly cleft, (*e*) some (belonging it is true to the more modified genera *Harpilius* and *Coralliocaris*) have a free, or nearly free, dactylopodite of the second maxilliped, (*f*) though the anterior pleurobranch is lost, *Urocaridella*, and according to Nobili some *Ancyclocaris*, have a podobranch on the second maxilliped, and (*g*) several species of *Periclimenes* have the comb arrangement on the fingers of the first chela, and in at least one (*P. denticulata*) it is found also on the second. Moreover (*h*) in the form of the outer flagellum of the antennule, which is generally but slightly cleft, the Pontoniinæ present a primitive feature not found in either *Desmocaris* or the Palæmoninæ. Since, however, this feature is in the present subfamily found in the genera which are otherwise not primitive, it seems likely that it is here not ancestral but a reversion.

It would appear therefore that, though *Desmocaris* has departed least from the structure of the ancestral palæmonid, the Pontoniinæ left the main stem before the evolution of the first representative of the Palæmoninæ.

* The molar surface is a plain, round area, about half of which is covered by toothed ridges. These are probably an exceedingly primitive feature, for they are found in many Branchiopoda.

† But see below, p. 335.

Desmocaris and the Palæmoninæ are active, free-living prawns, mostly inhabiting fresh or brackish water. The Pontoniinæ, on the other hand, are marine, and most of them lead a hidden and sluggish life, depending for shelter upon other animals, such as corals, bivalves, echinoderms, and ascidians. Are we to consider that the non-primitive characters which differentiate this group have any connection with their mode of life? Clearly, since not all Pontoniinæ lead a sluggish existence, it is not possible to regard the diagnostic characters of the subfamily as direct adaptations to such existence. In any case it would be hard to see this significance in the armature of the telson, or in the structure of the mandible, which is no doubt connected with some peculiarity, either in the food or in the mode of feeding, shared by the Palæmoninæ. It is, indeed, somewhat remarkable to find that the mandible of the most advanced commensals of the subfamily does not differ essentially from those of its most primitive members. But M. Sollaud is quite possibly right in considering* that the reduction of the gill series, though it cannot have been caused by the change to a less active life, has tended to bring about such a change. If, however, the characters of the Pontoniinæ as a whole cannot be regarded as direct adaptations to a sheltered life, there is within the group a long series of such modifications, exhibited by almost every organ of the body, and often traceable from genus to genus in a striking manner.

The History of the Pontoniinæ.

The subfamily Pontoniinæ comprises fifteen genera, described at various dates from 1829 to the present day. The first of these to be established was *Pontonia*, founded by Latreille in 1829†, for a species, commensal with bivalves, which had been named by Petagna *Astacus tyrrhenus* (Plate **57**, fig. 29). By 1837, when H. Milne-Edwards published his *Histoire Naturelle des Crustacés*, the number of species assigned to this genus had risen to four. Roux in 1831 gave the name *Pelias* to two prawns of more active habit which are now known as *Periclimenes scriptus* and *P. amethysteus*, *Pelias* being preoccupied as a generic name. *Periclimenes* was given its present name in 1844, by Costa, who at the same time founded *Typton* for a species living in sponges. In 1851, Peters established *Conchodytes* for two very specialized species related to *Pontonia*. Hitherto isolated genera had been founded, but in 1852 the first steps were taken towards recognizing the unity of a group of forms which was to become the nucleus of the present subfamily. In that year Dana, reporting on the Crustacea of the United States exploring expedition, separated from *Pontonia* certain coral-haunting species which he erected into the genera *Oedipus* and *Harpilius*. *Conchodytes* he did not recognize. At the same time he described as allied to these a genus *Anchistia*, which has subsequently proved to be the same as Costa's *Periclimenes*, and indicated in a footnote that the true position of *Typton* was in this neighbourhood. The name *Oedipus* was already in use, and Stimpson accordingly changed it in 1860 to *Coralliocaris*. *Palæmonella*, also founded by Dana, was placed by him between *Anchistia* and *Palæmon*, and Stimpson, in founding *Urocaris*, placed

* C. R. cli. p. 1158. † References will be found below.

it between *Anchistia* and *Palæmonella*. Both *Palæmonella* and *Urocaris* consist of gracefully built species, and until recently it has generally been considered that their affinities are Palæmonine rather than Pontoniine. In 1878 Kingsley founded a subfamily Pontoninæ for the genera *Pontonia*, *Coralliocaris*, *Harpilius*, *Anchistia*, *Urocaris*, and *Typton*, together with the *Euryrhynchus* of Miers and *Palæmonetes* of Heller which are certainly Palæmoninæ and have been treated as such by all subsequent authors. In 1879, however, Kingsley treated the members of the Pontoninæ merely as a section of his Palæmoninæ. In 1888 Bate raised them to the rank of a family—the Pontoniidæ. In 1890 Ortmann made considerable contributions to our knowledge of this family, and in 1899 he added to it the Hymenocerinæ, placing its original members in a subfamily Pontoniinæ. The true affinities of *Hymenocera*, however, are not represented by this arrangement*. In 1898 I revised the Pontoniidæ, establishing a new genus *Anchistus* for some species intermediate between *Periclimenes* and *Pontonia*. Since then Nobili has founded in 1902 the genus *Coutierea*, and in 1906 *Stegopontonia*, both related to *Coralliocaris*. *Ancyclocaris*, established in 1902 by Schenkel for a prawn which is now known to shelter under the protection of a sea anemone, was connected with the Pontoniidæ by Nobili in 1906. In 1907 I reverted to the view that the Pontoniinæ should rank as a subfamily of the Palæmonidæ. Finally, Sollaud, in an illuminating article (1910), discussed the characteristic features of the Pontoniidæ, and definitively included among them the genera *Palæmonella* and *Urocaris*. In the present paper five new genera—*Urocaridella*†, *Pontoniopsis*†, *Periclimenæus*†, *Pontonides*, and *Harpiliopsis*—are proposed, and four subgenera established within the genus *Periclimenes*‡.

The history of the Pontoniinæ as a unit of classification may be summed up as follows:

Subfamily **Pontoniinæ** Kingsley, 1878.

Pontoninæ Kingsley, Bull. Essex Institute, x. p. 53 (1878).

Pontoniidæ Bate, "Challenger" Macrura, p. 927 (1888). Ortmann, in Spengel, Zool. Jahrb. Syst. v. p. 460 (1890). Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 376 (1898). Rathbun, Bull. U. S. Fish. Comm. xx. II. p. 120 (1901). Sollaud, C. R. Ac. Sci., cli. p. 1158 (1910).

Pontoniinæ Ortmann, Bronn's Thierreich, v. II. pp. 1124, 1130 (1899). Borradaile, Ann. Mag. Nat. Hist. (7), xix. p. 472 (1907); Ib. (8) xv. p. 206 (1915).

The Organization of the Pontoniinæ.

The connection between structure and mode of life is very clearly shown by the *habit of body* of Pontoniinæ. In *Urocaridella* (Plate **53**, fig. 2) and *Urocaris*, whose members are probably all free swimmers, the body is slender and strongly compressed, with a very long sixth abdominal segment. In *Palæmonella* (Plate **53**, fig. 5) and *Periclimenes* (Plate **52**, fig. 1), which wander, with an activity that probably varies from species to species, over

* See pp. 405, 408, 410 in this volume.

† Preliminary descriptions of these genera have been published in the Annals and Magazine of Natural History for February, 1915.

‡ *Marygrande* Pesta, 1911, is not, in my opinion, distinct from *Anchistus*.

the surface of various objects on the sea-floor, or shelter without quiescence upon the bodies of echinoderms, where they have neither a stable foothold nor great protection, the habit of body is very much that of the *Leander* of the British coast—slender, but without the attenuation of *Urocaris*. *Periclimenes* (Plates **54**, **55**, figs. 10—16) shows considerable variety in body form, and this is no doubt connected with differences in habitat and activity. *Periclimenæus* (Plate **55**, figs. 19, 20) is an aberrant group of *Periclimenes* which has taken on an *Alpheus*-like habit of body, no doubt in accordance with some special mode of life. *Pontoniopsis*, commensal with a crinoid, is more modified in respect of some of its organs than is *Periclimenes*, but in regard to habit of body is in much the same condition. *Ancyclocaris*, living within the zone of protection of a large sea-anemone, whose mouth it even enters at times, has a more stoutly built body with, in the female, a hump on the back of the thorax which suggests some peculiarity in the ovary. *Harpiliopsis*. *Harpilius*, and *Coralliocaris* are adapted by their heavy, depressed bodies to a sluggish life among the branches of coral stocks, in that habitat which swarms with *Trapezia* and other small crabs, and is such a rich collecting ground for the marine zoologist in the tropics. *Stegopontonia* is an aberrant member of this group of genera, adapted for an existence spent among the spines of a sea-urchin, and *Coutierea*, also related here, bears, with its spiny, keeled abdomen, and long rostrum and supraorbital spines, the characteristic appearance of a deep sea crustacean. *Anchistus*, *Pontonia* and *Conchodytes*, which live within the shells and tests of bivalves and ascidians, have reached the highest degree of specialization in the subfamily. Their swollen, clumsy bodies, though not more depressed than those of *Coralliocaris* and *Harpiliopsis*, have in some cases almost lost the semblance of prawns, and suggest degeneration as strongly as that of the crab *Hapalocarcinus*, to which they bear no little resemblance. *Typton*, though heavily built, is compressed and prawn-like, and is no doubt adapted by its shape to life in the canal system of the sponges which it inhabits. In all these cases, the male, though his body tends to undergo the same modifications as that of his mate, has a more normal appearance than she, principally because his abdomen is less enlarged (Plate **57**, fig. 29).

Thoracic sterna are distinct and well formed in all genera of the subfamily, though narrow between the maxillipeds, and there is not in this respect the difference that might be expected between *Periclimenes* and the more stoutly built forms. In *Urocaridella* and *Urocaris*, the sterna are narrow, in correspondence with the compression of the body.

The *abdomen* of the Pontoniinæ is of the caridean type, with a fairly large first segment, a very large second segment, and a bend between the third and fourth segments. This bend is most marked in *Urocaridella* and *Urocaris*, but it is distinct in all other genera except *Pontonia*, *Pontonides*, and *Conchodytes*, where it is merged into a general curvature of the hinder segments. In the more sedentary genera the pleura of the first three segments of the female are very large and foliaceous, and form, with the incurved tail fan, a great pocket for the eggs. In *Urocaridella* and some species of *Urocaris* the hinder part of the third tergum is swollen into a hump, and bears a hooked process which overhangs the succeeding segment.

Like other prawns, the Pontoniinæ have an *armature of spines* on prominent parts of the body. The use of this armature is realised at once when a prawn is held alive in the hand. With its abdomen bent under the thorax, the animal is a wedge-shaped object with the broad end in the direction of escape—that is backwards—and all its spines projecting forwards, so that they preserve for it any ground which it gains in its struggles. The armature includes the rostrum and its teeth, spines on the carapace, on the two pairs of antennae, and often on the uropods, and in a few cases a hooked projection at the back of the third abdominal segment. As might be expected, it is less developed in the heavily built sedentary forms than in the lighter species which live a more exposed life.

The *rostrum* is probably seen in its earliest form in some of the species of *Periclimenes*. Typically, in this genus it is a straight, compressed, lanceolate structure (Plate **54**, fig. 10 *a*), of about the same length as the region of the carapace behind it, and bears above and below a fairly deep, toothed crest, the upper crest being continued upon the carapace by a row of two or three teeth. This form of rostrum is well seen in *P. scriptus*. In certain cases it loses some or all the teeth of the ventral crest (Plate **54**, fig. 9 *a*) or even the crest itself. Sometimes, as in *P. brevinaris*, it becomes shorter. In other species, as in *P. ensifrons*, it is curved upward at the end, so that the upper edge becomes concave. Often, as in *P. spiniferus* (Plate **52**, fig. 1 *a*), the curved rostrum is longer and slenderer than the lanceolate type, and this tendency reaches its height in *P. borradailei* and *P. kolumaduluensis*. *Urocaridella* (Plate **53**, fig. 2 *a*) has a very long and much upcurved rostrum, toothed above and below, with the dorsal crest high at the base. *Urocaris* loses the ventral teeth of this rostrum, and in some species has the organ shortened by the loss of the slender distal part. *Palæmonella* has a shallow rostrum, usually rather short and nearly straight. In *Ancyclocaris* it is short and straight, but of a good depth. The more sedentary genera show varying degrees of reduction and modification of this rostrum. The reduction is least marked in *Harpiliopsis*, *Harpilius*, and *Coralliocaris*. In *Harpiliopsis* and *Harpilius* the rostrum hardly differs from that of *Periclimenes*, but is rather small, and wide at the base. In *Coralliocaris* it is wide and shallow and the teeth show signs of reduction, though they are usually present, at least on the upper side. The free end is pointed both in dorsal and in side view, and is not curved downwards. In *Anchistus*, *Pontonia* (Plate **57**, fig. 29), and *Conchodytes*, on the other hand, the rostrum, though it is more or less depressed at the base, is (except in some species of *Pontonia*) deep and strongly compressed in the distal part. The tip is bent downwards, and in side view rounded or diminished abruptly to a point. Teeth are generally absent, but in some species of *Anchistus* there are small dentations near the tip. In *Typton* the rostrum is peculiar, being small, compressed, almost or quite toothless, and bent upwards at the free end, which is pointed. *Stegopontonia* and *Pontoniopsis* (Plate **57**, fig. 27), *Pontonides* (Plate **57**, fig. 28), and some species of *Pontonia*, differ from all other Pontoniinæ in having a broad and very shallow rostrum, lanceolate or triangular as seen from above.

Of the *spines of the carapace* the most persistent is the antennal, which is never entirely lost, though in some species of *Conchodytes* it becomes very blunt. The

hepatic spine is generally present in free-living species but it may be absent even here. It is found in *Harpiliopsis* but not in most species of *Harpilius* and *Coralliocaris*, or in the still more sedentary genera. The supraorbital spine is kept only by some *Periclimenes* (Plate **52**, fig. 1), *Coralliocaris rhodope*, *Typton* and *Coutierea*. In the latter two cases it is very large. True branchiostegal spines are never found. There is a pterygostomian spine in *Coutierea*. The lower angle of the orbit may be produced, but is generally blunt.

Here may be mentioned the *grooves of the carapace*. These are not well marked but very persistent. Groove *b* of Boas* is always present and there is usually some trace of *e*, though the latter never crosses the back.

The *telson* corresponds in width with the stoutness of the body, but always narrows towards its hinder end, which is triangular, with sometimes, in primitive forms, a pointed projection in the middle (Plate **52**, fig. 1 *p*). On the dorsum of the telson are two pairs of stout moveable spines. On each side of its hinder end are three spines, of which the outer is short and stout, and the intermediate long and strong. The sub-median is usually shorter than the intermediate and longer than the outer. It is also more slender, and in primitive forms often feathered (Plate **53**, fig. 2 *p*), showing thus a transition to the feathered bristles of other Palæmonidæ. In *Conchodytes*, *Pontonia*, and some *Anchistus*, however, the sub-median and intermediate spines are nearly equal, and in such cases they are usually of a clumsy, degenerate shape. The end of the telson also often bears two or three pairs of fine, unfeathered bristles, whose presence bears no relation to the degree of degeneracy of the species.

The *eyes* are set widely apart on a region immediately below the rostrum. Between them is a low swelling on which is seen the remains of the larval median eye (Plate **52**, fig. 1 *c*). Each eye-stalk starts with a narrow flexible region and suddenly expands into a wide region with stouter walls. This region is usually a little flattened, and at its end bears the cornea, which generally swells out beyond it at the sides. Such an eye is well seen in *Periclimenes* (Plate **52**, fig. 1 *b*) and the other little-modified genera, and also in *Harpiliopsis*, *Harpilius*, and *Coralliocaris*. In *Anchistus*, *Pontonia*, and *Conchodytes*, however, the eye, as might be expected, is smaller. It is also here more cylindrical, and the cornea is either of equal width with the stalk or even narrower. The eye of *Pontonides* (Plate **57**, fig. 28 *b*), in spite of the general resemblance of this prawn to *Pontonia*, is well developed and of the *Periclimenes* type. In *Ancyclocaris*, on the other hand, though the build of the body is *Harpilius*-like, the eye resembles that of *Pontonia*. Several interesting peculiarities are found. In *Periclimenæus* (Plate **55**, fig. 20 *a*) the moderately large cornea has a curious cup-shaped depression on the outer and lower side. In *Pontoniopsis* (Plate **57**, fig. 27 *b*) the eye is large and sub-globular, the cornea occupying one-half of the sphere. In the sub-genus *Corniger*, of *Periclimenes*, the cornea is ogival, and in *P.* (*C.*) *ceratophthalmus* (Plate **54**, fig. 9 *b*) this peculiarity culminates in the appearance of a papilla, such as is found in *Phyllognathia* and in the amphibious *Ocypode ceratophthalmus*. It would be interesting to determine the physiological result of the structure which thus recurs in genera

* K. Danske Vidensk. Selsk. Skrifter (6), ii. II. p. 25 (1880).

which are so widely separated, and differ even in respect of the medium through which light reaches the eye.

Genera with depressed bodies have the carapace hollowed behind the eye to give room for it to be turned backwards. In *Coralliocaris* this depression becomes a sharply-marked pit. There is here a striking repetition of the condition which in the crabs may be traced through further stages till it ends in the formation of a closed orbit.

In the *antennules* (Plate **52**, fig. 1 *c*), the basal joint bears on its outer side a thin flange which, generally speaking, varies in width with the body. At the base of this flange, on the outer side, stands the stylocerite, a forwardly-curved, strong spine, which is usually less than half the length of the joint, but sometimes, as in *Harpiliopsis* and *Coralliocaris*, becomes more important. At or near its end the flange bears another spine, smaller than the stylocerite. In *Urocaridella* and *Urocaris* the flange has a rounded, fringed tip, projecting beyond the end of the joint, with the distal spine at its side, so that the whole structure recalls the antennal scale. In *Palæmonella* and *Periclimenes* the end of the flange, slightly concave or convex, and usually fringed, is nearly on a level with the end of the joint, and bears its spine at its outer angle. In some species of *Periclimenes* (*P. frater*, etc., Plate **53**, fig. 6 *c*) there are two spines. In the heavier genera there is an unfringed projection forwards which bears the spine at its tip. In some species of *Conchodytes* this projection is blunt, the spine having disappeared. A well-developed statocyst is always present, which is not the case in all Carides. The second and third joints of the stalk vary a good deal in form. Typically they are sub-cylindrical and about as long as broad.

The inner flagellum is simple. The outer is more complex and shows variations of some importance. It is always thickened at the base, and bears in the thickened region a fringe of coarse, sensory hairs. At the end of this region, in all genera except *Typton*, a cleft separates a long, slender flagellum from a short, thick one, which is a continuation of the thickened region. The depth of the cleft varies. Usually it is less than the length of the uncleft basal region. In most *Periclimenes* (Plate **52**, fig. 1 *c*), some *Palæmonellæ*, and the heavier genera, it is a good deal less. In some *Periclimenes* (as *P. compressus*, Plate **55**, fig. 18), some *Palæmonellæ* (as *P. batei*), and in *Urocaris*, it is nearly or quite as long. In *Urocaridella* (Plate **53**, fig. 2 *a*) and *Ancyclocaris* it is longer than the basal region, and the antennule is then said to be "triflagellate." This is the condition found in other Palæmonidæ. Since the genera of Pontoniinæ which exhibit it are in other respects more primitive than the rest of the subfamily, it would appear to be in their case an ancestral feature, though of course the appearance of the third flagellum is in itself an innovation, and is one of the non-primitive features of the Palæmonidæ. The shortening of the cleft in higher Pontoniinæ is thus a return to primitive conditions, not a retained primitive feature. It is comprehensible that the lessened activity of these members of the subfamily should remove the necessity for a very mobile sensory apparatus.

The *antenna* (Plate **52**, figs. 1 *c* and *c'*) is of the normal caridean type. On the first joint (coxocerite) the tubercle for the opening of the green gland takes the form of a well-developed process on the inner side. The second joint (basicerite) is divided

longitudinally into two parts*—an inner, which bears the flagellum and its stalk (together forming the endocerite), and an outer, which bears the exocerite in the form of the scale (scaphocerite). On this outer division stands also a forwardly-directed spine, which may, as in *Harpiliopsis*, be very long and strong, or may be represented merely by a slight projection of the joint. As this spine is not homologous with the stylocerite of the antennule, standing indeed on a different joint, the same name should not be applied to it. The scale has a broad, fringed expansion and a stout, unfringed outer border, which ends in a distal spine. Its most remarkable variation is found in *Typton*, where it is reduced to a vestige, which does not reach as far as the beginning of the flagellum, though it shows traces both of the expanded region and of the distal spine. In the endocerite, the flagellum stands on a two-jointed stalk. It is doubtful whether there is any justification for calling the joints of this stalk "ischiocerite" and "merocerite." The flagellum, like those of the antennule, is shorter in the sedentary than in the active forms. It is shortest in *Conchodytes tridacnæ* and *C. meleagrinæ*.

The *mouth parts* show, on the whole, an absence of modification, either within the subfamily or in comparison with those of related groups, which is rather striking in view of the specialized nature of the food of many of the commensal forms—such, for instance, as those which live with crinoids or lamellibranchs—consisting as this must largely of minute organisms collected by the feeding currents of the host. The most remarkable features exhibited by the organs in question are (1) the tendency which appears in various genera to a broadening of some or all the joints of the third maxilliped, (2) in the *Pontonia* group, that the inner lacinia of the maxillule is very wide and hairy. The connection of these features with the functions of the organs is discussed below.

The *mandible* (Plate **52**, fig. 1 and Plate **57**, figs. 26 *d*—*d*‴) is deeply cleft into two diverging processes, both directed obliquely towards the median plane of the body. One of these—the *incisor process*—is thin and ribbon-like, trending at its base downwards, but curving inwards and at the same time twisting its outer edge forward, so that, while at its base it is nearly vertical, with its width transverse to the body, at its free end it is

* [June, 1917. These parts, of which the outer stands always a little forward of the inner, and in some Decapoda, as *Upogebia*, becomes almost wholly distal to it, probably represent the two components (protobasipodite and metabasipodite) of the basipodite (symbasipodite). I have recently discussed the composition of this segment (Proc. Zool. Soc. London, 1917, p. 53). The homologies of the antenna present a very difficult problem. It would appear from the case of the Mysidacea that the segment upon which the green gland opens is the second of the primitive series, and in that case the first, or precoxa, must in other cases have disappeared, by excalation or by fusion with the head or with the coxopodite. This suggestion is supported by the fact that the maxillary gland of Stomatopoda also opens upon the second segment of the limb to which it is adjacent (Proc. Zool. Soc. *loc. cit.*), and that the gonoducts of the Decapoda, probably homologous with the ducts of the excretory glands, open upon what development shows to be the second segment of the legs (except where, as in the crabs, the openings have secondarily shifted to the sterna). If Hansen be right in interpreting as segments the inconspicuous structures which undoubtedly exist in the antenna of *Nebalia* proximal to the first apparent segment and between those which appear to be the second and third, then there is in that genus a very complete and instructive retention of the primitive segmentation of the limb. The segments will be, in succession, precoxa (pleurocerite), coxocerite, protobasicerite, metabasicerite, and the so-called ischiocerite and merocerite incompletely fused. If, on the other hand, Hansen's view be not accepted, then the absence of exopodite and of visible opening of the green gland leaves the homologies of the segments obscure, though the flexion of the limb suggests that the incompletely double third joint belongs to the endocerite proper.]

nearly horizontal, with its width longitudinal in the body. The other—the *molar process*—is stout and subrectangular in section, and slants dorsally, to end obliquely truncated on the median plane. In *Urocaridella* (Plate **53**, fig. 2 d^{iv}) and *Palæmonella* (Plate **53**, fig. 5 d^{v}), a short, two-jointed palp is present, standing on the anterior side of the limb, at the base of, and just dorsal to, the incisor process, behind which it is partly hidden in ventral view. The incisor and molar processes perhaps represent the first two endites of the primitive crustacean appendage*. The palp represents the rest of the protopodite and the endopodite. Its first joint is probably the basipodite, but, in view of the facts of meristic variation, it is doubtful whether there would be any validity in such a statement as that the second is the ischiopodite. Still less can the third joint be regarded as the meropodite alone.

