BOPYRID ISOPODS PARASITIC ON INDIAN DECAPODA MACRURA.

By B. CHOPRA, *M.Sc., Assistant Superintendent, Zoological Survey of India, Calcutta.*

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INTRODUCTION.

Practically nothing has so far been published on the Bopyrid Isopods of the Indian Empire and very little on those of the neighbouring countries. The members of this group are, however, comparatively common in Indian waters and their presence is quite noteworthy, since almost all the species of Caridean prawns generally available in the Calcutta markets are infected with them. Not only is the fauna rich in number of species, but the number of individuals, of some of the species, at any rate, is large. This is especially so with some of the forms living in the Gangetic Delta, and I am informed by Dr. Baini Prashad of the Zoological Survey of India, who recently made collections in those parts that the proportion of infected prawns of some species is very large. In fact it was the apparent abundance of these parasites on the common species of prawns that led Dr. Prashad to suggest to me the study of this interesting group.

I am greatly indebted to Dr. S.W. Kemp, Superintendent, Zoological Survey of India, for the very great help that I have received from him

in the course of my work. He has very kindly named most of the hosts, and this in some cases, in spite of his expert knowledge of the subject, has been a matter of considerable difficulty. The valuable information that he has given me regarding the affinities and distribution of Indian and certain extra-Indian Decapoda has been of great help to me in discussing the distribution of Indian Bopyrids, and to some extent, in understanding their relationships. He has spared neither time nor trouble in answering my numerous queries, and has always been ready to place his extensive knowledge of the Decapoda at my disposal. He has also gone through the manuscript with me, and has made several valuable suggestions. For all this I owe him my best thanks.

Professor M. Caullery of Paris has kindly sent me in exchange a number of Bopyrids belonging, chiefly, to MM. Giard and Bonnier's valuable collection, and has very generously lent me for examination other specimens of which he possessed no duplicates. I am also indebted to Dr. W. T. Calman of the British Museum for representatives of some of the British species. This material has been of great help to me in determination of the Indian forms.

Most of the collection dealt with in this paper has been made at different times by the officers of the Zoological Survey, chiefly by Dr. Kemp, but among others must be mentioned the names of the late Mr. J. Wood-Mason, Col. A. Alcock, Mr. R. F. Lowis and Mr. T. Southwell, all of whom obtained material which has proved of value.

Most of the illustrations of this paper have been prepared by Babu A. C. Chowdhury, one of the able artists of the Zoological Survey of India, and myself jointly. The care which the artist has taken in this work, and the fidelity of his delineation will, I feel, add considerably to the value of this paper. Some of the more difficult drawings, especially those showing the entire females, have been made by the artist alone.

Under the somewhat loose term "Indian Macrura" I include the members of the tribes Penaeidea and Caridea, which have been found not only in the inland and coastal waters of India proper, but also further out in the Arabian Sea and the Bay of Bengal, while one of the hosts was obtained as far afield as Peninsular Siam. The present work is not intended as a complete account of the Indian Bopyridae, not even of those that live on Macrura. I have only dealt with the forms that have from time to time been acquired by the Zoological Survey, and are preserved in the collections of the Indian Museum. Both the named and the unnamed collections of Macrura have been searched for specimens. The parasites of the Brachyura and the Anomura have not been dealt with at all, and in the Macrura the parasites of Caridea only have been studied with any degree of thoroughness, for Bopyrids on Penaeidea seem to be very rare.

In the terminology of the various parts the most commonly used descriptive terms only have been employed. In describing the thoracic legs I have referred to the six segments as the basis, ischium, merus, carpus, propodus, and dactylus purely for the sake of convenience; it must not be thought that by such application any homology with the Decapod limb is intended. In spite of the lucid exposition of MM. Giard and Bonnier (1887*b*, pp. 31-35) the precise relationship between the

segments composing the thoracic leg in Bopyridae and in other Malacostraca is still doubtful. Similarly I have called the lateral parts of the thoracic and abdominal somites the pleura or the epimera only because these are the most commonly used terms.[1]

Analytical keys have been provided in almost all cases to facilitate the identification of genera and species. They usually embrace all the known species, but in one or two instances it has only been possible to include those from the Indo-Pacific.

A bibliography has been given at the end of the paper, but is not intended to be a complete enumeration of all references to the subject. For additional titles the reader is referred to the bibliographies given by Bonnier (1900) and Miss Richardson (1905).

All the type-specimens are the property of the Zoological Survey of India and are preserved in the collections of the Indian Museum at Calcutta.

SUMMARY OF PREVIOUS WORK ON THE SUBJECT.

The history of our knowledge of the Indo-Pacific Bopyridae is nota long one. From India proper only one species has hitherto been recorded under the name of *Portunicepon hendersoni* Giard and Bonnier (1888). It is a parasite of a crab, *Thalamita callianassa* Herbst, and was collected at Madras. Though the Bopyrid fauna of India has thus remained almost unknown, that of the islands forming the Malay Archipelago has received a great deal of attention at the hands of several eminent zoologists. Semper in 1880 described a parasite from the Philippines, which later (1888) served as the type of a new genus, *Probopyrus*, formed by Giard and Bonnier. These two famous French carcinologists, who have made a special study of the group, have dealt with a number of Malayan forms also. In 1888 they described two genera from these parts, one of which they called *Palaegyge*, while the other, *Probopyrus*, was based on Semper's *Bopyrus ascendens*. Bate (1888) recorded from the Philippines an undetermined species of *Hemiarthrus* G. & B. (= *Phryxus* Rathke) which had been collected by the Challenger Expedition. Weber (1892) in his *Zool. Ergeb. Niederland. Ost-Ind.* besides recording some already known forms, described a number of new species chiefly belonging to Giard and Bonnier's genera. Bonnier (1900) in his well-known monograph on the family gave a descriptive account of all the known Malayan species, and also described some new forms, based, for the most part, on material that Weber had already examined. He also described a new genus, *Bopyrella*. Nobili (1906a) described from Singapore a species of *Orbione*, a genus that Bonnier had already set up to accommodate two species, one from Hongkong and the other from Madagascar. Recently (1911) Horst has described a new species of *Palaegyge* from Java. Quite lately a valuable addition to our knowledge of the Indo-Pacific Epicaridea has been made by the publication of Nierstrasz and Brandis's (1923) report on the Siboga Expedition Epicarids. My comments on this publication are given in the addendum at the end of this memoir (p. 538).

[1] The lateral parts of the thoracic somites have been referred to as coxal plates by Nierstrasz and Brandis (1923). See addendum, pp. 538, 539

Of species known from the Western part of the Indo-Pacific region, Duvernoy, as early as 1841, described his *Kepon typus* (=*Cepon typus* of later writers), a parasite of a crab from Mauritius, while Kossmann in 1880 proposed the name of *Gigantione moebii* for another crab-parasite from the same island. Bonnier, as mentioned above, obtained a parasite from Madagascar, which he doubtfully referred to *Orbione*. Lastly, Stebbing in several papers (1902, 1904, 1908, 1910) has described a number of forms from the eastern coast of South Africa and different places in the Indian Ocean. A large number of the species dealt with by Stebbing were hitherto undescribed and some are referred to new genera.

Of works dealing with the Bopyrid fauna of places eastwards of the Malay Archipelago must be mentioned Miss Richardson's (1905) monograph on North American Isopods, and some of her later publications which deal with forms obtained in Japanese Seas. As already mentioned, Bonnier's genotype of *Orbione*, *O. penei*, had come from Hongkong, and later (1910) Miss Richardson referred a specimen to the same species which had been collected further south. Finally, Thielemann (1910) described from Japan a new species of Nobili's *Epipenaeon*, which had hitherto been known only from the Red Sea.

Of publications not dealing exclusively with Indo-Pacific forms Bonnier's monograph cited above will be found indispensable to all workers on this group of Isopods. Sars' (1899) valuable account in his Crustacea of Norway, and Miss Richardson's monograph, mentioned above, will also be found very useful.

List of Indian Species.

A very large number of Bopyrids are parasitic on Indian Macrurous Decapoda. The collection I have studied shows that there are at least thirty-three species belonging to thirteen different genera. As is to be expected in the case of highly specialized parasites such as Bopyrids, most of the forms found in Indian waters represent species hitherto unknown; and I have felt it necessary to add two new genera to a family in which, as Stebbing puts it, "the genera are already rather perplexingly numerous."

The genus *Argeia* Dana, hitherto known from two species, is represented in the Indian fauna by a new species. *Bopyrella* Bonnier (including *Synsynella* Hay) was so far known from two good species only. Besides the genotype, which lives in these waters, the genus has two other representatives living in the region under discussion—one a local race of an Atlantic form, and the other a new species. In Kossmann's *Bopyrina* six valid species were known, besides one or two others of which no adequate descriptions were available. In India I have been able to recognise five species, four new and one of those previously recorded from Europe. Stimpson's *Bopyroides*, which was so far known from a single species only, has another representative living in our waters. Latreille's *Bopyrus*, the oldest genus of the family, so far known from a single species, is represented in the Indian fauna by a new form which I provisionally regard as a variety of the European species. Nobili's *Epipenaeon* has hitherto included only two species; to these one new form is added. Giard and Bonnier's *Hemiarthrus* (a name which must be employed for the species generally included under *Phryxus*) has quite a number of representatives living in Indian seas. Three species and a variety have been named and described as new, and another form, also probably new, is represented by insufficient material. The type-species of Richardson's *Diplophryxus* also lives in Indian waters. Two species of Bonnier's *Orbione* have been met with, of which one has been described as new. Of the eight already known good species of Giard and Bonnier's *Palaegyge* two have been met with in Indian estuaries, and seven new forms have been described. To *Probopyrus*, so far known from six valid species, two new members are added.

Of the two new genera, *Parapleurocrypta*, as its name indicates, is thought to be a near ally of *Pleurocrypta* Hesse, and is represented in the Indian fauna by a single species. The other, *Stegoalpheon*, resembles the American genera *Stegophryxus* Thompson and *Stegias* Richardson in having triramous pleopods in the female. This genus also is described from a single species.

I have also suggested that the species referred by Gissler (1882) to *Bopyroides*, together with two Indian forms, probably represent an undescribed genus. I have not, however, formed a new genus for them, as the only specimens I have examined are in an unsatisfactory condition.

A table showing the names of all the Indian species with those of their hosts, and the localities from which they were obtained, together with notes on the generic distribution is given[1] on pp. 416, 417.

Hosts.

The names of the Bopyrids I have examined are given in the accompanying list. It will be seen that in several cases it has only been possible to identify the hosts approximately. This is due to the fact that the Indian species of some of the families to which the hosts belong have not as yet been worked out taxonomically with any degree of thoroughness. This is especially the case with the genus *Palaemon*. A large number of species, in *Palaemon* at any rate, are named only approximately or not at all; of these some at least are undescribed. Dr. Kemp is, however, shortly undertaking work on this genus, and it is hoped it will be possible to give the correct specific names when that work is accomplished. Specimens of this genus parasitized by Bopyrids are difficult to identify owing to the fact that the parasite inhibits sexual activity and prevents the full manifestation of secondary sexual characters. The second legs of males seem never to reach their full development, and females never carry eggs.

A large number of species have been found living on members of the families Palaemonidae and Alpheidae, on *Palaemon* in the first family, and *Alpheus* and *Synalpheus* in the other. The number of individuals of almost all the species living on Palaemons is in most cases quite large

[1] In view of the recent Siboga Report (Nierstrasz and Brandis, 1923) the range of several genera has now been considerably extended, as also a number of new host-genera has been added to the list of already known hosts.

Name of parasite.	Name of host.	Locality.	Remarks.
Hemiarthrus nigrocinctus, sp. nov.	*Periclimenes elegans* Paulson ...	Port Blair, Andaman Is. ...	Genus so far known to infest several families, *viz.*, Hippolytidae (*Hippolyte* and *Spirontocaris*), Pandalidae (*Pandalus*), Nematocarcinidae (*Nematocarcinus*), Palaemonidae (*Typton*), Alpheidae (*Alpheus*, *Synalpheus* and *Athanas*) and Processidae (*Processa*). Genus common in Europe and along both coasts of America. A single species recorded from Africa and one from Philippines. Indian forms resemble *H. subcaudalis* (Hay), known only from Atlantic coast of North America.
Hemiarthrus filiformis, sp. nov. ...	*Alpheus paralcyone* Coutière ...	Port Blair Andaman Is.
do. var. *attenuata*, nov. ...	*Alpheus paralcyone* Coutière ...	Port Blair, Andaman Is.
Hemiarthrus brevicauda, sp. nov. ...	*Synalpheus* prox. *theophane* de Man	Port Blair, Andaman Is.
Hemiarthrus (?) sp.	*Processa* sp.	Kilakarai, Gulf of Manaar
Diplophryxus jordani Richardson	*Leander serrifer* Stimpson ...	Una Island, Mergui Archipelago	Genus known from a single species, hitherto recorded as a parasite of *Leander serrifer* from Japan.
Orbione kempi, sp. nov. ...	*Sicyonia bispinosa* de Haan ...	Port Blair, Andaman Is. ...	Genus restricted to Penaeidae (*Penaeus* and *Metapenaeus*) and hitherto recorded only from Madagascar, Singapore and Hongkong.
Orbione sp.	*Processa* sp.	Pearl Banks, Ceylon.
Epipenaeon elegans, sp. nov. ...	*Penaeus carinatus* Dana ...	Delta of the Ganges ...	Genus known to live on *Penaeus* only and hitherto recorded from the Red Sea and Japan.
Parapleurocrypta alphei, gen. et sp. nov.	*Synalpheus* prox. *hululensis* Coutière	Part Blair, Andaman Is.	
Stegoalpheon kempi, gen. et sp. nov.	*Alpheus* prox. *crassimanus* Heller	Waltair, Bay of Bengal; Port Blair; Andaman Is.	
Bopyrella thomsoni Bonnier ...	*Alpheus* prox. *audouini* Coutière	Port Blair, Andaman Is. ...	All species hitherto known to live on Alpheidae; *B. thomsoni* recorded from Amis Islands Oceania, on *Alpheus strenuus* Dana; *B. deformans* (type form) from Atlantic Coast of North America on *Synalpheus longicarpus* (Herrick).
Bopyrella deformans (Hay), var. *indica*, nov.	*Synalpheus hululensis* Coutière ...	Karachi, Madras.
	Synalpheus nilandensis Coutière	N. E. of Ceylon.
Bopyrella hodgarti, sp. nov. ...	*Alpheus crassimanus* Heller ...	Waltair, Bay of Bengal.
Argeia lowisi, sp. nov. ...	*Alpheus* prox. *euphrosyne* Coutière	Port Blair, Andaman Is. ...	Genus hitherto known to infest Crangonidae (*Crangon*, *Nectocrangon* and *Sclerocrangon*), and recorded only from Pacific Coast of North America and Japan.

Palaegyge prashadi, sp. nov. ...	*Palaemon lamarrei*, Milne-Edwards	Delta of the Ganges ...	Genus so far found only on *Palaemon*. All known species (except a doubtful form from Atlantic Coast of North America) recorded from Malay Archipelago in freshwater. Indian species mostly estuarine. *P. demani* lives in Sumatra on *Palaemon pilimanus* de Man; *P. buitendijki* lives in Java on the same host as it does in India.
	? *Palaemon dayanus* Henderson	Delta of the Ganges.
Palaegyge buitendijki Horst ...	*Palaemon carcinus* Fabricius ...	Delta of the Ganges.
Palaegyge brachysoma, sp. nov. ...	*Palaemon mirabilis* Kemp ...	Delta of the Ganges.
	Palaemon prox. *scabriculus* Heller.	Delta of the Ganges.
Palaegyge godaveriensis, sp. nov. ...	*Palaemon* prox. *scabriculus* Heller	Delta of the Godaveri.
Palaegyge alcocki, sp. nov. ...	*Palaemon* prox. *malcolmsoni* Milne-Edwards.	Deltas of the Ganges and the Godaveri; and the Kistna River.
Palaegyge abhoyai, sp. nov. ...	*Palaemon* sp.	Delta of the Ganges.
Palaegyge demani Weber ...	*Palaemon* sp.	Delta of the Godaveri.
Palaegyge bengalensis, sp. nov. ...	*Palaemon malcolmsoni* Milne-Edwards.	Delta of the Ganges.
Palaegyge pica, sp. nov. ...	*Leander potamiscus* Kemp ...	Sanguem River, Portuguese India.
Probopyrus annandalei, sp. nov. ...	Young *Palaemon*, probably *P. sundaicus*, Heller.	Tale Sap, Siam	Genus known to live on *Palaemon* and *Palaemonetes* in the Malay Archipelago and on Atlantic Coast of North America. Indian species are estuarine, those in Malaysia occur in fresh water only.
Probopyrus gangeticus, sp. nov. ...	*Palaemon* sp.	Delta of the Ganges.	
Bopyrus squillarum Latreille, var. *bimaculatus*, nov.	*Leander styliferus* Milne-Edwards	Delta of the Ganges ...	Genus known to live only on *Leander* in almost all the seas of Europe, chiefly in the Mediterranean. *B. squillarum* not hitherto recorded as parasite of *L. styliferus*.
	Leander sp.	Jack and Una Islands, Mergui Archipelago.
Bopyrina andamanica, sp. nov. ...	*Periclimenes elegans* Paulson ...	Port Blair, Andaman Is. ...	All the hitherto known species infest Hippolytidae except *B. urocaridis* Richardson found on *Periclimenes*. Genus so far recorded only from British Isles, Mediterranean and Atlantic Coast of North America. *B. giardi* previously known from British Isles and Mediterranean.
Bopyrina kossmanni, sp. nov. ...	*Periclimenes elegans* Paulson ...	Port Blair, Andaman Is.
Bopyrina cochinensis, sp. nov. ...	*Periclimenes grandis* Stimpson ...	Cochin backwaters.
Bopyrina gracilis, sp. nov. ...	*Urocaridella gracilis* Borradaile ...	Port Blair, Andaman Is.
Bopyrina giardi Bonnier ...	*Hippolyte ventricosus* Milne-Edwards.	Port Blair, Andaman Is.
Bopyroides wood-masoni, sp. nov.	*Synalpheus* prox. *neomeris* (de Man).	Port Blair, Andaman Is. ...	Genus so far known to live on Pandalidae (*Pandalus* and *Pandalopsis*) and Hippolitidae (*Spirontocaris*). Found in several localities in the Atlantic, on the Pacific Coast of North America and in Japan.

and in some of the collections made in streams of the Gangetic Delta the number of infected prawns exceeds that of the normal ones. In *Alpheus* and *Synalpheus*, on the other hand, the number of individuals is generally small. In a collection made at Waltair, out of a large number of Alpheids procured, only three were found to carry Bopyrids and the same is the case with the collections of this family made in other places.

The distribution of the Indian Bopyrids as regards their hosts is interesting owing to the fact that a considerable number of forms have been met with living on genera from which they had not hitherto been recorded, and in some cases they have been found infecting members of altogether different families.

Thus the genus *Argeia* was so far known to infest a number of species of *Crangon*, *Nectocrangon* and *Sclerocrangon*—all members of the family Crangonidae. The Indian representative of the genus, however, lives on Alpheidae, a family which has no affinity whatsoever with the Crangonidae.

Bopyroides lives in Indian waters on a different host from those it is known to infest in other parts of the world. Its only known species, *B. hippolytes*, has been recorded from two distinct families Pandalidae (genera *Pandalus* and *Pandalopsis*) and Hippolytidae (genus *Spirontocaris*). The Indian species of this genus is a parasite of the Alpheidae (genus *Synalpheus*).

Bopyrella is less remarkable. All the species, both old and new, are parasites of the genera *Alpheus* and *Synalpheus*. It may, however, be pointed out that the American *B. deformans* (Hay) lives on a totally different *Synalpheus* from those on which the Indian sub-species has been found. Similarly with the type-species, *B. thomsoni* Bonnier; it has hitherto been found only on *Alpheus strenuus* Dana, but the specimen I have seen comes from a different species, resembling *A. audouini* Coutière, which is, however, a somewhat near ally of Dana's species.

All the species of Kossmann's *Bopyrina*,[1] except one, were hitherto known to live on the Hippolytid genera *Hippolyte* and *Thor*, the one exception being the American *B. urocaridis* Richardson, a parasite of *Urocaris* (=*Periclimenes*) which belongs to the Palaemonidae, subfamily Pontoniinae. Of the five Indian species of this genus four live on members of the subfamily Pontoniinae, and three of them, like the American species, on *Periclimenes*. The fourth is a parasite of *Urocaridella*. The remaining Indian species, *B. giardi*, is already known to live on the common European *Hippolyte varians* Leach. Indian specimens, apparently identical with those obtained in Europe, have been found on the allied but perfectly distinct species, *H. ventricosus* Milne-Edwards. This Indian Hippolytid does not occur in European waters, and the European *H. varians* does not extend beyond the Mediterranean. The American *B. abbreviata* Richardson, which is similar to, if not identical with, *B. giardi*, is a parasite of *H. zostericola* (Smith), a species which is possibly nearly related to *H. varians* and *H. ventricosus*.

[1] Nierstrasz and Brandis (1923) have added *Gelastocaris* and *Anylocaris* to the genera already known to be infested by *Bopyrina*. See addendum, p. 543.

The Indian form referred to as a variety of *Bopyrus squillarum* is, like the *forma typica*, a parasite of a *Leander*. But the host-species of the Indian variety, *L. styliferus* Milne-Edwards, is totally different from the species of *Leander* on which *Bopyrus* has hitherto been found. It is, besides, an estuarine form while all the European Leanders are marine. The Indian form has also been found on another undetermined species of *Leander*, which is not allied to *L. styliferus*.

The Indian species of *Epipenaeon* is a parasite of a *Penaeus* like both the other known forms.

The species of Giard and Bonnier's *Hemiarthrus* (=*Phryxus*) were known to live on a large number of hosts belonging to several different families, *viz.*, among others, Hippolytidae (*Spirontocaris* and *Hippolyte*), Pandalidae (*Pandalus*), Nematocarcinidae (*Nematocarcinus*) and Palaemonidae (*Typton*). The American *H. subcaudalis* (Hay) is known to live on Alpheidae (*Synalpheus*), and Giard's *Anisarthrus pelseneeri*, which seems to be a *Hemiarthrus*, is also a parasite of an Alpheid (*Athanas*). *H. philonika* G. and B. is a parasite of a species of Processidae (*Processa*). Of the Indian species *H. brevicauda* and *H. filiformis*, with its variety *attenuata*, are parasites of Alpheidae (*Alpheus* and *Synalpheus*), while *H. nigrocinctus* lives on a new family of hosts. It is a parasite of *Periclimenes elegans* Paulson which belongs to the subfamily Pontoniinae of the family Palaemonidae. On the same species of *Periclimenes* two other Bopyrids, *Bopyrina andamanica* and *B. kossmanni*, have also been found. A doubtful form is a parasite of a *Processa*.

Of the already known species of *Orbione*[1] two are parasites of Penaeidae, subfamily Penaeinae (*Penaeus* and *Metapenaeus*), while the third, *O. incerta*, was picked up from the abdomen of a crab, a position in which it had doubtless come by accident. The Indian species, *O. kempi*, is also a parasite of a Penaeid, but of the subfamily Sicyoninae (*Sicyonia*). Another form doubtfully referred to the genus is a parasite of a *Processa*, belonging to the tribe Caridea.

One of the Indian species of *Palaegyge* shows an interesting host distribution. All the species hitherto known have been found on *Palaemon*, but *P. pica* is the first species met with on *Leander*. The latter genus was until now thought to be parasitized almost exclusively by species of *Bopyrus*. This is the first record of the occurrence of a *Palaegyge* on any host other than *Palaemon* or (with the exception of *Diplophryxus jordani* Richardson, which lives on *L. serrifer* Stimpson) of a *Leander* being infected with a Bopyrid other than *Bopyrus*. In the remaining new species there is nothing interesting so far as the hosts are concerned, though they are remarkable from the point of view of geographical distribution. Of the two already known species *P. buitendijki* lives in Indian waters on *Palaemon carcinus* Fabricius, which is its host in the Malay Archipelago also. The other *P. demani*, which lives in Sumatra on *P. pilimanus* de Man, is found as a parasite of a different *Palaemon* in Indian waters.

[1] The two new species of this genus described by Nierstrasz and Brandis (1923) live on *Haliporus*—a genus not hitherto known to be parasitised by *Orbione*.

The hosts of the two Indian species of *Probopyrus*, like those of the already known forms from Malaysia, are Palaemons, though some of the American species have been recorded from the allied genus *Palaemonetes*.

The new genera *Parapleurocrypta* and *Stegoalpheon* are parasites of the Alpheidae, the former of a *Synalpheus* and the latter of an *Alpheus*.

Before proceeding to a discussion of geographical distribution a word may be said regarding MM. Giard and Bonnier's much-maligned hypothesis of specific relationship between the parasite and its host. These eminent zoologists, like several other equally famous carcinologists working on parasitic groups, have maintained that the same species of parasite cannot be found on more than one species of host, and that as a rule parasites infesting different genera of Crustacea must necessarily be generically distinct. This doctrine cannot of course be maintained, for, as Sars, Miss Richardson, and several other workers have shown, the same species of parasite has been found living on a large number of different host-species, sometimes belonging to several different genera. In the Indian species also instances are available which show that the hypothesis is untenable. Of the four already known species that I have obtained in Indian waters three were found on hosts different from those from which they were originally described, and some of the new species also occur on more than one species of host. Thus *Bopyrella deformans* var. *indica* is known from two species of *Synalpheus*, the var. *bimaculatus* of *Bopyrus squillarum* from two species of *Leander*, and *Palaegyge brachysoma* and *P. prashadi* each from two species of *Palaemon*. A multiplicity of host-genera is indeed more evident among Indian Bopyrids than in those from any other region of the world ; this is clearly shown in the list of hosts and parasites given on pages 416, 417. The case of *Hemiarthrus* illustrates this very well. This genus is now known to live on at least ten genera belonging to as many as five or six different families of Caridea. Thus it is abundantly clear that Giard and Bonnier's hypothesis cannot be maintained, but to deny altogether the existence of the principle that it lays down, especially in the case of species, is, in my opinion, equally impossible. Though it must not be considered a law, its application in practical working cannot be ignored. In the vast majority of instances parasites of different species of hosts are specifically distinct, and I have frequently obtained distinct Bopyrids from closely allied species of hosts collected in the same locality. As an instance of this I may mention the three allied species of *Palaemon*, *P. carcinus*, *P. malcolmsoni* and *P.* prox. *malcolmsoni* collected in the same streams in the Gangetic Delta and at the same time were found to carry three distinct parasites—*Palaegyge buitendijki*, *Palaegyge alcocki* and *Palaegyge bengalensis*. In the same way the two closely allied species of *Alpheus*—*A. crassimanus* and *A.* prox. *crassimanus*—collected at the same time at Waltair have parasites not only distinct specifically, but belonging to two widely different genera, *Bopyrella* and *Stegoalpheon*. In the course of my work I have often found it possible to sort out more or less correctly the different species of *Palaemon*, in a single collection by examining their parasites. Thus it will be seen that though the hypothesis—one host for one parasite—cannot be

considered of universal application, the theory, especially among certain genera of parasites, has a real practical value.

Geographical Distribution.

Our knowledge of the family Bopyridae is at present so meagre that any conclusions regarding geographical distribution are likely, in course of time, to prove fallacious. There are, however, under this heading one or two points of interest to be considered.

In view of our limited knowledge it is not surprising to find that the range of several genera and species has been extended.

In some cases genera already recorded from the Pacific coast of North America or Oceania have been met with in the eastern part of the Indian Ocean for the first time ; in others the genera were not at all known from the Indian and the Pacific Oceans.[1]

Argeia, hitherto known from the Western coast of North America and the inland sea of Japan, is represented in the collection by a species which comes from the Andamans in the Bay of Bengal.

Bopyrella was so far known from two species, one from the Amis Island of Oceania, and the other from the Atlantic coast of North America. Of the three Indian species, two, here described for the first time, resemble the Atlantic Ocean form, the third is the species previously known only from Oceania. The genus thus seems to have an enormously wide range, being found in the Atlantic, the South Pacific, and Indian Oceans. In Indian waters the genus occurs both in the Arabian Sea and the Bay of Bengal.

Bopyroides has been met with in various localities in the Atlantic and the Pacific extending as far north as Greenland and as far south as Japan. The Indian species comes from the Andamans and considerably extends the range of the genus.

The genus *Bopyrina* was not so far known to live in the Pacific region at all, having been recorded only from the Mediterranean, the British Isles and the Atlantic coast of North America. The frequent occurrence of the genus in Indian waters, both in the Arabian Sea and the Bay of Bengal, shows that it is common in the Indo-Pacific region also.

The case of *Bopyrus* is somewhat different from that of the preceding genera. It was so far known to occur in European waters only and had not been recorded from the Atlantic or the Pacific coasts of America. The Indian representative of the genus resembles closely the European *B. squillarum*.

In this, as in some of the other genera recorded for the first time from the Indo-Pacific region, the distribution seems to be discontinuous, but it may not really be so, at least in some cases, for our knowledge of the family is very scanty. It is quite possible that further investigations will show that *Bopyrus* extends all along the coasts of Africa from Gibraltar, round the Cape of Good Hope, to the Red Sea. In the same way it seems highly probable that *Bopyrella thomsoni*, which is hitherto

[1] In view of the recent Siboga Expedition Report (Nierstrasz and Brandis, 1923) the range of several genera has been considerably widened, and some genera have been recorded from the Indo-Pacific region for the first time.

known from only two places so far apart from one another as Amis Island in Oceania and the Andamans in the Bay of Bengal, has a continuous distribution over a considerable part of the Indo-Pacific region.

The range of Bopyridae must of necessity be limited by the range of the hosts which the species infest. The prawn-genera are, however, for the most part very widely distributed, and though some (such as the Palaemonidae in the Indo-Pacific) may predominate in certain regions, the great majority of the genera occur in all the warmer parts of the globe. A tendency, moreover, seems to exist for a particular genus of parasite to change its host as it extends its range. Of this *Argeia* and *Bopyroides* afford examples. The first of these genera was hitherto known from the Pacific coast of America on Crangonidae, the latter from the Atlantic (extending as far north as Greenland), and from Japan infesting Pandalidae and Hippolytidae. In Indian waters both genera occur on Alpheidae. The change in host in Indian waters may perhaps be due in these cases to differences in the Caridean fauna, for whereas Crangonidae, Hippolytidae and Pandalidae are dominant families and individually attain a large size in the region from which the two parasitic genera were previously recorded, in littoral Indian waters their representatives are small, insignificant and less numerous individually. A lack of large-sized hosts of the appropriate families may have been a factor in inducing change.

Another point to which attention may be drawn is the close affinity which appears to exist between the Bopyrids of Indian waters and those found on the Atlantic coast of America. Of this affinity, which is not unknown in other groups of littoral marine animals,[1] the following instances may be given[2] :—

Bopyrella deformans (Hay) is an Atlantic coast form known only from North Carolina. A number of Indian specimens agree so closely with the American species that they appear to represent merely a local race of it.

The case of *Hemiarthrus subcaudalis* (Hay) is perhaps still more interesting. This species has a somewhat southern range as compared with the genotype *H. abdominalis*, having been met with along the Atlantic coast of America near North Carolina. It is a parasite of an Alpheid, *Synalpheus longicarpus* (Herrick), while *H. abdominalis* is not known to infest any member of that family. In the possession of five well-developed legs on the longer side of the thorax Hay's species is very distinct from *H. abdominalis*, which has only one leg present on that side of the body, and in fact forms the type of a group within the genus. Now all the Indian species of the genus (except one the generic position of which is highly doubtful) show the same distinctive characters as *H. subcaudalis* and not those exhibited by *H. abdominalis*.

[1] See Alcock, An account of the Indian Deep-Sea Madreporaria collected by the Royal Indian Marine Survey ship "Investigator", Calcutta: 1898; A Descriptive Catalogue of the Indian Deep-Sea Fishes in the Indian Museum, Calcutta: 1899; An Account of the Deep-Sea Brachyura collected by R. I. M. S. "Investigator," Calcutta: 1899.

[2] Nierstrasz and Brandis (1923) have also pointed out this similarity, and have given a number of instances illustrating it. See addendum, p. 539.

Three, out of four, of the Indian forms are also parasites of the Alpheidae like *H. subcaudalis*. *H. abdominalis* occurs fairly abundantly along the Pacific coast of North America, but the Indian species resembles the Atlantic rather than the Pacific form.

Bopyrina giardi has already been referred to. It is a species which lives in the Mediterranean and around the coasts of British Isles. In India the same species is found in the Bay of Bengal. The American *B. abbreviata* Richardson from the Gulf of Mexico is also probably identical with the Indo-European form. The other Indian species of *Bopyrina* show a resemblance with the American fauna in another respect. The only species of the genus so far known to live on a Pontoniine prawn is the Atlantic *B. urocaridis*, a parasite of *Periclimenes*. All the Indian species except *B. giardi* live on members of the same subfamily and as many as three on the same genus as that infested by the American species.

Another instance is that of the Indo-Malayan freshwater genera *Palaegyge* and *Probopyrus*. The only other part of the world, except the Indo-Malayan region, where these genera are so far known to occur is near the Atlantic coast of America.

Tattersall[1] in a recent paper on Indian Mysidacea has drawn attention to their strong Mediterranean affinities. These affinities are also shown, though to a less extent, in the Bopyridae.

The freshwater fauna shows a close resemblance with that of the islands forming the Malay Archipelago. The two freshwater or semi-freshwater genera *Probopyrus* and *Palaegyge*, especially the latter, are for the most part confined to the Indo-Malayan region only, and some of the species even of the latter genus are common to India and Malaysia. Thus *Palaegyge buitendijki* lives on *Palaemon carcinus* Fabricius both in India and Java. This species of *Palaemon* has a wide range, occurring all over the Malay Archipelago and throughout India. The parasite of this species in India has so far been found in the Gangetic Delta only, but doubtless occurs in other localities also. *Palaegyge demani* is the other species common to these two places, but its host in Sumatra is different from that which it infests in India. In Sumatra the species is known to live on *Palaemon pilimanus* de Man, but in the deltaic waters of the Godaveri it is found to infest an undetermined species of *Palaemon* totally different from the Sumatran form. *P. pilimanus*, it may be pointed out, is not known to occur in India. The presence of this freshwater Bopyrid in these two places as a parasite of two different Palaemons is somewhat curious and is difficult to be explained. It is, however, possible that the larvae of these freshwater or semi-freshwater forms can stand salinity for a certain length of time, and being washed down to the sea are carried on by the waves for some distances. Thus they may be able to go from one island to another, and if they happen to find a suitable host they may be able to establish themselves in their new surroundings. An explanation like this may serve to account for a case like the present. The marked resemblance between the

[1] Tattersall, *Rec. Ind. Mus.* XXIV, p. 445 (1922).

freshwater fauna of Africa and Peninsular India pointed out by Annandale[1] can be explained, at least partly, on this hypothesis.

An interesting point in connection with the distribution of *Probopyrus* and *Palaeggge* is that all the species of these genera found in Indian waters were obtained in estuaries or in places subject to tidal influence. In the Malay Archipelago, however, all the species occur in fresh water. I am informed by Dr. Annandale that the case of *Probopyrus* and *Palaegyge* is not unique in this respect, and that there seems to exist a more or less definite law that forms which are exclusively marine in the west migrate more and more upstream as we proceed eastwards, and tend to become more and more fluvatile. This may be illustrated by a few instances.[2] The genus *Leander* is exclusively marine in Europe and America, in India some of its species are estuarine, and one, *L. potamiscus* Kemp, frequently lives in places where the water is almost, or quite fresh; in China it occurs in the lakes along with species of *Palaemon*; in Japan the common freshwater prawn is a *Leander*. The same is observable in the Molluscan genus *Modiola*. It is marine in Europe, mostly estuarine in India, and in China it is commonly met with in the inland lakes. The Rhizocephala, again, are exclusively marine in Europe, while in the Andamans a genus (*Sesarmaxenos*) has been found on a crab in a hill-stream.

In the Philippines a species of *Probopyrus, P. ascendens* (Semper), has been found living on its host, *Palaemon lar* Fabricius, captured in a hill-stream about 4,000 feet above sea-level. Nothing so remarkable is found in the Indian species of the genus. I am informed by Dr. Kemp that a parallel instance is to be found in crabs of the genus *Sesarma* (Grapsidae). In the Malay Archipelago specimens are known to ascend to considerable altitudes, whereas in the Indian Peninsula they never range beyond tidal influence.

SYSTEMATIC ACCOUNT.

Giard and Bonnier split up the Bopyridae into three groups, each presumably having the rank of a subfamily, the Phryxiens, the Ioniens and the Bopyriens. Later, Bonnier proposed the name Bopyrinae for a much larger section, under which he included several distinct families, *viz.*, Dajidae, Phryxidae, Bopyridae and Entoniscidae. The first and the fourth families in this assemblage seem to have no close affinity with the other two, while the second and the third have been combined by all subsequent workers under the latter name. The separation of genera like *Hemiarthrus* (=*Phryxus*) and *Athelges* from other typical Bopyrids does not appear to be taxonomically sound, for the differences between them, though sometimes great, are clearly bridged over by several intermediate forms.

In the following pages no great change has been made in the systematic arrangement of genera and species, and the classification of earlier

[1] Annandale, IX Congrès International de Zoologie, tenu à Monaco, 1913, pp. 579-586 (1914).

[2] The question of this upward migration has been discussed in an earlier paper, and most of these instances have already been given in that connection. (See Chopra, 1922, p. 71.)

workers has, for the most part, been adhered to. I have, however, felt it necessary to sink Hay's genus *Synsynella* in the synonymy of *Bopyrella* Bonnier, for the differences between the two do not appear to be of any great importance. I have also considered it desirable to replace Rathke's name *Phryxus* by Giard and Bonnier's designation *Hemiarthrus*. The reasons necessitating these changes are fully discussed in their appropriate places.

The Indo-Pacific genera of Bopyridae represented in the Indian Museum collection, may be distinguished thus:—

Key to the Indo-Pacific Genera of Bopyridae.

A. Body of adult female highly deformed, one side greatly swollen; thoracic legs of one side reduced, some generally suppressed; only five abdominal segments in female present. [Pleural lamellae of abdominal somites of female not developed; abdominal segments of male fused completely and devoid of pleopoda.]

I. Pleopoda in adult female biramous from the very point of origin, last two thoracic segments not larger than rest; all thoracic legs of shorter side of body well developed — *Hemiarthrus* Giard & Bonnier (=*Phryxus*).

