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Notes on Crustacea Decapoda in the Indian Museum, XV. Pontoniinae.

By

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NOTES ON CRUSTACEA DECAPODA IN THE INDIAN MUSEUM.

XV. PONTONIINAE.

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The Pontoniinae form one of the four subfamilies into which the Caridean family Palaemonidae is divided; the other three are the Palaemoninae, the Desmocaridinae and the Typhlocaridinae. Of the very numerous species known in the family all except three belong to the Palaemoninae and Pontoniinae. The Desmocaridinae comprise only a single species, *Desmocaris trispinosus* (Aurivillius), found in freshwater streams in West Africa, and Sollaud[1] who first drew attention to its peculiar characters regards it as the most primitive known Palaemonid. The Typhlocaridinae include two remarkable blind species, both belonging to the genus *Typhlocaris* Calman,[2] which inhabit waters of subterranean origin in Palestine and Cyrenaica. *Typhlocaris* differs from all other Palaemonidae in the presence of a longitudinal suture in the carapace, resembling that found in certain Penaeidae and in the Thalassinidea.

The Palaemoninae and Pontoniinae are closely related subfamilies, distinguished from the other two by a number of important characters.[3] They differ from one another in two respects. The pleurobranch found in the Palaemoninae above the base of the third maxilliped is invariably absent in the Pontoniinae, with the result that six *large* branchiae are found in the former subfamily as against five in the latter. The telson-tip in the Palaemoninae is usually armed with two pairs of spines and a varying number of plumose setae, whereas in the Pontoniinae there are always three pairs of spines.[4] This character is not an invariable one. There appears to be no real morphological distinction between spines and setae as found at the apex of the telson; in the Pontoniinae the median spines are frequently plumose and I have seen one species of Palaemoninae[5] in which there are three pairs of spines, almost precisely as in the related subfamily.

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[1] Sollaud, *Comptes rendus Acad. Sci. Paris* CLII, p. 913 (1911).

[2] Calman, *Trans. Linn. Soc.* (2) *Zool.* XI, p. 93 (1909); Annandale and Kemp, *Journ. Asiat. Soc. Bengal* (n.s.) IX, p. 245 (1913); Parisi, *Atti Soc. Ital. Sci. nat. Milano* LIX, p. 241 (1920).

[3] The characters of the four subfamilies are summarized by Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, p. 326 (1917).

[4] *Coutierea* is said to possess merely a single pair, but the genus is only known from one specimen. It may prove not to belong to the Pontoniinae.

[5] A remarkable species from South India, allied to *Palaemonetes* and hitherto undescribed.

In working through the large collection of Pontoniinae in the Indian Museum I have derived much assistance from the memoir which Borradaile has recently published [1]; his full lists of references to the species have been most useful to me. On a large number of taxonomic questions, however, I have formed conclusions which differ very widely from those which he has expressed, particularly in regard to the generic subdivision of the group. The latter question, as Borradaile has pointed out, is one of great difficulty. In the course of my work I have repeatedly been struck by the very homogeneous nature of the subfamily as a whole, and it is to this fact that we must turn for an explanation of the apparently trivial characters on which many of the genera have been founded.

The characters used for the generic subdivision of the Pontoniinae contrast very strongly with those employed for the same purpose in certain other families and subfamilies of Caridea. In the Hippolytidae, for example, we find that the genera can be separated by trenchant morphological characters based for the most part on the branchial formula, on the structure of the mandible and on the carpal segmentation of the second peraeopods. We are thus able, in this family, to devise a scheme of classification which should satisfy even the most earnest seeker after phylogenetic truth; we have confidence that our genera form natural groups and that they can be arranged in a manner which will demonstrate their true affinities.

The Pontoniinae present a far more difficult problem. We search almost in vain for important morphological features which will serve to separate the large assemblage of species into natural groups. We are obliged to define our genera on characters of a much inferior order of magnitude and we are often far from certain that they are phylogenetically valid.

This radical difference between two not distantly related groups of Caridea is perhaps to be explained by supposing that the Pontoniinae have succeeded in evolving a structural type that can be adapted without any deep-seated modifications to all needful kinds of environment; whereas the Hippolytidae, with a less useful stock-pattern, must needs undergo drastic change, sometimes assuming the most bizarre forms, in order to equip themselves for particular conditions of life. In this connection it is to be remarked that the Pontoniinae have proved themselves far superior to the Hippolytidae in their ability to accommodate themselves to unusual surroundings.

In subdividing such a homogeneous group as the Pontoniinae it is, I believe, of first importance that the genera should be established on a broad basis and that the characters used in separating them should so far as possible be unequivocal. That the classification of the family has hitherto been greatly lacking in this respect is clear from a study of the literature. As evidence of the confu-

[1] Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, p. 323 (1917).

sion that has prevailed, it may be mentioned that Balss has recently redescribed the type species of *Periclimenes* as a new form of *Urocaris* and that a single species has been described by Schenkel, Nobili, Lenz and Miss Rathbun—all writers of experience—under the names *Ancylocaris brevicarpalis*, *Palaemonella aberrans*, *Harpilius latirostris* and *Periclimenes hermitensis* respectively.

Borradaile's recent system of classification does little to remove the sources of error. The primary divisions in his synoptic key to the genera depend almost wholly upon habit of body. This character appears to me to possess little generic importance and, inasmuch as the subfamily comprises species with every imaginable gradation of form, between the most slender and the stoutest, it is frequently quite impossible to decide on the section to which any particular form should be allocated.

I have attempted in this paper to devise a more workable arrangement. In so doing I have been led to discard *Urocaris*, *Ancylocaris* and *Periclimenaeus* as distinct genera and to merge all the species belonging to them, together with those of Borradaile's subgenera *Falciger*, *Cristiger*, *Corniger* and *Hamiger* under the single name *Periclimenes*. The large assemblage of species thus constituted is divided into three subgenera, *Periclimenes*, *Periclimenaeus* and *Ancylocaris*, which together comprise the majority of known species of the subfamily. Except for *Harpiliopsis*, which is no doubt identical with *Harpilius*, the remaining genera retain their rank; several, however, are inadequately described and one or two may even prove not to belong to the subfamily.

Whether the new grouping in the *Periclimenes* section demonstrates the real affinities of the species better than the old one is a question on which it is difficult to express a decided opinion. It is clear from the manner in which they are combined that many of the characters which are used in the distinction of species must necessarily be convergent in origin and it is impossible to be certain that this is not also the case with some of those to which I have attached generic or subgeneric significance. The new grouping, however, removes some of the obvious anomalies that have hitherto existed and will, I believe, be found convenient in practice. In proposing this new scheme of classification it will be understood that I disagree with much that Borradaile has said regarding the phylogeny of the group and that my views on the way in which the different genera have originated differ very widely from those which he has illustrated in the form of a phylogenetic tree.

The Pontoniinae are for the most part Indo-Pacific in distribution and the subfamily is almost exclusively marine. The only exceptions to the latter statement are *Periclimenes indicus*, *P. demani* and *P. obscurus*, which frequent lagoons of variable salinity on the eastern side of the Indian Peninsula. The two former species are capable of enduring extreme alterations in salinity and both have been found in water that is quite fresh as well as in pure sea-water. *Periclimenes obscurus* has been found both in the sea and in brackish water. The members of the subfamily

occur for the most part in sheltered portions of the littoral zone and are especially abundant in the vicinity of coral-reefs. A small proportion occur in moderate depths, up to 50 fathoms, and a few live in deeper water. The greatest depth from which any Pontoniine is known is 703 fathoms.[1]

The most remarkable feature of the subfamily is the ability its members have shown in forming associations with other animals. In the variety of these associations they excel all other Caridea. Some are found on Sponges, others on Actinians, Alcyonaria and Madrepore corals, a few are to be met with on Asteroids and Echinoids and many live on Crinoids. A considerable number of species occur in the mantle-cavity of Lamellibranch molluscs and some are known from the branchial sac of Ascidians. Many species are, of course, free-living, but the association between a prawn and some other animal can usually be detected only by the collector and unless the facts are carefully noted on the label they are liable to escape notice. I have little doubt that many more species possess these associations than we now realize.

As to the nature of the association we are at present very ignorant. The species that live in Lamellibranchs and in Ascidians find a safe retreat from the perils they would meet outside and through the activities of their hosts are, no doubt, well supplied with food. They are commensals in the strict application of the term and, in so far as they deprive their hosts of a portion of their nutriment, may also be regarded as parasites. In the absence of any evidence that their presence is of advantage to the host, they cannot be called symbiotic in the sense in which the word is generally applied.

The species that live on the giant sea-anemone, *Discosoma*, are probably protected by their host and those that live on Sponges, Alcyonaria, Madreporaria and Echinoderms doubtless obtain the benefit of shelter. The species on *Discosoma* perhaps share the food of their host, but it is not unlikely that those on Alcyonaria feed directly on the polyps and are thus true parasites.