The incisor process usually ends in three teeth, the middle one of which is shorter than the others, but the intermediate teeth may be more numerous and sometimes differ in number on the two sides. Thus *Coralliocaris japonica* has two on one side and three on the other, while in *Conchodytes meleagrinæ* (Plate **57**, fig. 26 *d*) there are three and four, nearly equal to the outer teeth. The molar process ends in a roughly square, concave surface, surrounded by an incomplete wall made up of projecting lobes, from four to five in number. All but one of these have crescentic or horseshoe-shaped rims, open towards the middle. The remaining lobe has an unbroken rim, and a great part of its circumference is beset with a fur of bristles or a rough patch of tubercles. Opposite this lobe the wall is lower than elsewhere, and in the left mandible is also roughened. This roughening of the molar surface is, I think, the last remains of the clothing of bristles described for the Alpheidæ by Coutière†, who also figures in some cases an oval isolated area on one side of the process. The ridges which in *Amphibetæus* and some Hippolytidæ represent a part of the bristly surface may perhaps be transitional between this condition and that found in *Desmocaris* (p. 327). There are only very slight traces of a roughened surface in *Leander*, so that possibly the possession of a considerable extent of such a surface should be added to the list of primitive characters of the Pontoniinæ which are not found in Palæmoninæ. The lobes differ a good deal in shape, and there is only a general correspondence between those of the mandibles of the two sides. So far as this correspondence goes, it is not the mirror-likeness usually found in paired structures, but the two arrangements are reversed, so that the rough lobe of each molar process overhangs the lowest part of the edge of the other and the surfaces interlock.

The mandibles lie in a chamber enclosed between the *lips* (Plate **57**, figs. 26 *s* and *t*), the hood-like upper lip (labrum) standing in front of them and the large, bilobed lower lip (metastoma, Plate **52**, fig. 1 *q*) behind, while the swollen bases of the mandibles themselves close in the chamber at the sides. There are two openings to the lip chamber—a narrow median slit between the lobes (paragnatha) of the lower lip, and a wider transverse gap between the upper and lower lips. The incisor processes close the

* On the other hand, the incisor process may be merely an outgrowth from the molar process (gnathobase). An interesting analogue to it is seen in the flange at the end of the grinding surface of the mandible of *Apus*. As it stands, this flange is on the hinder side of the limb, but the shape of the mandible gives reason to suppose that it has been rotated backwards.

† Ann. Sci. Nat. Zool. (8), ix. pp. 152—157 (1899).

transverse opening, meeting in the middle line. The molar processes meet deeper in the chamber, just under the opening of the gullet.

In describing the maxillules and maxillæ, account must be taken of the fact that there is no agreement among authorities either as to the names to be applied to the leaf-like processes, usually known as *laciniæ*, which are borne on these limbs, or as to the joints which these processes represent. I shall assume the correctness of the following view. The maxillules and maxillæ of adult Decapoda can be derived from a type provided with five endites and a distal region which probably represents several further segments. Of these endites, the first stands in the region which represents the precoxal joint, the second proceeds from the region of the coxopodite, the third and fourth from that of the basipodite, and the fifth from that of the ischiopodite. The distal region forms the remainder of the endopodite. The laciniæ of the maxillule represent the first and third endites. I shall call them the *inner* and *outer laciniæ*. The two cleft lobes usually known as the "laciniæ" of the maxilla represent each two endites. I shall call them the *first* and *second lobes*. The first represents the endites of the precoxa and coxopodite, the second those of the basipodite. Boas* and Coutière† have shown that the endite of the ischiopodite is present in the larva, and in the adult is represented by a slight swelling often found at the base of the endopodite. The laciniæ of the first maxilliped represent the coxopodite and basipodite (two fused).

In the *maxillule* (*e* in figs.) the inner lacinia curves towards the outer. It is of varying width, widest in *Conchodytes* (Plate **57**, fig. 26*e*) and *Pontonia*, wide also in *Anchistus* (Plate **56**, fig. 25*e*), moderate in *Periclimenes* (Plate **52**, fig. 1*e*), narrow in *Harpiliopsis* (Plate **56**, fig. 22*e*) and *Urocaris* (Plate **53**, fig. 3*e*). It bears a varying number of bristles, of which a bunch at the end are stouter than the rest except in *Conchodytes*. The outer lacinia also varies in width. It has an edge directed towards the middle line of the body and bears along this edge a number of stout spines and usually also some that are more slender. In *Anchistus*, *Pontonia*, and *Conchodytes* both laciniæ are very hairy. The endopodite is bifid at the tip, the proximal branch, which possibly represents the fifth endite, being curved in a short spiral, the distal branch nearly straight. The latter is reduced to a faint lobe in *Harpiliopsis* (Plate **56**, fig. 22*e*), *Anchistus* (*Ib.* fig. 25*e*), *Pontonia*, and *Conchodytes* (Plate **57**, fig. 26*e*). The maxillules stand close against the paragnatha, the laciniæ of each opposed to those of the other across the middle line, but not quite meeting them. The inner laciniæ are behind the cleft of the metastoma, with a low median ridge between them; the outer stand beside the cleft. The endopodite (endognathite) is directed outwards and appears to give a purchase to the action of the limb by hooking its curved process around the outer edge of the lip, which is provided with a notch to receive it.

In the *maxilla* (*f* in figs.) the first double lobe has disappeared, and is represented only by a slight swelling of the edge of the limb, on which a faint notch sometimes still indicates its double nature. The second lobe is of a good length,

* K. Danske Vidensk. Selsk. Skr. (6), Afd. ii. 1. pl. 2, figs. 79, 80 (1880).

† Ann. Sci. Nat. Zool. (8), ix. pp. 157—167 (1899).

but tends to become simple. In this respect it is very variable, and the maxillæ of the two sides may differ in the same individual. The lobe is simple in the species of *Pontonia* and *Conchodytes* (Plate **57**, fig. 26 *f*) I have been able to examine*, and also in the only specimen of *Periclimenæus robustus* I have dissected (Plate **55**, fig. 20 *f*), in some *Coralliocaris* (as *C. japonicus*, Plate **56**, fig. 23 *f*) though not in others (as *C. macrophthalma*, Plate **56**, fig. 24), and, according to Sollaud, in *Harpilius*. In *Harpiliopsis* it is double, with obsolescent proximal lobule. From the frequent occurrence of reduction in the lobes of this limb in the Carides, it would seem that they are not of great physiological importance. The endopodite is gently swollen at the base, perhaps by the remains of the fifth endite, and the exopodite (scaphognathite) varies in shape and width with the gill-chamber, being broad in depressed forms, particularly in *Harpiliopsis* and *Coralliocaris*.

In the *first maxilliped* (*g* in figs.) two endites—the second and third—are nearly always recognizable, and usually separated by a very distinct notch. The edge of the proximal (second) endite is often indented by a shallower notch. The endopodite is usually simple and tapering, with a stout bristle at a short distance from the tip, which may perhaps represent a joint. In the *Anchistus-Conchodytes* group the endopodite is shorter and blunter, and often shows traces of a transverse joint. At the tip of the exopodite (exognathite) a few small joints may or may not be present, and at its base on the outer side is a fringed lobe (the lobe *a* of Boas) which generally varies in width with the body of the species, though it is wider than this would indicate in *Urocaridella* (Plate **53**, fig. 2 *g*) and some *Urocaris*. The epipodite (mastigobranch) varies greatly in size. Its outer border is usually notched, but in *Periclimenes* the notch is shallow or wanting. It is deep in *Urocaridella*, which is remarkable if it is to be regarded as an unprimitive feature. The lobes separated by the notch may be equal, or the distal one may be longer than the other and pointed.

The *second maxilliped* (*h* in figs.) has the typical caridean form, that is to say, (1) its main axis consists of six joints, owing to the fusion of the basipodite and ischiopodite, (2) the last two joints are bent strongly backwards, so as to lie parallel with the ischiobasipodite, (3) owing to the growth backward (morphologically forward) of a process of the propodite on the outer (morphologically inner) side of the dactylopodite, the latter comes to lie not at the apex of, but along the median side of the propodite. Thus these two joints are compacted into a firm plate, which presents a long median margin, fringed with bristles, against its fellow of the opposite side. To the third of these characters there is an exception in the case of the genus *Harpilius*, where, according to Dana's figure for the type species (*H. lutescens*), there is a very remarkable return to the primitive condition in respect of the position, though not of the shape, of the dactylopodite. This arrangement is approached in at least one species of *Coralliocaris* (*C. superbus*). The exopodite is obscurely annulate in the greater part of its length, and bears at the end a comparatively small number of true joints. The coxopodite carries on the outer side a simple oblong epipodite, and on the median side a knob bearing bristles which probably represents an endite.

* *Pontonia ascidicola* and *Conchodytes meleagrinæ* and *tridacnæ*. Ortmann (Zool. Jahrb. Syst. v. Pl. 37, figs. 9 f., 10 f.) figures a cleft in the maxilla of *P. tyrrhena*.

Its gill will be mentioned later. A swelling which is sometimes present at the base of the coxopodite may represent the precoxal endite.

The main axis of the *third maxilliped* (*i* in figs.) consists, in *Urocaridella* (Plate **53**, fig. 2 *i*), of five joints, the ischiopodite being fused with the meropodite, and the propodite with the dactylopodite. Curiously enough, this arrangement is found also in *Conchodytes* (Plate **57**, fig. 26 *i*) at the other end of the pontoniine series. In all other genera the basipodite is fused with the ischiomeropodite, though the junction is still marked by a notch. The coxopodite bears on the outside a small, rounded epipodite, and often also on the inside a knob with bristles which is perhaps to be regarded as an endite. The exopodite is obscurely annulate and at its end there are usually a few longer segments, which are sometimes true joints but in other cases appear to be marked merely by a change in the width of the organ and the attachment of bristles.

The long joint of the endopodite (ischiomeropodite) is in *Urocaridella* (Plate **53**, fig. 2*i*) and *Urocaris* (Plate **53**, fig. 3 *i*) straight, with the outer side somewhat swollen at the base. In the other genera it is almost always more or less curved, with the concave side towards the middle line of the body. It is always ribbon-like, and shows throughout the subfamily a tendency to widen. It is narrow in *Urocaridella*, *Urocaris*, *Ancyclocaris*, *Palæmonella*, *Periclimenes*, *Periclimenæus*, and *Pontoniopsis*, though in some species of *Periclimenes* (Plate **54**, fig. 8 *i*) and in *Periclimenæus* (Plate **55**, figs. 19 and 20 *i*) it is a little increased in width. In *Harpiliopsis* (Plate **55**, fig. 21 and Plate **56**, fig. 22 *i*), *Coralliocaris* (Plate **56**, figs. 23 and 24 *i*), and *Anchistus* it is wide or narrow according to species, reaching in some *Anchistus* the greatest width it attains in the subfamily. In *Harpilius* it is wide, but narrows towards the distal end. In *Pontonia* and *Conchodytes* (Plate **57**, fig. 26 *i*) it is broad. The last two joints are always a little narrower than the ischiomeropodite, but are of approximately the same width as it in the species in which it is narrow and in *Coralliocaris*. In *Harpilius*, in some species of *Anchistus*, and in *Harpiliopsis beaupresi*, they remain narrow though the ischiomeropodite is expanded. In *Pontonia* and *Conchodytes* they are wide, though the widening is not equally pronounced in all species. They have always a flat ventral surface but are sometimes, as in *Coralliocaris*, stoutly built. The curving of the ischiomeropodites brings the last two joints of each third maxilliped near to those of its fellow, so that, while the ischiomeropodites lie at the sides of the mouth, with a wide gap between them, in which the second maxillipeds are exposed, the distal parts of the limb lie side by side in front of the mouth region. A further complexity in the arrangement of the parts of the limb is brought about by the fact that the ischiomeropodites are twisted, so that the flat surface of the appendage, which in its distal part is in a horizontal plane, is in the proximal part in a plane between the horizontal and the vertical. This arrangement has the effect of forming a kind of basket below the mouth region, walled in at the sides by the ischiomeropodites, which are of course more efficient in that respect the wider they are, and by the long bristles which project downwards and inwards from the median edges of these joints. In front, the distal part of the limb, with its bristles, affords a surface, horizontally placed below the antennal region while the appendages are outstretched, which by bending can be brought ventrally under the mouth area to complete its enclosure.

The *process of feeding* has not been observed in Pontoniinæ, and as yet we do not even know upon what they feed, though it may be inferred that the species which live in intimate association with sessile or subsessile animals probably share the food of the latter, which consists of minute organisms swept up by ciliary currents from the surrounding water. In regard to the use of the organs around the mouth, something may be gathered from a study of the prawns of the genus *Leander*, in which these organs are very similar to those of the Pontoniinæ in their general structure and arrangement. In *Leander serratus* there are bristles, borne upon ridges of the coxopodite, basipodite, and ischiopodite of the first leg, which complete behind and below the basket under the jaws, but which are less well-developed or absent in Pontoniinæ. Small particles of food may be seized and conveyed by the chelipeds of either pair to the region of the mouth, where they are generally received by the second maxillipeds, though sometimes they appear to be placed directly in charge of more dorsally placed structures, probably the maxillules. A large morsel occasionally appears to be steadied by the legs of the second pair, while those of the first pair tear off fragments and carry them to the jaws, but it is more often placed as a whole within the grasp of the second maxillipeds, which hold it in place while pieces are torn off it by deeper-lying organs, probably in the main by the incisor processes. In handling bulky masses of food the chelipeds are assisted by the third maxillipeds, which bend back their last two joints for the purpose. The third maxillipeds are also capable by the same action of scooping up food and unaided carrying it to the second maxillipeds, between which they sometimes thrust it with their tips. During these processes the basket appears to serve the purpose of keeping the food under control till it has been seized by the second maxillipeds. These are very important organs, and play an indispensable part in passing the food to the mandibles. The animal can still feed if the legs and third maxillipeds have been removed, but if all the other organs be left and the second maxillipeds cut away it is apparently incapable of taking food. The second maxillipeds have three principal movements. In one, the broad flaps in which they end open downwards like a pair of doors and with their stout fringes gather up the food, in another they rotate in the horizontal plane to and from the middle line, in the third the bent distal part of the limbs tends to straighten so as to brush forward any object which lies between them. Frequently these movements are combined. Once the food is past the portals formed by the second maxillipeds its course is hard to trace, but the following seems to be its fate. If it be small in quantity and finely divided, or very soft, it is abandoned to the action of the maxillules, by whose strong, fringed laciniæ it is swept forwards and probably caused to enter the mouth chamber through the slit between the paragnatha*. If it be bulky or tough, the second maxillipeds assist the maxillules in brushing it forwards towards the incisor processes. The action of these latter is not so much a cutting one as a process of tucking the food into the mouth chamber, by first backing outwards and then moving

* Such is the impression made. But it may be that all food is worked into the mouth chamber by the incisor processes, and that the function of the cleft on the metastoma is to enable the paragnatha to part and give room for the admission of large pieces of food.

inwards and rotating upwards. No doubt during this the food undergoes some tearing, and when the mass is large pieces have to be torn off it before they can be swallowed. The palp does not appear to take any mechanical part in the process. If it has a sensory function this is probably not of great importance, for the organ is present and absent in closely related genera in many cases among Carides. Finally, to enter the gullet, the food must pass between the molar processes, and be pounded by them as it goes. Their concave ends are usually found to be clogged with a pasty matter. They must do their work very quickly, for the movement of the mandibles, as judged by that of the incisor processes, ceases very soon after the food leaves the latter. How swallowing takes place is not clear. Parker and Mocquard suggest that the food of Decapod Crustaceans is caused to pass up the gullet by suction from the crop (stomach), but, as I have shown elsewhere*, the case of the land hermit-crabs of the genus *Cœnobita* throws doubt upon this explanation. It may be that the constrictor muscles of the œsophagus play some part in the process.

The first maxillipeds and the maxillæ probably take no very prominent part in manipulating the food. The feeble lobes of the maxillæ are in incessant movement to and from the middle line as they are carried inwards and outwards by the action of the scaphognathite. It seems likely that their sole function is to regulate the motions of the latter. The large lacinia of the first maxilliped is a rather feeble structure with slender, silky bristles, and is not strongly moved during feeding. Probably, by covering the lobes of the maxilla, it prevents them from being clogged by the food.

The part played by the paragnatha seems to be a passive one. The labrum undergoes active movements whose function is probably to aid in keeping the food under the action of the incisor processes.

The exopodites of the maxillipeds are in constant rapid motion, setting up by their activity a strong current forwards from the mouth. No doubt this assists in carrying away the foul water from the gill chambers and the excreta of the green glands poured out at the base of the antennæ. But it has also a significance in the feeding process. From time to time particles are rejected by the second maxillipeds, which kick them violently forwards, the distal parts of the third maxillipeds at the same time straightening so as to admit them to the outgoing stream, by which they are swept away.

It has already been stated that the mouth-parts of the Pontoniinæ, even in the most decidedly commensal species, are not highly modified as compared with those of the free-living Palæmoninæ. For such modifications as exist it is, however, possible to suggest a connection with the nature of the food. The broad third maxillipeds seem better adapted to shepherd a crowd of minute organisms than narrower types of those organs, and the large, hairy laciniæ of the maxillules of the *Pontonia* group perhaps serve the same purpose.

The *legs of the first pair* are chelate, but relatively slender and never of great length. They are alike and equal. Their chelæ are usually of simple form, but in

* Gardiner's Fauna of the Maldives, i. p. 79 (1901).

several cases (*Periclimenes spiniferus* (Plate **52**, fig. 1 *k*), *P. soror*, etc.) they have a comb-like arrangement of fine teeth on the opposed edges of their fingers, and in others the tips of the fingers are double. The chela usually bears tufts of stiff hairs. The first three joints may show traces of the bristle-bearing ridges found in species of *Leander*.

The *legs of the second pair* are the stoutest limbs of the body, and nearly always longer than the first pair. They may be equal or unequal, alike or unlike, and that sometimes within the limits of one genus. They are rarely of complicated shape. Their fingers have usually some stout teeth on the apposed edges, but sometimes they are blade-like. In *Periclimenes denticulatus* they are edged with numerous fine denticles. In *P. petitthouarsi* and *P. spiniferus* (Plate **52**, fig. 1 *l*) each finger of the larger member of the pair bears a curious pit with raised edges, and in the great chela of *Periclimenæus* (Plate **55**, figs. 19, 20) a knob on one finger fits into a socket on the other, somewhat as in *Alpheus*. Curiously enough, in one of the two species as yet discovered the knob is on the fixed finger, while in the other it is on the "thumb" or movable finger (dactylopodite) as in *Alpheus*.

The stoutness of the limb varies, roughly speaking, with that of the body. In *Urocaridella* (Plate **53**, fig. 2 *a*) and *Urocaris* it is very slender throughout. In *Palæmonella* (Plate **53**, fig. 5 *a*) it is stouter but still slender. In *Periclimenes* it varies in stoutness but is never very heavy. In *Ancyclocaris* it is short and rather stout. In *Periclimenæus* one is massive and *Alpheus*-like in keeping with the general build of the body, and the other smaller and simpler but somewhat of the same type. In *Harpilius lutescens* both are rather slender and insignificant. In *Pontoniopsis* the larger is heavy, but not monstrous, and of fairly simple shape, while the smaller is very slender. In *Harpiliopsis* the palm is long and fairly heavy, and in *Coralliocaris* (Plate **56**, figs. 23 *l*, *l'*) this tendency is enhanced and the chela is a characteristic organ, long and heavy, swollen at the base, and narrowing towards the fingers, which are short. In *Anchistus* it is of moderate size, with parallel sides and fingers of a good length. In *Pontonia* (Plate **57**, fig. 29) and *Conchodytes* it grows heavier, but the palm is still generally of fairly even width and the fingers generally not very short, though in some cases there is an approach to the condition of *Coralliocaris*. The same may be said of *Typton*.

The thumb is on the outer side of the limb, and usually moves in a nearly horizontal plane, but a little upwards or downwards*. Sometimes, however, it becomes almost or quite vertical, and in this case it is generally above the other finger, but may be below, as in *Coralliocaris japonica* (Plate **56**, fig. 23 *l*).

In many cases, especially in *Periclimenes* (Plate **52**, fig. 1 *a*), one or more stout spines are found at the end of the "wrist" (carpopodite), or "arm" (meropodite), or both.

The *mode of use of the chelipeds* is as yet unknown. Presumably those of the first pair serve as cleaning organs, as they certainly do in *Leander*. They are no doubt also used to convey food to the mouth, as in *Leander*. The chelæ of the larger pair are perhaps, as in other cases, used for seizing and tearing masses of food and as weapons of offence both against prey and against foes; but they seem unsuited for handling

* This fact is exaggerated in many of the figures, by slightly twisting the hand, in order to show the shape of the fingers.

the minute organisms which must form the food of some species, and it is hard to imagine that a *Conchodytes*, for instance, can have many enemies against which such weapons would be of any avail. They may have sexual uses, but rarely differ in the sexes. The peculiar features which they present in the several species are quite unexplained, and the study of this limb in relation to the habits of the species presents an interesting field of observation.

The *legs of the last three pairs* are similar in all but minor details. In *Urocaridella* and some species of *Urocaris* they are directed forwards as in *Palæmon*, but in *Urocaris psamathe* there appears a change in their position which increases as the build of the body becomes heavier, and is probably to be regarded as an adaptation to walking. The basipodite is here curved so that, whereas the coxo-basipodite joint is transverse to the main axis of the body, the basi-ischiopodite joint tends to become longitudinal, and the limb is thrown outwards, and thus the body has a wider area of support. A row of movable spines is often found on the lower side of the propodite (Plate **52**, fig. 1 *m*), and sometimes there are spines on other joints. The dactylopodites vary greatly. In the more lightly built species they are generally slender, nearly straight, and simple (Plate **52**, fig. 1 *m*). In *Harpilius*, *Harpiliopsis*, *Coralliocaris*, and *Conchodytes*, they are strongly curved. *Coralliocaris* (Plate **56**, fig. 23 *m*) has at the base of the joint on the under side a curious prominence which is usually more massive than the terminal claw. In *Stegopontonia* this prominence is paired. *Conchodytes* (Plate **57**, fig. 26 *m*) has a swelling in the same position. In members of various genera the end-claw may be duplicated by a spine underneath it, so that the limb becomes "biunguiculate" (Plate **55**, fig. 19 and Plate **57**, fig. 26 *m*). In some cases the end-claw is exceedingly sharp, in others it is stouter and blunter. No doubt each of these peculiarities is an adaptation to the substratum upon which the species possessing it moves. Most of them are not as yet susceptible of explanation, but when the claws are both sharp and curved they are often dug into the soft tissues of the host.

The *abdominal limbs* (Plate **52**, fig. 1 and Plate **53**, figs. 2 *o*—*o''*) are of the ordinary caridean type and show few remarkable features. The *appendix interna* is present on the second to fifth pairs in both sexes, and on the second pair of the male there is an additional process beside the *appendix*. The endopodite of the first limb is always smaller than that of the others, and its inner edge is often crumpled over. *Urocaridella* is remarkable for having an *appendix interna* on this limb. This feature occurs also in *Amphipalæmon* and is one of many indications of a relationship between the Anchistioididæ* and the Palæmonidæ.

The fullest *gill formula* found among the Pontoniinæ is that of *Urocaridella* and *Ancyclocaris aberrans*. Here there is a pleurobranch for each leg, an arthrobranch for the third maxilliped, and a podobranch on the second maxilliped (Plate **53**, fig. 2 *h*), with a mastigobranch on each of the maxillipeds. A tiny lobe above the base of the mastigobranch of the second maxilliped is perhaps the last vestige of an arthrobranch. A second group of genera, comprising *Urocaris*, *Periclimenes*, *Harpiliopsis*, *Coralliocaris*, *Palæmonella*, *Pontonides*, *Periclimenæus* and *Anchistus*, have lost the podobranch of the

* See p. 405 in this volume.

second maxilliped and reduced in varying degrees the arthrobranch of the third maxilliped (*i* in figs.). In *Periclimenes*, however, as Sollaud has shown, there is often a vestige of the podobranch of the second maxilliped in the form of a finger-shaped process at the base of the mastigobranch (Plate **52**, fig. 1 *h*). I have not been able to satisfy myself of the presence of this process in some of the species I have examined, but it is possible that some trace of it is always present. A very minute protuberance found in the angle between the mastigobranch and the exopodite in *Urocaris*, *Harpiliopsis*, *Periclimenæus* and *Anchistus* may have the same significance. Curiously enough, *Palæmonella*, in other respects the most primitive of these genera, shows a greater reduction of the gill of the third maxilliped than *Coralliocaris* or *Harpiliopsis*, and has no vestige of that on the second maxilliped. In *Periclimenæus* and *Anchistus* the arthrobranch of the third maxilliped is represented by a slightly folded lobe. In *Harpilius*, *Pontonia*, *Conchodytes* and *Typton* the gills of both maxillipeds are entirely lost, save for a hardly recognizable vestige at the base of the third maxilliped of *Pontonia*.