II. Pleopoda in adult female uniramous at origin, and dividing into two at a considerable distance from body; last two thoracic segments considerably larger than rest; only first leg of shorter side of body well developed, others reduced ... ... — *Diplophryxus* Richardson.

B. Body of adult female not highly deformed, neither side swollen; thoracic legs of both sides equally developed, none suppressed; generally all six abdominal somites present in female.

I. Pleural lamellae of abdominal segments of female well developed, lamellar and separate. [Abdominal segments of male fused and devoid of pleopoda, pleural lamellae present on sixth abdominal segment of female.]

A. Pleural lamellae of thoracic segments well developed; pleopoda biramous, covered with tubercles.

1. All six abdominal segments of female distinct; uropoda uniramous ... ... — *Orbione* Bonnier.
2. Only five abdominal segments of female visible; uropoda biramous ... ... — *Epipenaeon* Nobili.

B. Pleural lamellae of thoracic segments poorly developed; pleopoda uniramous and not covered with tubercles. [Uropoda uniramous.] ... ... — *Parapleurocrypta*, nov.

II. Pleural lamellae of abdominal segments of female generally absent, rarely rudimentary.

A. Pleopoda of female triramous, two rami ventral and horizontal, the third dorsal forming a vertical ridge. [Uropoda of female uniramous; pleural lamellae absent in female; abdominal segments of male fused and not provided with appendages.] ... ... — *Stegoalpheon*, nov

B. Pleopoda not triramous in female.

1. Pleopoda biramous in female.

a. Head in both sexes fused with first thoracic segment; abdominal segments of female more or less completely fused; some of posterior pleopoda generally reduced or even suppressed. [Rudimentary pleural lamellae generally present on abdominal segments of female; uropoda absent in female; abdominal segments of male fused dorsally, but distinct laterally, anterior segments sometimes provided with pleopoda.] ... — *Bopyrella* Bonnier.

b. Head not fused with first thoracic segment; abdominal segments of female more or less distinct; all five pairs of pleopoda well developed.

i. Uropoda in female always present as a pair of large lamellae; abdominal segments of male fused completely, never provided with appendages. [Pleural lamellae on abdominal segments of female absent.] ... ... *Argeia* Dana.

ii. Uropoda of female absent or rudimentary, never lamellar; abdominal segments of male never fused completely, always provided with appendages.

α. Last abdominal segment of female more or less deeply cleft along its posterior margin; rudimentary sac-like uropoda generally present; rudimentary pleural lamellae generally present; abdominal segments of male distinct ... ... *Palaegyge* Giard & Bonnier.

β. Last abdominal segment of female rounded and entire along its posterior margin; uropoda in female absent; pleural lamellae on abdominal segments of female wanting; abdominal segments of male partly fused ... ... *Probopyrus* Giard & Bonnier.

2. Pleopoda not biramous in female. [Pleural lamellae absent on abdominal segments of female; uropoda absent.]

a. Pleopoda uniramous in female; abdominal segments of male more or less distinct, at least laterally.

i. All five pairs of pleopoda present in female; pleopoda developed in male; head in female distinct from first thoracic segment; abdominal segments of female free along both margins ... *Bopyrus* Latreille.

ii. At most four pairs of pleopods present in female; no pleopoda developed in male; head in female partially fused with first thoracic segment; abdominal segments of female generally somewhat fused along one margin ... ... *Bopyrina* Kossmann.

b. Pleopoda altogether absent in female, being represented by small fleshy lobes; abdominal segments of male completely fused. [Lateral margins of body in female almost continuous.] *Bopyroides* Stimpson.

Genus **Hemiarthrus** Giard and Bonnier.

1840, 41. *Bopyrus*, Krôyer, *Naturhist. Tidsschrift.* III, pp. 102-112 and 189-199, pls. i, ii.
1842. *Bopyrus*, Krôyer, *Skrift. K. Dansk. Vidensk. Selsk.* IX, p. 263.
1843. *Phryxus*, Rathke, Fauna Norwegens: in *Nova Acta Acad. Caes. Leopold. Carolin. Nat. Curios.* XX, p. 40, pl. ii, figs. 1-10 (*partim*).
1849. *Bopyrus*, Krôyer, in Gaimard, *Voy. en Scand., Crust.* pl. xix, fig. 1.
1868. *Phryxus*, Bate and Westwood, *Brit Sessile Eyed Crust.* II, pp. 232-250, text-figs. (*partim*).
1877. *Phryxus*, Meinert, *Naturhist. Tidsschrift.* XI, pp. 88-89 (*partim*).
1877. *Phryxus*, Miers, *Ann. Mag. Nat. Hist.* (4) XX, p. 65.
1884. *Phryxus*, Weber, *Bijdr. Dierkunde*, 10 Afl., p. 34.
1887. *Phryxus*, Hansen, *Vidensk. Meddel. Naturh. Foren, Copenhagen*, p. 196,

1887.[1] *Hemiarthrus*, (*nec Phryxus*) Giard and Bonnier, *Trav. Stat. Zool. Wimereux* V, p. 36 (foot-note).
1890. *Hemiarthrus*, Giard and Bonnier, *Bull. Sci. France Belgique* XXII, pp. 386, 387.
1890. *Phryxus*, Walz, *Arb. Zool. Inst. Wien* IV, pp. 66-69.
1892. *Hemiarthrus* (*nec Phryxus*) Stebbing, *Hist. Crust.*, pp. 417, 418.
1899. *Phryxus*, Sars, *Crust. Norway* II, pp. 214-217.
1905.[2] *Phryxus*, Richardson, *Bull. U. S. Nat. Mus.* LI, pp. 499-503.
1907.[3] *Anisarthrus*, Giard, *Compt. Rend. Soc. Biol. Paris* LXIII, pp. 321, 322.
1909. *Phryxus*, Richardson, *Proc. U. S. Nat. Mus.* XXXVII, p. 121.
1914. *Hemiarthrus*, Stebbing, *Ann. South Afric. Mus.* XV, pp. 47, 48, text-figs.
1916. *Phryxus*, Hansen, *Ingolf Exped.* III, pt. 5, *Crust. Malacostr.* (III), pp. 206-208.
1917. *Phryxus*, Hay, *Proc. U. S. Nat. Mus.* LI, pp. 569, 570, pl. ii c.
1920. *Hemiarthrus*, Barnard, *Ann. South Afric. Mus.* XVII, p. 429.
1923. *Phryxus*, Nierstrasz and Brandis,[4] *Siboga Exped. Rep.* XXXII *b*, p. 108.

The genus may be defined as follows[5]:—

Abdominal parasites.

Female. Body of adult female highly asymmetrical and deformed, one side being greatly swollen, and much larger than the other.

Head distinct from the thorax and deeply sunk in it. No frontal lamina developed. Eyes generally absent.

Thoracic segments crowded together, and visible dorsally only along the shorter side of the body. Ovarian bosses and epimera only sometimes faintly visible along the shorter side. Incubatory plates very unequally developed, those of the longer side large and covering almost the entire incubatory pouch; those of the shorter side more or less poorly developed. All the seven legs present on the shorter side, and densely crowded together along the margin on its dorsal aspect. Legs of the longer side reduced, and generally some of them suppressed; sometimes only one, sometimes five and sometimes all the seven present, in the last case two or more extremely reduced.

Abdomen short, consisting of five segments only, defined only on the dorsal surface. Pleural lamellae totally wanting. Terminal segment forming a small narrow structure, sometimes bifid posteriorly. Four pairs of pleopods present, spreading on the sides of the body, those on the longer side larger than the others. Pleopods biramous,[6] each having its outer ramus considerably larger than the inner; the latter,

[1] This is the earliest reference to the name that I have been able to find in Giard and Bonnier's works. A new generic name is proposed in a footnote without any definition. If the genus had been more satisfactorily defined, I have no doubt, it would not have escaped the notice of zoologists so long.

[2] For more references see the synonymy of *Phryxus abdominalis* given by Miss Richardson in this work.

[3] For a reference to *Hemiarthrus* also, see this paper, pp. 323, 324.

[4] See addendum, p. 539.

[5] For definition see also Sars (1899, pp. 214, 215) and Miss Richardson (1905, pp. 499, 500), under the genus *Phryxus*.

[6] In Miss Richardson's definition the pleopoda are described as single-branched, but in her description and figures of *P. abdominalis* these structures are shown to be biramous. In an earlier paper (1904, p. 50) also the pleopoda have been regarded as uniramous and a new genus, *Diplophryxus*, has been set up which "differs chiefly from *Phryxus* Rathke, in having the two pairs of pleopoda, one pair on either side of the body for each segment, double-branched instead of single-branched". This obviously is an incorrect statement, for the pleopoda in *Hemiarthrus* are also double-branched. *Diplophryxus* is, however, a good genus, and, as will be shown later, can be easily distinguished from *Hemiarthrus* by its characteristic pleopoda.

pushed on to the ventral surface, sometimes in the form of a thick fleshy structure, oval or reniform in shape. Uropoda absent.[1]

Male. Head distinct from the thorax, bearing a pair of small eyes. The antennules and the antennae well developed, the former biarticulate, and the latter formed of five segments.

Thoracic segments distinct, each carrying its pair of legs.

Abdominal segments all fused together, sometimes slightly indicated along the margins. Pleopods and uropoda wanting.[2]

Type-species :—Bopyrus abdominalis Krôyer.

I have adopted the generic designation of *Hemiarthrus* in preference to the generally used *Phryxus* for the reason that the latter, as shown by Giard (1907) is already appropriated in zoology. Rathke's *Phryxus* is a composite genus containing types of two distinct genera. Of his two species, the second *P. pagurus* (a parasite of *Eupagurus bernhardus* Linn.) has been referred to Hesse's *Atheleges* and there has been no question of its position ever since. But it has fared differently with his genotype *P. hippolytes* (a parasite of a *Hippolyte*), which as we know is specifically identical with that which Krôyer had already described under the name of *Bopyrus abdominalis*. Thus *P. abdominalis* (Krôyer) became the type-species of Rathke's *Phryxus*. In 1887 Giard and Bonnier [1887 (b), p. 36 footnote] pointed out that it was "absolument impossible de laisser dans le genre *Phryxus* les parasites de l' abdomen des *Virbius* et des *Hippolyte*," but instead of giving up the name *Phryxus* altogether they simply seem to have transferred it to a generically different Bopyrid from Brazil, while for Krôyer's *Bopyrus abdominalis* they erected the genus *Hemiarthrus*. Stebbing (1892) followed Giard and Bonnier in this arrangement and referred Krôyer's species to their genus *Hemiarthrus* and also included in it four other species from the Gulf of Naples that Giard and Bonnier (1890) had "described" without giving any descriptions of them. Like them also he retained the name of *Phryxus* for the parasite of *Pagurus* that Muller had described from the Coast of Brazil. Such a course as Giard and Bonnier and Stebbing followed is, as Sars (1899) pointed out, contrary to all rules of zoological nomenclature. The name *Phryxus* ought to have been given up altogether, but if it was to be retained it should not have been given to forms other than it was originally meant for. Sars (p. 215) foreshadowing the necessity for giving up the name altogether remarked : "If the name *Phryxus* is to be retained in the present group it ought certainly to be used for the form to which it was originally assigned, and cannot be replaced by a new generic name unless the former name is altogether to be abandoned. It may be that this will be found necessary as the name *Phryxus* is said to be already appropriated in zoology." No recent zoologist seems to have accepted the change proposed by Giard and Bonnier, or to have investigated the truth of Sars' statement, for all forms of *Hemiarthrus*

[1] In the form described in this paper under the name of *Hemiarthrus* (?) sp. the last abdominal segment of the female carries a pair of double-branched uropoda.

[2] In the new forms described as *H. filiformis* and *H. filiformis* var. *attenuata* the abdomen of the male carries two pairs of long filiform structures which appear to be of the nature of enlarged pleural lamellae.

have been recorded under Rathke's preoccupied name of *Phryxus*. In 1907, however, Giard, while describing his new genus *Anisarthrus*, justified the use of *Hemiarthrus* for the forms assigned to Rathke's genus. It was definitely pointed out there that the name *Phryxus* had already been used as a generic designation in the Lepidoptera. "Vers 1822, dans son *Verzeichniss* (p. 115 et suiv.), le lépidoptériste Hübner a donné ce nom à une division des *Sphinx* de la tribu des *Deilephilidae* dont le type est *Phryxus livornica* Pet. (*lineata* Fab.)." After this clear statement of facts it is impossible to retain the name *Phryxus* in the present group and it will be necessary to revert to Giard and Bonnier's name of *Hemiarthrus*.[1] It is to be regretted that such a well known name has to be abandoned, but in view of the circumstances mentioned above there seems to be no other alternative. It may, however, be pointed out here that the choice of the name *Hemiarthrus* is rather an unfortunate one, as a closely similar name *Hemiarthrum* is said to be already appropriated in zoology.

I have combined Giard's *Anisarthrus* with the present genus for the reason that the only difference between the two, as seen from Giard's brief description, is the somewhat greater development of the thoracic legs on the deformed side of the body in the adult female of *Anisarthrus*. This by itself does not seem to me to justify the setting up of a new genus. *H. subcaudalis* (Hay) and some of the forms described as new in the present paper have all five thoracic legs on the deformed side well developed. This group of species seems clearly to form an intermediate stage between *H. abdominalis* with a single leg, on the one hand, and Giard's *Anisarthrus pelseneeri* with all seven legs on the other. They are all in common characterized by a greater or less reduction of the legs on the deformed side of the body. This reduction is most marked in *H. abdominalis* and other species like it, is somewhat less marked in *H. subcaudalis* and others, while it is still less apparent in *H. pelseneeri*. Apart from this Giard has not mentioned any other difference of generic value, and until something more is known about this parasite of *Athanas nitescens* Leach, I think we are justified in regarding *Anisarthrus* as synonymous with *Hemiarthrus*.

The species of *Hemiarthrus* fall into three distinct groups according to the reduction of the thoracic legs on the deformed side of the body in the adult female.

1. The *abdominalis* group.—Only the first thoracic leg is present on the deformed side. This is really the group for which the genus was originally formed. The members of the group are for the most part parasites of Hippolytidae and Pandalidae. *H. nematocarcini* Stebbing, a parasite of a *Nematocarcinus* (Fam. Nematocarcinidae) also seems to belong to this group ; but it is difficult to be sure of its position as Stebbing's (1914) description and figures are inadequate. Besides *H. abdominalis* and *H. nematocarcini*, *H. virbii*, G. and B., *H. cranchii*, G. and B. and possibly *H. typtonis*, G. and B., also, seem to belong to this group, but as no descriptions of these species have so far been published their position is merely a matter of conjecture. The first two of these are parasites of Hippolytidae while the third lives on a member of the Ponto-

[1] See addendum, p. 539.

niinae. The form described by me as *H.* (*?*) sp.,[1] a parasite of *Processa* sp. (Fam. Processidae) is of too doubtful affinity to be placed in any group, although from the number of legs it seems to be a member of the *abdominalis* group.

2. The *subcaudalis* group.— Five thoracic legs are present on the deformed side, only those belonging to the second and third segments being absent. All the five legs are well developed and have the normal structure. The members of this group are for the most part parasites of the Alpheidae, though one lives on a *Periclimenes* (Fam. Palaemonidae). *H. subcaudalis* (Hay) a parasite of a *Synalpheus*, and three species described by me in this paper as new are placed in this group. Two of the new species are parasites of Alpheids while the third lives on a *Periclimenes*.

3. The *pelseneeri* group.—All the thoracic legs of the deformed side are present though markedly less developed than those of the other side, the last two especially being extremely reduced. The only species of this group, *H. pelseneeri* (Giard), is a parasite of an *Athanas* (Alpheidae). From the point of view of host as also from the number of legs this group perhaps resembles the *subcaudalis* more than the *abdominalis* group. It should, however, be noted that the missing legs of the *subcaudalis* groups do not correspond with the reduced legs of *H. pelseneeri*.

The genus has a very wide range of distribution, *H. abdominalis*[2] having been extensively met with in Europe and along the Atlantic coast of North America, and from a number of localities in the North Pacific also. This species on the whole is a northern form and occurs most abundantly in the Arctic Seas. *H. subcaudalis* is a more southern form and has been met with along the Atlantic coast of North America near North Carolina. Stebbing's *H. nematocarcini* is known from near Cape Point, South Africa. Bate's record of an undetermined species[3] collected on the coasts of the Philippines has hitherto been the only instance in which a member of this genus has been met with in the Indo-Pacific region. All the forms described in this paper were collected in Indian waters.

The species of *Hemiarthrus* live on several host-genera. *H. abdominalis* (Krôyer) is known from a large number of species of *Pandalus* Leach and *Spirontocaris* Bate; *H. nematocarcini* Stebbing is a parasite of *Nematocarcinus lanceopes* Bate; *H. subcaudalis* (Hay) lives on *Synalpheus longicarpus* (Herrick); *H. filiformis* and the var. *attenuata*, both new, are known from *Alpheus paralcyone* Coutière; *H. nigrocinctus*, sp. nov., from *Periclimenes elegans* Paulson; and *H. brevicauda*, sp. nov., from a *Synalpheus* resembling *S. theophane* de Man. *H.* (*?*) sp. is a parasite of *Processa* sp. and *H. philonika* Giard and Bonnier is known from *Processa edulis* (Risso). The other three species of Giard and Bonnier—*H. typtonis*, *H. virbii* and *H. cranchii* are parasites of *Typton spongicola* Costa, *Hippolyte viridis* Otto, and *Hippolyte cranchii* Leach respectively. Lastly Bate's species from the Philippine Islands lives on *Plesionika semilaevis* Bate.

[1] Giard and Bonnier's *H. philonika*, a parasite of a *Processa*, is also doubtfully placed in this group. The parasite of *Plesionika semilaevis* (Pandalidae) recorded by Bate (1888) from the Philippines is also possibly a member of this group.

[2] For distribution of this species see Hansen (1916, pp. 207, 208).

[3] This species according to Bate (1888, pp. 645, 646) closely approximates to *Phryxus abdominalis* Krôyer, but differs in having the branchial plates of the female pointed at the extremity, instead of being rounded as in typical specimens.

Key to the species of Hemiarthrus

A. A pair of biramous appendages (uropoda ?) present on last abdominal segment of adult female. Only one thoracic leg present on longer side of body ... ... *H.* (?) sp.

B. No appendages present on last abdominal segment of female.

I. All seven thoracic legs of deformed (longer) side of body present in adult female, some poorly developed. [Incubatory lamellae largely coloured.] ... ... *H. pelseneeri* (Giard).

II. Some thoracic legs of deformed side absent in adult female.

A. Five thoracic legs present on deformed side, those of second and third segments being absent.

1. All legs of deformed side placed on side of thorax; abdomen of male notched posteriorly. [Terminal segment of abdomen of female not notched posteriorly.] ... ... *H. subcaudalis* (Hay).

2. Some of the last legs of deformed side placed in space between abdomen and swollen incubatory pouch and partly covered over by latter; abdomen of male not notched posteriorly. [Last four legs of deformed side generally placed in groups of two each, the last group sometimes placed beyond the median line on the non-deformed side.]

a. A broad band of black or dark-brown pigment running on both surfaces of thorax in female; inner rami of pleopoda somewhat reduced and fleshy; abdomen of male about one-fourth of total length of body and distinctly longer than broad. [Last abdominal segment of female not notched; parasitic on a *Periclimenes*.] ... ... *H. nigrocinctus*, sp. nov.

b. No band of pigment present on thorax in female; inner rami of pleopods extremely reduced and sac-like; abdomen of male small, about one-fifth of total length of body and somewhat broader than long.

i. Abdomen of male provided with two pairs of long narrow "enlarged pleural lamellae"; abdomen of male pointed posteriorly.

α. Male about twice longer than broad; last abdominal segment of female slightly notched posteriorly ... ... *H. filiformis*, sp. nov.

β. Male about four times longer than broad; last abdominal segment of female deeply notched posteriorly *H. filiformis*, var. *attenuata*, nov.

ii. Abdomen of male not provided with pleural lamellae; abdomen of male rounded posteriorly. [Both rami of pleopods thick and fleshy.] ... *H. brevicauda*, sp. nov.

B. Only first thoracic leg of deformed side of body in adult female present, all others being absent. [Terminal segment of abdomen in female notched posteriorly; abdomen of male not notched posteriorly.] ... ... *H. abdominalis* (Krôyer).

In the above table I have not given a diagnosis for *H. nematocarcini* Stebbing (1914) as the characters used in building up this table are not clearly brought out in Stebbing's brief description. It is said to resemble *H. abdominalis* in most of its characters, but can be distinguished from it by the totally different shape of the abdomen of male. Giard and Bonnier's (1890) species from the Mediterranean are not also included in the table as no descriptions or figures of them have hitherto been published.

Hemiarthrus nigrocinctus, sp. nov.

(Plate XI, figs. 1–3.)

The largest *adult female* is 3·2 mm. and 2·6 mm. in its greatest length and breadth respectively, while the smallest, which is in a somewhat contracted condition, is only 2·2 mm. long and 1·3 mm. broad. Another small specimen in the collection measures 2·2 and 1·8 mm. in its length and breadth respectively. As is the rule in the genus the body is highly asymmetrical with one side extremely swollen. The head, in consequence of this, is pushed over to the shorter side of the body and does not seem to form its anterior extremity. The segmentation of the body is also greatly affected, so much so, that it is almost totally obliterated on the longer side. The general colour of the animal is white or slightly pale yellow. A band of dark pigment—to which the specific name refers—runs across the thorax both on the dorsal and ventral surfaces. This band is of an almost uniform breadth and lies in a definite position with regard to the two prominent constrictions on the sides of the thorax to be described later. On the shorter side of the body the band passes above the constriction, while in all the specimens it passes below the constriction on the other side. It is not continuous on the ventral surface, but is interrupted about the mid-ventral region, there being no pigment on that part of the large enclosing oostegite of the shorter side of the body. The band is of a jet black pigment in one specimen, while in all the others it is of a dark-brown colour. In all the specimens, except one, the last oostegite of the shorter side of the body is also pigmented in a shade similar to that of the band; in the remaining one this oostegite is colourless. On the dorsal surface there are sometimes a few irregular minute pigment spots scattered over the abdominal region.

The head is indistinctly separated from the thorax, the line of demarcation between the two being indistinct. It is deeply set in the thorax and is almost as long as broad. The anterior margin is almost straight and the antero-lateral corners are slightly pointed. The posterior margin is posteriorly produced and is rounded. A pair of small eyes is present.

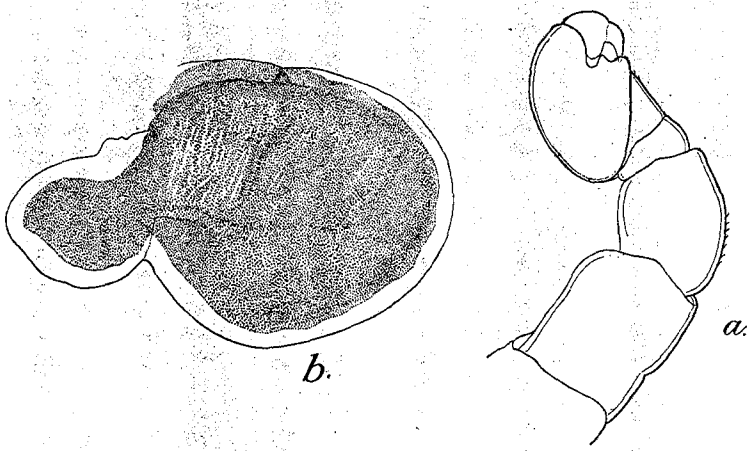
The segmentation of the thorax like that of the rest of the body, is greatly affected by the extreme asymmetry of the animal. Segmentation is seen on the dorsal surface only on the shorter side of the body

and even there the lines of demarcation are distinct only for a short distance in the middle of the body, and the boundaries of the segments cannot be easily made out. Along the longer side of the body segmentation is not at all visible. About a third of the length of the body from the anterior end there is a deep constriction one on each side of the body at the point where the two segments of the first oostegite meet. Below this constriction the margins of the thorax are turned upwards, especially on the shorter side. Ovarian bosses have not been made out even on the shorter side of the thorax, nor have the epimera been clearly seen. The margins of the first four thoracic segments on the shorter side seem to be constricted about their middle by a slight notch and thus appear to be formed of two halves.

The abdomen is proportionately short and is somewhat longer than broad. The segments are crowded together and their outlines are only indistinctly seen on the dorsal surface. As is the rule in the genus only five segments can be made out. The pleural lamellae are totally absent. The terminal segment is a short structure, with its posterior margin broadly rounded and not bifid.

The incubatory cavity is closed and the oostegites of the shorter side of the body enclose those of the longer side. Unlike *H. abdominalis* (Krôyer), and probably H. *subcaudalis* (Hay) also, the latter are considerably developed. The first oostegite of the shorter side is the largest and covers over, at least partly, all the rest except the fifth of the same side, which seems to enclose the marsupial pouch along a part of its posterior boundary. Unlike the other two species, the ventral surface of the body—and much less a part of the lateral also—is not formed entirely by the large oostegites of the shorter side, but the oostegites of the longer side also form a considerable part of it. The first oostegite of the shorter side overlaps, about the mid-ventral region, only a part of the oostegite of the other side, and thus the incubatory cavity is roofed over by the lamellae of both the sides. The first oostegite is, as usual, formed of two portions, separated by the constriction already mentioned, and its posterior lobe, as in *H. subcaudalis*, is longest in its transverse diameter. Unlike *H. abdominalis*, and like Hay's form, there are five well-developed legs on the shorter side of the body, one towards the anterior end, just behind the constriction, and the remainder on the posterior end of the thorax lying, at least some of them, between it and the abdomen and partly covered over by the swollen marsupium. The last two legs seem to lie beyond the median line well towards the shorter side of the body. The other two legs—the second and the third—lie forming a separate group placed on its own side of the body. The first leg, as already mentioned, lies well in the anterior region and is widely separated from the remaining four. There appear to be no legs belonging to the second and the third thoracic segments. Each leg has the usual number of segments, and is provided with a claw. The basis and the ischium are both large and rectangular, the former not being provided with a boss; the merus and the carpus are small and are crowded together; the propodus is large and has a prominent projection on its external margin; and the dactylus is well developed and acts against the projection of the propodus.

The four pairs of biramous pleopods are arranged near the margins of the abdomen, so that they can be clearly seen from the dorsal surface



TEXT-FIG. 1.—*Hemiarthrus nigrocinctus*, sp. nov,
a. Third thoracic leg of female: × 150. *b*. pleopod: × 64.

also. The inner rami are very much reduced and are in the form of small, almost circular, fleshy lobes; the outer rami which spread out on the sides are fairly large oval lamellae sometimes turned upwards and placed against the dorsal surface of the extended marsupium. The pleopods of the longer side of the body are larger than those on the other. The uropods are totally absent.

The *male* is small in size, the largest being about 0·6 mm. long. It is whitish in colour and has no characteristic colour markings on its surface.

The head is semicircular in outline, with the anterior margin slightly rounded. A pair of well-developed eyes is present near the posterior margin. The antennules are small triarticulate structures placed close behind the anterior margin of the head but not appreciably projecting beyond it. The antennae are five-jointed and project considerably beyond the head. The last one or two segments carry long hairs along their margins. The mouth parts are all normal.

The thoracic segments are distinct and their lines of demarcation are very well seen dorsally. The seven pairs of thoracic legs are long and slender and each has the usual structure. The legs are provided with a claw each.

The abdomen is proportionately small being less than one fourth of the total length of the body and is distinctly longer than broad. It is triangular in shape and tapers gradually to the posterior end. All the segments are completely fused, but slight undulations of the margins seem to indicate the first one or two segments. The abdomen does not end sharply, but the posterior margin is somewhat truncate with a slight depression about the middle. There are no pleopods or uropods.

Locality.—The types (C 495/1), two females and one male, are parasites of *Periclimenes elegans* Paulson, and were collected by Dr. S. W. Kemp in Ross Channel, Port Blair, Andaman Islands, in the Bay of Bengal, in February 1921. Additional specimens were collected by him at Port Blair from near the shore in North Bay and off the Pier, Ross Island, and like the types are all parasites of *P. elegans*. All the specimens are adult females and three of them are accompanied by their males. Their position on the abdomen of the host is like that of *H. abdominalis* and not like that of *H. subcaudalis*. The characteristic dark band of the female is clearly seen through the epimera of the abdominal appendages of the host.

A specimen brought back by the R. I. M. S. "Investigator" from the Jack and Una Islands in 1913 is also referred to this species. It is a parasite of *Periclimenes demani* Kemp and is an adult female, the male of which is missing. The swollen side of the body is considerably damaged, and it is impossible to make out all the characters in detail. The characteristic dark band is present around the thorax, but besides this, the thoracic segments on the dorsal side are also pigmented. In other characters the specimen seems to agree with the description given above. The host-species of this specimen, *P. demani*, it may be observed, is somewhat nearly related to *P. elegans*.

In the possession, by the female, of five thoracic legs on the longer side of the body the present form resembles *H. subcaudalis* (Hay), but the position of the legs in the two cases is quite different. The abdomen of the female is also proportionately smaller and that of the male is not notched posteriorly. The dark band of the female is an unmistakable distinguishing character between these two forms.

The host of *H. nigrocinctus*, it will be observed, is a *Periclimenes*, whereas the hosts of all the other known forms belong to different genera and even different families. The host species of *P. nigrocinctus* is also infected by another parasite, totally different from it and belonging to another genus. It has been described in this paper as a new species under the name of *Bopyrina andamanica*.

Hemiarthrus filiformis, sp. nov.

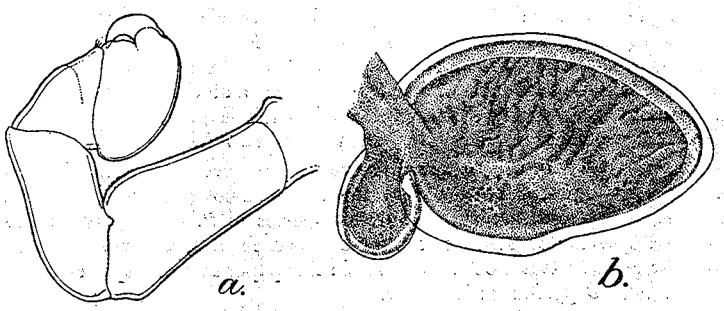
(Plate XI, figs. 4–6.)

The species comes fairly close to Hay's *H. subcaudalis*, with which it agrees among other characters in the possession, by the female, of five thoracic legs on the longer side of the body.

The *adult female* is about 3 mm. long and a little less than 2 mm. broad. As is the rule in the genus the body is highly asymmetrical and one side is greatly swollen. The animal is more or less white and there are no prominent colour-markings on the dorsal or the ventral surface.

The head as in the preceding species is deeply set in the thorax, but is distinctly separated from it. The anterior margin is slightly arched, and the posterior, which is much shorter than the anterior, is deeply rounded. Eyes are absent.

Segmentation is visible on the dorsal surface along the shorter side of the body only. All the seven thoracic segments, though closely crowded together, are very clearly defined along this margin and their lines of demarcation are very distinct. No trace of segmentation is visible on the longer side of the body. Ovarian bosses and epimera have not been made out. The first oostegite of the longer side completely encloses all the others and forms the ventral surface of the body. The oostegites of the other side also, especially the first, are fairly well developed. All the seven legs are present on the shorter side of the body, while on the other five well-developed legs are seen—one attached to the first oostegite and the remaining four to the last four thoracic segments. The second and the third segments seem to carry no legs. The first leg is placed near the anterior end of the body, while the last four are arranged more or less like those of the preceding species, and not like those of *H. subcaudalis*. They are placed between the thorax and the abdomen and are partly covered over by the swollen marsupium. The last two legs are placed near the median line on the shorter side of the body, and appear superficially to belong to that side. The other two are situated more or less on the corner formed by the swollen marsupium with the pleon. Each leg has the usual structure, similar to that described in *H. nigrocinctus*.



Text-Fig. 2.—*Hemiarthrus filiformis*, sp. nov.
a. Thoracic leg of female : × 137. *b*. Pleopod : × 66.

The abdomen is proportionately larger than that of the foregoing species and is an elongated triangular structure with the apex pointing posteriorly. The five segments of which it is composed are distinct both on the dorsal and the ventral surfaces. The last segment tapers gradually and is slightly notched posteriorly. The four pairs of biramous pleopods have the usual structure and are placed near the margins of the body, so as to leave the ventral surface of the abdomen uncovered. The outer ramus is a large flat lamella, more or less circular or oval in shape, and spreads out on the sides of the abdomen so as to be visible from the dorsal surface. The inner ramus is an extremely reduced, somewhat thick, rounded lobe. The pleopods of the two sides are more or less equal in size, but in one specimen those of the longer side of the body are markedly larger than those of the other. The uropods are wanting.

The *male* in its superficial appearance differs greatly from that of *H. subcaudalis* or any other form. It measures about 1 mm. long and is about half as broad. It has a stout and thick-set appearance.

The head has a semicircular shape and a pair of small, but distinct eyes near its posterior margin. The antennules and the antennae are placed a little behind the anterior margin of the head and both project beyond it—the former slightly, the latter to a considerable extent. The antennules are triarticulate, and in length do not go beyond the second antennal segment. Their terminal segment is crowned with a number of long setae. The antennae are formed of five segments and their terminal segment also has a tuft of setae. The fourth segment also carries some hairs near its anterior extremity.

The thoracic segments do not taper much on their sides and thus impart a stumpy appearance to the animal. The segments are all distinct and carry a pair of legs each. On account of the stout appearance of the animal the legs appear small.

The pleon is short, being about one-fifth of the total length of the body, and is broader than long. It is triangular in shape and tapers rapidly to the posterior end, where it forms a sharp acute angle. The posterior extremity is not notched. All the segments are fused together, but slight undulations of the lateral margins give indications of the first one or two segments. No pleopods or uropods are developed, but two pairs of long, curious structures are present in connection with the first two segments. These are large oval lamellae spreading out on the side of the abdomen and distinctly articulated with it. There are two such structures on each side of the abdomen, and both are more or less equal in size. Each is longer than the abdomen itself and is narrower near its articulation than at its distal extremity. I am unable to say definitely what these structures may be, for nothing similar has hitherto been described, to my knowledge, in the male of any *Hemiarthrus*. They appear, however, to be comparable with the similar structures present on the abdomen of the male in various species of *Ione* Latreille, as described and figured by several writers including Bonnier (1900) and Miss Richardson (1905). These structures have been differently interpreted by the earlier authors, but the two last mentioned regard them as enlarged pleural lamellae. Their position and structure in the present form seems to confirm this view. These structures in *H. filiformis* are not of exactly the same shape as they are in most species of *Ione*, but are flattened and leaf-like, somewhat like those of *I. brevicauda* Bonnier, and *I. thompsoni* Richardson.

Locality.—The four specimens (C 493/1), of which one is not accompanied by its male, are all parasites of *Alpheus paralcyone* Coutière, and were collected by Dr. S. W. Kemp in Ross Channel, Port Blair, Andaman Islands, at a depth of 2-9 fathoms in February 1921.

The presence of enlarged "pleural lamellae" on the abdominal somites in the male at once separates *H. filiformis* from all the other species of *Hemiarthrus*. The presence of such structures is of very rare occurrence in Bopyridae, and, so far as I am aware, they have not been described in any other genus except *Ione*. The genus *Hemiarthrus* is not probably directly connected with or closely allied to *Ione*, and the

presence in both of these of similar structures of such a rare occurrence cannot be said to have any genetic significance. In fact these genera are so very distinct from one another that Bonnier places them in two distinct families—Phryxidae and Bopyridae—of the section Bopyrinae. I am not here concerned with the suitability or otherwise of such an arrangement, but it suggests that the presence of this common character in these two, otherwise widely-separated, genera cannot be considered a case of homology, and is in all probability due to convergence.

The presence or absence of the " pleural lamellae " on the abdominal segments of the male may, perhaps, be considered to be a character of generic importance, and the propriety of placing *H. filiformis* in the genus *Hemiarthrus* may possibly be challenged. Except for this single character, however, the present species shows a close resemblance to the remaining forms included in *Hemiarthrus*. The general marked asymmetry ; the great development of the oostegites of one side ; the absence of some of the thoracic legs of the longer side ; and the absence of segmentation on that side ; the presence of only five abdominal segments carrying four pairs of biramous pleopods ; and total fusion of the abdominal segments of the male are some of the characters which unmistakably point to the desirability of including the species in *Hemiarthrus*. The resemblance with some of the other forms is indeed so great that if it were not for the presence of " pleural lamellae " on the abdomen of the male it would have been difficult to distinguish *H. filiformis* from *H. subcaudalis* (Hay).

var. **attenuata,** nov.

(Plate XI, fig. 7.)

This form which I regard as a variety of *H. filiformis* differs mainly from the type-species in characters of the male individuals.

Of the two *females* in the collection the larger is 4 mm. long and 3 mm. broad, while the other is 3·7 mm. long and about 2·2 mm. broad. The only appreciable difference from the *forma typica* is that the outer rami of the pleopods are more elongated and the last abdominal segments more deeply notched posteriorly.

The adult *male* is a little less than 1·5 mm. long and about two sevenths as broad. The thoracic segments taper considerably towards the sides and thus give the body an appearance of being loosely articulated. The breadth of the animal in the type-species is as much as half the length and the body has thus a stout appearance, but in the variety the breadth is only about one-fourth the length. The thoracic legs, perhaps as a result of the attenuation of the body, appear to be much longer than those of the *forma typica*. The abdomen is proportionately longer and tapers posteriorly as in the type-species, but unlike that of the latter does not end in a point. The posterior margin is, more or less, truncate and has a slight concavity about its middle. The segments are fused together, but the lateral undulations, which in the *forma typica* indistinctly mark off the anterior one or two segments, are better seen. Further, there appear to be some faint lines in correlation with these undulations which seem to mark off these segments.

The " pleural lamellae " are of the normal type and are almost as long as the thoracic legs. There are no pleopods or uropods.

Locality.—Like the type-species the variety is a parasite of *Alpheus paralcyone* Coutière, and the two specimens (C 491/1) belonging to it were collected by Dr. S. W. Kemp along with those of the *forma typica* in Ross Channel, Port Blair, Andaman Islands, in February 1921.

Hemiarthrus brevicauda, sp. nov.

(Plate XI, figs. 8, 9.)

The female in this species closely resembles *H. subcaudalis* (Hay), but the male shows considerable differences.