Dr. Asajiro Oka found two remarkable species of *Pontonia* when examining the Indian Museum collection of Tunicates and has pointed out that the size of the prawns indicates that they must have entered the Ascidian in the larval state and grown up to maturity in the branchial sac. In a specimen of *Polycarpa annandalei* Oka, in which the external measurements of the test were 33 mm. × 23 mm. × 19 mm., a male and female of *Pontonia anachoreta*, sp. nov., were found, the prawns being 6·5 and 10·5 mm. in length. From *Ascidia willeyi* Oka, with test 35 mm. × 20 mm. a pair of *Pontonia okai*, sp. nov., 8 and 8·5 mm. in length, was obtained. When it is considered that these Pontoniids are heavily built forms, with one of the chelate legs of the second pair extremely large, it is evident that they could not possibly

[1] A specimen of *Periclimenes laccadivensis* collected by the R.I.M.S. 'Investigator.'

pass through the small apertures in the test of the Ascidian. They are thus, like *Spongicola venusta* in *Euplectella*, perpetual prisoners.

In the course of an extremely interesting note on sex-phenomena in *Pinnotheres*, Orton[1] has pointed out that female crabs are frequently found alone in a mollusc and that males are scarce. This corresponds with my own observations on this and other genera of Pinnotherid crabs in India: single specimens, usually females, are of common occurrence and it is quite exceptional to find two crabs in one mollusc. It is probable, as Orton has pointed out, that the male crabs wander freely and visit the molluscs from time to time in search of females.

Conditions are different with the Pontoniids that live in Lamellibranchs, for in practically every instance a male and female prawn are found together in the same mollusc. From this fact it is perhaps legitimate to infer that, as with the species in Ascidians, the prawns after they are once established in their host never leave it throughout the whole course of their existence.

The animal associations recorded in the Pontoniinae are the following:—

On PORIFERA.

? *Periclimenes impar*, sp. nov.
Pontonia tyrrhena (Petagna).[2]
Typton spongicola Costa.

On COELENTERATA.

On Actiniaria.

Periclimenes brevicarpalis (Schenkel), on *Discosoma.*
,, *inornatus*, sp. nov., on *Discosoma.*

On Madreporaria.

Periclimenes spiniferus de Man.
,, *diversipes*, sp. nov.
Harpilius, probably all species.
Coralliocaris, probably all species.

On Alcyonaria.

Periclimenes investigatoris, sp. nov.
,, *diversipes*, sp. nov.
Dasycaris symbiotes, gen. et sp. nov., on *Pteroeides*
Pontonides beaufortensis (Borr.), on a Gorgonian.
Balssia gasti (Balss), on *Corallium rubrum.*

On ECHINODERMATA.

On Asteroidea.

Periclimenes parasiticus Borr., on *Linckia.*

On Echinoidea.

Periclimenes brocki de Man.
Stegopontonia commensalis Nobili, on *Echinothrix.*

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[1] Orton, *Nature* CVI, p. 533 (1920).

[2] *Fide* Heller. The species usually lives in *Pinna* and it seems to me a little unlikely that it should also occur on sponges.

On Crinoidea.

Palaemonella pottsi (Borr.), on *Comanthus.*
,, *affinis* Zehntner, on *Actinometra.*
" *Palaemonella orientalis* Dana," de Man.
Periclimenes brocketti Borr.
,, *ceratophthalmus* Borr.
,, *cornutus* Borr.
,, *commensalis* Borr., on *Comanthus.*
Pontoniopsis comanthi Borr., on *Comanthus*

In MOLLUSCA LAMELLIBRANCHIATA.

In *Pinna.*
Anchistus inermis (Miers).
,, *miersi* (de Man).
Pontonia tyrrhena (Petagna).
,, *pinnae* Lockington.
Conchodytes biunguiculatus (Paulson).
,, *domestica* (Gibbes).

In *Tridacna.*
Anchistus miersi (de Man).
,, *biunguiculatus* Borr.
,, *spinuliferus* (Miers).
,, *mirabilis* (Pesta).
,, *demani*, sp. nov.
Conchodytes tridacnae Peters.
,, *meleagrinae* Peters.

In *Meleagrina.*
Anchistus miersi (de Man).
Conchodytes meleagrinae Peters.

In *Margaritophora.*
Pontonia margarita Smith

In *Pecten.*
Conchodytes domestica (Gibbes).

In *Spondylus.*
Anchistus miersi (de Man).

In " clamp-shells."
Pontonia brevirostris Miers.

In ASCIDIACEA.
Pontonia flavomaculata Heller, in *Phallusia, Diazona* and *Ascidia.*
,, *ascidicola* Borr.
,, *okai*, sp. nov., in *Ascidia.*
,, *anachoreta*, sp. nov., in *Polycarpa.*

I have been able to include in this paper brief colour descriptions of a number of species which I have observed in the living state. Most of these are based on notes made at Port Blair in the Andaman Is., where the Pontoniid fauna is one of unparalleled richness. Though the colour pattern cannot as a rule be used in taxonomic work, there is no doubt that it is often of specific value

and even when the actual tints are variable the distribution of the pigment is frequently constant. A colour description of *Coralliocaris superba* made at Port Blair agrees in a wonderfully exact manner with the coloured figure published by Dana in 1852; had there been any doubts as to the identity of the species the evidence of colour would have been most helpful.

The colouration of many species of Pontoniinae is very striking and there can be little doubt that in some cases it is protective. Potts[1] has observed that the rather strikingly coloured species which live on Crinoids usually harmonize well with their hosts and a remarkable correspondence with the host in both pigment and pattern was noticed by Col. Alcock[2] in a Pontoniid associated with *Pteroeides*.

But protection will not always supply an explanation. Of the two Pontoniids associated with *Discosoma*, one, *P. inornatus*, is protectively coloured; it is semitransparent, without any pigmentation whatever, and can only be detected with difficulty as it crawls among the short tentacles of the Actinian. The other species, *P. brevicarpalis*, though very closely allied, is pigmented in a most remarkable manner and is probably one of the most gorgeous prawns in existence. By reason of its colour it is always excessively conspicuous. *Periclimenes rex*, another species with very brilliant colouration, is perhaps associated with a red and white sponge and it is possible that the colour, though very bright, is protective.

In addition to the rich collection of the Zoological Survey of India, I have been able, thanks to the courtesy of Prof. Ch. Gravier, to examine a number of undetermined specimens belonging to the Paris Museum. Among other interesting species this collection contains a very remarkable prawn for which I have proposed the new genus *Thaumastocaris*. To Dr. W. T. Calman I am indebted for much assistance while working at the British Museum and to Dr. C. Forster Cooper for the opportunity of examining some of the species described by Borradaile.

The types of the new species, unless otherwise noted, are in the collection of the Zoological Survey of India.

Key to the genera of Pontoniinae.

A. Mandibular palp present, usually composed of two segments [rostrum laterally compressed with conspicuous teeth; dactylus of last three legs (? always) simple].	
B. Second maxilliped with podobranch; first pleopod of male with appendix interna [free-living] ...	*Urocaridella*, p. 122.
B'. Second maxilliped without podobranch; first pleopod without appendix interna [free-living or associated with crinoids]	*Palaemonella*, p. 122.
A'. Mandibular palp absent.	
B. Antennal scale well developed.	

[1] Potts, *Public. Carnegie Inst. Washington*, no. 212, p. 81 (1915).

[2] Alcock, *A Naturalist in Indian Seas*, p. 14 (1902). The species on which this observation was made is *Dasycaris symbiotes*, gen. et sp. nov.

C. Dactylus of last three legs simple or biunguiculate,[1] but without basal protuberance.
D. All three maxillipeds with exopods.
E. Inner lacinia of maxillula narrow; free-living or epizootic on coelenterates or echinoderms.
F. Carpus of first leg not segmented.
G. Carapace not areolated; basal antennular segment normal in form; abdominal pleura usually rounded inferiorly.[2]
H. Rostrum laterally compressed, with conspicuous teeth.
J. Carapace not depressed [free-living or associated with coelenterates or echinoderms] ... ... *Periclimenes*, p. 134.
J'. Carapace depressed, often very strongly [associated with corals] ... *Harpilius*, p. 226.
H'. Rostrum depressed and toothless [associated with crinoids] ... *Pontoniopsis*, p. 239.
G'. Carapace areolated; basal antennular segment greatly attenuated anteriorly; third to fifth abdominal pleura sharply pointed inferiorly [rostrum laterally compressed, with dorsal teeth; associated with alcyonaria] ... ... *Dasycaris*, p. 240.
F. Carpus of first leg segmented [rostrum laterally compressed, with teeth; carapace not areolated; ? free-living] ... *Thaumastocaris*, p. 244.
E'. Inner lacinia of maxillula very broad; endozootic in lamellibranchs or ascidians.
F. Rostrum laterally compressed in distal half, toothless or with small teeth at apex only; dorsal spines of telson very small [living in lamellibranchs] ... ... *Anchistus*, p. 247.
F'. Rostrum depressed, toothless; dorsal spines of telson usually large [living in lamellibranchs or ascidians] ... ... *Pontonia*, p. 259.
D'. Exopods absent from some or all maxillipeds.
E. Rostrum toothless; carapace not sculptured, without supra-orbital crest; no tooth on first abdominal somite; free-living (?), or associated with gorgonians ... ... *Pontonides*, p. 266.
E'. Rostrum with teeth; carapace deeply sculptured, with supra-orbital crest on either side armed with teeth; a mid-dorsal tooth on first abdominal somite; associated with red coral ... ... *Balssia*, p. 267.
C'. Dactylus of last three legs simple or biunguiculate[3] and with a large basal protuberance.
D. Rostrum very long; carapace areolated, with huge antennal and supraorbital spines and with pterygostomian spine; abdominal pleura sharply pointed inferiorly [? free-living] ... *Coutierea*, p. 267.
D'. Rostrum little if at all longer than scale; carapace not areolated, without supraorbital or pterygostomian spines; antennal spine when present short; abdominal pleura inferiorly rounded

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[1] Biunguiculate in *Periclimenes s. str.*, in *Thaumastocaris* and in some species of *Anchistus* and *Pontonia*.
[2] The only exceptions are found in the genus *Harpilius*
[3] Biunguiculate only in *Conchodytes*.