It will be seen that, while all Pontoniidæ have undergone some reduction of the gill formula as compared with other Palæmonidæ, within the subfamily a loss of gills, roughly speaking, accompanies the adoption of a less active mode of life. Where there is less need for active respiration there is less provision of respiratory organs. In some cases, however (*Urocaris*, *Palæmonella*, *Periclimenes*), the loss of gills is in advance of the change of habits, at least in so far as that be indicated by the build of body and limbs. From this fact Sollaud draws the conclusion that the reduction of the gill apparatus is the cause rather than the effect of the altered mode of life. In that case, it has presumably come about by meristic variation, more or less fortuitously, and the animals have survived by the adjustment of their habits to their anatomy rather than by the selection of variations in their anatomy which were suitable to their habits. The theory is attractive, and consonant with a good deal in modern biological speculation, but before it can be adopted more must be known about the habits of the prawns. The build of body is not always an indication of the mode of life, either among the Pontoniinæ or in other prawns. *Metapenæus commensalis*, for instance, lives in the zone of protection of a large sea-anemone, though its general appearance is that of allied species which are believed to be free-living, and various gracefully built species of *Palæmonella* and *Periclimenes* are commensal with feather-stars. It may be after all that in the Pontoniinæ a change of behaviour has been the forerunner of structural change, and that the long series of modifications which we have traced in all parts of the body of these prawns, by whatever process of variation or selection it may in detail have been brought about, is but the result of congenital laziness in an environment which offers to the sluggish endless opportunities of retreat.

The Colours of the Pontoniinæ.

Most species of Pontoniinæ have been described on data obtained only from spirit specimens, and information concerning the colouration of the subfamily is consequently

limited*. It is certain however that they vary greatly in this respect, the animals being striped, spotted, or suffused in very different ways and with very different colours, while the differences between species are often as great between species of the same genus as between those of different genera. In the cases at present known the colours are usually gaudy and conspicuous when the prawns are removed from their proper environment, though, in some instances at least, their colouration harmonizes very strikingly with that of their natural surroundings. Nothing is known as to the colour changes which doubtless occur in the lifetime of the prawns, or as to the way in which there arises a correspondence between the colouring of the individual and that of its surroundings, or as to the value this may have to the prawn.

On Adaptation.

It will be clear, from various statements in the preceding pages, that our knowledge of the significance of peculiar features in the Pontoniinæ is at present very limited. Yet it may not be useless even now to consider the problem they present, if only because the alteration which is in progress in our views as to the mode of origin of such features may well result in an underrating of their importance in the economy of the organism. It has, for instance, quite lately been said that "to see fitness everywhere is mere eighteenth century optimism." Now, as a repudiation of the conception of an all-but personified "environment," which by "selection" forces organisms into a mould predetermined by itself, this statement is undoubtedly justified. But it may also convey a belief that an appreciable proportion of the characteristic features of organisms is not correlated with peculiarities in their modes of life, and in this sense it is of much more doubtful validity.

There was a time when the structural peculiarities of organisms were widely held to be due to the direct action of their environment in bringing them into harmony with itself, by means of the plasticity of the individual and the inheritance of the characters so "acquired." Thus every feature was shaped to meet some demand of an environment which could not be escaped, and each played its part in ensuring the viability of the species. That conception was replaced by one in which the organism was allowed more initiative, in that it presented numerous small but ready-made modifications to its environment, by which some of them were then "selected" to become the characters of an altered race. This view had in turn to be modified in the direction of attributing a greater importance to the organism itself, since it was discovered that only some of the variations presented by the organism were heritable, and that these were fixed and incapable of dilution or summation. Finally, it has to be recognized that what is selected is not this or that "character," but the organism as a whole, with its powers of adapting itself to the world by various means. Thus the part held to be played by the environment in the production of any single character has become less and less, and therewith has waned the belief that every character plays some part in the

* Dana, Nobili, Potts, Rathbun and others give information concerning the colours of various species.

struggle for existence, since that is too often still regarded as the activity of a machine-like organism in the face of a fixed and unavoidable environment.

Now it is true enough that the structural "fitness" of an organism does not consist in its characteristics having arisen in response to the fixed demands of an environment. But this does not mean that each of them is not caused to play its part in that reaction with the world which constitutes the life of the organism, including the habit of seeking an environment and maintaining itself there by the necessary measures. These habits are without doubt as modifiable, both in the individual and in the race, as any other characteristic of the organism, and one of the conditions of the persistence of any given structural modification is that it should not exceed the limits of the power of adjustment which is given by this susceptibility of modification of habit. So long as the structural alteration does not outrun the physiological possibilities, fitness is maintained, and it is incredible that this can ever be due to the alteration being indifferent to the life of the organism. Some disturbance it must cause, whether in the internal or in the external physiology, and in the long run a disturbance in internal physiology will cause a modification in behaviour, as in the amount of food taken, or in the sheltering of an animal which by any cause becomes deprived of its agility. Any belief to the contrary can only arise from the fact that the importance to the economy of the organism of any given structural modification by no means necessarily corresponds with its conspicuousness in the eyes of the human observer.

It is, of course, also the case, though this is beside the present point, that alterations in behaviour can only take place within limits set by the structure of the organism, though it is not the case that every such change must involve a modification in the structure of the organs used. Finally, it is still true that the organism must come to terms with its world; but that is not to say that it is dependent upon an inevitable environment, or that it can maintain itself in a given set of surroundings only by a fixed behaviour. Adaptation, in short, is a relation between structure and habit, and only secondarily between structure and environment; and there is no feature of an organism the investigation of which can safely be regarded by the naturalist as without significance, and relegated by him to the student of variation.

The Distribution of the Pontoniinæ.

The majority of the Pontoniinæ are members of the shallow water fauna of the tropical and subtropical Indopacific. Six species occur in the Mediterranean, six on the west coast of America, eight in the Western Atlantic, and one in South Australia. Three of the Mediterranean species are also recorded from British waters. *Urocaris longicaudata* and *Palæmonella tenuipes* are stated to occur both in the West Indies and in the Indopacific. Pontoniinæ appear to be entirely absent from the colder seas. Most are undoubtedly benthic, but very possibly a few of the more lightly-built forms, such as *Urocaris*, will prove to belong to the plankton. One species of *Urocaris* is bathypelagic, *Coutierea* lives in moderately deep water, probably on the bottom, *Palæmonella laccadivensis* is dredged in 100—600 fathoms, and *Periclimenes tenellus* in

230 fathoms. Most of the subfamily are to some extent cryptozoic, and a great many actually commensal. A sketch of the distribution of this habit within the group has already been given on pp. 329, 330. Unfortunately, little is known of the behaviour of the Pontoniinæ or of their relation to the animals which serve as their hosts. A detailed study of this subject, which could only be made in the field, would undoubtedly give very interesting results.

The Genera of the Pontoniinæ.

The genera of the Pontoniinæ may be briefly characterized by means of a key, as follows :

I. Body very slender and compressed. Thorax without swelling. 6th abdominal segment much elongate. Outer flagellum of antennule deeply cleft. A gill may be present on the second maxilliped.

A. Mandibular palp present. Gill on second maxilliped. Rostrum toothed below.

Urocaridella Borradaile, 1915.

B. No mandibular palp. No gill on second maxilliped. Rostrum without teeth below.

Urocaris Stimpson, 1860.

II. Body moderately stout, not compressed. Thorax of female swollen dorsally. 6th abdominal segment short. Outer flagellum of antennule deeply cleft. A gill may be present on the second maxilliped. [No mandibular palp.]

Ancyclocaris Schenkel, 1902.

III. Body never very slender, or much compressed. Thorax without swelling. 6th abdominal segment never much elongate. Outer flagellum of antennule rarely deeply cleft. No gill on second maxilliped.

A. Mandibular palp present.

Palæmonella Dana, 1852.

B. No mandibular palp.

1. Scale of second antenna rudimentary.

Typton Costa, 1844.

2. Scale of second antenna well developed.

i. Gracefully-built forms, with body little if at all depressed, rostrum well developed, and almost always toothed, slender legs, whose dactylopodites are usually narrow and never hook-like, and antepenultimate joint of third maxilliped narrow (except *P. brocki*, where it is of moderate breadth).

α. Eyes subspherical. Rostrum horizontally expanded.

Pontoniopsis Borradaile, 1915.

β. Eyes not subspherical. Rostrum vertically expanded.

(1) Body and chelipeds *Palæmon*-like. Dactylopodites of walking legs usually narrow.

Periclimenes Costa, 1844.

(2) Cephalothorax deep and flat-sided, recalling *Alpheus*. One of second chelæ very heavy, with short fingers bearing a knob and socket arrangement. Dactylopodites short, broad, and biunguiculate.

Periclimenæus Borradaile, 1915.

ii. Clumsy-bodied forms, with body obviously depressed, at least in female, rostrum usually in some way reduced and often toothless, stout legs, ending in short, usually hooked dactylopodites, and antepenultimate joint of third maxilliped moderately or very broad.

α. Rostrum straight or upcurved, diminishing in normal fashion to a sharp point, usually toothed, but generally with little or no ventral crest. Body not very clumsy. Third maxilliped not strongly twisted.

(1) Dactylopodites of walking legs without basal protuberance. Last two joints of third maxilliped narrow and usually contrast strongly in width with antepenultimate.

(*a*) Third maxilliped with arthrobranch. Second maxilliped with last joint mediad of penultimate.

Harpiliopsis n. gen.

(*b*) Third maxilliped without arthrobranch. Second maxilliped with last joint posterior (distal) to penultimate.

Harpilius Dana, 1852.

(2) Dactylopodites of walking legs bear a basal protuberance, usually large. Last two joints of third maxilliped do not contrast strongly in width with antepenultimate, and are usually broad.

(*a*) Rostrum not very broad. Basal protuberances of the dactylopodites simple.

(i) Rostrum very long. Enormous supraocular spines present. Abdomen carinate.

Coutierea Nobili, 1902.

(ii) Rostrum not very long. Supraocular spines absent or not very large. Abdomen not carinate.

Coralliocaris Stimpson, 1860.

(*b*) Rostrum very broad. Basal protuberances of dactyles paired.

Stegopontonia Nobili, 1906.

β. Rostrum downcurved, toothless, usually blunt pointed, sometimes with a sharp point of abnormal fashion, usually with good ventral crest. Body usually very clumsy. Third maxilliped strongly twisted.

(1) Last two joints of third maxilliped narrow.
Anchistus Borradaile, 1898.

(2) Last two joints of third maxilliped broad.

(a) No exopodites on maxillipeds. Eyes of good size.
Pontonides n. gen.

(b) Exopodites on maxillipeds. Eyes small.

(i) Dactylopodites of last three legs straight, without basal prominence.
Pontonia Latreille, 1829.

(ii) Dactylopodites of last three legs curved, with basal prominence.
Conchodytes Peters, 1851.

There can be no doubt that the most primitive genus of Pontoniinæ is *Urocaridella*. This very remarkable form has almost all the features which must have characterized the earliest members of the group. The complete retention of the caridoid facies, the forward direction and simple form of the legs, the gill formula only less by one small pleurobranch than that of *Leander* or *Desmocaris*, the mandibular palp, the straight, slender third maxilliped, the deeply-cleft outer flagellum of the antennule, all tell the same tale. Yet *Urocaridella* can certainly not be considered ancestral to the rest of the subfamily. It is specialized, probably for pelagic life, in its compression, in the peculiar form of the abdomen with the long sixth segment and projecting third segment, and in the long, upcurved rostrum. There can, again, be no doubt that *Urocaris* arose from *Urocaridella*, through such species as *Urocaris psamathe*, by the loss of the mandibular palp, of the gill on the second maxilliped, and of the lower teeth of the rostrum. The rest of the Pontoniinæ, however, must have taken independent origin from the common ancestor of the subfamily, to which *Urocaridella* remains nearer than they, though it is not transitional to them. *Ancyclocaris* represents such a line of independent descent. By the retention, in one species, of the gill on the second maxilliped, by the narrow third maxilliped, and by the deeply-cleft outer flagellum, it is linked directly with the ancestral form, for the lanceolate rostrum and some features of the abdomen make a descent through *Urocaridella* impossible, but it has lost the mandibular palp, and its stout body and legs, with the curved dactylopodites, show an interesting parallel to *Harpiliopsis* and allied genera. Probably, however, this is due only to a somewhat similar mode of life. The hump on the back of the female is a peculiarity which does not recur in the subfamily.

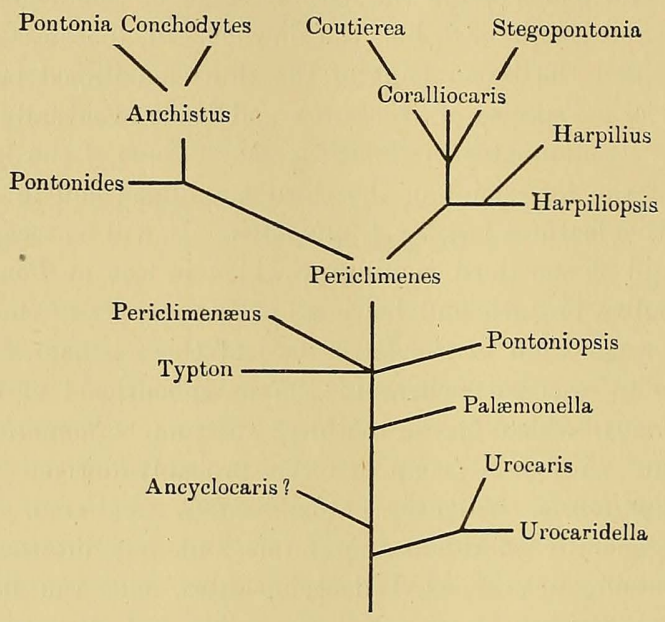
The remaining genera probably represent a third line of descent, through a form resembling *Palæmonella* and *Periclimenes*, from which *Periclimenes* has departed in the loss of the mandibular palp and *Palæmonella* in the loss of the vestige of the gill

of the second maxilliped and the greater reduction of that of the third maxilliped. In other respects there is no difference between these closely related genera. While, however, *Palæmonella* does not yet appear to have given rise to any daughter genera, *Periclimenes* represents a central stock from which groups of genera diverge in several directions. *Periclimenæus* is an interesting modification of this stock in which some of the features of *Alpheus* are reproduced. *Pontoniopsis* represents a second departure from the same stock. *Anchistus, Pontonia* and *Conchodytes* form a third group, characterized by degeneration in connection with the habit of living in the mantle cavity of bivalves and ascidians. The species described by Pesta as *Marygrande mirabilis*, which is however an *Anchistus*, shows the earliest stage in this degeneration. Its body is still fairly slender and compressed, but the downcurved, toothless rostrum, the stout legs, the great chela, and the broad joint of the third maxilliped betray the tendency which is increased in other species of *Anchistus* and leads eventually through *Pontonia* to *Conchodytes*, where it culminates in *C. meleagrinæ*. Some of the species of *Anchistus* retain, in the form of the long joint of the third maxilliped and in a minute dentation of the rostrum, primitive features lost by *A. mirabilis*. It will be recalled that *Anchistus* has a vestige of the gill of the third maxilliped which is lost in *Pontonia* and *Conchodytes*, and that a peculiar breadth and hairiness of the laciniæ of the maxillule are also less marked in the former than in the latter two of these genera. Possibly the point of origin of this group was somewhere in the neighbourhood of the coral-haunting *Periclimenes aurantiacus*, which has a toothless rostrum. *Pontonides* seems to have arisen near this point. A fourth group of forms probably derived from *Periclimenes* is presented by *Harpiliopsis, Harpilius, Coralliocaris, Coutierea*, and *Stegopontonia*. These are sluggish, generally coral-haunting forms, but not internal commensals. In them the legs are stout, with hooked dactylopodites, but the body, though more depressed than in the *Pontonia* group, is less swollen and degenerate. The rostrum loses in depth, but is straight and nearly always dentate, and the maxillules are of quite a different type. In *Harpiliopsis* and *Coralliocaris* the gill of the third maxilliped is comparatively well developed, but in *Harpilius* it is lost, according to M. Sollaud. The members of this group diverge more than those of the second group, but it is not necessary here to recapitulate their differences, which are given in the key above. *Harpiliopsis* is the most primitive of them, and it is quite impossible to reconcile the evidence either of its bodily habitus or of its maxillule with any theory of a descent common to it and *Anchistus*. Possibly it may have taken origin somewhere in the neighbourhood of *Ancyclocaris*, but it seems more likely to have arisen from *Periclimenes*. *Harpilius*, though outwardly it presents no very remarkable feature, is, in its loss of a gill and in the peculiar form of its second maxilliped, perhaps the most aberrant of all. *Coralliocaris* shows in its third maxilliped, its second cheliped, and the dactylopodites of its walking legs, certain convergences with *Conchodytes*.

The affinities of *Typton* are doubtful. Its supraorbital spines* and narrow third

* It is possible that these spines are not present in *T. bouvieri*. Nobili states in his preliminary description of the species that it has "ocular" spines, and in a later account that antennal spines are present, but in his figure he shows neither.

maxilliped are primitive features. On the other hand, the uncleft condition of the outer flagellum of its antennule is probably an exaggeration of one of the secondary features of the Pontoniinæ. Its vestigial antennal scales and small rostrum are no doubt adaptations to its habitat, and in any case are without parallel in the subfamily. Its reduced gill formula might be expected from its habits, and need not indicate any affinity with *Conchodytes*. Its heavy, compressed body with slender walking legs ending in biunguiculate dactylopodites, its large chela, and, very distantly, its rostrum, rather suggest *Periclimenæus*, but in view of other differences this is probably a convergence. It is perhaps best regarded as independently evolved from the ancestor of *Periclimenes*.



On some difficult questions in Phylogeny.

The making of phylogenetic trees, once a favourite pastime of zoologists, has of late years come under the censure of superior persons, on the ground that we know too little about the mode in which evolution takes place to speculate successfully as to its course. Yet to represent in a graphic manner the lines of resemblance and difference within zoological groups is a practice which dates from before the acceptance of the evolutionary theory, and is not without its convenience even in these days. Moreover, the objections to diagrammatic phylogeny apply also to any form of classification which is not purely empirical, and especially strongly to the attempt so to construct "keys" that they shall as far as possible represent real affinities. One of the difficulties which occur in such cases is prominent in the Pontoniinæ. It is presented by numerous instances in which classifications according to two or more different features cross one another, so that alternative arrangements are suggested. When one of these arrangements has the advantage of illustrating also the verdicts of several further characteristics the solution is easy, but this is often not the case. I have already described an instance

of this in another group of Crustacea* and have remarked on the appearance it presents of the kaleidoscopic distribution in several ways of a set of pairs of characters, and called attention to its suggestion of Mendelism. A simple case of this sort occurs among the members of the subgenus *Falciger*, where it is hard to decide whether the primary grouping of the species should be on the ground of the presence and absence of the supraorbital spine or on the shape of the rostrum. Many other such cases may be detected in the keys which are given later in this paper. Another form of the same difficulty arises in the sporadic distribution of a character in circumstances which make it impossible to trace direct connection by descent between the species in which it occurs, except by means of other species from which it must have been absent. This is the case, for instance, with the supraorbital spine throughout the subfamily, and with the denticulation of the fingers of the first leg in several *Periclimenes*.

In earlier days these phenomena would have been even harder of explanation than they are at present, when convergence is receiving more attention than formerly, and Mendelism has risen over the zoological horizon. In many cases close examination of features which at first appear to be due to repetition reveals, either between the fully evolved organs or between stages that lead up to them, differences which show that we are dealing with convergence. In others, the suggestion of Mendelism is probably correct, the feature in question having been suppressed over a series of generations by the absence of some factor necessary for its development or the presence of some hostile factor. It may, indeed, be doubted whether much of what is known as convergence in organisms be not rather due in this way to Mendelism. A further question, however, arises here. Is the sporadic repetition of such a feature, for instance, as the supraorbital spine, in apparently identical reincarnation, due to the releasing of the same "factor," which, once lost, cannot be regained, or is it brought about by a less organized tendency of the mechanism of development to fall into an identical condition from time to time? Far though we be from answering them, these questions are not without interest for others than the systematist. But it is doubtful whether they would be asked if phylogenetic speculation were regarded as wholly a waste of time.

Another problem which is continually suggesting itself concerns the mode in which special features arise and disappear. This has been generally assumed to take place by the gradual elaboration of a rudiment into the highly developed organ, and its loss, when it has outlasted its usefulness, by a series of vestigial stages. Now in some cases it is certainly possible to trace a set of incomplete forms of an organ, and it is justifiable to regard these as either rudimentary or vestigial, though it is often hard or impossible to choose one or other of those alternatives. As instances of such phenomena within species there may be quoted the various forms of armature of the finger of the great chela in *Harpiliopsis depressus*, where stages in the perfection of a cutting flange may be seen, and the varying degrees of inequality of the legs of the second pair in *Coralliocaris graminea*. It is easy to imagine that in either of these cases one form of the organ might come to persist to the exclusion of the others. Within the limits of a genus, the same thing may be seen in regard to the remarkable protuberance

* On the Genera of the Dromiidæ, Ann. Mag. Nat. Hist. (7), xi. p. 303 (1903).

on the dactylopodites of the walking legs of *Coralliocaris*, of which rudimentary or vestigial stages are shown by the subgenus *Onycocaris*, and in the horns of the eyes of *Corniger*, while the subfamily as a whole presents, from genus to genus, a very pretty example of the loss of an organ by gradual stages in the reduction of the arthrobranch of the third maxilliped, from the well-formed gill of *Urocaridella* to the evanescent lobe of *Pontonia*. But there are other cases in which an organ is always present in the same degree of perfection. This is perhaps not very remarkable, for instance, in the peculiar armature of the fingers of the chelæ of certain *Periclimenes*, such as the pits of *P. petitthouarsi* and *P. spinifera* or the combs of the same and certain other species, where imperfect stages may well have disappeared; but it is most striking in the many cases of well-formed and characteristic spines on the limbs and body which come and go throughout the subfamily without ever a trace of rudimentary or vestigial stages. Of such facts as these any theory of evolution must take account.

Finally it is necessary to state that even less conception can be formed of the nature of a "species" in the Pontoniinæ than in many other groups of animals. We have not the slightest knowledge as to what degree of fertility exists between the assemblages of individuals to which this name is given, and have not even the assurance that some of them are not merely allelomorphs. The attempt has been made in some instances to recognize certain entities as "varieties," but as none of these are connected by intermediate individuals I have felt bound, in accordance with principles which I have stated elsewhere*, to class them all in the same temporary category as the "species."

The Species of Pontoniinæ.

In the following lists the species of the subfamily at present known are arranged under their genera with a key to the species of each genus.

Genus Urocaridella Borradaile, 1915.

Ann. Mag. Nat. Hist. (8), xv. p. 207.

Definition: Body slender, much compressed; sixth abdominal segment elongate; rostrum long, slender, upcurved, with teeth above and below; outer flagellum of antennule deeply cleft; antennal scale long, narrow; mandible with palp; second maxilliped with podobranch, and last joint mediad of preceding joint; third maxilliped slender, with arthrobranch; legs very slender, directed forwards, with simple, slender, nearly straight dactylopodites; first abdominal limb with *appendix interna*.

Type: *Urocaridella gracilis* Borradaile, 1915 (Plate **53**, fig. 2).

Ann. Mag. Nat. Hist. (8), xv. p. 210.

Definition: Rostrum nearly twice as long as carapace, much upcurved, excavate at base, its formula $\frac{8-10}{10-12}$, one of the dorsal teeth standing in the middle of the

* Gardiner's Fauna of the Maldives, vol. i.

carapace, two, large, standing on a crest over the orbit, two to four, small, near antennule, three isolated near the tip, most of ventral teeth large and set on a crest between the antennules; antennal and hepatic spines present, the latter nearly in the branchiostegal position; antennular stalk three-quarters of length of antennal scale, its basal joint not much expanded, with stylocerite and distal spine small, the second joint shorter than the third, the second and third joints together shorter than the first; basipodite of antenna with very small spine, scale not half length of rostrum, slightly outcurved, its sides converging slightly towards the end, which is subtruncate, its subterminal spine not reaching the end, stalk of antenna more than half the length of first joint of antennule; third maxilliped reaching or outreaching end of second joint of antennule; first leg outreaching antennal scale by fingers, its wrist and palm subequal, fingers a little longer, its arm equal to wrist and palm together; second legs equal and similar, outreaching antennal scale by hand and part of wrist, fingers rather longer than palm, wrist more than half length of palm, arm equal to wrist and palm together, all joints unarmed; walking legs long, slender, with spines under the propodite, the longest at the end, dactylopodites long, nearly straight, simple; telson longer than sixth abdominal segment, shorter than uropods.

Length of longest specimen, 40 mm.

Maldive Is.

Genus Urocaris Stimpson, 1860.

Proc. Ac. Philadelphia, 1860, p. 39. Kingsley, Ib., 1879, p. 383 (1880). Rathbun, Bull. U. S. Fish Comm. xx. II. p. 126 (1901).

Definition: Body slender, much compressed; sixth abdominal segment elongate; rostrum with a toothed crest above but toothless below; outer flagellum of antennule deeply cleft; antennal scale long, narrow; mandible without palp; second maxilliped without gill; third maxilliped slender, with arthrobranch; legs very slender, their dactylopodites little curved.

Key to the species of *Urocaris*:

I. Rostrum very long and slender and much upcurved.
U. psamathe de Man, 1902.

II. Rostrum of moderate length, never very slender, hardly if at all upcurved.

A. Rostrum has high, arched dorsal crest.
U. infraspinis Rathbun, 1902.

B. Rostrum has low dorsal crest.

1. Rostrum arched, with concavity below. Third abdominal segment projects behind.

a. Two teeth of dorsal crest stand behind orbit. Walking legs biunguiculate.
U. longicaudata Stimpson, 1860.

b. Five teeth of dorsal crest stand behind orbit. Walking legs have simple dactylopodites.