The *adult female* is about 3 mm. long and a little over 2 mm. in its greatest breadth. The extreme asymmetry characteristic of the genus is well marked and one side is much longer than the other and is considerably swollen. The body is almost white in colour and there are no colour markings on the dorsal or the ventral surface.

The head is pushed over to one side of the body and is deeply set in the thorax. Its anterior border is almost straight and the posterior deeply rounded. A pair of rudimentary eyes seems to be present. Ventrally the head is completely covered over by the oostegites.

The thoracic segments are more or less distinct on the shorter side of the body and slight traces of them can be made out on the other side also. The oostegites of the longer side are highly developed, while those of the other are reduced. The first oostegite of the longer side completely encloses all the others and forms the ventral surface of the body. All the seven legs on the shorter side of the body are normal and occupy their usual positions. On the other side there are only five legs, of which the first is somewhat reduced, and the remaining four are placed in the space between the thorax and the abdomen and are partly covered over by the swollen incubatory pouch. The legs have the usual structure.

The pleon consists of five almost distinct segments and carries four pairs of biramous pleopods, the two rami of which are of very unequal size. The outer ramus instead of being an oval or circular lamella, as it is in most other species, is a sac-like thick fleshy lobe, oval or reniform in shape. The inner ramus is extremely reduced and like the outer is sac-like and fleshy. The posterior margin of the abdomen is like that of *H. subcaudalis*.

The *male* differs considerably from that of Hay's species and in fact from that of any other known form. The body is somewhat long and thin, but is not as loosely articulated as in *H. filiformis* var. *attenuata*. The greatest length of the body is 0·9 mm. and the breadth at the level of the third segment is slightly less than 0·3 mm. The breadth of the body increases considerably in an antero-posterior direction and the maximum breadth is reached at the level of the sixth thoracic segment.

The head is somewhat short and is semicircular in outline, its anterior margin being regularly rounded. A pair of small eyes is present on the dorsal surface. The antennules and the antennae are both well developed and project beyond the anterior margin of the head. The former

are considerably shorter than the latter and are formed of three segments only, of which the basal is the largest. The terminal segment at its apex carries three or four long setae and the other two segments also are provided, at their antero-internal angles, with a small number of similar setae. The antennae are long five-jointed structures and like the antennules are fringed with setae at their apices.

The thoracic segments are more or less well-set and are not loosely articulated. They increase in size in a backward direction and the seventh segment is much the largest, though the maximum breadth is attained by the sixth. Also, the last segment is more clearly marked off than any of the rest, and its lines of demarcation are clearly visible even on the ventral surface. The legs also vary in size in correlation with the size of their respective segments and the first three are considerably smaller than the remaining four. They are long and somewhat slender, but have the usual structure.

The abdomen has a different shape from that of the other species. It is small and rounded, about one-fifth of the total length of the body, and is distinctly broader than long. No traces of segmentation can be seen. The posterior margin is regularly rounded and entire, not being posteriorly notched as it is in some of the other forms. Pleopods and uropods are totally absent.

The specific name of this form refers to the shortness of the abdomen.

Locality.—The three specimens (C 492/1), of which one is not accompanied by its male, were collected in February 1921 by Dr. S. W. Kemp in Ross Channel, Port Blair, Andaman Islands, at a depth of 2-9 fathoms. They are all abdominal parasites of a species of *Synalpheus* belonging to the *S. paulsoni* group and closely resembling *S. theophane* de Man.

In the characters of the female *H. brevicauda* closely resembles *H. subcaudalis*, but may be distinguished from it by the different position of the thoracic legs on the longer side of the body and by the thick fleshy sac-like rami of the pleopods. The males of the two are quite different. The characters of the male and the sac-like pleopods of the female serve to distinguish the present form from the other species described in this paper.

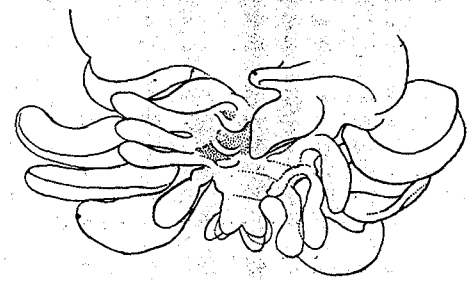
Hemiarthrus (?) sp.

The *adult female* is 4·5 mm. long and its greatest breadth slightly exceeds 2 mm. The body is highly asymmetrical and in its general characters resembles that of *H. abdominalis*. It is whitish in colour with almost the entire dorsal surface of the thorax coloured dark brown.

The head is deeply set in the thorax and is somewhat longer than broad. Its posterior margin is regularly rounded. Eyes seem to be totally absent.

The segmentation of the thorax is almost totally obliterated on the longer side of the body, while that on the other is faintly indicated. The segments are very closely crowded together. All the seven legs are present on the shorter side, each having the usual structure. I have not been able to find any leg on the longer side of the body, but I believe that the first leg must originally have been present and that its loss is, in all probability, due to a mechanical injury of some sort. The last four legs of this side are altogether absent. The oostegites of one side are highly developed and as usual enclose those of the other side.

The abdomen is proportionately large and though the lines of demarcation cannot be clearly made out, seems to consist of the usual number of segments. The four pairs of pleopods show a considerable development and look like those of *H. abdominalis*. The pleopods of the longer side are markedly larger than those of the other. The outer rami of both the sides are in the form of broad thin lamellae spreading out on the sides. The inner rami are proportionately much reduced and those of the longer side are moderately broad, while those of the other are narrow, especially towards their proximal ends. Besides these four pairs of pleopods the ultimate segment is also provided with appendages.



TEXT-FIG. 3.—*Hemiarthrus* sp.
Ventral view of abdomen of female: × 2 (slightly diagrammatic.)

These are small biramous lamellae looking from their position and structure very much like uropods. They stand out from the posterior end of the animal, one on each side of the body, and each consists of two small leaf-like plates, the outer of which, like that in the pleopods, is larger than the inner.

I have not examined any male specimen.

Locality.—The single adult female of this form that I have examined is an abdominal parasite of a species of *Processa*. It was collected by Dr. S. W. Kemp in February 1913 at Kilakarai in the Gulf of Manaar, among weeds, etc., near the shore. I am unable to say what exact position the parasite occupies on the under surface of the host, but the label in the bottle containing it notes that it was found on the abdomen.

I have some doubts regarding the generic position of this form as the presence of well-developed biramous appendages on the last abdominal segment in the female has not hitherto been recorded in any species of *Hemiarthrus*. Except for the possession of uropods, however, the female of the present form closely resembles that of *H. abdominalis*.

A species has already been recorded by Giard and Bonnier (1890) under the name of *Hemiarthrus philonika* as a parasite of *Nika* (=*Processa*) *edulis* Risso, but as no description or figures of it have, to my knowledge, been published I am unable to compare my form with the European species. Under the circumstances I have considered it best to describe the Indian form without assigning it a specific name.

Genus **Diplophryxus** Richardson.

1904. *Diplophryxus*, Richardson, *Proc. U. S. Nat. Mus.* XXVII, p. 50.

The genus may be defined thus :—

Abdominal parasites.

Female. Body of adult highly asymmetrical and deformed, one side greatly swollen.

Head deeply sunk in thorax, but distinct from it. Eyes absent.

Thoracic segments distinct on the shorter side ; the first five crowded together, the last two considerably longer than the rest. Ovarian bosses and epimera not developed. Incubatory plates only four pairs, and very unequally developed on the two sides of the body ; those of the shorter side consisting of four small plates placed near the anterior margin. All seven legs present on shorter side of the body, but all, except the first, poorly developed. On the other side only the first leg present.

Abdomen formed of five segments clearly defined on the dorsal surface. Pleural lamellae totally wanting. Last segment a small posteriorly rounded structure. First four segments carrying each two pairs of biramous pleopods, a pair on either side. Each pleopod arising as a uniramous structure and dividing into two branches at a considerable distance from the segment. Fifth pair of pleopoda and uropoda wanting.

Male. Head small and distinct from the thorax, sometimes bearing a pair of small eyes.

Thoracic segments distinct, each carrying a pair of well-developed legs.

Abdominal segments completely fused, without a trace of pleopoda and uropoda.

Type species :—*Diplophryxus jordani* Richardson.

The present genus is very closely related to *Hemiarthrus* (=*Phryxus*), from which it differs principally in the character of the pleopods of the female. Miss Richardson is obviously wrong in describing the pleopoda in *Hemiarthrus* as single-branched and in distinguishing her genus *Diplophryxus* by the double-branched pleopoda. Though these structures are biramous in both the genera, their nature is different ; in *Diplophryxus* the pleopod originates as a single-branched structure and divides into two at a considerable distance from the body, while in *Hemiarthrus* they are double-branched from the very point of their origin. The two rami of the pleopod in Miss Richardson's genus are more or less equal in size and somewhat similar in shape, while in the allied genus the outer ramus is considerably larger than the inner and is generally of a different shape. Correlated with this difference in the pleopods there are certain other characters which help to separate the two genera. In *Diplophryxus* the last two thoracic legs even on the shorter side of the body are considerably reduced. The incubatory lamellae of the shorter side are not concealed by those of the other side but are present as four small plates near the anterior end of the body and the first one of the other side folds back to cover a portion of the head dorsally. The first pair of antennae have a very remarkable shape.

The genus is so far known from a single species, a parasite of a *Leander* (=*Palaemon* of Miss Rathbun and some other American zoologists) from Japan. The Indian specimen which appears to me to belong to the same species was collected in the Bay of Bengal and was found on the same species of *Leander* as the Japanese form. A young specimen described by Miss Richardson (1904, p. 45) as *Phryxus* sp. perhaps also belongs to this genus.

Diplophryxus jordani Richardson.

1904. *Diplophryxus jordani*, Richardson, *Proc. U. S. Nat. Mus.* XXVII, pp. 50, 51, text-figs. 26-28.

The single Indian specimen which I refer to this species agrees in almost all essential respects with Miss Richardson's fairly detailed description of the Japanese form. My specimen is an ovigerous female and is accompanied by its male.

The adult *female* is 5·2 mm. in its greatest length and a little over 3 mm. broad. The colouration of the body seems to be very characteristic. The general colour is white, but the thorax on both its surfaces has large pigmented areas. Dorsally the thorax is coloured dark brown along the shorter side of the body, and a patch of a similar colour, but larger in size, runs along the other side of the body, which is really formed by the large marsupium extending dorsally beyond the limits of the body proper. Ventrally all the oostegites of the shorter side are coloured, and those of the other side have two broad bands of pigment, one near the anterior and the other near the posterior extremity of the thorax.

The head is deeply sunk in the thorax and is, on the dorsal surface, partly covered over by the first oostegite. The first pair of antennae are proportionately much longer than shown in Miss Richardson's figure, and are composed of two, somewhat flattened, joints of which the second, in my specimen, is about as long as the first.

The first five thoracic segments are crowded together but the last two, and especially the seventh, are considerably larger than the rest. The incubatory lamellae are arranged as described by Miss Richardson ; those of the shorter side are four small plates, partially overlapping one another, placed near the anterior end of the shorter side of the body. Only one leg is present on the longer side, and of the seven on the other all but the first are reduced ; some of the anterior ones of this side are partly covered over by the small oostegites.

The pleopoda are best seen from the dorsal surface, where those of the longer side seem to lie against the dorsal surface of the swollen marsupium. Each pleopod arises as a large stalk and after running outward for a considerable distance divides into two leaf-like branches. The undivided stalk is almost as long as the divided portion. The pleopods of the longer side are larger than those of the other, and the two rami of each pleopod on both sides of the body are more or less similar in size and shape. The five abdominal segments are clearly distinguishable on the dorsal surface and the terminal one is posteriorly rounded and not provided with appendages.

The *male* specimen that I have seen differs somewhat from Miss Richardson's description and figure. It is 1·2 mm. long and a little over 0·3 mm. broad. A few pigment spots are irregularly scattered over the thorax and the abdomen.

The head is small and its posterior boundary is almost straight. A pair of small distinct eyes is present near the anterior margin. Ventrally the antennules project slightly beyond the margin of the head. They are formed of two large joints of which the basal is somewhat broad and the terminal one is provided with a number of stiff setae. The antennae seem to be smaller and do not project beyond the head.

The abdomen in my specimen is proportionately larger than shown in Miss Richardson's figure. In the latter it is seen to be about two-sevenths of the total length of the body and is only slightly longer than broad. In my specimen, on the other hand, it is a little less than two-fifths of the total length and is only about half as broad as long. The shape of the two is also somewhat different. All the segments are completely fused and appendages are totally absent.

Locality.—The single Indian specimen is a parasite of *Leander serrifer* Stimpson, and was collected by the R. I. M. S. "Investigator" at Una Island in the Mergui Archipelago. It is a part of a large shore collection made in December 1913. Miss Richardson's specimens are parasites of the same *Leander* and were collected at Misaki in Japan. This species of *Leander* was hitherto known to live only along the coast of China and Japan; its occurrence in Indian waters infected with the same Bopyrid which it harbours in Japan is interesting.

Genus **Orbione** Bonnier.

1900. *Orbione*, Bonnier, *Trav. Stat. Zool. Wimereux* VIII, pp. 280-284, pl. xii and text-fig. 50.
1906. *Orbione*, Nobili, *Atti R. Accad. Sci. Torino* XLI, pp. 1101-1104, fig. 2.
1910. *Orbione*, Thielemann, *Abh. Bayer. Akad. Wiss. München*, II Suppl. Bd. 3 Abh., p. 78.
1910. *Parapenaeon*, Richardson, *Documents U. S. Bur. Fisheries*, No. 736, pp. 40, 41 (*partim*) *nec* 1904. *Parapenaeon*, Richardson, *Proc. U. S. Nat. Mus.* XXVII, pp. 43, 44.
1910. *Orbione*, Richardson, *Documents U. S. Bur. Fisheries*, No. 736, p. 40.
1923. *Orbione*, Nierstrasz and Brandis,[1] *Siboga Exped. Rep.* XXXII*b*, p. 64.

The genus is characterized as follows :—

Branchial parasites.

Female. Body of adult rounded or oval, only slightly asymmetrical. Head distinct from the thorax, prolonged anteriorly into a frontal lamina. Rudimentary eyes sometimes present. Maxilliped provided with a stout finger-shaped palp, not carrying any setae.

Thoracic segments all distinct and clearly defined. Ovarian bosses fairly well developed. Epimera of all the segments, especially those of the first four, highly developed in the form of large rounded lobes—sometimes bluntly pointed in the posterior segments. Incubatory cavity somewhat open or even totally covered up. Legs provided with a large prominence on the basal joint.

Abdomen fairly large, and considerably broader than long. All the abdominal segments distinct, their lines of demarcation being well

[1] See addendum, p. 540.

defined. Pleura of all the segments present, lamellar and separate. Sixth segment also distinct and provided with its pleural lamellae. Five pairs of biramous pleopods present. The rami and part of the ventral —as sometimes also the dorsal—surface of the abdomen covered with warts and tubercles. Uropoda uniramous and also covered with tubercles.

Male. Head distinct from the thorax and bearing a pair of well-developed eyes. Antennules triarticulate and antennae composed of five segments.

Thoracic segments all well defined, each carrying its pair of well-developed legs.

Abdomen small and rounded; its segments fused together, sometimes the first slightly indicated laterally. No pleopoda or uropoda present.

Type-species :—*Orbione penei* Bonnier.

Orbione is a member of the group of genera formed by *Gigantione* Kossmann, *Parapenaeon* Richardson, *Epipenaeon* Nobili and *Orbimorphus* Richardson. All the genera of this group are characterized by a considerable development in the adult female of pleural lamellae on all the thoracic segments and on all, or all but one, of the abdominal segments. Most of the genera have prominent secondary ramifications or tubercles on the pleopods and a part of the surface of the abdomen. Within the group *Orbione* is characterized by the development of pleural lamellae on all the six abdominal segments and by the possession of uniramous uropods. Further, all the six abdominal segments are clearly defined and there are five pairs of pleopods. This combination of characters easily distinguishes *Orbione* from the remaining members of this group as shown in the following key :—

I.—Only five abdominal segments visible in adult female. [Uropoda biramous.]
  A. Epimera present on all segments of abdomen; five pairs of pleopoda present ... ... *Epipenaeon* Nobili.
  B. Epimera present on first four abdominal segments only, not greatly developed; only four pairs of pleopoda present ... ... *Orbiomorphus* Richardson.

II.—All six abdominal segments visible in adult female. [Five pairs of pleopoda present.]
  A. Epimera present on all six abdominal segments; uropoda uniramous ... ... *Orbione* Bonnier.
  B. Epimera present on five abdominal segments only; uropoda biramous.
    1. Uropoda not provided with a basal peduncle; abdominal segments of male fused, not carrying pleopoda or uropoda ... *Parapenaeon*[1] Richardson.
    2. Each uropod provided with a large basal peduncle carrying two small branches; abdominal segments of male distinct, carrying pleopoda and uropoda ... *Gigantione* Kossmann.

[1] In *Parapenaeon* Miss Richardson described in 1904 uniramous uropods, but she seems to have discovered later (1910*b*) that these structures are really biramous. Not having examined any specimens myself I presume Miss Richardson's later statement must be correct.

Nierstrasz and Brandis have, however, recently (1923) shown that the uropoda are really uniramous as originally described by Miss Richardson.

Of all the genera in the group, *Orbione* seems most closely to resemble Miss Richardson's *Parapenaeon*, the two genera being distinguished from each other only by the biramous uropoda in the former and the absence of pleural lamellae on the sixth abdominal somite in the latter. The males in the two genera are also similar. These relationships have also been discussed under the account of the genus *Epipenaeon*.

In a short paragraph giving the principal characters of the genus, Bonnier definitely states that the uropoda in *Orbione* are uniramous. In his description of *O. penei* also he is clear about their uniramous nature. "Les uropodes sont bien developpés, simples, mais n'atteignent pas la longueur des lames pleurales du sixiéme somite" (1900, p. 282.) Again in the description of *O.* (?) *incerta* he says: "L'uropode est simple et formé d'une lamelle un peu plus étroite et un peu plus longue que la lame pleurale du cinquième somite" (p. 284). In his figure of *O. penei* also he has shown the uropoda uniramous. In fact he attaches so much importance to it that he uses this character alone for distinguishing *Orbione* from the genus *Gigantione*. Nobili (1906*a*) also, in describing his *O. bonnieri*, has mentioned uniramous uropoda. He writes: "Gli uropodi sono allungati, lunghi quasi come le lamine pleurali del vi segmento e uniramosi" (p. 1103). In his figure (1*d*) also the uropoda are shown uniramous. Miss Richardson,[1] however, seems to have discovered in 1910 that the uropoda are not uniramous. She says "Uropoda are biramous in the female and not single branched as described by Bonnier" (1910*b*, p. 40). I an unable to agree with this amended definition proposed by Miss Richardson for it is defficult to conceive how such careful workers as Bonnier and Nobili could have made such an extraordinary mistake. The uropoda in this genus are large and it is not difficult to find out their structure. In the specimen I have described in this paper under the name of *O. kempi*, sp. nov. the uropoda are clearly seen to be uniramous. It is possible that the specimen which Miss Richardson examined does not belong to *Orbione* at all. Her statements about the uropoda in the female of *Parapenaeon*, as pointed out above (p. 445, foot note), are also conflicting.

I am unable to agree with Miss Richardson, when without giving reasons, she refers *Orbione bonnieri* Nobili, to her genus *Parapenaeon*. As can be seen from the quotation given above Nobili has definitely described the uropoda as uniramous and his figures show their structure clearly. Further in Miss Richardson's genus the sixth abdominal segment is very small and does not carry any pleural lamellae; in *O. bonnieri* on the other hand "II pleon è ben sviluppate e tutti i suoi sei articoli sono distincti, e provvisti di *lunghe* lamine pleurali arrotondata o subacute all' apice" (Nobili, 1906*a*, p. 1103). The terminal segment of the abdomen is also quite large. To me there seems to be no reason to suppose that Nobili's figure is incorrect and that what he has figured and described as the pleural lamellae of the sixth segment are really the rami of the uropoda.

The genus *Orbione* is an oriental one, and lives exclusively in the warm waters of the tropics. The type-species, *O. penei* Bonnier, is a

[1] See Nierstrasz and Brandis (1923), p. 67, as also addendum p. 540.

parasite of an undetermined species of *Penaeus* and was found at Hong-Kong. Miss Richardson's "*O. penei*" was procured somewhat further south, having been collected near Antonia Island in latitude 11° 36′ N. The host of this form, though not mentioned by Miss Richardson, presumably belongs, like that of Bonnier's specimen, to the genus *Penaeus*. Nobili's *O. bonnieri* was collected still further south—at Singapore—and is a parasite of *Metapenaeus monoceros*. *O. kempi*, sp. nov., comes from the Andaman Islands and is a parasite of a species of *Sicyonia*. Mention must also be made of a form which Bonnier referred doubtfully to this genus. It was collected at Madagascar and was found, accidentally in Bonnier's opinion, on the abdomen of a crab. Except for the Brachyurous host there does not seem to be any substantial reason why *O. incerta* should not be placed in the genus *Orbione*. Pérez (1920), however, places this species in his new genus *Rhopalione*, chiefly because of the peculiar mode of attachment to the abdomen of the host. The species seems to me, however, to be a true *Orbione*, for among other characters, the pleural lamellae of the thoracic segments are very characteristic.[1] The form provisionally referred to in this paper as *Orbione* sp. is a parasite of *Processa* sp., and was collected on the Pearl Banks, Ceylon.

The four known species of the genus may be distinguished from one another as follows[2]:—

I. Body of adult female almost as long as broad; pleural lamellae of abdominal segments somewhat pointed.	
A. Frontal lamina of head large; exposed surface of pleopoda tuberculate	*O. penei* Bonnier.
B. Frontal lamina of head poorly developed; exposed surface of pleopoda not tuberculate	*O. incerta* Bonnier.
II. Body of adult female distinctly longer than broad; pleural lamellae of abdominal segments more or less rounded.	
A. Dorsal surface of abdomen partly tuberculate; frontal lamina of head longer than head; incubatory cavity closed; first two thoracic segments of male directed forwards	*O. bonnieri* Nobili.
B. Dorsal surface of abdomen not tuberculate; frontal lamina of head about half the length of head; incubatory cavity open; first two thoracic segments of male directed outwards	*O. kempi*, sp. nov.

Orbione kempi, sp. nov.

(Plate XII, figs. 1–5).

The *adult female* is 3·7 mm. long from the anterior margin of the frontal lamina to the posterior extremity of the uropoda and the breadth at the level of the third thoracic segments is 2·6 mm. The body is more or less oval in shape and as usual in the genus is only slightly asymmetrical. The single specimen I have examined is a "right bopyrid" with its left side slightly deformed. The body is pale yellowish in colour, with the head, sides of the thorax and abdomen almost white. There are no characteristic colour-makings on the dorsal or the ventral surface.

[1] See addendum, p. 540.

[2] Nierstrasz and Brandis's new species are not included in this key.

The head is distinct from the thorax and is deeply set in it. It is slightly broader than long and both its anterior and posterior margins are regularly rounded. The head is prolonged forward in a well-developed frontal lamina, the anterior margin of which is almost straight. The lamina is a little less than half the length of the head, resembling that of *O. penei* Bonnier, and differing from that of *O. bonnieri* Nobili, in which it is longer than the head itself. A pair of small eyes is present about the middle of the head, one on each side.

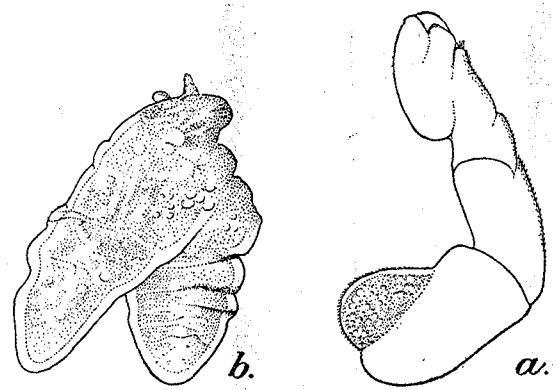
The thoracic segments are all distinct and their lines of demarcation, though somewhat faint, can easily be traced throughout the dorsal surface. The first segment is considerably shorter than the second, being about half its length, while all the rest are more or less equal. The ovarian bosses are fairly well developed, but are more distinctly seen on the deformed side of the body, where they appear as large oval or rounded structures occupying more than the anterior half of the margin of their respective segments. The pleura of the non-deformed side are better developed than those of the other and extend considerably on the side of the thorax. In the first four segments they lie lateral to the bosses, from which they are separated by distinct grooves. The margin of the segment behind the boss does not carry any pleural lamella. Though developed on the anterior part of the segments only, the pleural lamellae extend for some distance in front of the segment. The epimera of the last three segments are also large, and unlike those of the anterior segments occupy the entire margin of their respective segments. The epimera of the first six segments extend forward from their origin and some of them overlap the posterior portion of the epimera immediately in front of them; but those of the seventh segment—as shown also in Bonnier's figure of *O. penei*—extend outward. The epimera of the deformed side are comparatively much less developed.

The abdomen is proportionately small, being about one fourth the total length of the body, and is broader than long. In the other three species the abdomen is considerably larger. All the six segments are distinct, but their lines of demarcation, especially towards the posterior extremity, are seen only with difficulty. The sixth segment is small and is a rounded median structure. The pleural lamellae of all the segments are well developed and diminish in size from the first to the last. The sixth segment carries its own pair of small, divergent pleura. The pleura of the deformed side are considerably less developed than those of the other. There are no tubercles on the dorsal surface of the abdomen, as there are in *O. bonnieri*.

On the ventral surface the head carries the usual appendages. The antennules and the antennae are both placed close behind the anterior margin of the head and project somewhat beyond it. Both these appendages have a scaly appearance and the terminal segment in both is crowned with a small number of hairs. The antennules are triarticulate and the antennae are composed of five segments, the terminal segment in both being considerably reduced. The basal article is large and its surface is not covered with scales. The mandibles are large and somewhat curved. All the mouth parts resemble those of *O. penei* as

shown in Bonnier's figures. The posterior lamina is digitate and its secondary lobes have their external margins broken up into digitation and lobes. The margins of the lobes, especially the outer ones, appear to be somewhat scaly and hairy. The maxilliped, except for its palp, is completely covered over by the first oostegite. It is short and broad and has the usual shape. The palp is large, stout and finger-shaped, somewhat curved near the anterior end. It is devoid of hairs but its entire surface is strongly scaly. Except for its scaly nature the palp is very much like that of *O. penei*. A part of the inner margin of the anterior segment of the maxilliped is also scaly.

The oostegites are of a large size and the incubatory cavity is extensive. The cavity is not completely roofed over by the oostegites but an opening larger than that of *O. penei* is left in the middle. The first oostegite has the usual shape. The anterior segment is almost round and its anterior margin is strongly convex. The posterior segment is drawn out at its infero-external angle into a short blunt lobe. The internal crest is fairly well developed, but is not particularly lobate. Except for a large lobe and two or three smaller ones near the proximal end, it is entire. There are no hairs along the inner margin of the posterior lobe. The remaining oostegites have the usual shape and those of the fifth pair enclose the incubatory cavity posteriorly. The thoracic legs are large and are more or less normal in structure. The basipodite is large and rectangular and has a prominent rounded boss on its outer margin. The boss is scaly and its margin seems to be covered with minute hairs. The ischium is also well developed and like the preceding segment is rectangular. The merus and carpus are reduced and the latter has on its margin near its junction with the propodus about four long hairs. The propodus is large and bears a prominent projection on its margin opposed to the stout, pointed claw.



Text-fig. 4.—*Orbione kempi*, sp. nov.
a. Thoracic leg of female: × 100. *b*. Pleopod: × 100.

The abdominal segments on their ventral surface are all raised in strong ridges, the exposed surface of which is not frilled, as shown by

Bonnier in his figures of *O. penei*. All the five pairs of pleopods are well-developed, biramous structures extending along the sides of the body so as to leave the entire ventral surface of the abdomen uncovered. The pleopoda are in most cases larger than the pleural lamellae of their respective segments and are thus visible from the dorsal surface of the body also, especially along the deformed side, where the pleural lamellae are rather poorly developed. The uropoda are a pair of large uniramous structures projecting from the posterior extremity of the body. They are almost as large as the pleura of their segment. The surface of the pleopoda, especially near their margins, is covered with tubercles and warts. The uropoda also seem to have a few tubercles scattered on their surface.

The *male* is short and stout; it is 1·4 mm. long and a little less than half as broad. The general colour of the body is whitish and there are no characteristic markings on its dorsal or ventral surface.

The head is distinct from the thorax and is deeply set in it. The anterior margin is regularly rounded, while the posterior is drawn out backwards to a more or less sharp angle. A pair of well-developed black eyes is present about the middle of the head. The antennules and the antennae are both large and are formed of three segments each. The antennae are larger than the antennules and project a little beyond the anterior margin of the head. The two basal segments are large in both the pairs and the terminal is somewhat reduced. The latter has a crown of stiff setae, and the inner margin of the second segment at its anterior end also bears three or four hairs. The mandibles are large.

The seven thoracic somites have their margins rounded. Unlike *O. bonnieri* the anterior somites are not directed forward. The first three or four segments are more or less directed outward while the remaining ones are directed backward. The thoracic legs are large and the propodus is proportionately larger than that of the female, and the dactylus also shows a greater development.

The abdomen, as in *O. bonnieri*, is short, being only about a fourth of the total length of the body. Its breadth considerably exceeds the length and its posterior margin is regularly rounded. All the somites are completely fused together, only a slight constriction of the margin on both sides near the anterior end seems to indicate the first segment. No trace of pleopoda or uropoda is visible.

Locality.—The one male and one female (C 489/1) that I have examined were collected by Dr. S. W. Kemp in February 1921 in Ross Channel, Port Blair, Andaman Islands, at a depth of 2-9 fathoms. It is a left Bopyrid, having been found in the left branchial cavity of a specimen of *Sicyonia bispinosa* de Haan, a species that was so far known from Japan and the Sulu Archipelago only.

The principal characters in which *O. kempi* differs from the other species of the genus may be summarized as follows:—

1. The body of the adult female is distinctly longer than broad. The species in this respect resembles *O. bonnieri* and differs from the others.

2. The abdomen of the female is only about a fourth of the total length of the body. In the other three species it is markedly longer.

3. The frontal lamina of the head is about half as long as the head itself. In this character *O. kempi* resembles *O. penei*. In *O. bonnieri* the lamina is longer than the head itself, while in *O. incerta* it is almost insignificant.

4. The pleural lamellae of the deformed side of the abdomen are very considerably reduced. In none of the other species is the reduction at all appreciable.

5. There are no tubercles on the dorsal surface of the abdomen as there are in *O. bonnieri*.

6. The antennules and the antennae are both triarticulate. In the other species the antennae are formed of five segments.

7. The incubatory cavity has a large opening. In *O. bonnieri* the cavity is completely roofed over by the oostegites, while in *O. penei* there is a small opening left in the middle.

8. The ridges on the ventral surface of the abdomen are not frilled as they are in *O. penei*.

9. In the male the anterior segments of the thorax are not directed forward as they are in *O. bonnieri*. In the other two species the male is unknown.

Orbione sp.

A somewhat damaged specimen, parasitic on a species of *Processa*, also seems to belong to *Orbione*. Being in an unsatisfactory condition, it has not been possible to study it in detail, and consequently its generic position is somewhat doubtful.

The *adult female* is distinctly broader than long, its length and breadth being 2·5 and 3·2 mm. respectively. The body is only slightly asymmetrical, the right side in the present specimen being somewhat deformed. The general colour of the body is pale yellowish and there are no characteristic markings.

The head is distinct from the thorax and is considerably broader than long. It is prolonged forward into a frontal lamina, but the latter does not show any considerable development. The anterior margin is somewhat concave, while the posterior is regularly rounded. The eyes are wanting. The antennules and the antennae are both well developed and appear to be three-segmented. The maxilliped has the usual form, but its palp is considerably reduced.

The thoracic segments are all distinct and their lines of demarcation are clearly seen. The ovarian bosses are in the shape of prominent rounded structures, seen clearly on the deformed side of the body. The margins of the segment behind the bosses are separated off by slight constrictions. The pleural lamellae are moderately developed but not to as great an extent as in the preceding species. They are in the form of somewhat broad plates with their margins almost straight. In the first four segments they are developed only lateral to the bosses, but in the last three segments they occupy the entire margins. The incubatory cavity is large and is only partially covered over by the oostegites. The first oostegite is somewhat short and broad and its posterior segment is drawn out into a small but distinct lobe, rounded at the extremity. The internal crest is well developed and is almost entire. A few hairs

are present along the inner margin of the posterior lobe. The legs have the usual structure.

The abdomen is very short and is somewhat turned downward. Its length falls considerably short of its breadth. The segments are closely crowded together with the result that their lines of demarcation are difficult to make out. The segments are provided with well-developed pleural lamellae, those of the deformed side being somewhat shorter than the other. The lamellae are broad plates, separated from one another, with their free margins straight or slightly rounded. The sixth segment also has a well-developed lamella. On the ventral side the abdomen is damaged and some of the appendages are missing. The pleopoda are, however, clearly seen to be biramous and the uropoda are probably uniramous. The pleopoda do not seem to be appreciably tuberculate.

The male is not present.

Locality.—The single female specimen that I have examined is a parasite of the left branchial cavity of *Processa* sp. and was collected by Mr. T. Southwell on the Ceylon Pearl Banks.

From other species of the genus the present form may be distinguished by its markedly broader body and the smaller size of the epimera of the thoracic segments. The frontal lamina of the head is also poorly developed.

Genus **Epipenaeon** Nobili.

1906. *Epipenaeon*, Nobili, *Atti R. Accad. Sci. Torino* XLI, pp. 1098-1110, pl. fig. 1.

1910. *Epipenaeon*, Thielemann, *Abh. Bayer. Akad. Wiss. München*, II Suppl. Bd., 3 Abh., pp. 79-81, text-figs. 86, 87.

The genus may be defined as follows :—

Branchial parasites.

Female. Body large, oval, only slightly asymmetrical.

Head distinct from the thorax, prolonged anteriorly into a rather narrow frontal lamina. Rudimentary eyes sometimes present.

Thoracic somites distinct and the lines separating them clearly defined. Ovarian bosses large. Epimera of all the somites highly developed in the form of broad rounded lobes. Incubatory cavity somewhat open in the middle. All the legs provided with a large boss on the basipodite.

Abdomen generally large, considerably broader than long. Somites clearly defined but only five visible dorsally.[1] Pleural lamellae on all the somites well developed. Five pairs of biramous pleopoda present. Uropoda also biramous. Rami of the pleopoda and uropoda, a part of the ventral and sometimes also the dorsal surface of the abdomen covered with warts and tubercles.

Male. Body somewhat more than twice as long as broad.

Head small, distinct from the thorax. Eyes extremely reduced or even totally absent. Antennules three-segmented.

[1] In one of the two females from which Thielemann described his species *E. japonica* the sixth segment is said to be present in the form of a small projection between the pleural lamellae of the fifth segment. If the sixth segment is really present the specimen will probably have to be referred to Miss Richardson's genus *Parapenaeon*. I am, however, not at all sure if the structure described by Thielemann is really the sixth segment.

Thoracic somites distinct, their lateral margins deeply notched and rounded, the first two or three directed anteriorly.

Abdominal somites completely fused, forming a rounded or subtriangular structure. No trace of pleopoda or uropoda present.

Type-species :—*Epipenaeon ingens* Nobili.

The genus, according to Nobili, comes very close to *Parapenaeon* Richardson (1904a). I have elsewhere[1] explained how, in the possession of well-defined pleural lamellae on all the thoracic and all, or all but one, abdominal somites in the adult female, both these genera are members of the group in which *Gigantione* Kossmann, *Orbione* Bonnier and *Orbiomorphus* Richardson are also included. The marked resemblance between *Parapenaeon* and *Orbione* has also been pointed out. *Epipenaeon* seems to me to be, if anything, more clearly related to *Orbione* than to *Parapenaeon*. The general shape of the body, the marked similarity in the shape of the maxilliped and the first oostegite, the presence on all the segments of well-developed pleural plates, the presence of tubercles on the abdominal appendages and the great resemblance between the males show this relationship closely, but the genus is also related, though less nearly, with *Parapenaeon*. The principal point of difference between *Epipenaeon* on one side and *Orbione* and *Parapenaeon* on the other is that there are only five abdominal segments in the former while all the six are present in the latter two genera. The uropoda moreover, are biramous in Nobili's genus while uniramous in *Orbione*.[2] In *Parapenaeon* the uropoda according to Miss Richardson's latest statement (1910b) are biramous. Biramous uropoda coupled with the presence of pleural lamellae on the thoracic and the abdominal somites are also met with in *Gigantione*, but the differences[3] between these two forms outweigh these isolated points of similarity.

Epipenaeon also bears a great resemblance to *Orbiomorphus* Richardson (1911a). Both the genera are characterized in the female sex by a considerable development of epimera on the thoracic segments, the presence of only five abdominal somites and the biramous uropoda. The males[4] are also similar. Apart from the fact that *Orbiomorphus constrictus*, the type of Miss Richardson's genus, is a parasite of one of the Anomala [*Petrolisthes armatus* (Gibbs)], while the members of the genus *Epipenaeon* live on species of *Penaeus*, the only essential differences between them are that in *Orbiomorphus* there are, in the female, only four pairs of pleopods and that the fifth abdominal segment does not carry any pleural lamellae. The resemblance between the two genera

[1] See under the account of the genus *Orbione*, p. 445.

[2] I have already (p. 446) remarked on Miss Richardson's (1910) erroneous attribution of biramous uropoda to the genus.

[3] Even the uropoda of *Gigantione* are fundamentally different from those of *Epipenaeon*. In Bonnier's *G. bouvieri*, where the uropoda are in accordance with the generic characters, " ils sont formés d'un large pédoncule (basipodite) parfaitement distinct qui porte deux petites branches cylindriques, effilées à leur extrémité libre et à peu près égales " (1900, p. 279); while in Nobili's genus they are formed of two pairs of thin lamellae very much like the pleopoda, without any basal peduncle or any slender free extremity.

[4] In a foot-note Miss Richardson (1911a, p. 83) says that the male of the genus *Orbione* is not known and that she hopes to describe it shortly for the first time. She seems to have overlooked the fact that Nobili had already (1906a) published a detailed description and a fairly good figure of the male of *O. bonnieri*.

is, however, very noteworthy since both are in common characterized by the possession of an unusually small number of abdominal segments.