E. Dactylus of last three legs with basal protuberance double [rostrum toothless, concave above; associated with echinoids] ... *Stegopontonia*, p. 268.

E'. Dactylus of last three legs with basal protuberance single.

F. Rostrum laterally compressed, frequently with teeth; inner lacinia of maxillula narrow; dactylus of last three legs with a single claw and a hoof-shaped basal protuberance; living on corals ... ... *Coralliocaris*,[1] p. 268.

F'. Rostrum depressed, toothless; inner lacinia of maxillula very broad; dactylus of last three legs with two claws and flat basal protuberance; living in lamellibranchs ... ... *Conchodytes*, p. 279.

B'. Antennal scale rudimentary.

C. Rostrum present, with or without teeth; distal lacinia of maxilla well developed; all maxillipeds with exopods; dactylus of last three legs biunguiculate [associated (? always) with sponges] ... *Typton*, p. 286,

C'. Rostrum absent; distal lacinia of maxilla rudimentary; second and third maxillipeds without exopods; dactylus of last three legs simple .. *Paratypton*, p. 286.

In this key Nobili's *Onycocaris*, originally proposed as a subgenus of *Coralliocaris*, is not included (see p. 278). I am not convinced that the two species for which it was founded are related to *Coralliocaris*, and as I have not seen either I prefer to leave their position undetermined for the present. The generic position of a number of other species is doubtful[2]; when they are better known it is probable that some modification will be necessary in the generic arrangement here adopted.

Balss' *Bathypalaemonella*[3] evidently does not belong to the subfamily, as it possesses a series of arthrobranchs in addition to five pleurobranchs.

Of the seventeen genera which I recognise *Periclimenes* comprises by far the largest number of species. No less than eight genera are monotypic and the majority of these are known from single specimens only.

In the keys to the species I have followed Borradaile's example and have in each instance inserted the rostral formula. An expression such as R. 11–14 : 2–3 indicates that the teeth on the upper border of the rostrum vary from 11 to 14 and that there are 2 or 3 teeth on the lower border. The length of a specimen, as given in the descriptive parts, represents the distance between the tip of the rostrum and the tip of the telson with the animal extended as nearly as possible in a straight line. The figures in the text, even when forming part of a single text-block, are not necessarily drawn to the same scale.

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[1] Not including *Onycocaris* Nobili.

[2] In my attempts to readjust the generic classification of the subfamily I have found myself greatly handicapped by our inadequate knowledge of a number of species. It is important that we should have fuller knowledge of *Onycocaris*, of the two species from Japan which Balss referred to *Periclimenes* (see p. 138) and of the three forms attributed to *Coralliocaris* by Miss Rathbun (see p. 268).

[3] Balss, *Zool. Anz.* XLIV, p. 598 (1914).

Genus **Urocaridella** Borradaile.

1915. *Urocaridella*, Borradaile, *Ann. Mag. Nat. Hist.* (8) XV, p. 207.
1917. *Urocaridella*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, p. 352.

The presence of the appendix interna on the first pair of pleopods is a very remarkable character of this genus and one in which it differs, I believe, from all other known Caridea. It should be noted, however, that the appendix is to be found on the first pleopods in males only, not in both sexes as implied by Borradaile.

Urocaridella gracilis Borradaile.

1915. *Urocaridella gracilis*, Borradaile, *Ann. Mag. Nat. Hist.* (8) XV, p. 210.
1917. *Urocaridella gracilis*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, p. 352, pl. liii, fig. 2.

This species was described by Borradaile from Suvadiva, Kolumadulu and Haddumati Atolls in the Maldives. It is here recorded from the Orissa Coast, the Andaman Is. and the Mergui Archipelago.

Specimens from the Andamans were transparent when alive with brown speckling and with narrow transverse brown bands at the end of the carapace and on the second and third abdominal somites. There were brown patches in the middle and at the tip of the rostrum, on each side of the first abdominal somite, at the tips of the telson and uropods and at the base of the uropods. The antennules, antennae and all the legs were broadly banded with red.

The largest specimens in the collection are ovigerous females about 30 mm. in length.

2183/7.	Off Chilka Lake, Orissa Coast, 11 fms.	'Investigator,' Jan., 1890.	One.
C 342/1.	Port Blair, Andamans, 2–8 fms.	S. Kemp, Feb., 1915; Feb., March, 1921.	Many.
C 343/1.	Mergui Archipelago, 10 fms., 12°40′ N., 98°26′30″ E.	'Investigator,' Oct., 1913.	Many.
C 344/1.	Mergui Archipelago, 6 fms., 11°17′20″ N., 98°29′40″ E.	'Investigator,' March, 1914.	Three.

The specimens from Port Blair were caught in bottom nets hauled in Ross Channel and at the mouth of Brigade Creek; those from the Mergui Archipelago, none of which are fully adult, were obtained at night in surface nets.

Genus **Palaemonella** Dana.

1852. *Palaemonella*, Dana, *U. S. Explor. Exped., Crust.* I, p. 582.
1917. *Palaemonella*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, p. 356.

Borradaile includes twelve species in this genus, but except for the two originally described by Dana and the three that Borradaile himself named, all require re-examination. In general appearance

the species of *Palaemonella* bear an exceedingly close resemblance to those of *Periclimenes*. The only valid distinction between the two lies in the presence of a mandibular palp in the former genus and its absence in the latter. Unfortunately this character is one to which attention is seldom paid, with the result that the generic position of a number of species is doubtful.

Palaemonella laccadivensis Alcock and Anderson does not possess a mandibular palp and is transferred to the genus *Periclimenes*; in *Periclimenes pottsi* on the other hand this appendage is present and the species is in consequence removed to *Palaemonella*. Borradaile's *Palaemonella tridentata* is in my opinion a synonym of Dana's *P. tenuipes* and Zehntner's *Palaemonella amboinensis* is perhaps synonymous with *Periclimenes brevicarpalis* (Schenkel).

Several species with the dactyli of the last three legs biunguiculate have been referred to *Palaemonella*, but the position of all is uncertain.[1]

The five species that I have myself examined may be distinguished thus:—

A. Hepatic spine present.
  B. Distal margin of carpus of second leg toothed or angulate on its inner aspect, but without a large *subterminal* spine.
    C. Antennal scale strongly narrowed distally, with spine extending far beyond apex; a spine at distal end of merus of second leg.
      D. A vestigial supra-orbital spine; propodus of third leg at most 4·5 times length of dactylus; R. 6–8 : 1–3 ... ... *vestigialis*, sp. nov.
      D'. No vestige of supra-orbital spine; propodus of third leg more than 5 times length of dactylus; R. 7 : 2 ... ... *pottsi* (Borr.).
    C'. Antennal scale not narrowed distally, with spine scarcely extending beyond apex; no spine at distal end of merus of second leg; R. 8 : 3 ... *lata*, sp. nov.
  B'. A large subterminal spine on carpus of second leg [antennal scale narrowed distally, with spine extending much beyond apex; a spine at distal end of merus of second leg]; R. 6–8 : 1–3 ... *tenuipes* Dana.
A'. Hepatic spine absent [no spine at distal end of merus of second leg]; R. 6–7 : 1 ... ... *orientalis* Dana.

Palaemonella vestigialis, sp. nov.

(Plate III, fig. 2.)

The rostrum extends beyond the end of the antennular peduncle and reaches about to the apex of the antennal scale. It varies somewhat in depth and is straight for the greater part of its length with the terminal portion sometimes turned a little upwards. On the upper border it bears from 6 to 8 teeth,[2] usually 7; the pos-

[1] A specimen from Australia which Balss (*K. Svenska Vet.-Akad. Handl.* LXI, no. 10, p. 13, 1921) has doubtfully attributed to Nobili's *Palaemonella biunguiculata* bears only four spines at the apex of the telson and probably belongs to the subfamily Palaemoninae.

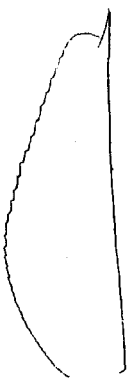
[2] Of thirteen specimens four have 6 dorsal teeth, six have 7 and three have 8.

terior tooth is placed in front of the middle of the carapace, the second is behind the orbit, while the foremost is small and is not far removed from the apex. On the lower border there are from 1 to 3 teeth,[1] usually 2, which are large and placed in the anterior half of the rostral length.

In the position usually occupied in other genera by the supra-orbital spine a small angular prominence or tubercle may be detected and extending downwards from this tubercle to the base of the antennal spine there is a well-defined curved ridge parallel with the orbit. From this ridge the carapace slopes obliquely inwards to the orbital margin, the orbit thus having a broadly bevelled edge. The antennal spine is strong; the hepatic spine is placed behind it, but on a lower level.