U. æsopius (Bate), 1864.

2. Rostrum straight. Third abdominal segment does not project behind.

a. Rostral formula $\frac{7}{0}$. Second leg of great length.

U. longipes Stimpson, 1860.

b. Rostral formula $\frac{10-11}{3}$. Second leg rather short.

U. korni (Lo Bianco), 1903.

1. (Type.) *Urocaris longicaudata* Stimpson, 1860.

Proc. Ac. Philadelphia, 1860, p. 39. Kingsley, Bull. Essex Inst. x. p. 65; Proc. Ac. Philadelphia, 1878, p. 330. Rathbun, Bull. U. S. Fish Comm. xx. II. p. 126 (1901). ? Pearson, Rep. Ceylon Pearl Fisheries, iv. p. 78, Pl. 1, fig. 5 (1905).

Specimens in the present collection of a *Urocaris* resembling this species do not agree with the descriptions given by the authorities cited, in the following points: (1) the rostrum outreaches the second joint of the antennular peduncle, (2) the flagella of the antennule are much longer than its stalk, (3) the first leg outreaches the antennal scale by the fingers, and the fingers and palm are subequal, (4) the fingers of the second leg are rather shorter than the palm. Further investigation of the reported occurrence of *U. longicaudata* in the Indian Ocean is desirable.

Carolina to Brazil. Western Indian Ocean ?

2. *Urocaris longipes* Stimpson, 1860.

Proc. Ac. Philadelphia, 1860, p. 39.
Ousima I., 20 fms.

3. *Urocaris æsopius* (Bate), 1864.

Anchistia æsopia Bate, Proc. Zool. Soc. Lond., 1863, p. 502, Pl. 41, fig. 5 (1864).
St Vincent Gulf.

4. *Urocaris infraspinis* Rathbun, 1902.

Proc. U. S. Mus. xxiv. p. 903; Decap. Crust. N.W. America, p. 31 (1904).
California to Mexico.

5. *Urocaris psamathe* de Man, 1902 (Plate **53**, fig. 3).

Abh. Senckenb. Ges. xxv. p. 816, Pl. 25, fig. 51.
Ternate.

6. *Urocaris korni* (Lo Bianco), 1903.

Anchistia Kornii, Lo Bianco, Mitt. Stat. Neapel, xvi. p. 250, Pl. 7, fig. 13 (1903).
Periclimenes Korni? Kemp, Journ. Mar. Biol. Assoc. (N. S.) viii. p. 411 (1910).
Mediterranean. Bay of Biscay ? Bathypelagic, 400—600 fms.

Genus Ancyclocaris Schenkel, 1902.

Verh. Naturf. Basel, xii. p. 503. Nobili, Bull. Sci. Fr. Belg. xl. p. 52 (1906).

Definition: Body rather stout; cephalothorax with dorsal swelling in female; sixth abdominal segment short; rostrum deep, of moderate length, lanceolate, with about half-a-dozen teeth above and one or two below; eyes small; outer flagellum of antennule deeply cleft; antennal scale broad; mandible without palp; second maxilliped with or without podobranch*, and with last joint mediad of preceding joint; third maxilliped slender, with arthrobranch; legs stout, with short, simple, curved dactylopodites.

The species of this genus are closely related, and the distinctions between them are hard to gather from the published descriptions. Possibly some of them will eventually have to be united. So far as can be learned from the diagnoses and figures given by their authors, they differ in the points stated in the following key:

Key to the species of *Ancyclocaris*:

I. Dorsal swelling of cephalothorax steep. Uncleft region of outer antennular flagellum 8-jointed. Hepatic spine farther forward than usual. [Outer edge of antennal scale converging towards inner. R. $= \frac{5-6}{1}$. Fingers of second leg gaping a little.]

A. aberrans (Nobili), 1904.

II. Dorsal swelling of cephalothorax gradual. Uncleft region of outer antennular flagellum 5—7-jointed. Hepatic spine not farther forward than usual.

A. All rostral teeth in front of orbit. Fingers of second leg gaping a little. [R. $= \frac{6}{1}$. Outer edge of antennal scale straight.]

A. latirostris (Lenz), 1905.

B. One tooth of rostrum behind orbit. Fingers of second leg not gaping appreciably.

1. R. $= \frac{6}{1}$. Cephalothorax with large swelling in middle of its length. Outer edge of antennal scale nearly straight †. Uncleft region of outer antennular flagellum 7-jointed.

A. hermitensis (Rathbun), 1914.

2. R. $= \frac{6}{2}$. Cephalothorax with low swelling in hinder region. Outer edge of antennal scale markedly convex. Uncleft region of outer antennular flagellum 5—6-jointed.

A. brevicarpalis Schenkel, 1902.

1. (Type.) *Ancyclocaris brevicarpalis* Schenkel, 1902.

Verh. Naturf. Basel, xiii. p. 563, Pl. 13, fig. 21.

Macassar.

* Nobili (Bull. Sci. Fr. Belg. xl. p. 52) very definitely states that *A. aberrans* has a gill on the second maxilliped. I have not been able to find this in *A. hermitensis*.

† See below, p. 356.

2. *Ancyclocaris aberrans* (Nobili), 1904.

Palæmonella aberrans, Nobili, Bull. Mus. Paris, 1904, v. p. 233.

Ancyclocaris aberrans, Nobili, Bull. Sci. Fr. Belg. xl. p. 52, Pl. 4, fig. 9 (1906); Ann. Sci. Nat. (9), iv. p. 64 (1906).

Jibuti, under protection of *Discosoma giganteum*. Persian Gulf.

3. *Ancyclocaris latirostris* (Lenz), 1905.

Harpilius latirostris, Lenz, Abh. Senckenb. Ges. xxvii. p. 380, Pl. 47, fig. 14 (1905).

Ancyclocaris (?) *latirostris*, Nobili, Ann. Sci. Nat. (9), iv. p. 65 (1906).

? *Eine nicht bestimmte Palæmonide*, Richters, Decap. Mauritius, Pl. 18, figs. 10, 11 (1880).

E. Africa. Mauritius ?

4. *Ancyclocaris hermitensis* (Rathbun), 1914.

Periclimenes hermitensis, Rathbun, Proc. Zool. Soc. Lond., 1914, p. 655, Pl. 1, figs. 1—3.

Monte Bello Is. Torres Straits, under protection of *Discosoma*, whose mouth it enters at times.

Miss Rathbun figures the antennal scale of this species without a distal spine. In specimens from Torres Straits which resemble hers in every other respect, including the colour pattern, the outer edge of the scale is straight from the base to a well-formed distal spine, and then curves abruptly inwards.

Genus Palæmonella Dana, 1852.

U. S. Explor. Exped. Rep. xiii. i. p. 582. Kingsley, Proc. Ac. Philadelphia, 1879, p. 425 (1880). Bate, "Challenger" Macrura, p. 786 (1888). Ortmann, in Spengel, Zool. Jahrb. Syst. v. p. 513 (1890); Bronn's Thierreich, v. ii. p. 1132 (1899).

Definition: Body slender; sixth abdominal segment of moderate length; rostrum straight or a little upcurved, shallow, with several teeth above but few below; outer flagellum of antennule deeply cleft or not; antennal scale of good length and moderate breadth; mandible with palp; second maxilliped without even a vestige of podobranch, and with last joint mediad of preceding joint; third maxilliped narrow, with vestigial arthrobranch; legs slender, with slender, slightly curved dactylopodites, biunguiculate or not in last three pairs.

Key to the species of *Palæmonella*:

I. Second leg unarmed: its wrist less than half the length of its hand.

A. No hepatic spine.

1. Wrist of first leg longer than hand. Dactylopodites of last three legs simple. (R. = $\frac{6}{1}$.)

P. orientalis Dana, 1852.

2. Wrist of first leg shorter than hand. Dactylopodites of last three legs bear a spine in the middle of the lower edge. (R. = $\frac{6}{1}$.)
P. batei n. nom.

B. A hepatic spine present.

1. Last three legs biunguiculate. Second wrist more than $\frac{1}{4}$ length of hand.

a. Second legs unequal. R. = $\frac{8}{2}$.
P. biunguiculata Nobili, 1904.

b. Second legs subequal. R. = $\frac{6-7}{3}$.
P. rathbunensis n. nom.

2. Last three legs not biunguiculate. Second wrist less than $\frac{1}{4}$ length of hand.

a. Rostrum deep, lanceolate. Palm of second leg only as long as fingers. (R. = $\frac{5-6}{1}$.)
P. amboinensis Zehnter, 1894.

b. Rostrum shallow, not lanceolate, slightly upcurved. Palm of second leg twice as long as fingers.

i. R. = $\frac{6}{1}$, lower tooth removed from tip.
P. affinis Zehnter, 1894.

ii. R. = $\frac{8-13}{2-3}$, lower teeth near tip.
P. laccadivensis Alcock and Anderson, 1894.

II. Second leg bears a spine at least on wrist, which is more than half length of hand.

A. Arm of second leg bears a spine at end. Indopacific.

1. Rostrum $\frac{3}{0}$, much shorter than antennal stalk.
P. elegans Borradaile, 1915.

2. Rostrum $\frac{6-8}{2-3}$, longer than antennal stalk.

a. Spine at end of arm of second leg subterminal. Fingers of same leg toothed. Teeth on lower side of rostrum well spaced.

i. Rostrum outreaches antennular stalk by nearly half its own length, decidedly upcurved. Wrist of first leg half as long again as hand.
P. longirostris Borradaile, 1915.

ii. Rostrum but little outreaches antennular stalk, hardly upcurved. Wrist of first leg less than half as long again as hand.
P. tridentata Borradaile, 1899.

b. Spine at end of arm of second leg terminal. Fingers of same leg not toothed. Teeth on lower side of rostrum stand close together near tip.
P. tenuipes Dana, 1852.

B. Arm of second leg bears no spine. West Indian. (R. = $\frac{7}{2}$.)
P. yucatanica Ives, 1891.

1. (Type.) *Palæmonella tenuipes* Dana, 1852.

U. S. Explor. Exped. Rep. xiii. 1. p. 582 ; Atlas, Pl. 38, fig. 3 (1855). Stimpson, Proc. Ac. Philadelphia, 1860, p. 40. de Man, Arch. Naturg. liii. 1. p. 551, Pl. 22 *a*, fig. 4 (1887). Heilprin, Proc. Ac. Philadelphia, 1888, p. 322 (?). Ortmann, Speng. Zool. Jahrb. Syst. v. p. 527 (1890). Zehnter, Rev. Suisse Zool. ii. p. 208 (1894). Nobili, Ann. Mus. Napoli, i. p. 6 (1901). Rathbun, Bull. U. S. Fish Comm. xxiii. p. 925 (1906).

? *Palæmonella tenuipes* var., Nobili, Ann. Sci. Nat. (9), iv. p. 70 (1906).

Indopacific. Bermuda ?

2. *Palæmonella orientalis* Dana, 1852.

U. S. Explor. Exped. Rep. xiii. 1. p. 583 ; Atlas, Pl. 38, fig. 4 (1855). de Man, Arch. Naturg. liii. 1. p. 552 (1887).

E. Indies, on comatulids.

3. *Palæmonella yucatanica* Ives, 1891.

Proc. Ac. Philadelphia, 1891, p. 183, Pl. 5, fig. 8.

Yucatan.

4. *Palæmonella amboinensis* Zehnter, 1894.

Rev. Suisse Zool. ii. p. 200, Pl. 9, fig. 27. de Man, Abh. Senckenb. Ges. xxv. p. 811 (1902).

E. Indies.

5. *Palæmonella affinis* Zehnter, 1894.

Rev. Suisse Zool. ii. p. 208.

Amboina, on *Actinometra*.

6. *Palæmonella laccadivensis* Alcock and Anderson, 1894.

Journ. As. Soc. Bengal, lxiii. p. 157 (1894). Illust. Zool. "Investigator," Crust. iv. Pl. 26, fig. 4 (1896). Ann. Mag. Nat. Hist. (7), iii. p. 4 (1889). Rathbun, Bull. U. S. Fish Comm. xxiii. p. 925, Pl. 22, fig. 2 (1906).

Laccadive Is. Hawaiian Is. 100—600 fms.

7. *Palæmonella tridentata* Borradaile, 1899.

Proc. Zool. Soc. Lond., 1898, p. 1007, Pl. 64, fig. 8.

Funafuti. Western Indian Ocean.

8. *Palæmonella biunguiculata* Nobili, 1904.

Bull. Mus. Paris, 1904, v. p. 233. Ann. Sci. Nat. (9), iv. p. 71, Pl. 3, fig. 6 (1906).

Jibuti.

9. *Palæmonella batei* n. nom.

Palæmonella orientalis, Bate, "Challenger" Macrura, p. 787, Pl. 128, fig. 4 (1888).

Philippine Is.

10. *Palæmonella rathbunensis* n. nom.

Palæmonella orientalis, Rathbun, Bull. U. S. Fish Comm. xxiii. p. 925 (1906).

Hawaiian Is.

11. *Palæmonella elegans* Borradaile, 1915 (Plate **53**, fig. 4).

Ann. Mag. Nat. Hist. (8), xv. p. 210.

Definition: Closely related to *P. tridentata* but with rostrum quite different, lanceolate, not reaching end of first joint of antennule, quite straight, of the formula $\frac{3}{0}$, two teeth standing behind the orbit.

Length of the single specimen, 17 mm.

Salomon.

It is possible that this is an abnormal specimen of *P. tridentata.*

12. *Palæmonella longirostris* Borradaile, 1915 (Plate **53**, fig. 5).

Ann. Mag. Nat. Hist. (8), xv. p. 210.

Definition: Related to *P. tridentata* but differs in that: (1) the rostrum is much longer, outreaching the antennular stalk by not much less than half its own length, very decidedly upcurved, and of the formula $\frac{8}{3}$, owing to the addition of a small tooth near the tip; (2) the third maxilliped is rather shorter, only reaching the end of the first joint of the antennule; (3) the wrist of the first leg is half as long again as the hand; (4) the second leg is longer and more slender, and has the arm of even width, not wider in the middle as in *P. tridentata,* the spine at the end of the arm smaller, and smaller teeth on the fingers.

Length of longest specimen, 17 mm.

Fadiffolu Atoll, Maldive Is.

Palæmonella gracilis Paulson, 1875 (Red Sea Crustacea, p. 117, Pl. 17, fig. 6) does not belong to this genus, and appears, from its telson, not to be a member of the Pontoniinæ.

Genus Periclimenes Costa, 1844.

Pelias, Roux, Mém. s. l. Salicoques, p. 25 (1831). H. M.-Edwards, Hist. Nat. Crust. ii. p. 381 (1837). Heller, Sitz. k. Ak. Wiss. Wien, xlv. p. 406 (1862); Crust. südl. Eur. p. 254 (1863).

Periclimenes, Costa, Ann. Ac. Aspir. Nat. Napoli, ii. (1844); Faun. Reg. Napoli, ii. i. (1846). Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 380 (1898). Rathbun, Bull. U. S. Fish Comm. xx. ii. p. 121 (1901).

Anchistia, Dana, U. S. Explor. Exped. Rep. xiii. i. p. 577 (1852). Kingsley, Proc. Ac. Philadelphia, 1879, p. 423 (1880). Carus, Prodr. Faun. Medit. i. p. 474 (1885). Ortmann, Bronn's Thierreich, v. ii. p. 1131 (1899).

Dennisia, Norman, Ann. Mag. Nat. Hist. (3), viii. p. 278 (1861).

Definition: Body slender, usually somewhat compressed; sixth abdominal segment of moderate length; rostrum of varying shape; outer flagellum of antennule usually not deeply cleft; antennal scale of moderate breadth; mandible without palp; second maxilliped without podobranch, though often with a vestige of it, last joint mediad of preceding joint; third maxilliped slender, with small arthrobranch; legs slender, except

second pair which may be fairly heavy ; dactylopodites of last three pairs usually simple and slightly curved.

Four distinct sections may be observed in *Periclimenes*. (1) *P. aurantiaca* (Dana) differs sharply from all the rest in the lack of teeth on its rostrum. Quite possibly further information will show that it should become the type of a new genus : for the present it must have subgeneric rank. The remaining species fall into three groups. (2) In one of these the rostrum is rather short and has a convex upper edge, while the second leg is unarmed and its wrist short. In this group the supraorbital spine is rare. (3) In another group, the dorsal edge of the rostrum is convex, and the second leg of the only species in which this limb is known is short-wristed and unarmed, but the cornea, which in all other *Periclimenes* is subhemispherical, is here ogival, and a strong supraorbital spine is present. (4) The remainder of the species, including more than half the genus, form a group which is characterized by a rostrum with straight or concave upper edge and tip nearly always upturned. The second leg generally bears a spine on arm or wrist or both, and almost always has the wrist of a good length. The supraorbital spine is common in this group. The existence of certain intermediate species, such as *P. commensalis* Borradaile and *P. amethysteus* (Risso), makes it undesirable that these sections should rank as genera. I have therefore established for them four subgenera, named respectively *Ensiger*, *Cristiger*, *Corniger*, and *Falciger**. The type species of the genus belongs to *Cristiger*.

Key to the subgenera of *Periclimenes* :

I. Rostrum toothless. No spines on trunk or legs.
Ensiger Borradaile, 1915.

II. Rostrum toothed. Spines at certain points on trunk or legs.

A. Cornea ogival. [Upper edge of rostrum convex. Strong supraorbital spine.]
Corniger Borradaile, 1915.

B. Cornea not ogival.

1. Upper edge of rostrum convex. Second leg with short wrist, and unarmed, save that angles of wrist and arm are sharp in *P. gracilis*. Supraorbital spine in one species only.
Cristiger Borradaile, 1915.

2. Upper edge of rostrum straight or concave. Second leg rarely with short wrist, generally with spine on wrist or arm or both. Supraorbital spine common.
Falciger Borradaile, 1915.

Subgenus Cristiger Borradaile, 1915.

Ann. Mag. Nat. Hist. (8), xv. p. 207.

Definition: Rostrum toothed, with convex upper edge, short or of medium length. Antennal and usually hepatic spines present. Supraorbital spine very rare. Second leg

* Since these subgenera were established, in an article in the Annals and Magazine of Natural History for February, 1915, I have learned that the names of two of them (*Corniger* and *Falciger*) are preoccupied as designations of genera. They must, however, continue to stand as subgeneric names.

with short wrist, and unarmed, save that in *P. gracilis* the angles of the wrist and arm are sharp.

Key to the species of *Periclimenes* (*Cristiger*):

I. Rostrum much shorter than antennular stalk. Second leg shorter than first. [R. = $\frac{5}{0}$, lanceolate, two teeth behind orbit.]

P. (*C.*) *brevinaris* Nobili, 1905.

II. Rostrum little if at all shorter than antennular stalk. Second leg longer than first.

A. Three or four rostral teeth behind orbit. Three teeth below rostrum. Atlantic and Mediterranean.

1. Rostrum deep, horizontal. Second leg outreaches antennal scale by hand only. European. [R. = $\frac{8-9}{3}$.]

P. (*C.*) *scriptus* (Risso), 1826.

2. Rostrum shallow, bent downwards. Second leg outreaches antennal scale by wrist and hand. W. Atlantic. [R. = $\frac{9}{3}$.]

P. (*C.*) *tenellus* (Smith), 1882.

B. No rostral tooth behind orbit. Very rarely more than one tooth below rostrum*. Indopacific.

1. Rostrum lanceolate.

a. Dorsal edge of rostrum bears nine or more teeth.

i. Antepenultimate joint of third maxilliped broad. R. = $\frac{9-10}{1}$. Fingers of first leg not denticulate.

P. (*C.*) *brocki* (de Man), 1887.

ii. Antepenultimate joint of third maxilliped narrow. R. = $\frac{11-13}{0}$. Fingers of first leg denticulate.

α. First joint of antennule bears two distal spines. No accessory spinule on dactylopodites of last three legs.

P. (*C.*) *frater* Borradaile, 1915.

β. First joint of antennule bears one distal spine. An accessory spinule on dactylopodites of last three legs.

P. (*C.*) *soror* Nobili, 1904.

b. Dorsal edge of rostrum bears seven or fewer teeth.

i. Ventral edge of rostrum bears more than one tooth.

α. A supraorbital spine. [R. = $\frac{5}{2}$.]

P. (*C.*) *commensalis* Borradaile, 1915.

* Only *P. notatus* has three.

β. No supraorbital spine.

(1) R. = $\frac{7}{3}$. Hepatic spine present. Antennal scale bears distal spine at end.

P. (*C.*) *notatus* (Heller), 1865.

(2) R. = $\frac{6}{2}$. Hepatic spine absent. Antennal scale bears distal spine at a little distance from end.

P. (*C.*) *pusillus* Rathbun, 1903.

ii. Ventral edge of rostrum bears one tooth.

α. Rostrum $\frac{5-6}{1}$; longer than antennular stalk; its tip not upturned. Angles of arm and wrist sharp.

P. (*C.*) *gracilis* (Dana), 1852.

β. Rostrum $\frac{5}{1}$; shorter than antennular stalk; its tip a little upturned. Angles of arm and wrist not sharp.

P. (*C.*) *potina* Nobili, 1905.

2. Rostrum not lanceolate, with decided reversal of curve at tip.

a. Rostrum $\frac{6}{1}$; outreaching antennular stalk. Hepatic spine present. Hand of second leg elongate.

i. A denticle on carapace behind rostral crest. Last joint of third maxilliped slightly shorter than penultimate.

P. (*C.*) *incertus* Borradaile, 1915.

ii. No denticle on carapace behind rostral crest. Last joint of third maxilliped slightly longer than penultimate.

P. (*C.*) *parvus* Borradaile, 1898.

b. Rostrum $\frac{7}{0}$; outreached by antennular stalk. No hepatic spine. Hand of second leg short.

P. (*C.*) *parasiticus* Borradaile, 1898.

1. (Type.) *Periclimenes* (*Cristiger*) *scriptus* (Risso), 1826.

Alpheus scriptus, Risso, Hist. Nat. Eur. Mér. v. p. 78 (1826); Acad. Leop., 1826, p. 821.

Pelias scriptus, Roux, Mém. s. l. Salicoques, p. 25 (1831). Heller, Sitz. k. Ak. Wiss. Wien, Math.-Nat. Cl. xlv. p. 406, Pl. 2, fig. 34 (1862).

Periclimenes insignis, Costa, Ann. Ac. Aspir. Nat. Napoli, ii. (1844); Faun. Regn. Napoli, ii. 1. Pl. 6, figs. 1—6 (1846).

Dennisia sagittifera, Norman, Ann. Mag. Nat. Hist. (3), viii. p. 278, Pl. 13, figs. 8—13 (1861).

Anchistia scripta, Heller, Crust. südl. Eur. p. 256, Pl. 8, figs. 18, 19 (1863). Carus, Prodr. Faun. Medit. i. p. 476 (1885).

Periclimenes scriptus, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 381 (1898).

Mediterranean, Guernsey. To 30 fms.

2. *Periclimenes* (*Cristiger*) *gracilis* (Dana), 1852.

Anchistia gracilis, Dana, U. S. Explor. Exped. xiii. i. p. 578 (1852); Atlas, Pl. 37, fig. 5 (1855),

Periclimenes gracilis, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 381 (1898).

Sulu Sea.

3. *Periclimenes* (*Cristiger*) *notatus* (Heller), 1865.

Anchistia notata, Heller, "Novara" Rep., Zool. ii. iii. p. 109, Pl. 10, fig. 3 (1865).

Periclimenes notatus, Borradaile, Ann. Mag. Nat. Hist. (7), iii. p. 382 (1898).

Nicobar Is.

4. *Periclimenes* (*Cristiger*) *tenellus* (S. J. Smith), 1882.

Anchistia tenella, S. J. Smith, Bull. Mus. Harvard, x. p. 55, Pl. 9, fig. 1 (1882).

Periclimenes tenellus, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 383 (1898).

E. coast of N. America, 229 fms.

5. *Periclimenes* (*Cristiger*) *brocki* (de Man), 1887 (Plates **53**, **54**, figs. 8*f*—*i*).

Anchistia Brockii, de Man, Arch. Naturg. liii. i. p. 548, Pl. 22 *a*, fig. 3 (1887).

Periclimenes Brocki, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 383 (1898).

Amboina. Maldive Is., to 43 fms., on sea urchin.

6. *Periclimenes* (*Cristiger*) *parvus* Borradaile, 1898.

Periclimenes parvus, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 384 (1898); Willey's Zool. Results, iv. p. 407, Pl. 1, fig. 3 (1899).

New Britain.

7. *Periclimenes* (*Cristiger*) *parasiticus* Borradaile, 1898.

Periclimenes parasiticus, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 384 (1898); Willey's Zool. Results, iv. p. 407, Pl. 1, fig. 4 (1899).

New Britain, on *Linckia*.