The genus has hitherto been known from two species *E. ingens* Nobili and *E. japonica* Thielemann. The former is a parasite of *Penaeus ashiaka* Kishinouye, and was collected in the Red Sea. *E. japonica* comes from Japan and is a parasite of an undetermined species of *Penaeus*. The Indian species, *E. elegans*, is a parasite of the common estuarine prawn (*Penaeus*) of the Gangetic Delta. The three species of the genus may be distinguished from one another thus :—

I. Body of adult female distinctly longer than broad; abdomen about one-third of total length.	
A. Frontal lamina of head large; dorsal surface of abdomen partly tuberculate; pleural lamellae of abdomen well developed; thoracic segments of male not deeply notched laterally	*E. japonica* Thielemann.
B. Frontal lamina of head very small; dorsal surface of abdomen not tuberculate; pleural lamellae of abdomen poorly developed; thoracic segments of male deeply notched laterally	*E. ingens* Nobili.
II. Body of adult female almost as long as broad; abdomen a little less than half total length of body. [Frontal lamina of head small; dorsal surface of abdomen not tuberculate; pleural lamellae of abdomen well developed; thoracic segments of male deeply notched laterally.] ...	*E. elegans*, sp. nov.

Epipenaeon elegans, sp. nov.

(Plate XII, figs. 6-11.)

The largest adult *female* in the collection is about 17 mm. long and almost as broad. The body is somewhat circular in outline and is slightly asymmetrical. The colour of the animal in spirit is uniformly whitish or pale yellowish, the oostegites of the deformed side having dark pigment spots.

The head seen from the dorsal surface is broader than long. The anterior border is regularly rounded and is provided with a narrow frontal lamina. It has the appearance of being transversely divided into two unequal portions; the anterior of which is the smaller of the two and carries a pair of small crescent-shaped eyes. The posterior border of the head is regularly rounded and is notched about its middle so that the posterior portion of the head seems to be formed of two longitudinal halves. In some specimens the notch is continued anteriorly into a groove, running in the middle of the posterior portion of the head.

All the thoracic somites are quite distinct, both dorsally as well-as laterally. The first somite is almost as long as the second. All the somites are arched anteriorly in the median line. There are well-developed ovarian bosses on the first four segments; the first is placed anteriorly, the second antero-laterally, while the last two are lateral. Each boss is an elongated oval structure, and those of the non-deformed side are better developed than those on the other. The bosses are placed on the anterior portion of their respective segments, and the posterior portion of each segmental margin behind the boss presents a large swelling like the ovarian boss itself, but running in a transverse direction. All the somites have well-developed pleural lamellae but those of the

non-deformed side show a greater development than those on the other. The arrangement of the pleura is clearly seen on the non-deformed side of the body. The first pleural lamellae extend forward on the dorsal surface of the head and backward on the ventral surface of the second pleural plate. The second similarly overlap the first on the dorsal side and are overlapped by the third on the ventral, and this arrangement continues till in the seventh segment the pleura overlap both the preceding and the succeeding lamellae dorsally. The pleura diminish in size from the first to the seventh somite.

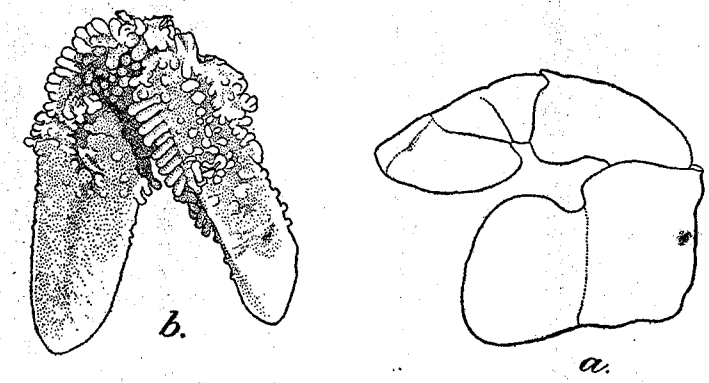
The abdomen is proportionately long being a little less than half the total length of the body. All the somites have their pleura well developed on both sides of the body, more so than those of *E. ingens*. The pleural lamella of the last somite is large and is formed of two portions. The lines of demarcation between the somites are distinct throughout the dorsal surface. Only five somites are visible dorsally. The abdominal somites like those of the thorax, are strongly arched in a forward direction in the median line.

Ventrally the head presents the usual appendages. The antennules are triarticulate. The basal segment is swollen while the terminal is small. The antennae seem to be formed of four segments, of which the basal is considerably swollen and the terminal somewhat small. Both the pairs of antennae do not bear any hairs. The "lips" and the rostrum are as usual well developed. The mandibles are powerful curved structures and the first pair of maxillae is somewhat elongated. The second pair is situated further backward and is extremely reduced. The posterior lamina of the head is like that figured by Bonnier (1900, pl.xii, fig.4) for *Orbione penei*, with the difference that the median rounded lobe is somewhat smaller and has a small number of filiform processes near its outer extremities, and also those in connection with the two pairs of secondary lamellae. The maxilliped is formed of the usual two portions, but the basal triangular segment is smaller than is generally the case. The muscles at the base of the anterior segment are powerfully developed. The palp[1] is a large finger-shaped process, the margins of which are wrinkled at places to give it an annular appearance. It does not bear any setæ. The palps of the two maxillipeds in the natural position almost meet in the middle line.

The incubatory cavity is large, and as in Nobili's species is only partly roofed over by the oostegites, there being left a small open space in the middle. The first oostegite has the usual two segments, the anterior of which is large and has its inner and anterior margins regularly rounded. The posterior segment is produced at its infero-external angle in a short blunt lobe rounded at its extremity. There appear to be no hairs along the inner margins of this lobe. The internal crest is prominent and the lower margin carries a large number of digitations and processes along its entire length. The fifth oostegite is much longer than broad and its posterior margin is beset with a row of cilia. Some of the anterior thoracic legs are partly covered over by the oostegites. The legs have the usual structure, and each has on the upper surface of the basal segment a very large, almost oval, prominence, not covered over with

[1] See also Bonnier's figure (pl. xii, fig. 5).

hairs and scales. This boss increases in size from the first to the seventh appendage. The ischium is large; the merus and carpus are as usual reduced and do not carry hairs along their outer margins; the propodus is large and with the help of the small dactylus forms the claw. The ventral surface of some of the posterior thoracic segments is raised in prominent ridges which are frilled.



TEXT-FIG. 5.—*Epipenaeon elegans*, sp. nov.
a. Thoracic leg of female: × 14. *b*. Pleopod: × 12.

The pleural lamellae of the abdominal segments, like those of the thoracic, are rounded plates and are not pointed. The five pairs of biramous pleopods do not project appreciably beyond the margin of the abdomen, so that they cannot generally be seen from the dorsal surface. The pleopods of the first pair are placed far apart from one another, almost on each side of the abdomen, but the succeeding pairs gradually approach one another till those of the fifth pair meet in the middle line. As a result of this the ventral surface of the first four segments is visible, with the appendages in their natural position, and is seen to be raised in prominent ridges which are frilled near their margins. In specimens not carrying males the pleopods are placed closer to one another, and most of them meet in the middle line, so that the ventral surface of the abdomen is not visible. Each pleopod has a large portion of its exposed surface closely covered with rounded and elongate tubercles.[1] The two rami of the pleopods are almost equal in length and at the place of attachment the endopodite is covered over by the exopodite. Even a part of the ventral surface of the two rami is beset with tubercles. The uropods are biramous, very much like the pleopods, and are generally completely covered over by the fifth pair of pleopods. The two rami of each uropod are placed one above the other, generally the upper being the smaller of the two[2]. A part of the surface of the uropods is covered with tubercles. The ventral surface of the pleural lamella of the last segment has also, in

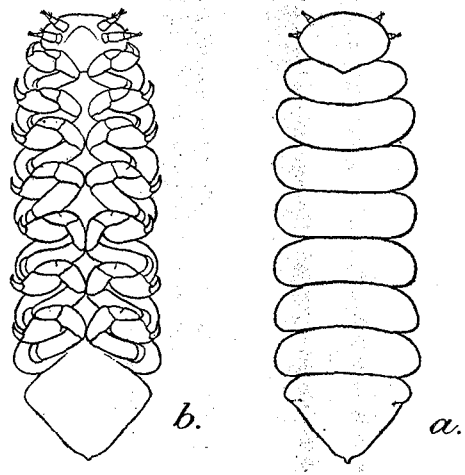
[1] According to Miss Richardson (1904a, p. 44) such tubercles represent secondary ramifications.

[2] In one or two specimens the upper ramus is somewhat larger than the lower.

part, a number of small tubercles. Ventrally all the six abdominal somites can be made out, though they are so crowded together that their distinct boundaries cannot be traced.

The *male* is 5 mm. long, and a little less than 2 mm. broad at the level of the third thoracic somite, though the breadth somewhat increases posteriorly. The body is uniformly whitish in colour and there are no marked pigment spots.

The head is proportionately small, being only a little larger than the first thoracic somite. It is distinct from the thorax and the posterior margin is drawn out into the first thoracic segment. The anterior margin is regularly rounded. Eyes seem to be totally absent. Both the pairs of antennae are well developed and project beyond the anterior margin of the head. The antennules are triarticulate, with the two basal segments large, and the third comparatively small. The latter has a large tuft of cilia at its apex, and the second segment also has a number of cilia at its antero-internal corner. The antennae are also formed of three segments, all of which are fairly large. The terminal segment at its apex and the second at its antero-inner angle carry cilia.



TEXT-FIG. 6.—*Epipenaeon elegans*, sp. nov. Type-specimen, male.
a. Dorsal view: × 12. *b*. Ventral view: × 12.

All the seven thoracic somites are distinct, and their lateral margins, which are rounded, are deeply incised. The margins of the first three somites are directed forward, that of the fourth outward, while those of the last three point backward. The legs are large and somewhat increase in size from the first to the last. Each has a large propodus and a prominent dactylus.

The abdomen is small, being less than a fourth of the length of the body, and is much broader than long. It is subtriangular in shape with the apex somewhat rounded. All the somites are completely

fused, and there is only a slight constriction of the lateral margins behind the anterior extremity. No trace of pleopoda or uropoda is visible.

Locality.—The species occurs in the Gangetic Delta as a parasite of the common estuarine prawn *Penaeus carinatus* Dana.[1] In certain seasons of the year it is obtainable abundantly in the Calcutta market, from which place a large number of specimens, including the type (C 543/1), were procured in July 1922. A single female specimen was collected by Mr. T. Southwell, and the label accompanying it reads "Parasite from common Bengal estuarine prawn." Only the carapace of the host is preserved, and from an examination Dr. Kemp thinks that the host probably belonged to *Penaeus semisulcatus* de Haan[1]. Both these species of prawns are commonly available in the Calcutta markets.

The females of most of the specimens obtained in the Calcutta market do not carry embryos or eggs in their incubatory cavities, and only a few of them are accompanied by their males. One large *Penaeus* was found carrying two parasites, one on each side of the carapace.

The figures of the female (pl. XII) have been prepared from the specimen collected by Mr. Southwell, as until recently this was the only specimen in the collection, efforts to obtain further examples from the Calcutta markets having proved unsuccessful.

E. elegans may be easily distinguished from the other two species by the different proportions of the body, and the larger abdomen. The frontal lamina of the head is much shorter than that of *E. japonica* and the pleural lamellae of the abdominal somites are much larger than those of *E. ingens*. The head is posteriorly rounded as in *E. japonica* and seems to be formed of two halves. Unlike *E. ingens* the posterior pairs of pleopoda of the two sides meet in the middle line and the uropoda are generally covered over by them. The abdomen of the male in the Indian species is subtriangular, while in the other two it is more or less rounded.

Genus **Parapleurocrypta,** nov.

The genus may be defined as follows:—

Branchial parasites.

Female. Body more or less rounded, slightly asymmetrical.

Head distinct from the thorax and not provided with a frontal lamina. A pair of well-developed eyes present.

Thoracic segments distinct on the dorsal surface. Ovarian bosses not clearly seen. Pleural lamellae not greatly developed. Incubatory cavity only partly roofed over by the oostegites.

Pleural lamellae of the abdominal somites well developed, somewhat lamellar and separate. All the segments distinct on the dorsal surface. Five pairs of uniramous pleopods present, each a long pointed structure

[1] There is some confusion about the synonymy of these two allied prawns. Dr. Kemp has given me the following information about them:—

Penaeus carinatus Dana (de Man)
= *P. semisulcatus* Alcock, *nec* de Haan.
Penaeus semisulcatus de Haan, *nec* Alcock
= *P. monodon* Alcock.

extending along the side of the body. Uropods uniramous, more or less like the pleopods.

Male. Head distinct from the thorax and provided with a pair of eyes.

Thoracic segments well defined, each carrying a pair of legs.

All the abdominal somites completely fused, without a trace of pleopods or uropods.

Type-species:—*Parapleurocrypta alphei*, sp. nov.

The present genus combines the characters of a number of distinct genera. The absence of thoracic pleural lamellae, the presence—though in a rudimentary condition—of these structures on the abdomen of the female and the almost complete fusion of the abdominal segments of the male show an unmistakable relationship with *Pleurocrypta* Hesse. The structure of the pleopods of the female in the two genera is, however, widely different. The combination of uniramous pleopods and simple uropods in the female is also met with in *Gyge* Cornalia and Panceri, but the total absence of pleural lamellae of the abdominal somites, and the presence of distinct abdominal segments in the male carrying pleopods in this genus preclude the possibility of a close affinity between these two genera. Rudimentary pleural lamellae on the abdominal segments, like those of *Parapleurocrypta*, occur in *Palaegyge* Giard and Bonnier also, but the differences between these two genera are too numerous to suggest anything but remote relationship.

The genus *Parapleurocrypta*, as we have seen above, presents a combination of characters not hitherto known in any genus of Bopyridae and I have no hesitation in describing it as new. Regarding the affinities of the genus, I am of opinion that it bears the same relationship to *Pleurocrypta* as *Bopyrus* and *Gyge* do to *Probopyrus* and *Palaegyge*, respectively. In other words I consider *Pleurocrypta* to be the more primitive form from which *Parapleurocrypta* arose by a reduction of the pleopods and the pleural lamellae of the abdominal segments. A partial reduction of the abdominal appendages, both the pleural lamellae and the pleopods, is to be found in some species of *Pleurocrypta*, for, according to Bonnier (1900, p. 310), "les variations de taille que presentent les lames pleurales et les appendices du pléon, caractères employés le plus souvent pour les differencier, augmentent la difficulté d'établir des diagnoses precises." As examples of such reduction *P. intermedia* Giard and Bonnier, and *P. porcellamae* Hesse, may be mentioned. The pleopods in the latter are normal in the first pair, but "elles decroissant rapidement jusqu' au cinquième somite où l'endopodite est très rèduit et l'exopodite allongé."[1] This reduction of the pleopods and the pleural lamella has proceeded still further in *Parapleurocrypta* and has resulted in the uniramous pleopods and altogether rudimentary pleural lamellae which are characteristic of the genus.

Only one species, parasitic on an Alpheid collected in the Bay of Bengal, is known.

[1] Bonnier (1900), p. 318.

Parapleurocrypta alphei, sp. nov.

(Plate XIII, figs. 8-12.)

The *adult female* is small in size and its length is considerably less than its greatest breadth. The greatest length is 2·2 mm. and the breadth at the level of the third thoracic segment is 2·55 mm. and slightly more a little posteriorly. In outline the animal is more or less rounded, with the posterior margins somewhat curved inwards. The body is not appreciably asymmetrical and, looking at the specimen, it is difficult to say whether it is a "right" or a "left bopyrid." The colour is uniformly whitish or pale yellowish with a few irregular colour-spots placed on the dorsal surface along the right margin of some of the posterior segments.

The head is not prolonged anteriorly into a frontal lamina, but in the natural position of the parts a portion of the first pair of oostegites projects in front of the head, so as to give an appearance of a narrow anterior lamina. The anterior margin of the head has a deep notch in the middle with the margins on both sides of the notch anteriorly convex. The posterior margin is regularly rounded. A pair of well-developed eyes is present near the anterior margin.

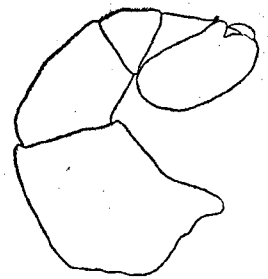
The thoracic somites have their lines of demarcation well defined on the dorsal surface. The first somite is rather short and its length in the mid-dorsal portion is about 2/3 that of the second. The ovarian bosses, especially those of the first and fourth segments, are not clearly seen; those of the second and third are placed on the anterior portion of the margins of their segments, separated from the rest by a notch. The epimera in the first four somites are hardly distinguishable; those in the last three somites are proportionately well developed and occupy the entire margin, extending beyond the body for a considerable distance in the form of somewhat broad rounded plates. They are better developed on the non-deformed side of the body than on the other.

The abdomen is proportionately small and is somewhat curved in a ventral direction. Its length is not even half its greatest breadth. The first somite is much larger than the rest, and looks, in fact, like a thoracic somite. All the somites are distinct and their lines of demarcation are visible throughout the dorsal surface. The pleural lamellae are fairly well developed and are in the form of distinct lamellar processes. They are somewhat short and the pleopoda extend considerably beyond them, with the result that the former appear to be much longer than they really are. The terminal segment is somewhat rounded and with its diverging pleural lamellae gives the appearance of being cleft posteriorly.

The head on the ventral surface is completely covered over by the first pair of oostegites. The antennules and the antennae, especially the latter, are reduced. Both are three-segmented, with the basal segment somewhat swollen, and the terminal crowned with a number of cilia. Both these appendages are placed close behind the anterior margin of the head and project slightly beyond it. All the other appendages, except the mandibles are greatly reduced and are hardly visible. The inferior lamina seems to have the usual mediam lobe

broad and rounded, and the two pairs of triangular secondary lamellae, of which the outer is the larger. The maxillipeds have the usual structure; the basal triangular portion is quite large and the terminal squarish portion has a small rounded palp provided with about eight long setae, all arranged along the inner margin. The outer margin of the palp carries a row of fine hairs, and some of the long setae of the palp bear small secondary hairs. The anterior segment of the maxilliped bears on its anterior margin, along both sides of the palp, a row of fine hairs and these extend for a considerable distance along the outer margin also.

The thorax is much broader than long. The oostegites are small and do not completely roof over the incubatory cavity, but leave a considerable portion of it open. The first pair of oostegites are small, being only one and a half times as large as the maxillipeds which they completely cover. The anterior portion of the first oostegite is more or less rounded and the posterior is drawn out into a large lobe sharply rounded in its extremity. The inner margin of this lobe is sparsely provided with hairs. The internal crest is poorly developed and is not broken into processes and digitations. The next three oostegites are somewhat rounded in shape and are almost as long as broad. The fifth oostegite is not much longer than broad, and its lower margin is beset with a row of stiff setae. The thoracic legs have the usual structure, but the prominent boss on the basal joint is absent. The external margin of the merus is covered with hairs and the carpus is provided with three or four long hairs on its outer margin near the propodal end. The propodus is large and has a well-developed process opposed to the dactylus.



Text-fig. 7.—*Parapleurocrypta alphei*, gen. et sp. nov. Thoracic leg of female: × 150.

The abdomen on the ventral surface is encroached upon to a considerable extent by the swollen marsupium and only a small portion of it is visible. On the ventral surface it is raised into a number of ridges, which are broken up into small lobes on their free margin. There are five pairs of uniramous pleopods, each having an elongate triangular form and pointed at the distal extremity. The pleopods are placed close to the sides of the abdomen and project considerably beyond it. Most of the ventral surface of the abdomen is left uncovered. The first pair of pleopods is much larger than the rest. The uropods are also uniramous and, though smaller in size, resemble the pleopods. The surface of the uropods and the pleopods is not covered with tubercles.

The *male* is short and stumpy, its breadth being more than half its greatest length. The body is 1·2 mm. long and 0·67 mm. broad at the level of the fourth thoracic segment where the breadth is the greatest. The colour of the body is almost white with some irregular colour-spots arranged near the lateral margins in the form of a band running from end to end.

The head has a pair of small eyes and on the ventral surface is provided with the usual appendages. Both the pairs of antennae are triarticulate, and the posterior pair, which is the longer of the two, projects beyond the margins of the head so as to be visible dorsally. The mandibles are well developed and the remaining appendages greatly reduced.

The thorax is deeply notched along the margins and the lines of demarcation between the segments are fairly distinct. The legs are well developed and do not appear to be of uniform size. They are provided with strong claws and have the usual structure.

The abdomen is about one quarter the total length of the body, and its breadth exceeds its length. It is regularly rounded, and is without the slightest indication of the segments of which it is composed. There is no trace of pleopods or uropods. From the anterior margin of the abdomen, on the ventral surface, there hang two rectangular structures, apparently thin and lamellar. Their position and form will be best understood by examining the figure (pl. XIII, fig. 12). I am unable to make any suggestion regarding the nature and function of these structures, for nothing similar, so far as I am aware, has hitherto been described in the male of any Bopyrid.

Locality.—The single specimen (C 491/1) I have examined was collected by Dr. Kemp in Ross Channel, Port Blair, Andaman Is. in February 1921. The specimen is a "left Bopyrid" and the female had its incubatory pouch full of developing embryos. It is the parasite of an Alpheid closely resembling, but apparently distinct from *Synalpheus hululensis* Coutière.

Genus **Stegoalpheon,** nov.

The genus may be defined thus :—

Branchial parasites.

Female. Form of body somewhat asymmetrical.

Head distinct from the thorax, not provided with an anterior lamina.

Thoracic segments quite distinct; all except the first more or less equal in length. Sixth segment not shorter than the rest. Ovarian bosses not distinct. Incubatory cavity open.

Abdominal segments distinct both dorsally and laterally. Pleural lamellae not developed. Five pairs of triramous pleopods present; two rami ventrally placed and extending on the sides of the abdomen, the third dorsally situated in the form of a vertical ridge. Uropods uniramous consisting of two elongated lamellae, like the ventral rami of the pleopods, and without a median conical process between them.

Male. Head distinct from the thorax, provided with a pair of large eyes. Antennules longer than the antennae.

Thoracic segments well defined.

Abdomen with all the segments completely fused. Pleopods and uropods totally absent.

Type-species:—*Stegoalpheon kempi*, sp. nov.

In the possession of triramous pleopods in the female, the present genus, as the name indicates, belongs to the group formed by *Stegophryxus* Thompson (1901), and *Stegias* Richardson (1904); but that it differs fundamentally from either of these will be obvious on comparing the generic definitions of the three genera.[1] In having all the pleopods triramous it comes nearer to *Stegophryxus* than to Miss Richardson's genus, in which only the first three pairs have this structure. Apart from the fact that *Stegoalpheon* is a parasite of a Macrurous Decapod, while *Stegophryxus* (as also *Stegias*) lives on Anomala, the difference between the length of the sixth thoracic segment, the shape of the pleopods and the disposition of their rami, the shape of the last abdominal segment and its appendage, and the shape of the abdomen of the male—to name only a few of the important characters—afford unmistakable distinctions. With *Stegias* it agrees in the length of the sixth thoracic segment, and the shape of the last abdominal somite and its appendage, but differs from it in having all the pleopods triramous and arranged in an altogether different manner, and in having the incubatory cavity open without any particular oostegite being greatly developed. The male in Miss Richardson's genus is not known.

It will be seen that the genus *Stegoalpheon* differs essentially from both the genera in which triramous pleopods are known to occur, and it would, in consequence, appear that the triramous condition in *Stegoalpheon* is in no way derived from that in the other genera. It is likely that it has arisen independently in the present genus and in a different way. The resemblance between *Stegophryxus* and *Stegias* is fairly close, both in the pleopods and the general characters of the body, and it seems not improbable that the triramous condition indicates close affinity. It thus appears that the triramous condition has arisen twice in the family Bopyridae, once in the ancestor of *Stegophryxus* and *Stegias* and once in *Stegoalpheon*.

I am unable to make any definite suggestions regarding the origin of the triramous pleopod. In the present genus it appears that the place of attachment of the rami of a normal biramous pleopod has become greatly enlarged so as to form a thin plate. If the original pleopods were arranged near the margins of the abdomen, as they are in several genera of Bopyridae, and if the enlarged "basal plate" were now to become twisted in such a way as to lie vertically instead of horizontally — as it must originally have done — a triramous structure will be formed with one ramus vertical and the other two horizontal, all arising from a single joint. The common place of origin might subsequently become reduced, and ultimately produce the appearance found in the genus *Stegoalpheon*. In this genus the structure is triramous with one ramus vertical, the other two horizontal, extending well beyond the margins of the body, and all the three appearing to arise from a common point. I am, in other words, of opinion that in the genus *Stegoalpheon* the third vertical ramus of the triramous pleopod represents the enlarged (and twisted) protopodite which in the normal pleopods is greatly reduced, the other two flat rami being the usual exopodite and the endopodite. It is difficult to say how the triramous condition in the other two genera

[1] For definitions of *Stegophryxus* and *Stegias* see also Miss Richardson's monograph (1905, pp. 531 and 535).

can have come about, but it is possible that it was produced in some similar way.

The genus is known from a single species, parasitic on an *Alpheus*, found in the Bay of Bengal.

Stegoalpheon may be distinguished from *Stegophryxus* and *Stegias* as follows :—

I. All pleopoda triramous.	
A. Sixth thoracic segment greatly developed. Uropoda with a small conical process between them. Incubatory cavity completely covered	*Stegophryxus.*
B. Sixth thoracic segment only as long as others. Uropoda without a median process between them. Incubatory cavity partly covered. [Fifth oostegite not enormously developed.]	*Stegoalpheon.*
II. Only first three pairs of pleopoda triramous. [Sixth thoracic segment not much longer than any of the others. Uropoda without a process between them. Incubatory cavity completely covered, with fifth pair of oostegites enormously developed]	*Stegias.*

Stegoalpheon kempi, sp. nov.

(Plate XIII, figs. 1–7.)

The adult *female* is about 5·3 mm. in length and 4·8 mm. in breadth at the level of the third thoracic segment. The body is somewhat asymmetrical, one side being markedly deformed. The dark pigmentation, usually characteristic of most species is entirely absent. The major part of the body is light or deep yellowish, and the borders of the thorax, the head, the oostegites and the abdomen with its appendages are all white.

The head in dorsal view is rounded and is considerably broader than long. The anterior margin is not produced into a frontal lamina and is straight ; the posterior is rounded and does not form an angle. A pair of small eyes is present close behind the anterior margin. The head is quite distinct from the thorax.

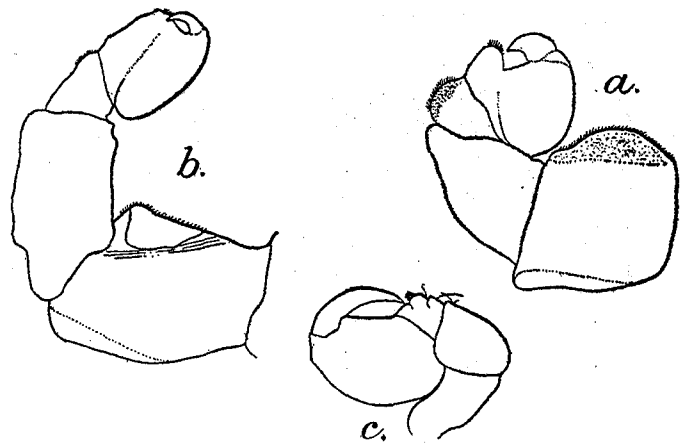
The first thoracic somite is much shorter than the second, while all the rest except the seventh are subequal. The last somite is also somewhat shorter than the rest. The lines separating the somites are quite distinct throughout the dorsal surface and are not particularly curved forward near the sides of the body. The first two somites are somewhat directed forwards at the sides, while all the rest, especially the last three, are markedly directed backward. The first four somites have their margins much longer than those of the last three and consequently the first five thoracic legs are widely separated from one another, while the last three are somewhat crowded together. The ovarian bosses are indistinctly seen as small oval structures placed on the anterior portion of each segment. The epimera of these four somites are narrow plates lying lateral to the bosses, while those of the last three segments occupy the entire margin.

The abdomen is short and is somewhat longer than broad. The lines of demarcation between the somites are very well defined. On the dorsal surface of the abdomen there are five parallel ridges on each side, the ridges representing the dorsal rami of the pleopods to be described in

detail presently. The sixth segment is triangular with the posterior margin almost truncate. Pleural lamellae are totally absent.

The antennules and the antennae are short, thick structures covered with a number of hairs near their distal extremities. The former appear to be biarticulate, while the latter are composed of three segments, of which the terminal is very small. The mandibles are normal, but both pairs of maxillae are extremely reduced. The maxillipeds are longer than they are broad, and consist of the usual two portions. The palp seems to be absent altogether, but is represented by a number of hairs—seven or eight long and a few small—along the margins. The muscles at the base of the anterior portion are strongly developed. The posterior lamina of the head consists of a median lobe broadly rounded and two pairs of triangular secondary lamellae on the sides, of which the inner is the larger.

The oostegites are small and consequently the large broad cavity is left widely open. The first pair which covers the ventral surface of the head, has the usual form. The posterior portion of each is drawn out at its infero-external angle in a fairly large lobe rounded distally. The internal crest is well developed and is not broken into processes or digitations, but is entire throughout its length. The inner margin of the posterior lobe is covered with small hairs. The fifth oostegite encloses the incubatory pouch on the posterior side and its posterior and lateral margins are ciliated. The legs have the usual structure and a prominent boss covered with small scaly structures is present on the basal joint. The boss decreases in size from the first to the seventh leg, till in the last it is hardly noticeable at all. A number of hairs, etc. are, however,



Text-fig. 8.—*Stegoalpheon kempi*, sp. nov.
a. First thoracic leg of female : × 100. *b.* Seventh thoracic leg of female : × 100.
c. Terminal portion of first leg of male : × 65.

present on the margin indicating its position. The outer margins of the merus and carpus are also in part covered with hairs and scales.

The ventral surface of the abdomen is raised into a number of conspicuous ridges running from side to side, and separated by deep grooves. The ridges are frilled on their free surface. There are five pairs of pleopods, the rami of which extend laterally well beyond the margins of the abdomen and leave its ventral surface entirely exposed. Each pleopod consists of three rami of which two resemble the usual oval lamellar rami of the normal pleopod, while the third is a thick plate-like structure, lying on the dorsal surface of the abdomen, in a direction almost vertical to the general plane of the body. The ventral edge of this vertical ramus is in part fused with the body, but the dorsal is quite free. The successive dorsal rami are arranged one behind the other like a series of vertical parallel plates on both sides of the abdomen. The three rami seem to arise from a short stalk which is formed by their union. The sixth segment is provided with a pair of uniramous uropods, the two rami being elongated oval lamellae, like the ventral rami of the pleopods, without a median piece between them.

The *male* is short and thick, being about 1·6 mm. long and less than 1 mm. broad. It lies across the abdomen of the female from side to side and is not covered over by the pleopods.

The head is large and has a pair of prominent eyes in its posterior half. The antennules are small and appear to be triarticulate; the antennae are long and project beyond the head so as to be visible from the dorsal surface. They are composed of five segments of which the basal is very long. Almost all the segments bear hairs on their antero-internal margins, and the terminal segment carries similar hairs at its tip. The maxillae are greatly reduced and the remaining appendages are normal. The maxillipeds are altogether wanting.

The thorax is composed of the usual seven somites which are well defined dorsally. The seven pairs of legs are well developed; the first has a strong claw and covers a portion of the head ventrally. The claws of the following legs are not as strongly developed as those of the first. The propodus in all the legs is well developed and is proportionately larger than that of the thoracic legs in the female (fig. 8*c*).

The abdomen is greatly reduced, being about a fifth of the total length of the body and considerably broader than long. Both the anterior and the posterior margins are rounded, the anterior more broadly than the posterior. Close behind the anterior margin is a prominent dark spot. The abdomen is undivided, without indication of the segments of which it is formed. The pleopods and uropods are totally absent.

Locality.—The types (C 507/1) were obtained from the branchial cavity of a species of *Alpheus* closely resembling *A. crassimanus* Heller. They were collected by Dr. Kemp and myself in February 1921 from under stones on the shore of a mangrove swamp, left exposed at low tide in backwaters at Vizagapatam in the Madras Presidency (Bay of Bengal). Out of a large number of Alpheids collected in this locality only two specimens were found infected with this species. Both are "left Bopyrids" and the females are 4·5 and 5·5 mm. long. Males of both the specimens are present. It may be pointed out that from almost the same locality a totally different Bopyrid was also found; it is described in this paper as a new species under the name *Bopyrella*

hodgarti, and is a parasite of *Alpheus crassimanus* Heller. Another specimen of *S. kempi*, the female of which is 6·1 mm. long, was brought back by Dr. Kemp from Andamans. This also is a left Bopyrid and is a branchial parasite of *Alpheus* prox. *crassimanus*. It was collected by Mr. R. E. Lowis at Port Blair.

I have great pleasure in associating this species with the name of Dr. S. W. Kemp, not only for the reason that most of the collection dealt with by me has been made by him, but also as a token of gratitude for the great help and valuable suggestions that I have been receiving from him.

Genus **Bopyrella** Bonnier.

1900. *Bopyrella*, Bonnier, *Trav. Stat. Zool. Wimereux* VIII, p. 347.
1917. *Synsynella*, Hay, *Proc. U. S. Nat. Mus.* LI, p. 571.
1923. *Bopyrella*, Nierstrasz and Brandis,[1] *Siboga Exped. Rep.* XXXIIb, p. 95.

The genus, as I understand it, may be defined thus:—

Branchial parasites.

Female. Body more or less regularly rounded or somewhat asymmetrical.

Head without an anterior lamina and fused almost completely on the dorsal surface with the first thoracic segment.

Thoracic segments distinct throughout their length. Ovarian bosses totally absent, and epimera slightly developed. Five pairs of oostegites present, covering only part of the incubatory cavity.

Abdomen with the pleural lamellae rudimentary or absent. Segments fused, indications of the segmental lines sometimes present along the margins, sometimes completely absent. Five pairs of biramous pleopods present. Uropods absent. Some of the pleopods sometimes rudimentary or even absent.

Male. Head fused completely with first thoracic segment; head-appendages usually reduced. Eyes rudimentary or absent.

Thoracic segments distinct both dorsally and laterally.

All the abdominal segments fused dorsally, but distinct laterally. Rudiments of pleopods present on some of the anterior segments or totally absent. Uropods wanting.

Type-species:—Bopyrella thomsoni Bonnier.

Bonnier in 1900 erected this genus for the reception of a single Bopyrid parasitic on *Alpheus strenuus* Dana, collected on the coral reefs of Tonga, Amis I., Oceania. Besides the type-species, *Bopyrella thomsoni*, Bonnier included provisionally in this genus three other species "à cause des hôtes qu'elles infestent et qui appartiennent tous à celle même famille des Alpheidae" (1900, p. 351). Until something more of these three species —*B. palaemonis* (Risso), *B. alphei* (Giard and Bonnier) and *B. nitescens* (Giard and Bonnier)—is known the propriety of placing them in the genus *Bopyrella* is open to grave doubts.

Bopyrella, as Bonnier points out, closely resembles *Probopyrus* Giard and Bonnier, from which it differs mainly by "la soudure plus complète des somites du pléon, surtout chez la femelle et l'existence à la face ventrale de rudiments des lames pleurales." To these points might

[1] See addendum, pp. 540, 541.

be added the fusion of the head in both the sexes with the first thoracic segment.

The genus *Synsynella* Hay (1917) is characterized by the more or less complete fusion, in both sexes, of the head with the first thoracic segment; the fusion, at least dorsally, of the abdominal segments in the female, and the presence on them of biramous rudimentary pleopods; and in the male by only partial fusion of the abdominal segments which have no appendages. The principal feature of this genus, as Hay points out, is the fusion of the head with the thorax. This fusion is also present in *Bopyrella* as can be seen from Bonnier's figure of *B. thomsoni*. In his description of this species Bonnier says that "il est à moitié soudé avec le premier somite du péreion" but his figure gives a fair idea as to how far this fusion goes. I have examined Bonnier's type specimen and have found that the fusion is at least as well marked as it is in Hay's species, as it also is in a specimen of *B. thomsoni* in the Indian Museum collection. In the male of Bonnier's form "la tête, vue par la face dorsale, est soudée par sa partie postérieure au premier somite thoracique"—a condition identical with what Hay has described in *Synsynella deformans*.

As regards the fusion of the abdominal segments the condition is practically the same in both the genera, but the fusion has gone much further in *B. thomsoni* than in *Synsynella*. In *S. deformans* the segments are completely fused on the dorsal surface, but are quite distinct laterally; in Bonnier's form, however, the segments are completely fused both dorsally and laterally.

The abdominal appendages in the female of *B. thomsoni* "sont au nombre de cinq pairs dont le premières sont le plus considèrables, les autres étant très reduites"; in *S. deformans* there are also five pairs but in Hay's specimens only the first one or two pairs are well developed and biramous, while the rest are rudimentary and consist of a single ramus each. I have, however, in my collection a number of specimens (a detailed description of which under the name of *B. deformans*, subspecies *indica* is given below) which have all five pairs distinctly biramous, though some of the posterior ones are in a reduced condition.

The structure of the abdomen of the male in the two genera is in principle the same. In *B. thomsoni* the segments are fused dorsally though all the six of them are distinct laterally; in *S. deformans* the segments are to some extent fused dorsally and about five of them are free laterally.

The only material difference that exists between the two genera is, in my opinion, the presence of "traces des lames pleurales" on the abdomen of *Bopyrella* and their complete absence in *Synsynella*. This, however, is not of itself sufficient to justify generic separation, for in certain other genera, notably *Palaegyge* Giard and Bonnier, rudimentary pleural lamellae are present in certain species while totally absent in others.

From these considerations I am led to believe that the genus *Synsynella* Hay, is synonymous with *Bopyrella* Bonnier[1].

[1] See also addendum, pp. 540, 541.

To this genus I have assigned with some doubts another species, *B. hodgarti*, described for the first time in this paper. It resembles *B. thomsoni* and *B. deformans* in the fusion of the head in both sexes with the first thoracic segment, in the dorsal fusion of the abdominal segments in the female, the presence of biramous pleopods in the female and their total absence in the male, but differs in that all the abdominal segments of the male are completely fused forming a single piece. The abdominal segments in the female are provided with rudimentary pleural lamellae.

The genus as so far recorded seems to have a wide and discontinuous range of distribution. Bonnier's specimen of *B. thomsoni* was obtained at Amis I., Oceania, in the S. Pacific, while my specimen of the same species comes from the Andamans in the Bay of Bengal. *B. deformans* has been recorded from the Atlantic Coast of N. America, while the subspecies *indica* has been obtained from around the Indian coasts, both in the Arabian Sea and the Bay of Bengal. *B. hodgarti* again seems to be a coastal form having been collected at Waltair on the Eastern Coast of India. All these species are parasites of the genera *Alpheus* and *Synalpheus*.