The eyes are stout with short, thick stalks. The cornea is a little wider than the stalk and frequently, as in some species of *Periclimenes*, shows two concentric bands of dark pigment. The ocular spot touches the cornea.

The basal segment of the antennular peduncle (text-fig. 2*a*) is broad; the lateral process does not reach the middle of the segment; the terminal spine is rather short and the margin between this spine and the articulation of the second segment is nearly straight. The two distal segments are stout. The free portion of the shorter ramus of the outer flagellum is half or rather less than half the length of the fused basal part, the latter consisting of 8 to 10 segments. The total length of the shorter ramus is equal to or rather less than that of the peduncle. The antennal scale (text-fig. 1) is from 3·3 to 4 times as long as wide, proportionately longest in males, and is strongly narrowed apically. The outer margin is straight or very slightly concave and terminates in a spine which reaches far beyond the end of the lamella.



TEXT-FIG. 1.—*Palaemonella vestigialis*, sp. nov.
Antennal scale of female.

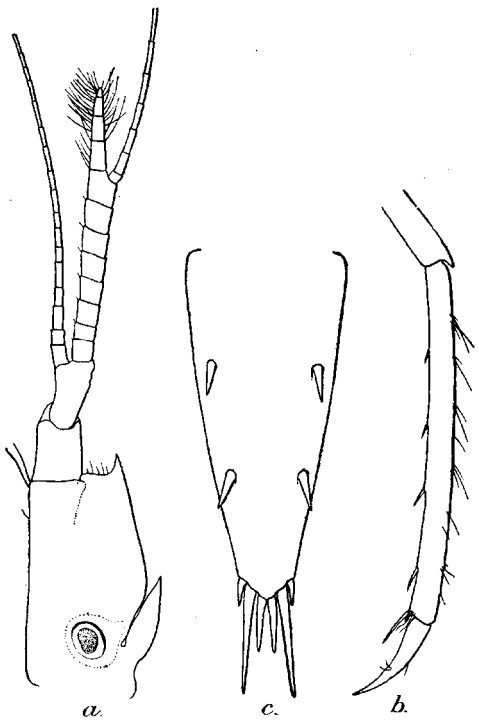
There is a minute arthrobranch at the base of the third maxilliped. The exopod almost reaches the end of the antepenultimate segment and the ultimate segment, excluding the terminal spine, is about three quarters the length of the antepenultimate.

The first peraeopods reach beyond the apex of the antennal scale by considerably more than the length of the chela. The carpus is about equal in length with the merus and is from 1·0 to 1·25 times as long as the chela. The fingers are longer than the palm and are unarmed.

The second peraeopods in adults of both sexes reach beyond the antennal scale by the whole of the chela and carpus. The

[1] Of thirteen specimens two have 1 ventral tooth, ten have 2 teeth and one has 3.

merus bears a strong spine close behind the distal end of the lower margin and is from 5·5 to 6 times as long as wide and from 1·25 to 1·4 times [1] as long as the carpus. The carpus is conical, from 2·8 to 3·2 times as long as its distal breadth, most slender in females. From the distal margin on the inner side there project two small acute processes or teeth, the upper the most conspicuous; the strong subterminal spine found in *Palaemonella tenuipes* is com-



TEXT-FIG. 2.—*Palaemonella vestigialis*, sp. nov.
a. Antennule. *c*. Telson.
b. Last two segments of third peraeopod.

pletely absent (*cf.* text-figs. 7*a* and 7*b*). Behind the distal edge, especially on the upper side, the carpus exhibits a transverse furrow, while the distal edge itself is somewhat dilated. The chela is from 2·3 to 2·65 times as long as the carpus and is proportionately longest in males. The palm is a little swollen, wider than the distal end of the carpus, 3 times as long as its greatest breadth and from 1·3 to 1·5 times as long as the fingers. The fingers have inturned tips, their cutting edges are unarmed distally, but in the proximal half each bears two teeth, those on the dactylus in advance of those on the fixed finger.

The last three pairs of peraeopods are slender; the fifth reach a little beyond the end of the antennal scale. In the third pair

[1] About equal to the carpus in a female from Mahé.

the merus is from 9 to 10 times as long as broad. The propodite bears spinules on its posterior border (text-fig. 2*b*) and is from 3·5 to 4·5 times as long as the dactylus.

The sixth abdominal somite is about 1·5 times the length of the fifth. The spinules on the dorsum of the telson (text-fig. 2*c*) are so arranged as to divide its length into three equal parts.

Large specimens are about 18 mm. in length.

C 394–5/1.	Port Blair, Andamans.	S. Kemp, March, 1915; Feb., 1921.	Four, including TYPES.
C 396/1.	Cheval Paar, Ceylon.	T. Southwell, Nov., 1910.	Five.
7717/6.	Kabusa I., Meigui.	'Investigator,' March, 1887.	One.
398–9/1.	Tor and Ain Musa, Gulf of Suez.	R. B. S. Sewell, 1916.	Three.

I have also seen three specimens from Mahé, Seychelles, belonging to the Paris Museum (Alluaud coll.).

The specimens from Port Blair were found at low water in rock-pools at Aberdeen and in North Bay. The type-specimens are from the former locality.

A male and female from Port Blair, found on a muddy shore near the mouth of Brigade Creek, differ from the specimens described above in the absence of the vestige of the supra-orbital spine and in the longer dactyli of the last three legs. In the third pair the propodite is only from 2·6 to 3 times as long as the dactylus. In the male the merus of the second peraeopod is about 4·5 times as long as wide and the carpus about 2·5 times as long as its distal width. The male possesses three pairs of spines on the back of the telson; but this is no doubt an abnormality as the teeth are not arranged symmetrically.

C 400/1.	Port Blair, Andamans.	S. Kemp, March, 1921.	Two.

The specimens were found among lumps of dead coral on muddy ground.

Palaemonella pottsi (Borradaile).

1915. *Periclimenes* (*Falciger*) *pottsi*, Borradaile, *Ann. Mag. Nat. Hist.* (8) XV, p. 213.
1915. *Periclimenes pottsi*, Potts, *Publ. Carnegie Inst. Washington*, no. 212, p. 82.
1917. *Periclimenes* (*Falciger*) *pottsi*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, p. 374.

I have examined two specimens, both unfortunately in poor condition, brought by Mr. F. A. Potts from the Torres Straits and find that Borradaile was mistaken in referring the species to the genus *Periclimenes*. The mandibular palp is present and is composed of two segments.

The species is very closely allied to *P. vestigialis*, differing as far as I am able to discover only in the following characters:—

(i) There is no vestige of the supra-orbital spine, though the orbit has a bevelled edge as in the allied species.

(ii) The spine at the end of the merus of the second peraeopod is quite terminal in position.

(iii) The dactylus of the last three peraeopods is much shorter, the propodite being from 5·3 to 5·5 times its length.

These characters are not very convincing. It is possible that other distinctive features will be found in the second peraeopods of the male, for I have only seen one detached leg of the second pair in *P. pottsi* and this appears to belong to a female.

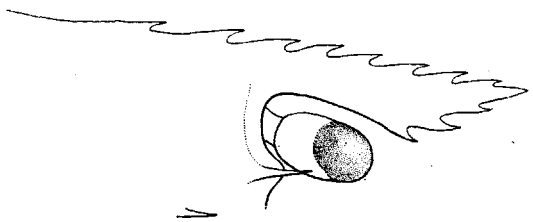
Palaemonella pottsi is purple in colour when alive and is associated with crinoids, whereas *P. vestigialis* is not conspicuously coloured in life and is free-living. There were no crinoids in the localities where the latter species was collected at Port Blair.

The species is known only from the Murray Is. in the Torres Straits.

Palaemonella lata, sp. nov.

This species, which is represented by a single adult male, is closely allied to *P. vestigialis* and *P. pottsi* but differs in the following characters:—

(i) There is no vestige of the supra-orbital spine (text-fig. 3).



TEXT-FIG. 3.—*Palaemonella lata*, sp. nov.
Anterior part of carapace.

(ii) The lateral process of the antennular peduncle is longer, extending beyond the middle of the segment and the terminal spine of the basal segment is also longer, reaching much beyond the middle of the second segment (text-fig. 4*a*).

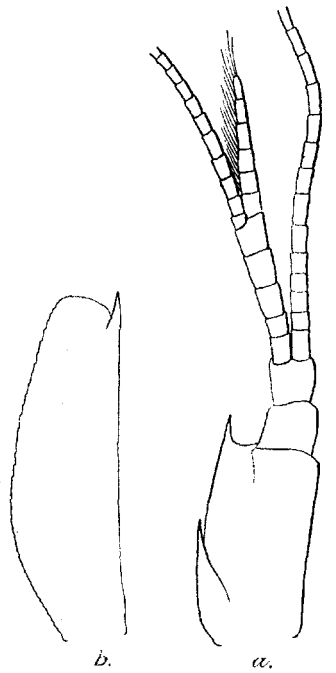
(iii) The outer antennular flagellum is more deeply cleft. The free portion of the stouter ramus is as long as the fused basal part, the latter comprising only 5 segments (text-fig. 4*a*).

(iv) The distal end of the antennal scale is very much broader and the terminal spine reaches scarcely at all beyond the apex of the lamella (text-fig. 4*b*).