8. *Periclimenes* (*Cristiger*) *pusillus* Rathbun, 1903.

Periclimenes pusillus, Rathbun, Bull. U. S. Fish Comm. xxiii. iii. p. 921, fig. 71, Pl. 24. fig. 7 (1903).

Hawaiian Is.

9. *Periclimenes* (*Cristiger*) *soror* Nobili, 1904.

Periclimenes soror, Nobili, Bull. Mus. Paris, 1904, v. p. 231; Ann. Sci. Nat. (9), iv. p. 50, Pl. 2, fig. 6 (1906).

Jibuti.

10. *Periclimenes potina* Nobili, 1905.

Periclimenes potina, Nobili, Bull. Mus. Paris, 1905, p. 159; Bull. Sci. Tr. Belg. xl. p. 44, Pl. 3, fig. 8 (1906).

Persian Gulf, on floating brown seaweed.

11. *Periclimenes* (*Cristiger*) *brevinaris* Nobili, 1905.

Periclimenes Borradailei, Nobili, Bull. Mus. Paris, 1905, iii. p. 159.

Periclimenes brevinaris, Nobili, Bull. Sci. Tr. Belg. xl. p. 42, Pl. 3, fig. 7 (1906).

Persian Gulf.

12. *Periclimenes* (*Cristiger*) *frater* Borradaile, 1915 (Plate **53**, fig. 6).

Ann. Mag. Nat. Hist. (8), xv. p. 210.

Definition: Closely related to *P. soror*, but differing from it in that (1) the teeth on the upper edge of the rostrum are closer set towards the tip than near the base, (2) there are *two* distal spines on the first joint of the antennule, (3) the antennal scale decidedly outreaches the first leg, (4) there is no accessory denticle on the dactylopodites of the last three legs.

Length of the longer of the two specimens, 13 mm.

Seychelles, on reef.

13. *Periclimenes* (*Cristiger*) *incertus* Borradaile, 1915 (Plate **53**, fig. 7).

Ann. Mag. Nat. Hist. (8), xv. p. 210.

Definition: Closely related to *P. parvus*, but differing from it in that (1) the body is more slender, (2) the rostrum is shallower, (3) there is a denticle on the carapace behind the beginning of the rostral crest, (4) the third maxilliped is rather longer, owing to the greater length of the penultimate joint, which is considerably longer than the end joint.

Length of the single specimen, 11 mm.

Maldive Is.

The specific distinctness of this form from *P. parvus* is somewhat doubtful.

14. *Periclimenes* (*Cristiger*) *commensalis* Borradaile, 1915.

Ann. Mag. Nat. Hist. (8), xv. p. 211. Potts, Pap. Dep. Mar. Biol. Carnegie Inst. Washington, viii. p. 82 (1915).

Definition: Body rather stout, not compressed; rostrum reaching end of antennular stalk, outreached by antennal scale, lanceolate, directed slightly downwards, its formula $\frac{5}{2}$; supraorbital, hepatic, and antennal spines present; cornea subhemispherical; first joint of antennular stalk broad, with moderate stylocerite and two distal spines, second and third joints subequal, together shorter than first joint, flagella of a fair length, the outer rather deeply cleft; antenna with small basal spine, stalk nearly reaching end of first joint of antennule, scale wide, with straight outer and convex inner side, and distal spine of good size but not reaching end; third maxilliped slender, reaching end of antennal stalk, its long joint a good deal curved; first leg reaching end of thicker division of outer antennular flagellum, arm and wrist equal, hand shorter, fingers a little longer than palm; second leg short, unarmed, its wrist subconical, hand nearly equal to three preceding joints together, fingers equal to palm, not gaping, each with three small teeth near base; last three legs short, hairy, with a spine above and one below end claw of short, rather stout dactylopodite; telson shorter than uropods.

Torres Straits, on *Comanthus annulatus*.

Subgenus Corniger Borradaile, 1915.

Ann. Mag. Nat. Hist. (8), xv. p. 207.

Definition: Rostrum toothed, but without teeth behind orbit; its upper edge convex, but sometimes only slightly so. Antennal, hepatic, and strong supraorbital spines present. Eye ogival. Second leg at present only known in one species, where it is unarmed and has short wrist.

Key to the species of *Periclimenes* (*Corniger*):

I. Rostrum lanceolate, outreached by antennular stalk.

A. Rostrum deep, $\frac{7}{1}$. Eye without papilla.
P. (*C.*) *cornutus* Borradaile, 1915.

B. Rostrum shallow, $\frac{4}{0}$. Eye with papilla at apex.
P. (*C.*) *ceratophthalmus* Borradaile, 1915.

II. Rostrum with upper edge but slightly convex and lower edge straight till within short distance of tip, which is slightly upturned. Antennular stalk outreached by rostrum. [R. $= \frac{6}{1}$.]
P. (*C.*) *amboinensis* (de Man), 1887.

1. (Type.) *Periclimenes* (*Corniger*) *ceratophthalmus* Borradaile, 1915 (Plate **54**, fig. 9).

Ann. Mag. Nat. Hist. (8), xv. p. 211.

Definition: Body not much compressed; rostrum outreached barely by antennular stalk but distinctly by antennal scale, straight, shallow, lanceolate, bearing above four teeth, all in its distal half, and no teeth below; eye ogival, ending in a papilla; supraorbital, antennal and hepatic spines present; first joint of antennular stalk not greatly expanded, with moderate stylocerite, second and third joints stout and subequal, flagella short; antennal stalk about $\frac{3}{4}$ length of first joint of antennule, scale broad, with small distal tooth set well back from end; third maxilliped short, rather stout; first leg outreaching antennal scale by its fingers, its arm and wrist subequal, hand about half length of wrist; second leg outreaching antennal scale by nearly the whole of its hand, stout, with short wrist and no spines on any joint, hand flattened, parallel-sided, with fingers simple and about $\frac{2}{3}$ length of hand; telson considerably shorter than uropods.

Length of the single specimen, 8 mm.

Malé Atoll, Maldive Is., on crinoid, with polychæte.

2. *Periclimenes* (*Corniger*) *cornutus* Borradaile, 1915 (Plate **54**, fig. 10).

Ann. Mag. Nat. Hist. (8), xv. p. 211.

Definition: Body moderately compressed; rostrum outreached slightly by antennular stalk and rather more by antennal scale, lanceolate, deep, bearing above seven teeth, none behind orbit, and one tooth below; antennal, hepatic close behind antennal, and strong, compressed supraorbital spines present; cornea ogival; first joint of antennule

well expanded, with moderate stylocerite and distal spine, second and third joints stout and subequal; antennal scale of moderate breadth, almost straight-sided, its end truncate and not reached by its distal spine; third maxilliped slightly outreaching antennal stalk, but not reaching end of first joint of antennular stalk; first leg outreaching antennal scale by hand, its wrist and arm equal, hand shorter than wrist, palm and fingers subequal; last three legs stout, their propodites hairy and armed with spines, their dactylopodites gently curved and ending in a sharp claw; telson shorter than uropods, diminishing rather suddenly near the end, which is rounded and has all the spines short.

Length of the single specimen 12 mm.

Malé Atoll, Maldive Is., on red and brown crinoid.

3. *Periclimenes* (*Corniger*) *amboinensis* (de Man), 1887.

Anchistia amboinensis, de Man, Arch. Naturg. liii. 1. p. 546, Pl. 22 *a*, fig. 2 (1887).
Periclimenes amboinensis, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 383 (1898).
Amboina.

Subgenus Falciger Borradaile, 1915.

Ann. Mag. Nat. Hist. (8), xv. p. 207.

Definition: Rostrum toothed, with straight or concave upper edge, nearly always upcurved at tip, long or of medium length. Antennal, usually hepatic, and often supraorbital spines present. Second leg usually with wrist long or of moderate length, usually with spine at end of wrist or arm or both.

Key to the species of *Periclimenes* (*Falciger*).

I. Fingers of great chela each with an oval pit; those of first legs with comb-like arrangement of fine teeth. [R. = $\frac{7}{3-5}$.]

A. Supraorbital spine present.

P. (*F.*) *spiniferus* de Man, 1902.

B. Supraorbital spine absent.

P. (*F.*) *petitthouarsi* (Audouin), 1825.

II. Fingers of great chela, and usually also those of first legs, not as in I.

A. Supraorbital spine present.

1. Rostrum without teeth below. [R. = $\frac{6}{0}$.]

P. (*F.*) *lifuensis* Borradaile, 1898.

2. Rostrum with teeth below.

a. Second leg unarmed. Antennal scale broad; with distal spine not projecting beyond end.

i. Antennular stalk reaches end of rostrum. Teeth above rostrum show a gap in middle of series. [R = $\frac{7}{3}$.]

P. (*F.*) *edwardsi* (Paulson), 1875.

ii. Antennular stalk does not reach end of rostrum. Teeth above rostrum show no gap in middle of series. [R. $=\frac{2}{4}$.]
P. (*F.*) *nilandensis* Borradaile, 1915.

b. Second leg bears one or more spines. Antennal scale narrow; with distal spine projecting beyond end.

i. Upper edge of rostrum straight at first, upcurved at end.

α. Rostrum shallow, little excavated at base, not reaching end of antennular stalk. Second wrist bears one spine.

(1) Antennal scale broad. Second wrist more than half length of hand. [R. $=\frac{7}{2-3}$.]
P. (*F.*) *danæ* (Stimpson), 1860.

(2) Antennal scale narrow. Second wrist about one-third length of hand. [R $=\frac{7}{7}$.]
P. (*F.*) *grandis* (Stimpson), 1860.

β. Rostrum deep, much excavate at base. Second wrist bears two or three spines.

(1) Outer edge of antepenultimate joint of third maxilliped bears one spine. Wrist of second leg has no spine on the inner side. Fingers of same leg toothless. [R. $=\frac{7}{3}$.]
P. (*F.*) *elegans* (Paulson), 1875.

(2) Outer edge of antepenultimate joint of third maxilliped bears several spines. Wrist of second leg has strong spine on inner side. Fingers of same leg toothed.

(*a*) R. $=\frac{7}{2}$; its tip simple. In second leg fingers about one-third length of palm, and wrist nearly twice length of fingers.
P. (*F.*) *affinis* Borradaile, 1915.

(*b*) R. $=\frac{8}{4}$; its tip bifid. In second leg fingers rather more than half length of palm, and wrist equal in length to fingers.
P. (*F.*) *dubius* Borradaile, 1915.

ii. Upper edge of rostrum concave from base.

α. Rostrum deep. Second wrist about as long as arm.

(1) Antennule has flagella shorter than stalk and third joint longer than second. Not more than one spine at end of second wrist.

(*α*) Second wrist without spine; a little longer than arm. [R $=\frac{6-7}{2-3}$.]
P. (*F.*) *ensifrons* (Dana), 1852.

(*β*) Second wrist bears a spine; a little shorter than arm. [R $=\frac{6-8}{3-4}$.]
P. (*F.*) *vitiensis* Borradaile, 1898.

(2) Antennule has flagella longer than stalk and third joint subequal to second. Two spines at end of second wrist.
P. (*F.*) *holmesi* Nobili, 1907.

β. Rostrum shallow. Second wrist not nearly as long as arm. [R. = $\frac{8}{3}$.]
P. (*F.*) *amymone* de Man, 1902.

B. No supraorbital spine.

1. Upper edge of rostrum straight at first, though its tip may be upturned.

a. Rostrum without teeth below. Last two joints of antennular stalk very long. [R = $\frac{6}{0}$.]
P. (*F.*) *longimanus* (Dana), 1852.

b. Rostrum with one or more teeth below. Last two joints of antennular stalk usually short.

i. Second leg unarmed.

α. Rostrum of good depth. Second wrist long. [R. = $\frac{7-9}{2-3}$.]
P. (*F.*) *americanus* (Kingsley), 1878.

β. Rostrum rather shallow. Second wrist short.

(1) Rostrum has three teeth below, and two behind orbit, and is directed straight forwards.

(*a*) R. = $\frac{5}{3}$ with additional denticle at tip. First and second legs outreach antennal scale.
P. (*F.*) *compressus* Borradaile, 1915.

(*b*) R. = $\frac{8}{3}$. First and second legs do not outreach antennal scale.
P. (*F.*) *amethysteus* (Risso), 1826.

(2) Rostrum has one tooth below, and one behind orbit, and is directed somewhat downwards. [R. = $\frac{6}{1}$.]
P. (*F.*) *brocketti* Borradaile, 1915.

ii. Second leg bears one or more spines.

α. Second wrist bears three spines. One rostral tooth behind orbit.

(1) Second arm bears four spines. Antennal scale of good breadth. [R. = $\frac{7}{3}$.]
P. (*F.*) *denticulatus* Nobili, 1907.

(2) Second arm bears one spine. Antennal scale narrow.
P. (*F.*) *brachiatus* (Stimpson), 1860.

β. Second wrist bears one spine. Two rostral teeth behind orbit.

(1) Antennal scale broad, not outcurved, its distal spine not projecting beyond its end. Rostrum not outreaching antennular stalk. [R. = $\frac{6}{2}$.]
P. (*F.*) *rotumanus* Borradaile, 1898.

(2) Antennal scale narrow, outcurved, its distal spine projecting beyond its end. Rostrum outreaching antennular stalk.

(*a*) Antennal scale shorter than carapace. Last two joints of antennular stalk slender. [R. = $\frac{6-7}{2}$.]

P. (*F.*) *suvadivensis* Borradaile, 1915.

(*b*) Antennal scale longer than carapace. Last two joints of antennular stalk stout. [R. = $\frac{7}{2}$.]

P. (*F.*) *pottsi* Borradaile, 1915.

2. Upper edge of rostrum decidedly concave from base.

a. Rostrum deep, $\frac{7-8}{3}$. Second leg unarmed.

P. (*F.*) *seychellensis* Borradaile, 1915.

b. Rostrum slender, $\frac{10}{7}$. Second leg bears spines on arm and wrist.

i. Rostrum not more than $1\frac{3}{4}$ times length of carapace. Second legs not more than five times length of carapace.

P. (*F.*) *borradailei* Rathbun, 1904.

ii. Rostrum $2\frac{1}{2}$ times length of carapace. Second legs seven times length of carapace.

P. (*F.*) *kolumadulensis* Borradaile, 1915.

1. (Type). *Periclimenes* (*Falciger*) *spiniferus* de Man, 1902 (Plate **52**, fig. 1).

Anchistia inæquimana, Heller, "Novara" Rep., Zool. ii. III. p. 109 (1865).

Anchistia Petitthouarsii, de Man, Arch. Naturg. liii. I. p. 54 (1887).

Periclimenes petitthouarsii var. *spinifera*, de Man, Abh. Senckenb. Ges. xxv. III. p. 824 (1902).

Periclimenes Petitthouarsii var. *spinigera*, Nobili, Ann. Sci. Nat. Zool. (9), iv. p. 49 (1906).

Periclimenes Petitthouarsi var. *spinifera*, Lenz, Voeltzkow's Reise in Ostafrika, ii. p. 567 (1910).

Tahiti. E. Indies. Indian Ocean.

2. *Periclimenes* (*Falciger*) *petitthouarsi* (Audouin), 1825.

Palæmon Petitthouarsii, Audouin, Descr. Egypte, Hist. Nat. i. IV. p. 91 (1825). Savigny, Atlas, Crust. pl. 10, fig. 3.

Anchistia inæquimana, Heller, Sitz. k. Ak. Wiss. Wien, xliv. I. p. 283 (1861).

Anchistia Petitthouarsii, Kossmann, Ergebn. Reise Rot. Meeres, p. 83 (1880).

Periclimenes Petitthouarsi, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 381 (1898). Nobili, Ann. Mus. Univ. Napoli, i. III. p. 6 (1901); Bull. Sci. Fr. Belg. xl. p. 41 (1906). Lenz, Ark. Zool. vii. XXIX. p. 2 (1912).

Periclimenes petitthouarsii, typischen art, de Man, Abh. Senckenb. Ges. xxv. III. p. 824 (1902).

Periclimenes Petitthouarsii, forme typique, Nobili, Ann. Sci. Nat., Zool. (9), iv. p. 49 (1906).

Red Sea. Persian Gulf.

3. *Periclimenes* (*Falciger*) *amethysteus* (Risso), 1826.

Alpheus amethysteus, Risso, Hist. Nat. Eur. Mér. v. p. 77, Pl. 4, fig. 16 (1826); Acad. Leop., 1826, p. 821.

Pelias amethysteus, Roux, Mém. s. l. Salicoques, p. 25 (1831). Heller, Sitz. k. Ak. Wiss. Wien, Math.-Nat. Cl. xlv. i. p. 408 (1863).

Anchistia amethystea, Heller, Crust. südl. Eur. pp. 256, 258 (1863). Carus, Prodr. Faun. Medit. i. p. 476 (1885).

Periclimenes amethysteus, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 381 (1895).

Mediterranean.

4. *Periclimenes* (*Falciger*) *longimanus* (Dana), 1852.

Anchistia longimana, Dana, U. S. Explor. Exped. Rep. xiii. i. p. 579 (1852); Atlas, Pl. 37, fig. 6 (1855).

Periclimenes longimanus, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 381 (1898).

Loc. ?

5. *Periclimenes* (*Falciger*) *ensifrons* (Dana), 1852.

Anchistia ensifrons, Dana, U. S. Explor. Exped. Rep. xiii. i. p. 580 (1852); Atlas, Pl. 38, fig. 1 (1855). Müller, Verh. nat. Ges. Basel, viii. i. p. 471 (1887). Ortmann, Jena. Denkschr. viii. p. 16 (1894).

Periclimenes ensifrons, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 382 (1898). Nobili, Mem. Ac. Torino (2), lvii. p. 350 (1907).

Indopacific.

6. *Periclimenes* (*Falciger*) *grandis* (Stimpson), 1860.

Anchistia grandis, Stimpson, Proc. Ac. Philadelphia, 1860, p. 39.

Periclimenes grandis, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 382 (1898). Balss, Abh. k. Bayer. Ak. Wiss., Math.-Phys. Kl. ii. Suppl. Bd. x. p. 49 (1914).

? *Anchistia Petitthouarsi*, Miers, "Alert" Report, Crust. p. 293 (1884).

Ousima I. Port Molle ?

7. *Periclimenes* (*Falciger*) *brachiatus* (Stimpson), 1860.

Anchistia brachiata, Stimpson, Proc. Ac. Philadelphia, 1860, p. 39.

Periclimenes brachiatus, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 382 (1898). Balss, Abh. k. Bayer. Ak. Wiss., Math.-Phys. Kl. ii. Suppl. Bd. x. p. 49 (1914).

Bonin Is.

8. *Periclimenes* (*Falciger*) *danæ* (Stimpson), 1860.

Anchistia Danæ, Stimpson, Proc. Ac. Philadelphia, 1880, p. 39.

Periclimenes Danæ, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 382 (1898).

Periclimenes danæ (?), Borradaile, Proc. Zool. Soc. Lond. 1898, p. 1004, Pl. 63, fig. 4 (1899).

Tahiti. Ellice Is., on coral reef.

9. *Periclimenes* (*Falciger*) *edwardsi* (Paulson), 1875.

Anchistia Edwardsi, Paulson, Crust. Red Sea, i. p. 114, Pl. 17, fig. 2 (1875). Nobili, Ann. Sci. Nat., Zool. (7) iv. p. 53 (1906).

Red Sea.

10. *Periclimenes* (*Falciger*) *elegans* (Paulson), 1875.

Anchistia elegans, Paulson, Crust. Red Sea, i. p. 113, Pl. 17, fig. 1 (1875). Nobili, Ann. Sci. Nat., Zool. (9), iv. p. 52 (1906).

Red Sea.

11. *Periclimenes* (*Falciger*) *americanus* (Kingsley), 1878.

Anchistia americana, Kingsley, Proc. Ac. Philadelphia, 1878, p. 96; Bull. Essex Inst. xiv. p. 109, Pl. 2, fig. 10 (1882).

Periclimenes americanus, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 383 (1898). Rathbun, Bull. U. S. Fish Comm. xx. II. p. 121 (1901).

Mid-west Atlantic. To 34 fms.

12. *Periclimenes* (*Falciger*) *rotumanus* Borradaile, 1898.

Periclimenes rotumanus, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 383 (1898); Proc. Zool. Soc. Lond., 1898, p. 1005, Pl. 63, fig. 5 (1899).

Rotuma.

13. *Periclimenes* (*Falciger*) *vitiensis* Borradaile, (1898).

Anchistia ensifrons, de Man, Arch. Naturg. liii. I. p. 545 (1887). Ortmann, Jena. Denkschr. viii. p. 16 (1894).

Periclimenes vitiensis, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 383 (1898). Proc. Zool. Soc. Lond., 1898, p. 1005, Pl. 64, fig. 6 (1899). Pearson, Rep. Ceylon Pearl Fish. iv. p. 78 (1905).

Periclimenes ensifrons, de Man, Abh. Senckenb. Ges. xxv. III. p. 126 (1902). Lenz, Abh. Senckenb. Ges. xxvii. IV. p. 380 (1905).

Indopacific.

The supposed spine at the end of the wrist of the *first* leg in this species is an appearance due to a bundle of long hairs. The spine at the end of the *second* wrist is found in both sexes and serves, together with the comparative shortness of this wrist and the greater average number of teeth on the rostrum, to distinguish *P. vitiensis* from *P. ensifrons*. The collection described by Ortmann contained members of both species.

14. *Periclimenes* (*Falciger*) *lifuensis* Borradaile, 1898.

Periclimenes lifuensis, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 384 (1898); Willey's Zool. Results, iv. p. 405, Pl. 36, fig. 1 (1899).

Loyalty Is.

15. *Periclimenes* (*Falciger*) *amymone* de Man, 1902.

Periclimenes amymone, de Man, Abh. Senckenb. Ges. xxv. III. p. 829, Pl. 25, fig. 53 (1902).

Ternate.

16. *Periclimenes* (*Falciger*) *borradailei* Rathbun, 1904.

Periclimenes tenuipes, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 384 (1898); Willey's Zool. Results, iv. p. 406, Pl. 36, fig. 2 (1899).

Periclimenes borradailei, Rathbun, Dec. Crust. N.W. America, p. 34 (1904). Nobili, Ann. Mus. Univ. Napoli, ii. xxi. p. 5 (1907).

New Britain, on coral reef.

17. *Periclimenes* (*Falciger*) *holmesi* Nobili, 1907.

Anchistia tenuipes, Holmes, Occ. Pap. Calif. Ac. Sci. vii. p. 216 (1900).

Periclimenes holmesi, Nobili, Ann. Mus. Univ. Napoli, ii. xxi. p. 5 (1907).

Santa Catalina I.

18. *Periclimenes* (*Falciger*) *denticulatus* Nobili, 1907.

Periclimenes Petitthouarsii var. *denticulata*, Nobili, Mem. Ac. Torino, (2), lvii. p. 359 (1907).

Polynesia.

19. *Periclimenes* (*Falciger*) *nilandensis* Borradaile, 1915 (Plate **54**, fig. 13).

Ann. Mag. Nat. Hist. (8), xv. p. 211.

Definition: Body moderately slender and compressed: rostrum distinctly outreaching antennular stalk but barely antennal scale, its upper edge gently concave from base, its formula $\frac{9}{4}$; supraorbital, antennal and hepatic spines present; antennular stalk slender, its basal joint not much expanded, second joint longer than third, flagella nearly twice as long as stalk, delicate; antennal scale moderately broad, with rounded end, its distal spine not reaching the end, its fringe very long; first leg with wrist and arm equal, hand slightly shorter than either, fingers equal to palm; second legs unequal, the longer outreaching antennal scale by wrist and hand, arm and palm subequal, wrist a little shorter than either, fingers about two-thirds length of palm, simple, all joints unarmed; last three legs slender, with simple, nearly straight dactylopodites, and a row of six spines under propodite.

Length of the single specimen, 16 mm.

S. Nilandu Atoll, Maldive Is.

20. *Periclimenes* (*Falciger*) *affinis* Borradaile, 1915 (Plate **54**, fig. 11).

Ann. Mag. Nat. Hist. (8), xv. p. 211.

Definition: Body graceful; rostrum of medium depth, straight for the first two-thirds of its length, gently upcurved at the tip, its formula $\frac{7}{2}$, the first two teeth standing behind the orbit, the last at a little distance from the tip, the first and last somewhat apart from the rest; antennular stalk ending between sixth and seventh rostral teeth, its last joint a little longer than its second joint; antennal scale slender, tapering, slightly outcurved, reaching end of rostrum; third maxilliped not quite reaching end of second joint of antennule, bearing several spines on outer edge of long joint; first leg just reaching end of wrist of second, with wrist about $1\frac{1}{2}$ times length of hand; second

leg outreaching rostrum by wrist and hand, its arm and wrist subequal, fingers about two-thirds length of wrist, palm a little longer than wrist, all joints smooth; arm bearing at end a spine below, and wrist a spine above, a similar spine inside, and a blunt tooth below, fingers straight, bent slightly inwards from axis of palm, and armed with two or three interlocking teeth; last three legs slender, with a few spinules on underside of propodites, and dactylopodites long and nearly straight; telson pointed, with naked submedian spines.