The species of this genus may be identified thus:—

I. Abdominal segments in female fused completely, both on dorsal surface and lateral margins. [Rudimentary pleural lamellae present on abdominal segments of female; abdominal segments of male distinct laterally.] ... ... *B. thomsoni* Bonnier.

II. Abdominal segments in female fused only dorsally, distinct along lateral margins.

A. Rudimentary pleural lamellae present on abdominal segments of female; all abdominal segments of male completely fused forming a single piece ... ... *B. hodgarti*, sp. nov.

B. Pleural lamellae totally absent on abdominal segments of female; abdominal segments of male free laterally.

1. Only first two pairs of pleopoda biramous ... *B. deformans* (Hay).
2. All pairs of pleopoda biramous ... ... *B. deformans*, sub. sp. *indica*, nov.

Bopyrella thomsoni Bonnier.

1900. *Bopyrella thomsoni*, Bonnier, *Trav. Stat. Zool. Wimereux* VIII, p. 348, pl. xxxiii.

Through the kindness of Prof. M. Caullery of Paris I have been able to examine Bonnier's type-specimen and am convinced that my specimen belongs to the same species. The few differences that do exist do not seem to be of any real importance.

The present specimen is about four times as large as Bonnier's for it is 10·5 mm. and 6·5 mm. in its length and breadth respectively. Bonnier has not described or figured any eyes in the female, but in my specimen they are present in the form of two small dark spots, one near each antero-lateral corner of the head. The head appendages are all normal; the maxilliped has the usual shape and its palp is terminated by

about twelve subequal setae, all except two of which are arranged along the inner margins.

The oostegites are small and cover only a part of the incubatory cavity. In those of the first pair the anterior margins are more deeply concave than Bonnier's figure shows. The internal crest which in Bonnier's specimen " est découpée, près de son origine, en cinq petits tubercules arrondis " shows a greater development in this case and has at least six well developed finger-like processes near its origin. The remaining oostegites and the peraeopods conform to the type, the latter having a prominent boss on the basipodite, the external surface of the meropodite covered with scales, and a portion of the carpus furnished with a number of hairs.

The first two pairs of pleopods show a somewhat greater development and meet in the middle line. The ridges on the ventral surface of the abdomen are very indistinct. The rudiments of the pleural lamellae are present.

The *male* also is large and is 2·8 mm. in its greatest length. Unlike Bonnier's specimen the breadth of the thoracic segments does not increase from the first to the last, but is more or less the same throughout. The abdomen shows no important differences from the type, but I have not been able to find in my specimen the two pairs of pleopods that Bonnier has described.

Locality.—The species has so far been recorded from Amis I., Oceania. My specimen has been found parasitic on a species of *Alpheus* different from the one on which it was already known to occur, and was collected by Mr. R. F. Lowis at Port Blair, Andaman Is. The host of the Indian specimen is closely allied to, but specifically distinct from *A. audouini* Coutière. The latter species, it may, however, be pointed out is nearly related to Dana's *A. strenuus*, the host-species of *B. thomsoni* in Oceania. The occurrence of this Bopyrid so far west as the Bay of Bengal extends the range of the species enormously, but in course of time it will no doubt be found in intermediate localities also.

Bopyrella deformans (Hay).

1917. *Synsynella deformans*, Hay, *Proc. U. S. Nat. Mus.* LI., p. 270, pl. ic.

sub. sp. **indica,** nov.

(Plate XIV, figs. 1–6.)

A number of specimens of *Synalpheus* collected in Indian waters were found infected with Bopyrids resembling those described by Hay under the name of *Synsynella deformans*. Unfortunately the description and figures given by this author are so inadequate that it is difficult to say whether the specimens really belong to his species. The general resemblance between the two is well marked and till a better description of Hay's specimens is forthcoming, I consider it advisable to regard my specimens as a subspecies of *Bopyrella deformans*. Besides some differences between Hay's form and mine, the habitat of the two is

widely different. Since the *forma typica* is rather inadequately described I give below a detailed description of my specimens.

The largest *adult female* in my collection is 5·9 mm. long and 4·2 mm. broad; the breadth, as pointed out by Hay, is about two-thirds of the length. The body is asymmetrical and one side is markedly shorter than the other. The colour of the animal is pale yellow, with the entire dorsal and ventral sides of the thorax somewhat darker. There are no characteristic colour-markings on the body.

The head is completely fused with the first thoracic segment, but a slight notch on each side indicates the anterior margins of the thorax. This notch is well developed in Hay's specimens, and according to him is continued into a shallow groove. In my specimens, however, the notch is rather poorly developed and the groove is almost invisible. The anterior margin of the head is regularly rounded, and a little behind it is placed a pair of small eyes.

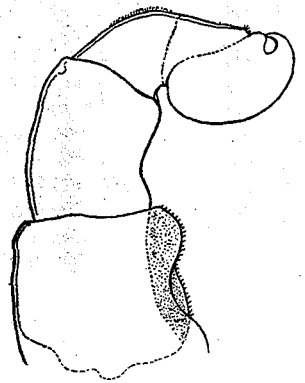
The second thoracic segment also is partially fused with the head in its mid-dorsal portion, but is quite distinct on both the sides. The second segment is a little shorter than the third, but all the rest are more or less equal in length. The lateral margins of the first four segments, especially on the longer side of the body are divided into two unequal portions by a slight notch. The epimera are somewhat poorly developed in the first four segments, but show a greater development in the last three. The ovarian bosses seem to be entirely lacking.

The abdomen has all the segments fused, more or less completely in the mid-dorsal region, but they are quite distinct along the lateral margins. Two or three faint lines can sometimes be seen for some distance on the dorsal surface and these seem to indicate some of the anterior segments, but no traces of such lines can be found in the posterior region. The outer ends of the segments turn backwards, but are not " from front to back increasingly acute." The sixth segment is posteriorly bifid, and its margins are like those of the other segments.

The appendages of the head and the mouth parts are extremely reduced, and it is difficult to make out exactly the number of segments of which the antennules and the antennae are formed. The mandibles, maxillae and the upper and lower lips are normal in shape though greatly reduced in size. The posterior lamina has the usual broadly rounded median lobe and two secondary lamellae. The latter are of almost the same size and the outer seems to be the more pointed of the two. The maxillipeds are provided with a well-formed palp, having a number of setae arranged along both its margins. There are in all about 13 setae, of which 8 are arranged along the inner margin. The palp is lodged in a distinct depression of the anterior margin, which is otherwise regularly rounded.

The thorax is longer than broad and the incubatory cavity is only partially covered by the small oostegites. Those of the first pair extend backward in the cavity, and each has the usual shape. The anterior margin of the anterior segment is almost straight, and the posterior has a small lamella at its infero-external angle. This lamella is rounded at its apex and a number of hairs are arranged along its inner margins. The

internal crest is well developed and except for three or four small rounded processes near its origin is entire. The remaining oostegites are rectangu'ar, with a considerable part of their outer margins attached to the segmental margins. The fifth pair extends backward so as to cover a part of the abdomen as well. The ventral surface of the last two or three segments is raised in ridges the free surface of which appears to be frilled near the margins. The thoracic legs have each a well developed double boss on the basal segment; the proximal of the two bosses is much the larger and both are covered with scales. The ischium is long; a portion of the merus along the outer margins is covered with scales; the carpus is reduced, a small projection along its margin near the anterior extremity being covered with a number of hairs; the propodus is, as usual, large and the dactylus is well developed.



Text-fig 9.—*Bopyrella deformans*, sub. sp. *indica*, nov. Thoracic leg of female: × 35.

The abdomen is proportionately short and its breadth by far exceeds its length. There are five pairs of pleopods, diminishing in size posteriorly. Unlike Hay's form all the pleopods are distinctly biramous. In the first two pairs both the rami are of about the same size, but in the last three the endopodite is distinctly reduced. This is especially observable in the fifth pair in which the inner ramus is only about half as long as the outer. The pleopods do not meet in the middle line, nor do they reach the posterior extremity of the body, thus leaving a large amount of space in the posterior part of the abdomen (as in *B. thomsoni*). The uropods are completely absent.

The *male* is about 1·5 mm. long and a little less than a quarter as broad. The head is semicircular in shape and is, more or less, completely fused with the first thoracic segment, only a marginal notch between the two marking its posterior limit. Eyes seem to be totally absent in some of the specimens. Ventrally the head carries a pair of small triarticulate antennules, and a still smaller pair of biarticulate antennae. The ultimate segments of both these appendages are covered with a number of hairs. The mandibles are long and curved and the maxillae greatly reduced.

The thoracic segments are large and well developed, and their lateral borders are distinct from one another. The legs have the ordinary shape.

The abdomen is quite large and its segments are to a certain extent fused on the dorsal surface. Only five segments are visible along the lateral margins; the first three have their lateral borders well developed and widely separated from one another; the fourth is small and slightly bulging at the sides, while the last is a finger-like process

rounded at the posterior extremity. There are no pleopods or uropods.

Locality.—The two type-specimens (C 474/1) were collected at Karachi, in the Arabian Sea and were presented to the Indian Museum by the Karachi Museum in May 1892. They were found parasitic in the branchial chambers of an Alpheid probably identical with *Synalpheus hululensis* Coutière. Another specimen parasitic on the same species of *Synalpheus* was collected by Dr. S. W. Kemp in May 1918 at Madras in the Bay of Bengal at a depth of 4-5 fms. I have also provisionally referred to this species two more specimens[1] collected by the "Investigator" in April 1894 at station 175, N.E. of Ceylon, 8° 51′ 30″ N., 81°11′52″ E., at a depth of 28 fms. These last are parasites of *S. nilandensis* Coutière.

The Indian specimens differ from Hay's chiefly in having all the pleopods in the female biramous. Also the oostegites are not developed to as great an extent and the lateral margins of the abdomen are not from front to back increasingly acute.

Bopyrella hodgarti, sp. nov.

(Plate XIV, figs. 7–12.)

The *adult female* is 5·5 mm. long and 3·5 mm. broad. The body is almost white in colour, with pale or dark yellow streaks in certain places. The head, abdomen and margins of the thorax are entirely white, but a little within the lateral borders there is a pale-yellowish area running the entire length of the thorax. There is a dark-yellowish area behind the head, and a similar area on the last two or three thoracic somites. Lastly in the middle line of the thorax there is a yellow streak running from end to end which becomes much darker at the posterior end. The oostegites are all colourless. The body is not markedly asymmetrical, and in the single specimen that I have examined the right side is a little shorter than the other, with the consequence that a major portion of the head lies to the right of the middle line.

The head is more or less completely fused with the first thoracic segment, but its posterior boundary is indicated by a notch and a shallow groove running for some distance inwards from it. There is no fusion with the second segment. The head is much broader than it is long, and its anterior margin is produced into a small frontal lamina. Behind the anterior margins, and placed on each side of the head is a small dark eye.

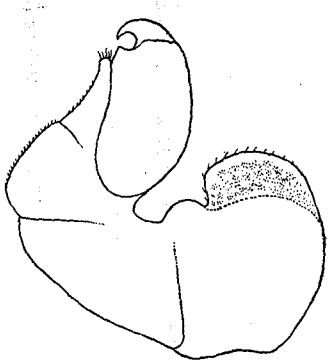
The thoracic segments are quite distinct throughout their dorsal surface. The first segment appears to be quite as long as the second, and the last five segments are of almost equal length. The ovarian bosses are quite absent, and the epimera are also poorly developed. Like the preceding species the margins of the first four segment are divided into two by a notch.

[1] I have some doubts regarding the identification of these specimens for in one of them small pleopods seem to be present on the abdomen of the male. The shape of the maxilliped and the first oostegite in both the specimens is different from what has been described above. It is possible these specimens represent a distinct species.

The abdomen is fairly large and is almost symmetrical. The segments of which it is formed are fused in the middle of the dorsal surface, but they are quite distinct along the lateral margins. The pleura of the abdominal segments are present in a rudimentary condition, and decrease in size posteriorly. The sixth segment is sub-triangular.

The head seen from the ventral surface appears to be squarish in outline, with the anterior margins somewhat rounded. The antennules, antennae and all the other mouth parts are greatly reduced. The maxillipeds have the usual form and the palp, which is well developed and conical, has about eight setae along its inner margins. The inner margins of the upper portion of the maxilliped also has a number of hairs all along its length. The posterior lamina of the head consists of a single broad rounded portion in the middle, a pair of thin pointed inner and a pair of broad tongue-like outer secondary lamellae.

The oostegites are small, inconspicuous structures on the ventral surface of the thorax and the incubatory cavity is large and widely open. The oostegites of the first pair are somewhat broader than they are long, and the tongue-like elongation of the posterior segment at its infero-external angle is short and ends roundly. The inner margin of the segment is deeply concave and is furnished with a number of small hairs along its length. The internal crest is well developed and near its origin is provided with a number of large rounded processes. The fifth pair, as usual, enclose the cavity on the posterior side. The peraeopods seem to possess a double boss on the basal segment.



Text-fig. 10.—*Bopyrella hodgarti*, sp. nov.
Thoracic leg of female : × 132.

All the pleopods are biramous, each ramus being a thin triangular sheet broad at the base where it articulates with its fellow. The exopodite and the endopodite are of almost the same length. The pleopods do not extend beyond the sides of the abdomen, nor do they meet in the middle line, but leave a considerable space where the male lies. Uropods are totally absent.

The *male* is 1·5 mm. long and 0·5 mm. broad at the level of the first abdominal segment where it is the broadest. The head is fused with the first thoracic segment, as is the case in the preceding two species. The head appendages are extremely reduced, and I have not been able to make out the number of segments of which they are composed. Eyes seem to be totally wanting.

The thoracic segments are distinct, and their appendages normal.

The abdomen is broader than the head or thorax, and the segments of which it is composed are completely fused. There are no traces of the segmental lines on the dorsal surface, nor are there any clear indications of the segments along the margins. The lateral undulations of the abdomen give some idea of the boundaries of the first two segments, but they are very indistinct. The pleopods and uropods are completely absent.

Locality.—The single specimen (C 478/1) that I have examined was obtained from the left branchial cavity of *Alpheus crassimanus* Heller, collected under stones on a small island left exposed at low tide in the backwater at Vizagapatam, Madras Presidency (Bay of Bengal). This Alpheid formed a part of a large collection made there by Dr. Kemp and myself in January 1921. The specimen unfortunately got damaged and so it has not been possible to give a very detailed description of it.

I have named this species after Mr. R. Hodgart, the energetic collector of the Zoological Survey of India, to whose efforts, next to Dr. Kemp's a considerable part of the collection dealt with in this paper is due.

I have given above briefly my reasons for regarding the generic position of this species as doubtful. The principal characters of the species may be summarized as follows :—

Female—

1. Head fused dorsally with the first thoracic segment.
2. Ovarian bosses quite absent and epimera poorly developed.
3. Abdominal segments fused dorsally, but distinct laterally.
4. All pleopods distinctly biramous and well developed.
5. Pleural lamellae of the abdominal segments distinctly developed though rudimentary.

Male—

6. Head fused with first thoracic segment.
7. All the abdominal segments completely fused, forming a single mass, only slight indications of the first two or three segments being visible laterally.
8. No pleopods or uropods present.

In all these characters, except the presence of pleural lamellae in the female and the complete fusion of the abdominal segments in the male, *B. hodgarti*, it will be seen, closely resembles *B. deformans* subsp. *indica*. From *B. thomsoni* it differs in having the abdominal segments in the female distinct laterally and those of the male completely fused. The only important point of difference is thus seen to be the condition of the abdomen in the male, and even here, it will be observed, the difference is only a matter of degree, for in *B. thomsoni*, and *B. deformans* also, the segments are more or less fused dorsally.

Genus **Argeia** Dana.

1852. *Argeia*, Dana, *U. S. Explor. Exped., Crust.*, p. 803.
1857. *Argeia*, Stimpson, *Boston Journ. Nat. Hist. Soc.* VI, p. 511.
1893. *Argeia*, Stebbing, *Hist. Crust.*, p. 415.
1900. *Argeia*, Bonnier, *Trav. Stat. Zool. Wimereux* VIII, p. 327.
1904. *Argeia*, Richardson, *Proc. U. S. Nat. Mus.* XXVII, pp. 60 and 64.
1905. *Argeia*, Richardson, *Bull. U. S. Nat. Mus.* LIV, p. 544.

The genus may be defined as follows :—

Branchial parasites.

Female. Body somewhat asymmetrical.

Head distinct from the thorax, provided with a narrow frontal lamina.

Thorax provided with normal pleural lamellae on all the segments. Ovarian bosses present on the first four segments. The posterior portion of the lateral margins in all or some of the segments sometimes produced into a process varying in length according to the stage of maturity. All the thoracic legs provided with a boss on the basal segment. Marsupium more or less open.

All the segments of the abdomen distinctly defined on the dorsal surface. Pleural lamellae totally absent. Five pairs of double-branched pleopods present; outer ramus often longer than the inner and attached close to the lateral margin of the segment, so as to look like the pleural lamella. Uropods uniramous.

Male. "The male has all the segments of the abdomen fused. The pleopoda and uropoda are wanting. All seven segments of thorax are distinct."[1]

Type-species:—Argeia pugettensis Dana.

Leaving aside Bonnier's (1900) undescribed species *A. calmani*, based on Calman's (1898) record of *Argeia* sp. parasitic on *Crangon affinis* de Hann, which Miss Richardson (1905) has placed in the synonomy of Dana's species, the genus *Argeia* is known from two species only: *A. pugettensis* Dana (1852) and *A. pauperata* Stimpson (1857). The latter of these has been described from a single female obtained from San Francisco Bay, parasitic on *Crangon franciscorum* Stimpson, and has never been found since. *A. pugettensis*, on the other hand, is a common species occurring chiefly along the Pacific Coast of North America and is a parasite of a large number of species of *Crangon*, *Nectocrangon* and *Sclerocrangon*. To these two species I now add another, *A. lowisi*, described below, and occurring as a parasite of an Alpheid, not only a distinct genus, but belonging to a different family from that in which the Crangons are placed.

In her generic diagnosis of *Argeia* Miss Richardson (1905) says "the posterior portion of the lateral margins in all the (thoracic) segments are more or less produced, the length of the process varying in each individual". I have not been able to find any such processes in my species. In *A. pauperata* the processes are absent on some of the anterior segments, while in *A. pugettensis* they are well developed in immature females but get appreciably reduced in adults and are sometimes, for all practical purposes, quite absent. Giard and Bonnier (1887b) have described their function as organs of fixation and on this hypothesis it is easy to explain why so much variation occurs among the species of this genus and even in individuals of one species. Organs of such a nature cannot in my opinion have a specific, much less generic, significance.

In Dana's species the pleopods have the "outer branches oblong, inner subglobose and small" (1852, p. 804). Miss Richardson has described them as "rounded sac-like bodies, usually decreasing in size from the first to the last," and she attaches so much importance to this character that she has incorporated it in her definition of the genus. In *A. pauperata* Stimpson, "the inner branches of the first three abdominal appendages are broader; those of the last three pairs are wanting" (1857, p. 511). In my species the condition is still more different; the inner rami of all the pleopods are almost similar in shape and size to the outer. They are the normal type of broad, rounded, thin lamellae, like those present in most of the other genera possessing biramous pleopods in the female.

[1] I have not been able to examine any male specimens of this genus and have taken this part of the definition from Miss Richardson's monograph (1905, p. 544) on the Isopods of North America.

The genus has hitherto been recorded from various localities in the Pacific Ocean only, chiefly along the western coast of North America. *A. pugettensis* has been collected off the N. W. coast of Japan, and the S. E. coast of Korea (Miss Richardson, 1910a). The Indian species *A. lowisi* has been found off Port Blair, Andaman Is., in the Bay of Bengal. It is a parasite of an Alpheid, while the other two species are known to live on members of the family Crangonidae.

A. lowisi may be distinguished from the other known species of the genus as follows:—

I. Inner rami of all pleopods present.	
A. Inner rami in form of small rounded sacs; thoracic processes present on all (thoracic) segments; posterior lobe of first oostegite absent ...	*A. pugettensis* Dana.
B. Inner rami in form of broad lamellae like outer; thoracic processes totally absent; posterior lobe of first oostegite present	*A. lowisi*, sp. nov.
II. Inner rami of only first three pleopods present. [Inner rami not in form of rounded sacs; thoracic processes in some of the anterior segments absent; incubatory cavity more completely covered than in other species.]	*A. pauperata Stimpson.*

Argeia lowisi, sp. nov.

(Plate XV, figs. 1–5.)

The *adult female* is 5·2 mm. long and 4·4 mm. in greatest breadth. The single female that I have examined is a right Bopyrid and its form is markedly asymmetrical, the left side of the body being deformed and shorter. The animal is uniformly pale in colour and does not bear any particular colour markings. A band of a little darker shade than the rest of the body runs in the median line of the thorax.

The head is much wider than long; the greatest length being a little more than half the breadth. There is a narrow frontal lamina with the anterior margins almost straight, and produced at its antero-lateral angles into small lobes. Behind the lamina, placed in the anterior part of the head, are two rudimentary eyes in the form of a number of dark pigmented spots aggregated together. The posterior margin is rounded with a small concavity in the middle giving a somewhat bilobed appearance to the head.

The lines of demarcation between the thoracic segments are distinct throughout the dorsal surface. The first segment is short and in its mid-dorsal line is less than half as long as the second. The ovarian bosses are clearly seen on the left side occupying about the anterior half

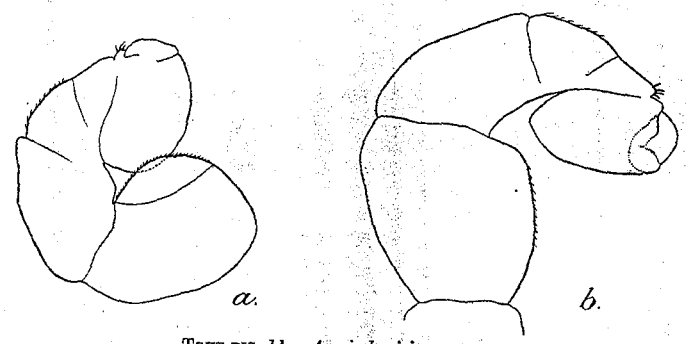
of the first four segments ; they are oval and somewhat rounded in shape. The two halves of the lateral margins of the segments are separated by a slight notch, but this arrangement is only clearly seen on the shorter side of the body, where both the halves are provided with epimera, those in the upper half lying lateral to the ovarian bosses. The epimera in the last three segments occupy the entire margins.

The abdomen is proportionately small, and the segments of which it is formed are quite distinct both on the dorsal surface as well as along the lateral margins. The first segment is quite broad, but the abdomen narrows rapidly till the sixth segment is only about as long as it is broad. The segments of the abdomen, as in fact those of the rest of the body as well, are greatly flattened. The last abdominal segment is somewhat bifid posteriorly. The pleopods and the uropods are spread out on the sides of the body, so as to form a border around the abdomen. The pleural lamellae are totally absent, but the outer rami of the pleopods are placed so close to the margins that they look superficially like the pleural lamellae. The uropods are simple.

The antennules are of two segments ; the basal segment is greatly swollen and the terminal is moderately long. The antennae appear to be composed of four segments the basal one being much swollen and the terminal crowned with a number of setae. The last two antennal joints have a scaly appearance. The labrum and the hypostome are well developed, the former being longer than is usually the case. The mandibles are strong elongated and spindle-shaped and the maxillae, as usual, reduced. The first pair is placed near the base of the mandibles, while the second has not been examined. The maxilliped is normal in shape, but its anterior segment is somewhat broader than usual. The palp is well developed and is peculiar in form. It is formed of two distinct portions, separated by a deep cleft, each provided with its own set of setae. The inner portion is the smaller of the two and seems to possess a smaller number of setae. The entire margin of the palp is covered with small hairs, and some of the setae also seem to be provided with secondary hairs. The posterior lamina of the head has the usual shape —a broadly rounded median lobe, and two pairs of secondary lamellae. The inner lamella of each side is sharply pointed, while the outer is rounded.

The thorax is by far the largest portion of the body and is much wider than it is long. The incubatory cavity is large and is only partially covered by the oostegites which are proportionately smaller than those of *A. pugettensis* or *A. pauperata*. On the ventral surface of the thorax are seen a large number of lines, like those separating the segments on the dorsal side of the body, but in no way representing the segmental boundaries. The oostegites are thin and almost transparent. The first pair has the normal shape and, unlike that of *A. pugettensis*, has a well-developed posterior lamella in connection with the posterior segment. The inner margin of this lamella is beset with a number of small hairs. The internal crest is somewhat poorly developed and seems to be entire. The thoracic legs have the usual shape and number of segments. There is a boss covered with hairs and scales on the basal segment but it diminishes in size posteriorly and in the seventh leg

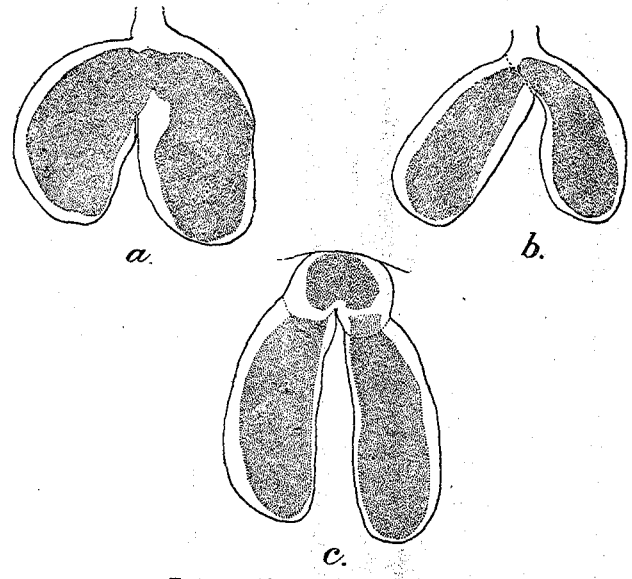
it is almost absent. The claw is well developed and a projection on



Text-fig. 11.—*Argeia lowisi*, sp. nov.
a. Third thoracic leg of female : × 135.
b. Seventh thoracic leg of female : × 135.

the carpus carries four setae, while the outer margin of the merus is hairy.

The abdomen is broader than long, and tapers rapidly. The five pairs of pleopods are well developed and biramous, both the rami being more or less similar in shape and equal in size. They are in the form



Text-fig. 12.—*Argeia lowisi*, sp. nov.
a. Fourth right pleopod : × 50. *b*. Fourth left pleopod : × 50.
c. Sixth abdominal segment of female and uropod : × 50.

of broad elongate lamellae spreading out on the sides of the abdomen. The rami of the deformed (left) side are narrower than those of the

other, which are shorter and broader. The pleopods decrease somewhat in size posteriorly, but not to so great an extent as the inner rami of *A. pugettensis*. The uropods are uniramous and consist of two long narrow lamellae like those of the pleopods of the left side.

The male is not known.

Locality.—The single specimen (C 473/1) that I have examined was found parasitic on an *Alpheus*, resembling *A. euphrosyne* de Man, collected at Port Blair, Andamans, by Mr. R. F. Lowis. The specimen is a mature female but unfortunately is not accompanied by its male.

Genus **Palaegyge** Giard and Bonnier.

1888. *Palaegyge*, Giard and Bonnier, *Compt. Rend. Acad. Sci. Paris* CVI, p. 304 and *Ann. Mag. Nat. Hist.* (6) 1, pp. 234-236.
1888. *Palaegyge*, Giard and Bonnier, *Bull. Sci. France Belgique* XIX, p. 63.
1890. *Palaegyge*, Giard and Bonnier, *ibid.*, XXII, pp. 373-377 (*partim*).
1892. *Palaegyge*, Max Weber, *Zool. Ergeb. Niederland. Ost-Ind.* II, p. 557.
1893. *Palaegyge*, Stebbing, *Hist. Crust. London*, p. 410 (*partim*).
1900. *Palaegyge*, Bonnier, *Trav. Stat. Zool. Wimereux* VIII, p. 332.
1910. *Palaegyge*, Horst, *Notes Leyden Mus.* XXXII, p. 67.
1912. *Palaegyge*, Richardson, *Proc. U. S. Nat. Mus.* XLII, p. 521.
1923. *Palaegyge*, Nierstrasz and Brandis,[1] *Siboga Exped. Rep.* XXXII*b*, p. 89.

The genus may be defined as follows :—

Branchial parasites.

Female. Body slightly asymmetrical.

Head distinct from the thorax, rarely prolonged forward into a narrow frontal lamina. Rudimentary eyes sometimes present.

Thoracic segments well defined on the dorsal surface. Ovarian bosses and pleural lamellae distinctly developed. Incubatory cavity only partially roofed over by the oostegites. Peraeopods provided with a single or double scaly boss. The ventral surface of the last two thoracic and some of the anterior abdominal segments generally raised into ridges, the free surface of which may or may not be frilled.

Abdominal segments more or less clearly defined on the dorsal surface, lines of demarcation between some of the posterior ones sometimes partly obliterated. Pleural lamellae rudimentary or altogether absent. Sixth segment large and more or less deeply cleft posteriorly. Five pairs of biramous pleopods present, with the outer ramus in some of the posterior pairs distinctly longer than the inner. Sac-like rudimentary uropods generally present.

Male. Head distinct from the thorax, bearing dorsally a pair of well-developed eyes. Antennules and antennae both reduced, former triarticulate, sometimes projecting slightly beyond the anterior margin of the head ; the latter composed of two joints.

Thoracic segments distinct, each carrying a pair of well-developed legs.

At least the first four abdominal segments clearly defined on the dorsal surface ; the fifth and the sixth fused dorsally, but generally distinguishable laterally. Pleopods present on some or all of the segments. Uropods absent.

Type-species :—Palaegyge borrei Giard and Bonnier.

The forms belonging to the genus *Palaegyge* are very similar to those included in Cornalia and Panceri's (1858) genus *Gyge*, and, as the name

[1] See addendum, p. 541.

indicates, are believed by Giard and Bonnier to represent a more primitive type. In their words (1888b, p. 63) "ils représentent une forme ancestrale moins dégradée et qui a gradé dans la structure du pléon l'organisation typique des Ioniens. Par les caractères de la patte-mâchoire, par les replis ventraux longitudinaux des deux derniers segments thoraciques et de certains anneaux de l'abdomen chez la femelle, par la séparation des anneaux du pléon chez le mâle, le *Palaegyge Borrei* se rapproche beaucoup du genre *Gyge*, mais il en diffère en ce que les lames pléales (branchies des anciens auteurs) au lieu d'être simples sont doubles (*b* et *c* pour employer notre notation ordinaire) comme cela existe chez les femelles jeunes seulement chez *Gyge branchialis*. La femelle adulte de *Palaegyge* a donc conservé d'une facon définitive une disposition qui n'est que transitoire chez la femelle de *Gyge*." As other important differences between the two genera may be mentioned the total absence of the pleural lamellae on the abdomen of the female in *Gyge* and the presence of uropods in its male. The pleura of the pleon in the female *Palaegyge*, it will be observed, are in a rudimentary condition, where they are present at all, and their further reduction, coupled with a similar process in the pleopods ("lames pléales" of Giard and Bonnier and "branchies" of other authors) to such a degree that the former vanish altogether, while the latter remain as small, fleshy, uniramous structures will approximately give us a condition that obtains in *Gyge branchialis* Cornalia and Panceri. The uropods of the male *Gyge*, according to this view, must have arisen independently. Within the genus (*Palaegyge*) itself, it must, therefore, be assumed, that forms having well-developed pleural lamellae and long pleopods are more ancient than those in which these structures are reduced. *P. brevipes* Bonnier and *P. godaveriensis*, sp. nov., would thus appear to be some of the most specialized members of the genus, while *P. borrei* Giard and Bonnier seems perhaps to be the most primitive.

The genera *Palaegyge* and *Probopyrus* G. and B., though perhaps widely different in their genetic relationships, are nevertheless very similar to each other,[1] so much so that one is easily confused with the other. Giard and Bonnier while describing the two genera do not mention any well-defined characters by which the two may be distinguished from one another. Bonnier separates the two on the character of the abdominal segments of the female—in *Probopyrus* they are said to be a little distinct while they are clearly so in *Palaegyge* ; but the figures of the various species belonging to these two genera given in his monograph show how little this character can be relied upon. The two genera may, however, be distinguished by the fact that in *Probopyrus* the uropods and the pleura of the abdominal segments in the female are totally absent, that the sixth abdominal segment in the female is a triangular structure with its posterior margin regularly rounded and generally entire, and that some or all of the abdominal segments of the male are dorsally fused. The abdominal segments of the female are also partly fused dorsally.

[1] This question has been discussed by Nierstrasz and Brandis also (1923, pp. 90, 91). See also addendum, p. 541.

In 1890 Giard and Bonnier pointed out the resemblance between their genus *Palaegyge* and Hesse's *Pleurocrypta*, but the differences between the two, especially in the abdomen of the male, are far too great to suggest any close genetic affinity. With *Pseudione* Kossmann, however, the relationship seems to be a little closer, for both the male and the female agree substantially in some of the important characters. In the female of *Palaegyge* the pleural lamellae of the abdominal segments can well be supposed to represent the similar, but better-developed, structures met with in *Pseudione*, and the uropods of the former by a similar process of reduction are derivable from those of the latter. The abdominal segments in both sexes are distinct dorsally and laterally in both the genera.

The genus *Palaegyge*, as Giard and Bonnier recognised it in 1890, is obviously a composite one, for as pointed out by Stebbing (1893) it consists of forms clearly belonging to two distinct genera, *Pseudione* and *Palaegyge*. The authors themselves suggest in that paper (1890, p.373) that it will probably be necessary to split the genus in two divisions : "l'une de ces divisions caractérisée par les lames pléales de la femelle garnies de verrues on tubercules, comprendra les espèces parasites des *Anomala* et des *Thalassinida* ; l'autre caractérisée par des appendices pléaux entièrement lisses renfermera les espèces parasites des *Eukyphota*". According to this definition they placed the following six species in the first group :—

Palaegyge hyndmani (Bate & Westwood).	*Palaegyge calliqnassae* (Kossmann).
P. frassei (Kossmann).	*P. insignis* Giard and Bonnier.
P. dohrni Giard and Bonnier.	*P. confusa* (Norman).

The second group comprised :—

Palaegyge borrei Giard and Bonnier. *Palaegyge affinis* (Sars).
Palaegyge hoyli (Giard and Bonnier).

This grouping was also followed by Stebbing who retained the name *Palaegyge* for the second group, while referring those of the first to Kossmann's *Pseudione*. Later workers, such as Sars (1899) and Bonnier (1900), however, referred *P. affinis* and *P. hoyli* also to *Pseudione*, retaining *P. borrei* only in the genus *Palaegyge*, Sars pointing out also (p.203) that "the distinctive character quoted by M. M. Giard and Bonnier between the genera *Palaegyge* and *Pseudione*, *viz.*, the presence or absence of tubercles on the pleopoda, is certainly of no generic value ".

The genus lives exclusively in fresh or estuarine waters and was described by Bonnier as comprising only species parasitic on freshwater Palaemonids in the islands of the Malay Archipelago. From this region the following species have been recorded :—

Name of species.	Locality.	Host.
P. borrei Giard & Bonnier	Amboina ...	... *Palaemon dispar* von Martens.
P. bonnieri Weber	... Celebes, Flores, Timor Is.	... *P. lar* Fabricius.
P. weberi Bonnier	... Flores ...	... *P. dispar* von Martens.
P. brevipes Bonnier	... Flores ...	... *P. endehensis* de Man.
P. incerta Bonnier	... Flores ...	... *P. bariensis* de Man.
P. demani Weber	... Sumatra	... *P. pilimanus* de Man.
P. fluviatilis Weber	... Sumatra ...	... *P. lampropus* de Man.
P. buitendijki Horst	... Java ...	... *P. carcinus* Fabricius.

Of these eight species I have obtained two in Indian waters. Horst's species is not uncommon in the Gangetic delta and probably in many other places, and occurs on the same species of *Palaemon*, as that from which it was originally recorded. Weber's *P. demani* has also been found on a different species of *Palaemon* in the deltaic waters of the Godaveri.

Of all the seven new species described in this paper six are parasites of *Palaemon*. They were for the most part collected in the deltaic regions of the Ganges and Godaveri, in waters subject, at any rate at some seasons, to tidal influence. The prawns themselves are (perhaps without exception) migratory species migrating in the rainy season from the tanks and freshwater streams to liberate their young in tidal waters[1]. Their localities and hosts are shown in the accompanying table :—

Name of species.	Locality.	Host.
P. prashadi ...	... Gangetic delta	... *Palaemon lamarrei*, H. M.-Edw.
P. brachysoma	... Gangetic delta	... *P. mirabilis* Kemp.
P. godaveriensis	... Delta of the Godaveri	... *P.* prox. *scabriculus* Heller.
P. alcocki ...	... Deltas of the Ganges and Godaveri, and the Kistna R. on the E. coast of India. ...	... *P.* prox. *malcolmsonii* H. M.-Edw.
P. abhoyat ...	... Gangetic delta	... *P.* sp.
P. bengalensis	... Gangetic delta	... *P. malcolmsonii* H. M.-Edw.

The seventh species lives on a different genus of hosts :—

P. pica ... ... Gangetic delta ... ... *Leander potamiscus* Kemp.

This is the first instance, so far as I am aware, of a *Palaegyge* being found living on a host other than a *Palaemon*. This fact taken along with certain structural differences in the parasite, mentioned in the description of the species, may perhaps give rise to doubts regarding its generic validity. The resemblance between this form and other members of the genus *Palaegyge* is, however, too close to justify any other view. Though *Leander* is as a rule marine, the water at the place where this particular species was collected was almost fresh.

From the localities of the nine species occurring in India, given above, it will be observed that *Palaegyge*, which is said to be an exclusively freshwater genus in the Malay Archipelago, is almost deltaic in India and is not met with inland. This question has been discussed in the introductory part of the paper (p. 424).

Besides these fifteen species there remains for consideration another, described by Miss Richardson (1912) under the name of *P. meeki*. It is found in various places in Panama and the Canal Zone and is a parasite of a species of *Macrobrachium* (=*Palaemon*). In view of the fact that all the other species of Palaegyge are strictly Oriental, Miss Richardson's record is very interesting. Apart from the total absence of pleopods in the male, and the fact that the incubatory plates are "very close together" so as to leave "only a small opening" in the marsupial pouch, there does not appear to be any ground for supposing that the species should be referred to some other genus.