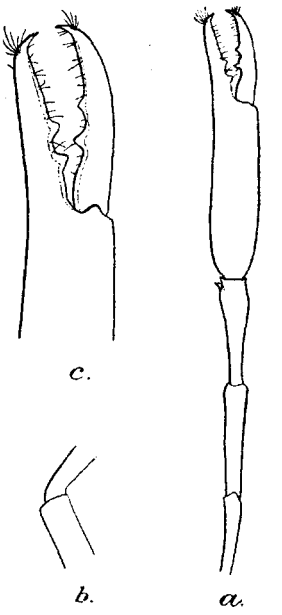
(v) The fingers of the first peraeopod are equal in length with the palm.

(vi) There is no spine at the distal end of the merus of the second peraeopods (text-fig. 5*b*).

In other respects there is little difference. The rostrum reaches beyond the end of the antennular peduncle and is rather



TEXT-FIG. 4.—*Palaemonella lata*, sp. nov.
a. Antennule. *b*. Antennal scale.



TEXT-FIG. 5.—*Palaemonella lata*, sp. nov.
Second peraeopod.
a. In dorsal view.
b. Mero-carpal articulation in lateral view.
c. Fingers.

deep in lateral view. It bears 8 teeth above and 3 below, two of the former being situated on the carapace. The antennal scale is a little more than 3 times as long as wide. The carpus of the first peraeopod is about 1·2 times the length of the chela. In the second peraeopods the merus is a little more than 5 times as long as wide. The carpus bears two conspicuous teeth on the inner side of its distal margin and is slightly less than 4 times as long as its distal breadth. The chela is about 2·5 times as long as the carpus and the palm is nearly 4 times as long as broad. There are two teeth in the proximal half of each finger as in *P. vestigialis*. The last three peraeopods are slender, the fifth reaching well beyond the antennal scale. In the third pair the merus is 10 times as long as wide and the propodus, which bears spinules on its posterior edge, is 3·3 times as long as the dactylus. The telson spines are arranged as in the preceding species.

TEXT-FIG. 6.—*Palaemonella lata*, sp. nov.
Last three segments of third peraeopod.

As in the two preceding species the mandibular palp is composed of two segments, but it differs in that the distal segment is very much shorter than the proximal. This is perhaps merely an abnormality and only one mandible was examined.

The single specimen is about 15 mm. in length. In life it was perfectly transparent except for a few small red chromatophores on the carpus and chela of the second legs.

P. lata is readily distinguished from related species by the broad apex and short terminal spine of the antennal scale and by the absence of the spine at the distal end of the merus of the second peraeopods.

C 401/1. Port Blair, Andamans. S. Kemp, Feb., 1921. One, TYPE.

The specimen was found in a rock-pool at Aberdeen at low water.

Palaemonella tenuipes Dana.

1852. *Palaemonella tenuipes*, Dana, *U. S. Explor. Exped., Crust.* I, p. 582, pl. xxxviii, figs. 3*a–d*.
1898. *Palaemonella tridentata*, Borradaile, *Proc. Zool. Soc. London*, p. 1007, pl. lxiv, figs. 8*a–c*.
1899. *Palaemonella tridentata*, Nobili, *Ann. Mus. civ. Genova* (2) XX, p. 235.
1906. *Palaemonella tenuipes* var. (ann. sp. ?), Nobili, *Ann. Sci. nat., Zool.* (9) IV, p. 70.
1917. *Palaemonella tenuipes* and *tridentata*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, pp. 323, 358.
1921. *Palaemonella tenuipes*, Tattersall, *Journ. Linn. Soc., Zool.* XXXIV, p. 383.
? 1921. *Palaemonella tenuipes*, Balss, *K. Svenska Vet.-Akad. Handl.* LXI, no. 10, p. 14.

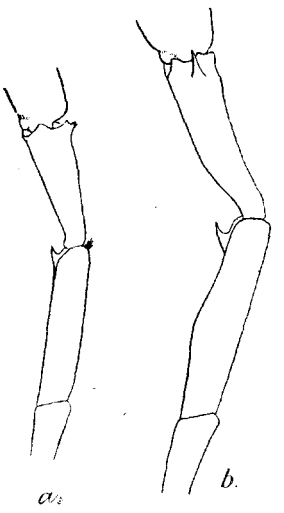
I have examined a single example of this species obtained at Peros Banhos in the Chagos Archipelago. It differs conspicuously form all other species of the genus that I have seen in the possession of a large *subterminal* spine on the upper and inner aspect of the carpus of the second peraeopod in addition to one or two small angular projections on the actual distal margin of the segment. The subterminal spine is clearly shown in Dana's figure.

In determining the specimen in the collection I have derived much assistance from the notes which Tattersall has recently published. I have no doubt that my specimen is specifically identical with those that he examined and I accept his view that they should be referred to Dana's *P. tenuipes*. The identification presupposes a considerable amount of error in Dana's figures, but we have ample evidence that these are not to be trusted in the finer detail now necessary for systematic work on the Macrura.

Tattersall remarks that Borradaile's *P. tridentata* is closely allied to *P. tenuipes* and is doubtfully distinct. I go further and regard the former as a synonym of the latter.

The specimen examined was obtained by Prof. Stanley Gardiner's expedition and was determined by Borradaile as *P.*

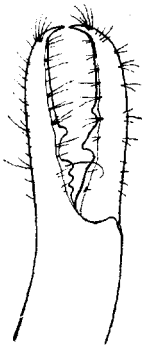
tridentata. Apart from the fact that it possesses only a single tooth on the lower border of the rostrum, it differs conspicuously from Borradaile's figure in the proportions of the segments of the second peraeopods. The merus is longer than the carpus and much longer than the fingers and the carpus is stouter, only about 3·5 times as long as its distal breadth. Tattersall has given a tabular statement of the proportionate lengths of the segments of the second peraeopod, the figures being derived from his own specimens, from Nobili's measurements and from the illustrations by Dana and Borradaile. The corresponding values for my specimen are merus 1·2, carpus 1·0, palm 1·6 and fingers 0·8. In these proportions the specimen agrees fairly well with those that Tattersall and Nobili examined. The shorter palm in Dana's figure may be due to the less well-developed condition of his specimen; the very short merus in Borradaile's figure is, I believe, an error in drawing. In my specimen, which is a male, the lower border of the merus is sinuous, conspicuously convex in the middle; this character is shown in Borradaile's figure and is probably found only in males. The dentition of the fingers is shown in text-fig. 8.



TEXT FIG. 7.—Merus and carpus of second peraeopod viewed laterally from inner side.

a. Palaemonella vestigialis, sp. nov.
b. Palaemonella tenuipes Dana.

Tattersall's notes and the evidence of my specimen, identified as *P. tridentata* by Borradaile himself, all point to the conclusion that only one species of *Palaemonella* with subterminal carpal spine is at present known.



TEXT FIG. 8.—*Palaemonella tenuipes* Dana.

Fingers of second peraeopod.

Dana's specimen came from the Sooloo Sea. Borradaile's original example of *P. tridentata* was obtained at Funafuti in the Ellice Is. and he has since recorded the species under the same name from various localities in the Maldives and the Chagos Archipelago. Nobili has recorded a specimen under the name *P. tridentata*

from Beagle Bay in British New Guinea. Nobili and Tattersall have examined specimens from the Red Sea, the former from Djibouti and other undetermined localities, the latter from Khor Dongonab and Suakin Harbour.

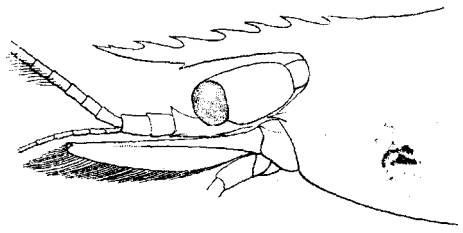
I look on most other records of *P. tenuipes*[1] with suspicion, but those of Stimpson from Ousima in the Loo-Choo Is., of Miss Rathbun from the Hawaiian Is. and of Balss from N. W. Australia are perhaps trustworthy. No reliance can be placed on de Man's record from Amboina as his specimen did not possess either of the second legs and the identity of Ortmann's specimens from Japan and the Maldives appears to me to be extremely doubtful. Zehntner in recording a specimen from Amboina remarks that the colour is entirely black, a fact not noted elsewhere and possibly not true of real *P. tenuipes*. Heilprin's record from the Bermudas cannot be accepted without corroboration.

Palaemonella orientalis Dana.

1852. *Palaemonella orientalis*, Dana, *U. S. Explor. Exped., Crust.* I, p. 583, pl. xxxviii, figs. 4*a–d*.
? 1887. *Palaemonella orientalis*, de Man, *Arch. Naturgesch.* LIII, i, p. 552.

The single specimen which I refer to this species exhibits the following characters:—

The rostrum (text-fig. 9) is slender, straight at the base and a little upturned at the tip; it reaches almost to the end of the antennal scale. On the upper border it bears 7 equidistant teeth, the hindmost placed on the carapace, the next a little in advance of the posterior limit of the orbit, and the foremost small and



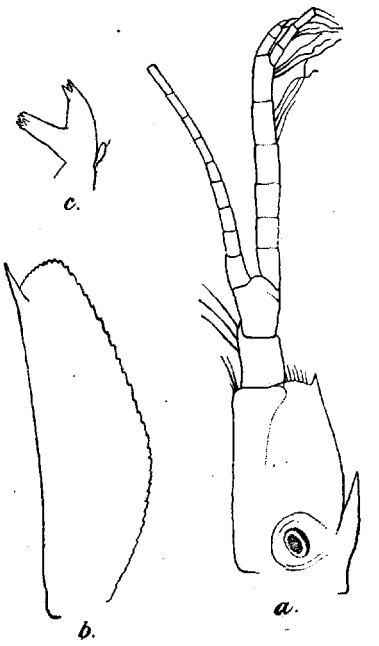
TEXT-FIG. 9.—*Palaemonella orientalis* Dana.
Anterior part of carapace, etc., in lateral view.

situated close to the apex. On the lower border there is a single tooth, placed beneath the fifth of those on the upper edge.