Length of longer of the two specimens, 11 mm.

Salomon I., Western Indian Ocean.

21. *Periclimenes* (*Falciger*) *dubius* Borradaile, 1915 (Plate **54**, fig. 12).

Ann. Mag. Nat. Hist. (8) xv. p. 211.

Definition: Closely related to *P. affinis*, but differing in that (1) the rostral formula is $\frac{8}{4}$, (2) the tip of the rostrum is bifid, (3) the stalk of the antennule is shorter and stouter, (4) in the second leg the arm and wrist are stouter, while the fingers are rather more than half the length of the palm and about equal in length to the wrist, (5) the end of the telson bears a few bristles besides the ordinary spines.

Length of the single specimen, 22 mm.

Minikoi.

P. elegans, *P. affinis*, and *P. dubius* are very closely related species and may eventually prove not to be distinct.

22. *Periclimenes* (*Falciger*) *compressus* Borradaile, 1915 (Plate **55**, fig. 18).

Ann. Mag. Nat. Hist. (8), xv. p. 212.

Definition: Body a good deal compressed; rostrum outreaching antennal scale very little, and antennular stalk rather more, deepest at its base, diminishing evenly towards tip which is slightly upturned, bearing above five teeth, of which two stand behind the orbit, and a minute vestigial tooth near the tip, and below three teeth; antennal and hepatic spines present; first joint of antennular stalk well expanded, with strong distal spines, second and third joints subequal, subcylindrical, together shorter than first joint; antennal scale narrow, with sides parallel, tip rounded, and distal spine not reaching tip, antennal stalk not reaching end of first joint of antennule; third maxilliped not reaching end of antennal stalk; first leg outreaching antennal scale by more than half the hand, its wrist, palm, and fingers subequal; second legs equal and similar, outreaching antennal scale by hand, wrists short and subconical, with a notch on the inner side, hands long, parallel-sided, somewhat compressed, fingers less than half length of palm, a small tooth near the base of each moveable finger, and two or three vestigial teeth on the fixed finger; last three legs long, slender, without spines, and with long, sharp, simple dactylopodites; telson little shorter than uropods, long, and truncate.

Length of single specimen, 24 mm.

Saya de Malha.

23. *Periclimenes* (*Falciger*) *brocketti* Borradaile, 1915 (Plate **55**, fig. 15).

Ann. Mag. Nat. Hist. (8), xv. p. 212.

Definition: Body moderately compressed; rostrum not quite reaching end of antennal scale, but outreaching antennular stalk, shallow, directed slightly downwards, straight, save for a very slight upcurving of the tip, bearing above six teeth, of which one stands immediately behind the orbit, and below one tooth; antennal and hepatic spines present; first joint of antennular stalk moderately expanded, with stylocerite half as long as the joint, and two small distal spines, second joint wide, shorter than third joint; stalk of antenna a good deal shorter than first joint of antennular stalk, scale of antenna rather broad, with pointed end and small distal spine which does not nearly reach the end; third maxilliped not reaching end of antennal stalk, its long joint rather broad; first leg slightly outreaching antennal scale, with wrist a little shorter than arm, hand shorter than wrist, fingers longer than palm, hairy; second leg outreaching antennal scale by its hand and greater part of wrist, which is comparatively short, hand slender, fingers simple, about as long as palm; last three legs with propodites unarmed and dactylopodites small, slender, and set in a tuft of hairs; telson narrow, a good deal shorter than uropods.

Length of the longest of the three specimens, 16 mm.

Malé Atoll, Maldive Is., on brown crinoid.

I have called this species after Mr W. Brockett, Head Attendant in the Cambridge University Laboratory of Zoology, to whose skilled and ready assistance all Cambridge zoologists are greatly indebted.

24. *Periclimenes* (*Falciger*) *pottsi* Borradaile, 1915.

Ann. Mag. Nat. Hist. (8) xv. p. 213. Potts, Pap. Dep. Mar. Biol. Carnegie Inst. Washington, viii. p. 82 (1918).

Definition: Body moderately stout, somewhat compressed; rostrum reaching end of antennal scale, outreaching antennular stalk, its upper edge curving very slightly downward from the base and more strongly upward near the tip, its formula $\frac{7}{2}$, two teeth behind the orbit; hepatic and antennal spines present; basal joint of antennule elongate, with small distal spine, second and third joints stout, subequal, flagella about twice length of stalk, outer not deeply cleft; antennal scale shorter than carapace, rather narrow, outcurved, its distal spine projecting beyond its end; antennal stalk falling considerably short of end of first joint of antennular; third maxilliped outreaching by its last joint antennal stalk, slender, nearly straight, its last two joints together longer than preceding joint; first leg outreaching antennal scale by its hand, its arm and wrist subequal, hand nearly as long, and fingers slightly longer than palm; second leg outreaching antennal scale by hand and part of wrist, with arm a little longer than wrist, palm than arm, fingers and wrist subequal, a spine at end of arm and a small spine above at end of wrist; last three legs slender, sparsely hairy, with small spinules under propodites, and rather slender, slightly curved dactylopodites.

Colour, purple, brownish in parts and varying in depth with the region of the body.

Length of longest specimen 13 mm.

Torres Straits, on *Comanthus*.

25. *Periclimenes* (*Falciger*) *suvadivensis* Borradaile, 1915 (Plate **55**, fig. 16).

Ann. Mag. Nat. Hist. (8), xv. p. 212.

Definition: Body rather slender and compressed; rostrum outreaching antennular stalk, outreached by antennal scale, straight, except at the end, which is gently upcurved, diminishing evenly to its end, with formula $\frac{6-7}{2}$, two of the teeth standing behind the orbit; hepatic, antennal, and suborbital spines present; antennule slender throughout; its second and third joints equal, its first joint equal to the second and third together, its outer flagellum long and only cleft near the tip; antennal scale longer than carapace, narrow, outcurved, its distal spine projecting at the end; third maxilliped reaching end of first joint of antennule; first leg outreaching antennular stalk by wrist and hand, arm shorter than wrist, hand about half as long as wrist, fingers slightly longer than palm; second leg outreaching antennal scale by hand, wrist, and small part of arm, its wrist bearing at the end a short stout spine above, its arm a small spine below, wrist and palm subequal, fingers rather more than half the length of palm, simply toothed; last three legs very long and slender, outreaching antennal scale, bearing a few stout hairs, their dactylopodites simple, slender, and nearly straight; uropods considerably outreaching telson.

Length of the longest of the two specimens, 14 mm.

Suvadiva Atoll, Maldive Is.

26. *Periclimenes* (*Falciger*) *seychellensis* Borradaile, 1915 (Plates **54**, **55**, figs. 14 *a*—*i*).

Ann. Mag. Nat. Hist. (8), xv. p. 212.

Definition: Body moderately stout, not much compressed; rostrum outreaching antennular stalk, and antennal scale, deep, its ventral edge excavate at base, its dorsal edge concave throughout, its formula $\frac{7-8}{3}$, with two teeth behind the orbit; antennal and hepatic spines present; first joint of antennular stalk moderately expanded, stylocerite nearly half the length of this joint, distal spine small, second and third joints subequal, slender, flagella longer than stalk, the outer cleft for about $\frac{1}{4}$ of length of thicker part; antennal scale longer than antennular stalk, rather broad, subtruncate, with distal spine projecting beyond end; third maxilliped reaching end of first joint of antennule; first leg reaching end of antennal scale, its arm, wrist, and hand subequal, its fingers rather longer than its palm; second legs equal, each outreaching antennal scale by fingers and half palm, its fingers and all joints unarmed, wrist and arm subequal, hand nearly half as long again as wrist, palm and fingers subequal; last three legs slender, sparsely hairy, with a long spine at end of propodite, dactylopodites long, slender, simple, nearly straight.

Length of the longer of the two specimens, 17 mm.

Praslin, Seychelles.

27. *Periclimenes* (*Falciger*) *kolumadulensis* Borradaile, 1915 (Plate **55**, fig. 17).

Ann. Mag. Nat. Hist. (8), xv. p. 213.

Definition: Closely related to *P. borradailei* Rathbun, but differing in that (1) the rostrum is $2\frac{1}{2}$ times the length of the carapace behind it (not more than $1\frac{3}{4}$ times in *P. borradailei*), (2) the second leg is seven times the length of the carapace (five times in *P. borradailei*), (3) the last three legs are about $\frac{1}{5}$ longer than in *P. borradailei* of the same size, (4) the shape of the great chelæ is very different, the fingers of that on one side meeting and bearing a row of about a dozen small teeth, while those of the other gape widely and bear each two basal teeth and a distal cutting flange.

Length of the single specimen, 29 mm.

Kolumadulu Atoll, Maldive Is.

Subgenus Ensiger Borradaile, 1915.

Ann. Mag. Nat. Hist. (8), xv. p. 207.

Definition: Rostrum toothless, straight, of medium length. An absence of spines from trunk and limbs. Second wrist of medium length.

Type: *Periclimenes* (*Ensiger*) *aurantiacus* (Dorna), 1852.

Anchistia aurantiaca, Dana, U. S. Explor. Exped. xiii. p. 581 (1852); Atlas, Pl. 28, fig. 2 (1855).

Periclimenes aurantiacus, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 382 (1898).

Fiji, in coral.

Doubtful and wrongly placed species attributed to *Periclimenes*.

Periclimenes tenuipes (Leach).

Nobili, Ann. Mus. Univ. Napoli, ii. xxi. p. 5 (1907), alludes to this species, which he states to be of Mediterranean habitat. I have not been able to find the original description of it.

Periclimenes hertwigi Balss, 1914, and

Periclimenes gorgonidarum Balss, 1914.

Abh. k. Bayer. Ak. Wiss., Math.-Phys. Kl. ii. Suppl. Bd. x. p. 49 (1914).

These species do not belong to *Periclimenes*, and indeed appear from statements regarding their telsons not to be Pontoniinæ. Further information regarding the mouth-parts and gills of these very interesting forms is desirable.

Periclimenes hermitensis, Rathbun, 1914.

Proc. Zool. Soc. Lond., 1914, p. 655, Pl. 1, figs. 1—3.

The correct position of this species is probably in the genus *Ancyclocaris* (see above, p. 356).

Periclimenes sp. de Man, 1902.

Abh. Senckenb. Ges. xxv. iii. p. 833.

It is not possible to assign this species to any genus until further information concerning it be available.

Genus Pontoniopsis Borradaile, 1915.

Ann. Mag. Nat. Hist. (8), xv. p. 207. Potts, Proc. Camb. Philos. Soc. xviii. p. 59 (1915).

Definition: Body rather slender, compressed but with the cephalothorax somewhat flattened dorsally; rostrum short, shallow, lanceolate in *dorsal* view, toothless; a sharp antennal spine, but no hepatic or supraorbital spines; eye subspherical, with large cornea; outer flagellum of antennule not deeply cleft; antennal scale broad; mandible without palp; second maxilliped without podobranch, its last joint mediad of preceding joint; third maxilliped with vestigial arthrobranch, narrow in all joints; legs short, directed outwards, rather stout, second pair very unequal, the smaller of the type of the first pair, the larger with long, stout, parallel-sided palm and short fingers, dactylopodites of last three pairs stout, curving at tip to simple end-claw.

Type: *Pontoniopsis comanthi* Borradaile, 1915 (Plate **57**, fig. 27).

Ann. Mag. Nat. Hist. (8), xv. p. 213. Potts, Pap. Dep. Mar. Biol. Carnegie Inst. Washington, viii. p. 81, Pl. 1, fig. 3 (1915).

Pontoniopsis sp. Potts, Proc. Camb. Philos. Soc. xviii. pp. 59, 62 (1915).

Definition: Rostrum reaching end of second joint of antennular stalk, with slight keel above and deeper keel below, straight, its breadth much greater than its depth, about equal to greatest width of eye; basal joint of antennule broad, its expansion consisting of two broad spines, of which the foremost ends in the distal spinule and the hinder is the stylocerite, second and third joints broad and flattened, second longer than third, its distal angles sharp, flagella short, outer cleft to moderate depth; antennal scale outreaching antennular stalk, broad, with straight outer and convex inner sides, and subrectangular end, which is not nearly reached by the small distal spinule; antennal stalk outreaching basal joint of antennule, with basal spine well developed; third maxilliped not reaching end of antennal stalk, its last two joints subequal, together shorter than preceding joint; first leg outreaching antennular stalk by hand and wrist, arm and wrist subequal, hand rather shorter, fingers shorter than palm, hairy; longer leg of second pair outreaching antennular stalk by hand, wrist very short and wide, with a sharp process below at the end, hand about equal to preceding three joints, fingers much shorter than palm, bearing interlocking teeth; last three legs hairy at end, with stout dactylopodites curving at the top rather strongly to form a sharp end-claw; telson rather narrow, blunt ended, shorter than uropods.

Length of longest specimen, 8 mm.

Torres Straits, on *Comanthus*.

Genus Periclimenæus Borradaile, 1915.

Ann. Mag. Nat. Hist. (8), xv. p. 207.

Definition: Body rather stout, decidedly compressed, without sudden change in curvature of abdomen, suggestive of *Alpheus*; rostrum rather short, straight, with

convex upper and almost straight lower edge, bearing above a row of long, close-set, subequal teeth, but toothless below; a strong antennal, but no supraorbital or hepatic spine; eye subcylindrical with rather small cornea, which has a cup-shaped depression on the outer side; outer flagellum of antennule not deeply cleft; antennal scale of moderate breadth; mandible without palp; second maxilliped without podobranch, its last joint mediad of preceding joint; third maxilliped with vestige of arthrobranch, and with antepenultimate joint of medium breadth; legs rather stout, those of the second pair granulate, unequal, and in one of them the chela very heavy but not very long, with short, stout fingers, of which one bears a knob and the other a corresponding socket, those of last three pairs with short, stout, biunguiculate dactylopodites; submedian and intermediate spines of telson subequal.

Key to the species of *Periclimenæus*:

I. Two teeth of rostrum stand behind orbit. Moveable finger of second leg bears knob and fixed finger socket. Fringes on limbs not remarkably long.

P. robustus Borradaile, 1915.

II. None of rostral teeth stands behind orbit. Fixed finger of second leg bears knob and moveable finger socket. Fringes of limbs very long.

P. fimbriatus Borradaile, 1915.

1. (Type.) *Periclimenæus robustus* Borradaile, 1915 (Plate **55**, fig. 20).

Ann. Mag. Nat. Hist. (8), xv. p. 213.

Definition: Body rather strongly compressed; rostrum slightly outreached by antennal scale and rather more by antennular stalk, directed somewhat downwards, sublanceolate, its formula $\frac{2}{0}$; a strong antennal spine; first joint of antennular stalk long, but little expanded, second and third joints subequal; antennal stalk reaching end of second joint of antennule, scale subovate; antepenultimate joint of third maxilliped short, rather wide at base but narrowing towards penultimate joint, which nearly equals it in length, last joint shorter than penultimate; first leg outreaching antennular stalk by wrist and hand, wrist longer than arm, hand stout, the fingers a little shorter than the palm, a tuft of hairs on the moveable finger; second legs unequal, the larger without spines on any joint, its hand very large, stout, granulate and in parts spinulose, the fingers short, abruptly hooked at the tip, the moveable one very wide, with a blunt process which fits into a hollow on the fixed finger and a notch which receives a sharp tooth of the fixed finger, the smaller hand with the same general characters as the larger but shorter, more swollen, and with simple edges to the fingers; the walking legs moderately stout, with five spines on the propodites, and the dactylopodites short, stout, bearing a sharp end-claw and a smaller claw below it; telson as long as uropods, of moderate width, narrowing somewhat towards end, which is truncate.

In young specimens three or four of the teeth at the base of the rostrum are wanting.

Length of the longest specimen, 14 mm.

Amirante I., 20—39 fms.

2. *Periclimenæus fimbriatus* Borradaile, 1915 (Plate **55**, fig. 19).

Ann. Mag. Nat. Hist. (8), xv. p. 213.

Definition: Body rather stout, compressed; rostrum outreached by antennular stalk, and rather more by antennal scale, straight, with convex upper and almost straight lower edge, bearing above 4—7 subequal teeth, of which the first lies in front of the eyes, and without teeth below; strong antennal spine; first joint of antennular stalk moderately expanded, second shorter than third, outer flagellum fringed with long hairs; antennal scale of moderate length, with straight outer and convex inner sides, the latter fringed with very long hairs, distal spine small; third maxilliped with penultimate joint considerably longer than last joint, last two joints together equal in length to rest of limb, exopodite rather short, endopodite bearing a fringe of unusually long hairs; first leg outreaching antennal scale by hand and wrist, its wrist equal to arm, fingers equal to palm, hand stout and hairy; legs of second pair unequal, the larger, which may be on either side, about as long as body, no spine on any joint, hand very large, granulated, thick on the outer side and sharp edged on the inner, its fingers short, with a knob on the fixed one fitting into a socket in the moveable one, the smaller hand much like the larger but with simple fingers; last three legs moderately stout, with a group of long spines at the end of the propodites, and dactylopodites very short and stout and bearing two long, hooked claws; telson shorter than uropods, narrow, tapering, with rounded end; uropods fringed with very long hairs.

Length of the longest specimen, 9 mm.

Mulaku Atoll, Maldive Is. Providence I., to 50 fms.

Genus Harpiliopsis n. gen.

Definition: Body stout, depressed; sixth abdominal segment not elongate; rostrum of moderate length, lanceolate, toothed above and below; outer flagellum of antennule not deeply cleft; antennal scale broad; mandible without palp; second maxilliped without podobranch, with last joint mediad of preceding; third maxilliped with arthrobranch, and with last two joints narrow, antepenultimate joint broad or narrow; legs stout, directed outwards, the last three with hooked dactylopodites.

Key to the species of *Harpiliopsis*:

I. Antepenultimate joint of third maxilliped narrow.
H. depressus (Stimpson), 1860.

II. Antepenultimate joint of third maxilliped broad.
H. beaupresi (Audouin), 1825.

1. (Type.) *Harpiliopsis beaupresi* (Audouin), 1825 (Plate **55**, fig. 21).

Palæmon Beaupresii, Audouin, Descr. Egypte, Crust. p. 91 (1825). Savigny, Atlas, Crust. Pl. 10, fig. 4.

Harpilius Beaupresii, Heller, Sitz. k. Ak. Wiss. Wien, xliv. i. p. 280 (1861). Paulson, Crust. Red Sea, p. 113 (1875). de Man, Arch. Naturg. liii. i. p. 539 (1887). Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 386 (1898). Nobili, Ann. Mus. Univ. Napoli, i. III. p. 3 (1904); Ann. Sci. Nat. (9), iv. p. 63 (1906).

? *Pontonia* (*Harpilius*) *dentata*, Richters, Decap. Mauritius, p. 165, Pl. 17, figs. 36—38 (1880).

Red Sea. E. Indies. Indian Ocean.

2. *Harpiliopsis depressus* (Stimpson), 1860 (Plate **56**, fig. 22).

Harpilius depressus, Stimpson, Proc. Ac. Philadelphia, 1860, p. 38. Rathbun, Bull. U. S. Fish Comm. xxiii. III. p. 920, fig. 68 (1903).

Anchistia spinigera, Ortmann, Speng. Zool. Jahrb. Syst. v. p. 511, Pl. 36, fig. 23 (1890). Lenz, Ib. xiv. p. 434 (1901).

Periclimenes spinigerus, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 383 (1898); Willey's Zool. Results, iv. p. 405 (1899).

The fixed finger of the great chela in this species varies in shape. Sometimes it has three teeth, of which the most distal is broader than the others. Sometimes this tooth loses its point and becomes a blade-like flange.

Indopacific, in corals.

Genus HARPILIUS Dana, 1852.

U. S. Explor. Exped. Crust. i. p. 575. Kingsley, Proc. Ac. Philadelphia, 1879, p. 423 (1880). Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 386 (1898).

Definition: Body stout, depressed; sixth abdominal segment not elongate; rostrum of good length, toothed above and below, sharp ended; outer flagellum of antennule not deeply cleft; antennal scale of good breadth; mandible without palp; second maxilliped without podobranch, with last joint posterior to preceding joint; third maxilliped without arthrobranch, and with last two joints narrow, together longer than preceding joint, which is broad; legs stout, the last three with hooked dactylopodites.

Key to the species of *Harpilius**:

I. No hepatic spine. Second leg unarmed.
H. gerlachei Nobili, 1905.

II. A hepatic spine. Second leg bears one or more spines.

A. Fingers of second leg curved inwards. Inner edge of hand concave.
H. consobrinus de Man, 1902.

B. Fingers of second leg not curved inwards. Inner edge of hand almost straight.
H. lutescens Dana, 1852.

* The limits of this genus are doubtful. In most respects its characters are similar to those of the species on which I have founded *Harpiliopsis*, but the second maxilliped of the type of *Harpilius* is so remarkable that no species which does not share this peculiarity can be retained in the genus. The other species here included in *Harpilius* are so placed provisionally, until further information as to their second maxilliped is available. Sollaud states that the third maxilliped in this genus has no arthrobranch, but does not state what species he has seen.

1. (Type.) *Harpilius lutescens* Dana, 1852.

U. S. Explor. Exped. Rep. xiii. I. p. 576; Atlas, Pl. 38, fig. 4 (1855). Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 386 (1898). Nobili, Ann. Mus. Napoli, i. III. p. 3 (1901); Ann. Sci. Nat. Zool. (9), iv. p. 63 (1906).

Tongatabu, Red Sea.

2. *Harpilius consobrinus* de Man, 1902.

Harpilius lutescens, de Man, Arch. Naturg. liii. I. p. 536, Pl. 22 *a*, fig. 1 (1887).
Harpilius consobrinus, de Man, Abh. Senckenb. Ges. xxv. III. p. 836, Pl. 26, fig. 54 (1902).

E. Indies.

3. *Harpilius gerlachei* Nobili, 1905.

Bull. Mus. Paris, 1905, iii. p. 160; Bull. Sci. Fr. Belg. xl. p. 45, Pl. 4, fig. 10 (1906).

Persian Gulf, "parmi les polypiers."

Genus Coralliocaris Stimpson, 1860.

Œdipus, Dana, U. S. Explor. Exped. Rep. xiii. I. p. 572 (1852).
Coralliocaris, Stimpson, Proc. Ac. Philadelphia, 1860, p. 38. Kingsley, Ib. 1879, p. 423 (1880). Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 384 (1898). Ortmann, Bronn's Thierreich, Arthropoden, v. II. p. 1131. Rathbun, Bull. U. S. Fish Comm. xx. II. p. 122 (1901).

Definition: Body stout, depressed; sixth abdominal segment not elongate; rostrum of moderate or good length, with or without teeth, usually somewhat depressed, shallow, not curved downwards; outer flagellum of antennule not deeply cleft; antennal scale broad; mandible without palp; second maxilliped without podobranch, with last joint mediad of preceding joint, but often projecting far behind it; third maxilliped with arthrobranch and with last two joints usually broad, antepenultimate joint more or less broadened, not contrasting sharply in width with last two joints; legs stout, directed outwards, one or both of second pair with large chela, swollen at base and very short-fingered, the last three pairs with hooked dactylopodites and a basal protuberance, which is usually large.

Key to the subgenera of *Coralliocaris:*

I. Dactylopodites of walking legs with an accessory spine and small basal protuberance.

Onycocaris Nobili, 1904.

II. Dactylopodites of walking legs without accessory spine, and with basal protuberance of a good size.

Coralliocaris s. str.

Subgenus Coralliocaris s. str.

Definition: Dactylopodites with well-developed basal protuberance, without accessory spinules, not biunguiculate; great chela generally opens horizontally, or has the thumb below.

Key to the species of *Coralliocaris* s. str.

I. Rostrum toothless.

A. Rostrum reaches only to middle of first joint of antennule. Antennular stalk reaches middle of antennal scale.

C. brevirostris Borradaile, 1898.

B. Rostrum outreaches first joint of antennule. Antennular stalk nearly reaches end of antennal scale.

C. nudirostris (Heller), 1862.

II. Rostrum toothed.

A. Rostrum bears no teeth below.

1. Rostrum bears only one tooth above.

C. macrophthalma (H. M.-Edwards), 1837.

2. Rostrum bears 4—5 teeth above.

a. Rostrum curved upwards. Eyes subspherical.

C. atlantica Rathbun, 1901.

b. Rostrum not curved upwards. Eyes subcylindrical.

i. Rostrum straight, reaching middle of second joint of antennule. Great chela opens vertically.

C. hecate Nobili, 1904.

ii. Rostrum bent downwards, reaching end of second joint of antennule. Great chela opens horizontally.

C. quadridentata Rathbun, 1906.

B. Rostrum bears one or more teeth below.

1. Rostrum bears only one tooth above.

C. camerani Nobili, 1902.

2. Rostrum bears 4—6 teeth above.

a. Second legs subsimilar (often unequal).

i. Moveable finger not of great width or very much curved.

a. Rostrum rather deep. Great chela not long or much swollen at base.