[1] See Kemp, *Mem. Ind. Mus.* V, p. 203 (1915).

The paucity of well-defined characters and the somewhat brief descriptions which have been given in some cases make the task of constructing a really good key difficult, and I have been obliged, under the circumstances, to include a large number of minor characters in cases where no sharply defined characters could be found. The fifteen Indo-Malayan species may be distinguished as follows :—

A. Abdomen of adult female two-fifths or more, of total length of body. [Abdomen of male somewhat longer than broad; uropods of female present.]

I. Abdomen of female about half total length of body, and about as long as broad. [Rudimentary pleural lamellae present on all abdominal segments; sixth abdominal segment in female deeply bifid; sixth abdominal segment in male small, but distinct and rounded] ... *P. borrei* Giard and Bonnier.

II. Abdomen of female distinctly less than half total length of body and broader than long.

A. All abdominal segments of female well defined dersally; pleural lamellae of abdominal segments absent; sixth abdominal segment in female notched posteriorly.

1. Median lobe of posterior lamina of head produced in its middle in a small finger-like process; margins of abdominal segments almost continuous; sixth abdominal segment in female broad, with its posterior margin "slightly emarginated about the middle"; sixth abdominal segment in male a small inconspicuous structure, not distinct from fifth ... ... *P. buitendijki* Horst.

2. Median lobe of posterior lamina of head regularly rounded; margins of abdominal segments well separated; sixth abdominal segment in female comparatively narrow, with its posterior margin deeply cleft; sixth abdominal segment in male rounded ... ... *P. bengalensis*, sp. nov.

B. Lines of demarcation between some of posterior abdominal segments in female almost obliterated; pleural lamellae of abdominal segments present; sixth segment in female only slightly depressed about middle of posterior margin. [Sixth segment in male finger-shaped] ... ... *P. alcocki*, sp. nov.

B. Abdomen of female distinctly less than two-fifths of total length of body.

I. Abdomen of female a little less than one-fourth of total length of body.

A. Abdomen of female about as long as broad; no prominent ridges on ventral surface of abdomen in female; uropods present; abdomen in male longer than broad, its terminal segment long and finger-shaped .. .. *P. brachysoma*, sp. nov.

B. Abdomen of female markedly broader than long; ventral surface of abdomen in female raised in prominent ridges; uropods absent; abdomen of male broader than long, its terminal segment rounded ... *P. demani* Weber[1].

II. Abdomen of female about one-third of total length of body.[2]

A. Abdomen of female broader than long.

1. Sixth abdominal segment of female more or less deeply cleft posteriorly.

[1] In *P. demani* the shape of the abdomen in the female and that of its sixth segment varies considerably in different specimens.

[2] In *P. weberi* and *P. brevipes* the abdomen of the female is slightly longer than one-third the total length of the body, while in *P. pica* it is slightly less than one-third.

a. External margin of outer secondary lobe of posterior lamina of head broken up into small lobes and processes; abdomen of male not much longer than broad. [Head of female broader than long; uropods absent. Last abdominal segment in male rather small, distinct and rounded] ... ... *P. prashadi*, sp. nov.

b. External margin of outer secondary lobe of posterior lamina of head entire; abdomen of male longer than broad.

i. Uropoda absent; maxilliped about one and half times as long as broad, its palp bearing about seven hairs .. *P. incerta* Bonnier.[1]

ii. Uropoda present; maxilliped about twice as long as broad, its palp bearing about four hairs. [Prominent ridges on all abdominal segments in female present.]

α. Head of female distinctly broader than long, a longitudinal groove about its middle apparently dividing it into two; sixth abdominal segment in male small and rounded, indistinctly separated from the fifth *P. weberi* Bonnier.[2]

β. Head of female almost as long as broad, without any indication of its being formed of two longitudinal portions; sixth abdominal segment of male thick and squarish ... *P. bonnieri* Weber.

2. Sixth abdominal segment of female almost entire posteriorly, or slightly notched. [Head of female broader than long; external margin of outer secondary lobe of posterior lamina of head wavy; pleopoda of female small, not projecting beyond margins of abdomen; small tuberculiform uropods present; abdomen of male broader than long; terminal segment semicircular] .. ... *P. pica*, sp. nov.[2]

B. Abdomen of female almost as long as broad. [Pleural lamellae of abdominal segments in female absent.]

1. Uropoda present.

a. Head of female broader than long, its posterior limit not clearly defined on dorsal surface; abdomen in male broader than long; sixth abdominal segment in male rounded ... *P. godaveriensis*, sp. nov.

b. Head of female slightly longer than broad, its posterior limit well defined on dorsal surface; abdomen in male somewhat longer than broad; six abdominal segment in male short and squarish. [Posterior portion of head in female coloured black on dorsal surface] ... ... *P. abhoyai*, sp. nov.

2. Uropoda absent.

a. Head of female about twice as broad as long; palp of maxilliped bearing a single hair; abdomen in male broader than long, its terminal segment distinct and rounded ... *P. fluviatilis* Weber.

b. Head of female slightly broader than long; palp of maxilliped bearing a number of hairs; abdomen in male almost as long as broad, its terminal segment thick, and broader than long ... ... *P. brevipes* Bonnier.[2]

[1] The male in *P. incerta* has not been described, and the characters referring to the male given in this section of the table do not apply to this species.

[2] In *P. weberi* and *P. brevipes* the abdomen of the female is slightly longer than one-third the total length of the body, while in *P. pica* it is slightly less than one-third.

Miss Richardson's *P. meeki*, which is not included in the above table, seems to belong to the same group in which *P. weberi* and *P. bonnieri* have been placed. Judging from her figures and description, the abdomen in the female seems to be a little less than 1/3 of the total length of the body, is broader than long and is devoid of all traces of the pleural lamellae. The head, which is clearly separated off from the thorax, is broader than long and there is no longitudinal groove separating it into two portions; the first oostegites have no covering structure over them; the sixth abdominal segment is deeply cleft posteriorly; and the uropods are present. The male has its abdomen longer than broad and the sixth segment is rounded and indistinctly separated off from the fifth. The pleopods are absent.

P. plesionikae Barnard (1920, p. 425) has also not been included in the above key, for I am of opinion that the parasite described under that name is not a *Palaegyge*.[1] Besides other minor differences, the incubatory cavity is never quite closed in the genus nor are the uropods ever so well developed. Further the host of Barnard's species is a marine Pandalid coming from a considerable depth, whereas all the hitherto known species of *Palaegyge* are known to infest fresh or semi-freshwater Palaemons.

Palaegyge prashadi, sp. nov.

(Plate XV, figs. 6–11.)

The average size of the adult *female* is about 9 mm. long and 7 mm. broad at the level of the third thoracic segment. The size, however, varies a great deal, the length ranging between a little over 6 mm. and as much as 11 mm. The form of the body does not present any striking differences from that of the other known species of the genus. The general colour is yellowish, with the head, sides of the thorax and the abdomen of a lighter shade. On the dorsal surface, along the deformed border of the thorax there are three conspicuous dark patches on the posterior half of the 2nd, 3rd and 4th segments and somewhat inconspicuous spots on the first and fifth somites. These colour patches are found to be invariably present in all the specimens examined. There is also a dark ring surrounding the head along its posterior and lateral margins and sometimes the posterior portion of the head is also shaded. The non-deformed side has no pigmentation. Ventrally the oostegites of both sides are pigmented, and a streak of pigment generally runs in the mid-ventral line of the thorax.

The head, as seen on the dorsal surface, is rounded, almost as long as broad and somewhat raised above the surface of the body. It appears to be formed of two halves separated by an indistinct median longitudinal groove. The anterior margin is not prolonged into a frontal lamina, and is more or less regularly rounded. Posteriorly the head tapers gradually and is rather narrowly rounded behind. Eyes are completely absent.

[1] See addendum, p. 541.

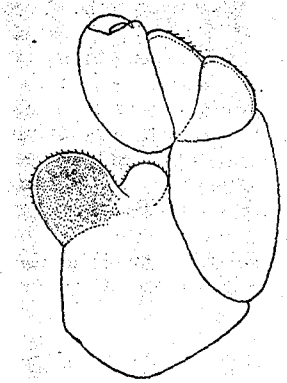
The thoracic segments are very well defined on the dorsal surface. The first segment is short and is not half as long as the second. The ovarian bosses are well developed; they are oval in form and are placed on the anterior portions of the first four segmental margins. This portion is separated by a notch from the rest of the margin, which on the deformed side is pigmented. The epimera on the first four segments are only slightly developed and are in the form of narrow plates lying lateral to the bosses and separated from them by distinct sutures. Those of the last three segments also are not strongly developed, but occupy the entire margin. The epimera of the deformed side are greatly reduced.

The abdomen is proportionately short, being about one-third the total length of the body. The segments of which it is formed are for the most part distinct on the dorsal surface. The pleural lamellae of the abdominal segments are totally absent. The sixth segment is large and has the posterior margin rounded and somewhat deeply cleft about the middle.

The head, seen from the ventral surface after removing the first oostegites and the maxillipeds, is distinctly broader than long and is rounded in shape. Most of its appendages are greatly reduced and are hardly visible without strong magnification. The two pairs of antennae are very insignificant structures placed near the anterior margin; the antennules appear to be three-segmented while the antennae are formed of two segments. The mandibles, as usual, are well developed, long and stout. The first maxillae are placed close behind the mandibles and are easily seen, while those of the second pair have not been made out. The posterior lamina consists of a median lobe, somewhat sharply rounded in the middle, and the usual two pairs of secondary lamellae, the inner of which are the smaller and more sharply pointed. Both the lamellae, especially those of the outer pair, are broken into small lobes and processes along their outer margins. This condition, it is to be noted, is not met with in any other species of the genus. The maxilliped is about 1 1/2 times as long as broad and is normal in form. The palp is distinct, dome-shaped and somewhat deeply set in the maxilliped; its margins are beset with 5 or 6 hairs. There are generally a few more hairs along the anterior border of the maxilliped on both sides of the palp, and close to it. Dark pigment spots are scattered on the ventral surface of the head in great abundance and are especially aggregated towards its posterior portion. The mandibles together with a part of the first maxillae are black and the posterior lamina has a large amount of pigment on all its lobes. The maxillipeds, besides other markings, invariably have a large dark spot on the anterior portion of the basal segment.

The ventral surface of the thorax is raised into a number of ridges but their free edges are not frilled. The first pair of oostegites is darkly pigmented throughout. They have the usual shape and are formed of the usual two portions, the anterior of which is more or less rounded. The posterior is drawn out into a prominent lobe, rounded at its extremity, and fringed with hairs along its inner margin. This margin is very often folded inwards so that the lobe appears to be pointed

distally, and its hairs are not seen. The internal crest is well developed, and has about eight or ten rounded processes near its origin, the most proximal two to four of which are always larger than the rest. The remaining oostegites are normal in all respects and are almost as long as broad. As usual in the genus they do not overlap one another in the median line, and thus the incubatory cavity is left partially open. The fifth oostegite encloses the cavity from behind; it is many times longer than broad, and has a row of hairs along its posterior margin. All the thoracic legs have two well-developed bosses on the basipodite, of which the lower is the larger, and both are covered with scales. The bosses are on the opposite surfaces of the segment and the lower partly covers the upper. The ischium is large and rectangular; the merus is short and fringed with small hairs on its external margin. The carpus is distinct and moderately large and its external margin also is fringed with hairs. The propodus is large and has a prominent rounded process on its external margin near its junction with the carpus, against which the dactylus acts.



Text-fig. 13.—*Palaegyge prashadi*, sp. nov. Thoracic leg of female: × 100.

The abdomen is broader than long. On its ventral surface the first two segments are raised into inconspicuous ridges with their free surface somewhat frilled. The five pairs of biramous pleopods cover the entire surface of the pleon, and some of the anterior pairs of the two sides overlap one another in the middle line. The pleopods go beyond the margins of the abdomen and are thus visible in part from the dorsal surface. The anterior pairs have short and broad rami, but posteriorly the rami become long and narrow. The exopodite and the endopodite in at least the first three pairs are of almost the same length, but in those of the last one or two pairs the latter is as a rule considerably shorter than the former. The uropods seem to be totally absent.

The adult *male* has a somewhat stout appearance being about three times longer than broad. The average length is 1·7 mm. and the breadth at the level of the third segment a little over 0·6 mm. The body is whitish in colour, and the dorsal surface is profusely pigmented, especially the thorax, where the somewhat brownish pigment spots are arranged in the form of three parallel bands, running from end to end, one median and two near the sides. The head is also pigmented near its anterior and lateral margins. There are also a few faint colour-spots on the abdomen.

The head is semicircular in shape and is distinct from the thorax. It has a pair of well-developed eyes placed in the posterior half, one near each lateral border. The antennules are three segmented; the terminal segment, which is crowned with a number of setae, being very small. The antennae are formed of two articles, the basal of which is short and

swollen, while the terminal is fairly long and is distally rounded. They also carry a small number of setae. The remaining appendages are normal.

The thoracic segments are distinct and the legs have a large propodus, and a well-developed claw.

All the abdominal segments, as is the rule in the genus, are quite distinct, and their lines of demarcation are well defined on the dorsal surface. The abdomen is almost as long as broad or even sometimes slightly broader than long. The first four segments are large, but the fifth is comparatively small, its margins bulging out slightly near the base of the sixth. The last segment is a short rounded process projecting posteriorly, about one-fifth the total length of the abdomen and broadly rounded posteriorly. The first four segments each carry a pair of small pleopods; the last two are devoid of all appendages.

In quite a large number of specimens the abdomen differs somewhat from the above description of typical individuals. The length slightly exceeds the breadth and the sixth segment is proportionately much longer (sometimes even more than 1/4 the total length) and its posterior margin is truncate.

Locality.—The species is a parasite of *Palaemon* (*Eupalaemon*) *lamarrei* H. M.-Edwards and occurs commonly all over the Gangetic Delta, both in fresh as well as brackish waters. In preserved specimens the dark oostegites of the parasite surrounding the central mass of yellowish eggs are clearly seen through the carapace of the host. The localities from which the species has been collected are as follows :—

Tantuliah, Madhumati R., Gangetic Delta	... B. Prashad. 14.x. 17. (TYPES C 575/1).
Tantuliah, Madhumati R., Gangetic Delta	... B. Prashad. 16,17.x.17.
Bardia, Bardia Stream, Gangetic Delta.	... B. Prashad. 21.ix.17.
Pussar R., Khulna, Gangetic Delta ...	... T. Southwell. 22.ix.15.
Udhabganj on Munikhali Khal, Dacca.	... H. A. Stapleton.
Near Khulna, Gangetic Delta ...	... ? 19.viii.15.
Mungura	... J. Wood-Mason and A. Alcock.
Narail, nr. Khulna	... J. Wood-Mason and A. Alcock.

Of these the specimens from Udhabganj, and those collected near Khulna are for the most part young. Of the Palaemons collected at Mungura four do not seem to belong to *P. lamarrei*; they are probably *P. dayanus* Henderson. The parasites, however, are like the typical *P. prashadi*. The identification of the hosts is somewhat doubtful.

Palaegyge buitendijki Horst.

1910. *Palaegyge buitendijki*, Horst, *Notes Leyden Mus.* XXXII, pp. 67-70, text-figs. 1-4.

To Horst's fairly detailed description of the species I have only to add a few notes, as the Indian specimens agree closely with his account.

The pigment on the dorsal surface is almost entirely restricted to the posterior halves of the 2nd, 3rd and 4th segments, the small, inconspicuous colour-spots that do exist on the posterior thoracic segments extend also on the first two abdominal somites. There is no pigment around the head in my specimens.

The head, as shown in Horst's figure, is clearly formed of two halves, and its posterior margin, which is much shorter than the anterior, is almost straight.

The pleura of the first four thoracic somites are in the form of very narrow plates lying lateral to the ovarian bosses and separated from them by distinct longitudinal grooves.

The abdomen is large and is about 2/5 the total length of the body. The lines of demarcation between some of the posterior segments are not distinctly visible in the mid-dorsal region. The pleural lamellae are totally absent. The sixth segment is large and its posterior margin is slightly notched about the middle.

The three parallel folds below the articulation of the palp of the maxilliped are not seen in the Indian examples. The median lobe of the posterior lamina has a large finger-shaped process projecting well beyond all the other structures.

The figure and description given by Horst of the first oostegite show its posterior lobe to be narrow and posteriorly pointed. I have no doubt that in his specimens the inner margin of this lobe, as is very often the case, was folded inwards, thus making the lobe appear narrow and pointed. In reality the lobe is a large broad structure with its distal end broadly rounded and the inner margin beset with hairs. The peraeopods have, as in *P. prashadi*, a double boss on the basal joint, the lower boss being much the larger of the two. All the other joints are distinct.

The pleopods do not overlap one another in the median line, nor do they extend much beyond the sides of the abdomen. The ventral surface of some of the anterior abdominal segments is raised into strong ridges, like those of *P. borrei* Giard and Bonnier (1888*b*). The uropods are small pear-shaped structures at the base of the sixth segment.

The *male* is about three times as long as broad, and is almost white in colour without any colour-markings on its dorsal or ventral surface.

The antenules are three-segmented with the third segment very small, and the antennae are composed of two segments only, the distal being long and cylindrical. Both have small hairs along the margins.

The abdomen is about 1/3 the length of the body and is a little longer than it is broad. The sixth segment is small and rounded, indistinctly separated from the fifth and not even one-sixth the total length of the abdomen.

Localities.—The specimens of this Bopyrid, like those examined by Horst, were found living in the branchial cavity of *Palaemon carcinus* Fabricius. My specimens were obtained from the Calcutta market and had probably been collected somewhere in the Khulna District. *Palaemon carcinus* occurs over a large part of India, and it is possible the parasite is also fairly common. Henderson and Matthai,[1] however, do not record the presence of a parasite on any of the numerous specimens of *P. carcinus* which they obtained in South India. Two specimens from an unknown locality and not accompanied by their hosts, presented by M. de Folin, are also in our collection. Another specimen, an immature female, was collected at Gatigarh, Hugli District, by Mr. Ati-ur-Rahman in October 1917.

[1] Henderson and Matthai, *Rec. Ind. Mus.* V, p. 280 (1910).

Palaegyge brachysoma, sp. nov.

(Plate XVI, figs. 1–4.)

The *adult female* is markedly asymmetrical in form, one side of the body being much shorter than the other. The animal is a little less than 6 mm. long and about 4·7 mm. broad. The general colour of the body is pale yellow, with the head, sides of thorax and abdomen white. The amount of pigmentation is much less than in the preceding species, and the pigment itself is somewhat brownish. As in *P. buitendijki*, there are on the deformed side only three broad patches in the posterior half of the second, third and fourth segments. Ventrally all the oostegites of the deformed side are coloured ; on the non-deformed side only the first two are slightly pigmented while all the rest are white.

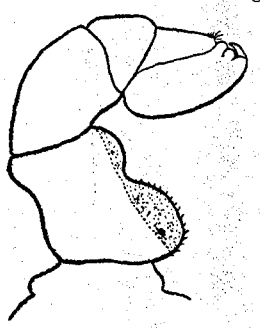
The head in dorsal view is somewhat broader than long and its anterior margin, which is not produced forward into a frontal lamina, is regularly rounded. The posterior margin is much shorter than the anterior and is slightly rounded. A little behind the anterior margin is a pair of small dark spots, the rudimentary eyes. There is no median longitudinal groove on the head.

The lines of demarcation between the thoracic segments are very well defined on the dorsal surface. The first segment is very short and in its mid-dorsal portion is 1/3 as long as the second. As usual all the segments except the first two are directed backwards at their margins. The ovarian bosses are well developed, and the segmental margin behind them is separated off by a deep notch. The bosses as well as the epimera of the first four segments are better developed on the non-deformed side and the former are elliptical and occupy the anterior half or more of the margin. The epimera of these four segments are separated off from the bosses by distinct grooves ; those of the last three segments are broad and occupy the entire margins.

The abdomen is short, being a little less than 1/4 the length of the body. Its segments are quite distinct, but the lines of demarcation are sometimes not well defined mid-dorsally. The pleural lamellae are totally wanting. The sixth segment has the posterior margin deeply bifid, much more so than it is in *P. prashadi*.

The head appendages are greatly reduced. The antennules are formed of three segments of which the terminal is very short. The antennae consist of two segments, the second being large, somewhat rounded distally and, like the terminal segment of the antenules, provided with small hairs. The mandibles are well developed, and are of the usual shape. All the other structures are extremely reduced. The posterior lamina of the head consists of a large somewhat triangular median lobe, pointed at its tip and projecting beyond all other structures, and two pairs of secondary lamellae of which the inner is narrow and pointed while the outer is broad and somewhat blunt. The maxilliped is about one and a half times longer than broad, and has its dome-shaped palp deeply set in the supero-internal corner of the squarish anterior segment. The palp is crowned with six hairs, two at its tip and about four along its inner margin ; there are no hairs along the outer margin. A little below the palp, along the inner margin of the maxilliped, there are two more hairs almost as long as the others.

The thorax has a large incubatory cavity, only partially covered by the five pairs of oostegites. In the first pair the anterior portion is proportionately short, and is about 1 1/2 times broader than long. The posterior portion has a large posterior lobe rounded distally, and sparsely beset with hairs along its inner margin. The internal crest is feebly developed and has a number of small rounded processes near its proximal end. The remaining oostegites are small triangular structures projecting into the incubatory pouch. The seven pairs of thoracic legs have each a well-developed double scaly boss on the outer surface of the basipodite. The ischium is long, but the merus and carpus, especially the latter, are reduced. The carpus bears a tuft of hairs near its anterior end. The propodus has a rounded projection against which the dactylus closes.



TEXT-FIG. 14.—*Palaegyge brachysoma*, sp. nov. Thoracic leg of female : × 75.

The abdomen is about as long as broad, and its sides are deeply notched. The five pairs of pleopods are closely crowded together, but those of the opposite sides do not overlap one another in the middle line. The rami of the first three pairs are of almost the same size, but in the last two the outer ramus is considerably longer than the inner, is curved and extends a good deal beyond the margins of the abdomen. The uropods, placed about the middle of the sixth segment, are rudimentary and appear to be attached by short stalks.

The *male* is about 1·5 mm. long and 0·6 mm. broad at the level of the third segment. The body is pale in colour and has no conspicuous colour-markings.

The head, seen dorsally, presents a semicircular contour with a slight concavity in the middle of the anterior margin. A pair of small eyes is present in the posterior portion of the head. The antennules are fairly large and project a little beyond the anterior margin ; each consists of two large segments and another small one at the top. The antennae are two-segmented. The mandibles, maxillae and all other parts appear to be normal.

The thoracic segments are distinct, and the legs are provided with strong claws.

The pleon is about one-third the total length of the animal, and is a little longer than broad. The first four segments are distinct and their lines of demarcation are well defined on both the surfaces. The fifth and the sixth are partly fused together. The sixth segment is a long and stout finger-shaped structure projecting posteriorly and somewhat rounded at its distal end. It is much longer proportionately than that of *P. prashadi* and forms about a third of the total length of the abdomen. Ventrally each of the first three segments is provided with a pair of small tuberculiform pleopods projecting from the posterior margin. In one specimen slight traces of pleopods appear to be present on the fourth segment also. The uropods are absent.

Localities.—The species is a parasite of *Palaemon mirabilis* Kemp occurring chiefly in the Gangetic Delta. The type-specimens (C 519/1), an adult male and female, is a right bopyrid and was collected near Shela in the Khulna district by Dr. J. T. Jenkins in December 1909. Another specimen, an adult couple and a left bopyrid, was captured at Assasani, Katipara in February 1917, while a third specimen, also an adult couple and a right Bopyrid, was collected by Drs. Annandale and Kemp in January 1917 in the river Hugli at Sibpur near Calcutta. Another specimen from the same locality as the last is also referred to this species. It is a parasite of a species of *Palaemon* very closely resembling *P. scabriculus* Heller, but differing from it in certain material respects. The parasite differs from the typical forms in having the sixth abdominal segment of the male proportionately shorter but agrees in all other respects with the description given above.

The name of the species refers to the short abdomen of the female.

Palaegyge godaveriensis, sp. nov.

(Plate XVI, figs. 5–9.)

This species, based upon a single individual, bears a very close resemblance to *P. brachysoma*, especially in the characters of the female.

The adult *female* is 5·2 mm. long and 4 mm. across at the level of the third somite. The form resembles that of the preceding species, as does also the general arrangement of colour-spots. There are, however, on the dorsal surface, besides the three broad colour-patches, smaller patches on the fifth, sixth and seventh somites and irregular spots around the posterior border of the head. Ventrally all the oostegites of the deformed and the first two oostegites of the non-deformed side are pigmented.

The head seen dorsally is not raised above the general level of the body, as is the case in the preceding species. The anterior border is rounded, while the posterior limit is not clearly distinguishable as the head seems to be slightly fused with the first thoracic segment. A pair of small eyes is present close behind the anterior margin.

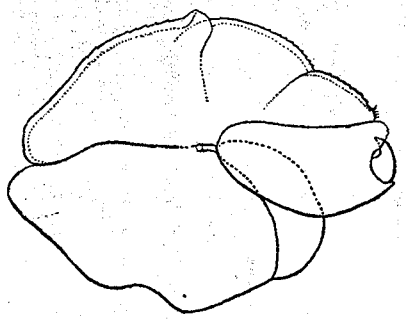
With the exception of the first, all the thoracic segments are distinct. The ovarian bosses are not developed to as great an extent as in the foregoing species, and are seen on the longer side of the body as narrow elliptical structures, occupying about half of the anterior part of the thoracic margin. The epimera have the usual shape and position.

The abdomen is about one-third the total length of the body, and is as long as broad. The lines of demarcation between some of the posterior segments are not defined mid-dorsally. The pleural lamellae are totally absent. The sixth segment is not triangular, but is somewhat oval, and has the posterior margin deeply bifid.

The antennules and the other appendages are as in *P. brachysoma*. The posterior lamina has the outer secondary lobe very broad, while the inner is long, narrow and tongue-shaped. The median lobe is narrowly rounded posteriorly. The maxilliped is over one and a half times longer than broad and its palp is thick and rounded at the tip and is not

deeply set in the anterior margin. It seems to have about four hairs in all, three along the anterior and inner margins, while the fourth is on the outer margin at the junction of the palp with the maxilliped. The posterior portion of the head has pigment spots closely scattered on it, and the median lobe of the posterior lamina is also pigmented.

The first oostegite is like that of the former species, but the internal crest is digitate over a greater portion and the number of processes is larger. The boss on the basal joint of the thoracic legs is single, but very large and is covered with scales. The outer margins of the merus and carpus are in part hairy, and the latter has its usual small projection covered with a number of long hairs. The projection of the propodus, against which the dactylus acts, is very conspicuous.



Text-fig. 15.—*Palaegyge godaveriensis*, sp. nov. Thoracic leg of female : × 120.

The pleopods are small and leave a large space uncovered in the middle. They extend very slightly beyond the margins of the abdomen and consequently are almost invisible from the dorsal surface. In the fourth and fifth pairs, especially the fifth, the exopodites are considerably longer than the endopodites. The uropods are small and oval and appear to have no stalks.

The *adult male* is stout, being two and a half times longer than broad. It is 1·3 mm. long and a little over 0·5 mm. broad. The body is almost white in colour, with only a few irregular colour-spots on the thorax along the dorsal surface.

The antennules do not project beyond the anterior margin of the head and are composed of three segments of which the third is the shortest and is beset with setae along its anterior margin. The antennae are two-segmented, the second segment being long and somewhat rounded distally.

The abdomen differs markedly from that of the preceding species. It is less than a third of the total length and is distinctly broader than long. The segments are all distinct both dorsally and laterally, but the posterior line of demarcation of the fifth segment is not clearly visible on the dorsal surface. The sixth somite is a short rounded process less than one fourth of the length of the abdomen, and is narrower at its proximal end than at its posterior extremity. Three pairs of tuberculiform pleopods are present.

Locality.—The single specimen (C 516/1) that I have examined was collected by Dr. N. Annandale in the Godaveri River, near Rajahmandry, Madras Presidency, in August 1918. It is a left Bopyrid and is a parasite of a *Palaemon* closely resembling, but distinct from, *P. scabriculus* Heller,

P. godaveriensis differs from *P. brachysoma* in the following essential respects :—

Female.

1. The posterior boundary of the head is not visible dorsally, as it is partly fused with the thorax.
2. The ovarian bosses are feebly developed.
3. The abdomen is proportionately longer.
4. The outer secondary lamella of the posterior lamina of the head is proportionately much broader and the median lobe, which is pigmented, is not pointed in the middle.
5. The palp of the maxilliped is thicker and more rounded and has a different arrangement of hairs.
6. The internal crest of the first oostegite is more strongly digitate.
7. The pleopods are small and the uropods do not appear to have any stalks.

Male.

8. The abdomen is distinctly broader than long.
9. The sixth abdominal segment is proportionately shorter and is rounded.

Palaegyge alcocki, sp. nov.

(Plate XVII, figs. 1–5).

This species closely resembles Horst's *P. buitendijki.*

The *adult female* is a little over 15 mm. long and about 13 mm. broad. The colour of the body is pale yellowish and on the dorsal surface along the deformed side there are only three broad colour-patches on the margins of the second, third and fourth segments. Ventrally all the oostegites of the deformed and the first two of the non-deformed side are coloured.

The head is almost as long as broad and is distinctly separated from the thorax. An indistinct groove running longitudinally about the middle gives an appearance of its being formed of two halves. The anterior border is regularly rounded, while the posterior, which is much shorter, also forms a regular curve. Eyes are totally absent.

The first thoracic segment is very short and is less than half as long as the second. The ovarian bosses are well developed and are narrow and elliptical. The epimera of the first four segments on the longer side of the body are prominent structures and are about as broad as the bosses themselves. Those of the last three segments are also well developed. The epimera on the deformed side are greatly reduced.

The abdomen is about two-fifths the total length of the body and is slightly broader than long. The lines of demarcation of the first three segments are quite distinct but those of the posterior ones are almost totally obliterated. The rudiments of the pleural lamellae of all the segments, especially on the longer side of the body, are fairly large. Their shape, etc., is like that of similar structures in *B. borrei* as seen from Giard and Bonnier's description and figures (1888b). The sixth segment is large and triangular, with its posterior margin slightly depressed about the middle, but with its pleural lamellae presenting the appearance of being deeply cleft.

The two pairs of antennae are greatly reduced and are hardly visible. The posterior lamina of the head has a large median lobe in the form of

a triangle, the apex of which is pointed and projects posteriorly beyond all other structures. Both the secondary lobes are well developed, but the inner is somewhat narrower and is pointed posteriorly. The median lobe, (as also some portion of the head near it), has a large number of pigment spots scattered over the surface. The maxilliped is about one and a half times longer than broad and has the usual shape. The palp is deeply set in the anterior margin and is considerably broader near its tip than at the base. Along its antero-internal margin it has seven or eight thick setae, looking like short spinous processes of the margin. There are no setae along its outer margin.

The ventral surface of the thorax is raised in prominent thick fleshy ridges running obliquely. The first oostegite has a large distally rounded posterior lobe beset with stiff hairs along its inner margin. The internal crest is well developed and is strongly digitate. It has about eight large irregular processes near its origin diminishing in size from the first to the last. The digitation, on the whole, is less prominent than in Horst's species. The peraeopods have a large scaly boss on the basal joint, occupying almost its entire margin. The margin of the carpus is hairy and the propodus has a large process against which the dactylus acts.

The pleopods touch one another in the middle line and thus cover the entire surface of the abdomen. The rami are more or less equal in size, except those of the last pair, in which the exopodite is longer and projects beyond the sides of the abdomen. The rudimentary uropods are present in the form of small oval bodies at the base of the sixth segment.

The *male* is about two and a half times longer than broad and is whitish in colour without any prominent pigment-spots.

The head has a pair of small eyes in its posterior portion. The antennules are three-segmented and the antennae are composed of two segments. The mandibles are long and curved and the maxillae are placed close behind them.

The abdomen is a little longer than broad and has the first four segments quite distinct. The fifth is small and bulges out at the sides of the sixth and is not clearly distinguishable from it. The latter is a small thick process, rounded distally, about a fourth of the length of the abdomen. Ventrally four pairs of pleopods are present.

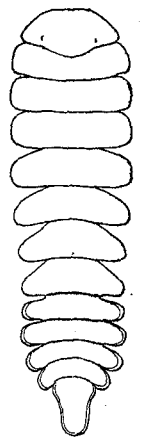
Localities.—All the specimens in our collection have been obtained from the branchial cavity of a species of *Palaemon* resembling *P. malcolmsonii* H. M.-Edwards, but differing varietally or specifically from it.[1] The localities are shown in the following table :—

Mathabhanga R., Nadia Dist.	A. Alcock, 15th November, 1892. (TYPES C 564/1).
Magura, Jessore Dist., E. B.	J. Wood-Mason and A. Alcock.
Narail, nr. Jessore, E. B.	Capt. Stege.
Calcutta Market	B. N. Chopra, 22nd January, 1921.
Calcutta Market	G. C. Chatterjee.
Edge of Godaveri R., nr. Railway Bridge, Rajahmundry, Madras	N. Annandale, 30th August, 1918.
Mud Bank, edge of Kistna R., Bezwada ...	N. Annandale, 6th September, 1918.

[1] The proportions of the large chelipeds are different in these specimens for the carpus is decidedly longer than the chela, whereas the reverse is the case in *P. malcolmsonii*.

The types consist of two adult females and one male. Most of the specimens are adult, but some from Narail and Bezwada appear to be young. Two specimens from the last locality are doubtfully referred to this species.

The male in some of these specimens differs considerably from those which have been taken to represent the typical form. The abdomen is markedly longer than broad, and the fifth segment is sometimes so reduced that it is hardly visible, even at the sides near the base of the sixth segment where, in typical forms it has been described as bulging out. The sixth segment, perhaps as a result of the reduction of the fifth, is seen to be a long finger-shaped process tapering posteriorly and about a third of the total length of the abdomen. This is the case in one of the males obtained from Magura, one from those collected at Narail and in both the Calcutta market, the Godaveri and Kistna R. specimens. The females of all these specimens agree closely with the typical forms. It is possible these specimens represent a distinct variety, but as there are no differences in the female nor any other difference in the male except in the shape of the abdomen and as they have been found along with the typical individuals from the same host-species and from the same locality, I prefer, for the present at any rate, to include them under *P. alcocki*.



TEXT-FIG. 16.—*Palaegyge alcocki*, sp. nov. Dorsal view of male with long abdomen and terminal segment.

From the description given above it will be observed that correlated with the presence of rudimentary pleural lamellae on the abdominal segments of the *adult* female in *P. alcocki* there are also certain other differences which distinguish it from *P. buitendijki*. Among such differences may be noted the almost complete obliteration of the lines of demarcation between the posterior abdominal segments of the female ; the slightly depressed posterior margin of the sixth abdominal somite; the differences in the shape of, and disposition of the hairs on, the palp of the maxilliped ; the smaller and fewer processes of the internal crest of the first oostegite and the marked differences in the abdomen of the male. In the possession of pleural lamellae on the abdominal segments of the *adult* female, *P. alcocki* resembles *P. borrei*, the only other species of the genus in which these structures are so well developed in the adult.

Palaegyge abhoyai, sp. nov.

(Plate XVII, Figs. 6-10.)

The species in its general appearance very closely resembles *P. prashadi*. The *adult female* is about 8 mm. long and a little over 6 mm. broad at the level of the third segment. The colouration of the body is somewhat like that of *P. prashadi*, but the three pigment-patches along the deformed margin of the body are larger and extend even onto the an-

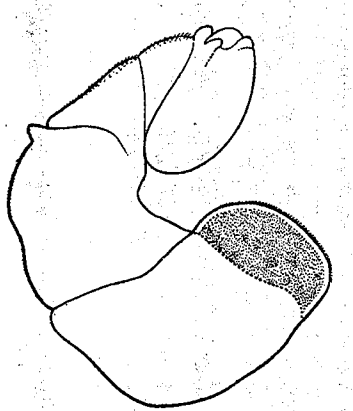
terior portion of the segment. Besides these there are colour-spots on almost all the other thoracic segments along both sides, those on the non-deformed side being the smaller. The posterior portion of the head is invariably found pigmented. Ventrally all the oostegites of both the sides are coloured and there is a streak of pigment running mid-ventrally. Unlike *P. prashadi*, the posterior lobe of the first oostegite is not pigmented.

The head, unlike that of *P. prashadi*, is longer than broad and has a regularly rounded outline. An indistinct longitudinal groove gives it the appearance of being formed of two halves. Both the anterior and posterior margins are rounded.

The thoracic segments are distinct and the ovarian bosses are not as strongly developed as those in *P. prashadi*. The epimera also, especially those of the deformed side, are poorly developed.

The abdomen is short, being about one-third the total length of the body, but is proportionately narrow for it is about as long as broad. It tapers more rapidly posteriorly, and its segments are better defined on the dorsal surface. The sixth segment is narrower and longer and is much less deeply cleft along the posterior margin. Pleural lamellae are totally absent.

The posterior lamina of the head consists of a large broadly rounded median lobe, and two pairs of secondary lamellae of which the inner are sharp, tongue-like, curved structures. The outer lamellae are broad at the base but taper rapidly to the tip and their margins, like those of the inner lamellae, are entire, and are not broken into lobules as they are in the allied species. A portion of the ventral surface of the head close behind the posterior lamina is pigmented. The palp of the maxilliped is large and dome-shaped and is set obliquely in the anterior margin. It has on its anterior and internal margins five or sometimes six long setae, the outer margin being entirely unarmed. The characteristic dark spot on the basal joint of the maxilliped of *P. prashadi* is absent.



Text-fig. 17.—*Palaegyge abhoyai*, sp. nov. Thoracic leg of female: × 75.

The first oostegites have the same shape as those in the related species, but the internal crest is different. It is less strongly developed and the digitations towards the proximal end are also less marked. There are about eight irregular processes, all more or less of the same size; the two especially large proximal processes that are present in *P. prashadi* are absent in this species. The posterior lobe is large and rounded, and there are hairs along its inner margin. The legs have a large scaly boss on their basal segment representing the lower boss of the allied species. All the remaining segments are as in the other species.

The pleopods are proportionately small and do not overlap one another in the middle line, nor do they extend to any appreciable extent beyond the margins of the abdomen. The rami are more or less of the same size except in the last pair, where the outer ramus is larger than the inner. A pair of moderately large sac-like uropods is present near the base of the sixth segment.