The antennal spine is present, but both the supra-orbital and the hepatic are missing. The eyestalks are swollen and, in the middle, are distinctly wider than the hemispherical cornea. The ocular spot is not visible.

[1] For references see Borradaile, *loc. cit.*, 1917, p. 358.

The lateral process of the antennular peduncle (text-fig. 10*a*) reaches about to the middle of the basal segment. The spine at the outer distal angle of the same segment is short and the margin between this spine and the articulation of the second segment is gently convex. The free portion of the shorter ramus of the outer antennular flagellum is only about one quarter the length of the fused basal part, the latter comprising 6 elongate segments. The antennal scale (text-fig. 10*b*) is narrow at the distal end and widest in the middle; its greatest breadth is a little less than one-third the total length. The outer margin is very slightly concave and terminates in a strong spine which reaches a little beyond the end of the lamella.



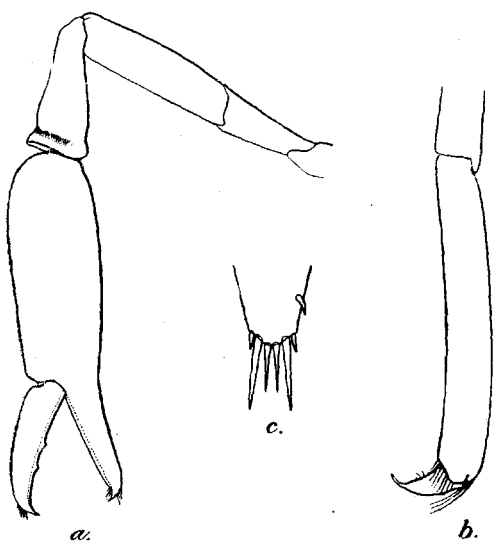
TEXT-FIG. 10.—*Palaemonella orientalis* Dana.
a. Antennule. *b*. Antennal scale.
c. Mandible.

The mandible (text-fig. 10*c*) resembles Dana's figure, but the palp consists only of a single segment, bearing a seta near the apex. The exopod of the third maxilliped reaches only a little beyond the end of the antepenultimate segment. The terminal segment is two-thirds the length of the penultimate. The first peraeopods reach about to the end of the antennal scale. The merus is equal in length with the carpus and about 1·2 times as long as the chela; the palm is a little swollen, and is fully 1·5 times as long as the fingers.

The second peraeopods (text-fig. 11*a*) are equal and reach beyond the scale by rather more than the entire length of the chela. The merus is stout, not more than 3·5 times as long as broad, about one-fifth longer than the carpus; it does not possess a spine at its distal end. The carpus is conical, less than 2·5 times as long as its distal breadth. Anteriorly, on the dorsal side, the carpus is feebly furrowed transversely and the distal margin is reflected outwards. The carpus is a little longer than the fingers and is rather less than two-thirds the length of the palm. The chela is massive; the palm is about 2·5 times as long as broad and is 1·75 times the length of the fingers. The tips of the latter are inturned and their inner margins have blade-like cutting edges; on the dactylus there are two small and obscure teeth.

The last three peraeopods are rather stout. The propodites (text-fig. 11*b*) are unarmed except for a spinule at the distal end of the posterior margin; they are from 4·5 to 5 times the length of the dactyli. The dactylus is broad at the base, simple, strongly curved and is partially concealed by long setae springing from the end of the propodus.

The appendix masculina on the endopod of the second pair of pleopods is fully formed; the specimen thus appears to be an adult male. The sixth abdominal somite is less than 1·5 times the length of the fifth. The telson has the usual three pairs of apical spines, but is unarmed on the dorsal surface except for a single spine on the right hand side placed quite close to the apex (text-fig. 11*c*).



TEXT-FIG. 11.—*Palaemonella orientalis* Dana.

a. Second peraeopod.
b. Last two segments of third peraeopod.
c. Tip of telson.

The single specimen is about 9 mm. in total length. In life it was completely transparent.

The specimen agrees almost exactly with Dana's description and differs but slightly from his figures. The principal discrepancies are that in the Indian specimen the mandibular palp is one-segmented, that the exopod of the third maxilliped does not reach so far beyond the end of the antepenultimate segment and that the second peraeopods are rather longer and a little more slender.

The specimens recorded by de Man differ more considerably. According to his description the first legs are much longer, with the carpus longer in relation to the chela. The second peraeopods are also much longer and the fingers bear teeth and are only half the length of the palm. The dactyli of the last three peraeopods are one-third the length of the propodus.

Dana gives the length of the adult female as 8 lines, while a male examined by de Man was 13 mm. in length; the Indian specimen is thus much smaller than any previously referred to the species.

C 353/1. Port Blair, Andamans. S. Kemp, March, 1915. One.

The specimen was obtained at low water on the reef at the northern end of Ross Island and was not associated with a crinoid.

Dana described *P. orientalis* from the Sooloo Sea. The specimens described by de Man were obtained on a crinoid at Amboina.

Genus **Periclimenes** Costa.

1831. *Pelias*, Roux, *Mém. sur les Salicoques*, p. 25 (*nom. praeocc.*).
1846. *Periclimenes*, Costa, *Cat. Crost. Napoli* (unpaged).
1852. *Anchistia*, Dana, *U. S. Explor. Exped., Crust.* I, p. 577.
1860. *Urocaris*, Stimpson, *Proc. Acad. Sci. Philadelphia*, p. 39.
1861. *Dennisia*, Norman, *Ann. Mag. Nat. Hist*, (3), VIII, p. 278.
1902. *Ancylocaris*, Schenkel, *Verhandl. naturf. Ges. Basel* XIII, p. 563.
1915. *Periclimenaeus* and *Periclimenes* with subgenera *Corniger*, *Cristiger* and *Falciger*, Borradaile, *Ann. Mag. Nat. Hist.* (8) XV, p. 207.
1916. *Periclimenes* subgenus *Hamiger*, Borradaile, *Brit. Antarct. Exped.* 1910, *Zool.* III, p. 87.
1917. *Urocaris*, *Ancyclocaris*, *Periclimenes* and subgenera, *Periclimenaeus*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, pp. 353 *et seq.*
1919. *Periclimenes*, subgenera *Laomenes* and *Cuapetes*, Clark, *Proc. Biol. Soc. Washington*, XXXII, p. 199.

In working through the collection of Pontoniinae in the Indian Museum I have reached conclusions regarding the limits of this genus which, as the above references show, differ widely from those expressed by Borradaile in his recent memoir. That *Anchistia* and *Dennisia* are synonymous with *Periclimenes* has long been well established, but the inclusion of other names in the same category requires explanation.

Almost at the beginning of my work I found the greatest difficulty in distinguishing the three genera *Urocaris*, *Ancylocaris* and *Periclimenes*, and it is evident from the literature that others have found themselves in the same position. In Borradaile's key (*loc. cit.*, 1917, p. 346) the three are placed under primary headings, distinguished for the most part by habit of body. Thus in *Urocaris*: "Body very slender and compressed. Sixth abdominal segment much elongate"; in *Ancylocaris*: "Body moderately stout, not compressed. Sixth abdominal segment short"; in *Periclimenes*: "Body never very slender, or much compressed. Sixth abdominal segment never much elongate." The large assemblage of species which these three genera comprise exhibits a very great range of variation in the form of the body and between the most slender and the stoutest every degree of transition can be found. On these grounds it is quite impossible to distinguish separate genera with any certainty. Borradaile himself is inconsistent, for in *P. parasiticus*, which he retains in the genus *Periclimenes*, the habit of body is extremely slender and the sixth abdominal somite

is decidedly longer than in nearly all the species referred to *Urocaris*.

It remains to be seen whether there are any other characters which will justify the retention of *Urocaris* and *Ancylocaris* as separate genera. The type of Stimpson's *Urocaris* is *U. longicaudatus*, from the West Indies. In this species, as in *P. scriptus* (Risso), the type of Costa's *Periclimenes*, the last three peraeopods have biunguiculate dactyli. Several Indo-Pacific species are closely allied to *U. longicaudatus*, but the latter does not possess the antennal spine of the carapace which is present without exception in all other species hitherto referred to *Urocaris*, *Ancylocaris* and *Periclimenes*. On the closest examination and comparison it does not seem possible to separate a group of species to which the name *Urocaris* can be applied and, if the genus is to be retained, it must be monotypic and characterized solely by the absence of the antennal spine of the carapace. It is very difficult to assess the value of a unique character of this kind; but in view of the clear affinity which exists between *U. longicaudatus* and various other species I am of the opinion that *Urocaris* should be regarded as a synonym of *Periclimenes*. An illustration of the impossibility of distinguishing between *Urocaris* and *Periclimenes*, as usually applied, is to be found in a recent paper by Balss, in which the type of the latter genus is redescribed as a new species of the former.