C. truncata Rathbun, 1906.

β. Rostrum shallow. Great chela elongate and swollen at base.

(1) Third maxilliped broad. Rostrum not as long as antennular stalk.

C. superba (Dana), 1852.

(2) Third maxilliped relatively narrow. Rostrum as long as antennular stalk.

C. japonica Ortmann, 1891.

ii. Moveable finger very wide and much curved.

C. graminea (Dana), 1852.

b. Second legs quite unlike.

C. lucina Nobili, 1901.

1. (Type.) *Coralliocaris superba* (Dana), 1852.

Œdipus superbus, Dana, U. S. Explor. Exped. Rep. xiii. I. p. 573 (1852); Atlas, Pl. 37, fig. 2 (1855).

Coralliocaris superba, Stimpson, Proc. Ac. Philadelphia, 1860, p. 38. de Man, Arch. Naturg. liii. I. p. 536 (1887). Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 385 (1898). Nobili, Ann. Mus. Univ. Napoli, i. III. p. 3 (1901). Ann. Sci. Nat. (9), iv. p. 55 (1906). Balss, Abh. k. Bayer. Ak. Wiss., Math.-Phys. Kl. ii. Suppl. Bd. x. p. 53 (1914).

Œdipus dentirostris, Paulson, Crust. Red Sea, i. p. 112, Pl. 14, fig. 7 (1875).

Indopacific, in corals.

2. *Coralliocaris macrophthalma* (H. M.-Edwards), 1837 (Plate **56**, fig. 24).

Pontonia macrophthalma, H. M.-Edwards, Hist. Nat. Crust. ii. p. 359 (1837); Cuvier's R. An., Crust., Atlas, Pl. 52, fig. 3 (1849).

Œdipus macrophthalmus, Dana, U. S. Explor. Exped. Rep. xiii. I. p. 573 (1852).

Coralliocaris macrophthalma, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 385 (1898). Nobili, Ann. Mus. Univ. Napoli, i. III. p. 3 (1901).

"Mers d'Asie," Red Sea. Saya de Malha, to 26 fms.

3. *Coralliocaris graminea* (Dana), 1852.

Œdipus gramineus, Dana, U. S. Explor. Exped. Rep. xiii. I. p. 574 (1852); Atlas, Pl. 37, fig. 3 (1855).

Coralliocaris graminea, Stimpson, Proc. Ac. Philadelphia, 1860, p. 38. Miers, "Alert" Crust. p. 563 (1884). de Man, Arch. Naturg. liii. I. p. 536 (1887); Abh. Senckenb. Ges. xxv. III. p. 840 (1902). Ortmann, Semon's Forschungsreisen in Austral. v. I. p. 16 (1894). Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 385 (1898). Lenz, Abh. Senckenb. Ges. xxvi. IV. p. 381 (1905).

Coralliocaris inæqualis, Ortmann, Speng. Zool. Jahrb. Syst. v. p. 510, Pl. 26, fig. 21 (1890). Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 386 (1898); Willey's Zool. Results, iv. p. 408 (1899). Balss, Abh. k. Bayer. Ak. Wiss., Math.-Phys. Kl. ii. Suppl. Bd. x. p. 33 (1914).

Indopacific, in corals.

4. *Coralliocaris lamellirostris* Stimpson, 1860.

Proc. Ac. Philadelphia, 1860, p. 38. Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 385 (1898). Nobili, Ann. Mus. Univ. Napoli, i. III. p. 5 (1901). Balss, Abh. k. Bayer. Ak. Wiss., Math.-Phys. Kl. ii. Suppl. Bd. x. p. 53 (1914).

Loo-Choo I., in corals.

5. *Coralliocaris nudirostris* (Heller), 1862.

Œdipus nudirostris, Heller, Sitz. k. Ak. Wiss. Wien, xliv. I. p. 279, Pl. 3, fig. 25 (1862).

Coralliocaris nudirostris, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 385 (1898).

Red Sea.

6. *Coralliocaris japonica* Ortmann, 1891 (Plate **56**, fig. 23).

Coralliocaris superba var. *japonica*, Ortmann, Speng. Zool. Jahrb. Syst. v. p. 509 (1890). Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 385 (1898).

Professor Gardiner's collection contains a number of specimens of a *Coralliocaris* which is related to *C. superba* but differs from it in the following points:

(i) The rostrum is much narrower than in *C. superba*, and is at least as long as the antennular stalk, generally considerably longer.

(ii) The rostral formula is $\frac{3-5}{1}$, generally $\frac{4}{1}$.

(iii) The third maxilliped, though it is broader than in *Periclimenes*, is considerably narrower than in *C. superba*.

(iv) The hand of the first leg is longer, slender, and hairless, and its fingers are not more than half the length of the palm.

(v) The legs of the second pair are unequal, and the arm bears below at the end a flange with a sharp point. The wrist bears a tooth on the inner side, but the little teeth found on the upper side in *C. superba* are wanting. The smaller chela is of simple form, with the fingers nearly as long as the palm.

This species is probably the *C. superba* var. *japonica* of Ortmann.

Japan. Indian Ocean, to 26 fms.

7. *Coralliocaris brevirostris* Borradaile, 1898.

Ann. Mag. Nat. Hist. (7), ii. p. 386; Proc. Zool. Soc. Lond., 1898, p. 1006, Pl. 64 fig. 7 (1899).

Ellice Is.

8. *Coralliocaris lucina* Nobili, 1901.

Ann. Mus. Univ. Napoli, i. III. p. 5; Ann. Sci. Nat. (9), iv. p. 57 (1906).

Coralliocaris lamellirostris, de Man, Abh. Senckenb. Ges. xxv. III. p. 842, Pl. 26, fig. 5 (1902).

Red Sea. Ternate. In corals.

9. *Coralliocaris atlantica* Rathbun, 1901.

Bull. U. S. Fish Comm. xx. II. p. 122, fig. 26.
St Thomas, 20 to 23 fms.

10. *Coralliocaris camerani* Nobili, 1902.

Boll. Mus. Torino, xvi. XXIII. p. 3.
Flamenco I.

11. *Coralliocaris hecate* Nobili, 1904.

Bull. Mus. Paris, 1904, p. 232 ; Ann. Sci. Nat. (9), iv. p. 58, Pl. 3, fig. 2 (1906).
Jibuti.

12. *Coralliocaris rathbuni* n. nom.

Coralliocaris tridentata, Rathbun, Bull. U. S. Fish Comm. xxiii. III. p. 920, fig. 69, Pl. 24, fig. 1 (1906).
Hawaiian Is., 28 to 43 fms.

13. *Coralliocaris truncata* Rathbun, 1906.

Bull. U. S. Fish Comm. xxiii. III. p. 920, fig. 70, Pl. 24, fig. 2.
Hawaiian Is., 24 fms.

Subgenus Onycocaris Nobili, 1904.

Bull. Mus. Paris, 1904, p. 232 ; Ann. Sci. Nat. (9), iv. p. 60 (1906).

Definition: Dactylopodites with small basal protuberance, with accessory spinules, biunguiculate ; great chela opens vertically, with the thumb above.

Key to the species of *Coralliocaris* (*Onycocaris*) :

I. Rostrum toothless.

C. (*O.*) *aualitica* Nobili, 1904.

II. Rostrum toothed.

A. R. $= \frac{3}{0}$. No supraorbital spine.

C. (*O.*) *tridentata* Miers, 1884.

B. R. $= \frac{7-9}{0-1}$. A supraorbital spine.

C. (*O.*) *rhodope* Nobili, 1904.

1. *Coralliocaris* (*Onycocaris*) *aualitica* Nobili, 1904.

Bull. Mus. Paris, 1904, p. 232 ; Ann. Sci. Nat. (9), iv. Pl. 3, fig. 3 (1906).
Jibuti.

2. *Coralliocaris* (*Onycocaris*) *rhodope* Nobili, 1904.

Bull. Mus. Paris, 1904, p. 232 ; Bull. Sci. Fr. Belg. xl. p. 49 (1906) ; Ann. Sci. Nat. (9), iv. p. 61, Pl. 2, fig. 8 (1906).
Jibuti.

3. *Coralliocaris* (*Onycocaris*) *tridentata* (Miers), 1884.

Coralliocaris (?) *tridentata*, Miers, "Alert" Crust. p. 294. Pl. 32, fig. *c*. (1884).
Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 386 (1898).
Coralliocaris (*Onycocaris*) ? *tridentata*, Nobili, Ann. Sci. Nat. (9), iv. p. 60 (1906).
Thursday I.

Genus Coutierea Nobili, 1902.

Bull. Mus. Torino, xvi. 415, p. 4.

Definition: Body fairly slender, somewhat depressed, with regions of carapace well marked; abdominal pleura ridged and armed each with a spine, and sixth abdominal segment rather longer than the rest; antennal and supraorbital spines very large, hepatic and pterygostomian spines well developed; rostrum long and narrow, but shallow and simple; outer antennular flagellum not deeply cleft; antennal scale of a good breadth; mandible without palp (?); second maxilliped with last joint mediad of preceding joint and projecting but little behind it; third maxilliped narrower than in most *Coralliocaris*; legs rather stout, those of second pair unequal but similar, with regularly ovoid palm and long fingers, those of last three pairs with simple, moderately curved dactyles, bearing basal protuberance.

Type: *Coutierea agassizi* (Coutière), 1901.

Coralliocaris agassizi, Coutière, Bull. Mus. Paris, vii. p. 115 (1901).
Coutierea agassizi, Nobili, Boll. Mus. Torino, xvi. 415, p. 4 (1902).
Barbados, deep water.

Genus Stegopontonia Nobili, 1906.

Bull. Mus. Paris, xii. p. 258; Mem. Ac. Sci. Torino (2), lvii. p. 360 (1907).

Definition: Body fairly slender, a little depressed, with short carapace; which bears only a small antennal spine; rostrum toothless, broad, depressed, lanceolate in *dorsal* view; outer antennular flagellum not deeply cleft; antennal scale rather narrow, with long distal spine; mandible without palp; second maxilliped with last joint mediad of preceding joint; third maxilliped broad (?); legs rather stout, those of second pair unequal and unlike, the smaller of Palæmonid form, the larger with elongate, swollen palm and short fingers, those of last three pairs with short, deep, curved dactylopodites, bearing a pair of basal prominences.

Type: *Stegopontonia commensalis* Nobili, 1906.

Bull. Mus. Paris, xii. p. 258; Mem. Ac. Sci. Torino (2), lvii. p. 360, Pl. 1, fig. 2 (1907).
Hao I., Polynesia, on *Echinothrix turcarum*.

Genus Pontonides n. gen.

Definition: Body stout, depressed; sixth abdominal segment not elongate; rostrum short, flat horizontally, subtriangular, curved downwards, not dentate, with slight keels above and below; eye well developed; outer flagellum of antennule not deeply cleft; antennal scale broad; mandible without palp; maxillipeds without exopodites, second maxilliped without podobranch, with last joint mediad of preceding joint; third maxilliped with vestigial arthrobranch and with all joints broad; legs moderately stout, last three ending in simple, nearly straight dactylopodites without basal prominence.

Type: *Pontonides maldivensis* (Borradaile), 1915 (Plate **57**, fig. 28).

Pontonia maldivensis, Borradaile, Ann. Mag. Nat. Hist. (8), xv. p. 213 (1915).

Definition: Body much depressed; carapace broader than long, with small spine behind antenna and a blunt process below it; rostrum not reaching end of first joint of antennule, sharp pointed both in horizontal and in vertical view; first joint of antennular stalk broad, its spines sharp but not very long, third joint a little longer than second, flagella of a fair length; antennal scale ovate, longer than antennular stalk, its distal spine very small; last two joints of third maxilliped but little twisted from horizontal plane; first leg outreaching antennular stalk by hand and part of wrist, hand and wrist subequal, each rather shorter than arm, fingers equal to palm; second legs unequal, the larger about twice as long as carapace but shorter than body, its hand long, parallel-sided, with short, simple fingers, smaller hand with short swollen palm and long, slender, simple fingers; last three legs with long, slender dactylopodites; telson shorter than uropods.

Length of longest specimen, 7 mm.

Fadiffolu Atoll, Maldive Is.

Genus Anchistus Borradaile, 1898.

Ann. Mag. Nat. Hist. (7), ii. p. 387. Nobili, Bull. Sci. Fr. Belg. xl. p. 48 (1906).

Tridacnocaris, Nobili, Ann. Mus. Genova, xl. p. 235 (1899).

Marygrande, Pesta, Zool. Anz. xxxviii, p. 571 (1911).

Definition: Body stout, usually swollen and somewhat depressed; sixth abdominal segment not elongate; rostrum of fair length, compressed, bent or curved downwards, with broad, usually rounded end, dentate at the tip only or without teeth; outer flagellum of antennule not deeply cleft; antennal scale broad; mandible without palp; inner lacinia of maxillule broad and hairy; second maxilliped without podobranch, with last joint mediad of preceding joint; third maxilliped with vestigial arthrobranch, and with last two joints narrow, together longer than preceding joint, which is broad or narrow; legs stout, directed outwards, the last three with curved dactylopodites, with or without a small tooth on the lower side, without basal protuberance.

Key to the species of *Anchistus*:

I. Last two joints of third maxilliped contrast strongly in width with antepenultimate.

A. Rostrum shallow, pointed at end.

A. mirabilis (Pesta), 1911.

B. Rostrum deep, rounded at end,

A. inermis (Miers), 1884.

II. Last two joints of third maxilliped do not contrast strongly in width with antepenultimate.

A. Rostrum toothed.

A. miersi (de Man), 1888.

B. Rostrum toothless.

1. Rostrum rounded at end. Moveable finger of second cheliped much longer than fixed finger.

A. biunguiculatus Borradaile, 1898.

2. Rostrum ends in a sharp point. Fingers of second cheliped subequal.

A. spinuliferus (Miers), 1884.

1. (Type.) *Anchistus miersi* (de Man), 1888 (Plate **56**, fig. 25).

Harpilius Miersi, de Man, Journ. Linn. Soc. Lond., Zool. xxii. p. 274, Pl. 17, figs. 6—10 (1888). Whitelegge, Mem. Austral. Mus. iii. p. 148 (1897).

Anchistus miersi, Borradaile, Ann. Mag. Nat. Hist. (7), p. 387 (1898); Willey's Zool. Results, iv. p. 408 (1899). Lanchester, Proc. Zool, Soc. Lond. 1901, p. 565 (1902). Nobili, Bull. Sci. Fr. Belg. xl. p. 48 (1906); Mem. Ac. Torino (2), lvii. p. 357 (1907).

Indopacific, in various Lamellibranchs.

2. *Anchistus inermis* (Miers), 1884.

Harpilius inermis, Miers, "Alert" Crust. p. 291, Pl. 32, fig. B (1884). Müller, Verh. nat. Ges. Basel, viii. II. p. 471 (1887).

Anchistus inermis, Borradaile, Ann. Mag. Nat. Hist. (7) ii. p. 387 (1898). Pearson, Rep. Ceylon Pearl Fisheries, iv. p. 77 (1905). Rathbun, Proc. Zool. Soc. Lond. 1914, iii. p. 656 (1914).

Indian Ocean, in *Pinna*.

3. *Anchistus spinuliferus* (Miers), 1884.

Harpilius spinuliferus, Miers, "Alert" Crust. p. 292 (1884).

Anchistus spinuliferus, Borradaile, Ann. Mag. Nat. Hist. (7) ii. p. 387 (1884).

Loc.? In *Tridacna*.

4. *Anchistus biunguiculatus* Borradaile, 1898.

Ann. Mag. Nat. Hist. (7) ii. p. 387; Willey's Zool. Results, iv. p. 408, Pl. 1, fig. 5 (1899).

British New Guinea, in *Tridacna*.

5. *Anchistus mirabilis* (Pesta), 1911.

Marygrande mirabilis, Pesta, Zool. Anz. xxxviii. p. 571.
Samoa, in *Tridacna gigas*.

6. *Anchistus* (?) *armatus* (H. M.-Edwards), 1837.

Pontonia armata, H. M.-Edwards, Hist. Nat. Crust. ii. p. 359 (1837).
Anchistus (?) *armatus*, Borradaile, Ann. Mag. Nat. Hist. (7) ii. p. 387 (1898).
New Zealand.

Genus *Pontonia* Latreille, 1829.

Cuvier's R. An. 2nd ed. iv. p. 96. Roux, Mém. s. les Salicoques, p. 26 (1831). H. M.-Edwards, Hist. Nat. Crust. ii. p. 358 (1837). De Haan, von Siebold's Fauna Japonica, Crust. p. 175 (1850). Dana, U. S. Explor. Exped. Rep. xiii. I. p. 570 (1852). Kingsley, Proc. Ac. Philadelphia, 1879, p. 422 (1880). Joliet, Arch. zool. exper. x. p. 19 (1882). Carus, Prodr. Faun. Medit. i. p. 475 (1885). Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 388 (1898). Ortmann, Bronn's Thierreich, Arthropoden, v. II. p. 1131 (1899). Rathbun, Bull. U. S. Fish Comm. xx. II. p. 121 (1901).

Definition: Body stout, swollen, somewhat depressed; sixth abdominal segment not elongate; rostrum short, depressed, curved downwards, not dentate, with or without a keel below at the free end; eye more or less reduced, outer flagellum of antennule not deeply cleft; antennal scale broad; mandible without palp; inner lacinia of maxillule very broad and hairy; second maxilliped without podobranch, with last joint mediad of preceding joint; third maxilliped without arthrobranch and with all joints broad, but the widest surface of the last two in a different plane from that of the antepenultimate, so that they are apt to appear narrow; legs stout, directed outwards, the second pair with heavy chela, the last three with dactylopodite nearly straight, simple, and without basal protuberance.

Key to the species of *Pontonia*:

I. Rostrum reaches at least to middle of second joint of antennule.

A. Last three legs end in simple claw. Southern species.

1. Rostrum outreaches antennular stalk. Dactylopodites of last three legs strong. Second legs subequal and similar.
P. minuta Baker, 1907.

2. Rostrum ends at middle of second joint of antennular stalk. Dactylopodites of last three legs weak. Second legs unequal and unlike.
P. pinnæ Ortmann, 1894.

B. Last three legs end in double claws. Northern species.

1. Rostrum very narrow throughout. W. American.
P. californiensis Rathbun, 1902.

2. Rostrum broad at base. Old World and Atlantic.

a. Antennal stalk as long as antennular. Eyes and first joint of antennular stalk subequal. Japanese.

P. nipponensis de Haan, 1850.

b. Antennal stalk shorter than antennular. First joint of antennular stalk distinctly longer than eyes. Western species.

i. Antennal scale has a spine and outreaches antennular stalk. Mediterranean.

α. Third maxilliped does not reach end of antennular stalk. Body bears yellow spots.

P. flavomaculata Heller, 1864.

β. Third maxilliped reaches end of antennular stalk. Body rose-pink.

P. tyrrhena (Petagna).

ii. Antennal scale has no spine and does not outreach antennular stalk W. Indies.

P. grayi Rathbun, 1901.

II. Rostrum short, not reaching end of first joint of antennule.

A. Rostrum reaches middle of first joint of antennule.

1. Rostrum without keel below.

P. ascidicola Borradaile, 1898.

2. Rostrum with keel below.

P. mexicana Guérin, 1856.

B. Rostrum not more than $\frac{1}{6}$ length of first joint of antennule.

P. brevirostris Miers, 1884.

1. (Type.) *Pontonia tyrrhena* (Petagna) (Plate **57**, fig. 29).

Astacus tyrrhenus, Petagna, Ent. Pl. 5, fig. 5 (*fide* Risso).

Gnathophyllum tyrrhenus, Desmarest, Consid. sur les Crust. p. 229.

Alpheus pinnophylax, Otto, Mém. Ac. cur. nat. Bonn, xiv. Pl. 21, figs. 1, 2.

Pontonia tyrrhena, Latreille, Encycl. Pl. 326, fig. 10; Cuvier's R. An. 2nd ed. p. 96 (1829). H. M.-Edwards, Crust. ii. Pl. 360 (1837). Cuvier's R. An. Crust. Atlas, Pl. 52, fig. 4 (1849). Heller, Crust. südl. Eur. p. 251, Pl. 8, figs. 10, 11 (1863). Ortmann, Speng. Zool. Jahrb. Syst. v. p. 509, Pl. 27, fig. 9 (1891). Nobili, Bull. Sci. Fr. Belg. xl. p. 49 (1906).

Callianassa thyrrhenus, Risso, Hist. Nat. Eur. Mér. p. 54 (1826).

Pontonia custos, Guérin, Expéd. Morée, Zool. p. 36, Pl. 37, fig. 1. Carus, Prodr. Faun. Medit. p. 475 (1885). Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 388 (1898).

? *Pontonia parasitica*, Roux, Mém. sur les Salicoques, p. 26 (1831).

Mediterranean. In lamellibranchs and sponges.

2. *Pontonia nipponensis* De Haan, 1850.

Von Siebold's Fauna Japonica, Crust. p. 180. Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 388 (1878). Balss, Abh. k. Bayer. Ak. Wiss., Math.-Phys. Kl. ii. Suppl. Bd. 10, p. 53 (1914).

Hymenocera nipponensis, De Haan, *loc cit.* Pl. 46, fig. 8 (1850).

Japan.

3. *Pontonia mexicana* Guérin, 1856.

De la Sagra's Hist. Cuba. Rathbun, Bull. U. S. Fish. Comm. xx. II. p. 122 (1901).

? *Pontonia unidens*, Kingsley, Proc. Ac. Philadelphia, 1879, p. 422, Pl. 14, fig. 9 (1880). Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 389 (1898).

Mid-west Atlantic.

4. *Pontonia flavomaculata* Heller, 1864.

Verh. zool.-bot. Ges. Wien, xiv. p. 51. Carus, Prodr. Faun. Medit. i. p. 475 (1885). Ortmann, Speng. Zool. Jahrb. Syst. v. p. 509 (1890).

Pontonia diazonæ, Joliet, Arch. Zool. Exper. x. p. 108 (1882).

Pontonia phallusiæ, Marion, Ann. Mus. Nat. Hist. Marseille, Zool. i. (1883). Gourret, Compt. Rend. civ. p. 187 (1887).

Mediterranean, in ascidians.

5. *Pontonia brevirostris* Miers, 1884.

"Alert" Crust. p. 562, Pl. 51, fig. B. Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 389 (1898).

Seychelles, "in clamp (clam ?) shells."

6. *Pontonia pinnae* Ortmann, 1894.

Jena. Denkschr. viii. p. 16, Pl. 1, fig. 3. Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 389 (1898). Nobili, Ann. Sci. Nat. (9), iv. p. 65 (1906); Bull. Sci. Fr. Belg. xl. p. 46, Pl. 4, fig. 11 (1906).

? *Cancer custos* Forskål, Descrip. Anim. p. 94 (1775).

Red Sea. E. Africa. In *Pinna*.

7. *Pontonia ascidicola* Borradaile, 1898.

Ann. Mag. Nat. Hist. (7), ii. p. 389; Willey's Zool. Results, iv. p. 409, Pl. 1, fig. 6 (1899).

New Britain, in ascidian.

8. *Pontonia grayi* Rathbun, 1901.

Bull. U. S. Fish Comm. xx. II. p. 122.

Porto Rico.

9. *Pontonia californiensis* Rathbun, 1902.

Proc. U. S. Mus. xxiv. p. 902; Dec. Crust. N.W. America, p. 33, fig. 34 (1904).

California.

10. *Pontonia minuta* Baker, 1907.

Tr. Roy. Soc. S. Australia, xxxi. p. 189, Pl. 24, figs. 9—12.
S. Australia.

Genus Conchodytes Peters, 1851.

Ges. naturf. Freunde Berlin, 1851 (*fide* Hilgendorf); Ber. k. Ak. Wiss. Berlin, 1852, p. 591. Hilgendorf. Monatsber. k. Ak. Wiss. Berlin, 1875, p. 835. Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 389 (1898).

Definition: Body stout, swollen, depressed; sixth abdominal segment not elongate; rostrum short, depressed, curved downwards, toothless, with a keel below; eye small, outer flagellum of antennule not deeply cleft; flagella of antennule always, and that of antenna often, very short; antennal scale broad; mandible without palp; inner lacinia of maxillule very broad and hairy; second maxilliped without podobranch, with last joint mediad of preceding joint; third maxilliped without arthrobranch, with all joints broad, but with widest surface of last two in different plane from that of antepenultimate; legs stout, directed outwards, the second pair with heavy chela, the last three with strongly curved dactylopodites which bear basal protuberance.

Key to the species of *Conchodytes*:

I. Flagellum of antenna less than twice length of rostrum. Latter ends bluntly. Distal spine of antennal scale projects beyond end of scale. Indopacific.

A. Fingers of chelae without projection on outer side.

1. Rostrum outreaches antennal scale.
C. tridacnæ Peters, 1851.

2. Rostrum does not outreach antennal scale.
C. meleagrinæ Peters, 1851.

B. Moveable finger of one of second chelæ bears square projection on outer side.
C. biunguiculata (Paulson), 1875.

II. Flagellum of antenna a good deal more than twice length of rostrum. Latter ends in sharp spine. Distal spine of antennal scale does not reach end of scale. American.