The *adult male* is 1·8 mm. long and a little over 0·7 mm. broad at the level of the third thoracic segment. It is whitish in colour without any pigment-spots on the dorsal or ventral surface.

The head is semicircular in outline and has a pair of distinct eyes. The antennules are three-segmented and the antennae are smaller and formed of two segments.

The abdomen is about one-third the length of the body and is about as long as broad. Sometimes, however, the length slightly exceeds the breadth. The first four segments are quite distinct, but the fifth is somewhat fused with the sixth and is visible only on the sides, where it bulges out near the base of the sixth. The last segment is small and squarish about one-fourth the total length of the abdomen and has its posterior margin almost straight. Only three pairs of pleopods are present.

Localities.—The species is a parasite of an undetermined species of *Palaemon* and occurs commonly, for the most part in the Gangetic Delta.

Calcutta Market	B. N. Chopra. TYPES (C 599/1 and Cotypes.
R. Hughli, Sibpur, near Calcutta	N. Annandale and S. Kemp.
Garia, near Calcutta	?
Karsalang, 110 miles from Chittagong, Chittagong Hill Tracts	R. P. Mullins.

The specimen from Karsalang is somewhat doubtfully referred to the species, as it does not agree with the typical forms in the proportions of the body. This is the only Bopyrid which has hitherto been obtained in a place where the water is presumably fresh at all times and is definitely beyond tidal influence. The specimens from the Hughli River also were captured at a place where the water is generally fresh at all times, but is not definitely beyond the influence of tides.

The conspicuous dark oostegites of the parasite are visible through the carapace of the host, and the greyish, or sometimes yellowish, mass of eggs is also dimly seen through it.

I have associated this species with the name of Babu Abhoya Charan Chowdhary, the able artist of the Zoological Survey of India, to whom I am indebted for the careful and accurate illustrations that accompany this paper.

Palaegyge demani Weber.

1892. *Palaegyge demani*, Weber, *Zool. Ergeb. Niederland. Ost-Ind.* II, pp. 560, 561, text-figs. 6-8.
1893. *Palaegyge demani*, Stebbing, *Hist. Crust.*, p. 411.
1900. *Palaegyge demani*, Bonnier, *Trav. Stat. Zool. Wimereux* VIII, pp. 340, 341, pl. xxix.

The Indian examples of this species agree closely with the descriptions given by Weber and Bonnier and I have only to add a few notes.

Of the six specimens that I have examined one is young, while another, the female of which does not carry any eggs in its incubatory

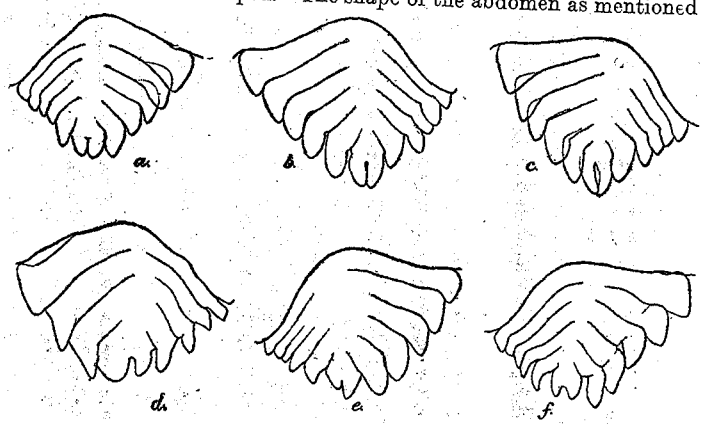
pouch, is also possibly immature. All these specimens are markedly larger than even Weber's largest example, for whereas the latter is 5·1 mm. long, my smallest specimen is 6·2 mm. in length, while the largest is as much as 8·5 mm. long. The breadth varies between 5·5 mm. and 7·2 mm.

The colouration of the female has not been described by Weber or Bonnier, but from an examination of one incomplete female from Weber's collection kindly sent me by Prof. M. Caullery, I find there are no differences in this respect between the Sumatran and the Indian specimens. The general colouration of the body is pale-yellowish and on the dorsal surface along the deformed margin there are three large patches of pigment on the posterior half of the second, third and fourth segments and sometimes a smaller patch in a similar position on the first segment. Ventrally, on the deformed side, all the oostegites and even the pleura of the first four segments are coloured. Along the non-deformed margin the first, second and fifth oostegites are always coloured, and sometimes the third is also lightly pigmented.

In all of my specimens the head is prolonged forwards in a narrow frontal lamina. This structure has not been described by the author of the species or by Bonnier, and in the single Sumatran example that I have examined the anterior part of the head is somewhat damaged and I am unable to say whether this structure was originally present.

The ovarian bosses are well developed and the pleura of the first four segments on the non-deformed side show a considerable development.

The abdomen is a little less than one-fourth the total length of the body and is considerably broader than long. The lines of demarcation between all the segments are more or less clearly visible, and the pleural lamellae, especially on the longer side of the body, as pointed out by Weber, are well developed. The shape of the abdomen as mentioned by



Text-fig. 18.—*Palaegyge demani* Weber.
Dorsal view of abdomens of six female specimens showing variation in its shape: drawn to same magnification: × 8.

the previous authors, is very variable, and I have figured the abdomen in a number of females to show this variation in the Indian specimens.

In none of my examples, however, does the sixth abdominal segment form " une petite plaque carrée " (Bonnier, p. 340) with the " Hinterrande entweder ganzrandig abgeschnitten " (Weber, p. 561), but it is more or less deeply cleft with the posterior extremities sometimes pointed, sometimes blunt. In one specimen (fig. 18*d*) some of the posterior segments are so reduced that the abdomen when seen along the longer side appears to be formed of only four segments. This condition, however, seems to be abnormal.

The maxilliped in my specimens is proportionately longer than shown in Bonnier's figure (pl. xxxix, fig. 2) and its palp is armed with six or seven hairs. The posterior lamina has on all of its lobes streaks of pigment on the exposed surface and its outer secondary lamella is somewhat broader in my specimens.

The posterior lobe of the first oostegite is more or less rounded distally, and its internal crest has about eight small rounded processes towards its origin. The peraeopods have the usual large scaly boss on the basipodite, and a smaller protuberance a littler higher up on the other face of the same segment. The outer margins of the merus and carpus are hairy, and the latter has a number of long hairs on a process near its junction with the propodus.

The pleopods are proportionately larger and do not leave as much space uncovered as is shown by Bonnier (pl. xxix, fig. 4). On the shorter side of the body some of the posterior pleopods project beyond the margin of the abdomen. The rami are not sac-like, but are thin plates and the exopodites in the last two or three pairs are considerably longer than the endopodites. The ventral surface, as shown by Bonnier, is raised in prominent ridges. Uropods are totally absent.

The *male* is thick and stumpy, being about half as broad as long. The average length of the Indian specimens is 1·6 mm. On the dorsal surface the pigment is arranged in large patches, one on each side of the thoracic segments. A pair of similar patches is present on the head and an incomplete band of pigment runs in the mid-dorsal line also. The antennules are three-segmented and the antennae are composed of two segments. The abdomen in my specimen is about one and a half times broader than long, and the sixth segment is not particularly narrower near the base than at its posterior extremity. Four pairs of pleopods are present.

Locality.—The species has hitherto been recorded from Sumatra only, occurring as a parasite of *Palaemon pilimanus* de Man. The Indian specimens are parasites of an undetermined species of *Palaemon*, and were collected by Dr. N. Annandale in the Godaveri River near Rajahmundry, Madras Presidency, in August 1918. The occurrence of identically the same parasite on different species of *Palaemon* and at places so widely separated from one another as Sumatra and Southern India is interesting.

Palaegyge bengalensis, sp. nov.

(Plate XVIII, figs. 1-4.)

The species very closely resembles *P. buitendijki* and *P. alcocki* and is likely to be confused with them. The chief differences between these species are given below.

The largest *female* is 16 mm. long and 14 mm. broad, though the average size appears to be much smaller. The general colour of the body and arrangement of pigment spots is like that of *P. alcocki*, with the difference that the head in its posterior portion is also sometimes coloured.

The head is longer than broad and seems to be formed of two halves. The posterior border is much shorter than the anterior and, like the latter, is rounded.

The abdomen is proportionately shorter than in the two allied species, and is somewhat broader than long. The lines of demarcation of all the segments are well defined on almost the entire dorsal surface. The pleural lamellae are absent, but the margins of the segments are well separated from one another and are not almost continuous, as they are in Horst's *P. buitendijki*. The sixth segment is long and comparatively narrow and has its posterior margin deeply cleft. In this respect the species differs from both the related forms.

The antennules are two-segmented while the antennae appear to be formed of three segments. The median lobe of the posterior lamina is broadly rounded, and is not pointed in the middle like that of the other two species. The secondary lobes are comparatively smaller, and of the two the outer is somewhat broader. The median lobe has streaks of pigment on its surface, and the secondary lobes also have a few similar streaks. The maxilliped has a well-developed dome-shaped palp deeply set in the anterior side, and armed with five or six setae.

The first oostegite is like that of the allied forms and its internal crest is well developed and digitate. The peraeopods have the usual structure.

The pleopods cover the entire surface of the abdomen, and consequently the male is completely hidden under them. The exopodites of some of the posterior pairs on the shorter side of the body project beyond the abdomen. The uropods are present.

The *male* does not appear to differ much from that of the typical *P. alcocki*. The abdomen is, however, markedly longer than broad, and the sixth segment, which is almost circular in outline is proportionately shorter. Four pairs of pleopods are present.

Locality.—The types (C 525/1) were found in the branchial cavities of *Palaemon malcolmsonii* H. Milne-Edwards, obtained by myself from the local market in January 1921. Three more specimens (of which one is somewhat doubtfully placed in this species) parasites on the same species of *Palaemon* collected near Calcutta by Mr. J. Wood-Mason are also in our collection.

The species is distinguished from the allied forms, among other characters, by the absence of pleural lamellae on the abdomen of the female, the well-separated margins of the abdominal segments, the different proportions of the abdomen, the long, narrow and deeply-cleft sixth segment and the rounded median lobe of the posterior lamina of the head. In the male the abdomen is distinctly longer than broad.

In all probability this is the parasite, referred to by Henderson and Matthai[1] under the generic designation of *Probopyrus*, as being "met

[1] Henderson and Matthai, *Rec. Ind. Mus.* V, p. 280 (1910).

with sometimes abundantly on *P. malcolmsonii*, inhabiting the branchial chamber of either side."

Palaegyge pica, sp. nov.

(Plate XVIII, figs. 5—9.)

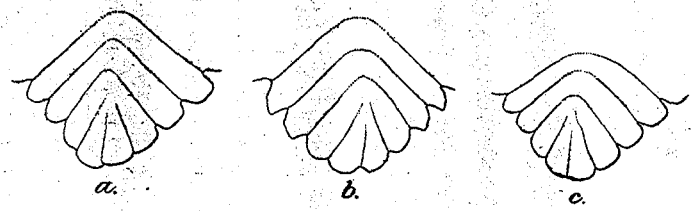
The *adult female* of an average size is about 5·2 mm. long and 4·6 mm. broad, though the smallest specimen is 4·0 mm. long and 3·6 broad, while the largest is as much as 6·2 by 5·2. The form is somewhat asymmetrical, the deformed side of the body being considerably shorter than the other. The general colour of the body is whitish or slightly yellowish, with the abdomen and the sides of the thorax, on the dorsal surface perfectly white. The colour-markings on the dorsal surface are very characteristic and are arranged in the form of three bands, one median and two lateral. The median band is fairly broad and runs continuously from end to end of the thorax and bifurcates anteriorly so as to extend onto the posterior and lateral margins of the head also. In some specimens the anterior margin of the head is also coloured. The lateral bands are not continuous, but consist of separate patches of pigment arranged in a line. That along the deformed margin is double, the outer portion of it consisting of darker patches placed close to the margin, while the inner corresponds in position to the band of the non-deformed side. The abdomen has no pigment spots on its dorsal or ventral surface. Ventrally all the oostegites of both the sides are more or less equally coloured, and most of the pleural lamellae of the thoracic segments on the deformed side are also pigmented. Both the segments of the first oostegite are coloured, but the posterior lobe is unpigmented. The median band of the dorsal side, mentioned above, is seen on the ventral surface also.

The head is distinct from the thorax and is markedly broader than long. A slight prolongation of the anterior margin looks like a narrow frontal lamina, the anterior border of which is slightly arched. The antero-lateral corners are blunt, and do not form lobular processes. The posterior margin is much shorter than the anterior and is slightly rounded, or almost straight. Eyes are absent.

The first thoracic segment is moderately long, in the mid-dorsal line about two thirds the length of the second. The latter is almost as long as the succeeding ones. The ovarian bosses are well developed and are clearly seen, especially along the deformed margin. They are long and oval, and that of the first segment occupies almost the anterior three-fourths of the margin, while those of the following three segments occupy about half of the margins. The epimera of the first four segments are narrow plates lying lateral to the bosses and separated from them by indistinct grooves. In some of these segments epimera seem to be present on the posterior portion of the margins also. Those of the last three segments are broad and occupy the entire margins.

The abdomen is somewhat small, being slightly less than one-third the total length of the body, and is markedly broader than long. The pleural lamellae are totally absent and the segmental margins are well separated from one another, those on the non-deformed side being much longer than those on the other. The lines of demarcation between

some of the anterior segments are well defined throughout the dorsal surface, but in the posterior segments the lines are distinct near the margin, while they are almost totally obliterated in the mid-dorsal region. The sixth segment differs somewhat from that of the other species, and its shape varies considerably in the specimens examined. It is in the form of a median triangle, the length of which considerably



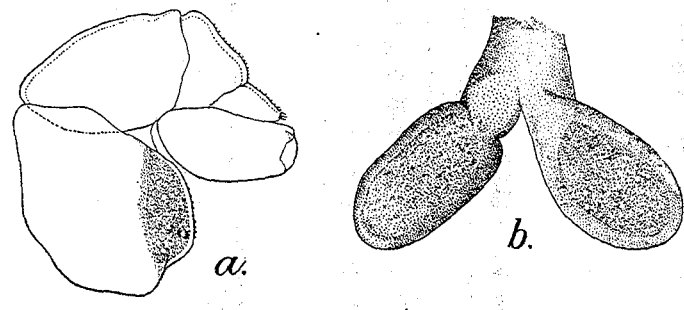
Text-fig. 19.—*Palaegyge pica*, sp. nov.
Dorsal view of posterior abdominal region of female, showing variation in shape of terminal segment; drawn to different magnifications; *a*: × 11, *b*: × 16, *c*: × 11.

exceeds the breadth. The posterior margin is, in some specimens, almost entire, while in others it has a minute excavation in its middle. The excavation in one specimen is well developed and looks almost like a slight notch.

The head on the ventral surface is profusely pigmented. The antennules and the antennae are placed close behind the anterior margin of the head and are both reduced to such an extent that their segments cannot be definitely made out. The upper lip is large and has the usual triangular shape and the hypostome is pyriform with the narrow end deeply concave. The mandibles are strong and curved and the two pairs of maxillae are very much reduced; the anterior pair is placed close behind the mandibles, while the posterior is situated further backwards and outwards. The posterior lamina has a large rounded median lobe, the posterior margin of which is almost straight in the middle. Of the two secondary lobes, the outer is much larger than the inner, is sharply pointed, and has a wavy external margin. The inner lobe is narrow and tongue-shaped, with its apex pointed and the margins entire. The maxilliped is a little longer than one and a half times its breadth and has the usual shape. The palp is large and dome-shaped beset with about ten long setae, of which eight are arranged along the internal and anterior margins while only two are present along the external.

The oostegites are comparatively small and the extensive marsupial cavity has consequently a large opening. The first oostegite has its anterior margin slightly concave. The posterior lobe is in most cases folded, but seems to be large and bluntly rounded with its inner margin sparsely beset with hairs. The internal crest is strongly developed and except for three large, irregularly-rounded processes at its proximal end, is entire. The remaining oostegites have the usual shape. The thoracic legs have a large scaly boss on the basal segment. The ischium is large and rectangular, the merus and carpus are reduced, the latter

having three or four long hairs on its external margin near its junction with the propodus, which has a large process in the usual position, against which the dactylus acts.



Text-fig. 20.—*Palaegyge pica*, sp. nov.
a. Thoracic leg of female: × 100. *b*. Pleopod: × 100.

The five pairs of pleopods are well developed and diminish markedly in size posteriorly. The pleopods of the two sides of the body are not equal in size, but those on the deformed side are somewhat larger. The inner rami of some of the anterior pairs in some specimens meet those of the other side in the median line, the posterior pairs remaining wide apart, thus leaving a considerable portion of the ventral surface of the abdomen uncovered. The endopodites of the first two pairs are somewhat larger than the exopodites, but the two rami of the posterior pairs are more or less equal in size. All the pleopods are proportionately reduced and none projects beyond the margins of the abdomen. A pair of small tuberculiform uropods is present near the base of the sixth segment, but it is clearly seen only in some of the specimens. The ventral surface of the abdomen, after the removal of the pleopods, is seen to be raised in ridges which are broken up into large lobes.

The adult *male* is short and thick-set. It is whitish in colour and has, on the dorsal surface of the thorax, three discontinuous bands of dark pigment running parallel to one another, one in the middle line and two near the margins. A few streaks are present on the head also. An average sized specimen is about 1·4 mm. long and 0·75 mm. broad.

The head is distinct from the thorax and has a semicircular contour. The anterior margin is slightly arched while the posterior is produced backwards in the form of an acute angle and is deeply set in the first thoracic segment. The eyes consist of a small number (usually three or four) of minute, dark ocular spots aggregated together, or sometimes arranged in the form of an arch, each group being placed near the margin, about the middle of the head. The two pairs of antennae are placed considerably behind the anterior margin of the head and do not project beyond it. The antennule is formed of two large segments and a small terminal one, the latter crowned with setae. The antennae are formed of two segments only, the terminal being almost as large as the basal, and none carrying setae.

The abdomen is less than a third of the total length of the body, and is considerably broader than long. The first four segments are quite distinct laterally and are fairly well defined dorsally also, but the fifth and the sixth are completely fused together so as to be indistinguishable even laterally. As a result of this fusion the abdomen seems to be formed of five segments only. The terminal segment is large and semi-circular in form. Ventrally three pairs of large tuberculiform pleopods are present on the first three segments. Uropods are absent.

Locality.—The five specimens that I refer to this species are parasitic on *Leander potamiscus* Kemp, and were collected by Dr. S. W. Kemp at Sanvorden in the Sanguem river in Portuguese India in September 1916. Though within tidal influence, the water at this particular place, I am informed by Dr. Kemp, was almost fresh at the time of collection. The type specimen is numbered C 517/1 in the register of the Zoological Survey of India.

So far as I am aware this is the first record of the occurrence of a member of the genus *Palaegyge* on a host other than a *Palaemon* and the generic position of the present species may possibly be doubted by those who follow the lead given by Giard and Bonnier and restrict a particular genus of parasite to a particular genus of host. Apart from differences in the sixth abdominal segment of the female there does not, however, appear to be any ground for doubting the generic identity of *P. pica*, and even in the case of the sixth segment, the difference, as will be seen from the accompanying text-figures, is one of degree only. In *P. alcocki* also the sixth segment of the female is only slightly depressed in the middle of its posterior margin, though the presence of pleural lamellae makes it look distinctly cleft.

Genus **Probopyrus** Giard and Bonnier.

1879. *Bopyrus (?)*, Leidy, *Proc. Acad. Nat. Sci. Philadelphia*, pt. 2, p. 198.
1880. *Bopyrus*, Semper,[1] *Die Natürl. Existenzbedingungen der Thiere* I.
1881. *Bopyrus*, Packard[1], *Zoology for High Schools and Colleges*, p. 289.
1882. *Bopyrus*, Gissler, *Amer. Naturalist* XVI, p. 6.
1888. *Probopyrus*, Giard and Bonnier, *Comp. Rend. Acad. Sci. Paris* CVI, p. 304 and *Ann. Mag. Nat. Hist* (6) I, p. 234.
1888. *Probopyrus*, Giard and Bonnier, *Bull. Sci. France Belgique* XIX, p. 55.
1892. *Probopyrus*, Weber, *Zool. Ergeb. Niederland. Ost.-Ind.* II, p. 557.
1893. *Probopyrus*, Stebbing, *Hist. Crust.*, p. 416.
1900. *Probopyrus*, Bonnier, *Trav. Stat. Zool. Wimereux* VIII, p. 342.
1901. *Bopyrus*, Richardson, *Proc. U. S. Nat. Mus.* XXIII, p. 578.
1904. *Probopyrus*, Richardson,[2] *Proc. U. S. Nat. Mus.* XXVII, p. 66 (*partim*).
1905. *Probopyrus*, Richardson,[3] *Bull. U. S. Nat. Mus.* LIV, p. 553 (*partim*).
1912. *Probopyrus*, Richardson, *Proc. U. S. Nat. Mus.* XLII, p. 523.
1923. *Probopyrus*, Nierstrasz and Brandis[4], *Siboga Eped. Rep.* XXXII*b*, p. 93.

[1] I have not seen these papers.
[2] I am of opinion that Miss Richardson's *Probopyrus alphei* does not belong to the genus *Probopyrus* at all, though from the existing descriptions I am unable to refer it to any other genus.
[3] I have not included *Probopyrus latreuticola* (Gissler) in this genus, for the reason that complete fusion of the abdominal segments in the female and total absence of the abdominal appendages in the male is not known to occur in *Probopyrus*. I am of opinion that it represents an undescribed genus. For further particulars see under "*Bopyroides latreuticola*", p. 537.
[4] See addendum, p. 541. The generic position of Nierstrasz and Brandis's species is somewhat doubtful.

I define the genus as follows:—

Branchial parasites.

Female. Body only slightly asymmetrical.

Head distinct from the thorax, generally prolonged forwards into a frontal lamina. Eyes invariably absent.

Thoracic segments well defined on the dorsal surface, and separated by distinct notches along the margins. Ovarian bosses well developed and epimera distinct. Incubatory cavity only partially covered over by the oostegites. A single prominent boss covered over with hairs and small scaly structures present on the basal joint of all the thoracic legs. Ventral surface of thorax raised in large fleshy ridges.

Abdomen about one-third (or slightly less) of the total length of the body, rarely longer. Segments generally somewhat fused on the dorsal surface, always separated by deep clefts along the margins. Pleural lamellae totally absent. Sixth abdominal segment a large triangular structure with the posterior margin regularly rounded and entire, rarely notched in the middle. Five pairs of biramous pleopods present, diminishing markedly in size from the first to the last. Uropods wanting.

Male. Head distinct from the thorax, bearing a pair of well-developed eyes.

Thoracic segments distinct both dorsally and laterally.

Some of the anterior abdominal segments sometimes distinct dorsally, sometimes all fused entirely but always well defined laterally. Three to five pairs of rudimentary pleopods present. Uropods absent.

Type-species:—*Bopyrus ascendens* Semper.

Some confusion seems to exist regarding the definition of this genus. Giard and Bonnier who are its authors do not mention any sufficiently well-marked characters by which it may be distinguished from the other genera of Bopyridae. One character, however, which they (1888*b*, p. 55) especially mention is that "chez la femelle du côté dorsal, les anneaux de l'abdomen quoique soudés entre eux sont séparés par des lignes de demarcation très nettes et visibles même sur le milieu du corps." In their account of the type-species, *P. ascendens* (Semper), they describe the male as having all the abdominal somites fused together and carrying five pairs of pleopods. The female has no uropods. In the genus they also included Packard's *Bopyrus palaemoneticola* in which the first three or four segments of the abdomen of the male are quite distinct even dorsally and only three pairs of pleopods are present.

In 1892 Weber described his species *P. giardi* in which the first four segments of the abdomen of male are distinct, and carry a pair of pleopods each; the fifth and the sixth are fused together to form a "pygidium" and are devoid of appendages.

Stebbing in 1893 defined the genus as follows: "In the female the pleon has the boundaries of the segments well marked all across the back and has five pairs of two branched pleopods. In the male the pleon has five pairs of tuberculiform pleopods....." The part of this definition relating to the pleopods of the male is accurate for the type-species only.

In the key to the genera of Bopyridae given by Bonnier in his monograph *Probopyrus* is distinguished from the closely allied genus *Palae-*

gyge Giard and Bonnier by the fact that in the female the somites of the pleon are "à peine distincts" in the former, while they are "nettement distincts" in the latter. But in his figures of the various species of these two genera there does not appear to be any appreciable difference in this respect. The same lack of difference is observed in Giard and Bonnier's figures (1888*b*, pl. ii and iv) of *Probopyrus ascendens* and *Palaegyge borrei*. The condition of the abdominal somites of the male does not appear to be constant from Bonnier's figures, for in *P. palaemoneticola* and *P. giardi* at least the first three or four of them are quite distinct, while in *P. ascendens* all the somites are fused. The number of pleopods of the male also, as already pointed out, is different in these three species, there being three pairs in the first, four in the second, while all five are present in the last.

Miss Richardson in her key to the genera of Bopyridae (1905, p. 499) distinguishes *Probopyrus* from other genera by its having the "segments of abdomen fused in male" and the "segments of abdomen distinct in female." When defining the genus (p. 553) she says: "Segments of abdomen in male fused dorsally, but defined on the lateral margins. Five pairs of small tuberculiform pleopods present. Uropoda wanting." I have not been able to consult Packard's original description and figures of *Bopyrus palaemoneticola*, but as mentioned above, from Bonnier's description and figures, it appears that in this species, as in *P. giardi*, the four anterior segments are more or less distinct on the dorsal surface. Miss Richardson's statement that five pairs of pleopods are present in the male is also incorrect, as in two of the species[1] mentioned above the number is smaller, as it is also in some of her own species. In *P. bithynis* and the doubtful *P. alphei* the number of pleopods has not been mentioned while in Gissler's *P. latreuticola*[2] they are described as entirely absent. Later, in her species *P. panamensis*, Miss Richardson (1912) describes only three pairs of pleopods in the male. Thus among Miss Richardson's species it is only in *P. floridensis* that the full number of pleopods is present.

Of the two new species described in this paper, one, *P. annandalei*, has three abdominal segments of the male quite distinct dorsally, the fourth is partly so, while the fifth and the sixth are fused on the dorsal surface. In *P. gangeticus* the first three or four segments are distinct, the last two being partly fused. Five pairs of pleopods are present in both these species.

A number of well-defined characters are, however, as a rule present in all these species by which the genus *Probopyrus* may be distinguished from other genera of Bopyridae. As already mentioned under the account of the genus *Palaegyge*, the uropods and the pleural lamellae of the abdominal segments in the female are absent in *Probopyrus* and the

[1] Bonnier and Miss Richardson attribute different number of pleopods to the male of *P. palaemoneticola*; the former states that there are three pairs, while the latter in 1904, and under the name of *P. pandalicola* in 1905, mentions five pairs. Miss Richardson describes the abdominal segments of the male as fused about the middle of the dorsal surface while Bonnier's figure shows them as distinct. I have not myself examined any specimen of this species.

[2] I have elsewhere (pp. 537, 538) shown that Gissler's *Bopyroides latreuticola* cannot be considered a member of the genus *Probopyrus*.

sixth abdominal somite is large and triangular in shape with a rounded and generally unbroken posterior margin. In addition, some or all of the abdominal segments of the male are generally fused on the dorsal surface. These characters are constant in all except two of the American forms. In *P. floridensis* Richardson, there is sometimes a minute excavation in the middle of the posterior margin of the terminal abdominal segment in the female, and in *P. panamensis* Richardson, this goes a step further and becomes a small rounded notch in the posterior margin.

The forms belonging to the genus *Probopyrus* are very similar to those included in Latreille's genus *Bopyrus*, and are believed by Giard and Bonnier to represent their less degraded ancestors, which have retained in the structure of the pleon the typical organization of the Ioniens. The adult female of *Probopyrus* has, as it were, definitely preserved the characters which are only transitory in the female of *Bopyrus*. The partial fusion, on the dorsal surface, of the abdominal segments of the female of *Probopyrus* has gone further, so as to become almost complete in the female of *Bopyrus*, and the well-developed biramous pleopods of the former are so reduced as to become mere rudimentary plates in the latter.

The relationship,[1] though perhaps not genetic, between *Palaegyge* and *Probopyrus* has already been discussed in the account of the former genus, and a number of distinct characters separating the two have been pointed out. It may, however, be reiterated here that the resemblance between these two genera is sometimes so great that it is exceedingly difficult to distinguish one from the other. As an example of this similarity may be mentioned the two American species which Miss Richardson (1912) has recently described, *Palaegyge meeki* and *Probopyrus panamensis*. Except for the presence in the female of the former, of uropods, appendages which, it may be pointed out, are not infrequently absent in the members of this genus, there does not appear to be any well-marked character to indicate the generic position of these two forms, and it is exceedingly doubtful if, from the published description and figures of the latter species, one could be sure of the correctness of its generic diagnosis.

Like *Palaegyge*, the genus *Probopyrus* lives mostly in fresh or brackish waters, though one species is littoral and marine. All the hitherto known species live parasitically in the branchial cavities of the members of the genera *Palaemon* and *Palaemonetes*, and have been met with in the Malay Archipelago, India and various parts of N. America. The hosts and localities of the species which I recognise as belonging to this genus are as follows:—

Name of species.	Locality.	Host.
P. ascendens (Semper)[2] ...	Streams of Philippine Is. and Amboina.	*Palaemon lar* Fabricius.
P. palaemoneticola (Packard).	Atlantic Coast of North America.	*Palaemonetes vulgaris*. Stimpson.
P. giardi Weber ...	Streams of Sumatra ..	*Palaemon placidus* de Man.

[1] This question has also been discussed by Nierstrasz and Brandis (1923, pp. 90, 91). See also addendum, p. 541.

[2] Prof. M. Caullery of Paris was kind enough to send me for examination a specimen of this species collected in Amboina. This specimen is one of the two on which Giard and Bonnier's description was based.

Name of species.	Locality.	Host.
P. floridensis Richardson	St. John River, Florida ...	*Palaemonetes exilipes* Stimpson.
P. bithynis Richardson ...	Delta of the Mississipi R., U. S A., and Escondido River in Nicaragua.	*Palaemon ohionis*[1] Smith and *Palaemon acanthurus*[1] Wiegmann.
P. panamensis Richardson	Canal Zone, Central America.	*Palaemon acanthurus*[2] Wiegmann.

Most of the species are purely freshwater forms and *P. ascendens* has been found living on its host *Palaemon lar*, captured at considerable altitudes. Some of the American forms are deltaic and *Palaemonetes vulgaris*, the host of *P. palaemoneticola*, is littoral and marine, though most of the species of the genus *Palaemonetes* live in fresh or brackish water.

The two new species described in this paper are parasites of *Palaemon* and were both collected in places subject to tidal influences. Their localities, etc., are given here :—

Name of species.	Locality.	Host.
P. annandalei ...	Tale Sap in Peninsular Siam (water slightly brackish).	Young of probably *Palaemon sundaicus* (Heller).
P. gangeticus ...	Gangetic Delta	*Palaemon* sp.

The Indo-Malayan species of the genus *Probopyrus* may be distinguished from one another thus :—

I. Abdomen of *female* one-third or less of total length of body, and generally markedly broader than long.
  A. Abdomen of *male* distinctly broader than long; abdominal segments of *female* almost distinct mid-dorsally; external margin of outer secondary lobe of posterior lamina of head more or less digitate.
    1. Body of female almost as long as broad; abdominal segments of *male* completely fused dorsally; five pairs of pleopods present ... *P. ascendens* (Semper).
    2. Body of female longer than broad; some of anterior abdominal segments of *male* distinct dorsally; four pairs of pleopods present .. *P. giardi* Weber.
  B. Abdomen of *male* almost as long as broad; abdominal segments of *female* partly fused mid-dorsally; external margin of outer secondary lobe of posterior lamina of head entire. [Most of the abdominal segments of *male* distinct dorsally; five pairs of pleopods present in male] ... ... *P. annandalei*, sp. nov.

II. Abdomen of *female* about two-fifths of total length of body, and slightly broader than long. [External margin of outer secondary lobe of posterior lamina of head entire; abdomen of *male* broader than long, most of the abdominal segments distinct dorsally and five pairs of pleopods present] ... ... *P. gangeticus*, sp. nov.

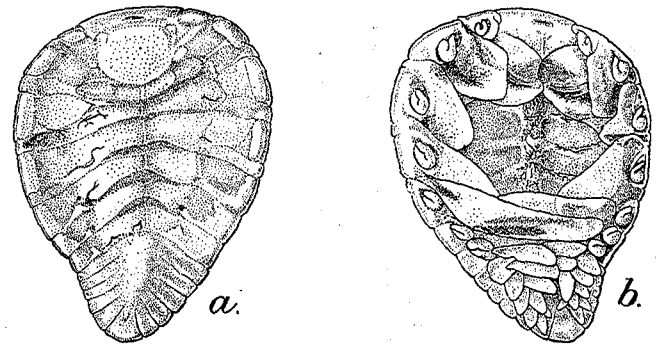
Probopyrus annandalei, sp. nov.

The *adult female* is slightly asymmetrical, and in the only specimen that I have examined, the left side of the body is shorter than the right.

[1] Following Miss Rathbun, Miss Richardson has referred these two species to the genus *Bithynis* but I am informed by Dr. Kemp that the genus is more generally known as *Palaemon*.

[2] This species has been referred to the genus *Macrobrachium*, which is, at most, a subgenus of *Palaemon*.

It is 6 mm. in its greatest length and is 4·5 mm. broad at the level of the third thoracic segment. The body is pale yellowish in colour, with the head, abdomen and sides of the thorax, on the dorsal surface, white. Dorsally the thorax has pigment-streaks arranged more or less regularly, in the posterior portion of some of the segments on the deformed side of the body. On the non-deformed side also there are a few spots irregularly scattered about. On the ventral surface all the oostegites, especially those of the deformed side, are coloured.



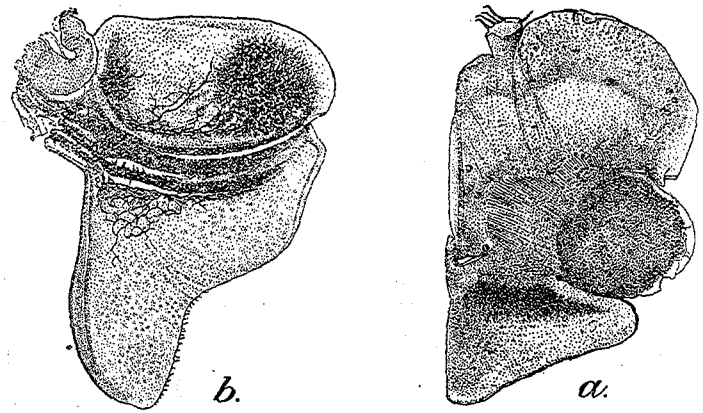
Text-fig. 21.—*Probopyrus annandalei*, sp. nov.
a. Dorsal view of female : ×8. *b.* Ventral view of same : ×8.

The head in dorsal view is rounded, broader than long, and is enclosed on the posterior and lateral sides by the first thoracic segment. It is produced forward into a narrow frontal lamina, the anterior border of which is only slightly arched. The antero-lateral corners are not produced into lobes, but form somewhat sharp angles. The posterior margin forms a broad, regularly rounded curve, not sharply marked off from the thorax. Eyes are totally absent.

The thoracic segments are all distinct both dorsally and laterally. The first segment is very short in the mid-dorsal region, the second is almost as long as the third, while the rest are slightly longer. All the segments, except the first two, are directed backwards at the sides, the former being turned forwards. The four pairs of ovarian bosses occupy the anterior two-thirds or three-fourths of the segmental margins, this portion being separated off by a prominent constriction from the posterior portion, more or less rounded at the margin. Each boss is long and oval and the third is the longest. The epimera of the first four segments are in the form of very narrow plates, lying lateral to the bosses, while those of the following three occupy the entire margins.

The abdomen is about one-third of the total length of the body, and is broader than long. The segments are all distinct from one another, though the lines of demarcation between them are not well defined in the mid-dorsal region. The pleural lamellae are totally absent but the margins of the segments are well separated from one another. The sixth segment is large and triangular and extends posteriorly a little beyond the fifth, its posterior margin being regularly rounded and entire.

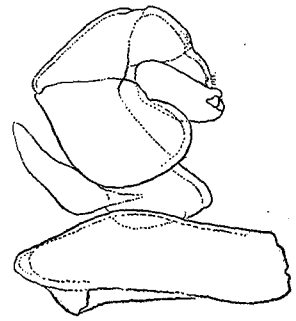
After removing the first pair of incubatory plates the head is seen to be a squarish structure, with the anterior side somewhat longer than the posterior. The antennules and the antennae are extremely reduced and the latter appear to be three-segmented. The upper and the lower lips and the mandibles have the usual shape and position and the maxillae are extremely reduced. The posterior lamina of the head consists of a large broadly-rounded median lobe, and the two usual pairs of secondary lamellae; the inner lamella is narrow with a somewhat blunt extremity, while the outer is much broader and tapers towards the tip, where it is pointed. The outer margin of the latter is entire and is not broken up into digitations and lobes as it is in *P. ascendens* (Semper) or *P. giardi* Weber. Each maxilliped is about one and a half times longer than broad and consists of the usual two segments; the basal is small and triangular, while the anterior is quadrilateral with the inner margin straight and outer rounded. The palp is short and thick with its anterior extremity slightly rounded or almost straight. It is armed with five or six long setae arranged chiefly along the anterior margin. The muscles at the base of the anterior segment are strongly developed.



Text-fig. 22.—*Probopyrus annandalei*, sp. nov.
a. Left maxilliped: ×55. *b*. First oostegite: ×27.