Ancylocaris was erected by Schenkel for a species, *A. brevicarpalis*, which is now known to be commensal with giant anemones of the genus *Discosoma*. The same species has since been described under a variety of specific names; it was referred to the genus *Palaemonella* by Nobili, to *Harpilius* by Lenz, and to *Periclimenes* by Miss Rathbun. It will be seen from Borradaile's key that *Ancylocaris* in reality differs from *Periclimenes* in only one character —that the carapace of the female is strongly swollen dorsally. This feature is well developed only in large females and a slight swelling of the carapace is not infrequently seen in normal *Periclimenes*. Moreover, in a species described in this paper which is also commensal with *Discosoma*, the carapace is not at all swollen, though in all other respects it shows an extremely close affinity wih *A. brevicarpalis*. There is thus clear proof that the swollen carapace of the female in *A. brevicarpalis* is not a character of generic value. As will be seen further on, the name *Ancylocaris* may be employed in a new sense for a subgenus of *Periclimenes*.

It may here be pointed out that the extent to which the outer antennular flagellum is cleft—a character to which Borradaile attributes importance—cannot be used, at any rate in the *Periclimenes* group, for the separation of genera. In *Periclimenes* there is a small and rather clearly defined group of species inhabiting water of moderate or great depth and the four known representatives of this group agree among themselves even in a peculiar disposition of teeth in the second pair of chelae. In two of them (*P. latipollex* and *P. laccadivensis*) the outer antennular flagellum is

deeply cleft, with the free portion of the shorter ramus longer than the fused basal part: in a third (*P. lanipes*) the free portion is slightly shorter than the fused part: in the fourth (*P. alcocki*) the flagellum is scarcely cleft at all, the free portion of the shorter ramus being less than one-third the length of the fused basal part.

Urocaris and *Ancylocaris* are thus, in my opinion, to be regarded as synonyms of *Periclimenes*.

As regards the subdivision of the large assemblage of forms included in the genus, it will be observed that Borradaile in 1915 proposed four subgenera, *Ensiger*, *Corniger*, *Cristiger* and *Falciger* and in 1916 added a fifth, *Hamiger*. Two of these terms are preoccupied as genera, and Mr. Austin H. Clark, who does not seem hitherto to have interested himself in carcinology, has felt it necessary to substitute others.

The subgenus *Ensiger* includes only Dana's *Anchistia aurantiaca*, a species of doubtful affinity which has not been examined since 1852. From the original account it is not even certain that the species belongs to the subfamily Pontoniinae, for the telson is described as "a little hairy at tip, with two short spines." Any decision as to the proper position of *Ensiger* must therefore be postponed until the type-species has been rediscovered.

Borradaile refers the great majority of the species which he includes in *Periclimenes* to the subgenera *Cristiger* and *Falciger*. He separates the two (*loc cit.*, 1917, p. 360) by a number of features, but it will be seen that the only absolute criterion for their discrimination lies in the form of the rostrum, which is stated to be convex in the former and straight or concave in the latter. This character is one of very little value. In determining the specimens in the Indian Museum I have made every endeavour to separate the species on the lines which Borradaile advocates, but have been forced to the conclusion that the division he recommends, even if it were possible in practice, tends only to obscure the real affinities of the species. The two Mediterranean species, *P. amethysteus* and *P. scriptus*, are so far as I am aware distinguished from one another only by colour, yet Borradaile refers the former to the subgenus *Falciger* and the latter to *Cristiger*.

The subgenus *Hamiger* is without doubt synonymous with *Periclimenaeus*, the position of which is discussed below.

To the curious little group of species in which the cornea is conoidal and pointed anteriorly Borradaile has applied the subgeneric name *Corniger*; but the character, though an interesting one, does not in my opinion, possess the importance that he attributes to it. In the collection on which this paper is based I have found one specimen with a conoidal cornea; but though in this respect it resembles the forms that Borradaile refers to *Corniger*, it is otherwise very different, for it possesses neither hepatic nor supra-orbital spines. It is unfortunately impossible to draw up a specific description from this individual, as it is without locality and is much damaged, possessing only the first pair of legs. The existence of such a form seems, however, to indicate that the

species with a conoidal cornea do not necessarily form a natural group.

Elsewhere in the genus *Periclimenes* other modifications of the eye are sometimes found. In *P. seychellensis* there is a papilla on the eyestalk and in two of the three species of *Periclimenaeus* the cornea has a circular cup-shaped depression. The evidence we possess at present tends to show that the structure of the eye, when unsupported by other characters, does not afford a valid basis for subgeneric division.

For these reasons I am unable to accept the subgenera proposed by Borradaile. I recommend instead an arrangement in which the primary division is based on the structure of the dactyli of the last three pairs of peraeopods, whether simple or with an accessory lobe or claw. The structure of the dactyli in these limbs is of generic importance in the more highly specialized Pontoniinae and the character is of established value in other Caridea.

Whether the arrangement leads to a natural grouping of the species on a phylogenetic basis, is a question that cannot be answered in the present state of our knowledge. I incline to the view that it does. In some species, however, the additional dactylar claw is reduced to a mere process or lobe,[1] and there is thus a possibility that certain specialized species in which the dactylus is simple may have been derived from forms in which it was once biunguiculate.[2]

In *P. scriptus*, the type-species of *Periclimenes*, the dactyli are biunguiculate, and the subgenus to which this species belongs may thus be termed *Periclimenes s.s.* For the more primitive forms with simple dactylus Schenkel's *Ancylocaris* may be employed, though in a different sense to that in which it has hitherto been used.

Borradaile's *Periclimenaeus*, of which his *Periclimenes* subgen. *Hamiger* is a synonym, is at most a subgenus of *Periclimenes*. In the three known species the dactyli of the hinder peraeopods are biunguiculate, thus resembling *Periclimenes s.s.*, but the hepatic spine of the carapace, which is invariably present in the latter, is here absent. The chelae of the second peraeopods are more massive in *Periclimenaeus* than in *Periclimenes s.s.*, though the species of the latter subgenus exhibit a very great range of variation in this respect.

The characters of the three subgenera that I propose may be summarized thus:—

Dactyli of last three peraeopods biunguiculate or with an accessory process or lobe behind terminal claw.	[139.
Hepatic spine present	*Periclimenes s.s.*, p.
Hepatic spine absent	*Periclimenaeus*, p. 166.
Dactyli of last three peraeopods simple [Hepatic spine usually present]	*Ancylocaris*, p. 167.

[1] e.g., *Periclimenes rex* and *P. noverca*.
[2] Of this *P. frater* is perhaps an example.

Under the subgeneric headings synoptic tables to the majority of the known species will be found. In *Periclimenes s.s.* 20 species are recognised, in *Periclimenaeus* 3 species and in *Ancylocaris* 44 species. The following are omitted from these tables:—

Anchistia aurantiaca Dana, *U. S. Explor. Exped., Crust.* I, p. 581, pl. xxxviii, figs. *2a–d* (1852).

The generic position of this species is very doubtful and it is not certain that it belongs to the Pontoniinae. The mouth-parts have apparently not been examined and the telson is described as "a little hairy at tip, with two short spinules." Dana's specimens were found at the Fiji Is.

Anchistia danae Stimpson, *Proc. Acad. Sci. Philadelphia*, 1860, p. 108.

This species, from Tahiti, will probably never be recognized with certainty. There is no description of the second peraeopods and it is uncertain whether the posterior dactyli are simple or biunguiculate. The specimens doubtfully referred to this species by Borradaile[1] perhaps belong to the *P. grandis* section of *Ancylocaris*, but the description is insufficient.

Anchistia brachiata Stimpson, *loc. cit. supra*, p. 108.

Found at Port Lloyd in the Bonin Is. There is no description of the last three peraeopods.

Anchistia notata Heller, *Crust. 'Novara' Exped.*, p. 109, pl. x, fig. 3 (1865).

Described from a specimen without the second peraeopods obtained at the Nicobars.

Periclimenes parasiticus Borradaile, *Ann. Mag. Nat. Hist.* (7) II, p. 384 (1898) and in Willey's *Zool. Results*, p. 407, pl. xxxvi, fig. 4 (1899); Nobili, *Ann. Mus. civ. Genova* (2) XX, p. 235 (1899).

The description of this species is most inadequate. I examined the type-specimens in the Cambridge Museum, but found that all the legs were missing except those of the first pair. The species was found at New Britain on a black starfish belonging to the genus *Linckia*.

Periclimenes hertwigi and *gorgonidarum* Balss, *Abhandl. math.-phys. Kl. K. bayer. Akad. Wiss.* Suppl. Bd. II, pp. 49-52, text-figs. 28-32 (1914).

Further particulars of these two remarkable species are required before their position can be determined. It is possible, as Borradaile has remarked, that they do not belong to the Pontoniinae.

[1] Borradaile, *Proc. Zool. Soc. London*, 1898, p. 1004, pl. lxiii, figs. 4, 4*a*, *b*.

Periclimenes beaufortensis Borradaile, *Ann. Mag. Nat. Hist.* (9) V, p. 132 (1920).

According to the description this species does not possess exopods on the second and third maxillipeds. It cannot therefore be retained in the genus *Periclimenes*, but belongs in all probability to *Pontonides* (see p. 266).