A. Palm of great chela more than half as wide as long. Third maxilliped does not reach end of antennal stalk Panama.
C. margarita (Verrill), 1869.

B. Palm of great chela less than half as wide as long. Third maxilliped slightly outreaches antennal stalk. W. Atlantic.
C. domestica (Gibbes), 1851.

1. (Type.) *Conchodytes tridacnæ* Peters, 1851.

Ges. naturf. Freunde Berlin, 1851 (*fide* Hilgendorf); Ber. k. Ak. Wiss. Berlin, 1852, p. 594; Arch. Naturg. xviii. p. 288 (1852). Hilgendorf, Monatsber. k. Ak. Wiss. Berlin, 1878, p. 835. Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 390 (1898); Proc. Zool. Soc. Lond. 1898, p. 1007 (1899); Willey's Zool. Results, iv. p. 407 (1899). Nobili, Ann. Mus. Genova, xl. p. 235 (1899); Ann. Sci. Nat. (9), iv. p. 66 (1906).

Pontonia tridacnæ, Dana, U. S. Explor. Exped. Rep. xiii. 1. p. 371 (1852); Atlas, Pl. 37, fig. 1 (1885). Miers, "Alert" Rep. Crust. p. 290 (1884). ?Ortmann, Speng. Zool. Jahrb. Syst. v. p. 509, Pl. 37, fig. 10 (1891).

Indopacific, in *Tridacna*.

The separation of this species from *C. meleagrinæ* is difficult. Peters, whose statements are none too explicit, gives several points of difference, but these all vary independently, with the exception of that which consists in the absence of a fringe to the antennal scale in *C. tridacnæ*. I have not met with this feature, and believe it to have been due to accident in Peters' specimens. Examination of a number of specimens from various localities shows the following facts: (1) specimens in which the rostrum outreaches the antennal scale always have the third maxilliped falling considerably short of the end of the rostrum, and the arm of the first leg no longer than the wrist, and are always found in *Tridacna*, (2) specimens in which the rostrum is outreached by the antennal scale may have the third maxilliped reaching or exceeding the end of the rostrum, and may have the arm of the first leg longer than the wrist, and are usually, though not always, found in *Meleagrina*. Form (1) is presumably *C. tridacnæ*, and form (2) *C. meleagrinæ*. Whether they are specifically distinct is another question. In both forms the chelipeds of the second pair vary greatly both in degree of inequality and in the actual size of the greater of them.

2. *Conchodytes meleagrinæ* Peters, 1851 (Plate **57**, fig. 26).

Ges. naturf. Freunde Berlin, 1851 (*fide* Hilgendorf); Ber. k. Ak. Wiss. Berlin, 1852, p. 594; Arch. Naturg. xviii. p. 288 (1852). Hilgendorf, Monatsber. k. Ak. Wiss. Berlin, 1878, p. 836. Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 390 (1898). Nobili, Mem. Ac. Torino (2), lvii, p. 59 (1907). Pearson, Rep. Ceylon Pearl Fisheries, iv. p. 77 (1905).

Pontonia meleagrinæ, Bate, "Challenger" Macrura, p. 707, Pl. 124, figs. 1, 2 (1888).

Pontonia tridacnæ, Miers, "Alert" Rep. Crust. p. 290 (1884).

? *Pontonia maculata*, Stimpson, Proc. Ac. Philadelphia, 1860, p. 38. Balss, Abh. k. Bayer. Ak. Wiss., Math.-Phys. Kl. ii. Suppl. Bd. x. p. 53 (1914).

? *Pontonie enflée*, H. M.-Edwards, Hist. Nat. Crust. ii. p. 360 (1837).

Indopacific, in *Meleagrina*, and occasionally in *Tridacna*.

3. *Conchodytes domestica* (Gibbes), 1850.

Pontonia domestica, Gibbes, Proc. Am. Assoc. iii. p. 196 (1850). Kingsley, Proc. Ac. Philadelphia, 1878, p. 95.

Pontonia (?) *domestica*, Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 389 (1898).

Conchodytes domestica, Rathbun, Bull. U. S. Fish Comm. 1900, ii. p. 122 (1901).
Bahamas, S.E. United States, in *Pinna*. Porto Santo, in *Pecten* (Brit. Mus.).

4. *Conchodytes margarita* (Verrill), 1869.

Pontonia margarita Smith, Verrill, Amer. Nat. iii. p. 245 (1869). Lockington, Bull. Essex Inst. xi. p. 163 (1878).
Conchodytes margarita, Rathbun, Dec. Crust. N.W. America, p. 34 (1904).
Panama, in *Margaritophora fimbriata*.

5. *Conchodytes biunguiculata* (Paulson), 1875.

Pontonia biunguiculata, Paulson, Crust. Red Sea, p. 111, Pl. 15, fig. 1 (1875).
Conchodytes biunguiculata, Nobili, Ann. Sci. Nat. (9), iv. p. 67 (1906).
Red Sea.

Genus Typton Costa, 1844.

Ann. Ac. Aspir. Nat. Napoli, ii.; Faun. Regn. Napoli, ii. i. (1846). Heller, Crust. südl. Eur. p. 254 (1863). Bate, Ann. Mag. Nat. Hist. (4), ii. p. 119 (1868). Kingsley, Proc. Ac. Philadelphia, 1879, p. 422 (1880). Carus, Prodr. Faun. Medit. i. p. 475 (1885). Ortmann, Speng. Zool. Jahrb. Syst. v. p. 508 (1890); Bronn's Thierreich, Arthropoden, v. ii. p. 1131 (1899). Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 390 (1898).
Pontonella, Heller, Verh. zool.-bot. Ver. Wien, vi. p. 629 (1856).

Definition: Body stout, compressed; sixth abdominal segment not elongate; rostrum short, compressed, bent upwards at free end, pointed, with few or no teeth; outer flagellum of antennule short, not cleft; antennal scale vestigial; second maxilliped without podobranch, with last joint mediad of preceding joint; third maxilliped without arthrobranch, with narrow endopodite; legs fairly stout, one of the second pair with a very large chela, the dactylopodites of the last three much or little curved, biunguiculate, without basal protuberance.

Key to the species of *Typton*:

I. Rostrum toothless. Dactylopodites of last three legs not strongly curved.
T. spongicola Costa, 1844.

II. Rostrum toothed. Dactylopodites of last three legs strongly curved.
T. bouvieri Nobili, 1904.

1. (Type.) *Typton spongicola* Costa, 1844.

Ann. Ac. Aspir. Nat. Napoli, ii.; Faun. Reg. Napoli, ii. i. Pl. 6, figs. 1—6 (1846). Grube, Ausflug nach Triest, pp. 65 and 125. Heller, Crust. südl. Eur. p. 254, Pl. 8, figs. 12—17 (1863). Norman, Ann. Mag. Nat. Hist. (4), ii. p. 176 (1868). Carus, Prodr. Faun. Medit. i. p. 475 (1885). Ortmann, Speng. Zool. Jahrb. Syst. v. p. 508, Pl. 37, fig. 8 (1891). Borradaile, Ann. Mag. Nat. Hist. (7), ii. p. 390 (1898).

Pontonella glabra, Heller, Ver. zool.-bot. Ver. Wien, 1856, p. 629, Pl. 9, figs. 1—15.

Alpheus edwardsii, Couch, Journ. Linn. Soc. Lond., Zool. v. p. 210 (1860).

Typton spongiosus, Bate, Ann. Mag. Nat. Hist. (4), ii. p. 119 (1868).

Mediterranean. Cornwall. In sponges.

2. *Typton bouvieri* Nobili, 1904.

Bull. Mus. Paris, 1904, v. p. 233; Ann. Sci. Nat. (9), iv. p. 67, Pl. 3, fig. 4 (1906).

Jibuti.

EXPLANATION OF PLATES **52—57.**

Fig. 1. *Periclimenes spiniferus* de Man, 1902 (Plate **52**). *a*, side view; *b*, dorsal view of cephalothorax; *c*, dorsal view of antennule and antenna with adjacent structures: α = coxocerite, β = basicerite (outer division), δ = scale, ϵ = base of eyestalk, ii = second joint of endocerite; *c′*, ventral view of base of antenna, lettering as in *c*, also β^* = inner division of basicerite, γ = tubercle for opening of green gland, i = first joint of endocerite; *d*, ventral view of left mandible; *d′*, end of molar process of the same; *d‴*, end of molar process of right mandible; d^{iv}, anterior view of right mandible; *e*, maxillule; *f*, maxilla; *g*, 1st maxilliped; *h*, 2nd maxilliped; *i*, 3rd maxilliped, removed with arthrobranch; *k*, chela of 1st leg; *l*, chela of 2nd leg (larger of pair); *m*, walking leg; *n*, 1st abdominal limb of male; *o*, 2nd abdominal limb of male; *o′*, 2nd abdominal limb of female; *p*, dorsal view of telson; *q*, paragnatha.

Fig. 2. *Urocaridella gracilis* Borradaile, 1915 (Plate **53**). *a*, *e*, *f*, *g*, *h*, *i*, *n*, *o*, *p*, as fig. 1; d^{iv}, anterior-ventral view of right mandible; *o″*, 3rd abdominal limb of male.

Fig. 3. *Urocaris psamathe* de Man, 1902 (Plate **53**). *e—i*, as fig. 1.

Fig. 4. *Palæmonella elegans* Borradaile, 1915 (Plate **53**). Side view of forepart of body.

Fig. 5. *Palæmonella longirostris* Borradaile, 1915 (Plate **53**). *a*, as fig. 1; d^{v}, anterior-ventral view of left mandible.

Fig. 6. *Periclimenes frater* Borradaile, 1915 (Plate **53**). *c*, basal joint of right antennule in dorsal view; *m*, end of a walking leg.

Fig. 7. *Periclimenes incertus* Borradaile, 1915 (Plate **53**). Side view.

Fig. 8. *Periclimenes brocki* (de Man), 1887 (Plates **53**, **54**). *f*, *g*, *h*, *i*, as fig. 1.

Fig. 9. *Periclimenes ceratophthalmus* Borradaile, 1915 (Plate **54**). *b*, as fig. 1; *a*, side view of carapace.

Fig. 10. *Periclimenes cornutus* Borradaile, 1915 (Plate **54**). *a*, *b*, as fig. 1.

Fig. 11. *Periclimenes affinis* Borradaile, 1915 (Plate **54**). *a*, *b*, *e*, *g*, *h*, *i*, *p*, as fig. 1.

Fig. 12. *Periclimenes dubius* Borradaile, 1915 (Plate **54**). *a*, *b*, *p*, as fig. 1.

Fig. 13. *Periclimenes nilandensis* Borradaile, 1915 (Plate **54**). *a*, *b*, as fig. 1.

Fig. 14. *Periclimenes seychellensis* Borradaile, 1915 (Plates **54**, **55**). *a*, *b*, *e*, *f*, *h*, *i*, as fig. 1.

Fig. 15. *Periclimenes brocketti* Borradaile, 1915 (Plate **55**). *a*, *b*, as fig. 1.

Fig. 16. *Periclimenes suvadivensis* Borradaile, 1915 (Plate **55**). Side view.

Fig. 17. *Periclimenes kolumadulensis* Borradaile, 1915 (Plate **55**). *l*, *l′*, chelæ of second pair.

Fig. 18. *Periclimenes compressus* Borradaile, 1915 (Plate **55**). *a*, *b*, as fig. 1.

Fig. 19. *Periclimenæus fimbriatus* Borradaile, 1915 (Plate **55**). *a*, *b*, *i*, *l*, *m*, *p*, as fig. 1.

Fig. 20. *Periclimenæus robustus* Borradaile, 1915 (Plate **55**). *a*, *b*, *f*, *g*, *h*, *i*, as fig. 1.

Fig. 21. *Harpiliopsis beaupresi* (Audouin), 1825 (Plate **55**). Third maxilliped.

Fig. 22. *Harpiliopsis depressus* (Stimpson), 1860 (Plate **56**). *e—i*, as fig. 1.

Fig. 23. *Coralliocaris* sp. ? *C. japonica* (Ortmann), 1891 (Plate **56**). *f*, *i*, *l*, *m*, as fig. 1; *a'*, side view of rostrum; *b'*, dorsal view; *l'*, small chela of second pair.

Fig. 24. *Coralliocaris macrophthalma* (H. M.-Edwards), 1837 (Plate **56**). Third maxilliped.

Fig. 25. *Anchistus miersi* (de Man), 1888 (Plate **56**). *e*—*i*, as fig. 1.

Fig. 26. *Conchodytes meleagrinæ* Peters, 1851 (Plate **57**). *a'*, *b'*, views as fig. 23 of female specimen with tail fan turned forward; *d*, *d'*, *d'''*, *e*, *f*, *g*, *h*, *i*, *m*, as fig. 1; *d''*, view of end of molar process of left mandible from dorsal side; *r*, ventral view of region of mouth, semidiagrammatic; *s*, the same, after removal of maxillipeds and maxillæ; *t*, the same, after removal of maxillules and paragnatha.

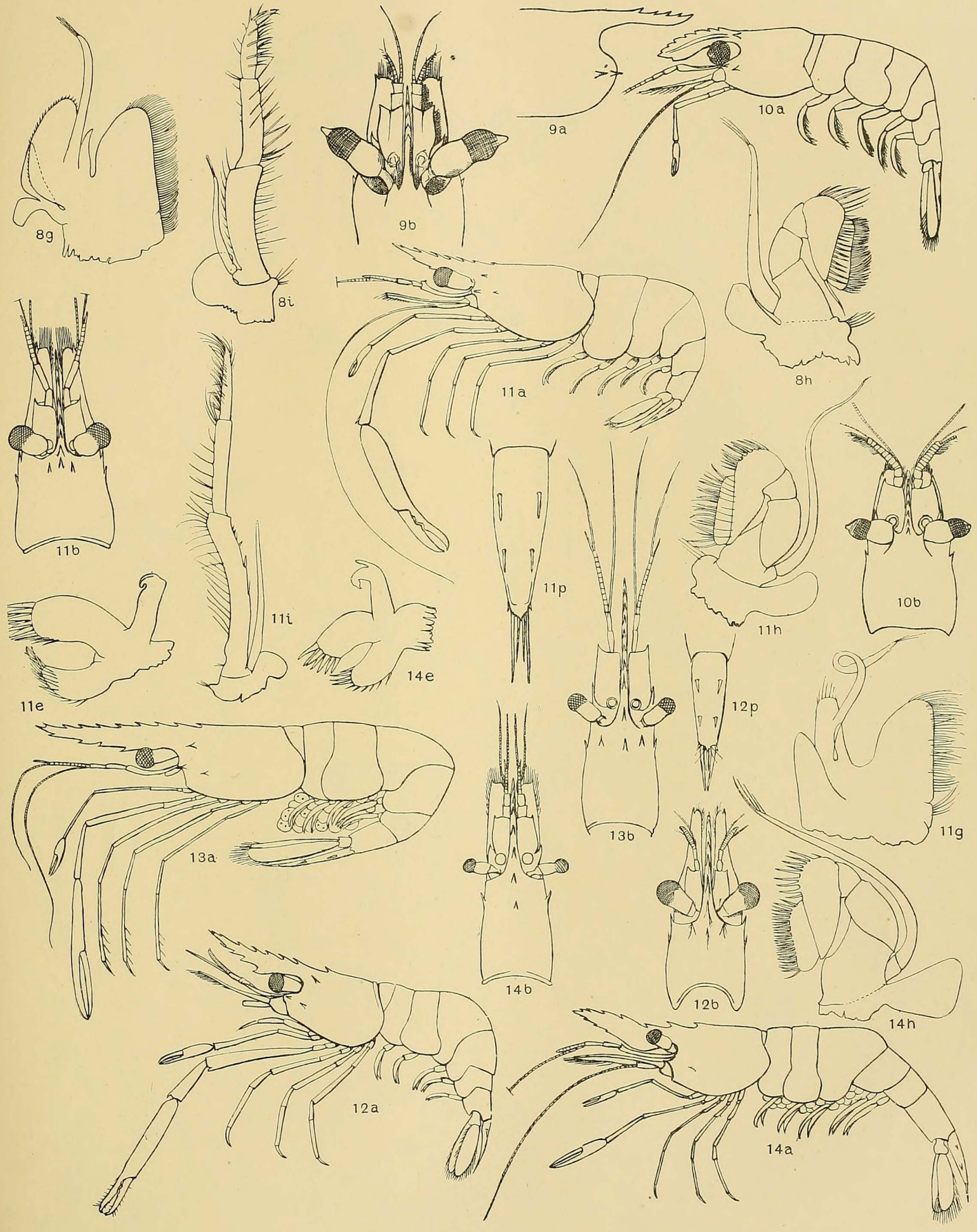
Fig. 27. *Pontoniopsis comanthi* Borradaile, 1915 (Plate **57**). Dorsal view of rostrum and eyes.

Fig. 28. *Pontonides maldivensis* (Borradaile), 1915 (Plate **57**). *a*, *i*, as fig. 1; *b*, dorsal view of rostrum and eyes.

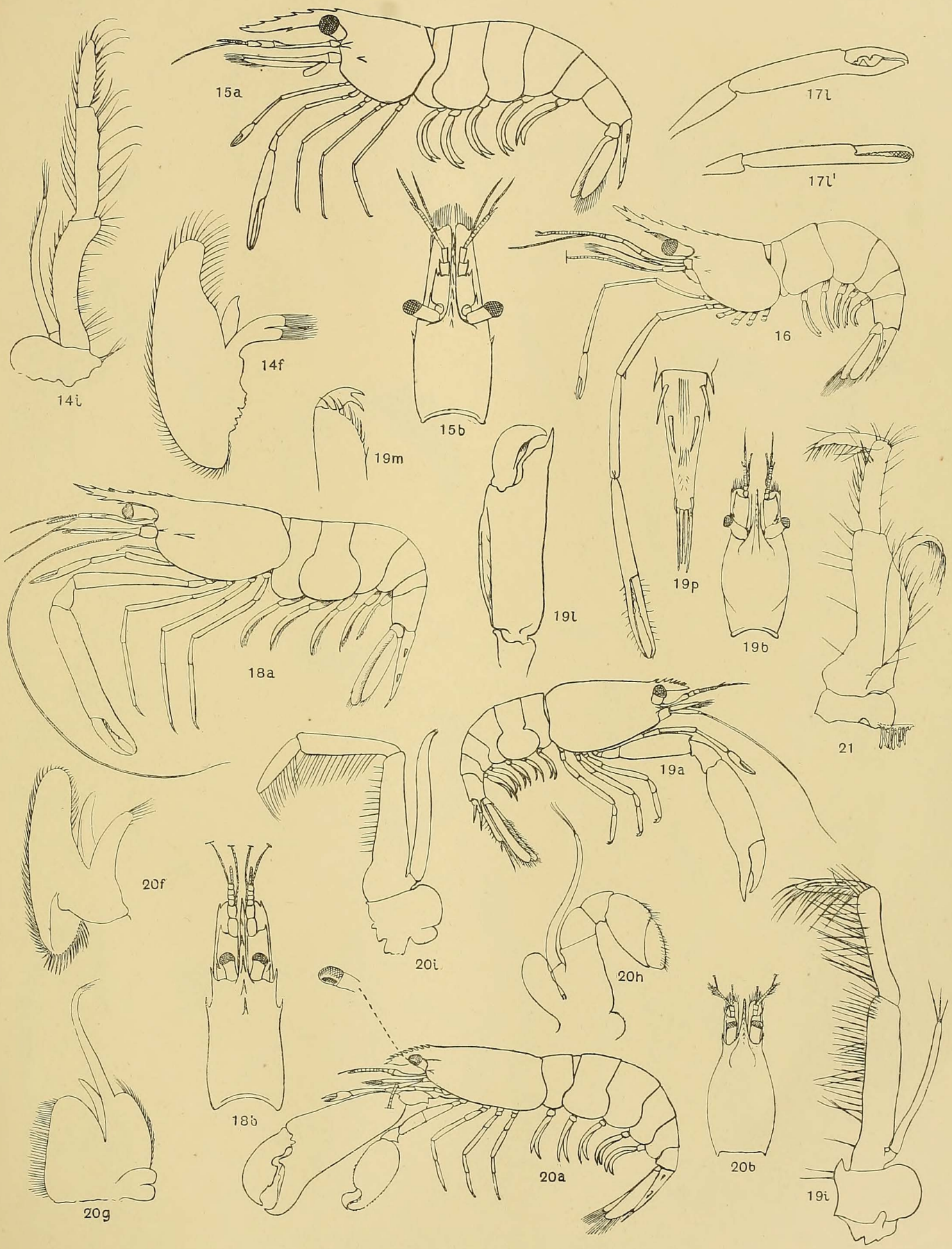
Fig. 29. *Pontonia tyrrhena* (Petagna) (Plate **57**). ♂ male specimen in dorsal view, after Milne-Edwards; ♀ female specimen in dorsal view.

PONTONIINÆ FROM THE INDIAN OCEAN

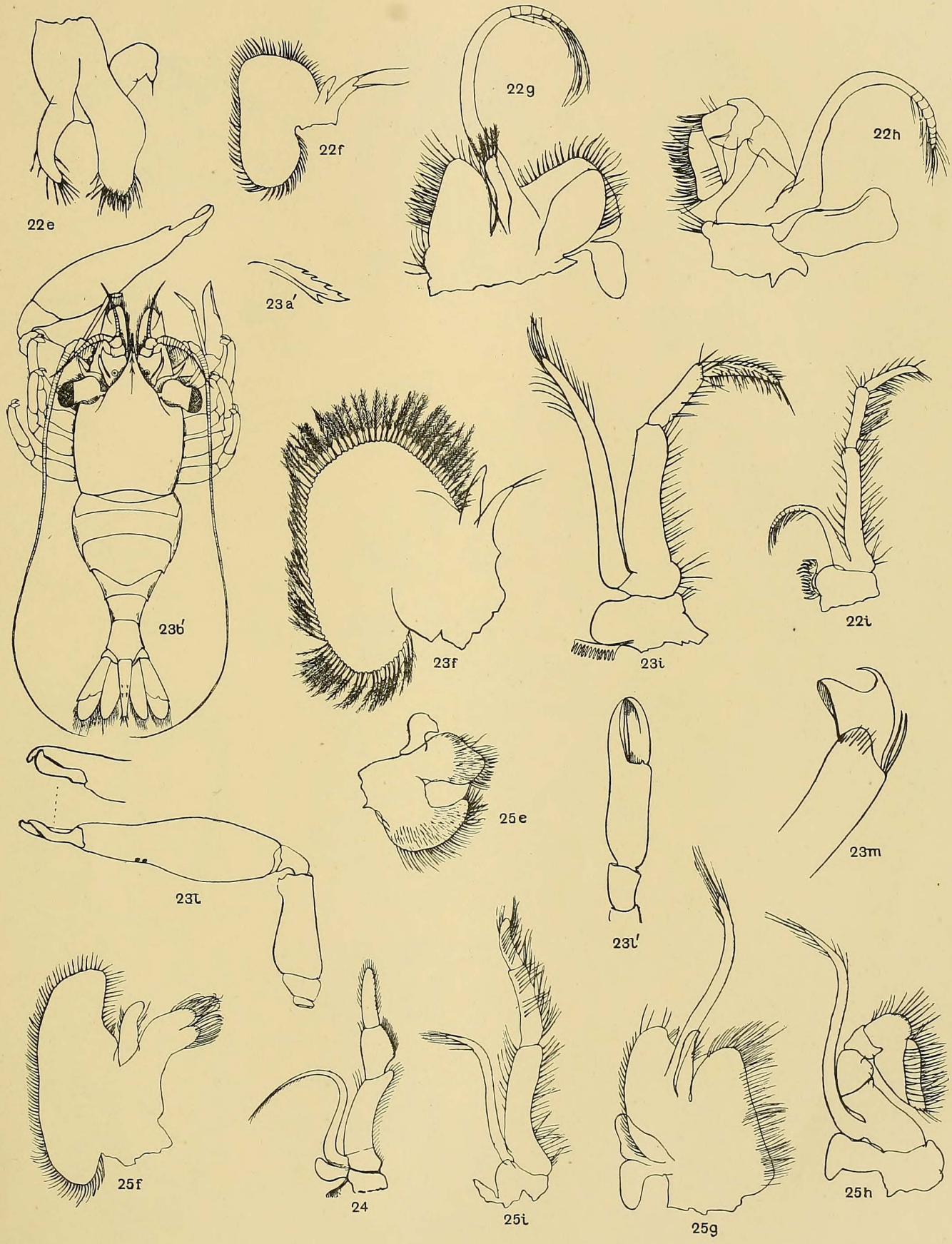
PONTONIINÆ FROM THE INDIAN OCEAN



PONTONIINÆ FROM THE INDIAN OCEAN



PONTONIINÆ FROM THE INDIAN OCEAN



PONTONIINÆ FROM THE INDIAN OCEAN

PONTONIINÆ FROM THE INDIAN OCEAN