Periclimenes tenuipes Leach.

Nobili's statement that Leach described a Mediterranean species under this name is erroneous (*v. infra*, p. 223).

Subgenus **Periclimenes**, *sensu stricto.*

The accessory claw or process found on the dactyli of the last three peraeopods in this subgenus is, I presume, to be regarded as a sign of specialization; *Periclimenes s.s.* is thus less primitive than *Ancylocaris*.

The species included in the subgenus exhibit great variation in habit of body. Some, such as *P. longicaudatus* are extremely slender in build, while others, such as *P. lanipes*, are remarkably stout. *P. scriptus*, the type of the subgenus, is intermediate in form, without any strongly marked characters, and it appears to me probable that it is from some such species as this that the remainder have evolved.

P. latipollex, *P. laccadivensis*, *P. alcocki* and *P. lanipes* form a rather distinct section of the subgenus, distinguished by the tooth and socket arrangement in the dentition of the fingers of the second leg. *P. soror* and *P. noverca* differ from all other species of the subgenus in the possession of a series of fine teeth on the edges of the fingers of the first leg. In this they resemble *P. spiniferus*, *P. petitthouarsi* and *P. denticulatus*,[1] which belong to the subgenus *Ancylocaris*. I think it most improbable that there is any real affinity between these two groups of species and regard the similarity in structure of the fingers of the first leg as an instance of convergence.

Certain species possess characters which are unique in the genus: *P. longicaudatus* has no antennal spine, *P. aesopius* has a large compressed tooth on the third abdominal somite and in *P. investigatoris* the lateral process of the antennule is of abnormal length.

[1] The same character is also found in *P. frater*. Borradaile considers this species to be a close ally of *P. soror*, but the dactylus is said to be simple and I have consequently included it in the subgenus *Ancylocaris*. In *P. noverca* the accessory claw of the dactylus is reduced to a mere lobe and it is easy to understand how this lobe might disappear altogether by further modification along the same lines. If Borradaile's views on the relationships of *P. frater* are correct, the species has presumably been evolved from one with biunguiculate dactyli and has no affinity with the more primitive forms included in the subgenus *Ancylocaris*. The position of the species thus requires further consideration.

Key to the species of the subgenus *Periclimenes*.

A. Supra-orbital spine absent.
  B. Antennal spine absent; R. 7–8 : 1–2 ... *longicaudatus* (Stimpson).

  B'. Antennal spine present.
    C. Third abdominal somite produced backwards over fourth in the form of a large compressed tooth; R. 9–11 : 2 ... ... *aesopius* (Bate).
    C'. Third abdominal somite little produced posteriorly.
      D. Fingers of chela of first leg unarmed.
        E. Lateral process of antennular peduncle of normal length, not reaching beyond middle of basal segment.
          F. Second leg with carpus more than one-third length of palm.
            G. One or more upper rostral teeth situated on carapace behind posterior limit of orbit.
              H. Dactylus of last three legs slender, at least 4 times as long as broad.
                J. Posterior dorsal tooth of rostrum separated from next by a wide interval; carpus of second leg much more than half as long as palm.
                  K. Upper border of rostrum very strongly arched, with ventral teeth placed close to apex below or in advance of foremost dorsal tooth; fingers of second leg as long as palm.
                    R. 6–8 : 1–2 ... ... *infraspinis* (Rathbun).
                    R. 9–11 : 1–3 ... ... *indicus* (Kemp).
                  K'. Upper border of rostrum only a little convex, with ventral teeth placed behind foremost of dorsal series; fingers of second leg usually shorter than palm; R. 7–10 : 1–2 ... ... *obscurus*, sp. nov.
                J'. Posterior dorsal tooth of rostrum not separated from second by a wider interval than that between second and third, carpus of second leg about half as long as palm.
                  K. Abdomen transversely banded and blotched with red; R. 8–10 : 2–4 ... ... *scriptus* (Risso).
                  K'. Abdomen longitudinally striped with violet; R. 8 : 4 ... *amethysteus* (Risso).
              H'. Dactylus of last three legs stout, less than 4 times as long as broad [posterior dorsal tooth of rostrum not separated from second by a wider interval than that between second and third]; R. 9 : 2 ... ... *impar*, sp. nov.
            G'. No teeth of upper rostral series situated on carapace behind orbit.
              H. Rostrum deep, downcurved; apex of antennal scale broadly rounded; R. 6 : 1 ... ... *parvus* Borr.
              H'. Rostrum shallow, straight; apex of antennal scale sharply rounded; R. 6 : 1 ... ... *incertus* Borr.

F'. Second leg with carpus one-third or less than one-third length of palm.
G. Rostrum with at most 10 dorsal teeth.
H. Fingers of second leg more than half as long as palm, ? without teeth on inner margins [merus of second leg with tooth at end of lower border]; R. 6 : 1 ... ... *gracilis* (Dana).
H'. Fingers of second leg half or less than half as long as palm, dactylus with a tooth fitting into a cavity in fixed finger.
J. Rostrum straight or upturned; merus of second leg unarmed; last three legs slender with merus unarmed and without thick hair.
K. Fused portion of outer antennular flagellum short; second legs smooth; two pairs of spines on back of telson.
L. Hepatic spine on a level with antennal; dactylus of second leg flanged externally; R. 7–8 : 2–3 ... ... *latipollex*, sp. nov.
L'. Hepatic spine below level of antennal; dactylus of second leg not flanged externally; R. 10 : 2–3 ... ... *laccadivensis* (Alc. and And.).
K'. Fused portion of outer antennular flagellum very long; second legs minutely tuberculate; four pairs of spines on back of telson; R. 9 : 3 ... .. *alcocki*, sp. nov.
J'. Rostrum downcurved; merus of second leg with tooth at end of lower border; last three legs stout, inferior margin of merus with spinules and distal tooth, propodus densely clothed with hair; R. 8–9 : 0–1 ... ... *lanipes*, sp. nov.
G'. Rostrum with 23 dorsal teeth, lower border unarmed ... .. *rex*, sp. nov.
E'. Lateral process of antennular peduncle abnormally long, reaching distal end of basal segment; R. 9 : 1 ... ... *investigatoris*, sp. nov.
D'. Each finger of chela of first leg with inner margin finely pectinate.
E. Second leg with merus unarmed and fingers one-third length of palm; no tooth at distal end of merus of last three legs; R. 11–13 : 0 ... ... *soror* Nobili.
E'. Second leg with merus armed with a tooth at distal end of lower border and with fingers more than half as long as palm, a tooth at distal end of merus of last three legs; R. 7 : 0 ... ... *noverca*, sp. nov.
A'. Supra-orbital spine present; R. 5 : 2... ... *commensalis* Borr.

Periclimenes (Periclimenes) longicaudatus (Stimpson).

1860. *Urocaris longicaudatus*, Stimpson, *Proc. Acad. Sci. Philadelphia*, p. 39.

1900. *Urocaris longicaudata*, Rathbun, *Proc. Washington Acad. Sci.* II, p. 155.
1902. *Urocaris longicaudata*, Rathbun, *Bull. U. S. Fish Comm.* XX, ii, p. 126.
1918. *Urocaris longicaudata*, Hay and Shere, *Bull. U. S. Bur. Fisheries* XXXV, p. 394.

This species, which is the type of Stimpson's genus *Urocaris*, inhabits the West Indies and the adjacent coasts of America as far south as Brazil. The specimens I have examined are from Punta Rassa in Florida.

The anterior margin of the carapace, immediately below the orbit, projects in the form of a long strap-shaped process with rounded apex. This projection is homologous with the less prominent infra-orbital lobe found in many related species and is imperfectly described by Miss Rathbun (*loc. cit.*, 1902) as a 'rounded extra-orbital tooth.' The antennal spine which usually arises from the vicinity of the lower limit of the infra-orbital lobe is completely absent in *P. longicaudatus*, though it appears to be present in all other known representatives of the subgenus *Periclimenes*.

Periclimenes aesopius (Spence Bate).

1864. *Anchistia aesopia*, Spence Bate, *Proc. Zool. Soc. London*, 1863, p. 502, pl. xli, fig. 5.
1917. *Urocaris aesopius*, Borradaile, *Trans. Linn. Soc.* (2) *Zool.* XVII, p. 354.

Through the kindness of the authorities of the British Museum I have been able to examine the types of this remarkable species which has apparently not been rediscovered during the past fifty years. There are two specimens, one complete and one which has been dissected and is in a fragmentary condition.

The rostrum is slender and straight, with the ventral portion below the midrib greatly reduced. On the upper margin there are 9 or 11 teeth, the three hindmost placed on the carapace behind the orbit. On the lower margin there are two small teeth near the apex and behind these teeth a fringe of very long plumose setae.

The carapace is prominently angled below the orbit. There are antennal and hepatic spines, the latter on a lower level than the former.[1] The eyes are slender, with stalk fully twice the length of the cornea. The lateral process of the antennule is short, not reaching the middle of the basal peduncular segment. The anterior margin of this segment external to the insertion of the second segment is greatly produced, as shown in Bate's figure, reaching the end of the second segment and extending far beyond the spine that terminates the outer margin. The antennal scale is unusually broad distally; it is about two and a half times as long as wide, with the terminal spine not reaching the end of the lamella.

[1] The position given to these spines in Spence Bate's figure is erroneous.