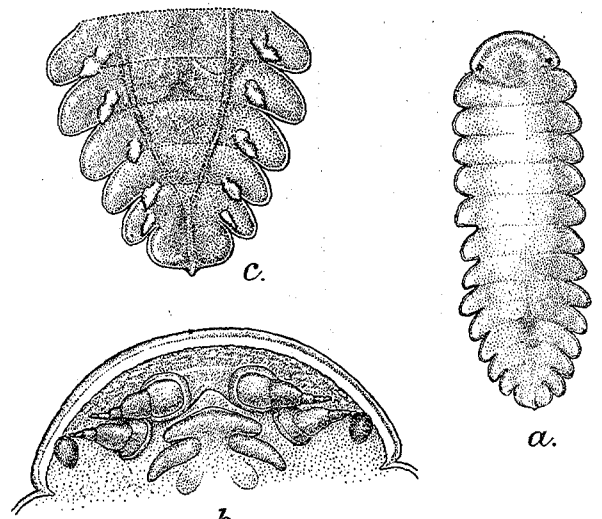
The ventral surface of the thorax is raised in large fleshy ridges. The five pairs of oostegites are large and consequently the opening of the incubatory cavity is considerably restricted. The first oostegite is much longer than broad and consists of the usual two portions. The anterior margin of the anterior segment is almost straight, while the posterior segment is drawn out at its infero-external corner into a large lobe rounded at the extremity. The inner margin of this lobe, which is deeply concave, is beset with a number of small hairs. The internal crest is not strongly developed, and, except for a small number of almost insignificant lobules near its origin, is entire. The remaining oostegites are of the usual shape; those of the fifth pair are much

longer than the rest and enclose the incubatory pouch from behind. Their posterior margins have a row of long hairs arranged along their length. The seven pairs of thoracic legs are well developed and the last three, especially on the deformed side of the body, are somewhat crowded together. Each leg possesses a large scaly boss on the basal segment, which is the largest; the ischium is also quite large and is triangular; all the other segments except the propodus are small. The external margins of the carpus and the merus are in part hairy, and the propodus has near its junction with the merus a prominent projection against which the dactylus acts.



Text-fig. 23.—*Probopyrus annandalei*, sp. nov.
Thoracic leg of female: × 75.

The abdomen is broader than long and has the pleural lamellae of its segments totally absent. The five pairs of biramous pleopods are well developed and diminish in size from the first to the last. In the anterior pairs the endopodite is the larger of the two rami, and those of the first two pleopods meet in the middle line. In the fourth pair the



Text-fig. 24.—*Probopyrus annandalei*, sp. nov.
a. Dorsal view of male: ×50. *b*. Head appendages of male: ×165.
c. Ventral view of abdomen of male: ×100.

exopodite and the endopodite are almost equal in size, while in the last the former is distinctly the larger of the two. The inner rami of the

last three pairs do not meet in the middle line; they leave a considerable part of the ventral surface of the abdomen uncovered, where the male lies. All the rami are oval or elliptical with their tips bluntly rounded in the anterior pairs, while those in some of the posterior ones are more or less pointed. The uropods are totally wanting.

The *male* (Text-fig. 24) is a little over 1 mm. in length and about 0·4 mm. broad. It is pale yellowish in colour and has no prominent colour-markings on the dorsal surface.

The head is semicircular in form, with the anterior margin regularly rounded. A pair of small eyes is present on the dorsal surface, in the posterior half of the head, one near each lateral margin. Ventrally the usual appendages are present. The antennules are five-segmented, the basal segment being very large and the terminal extremely reduced. The antennae are also composed of five segments, and here again the terminal segment is very small. The margins of some of the distal segments in both the pairs of antennae are beset with small setae. The mandibles, the maxillae and the upper and the lower lips are all normal and the maxillipeds are, as usual, absent.

The thoracic segments are all distinct and the seven pairs of legs are provided with a well-developed claw each.

The abdomen is about one-third of the total length of the body, and, contrary to the rule in the genus, is as long as broad. Along the margins all the six segments are quite distinct, while on the dorsal surface the lines of demarcation of the first three are clearly defined. The line between the fourth and the fifth is somewhat indistinct, especially in the mid-dorsal region, while the fifth and the sixth have no line between them. Ventrally also the boundaries of the first four segments are well defined. The terminal segment is broad and squarish and its posterior margin is produced into a small process in the middle. Five pairs of pleopods are present, one near the postero-lateral corner of each of the first five segments. Some of the pleopods are constricted about the middle of their length, so as to give an appearance of being formed of two portions. The uropods are absent.

Locality.—The single specimen (C 503/1) that I have examined was collected by Dr. N. Annandale during his tour in the Far East. It is a parasite of the right branchial cavity of a young specimen of, probably, *Palaemon sundaicus* (Heller), captured at Pak Raw in the Tale Sap in the Peninsula of Siam, during the month of January 1916. The water at this particular point, I am told by Dr. Annandale, is only slightly brackish.

Probopyrus gangeticus, sp. nov.

(Plate XIX, figs. 1–5.)

The *adult female* is on an average, approximately 7·5 mm. in its greatest length and about 5·5 mm. broad at the level of the third thoracic somite. The form of the body is slightly asymmetrical, one side being somewhat curved in. The general colour of the body is pale yellowish and there are no prominent markings on the dorsal surface. There are, however, some faint pigment-patches near the deformed margin of the

body and sometimes a few colour-streaks are present in the mid-dorsal region also. Ventrally all the oostegites of both the sides are coloured, but the amount of pigment on the deformed side of the body is markedly more than that on the other.

The head seen from the dorsal surface is rounded, and is almost as long as broad, and in some specimens has an indistinct groove running longitudinally along its middle, so as to give it the appearance of being formed of two halves. Anteriorly the head is prolonged into a fairly broad frontal lamina, the anterior margin of which is slightly arched. The antero-lateral corners do not form sharp angles, but are blunt and somewhat lobular. The posterior margin is distinctly separated from the thorax and is broadly rounded. Eyes are totally wanting.

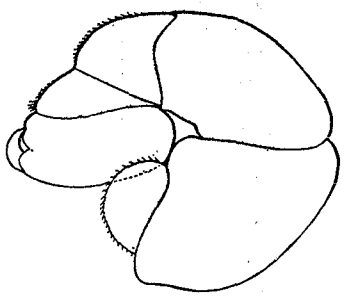
The first thoracic segment is very short in the mid-dorsal line, the second is shorter than the third, while the rest are sub-equal. The ovarian bosses are fairly distinct, long and oval, situated on about the anterior three-fourths of the margins of the first four segments. This anterior portion is constricted off by a deep notch from a posterior rounded and finger-like portion. The margins of the last three segments are entire. The epimera of the first four segments are somewhat narrow, but distinct; they lie lateral to the bosses and are separated from them by indistinct grooves. They do not extend to the posterior portion of the margin behind the ovarian boss. In the last three segments the epimera are well developed and occupy the entire margins.

The abdomen is proportionately longer than that of *P. annandalei*, being in this case about two-fifths of the total length of the body. The breadth, as in the former case, slightly exceeds the length. The segments are all distinct laterally, but the lines of demarcation between most of them are somewhat obliterated in the mid-dorsal region. The pleural lamellae are absent, but the segments are separated by deep clefts along the lateral margins. The sixth segment is large and triangular and extends slightly beyond the fifth, and its posterior margin, which is rounded and entire, has a small pointed projection at its middle. This is better marked in young specimens than in mature ones.

The antennules and the antennae are extremely reduced, and the number of segments of which they are composed has not been definitely made out. The latter are probably three-segmented while the former appear to be formed of two segments only. These appendages are placed considerably behind the anterior margin of the head, and consequently do not project beyond it. The maxillae are also extremely reduced and all the other appendages are normal. The posterior lamina of the head has the usual structure; the median lobe is somewhat triangular, with its posteriorly pointing apex rounded, and of the two secondary lobes the outer is the broader, especially near its base. Both the lobes are more or less sharply pointed at the apex. As in *P. annandalei* the outer margins of both the lobes are entire. The median lobe is darkly pigmented, and the secondary lobes also have some streaks of pigment on their exposed surface. The maxilliped is proportionately broad, being less than one and a half times longer than wide. It has the usual shape, but the basal segment is somewhat smaller and the

terminal squarish. The palp is deeply set in the anterior margin, and is large and pyramidal with its apex actually pointed. It carries about three setae, one at its extremity, and two along its inner margin.

The ventral surface of the thorax is raised into large, obliquely running, fleshy ridges. The five pairs of oostegites are somewhat small and only partially cover the incubatory cavity, thus leaving it with a large opening. The first oostegite has its anterior segment about half the length of the posterior and is considerably broader than long. Its anterior margin is almost straight, or even slightly concave. The posterior segment is drawn out into a large lobe bluntly rounded distally, and beset with hairs along its inner margin. The internal crest, unlike that of the preceding species, is well developed and is strongly digitate over about half of its length towards its proximal end. In this region it is broken into about ten large processes of an irregular shape. The distal portion of the crest is entire. The remaining oostegites are all normal, and those of the fifth pair, as usual, are provided with long hairs along their posterior borders. The thoracic legs possess a prominent boss on their basal joints, which is covered with hairs and small scaly structures. The ischium is better developed than in the former species, and is quadrilateral in shape; the merus and the carpus, especially the latter, are small and their outer margins are hairy, that of the carpus having three or four long hairs near its junction with the propodus. The propodus is of large size, and has a prominent projection of its margin, in the usual position, against which the well-developed claw acts. Some of the posterior pairs of legs, especially on the deformed side of the body, are placed close to one another.



TEXT-FIG. 25.—*Probopyrus gangeticus*, sp. nov.
Thoracic leg of female: ×100.

The abdomen is somewhat broader than long, and the pleural lamellae of its segments are totally absent. The pleopods are well developed and decrease in size posteriorly. The endopodites of the anterior two or sometimes three, pairs meet in the middle line; those of the last pleopods remaining wide apart. The inner rami of the anterior pairs are markedly larger than the outer, but the two rami of the posterior pairs are more or less equal. All the rami are oval or elliptical with their tips rounded—bluntly in the anterior pairs, somewhat sharply in the posterior. The uropods are absent.

The *male* is about 1·8 mm. long and over 0·6 mm. broad. It is whitish in colour and has no characteristic colour-markings, except a broad band of a darker shade than the rest of the body running parallel to each side of the body on the dorsal surface of the thorax.

The head is semicircular in outline, with the anterior margin slightly arched. A pair of eyes is present about the middle of the head, one near each margin. The antennules and the antennae are placed considerably

behind the anterior margin of the head and do not project beyond it. The antennules are composed of five segments of which the terminal two are extremely reduced. The antennae are somewhat smaller and are probably formed of two or three segments only, the terminal being fairly large and truncate distally. The mandibles, maxillae and the other appendages are of the usual type.

The abdomen is slightly less than a third of the total length of the body and, as is the rule in the genus, is distinctly broader than long. All the six segments are distinct along the margins, and the lines of demarcation of the first five are well defined on the dorsal surface also, that between the fifth and the sixth being obliterated about the middle. Ventrally also these lines are clearly seen. The sixth segment is squarish, but is proportionately less broad than that of *P. annandalei*. Five pairs of pleopods seem to be present.

Locality.—The species is a parasite of the branchial cavity of an undetermined species of *Palaemon*, and seven specimens of it, including the types (C 504/1), were collected by Mr. T. Southwell on board the Bengal Fisheries steam launch "Kitty" in the Pussar River near Khulna, in the Gangetic Delta, in September 1915. Of these seven specimens two are young, while another in which the incubatory cavity of the female does not carry any eggs, is also possibly immature. None of these three is accompanied by its male. All the four remaining females are adult, having their incubatory pouches full of developing embryos, and three of them carry males between their pleopods. The largest of these specimens is 9 mm. long, while the smallest—an immature female—is 6·5 mm. in length. A number of other specimens, both immature and adult, parasitic on the same species of *Palaemon*, procured by myself from the local markets and probably collected in the neighbouring streams of the Delta, are also referred to this species. The largest of these is over 12 mm. long and about 9 mm. broad, but it is probable that some specimens attain a size even larger than this.

P. gangeticus differs from *P. annandalei* in the following essential respects:—

Female.

1. The head is somewhat longer than broad and is indistinctly divided into two longitudinal halves.
2. The abdomen is proportionately longer.
3. The posterior lamina of the head has a different shape.
4. The maxilliped is proportionately broader, and its palp, which is pyramidal in shape, is provided with fewer hairs.
5. The internal crest of the first oostegite is better developed, and is more strongly digitate, and the posterior lobe is bluntly rounded distally.

Male.

6. The second pair of antennae is shorter than the first, and composed of a smaller number of segments.
7. The abdomen is broader than long and its terminal segment is proportionately narrower. The pleopods are reduced and are not constricted.

Genus **Bopyrus** Latreille.

1772. "Insecte de la crevette," Fougeroux De Bondaroy,[1] *Mem. Acad. Roy. Soc. Paris*, p. 29.
1798. *Monoculus*, Fabricius, *Ent. Syst. Suppl*, p. 306 (*partim*).
1802. *Monoculus*, Bosc,[1] *Hist. nat. des Crust.* II.
1802. *Bopyrus*, Latreille, *Hist. Crust. Insectes* VII, p. 51.
1808. *Oniscus*, Montagu, *Trans. Linn. Soc. London* IX, pp. 104, 105. (*partim*).
1868. *Bopyrus*, Bate and Westwood, *Brit. Sessile-Eyed Crust.* II, pp. 214-222.
1890. *Bopyrus*, Giard and Bonnier, *Bull. Sci. France Belgique* XXII, p. 368 (*partim*).
1893. *Bopyrus*, Stebbing, *Hist. Crust*, p. 415 (*partim*).
1899. *Bopyrus*, Sars, *Crust. Norway* II, p. 196.
1900. *Bopyrus*, Bonnier, *Trav. Stat. Zool. Wimereux* VIII, p. 357.
1923. *Bopyrus*, Nierstrasz and Brandis,[2] *Siboga Exped. Rep.* XXXIIb, p. 97

The genus may be defined as follows :—

Branchial parasites.

Female. Body broad, flattened, somewhat asymmetrical.

Head sunk in thorax, but distinct.

Thoracic segments well defined both dorsally and laterally. Ovarian bosses present; epimera moderately developed. Incubatory cavity only partially covered. Peraeopods provided with a boss on the basal segment.

Abdominal segments fused dorsally, but distinct laterally. No pleural lamellae developed. Five pairs of uniramous pleopods present; uropods absent.

Male. Head distinct from thorax.

Thoracic segments well defined.

Abdominal segments fused dorsally, but distinct laterally. Pleopods present in a reduced condition. Uropods wanting.

Type-species :—*Bopyrus squillarum* Latreille.

Though *Bopyrus* is the oldest genus of Bopyridae the species so far known to belong to it are not very many. Besides *B. squillarum*, the genotype, a number of species have been described by Giard and Bonnier (1890), but most, if not all, appear synonymous with it.[3] *B. xiphias* G. and B., however, appears to be somewhat different from *B. squillarum*, for, among other characters, the abdomen of the male is more pointed posteriorly and is markedly longer than broad. I have examined males and females of this form, parasitic on *Leander xiphias*, obtained from the Zoological Station, Naples—the type-locality of the species—and find the former agrees fairly with Bonnier's (1900) figure. Through the courtesy of Dr. Calman, I have been able to examine a specimen of *B. squillarum*, parasitic on *L. squilla*, and Prof. M. Caullery has also kindly sent to me from MM. Giard and Bonnier's collection specimens of *B. fougerouxi* (=*B. squillarum*), presumably parasitic on *L. serratus*, but unfortunately none of these specimens is accompanied by its male and I am thus unable to compare the condition of the abdomen in this sex with that of the Naples specimens. I have, however, relied for these characters upon Bonnier's excellent drawings of *B. fougerouxi* and *B. helleri* (=*B. squillarum*). Besides the differences in the abdomen

[1] I have not been able to consult these works.
[2] See addendum, pp. 541, 542.
[3] Nierstrasz and Brandis have recently (1923, pp. 97, 98) described another species of the genus under the name of *B. stebbingi*.

of the male there are certain other characters also, notably the shape of the first oostegite and its internal crest, which point to the desirability of regarding the parasite of *L. xiphias* as distinct from that of *L. serratus* and *L. squilla*; but until the specific limits of *B. squillarum* have been better defined it is impossible to be sure of the specific validity of *B. xiphias*.

Apart from this form, *B. squillarum* is the only species of *Bopyrus* so far known. I have described below a new form which I have provisionally regarded as a variety of *B. squillarum*. The variety is based on a large number of specimens of a form found commonly in Indian waters. The female agrees closely with that of the *forma typica* but has invariably a pair of dark spots on the dorsal surface of the abdomen. The male has the abdomen generally longer than broad.

It is possible the differences between the variety and the typical *B. squillarum*, as pointed out below, may be considered enough to warrant specific rank, but in view of the fact that the limits of the latter have been differently regarded by different eminent carcinologists, it appears preferable to regard it, at any rate for the present, merely as a variety. Besides the differences in the parasite, it may be pointed out that *L. styliferus*, the host-species of the Indian form differs widely from all the species of *Leander* on which the genus *Bopyrus* has hitherto been found.

The genus is commonly found in most of the European seas, having been recorded from the Mediterranean, the English Channel, the North Sea, the Black Sea (Rathke, 1837) and the Atlantic Ocean along the Irish coasts (Tattersall, 1906). The Indian specimens come mostly from the estuarine waters of the Gangetic Delta and one from near the shore of an island in the Bay of Bengal.

Bopyrus squillarum Latreille.

1772. "Insecte de la crevette," Fougeroux De Bondaroy, *Mem. Acad. Roy. Soc. Paris*, p. 29.
1798. *Monoculus crangorum*, Fabricius, *Ent. Syst. Suppl.*, p. 306.
1802. *Bopyrus squillarum*, Latreille, *Hist. Nat. Crust. Insectes* VII, p. 51, pl. lix. figs. 2-4.
1803. *Oniscus squillarum*, Montagu, *Trans. Linn. Soc.*, IX, pp. 104-105.
1837. *Bopyrus squillarum*, Rathke, *De Bopyro et Nereide.* Rigae et Dorpati, p. 3, pl. i.
1850. *Bopyrus squillarum*, White, *Cat. Brit. Crust.* (*Brit. Mus.*) IV, p. 82.
1887. *Bopyrus squillarum*, Bonnier,[1] *Bull. Sci. France Belgique* XVIII, pp. 374-375 (*partim*).
1890. *Bopyrus fougerouxi, B. rathkei, B. helleri, B. treillianus*, Giard and Bonnier, *Bull. Sci. France Belgique* XXII, p. 369, text-figs. 1-2.
?1890. *Bopyrus xiphias, id, ibid.*, p. 369, text-figs. 3, 4.
1899. *Bopyrus squillarum*, Sars, *Crust. Norway* II, p. 197, pl. lxxxiv, fig. 1.
1900. *Bopyrus fougerouxi, B. helleri, B. rathkei, B. treillianus*, Bonnier,[1] *Trav. Stat. Zool. Wimereux* VIII, pp. 358-364, pl. xxxv, xxxvi and xxxvii, figs. 1-7.
?1900 *Bopyrus xiphias*, Bonnier, *id. ibid.*, pp. 363-364, pl. xxxvii, figs. 8-10.
1906. *Bopyrus squillarum*, Tattersall, *Fisheries, Ireland, Sci. Invest.* for 1904, part ii, p. 54.
1906. *Bopyrus squillarum*, Sinel,[2] *Trans. Soc. Nat. Sci. Guernsey*, p. 323.
1907. *Bopyrus squillarum*, Norman, *Ann. Mag. Nat. Hist.* (7), XX, p. 363.
1923. *Bopyrus fougerouxi, B. helleri, B. rathkei, B. treillianus*, Nierstrasz and Brandis,[3] *Siboga Exped. Rep.* XXXIIb, p. 98.

[1] Other references will be found in these two works.
[2] I have not been able to consult this work, as it is not available in Calcutta.
[3] See addendum, pp. 541, 542.

The confusion that exists in the synonymy of *B. squillarum* is chiefly due to Giard and Bonnier's erroneous hypothesis that one Epicarid cannot infest more than one species of host. Fabricius's name of *crangorum*, though the oldest, cannot be retained, as it gives the impression of a parasite of a *Crangon*. Latreille's name of *B. squillarum* has generally been accepted by all zoologists, but Giard and Bonnier gave it up on the ground that the Bopyrid described under that name is not a parasite of *Palaemon* (*Leander*) *squilla*, as Latreille supposed, but of *L. serratus*, and according to their hypothesis ought to receive a distinct name. They thus named the parasite of *L. serratus*, *B. fougerouxi*, and that of *L. squilla*, not *B. squillarum* as one would have expected, but *B. helleri*. These views were opposed by Sars, who combined these species under the old name of *B. squillarum*, pointing out that the parasites of *L. squilla*, *L. serratus*, and also of *L. rathkei*, belong to one species only. Later Bonnier, disagreeing with Sars, followed the views that Giard and he had expressed earlier. Subsequent workers such as Tattersall, Sinel and Norman have retained the old name of *squillarum* under which they presumably combine all the forms described by Giard and Bonnier.

I have carefully examined the parasites of *L. squilla*, *L. serratus*, and *L. xiphias*, and, except for some small differences in the abdomen of the last, find them all identical. I am convinced that at least the first two belong to one and the same species. The parasite of *L. rathkei*, as pointed out by Sars, and possibly that of *L. treillianus* and *L. rectirostris*—of which no satisfactory descriptions are available—also belong to the same species. Thus Giard and Bonnier's objection that *B. squillarum* is not a parasite of *L. squilla* does not arise at all, as the former lives on a number of Leanders including *L. squilla*. The name of *B. fougerouxi* and *B. helleri* proposed by these authors for the parasites of *L. serratus* and *L. squilla* respectively ought, therefore, to give place to Latreille's older designation.

var. **bimaculatus,** nov.

(Plate XIX, figs. 6-11.)

An average sized adult *female* is a little over 7 mm. in its greatest length and 5 mm. across at the level of the third thoracic somite. The body is markedly asymmetrical and the axis is strongly turned to right or left according to the side of the host on which the parasite is attached. The dorsal surface of the animal is uniformly pale, with a small number of pigment spots irregularly scattered on it. In the mid-dorsal region of the abdomen there is found almost invariably a pair of large dark spots, apparently caused by some underlying structures dimly seen through the body wall. On the ventral surface the oostegites of both the sides are pigmented, and the pleural rudiments of some of the thoracic segments are also coloured.

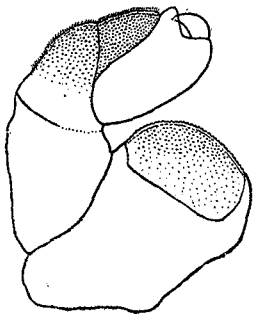
The head is distinct from the thorax and its anterior margin is almost straight. Eyes are absent.

The first thoracic segment is very short in the mid-dorsal line. The ovarian bosses are well developed and are oval in shape. They are better seen on the shorter side of the body, where they occupy the anterior three-fourths or more of the margin, which is constricted off by a slight notch from a posterior shorter portion. Epimera are strongly developed,

The abdominal segments are fused dorsally, but are quite distinct laterally, especially on the shorter side of the body. The pleural lamellae are totally absent. The posterior margin of the ultimate segment does not reach far enough to form the posterior extremity of the body.

The antennules and the antennae are two-segmented each, the basal segment being swollen and the terminal provided with a number of setae. The maxilliped has a short rounded palp, crowned with five or six setae equally distributed on all its margins. The basal segment, and sometimes the outer margin of the distal segment also, is pigmented.

The first pair of oostegites have a well-developed posterior lobe rounded distally. The internal crest has five or six small tuberculiform processes near its origin. The thoracic legs have a prominent boss, covered with scales and hairs, on the basal segment, and the margins of merus and carpus are also hairy. The ventral surface of the thorax is raised into inconspicuous ridges.



Text-fig. 26.—*Bopyrus squillarum* var. *bimaculatus*, nov. Thoracic leg of female: ×80.

Five pairs of uniramous pleopods are present, none of which meet in the middle line. In the mid-ventral region of the abdomen, about the level of the third segment there is a pair of small elongated dark bodies, which when seen dimly through the body-wall appear as dark patches on the dorsal surface. In the natural position they are covered over by the male, which lies between the pleopods. I am unable to say anything regarding the nature or function of these structures. The uropods are absent.

The *male* is about 1·5 mm. long. The head and thorax with their appendages are normal. The abdomen, like that of *B. xiphias*, is longer than broad. The lines of demarcation between the segments are only partly visible on the dorsal surface. Four pairs of rudimentary pleopods are present. Uropods are wanting.

The name of the variety refers to the pair of dark spots on the abdomen of the female.

Locality.—The type-specimens (C 509/1) were found infesting individuals of *Leander styliferus* Milne-Edwards, purchased by myself in the Calcutta market. From the large numbers available, this Bopyrid seems to be very common in the Gangetic Delta. Another specimen was collected by Dr. S. Kemp in the Matlah River in the Delta. This too is a parasite of *L. styliferus*. One other specimen was brought back by the "Investigator" from the Jack and Una Is. in the Mergui Archipelago. The host of this specimen is an undetermined species of *Leander*, which does not appear to be nearly related to *L. styliferus*.

Besides the characteristic colour-spots on the abdomen, the variety differs in the following minor points from the typical form :—

1. The palp of the maxilliped is smaller and has fewer hairs.
2. The internal crest of the first oostegite has a smaller number of processes.

3. The sixth abdominal segment in the female does not form the posterior extremity of the body.

4. The abdomen of the male is longer than broad.

Genus **Bopyrina** Kossmann.

1868. *Bopyrus*, Czerniavsky, *Materialia ad zoographiam Ponticum comparatum*, p. 83.
1881. *Bopyrus*, Walz, *Arb. Zool. Inst. Wien* IV, p. 62 (*partim*).
1881. *Bopyrina*, Kossmann, *Zeitschr. Wiss. Zool.* XXXV, p. 667.
1885. *Bopyrus*, Carus, *Prod. Faun. Mediter.*, p. 452.
1890. *Bopyrina*, Giard and Bonnier, *Bull. Sci. France Belgique* XXII, p. 383.
1893. *Bopyrina*, Stebbing, *Hist. Crust.*, p. 416.
1900. *Bopyrina*, Bonnier, *Trav. Stat. Zool. Wimereux* VIII, p. 364 (*partim*).
1905. *Bopyrina*, Richardson, *Bull. U. S. Nat. Mus.* LI, p. 563 (*partim.*)
1923. *Bopyrina*, Nierstrasz and Brandis,[1] *Siboga Exped. Rep.* XXXIIb, p. 98.

The genus is characterized as follows :—

Branchial parasites.

Female. Body markedly asymmetrical; ventral surface sometimes swollen.

Head slightly fused with the first thoracic segment and provided with an anterior lamina. Eyes usually present.

Thoracic segments distinct throughout their length. Ovarian bosses indistinct or totally wanting. First oostegite generally proportionately large, others reduced.

Abdominal segments somewhat fused mid-dorsally, but most of them defined on one or both sides of abdomen. Pleural lamellae totally absent. Only four pairs of uniramous pleoplods present. Uropods wanting.

Male. Head sometimes slightly fused with first thoracic segment.

Thoracic segments distinct both dorsally and laterally.

Abdominal segments fused considerably on the dorsal surface, but some or all indicated laterally. Pleopoda and uropoda absent.

Type-species :—*Bopyrus virbii* Walz.

Except for the fact that Kossmann (1881) in his definition of the genus described the first pair of antennae in both sexes as " relativ kräftig " and the second pair in the adult animal " einen Stummel reducirt " the definition given above agrees substantially with his. I am unable to confirm his statement regarding the antennae for in some of the species I have examined I find both pairs of antennae somewhat reduced, and the second pair at least as well developed as the first. Miss Richardson (1904a) has unfortunately omitted to note the relative development of the antennules and the antennae in her species and apparently does not regard the character as one of generic importance. The large size of the first pair of oostegites, described by Kossmann as " kolossal entwickelt," is not a constant feature of the genus.

Giard and Bonnier (1890) recorded four species of the genus from the Gulf of Naples, describing two as new, while a third was referred to the genus for the first time. Unfortunately, as is not infrequent with these authors, the descriptions of the new species, *B. nitescens* and *B. hippolytes*, do not extend beyond the naming of their respective hosts, and it is consequently impossible to arrive at any satisfactory conclusion regarding them. As for the third, *B. ocellata* (Czerniavsky), I have not been

[1] See addendum, p. 542.

able to consult Czerniavsky's (1868) original description, but from Carus' (1885) and Bonnier's (1900) brief accounts, and the latter's figures (copied from Czerniavsky's) I am led to conclude that this species is correctly referred to the genus *Bopyrina*. Carus does not recognise the genus *Bopyrina* at all, and considers *B. virbii* (Walz) synonymous with *Bopyrus ocellatus*. With this view I disagree, for *B. virbii* and *B. ocellatus* seem to be two distinct species.

Stebbing (1893) followed Kossmann in his generic definition and gave a list of all the then-known species, pointing out, however, that Giard and Bonnier's species were only doubtfully included in the list.

Bonnier in his monograph described a new species, *B. giardi*, besides changing the generic designation of *Bopyroides latreuticola* Gissler, from *Bopyroides* to *Bopyrina*. I have given elsewhere (pp. 537, 538) my reasons for thinking that *B. latreuticola* does not belong to *Bopyroides*, or to any other genus it has hitherto been assigned to. Tattersall (1906) considers *B. giardi* synonymous with *B. virbii*, but I am of opinion that it represents a new species, inasmuch as the first pair of oostegites in the female is much smaller, the pleopods less developed, the abdomen in the male less pointed and provided with a pair of anal spines, which Bonnier regards as uropods. The condition of the two pairs of antennae in *B. giardi* agrees precisely with Kossmann's description.

Miss Richardson in her monograph on the North American Isopoda defined the genus in a more satisfactory way than had hitherto been done, and gave an account of three species, *B. abbreviata*, *B. urocaridis* and *B. thorii*, that she had already (1904a) described from the Atlantic coast of North America. Of these *B. abbreviata* is very similar to Bonnier's *B. giardi*, and is possibly synonymous with it.

Bopyrina has a very wide range of distribution. *B. virbii* is a common Mediterranean form having been recorded at Trieste (Walz) and Naples (Kossmann and Lo Bianco, 1888). Giard and Bonnier also mention it from " l' ocean et la Mer du Nord." *B. ocellata* has been found in the Black Sea (Czerniavsky). *B. giardi* is common at Wimereux (Bonnier) and has also been recorded from British waters by Stebbing, Tattersall and Norman (1907). All the three species described by Miss Richardson were collected on the western coast of Florida in the Atlantic Ocean. Of the five Indian species four come from the Andamans in the Bay of Bengal, while the fifth was collected on the south-west coast of India.

The hosts [1] of this genus belong to four genera of two different families of Caridea. *B. virbii*, *B. ocellatus*, *B. giardi* and *B. abbreviata* live on different species of *Hippolyte ; B. thorii* on *Thor* ; *B. urocaridis*, *B. andamanica*, *B. kossmanni* and *B. cochinensis* (the last three new) on *Periclimenes ;* while *B. gracilis*, also new, is a parasite of *Urocaridella*. The host of *B. giardi* in Europe is a different species of *Hippolyte* from that on which it is found in India.

The new species described in this paper are very similar to one another, and are chiefly distinguished by the characters of the abdomen in the two sexes. To facilitate identification the characters are summed up in the table on p. 524.

[1] Nierstrasz and Brandis (1923) have added two new genera of hosts (*Gelastocaris* and *Anylocaris*) to those already known to be infested by *Bopyrina*. See addendum, p. 543.

B. andamanica.	*B. kossmanni.*	*B. cochinensis.*	*B. gracilis.*	*B. giardi.*
Female :				
Abdomen almost as long as broad.	Abdomen broader than long.	Abdomen longer than broad.	Breadth of abdomen slightly exceeds length.	Abdomen broader than long.
Abdominal segments fused dorsally but distinctly visible on both sides.	Abdominal segments fused dorsally but quite distinct on both sides.	Abdominal segments fused dorsally but more or less distinct on both sides.	Abdominal segments fused dorsally but distinct on both sides.	Abdominal segments fused completely dorsally and along one margin. Only three or four segments visible along other margin.
Fifth segment extending considerably beyond sixth, its posterior extremities pointed.	Fifth segment extending beyond sixth, its posterior extremities rounded.	Fifth segment not extending beyond sixth.	Fifth segment extending considerably beyond sixth, its posterior extremities rounded.	Fifth segment not extending beyond sixth, being fused on both sides with preceding segments.
Male :				
Abdomen longer than broad.	Abdomen almost as long as broad.	Abdomen almost as long as broad.	Abdomen somewhat broader than long.	Abdomen considerably longer than broad.
Abdomen tapering greatly towards posterior extremity; breadth near posterior extremity about one-fifth that at anterior.	Abdomen tapering slightly; breadth near posterior extremity about half of that at anterior.	Abdomen tapering greatly; breadth near posterior extremity many times less than that at anterior.	Abdomen not tapering greatly; breadth near posterior extremity about one-third that at anterior.	Abdomen tapering greatly; breadth near posterior extremity about one-fifth that at anterior.
First three abdominal segments almost distinct even dorsally, remaining distinct only laterally.	All abdominal segments completely fused dorsally, first two slightly indicated laterally.	Most abdominal segments almost distinct both dorsally and laterally	First three abdominal segments distinct even dorsally, remaining only laterally.	First three abdominal segments almost distinct, even dorsally, remainder completely fused.
Terminal segment finger-like.	Terminal segment rounded.	Terminal segment not finger-like.	Terminal segment rounded.	Terminal segment slightly rounded.
Anal spines present.	Anal spines absent.	Anal spines absent.	Anal spines absent.	Anal spines present.

Bopyrina andamanica, sp. nov.

(Plate XX, figs. 1–6.)

The *adult female* is markedly asymmetrical, the axis of the body being inclined strongly to right or left according as the parasite is a left or a right Bopyrid. The largest specimen examined is 4·5 mm. in its greatest length and 2·5 mm. in greatest breadth. The colour of the animal is uniformly white, and sometimes the thorax has a pinkish tinge. The usual colour-markings are for the most part absent, but on the lateral margins of the head there is a characteristic colour-patch, one on each side. This patch sometimes extends forwards so as to enclose the head anteriorly. Except for these two spots of dark brown pigment the dorsal surface of the animal is unpigmented. On the ventral surface all the oostegites are covered with spots of brown pigment. The lateral margins of the abdomen have also some irregular patches of colour.

The head is turned towards the shorter side of the body, and is produced in front into a large broadly rounded anterior lamina. The antero-lateral angles are not very prominent. The posterior margin of the head, as is common in the genus, is partly fused with the first thoracic segment and is not clearly seen. A pair of small eyes of conspicuous dark colour is placed in the anterior part of the head.

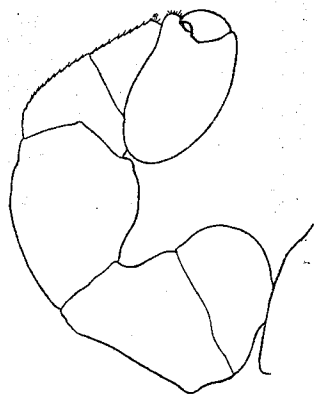
The thoracic segments are distinct and their lines of demarcation are well defined. The first segment in the mid-dorsal region seems to be more than half as long as the second. The ovarian bosses are not distinctly seen, but can sometimes be made out on the longer side of the body as oval structures occupying about the anterior three-fourths of the margins. The epimera occupy the usual position and are somewhat poorly developed.

The pleon is proportionately large and is almost as long as broad. The segments of which it is formed are fused in the middle of the dorsal surface but the boundaries are clearly seen on the margins. The segments are distinct on both the sides as in Miss Richardson's *B. urocaridis*, and not as in her other species *B. thorii* or *B. abbreviata*. The posterior extremities of the fifth segment extend considerably beyond the posterior limits of the sixth and are pointed. The posterior margin of the sixth segment is sometimes entire, sometimes notched.

The head appendages are extremely reduced and are not easily seen. The posterior lamina has the usual median lobe and the two secondary lamellae ; the former has an almost straight margin, and the latter are of about the same size and are both pointed at the tips. The maxiliped is rectangular and is 1 ½ times longer than broad. The palp is long and prominent, situated a little away from the antero-internal angle. The anterior margin is rounded and is provided with five or six thick setae, almost as long as the palp itself. The thick muscles at the base of the anterior segment of the maxilliped are well developed.

The ventral surface of the thorax is raised into small, inconspicuous, fleshy ridges, which run somewhat obliquely. The incubatory cavity is large and is only partially covered over by the oostegites. Those of the first pair consist of the usual two portions ; the anterior is a little longer than broad and its anterior margin is almost

straight with a slight concavity in the middle ; the posterior is prolonged into a short blunt lobe at its infero-internal angle. The internal crest is well developed and entire. The remaining oostegites are rectangular and in all except the fifth the length is 1 ½ times the breadth. The fifth pair encloses the incubatory cavity posteriorly, and each carries a small number of hairs along the posterior border. The thoracic legs have the



Text-fig. 27.—*Bopyrina andamanica*, sp. nov.
Thoracic leg of female : ×200.

usual structure, and a boss is present on the basal segment of each. The external margins of merus and carpus are beset with small hairs ; the dactylus is large and forms a strong claw with the propodus.

The pleopods are greatly reduced and are uniramous. Only four pairs are present, the last two segments being totally devoid of appendages. Each pleopod is a small plate-like triangular structure with an acute apex pointing inwards. The pleopods of the opposite sides do not meet in the middle line. Uropoda are altogether absent.

The *male* is small in size, being only 0·75 mm. long and less than 0·3 mm. broad. The head is semicircular in outline, and a pair of conspicuous eyes is placed about its middle on the dorsal surface. It is slightly fused with the first thoracic segment on the dorsal surface. On the ventral surface the two-segmented antennules are seen to be smaller than the antennae, which are triarticulate. The ultimate segment in both is fringed with setae. The mandibles are long and curved, and the two pairs of maxillae are also well developed.

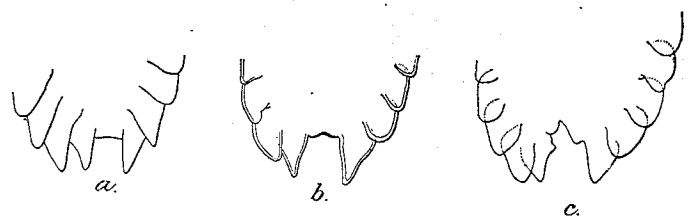
The thoracic segments are distinct and are deeply notched along the margins. The legs have the usual shape and structure and the propodus is proportionately large.

The abdomen is fairly large and is longer than broad. The first three segments are distinct even on the dorsal surface ; the last three are completely fused dorsally but are indicated by lateral undulations. The sixth segment is a large finger-shaped structure rounded at the posterior extremity. On each side of the anal opening is a small, but distinct, process terminated by a number of minute hairs. Bonnier (1900) thinks such structures in *B. giardi* represent uropods, but their homology with

the true uropods appears to me very doubtful. I prefer to refer to them as " anal spines." Pleopods are totally absent.

Locality.—All the three specimens in the collection were collected by Dr. S. W. Kemp at Port Blair in the Andaman Is. in February 1921. The type (C 479/1) was obtained at North Bay, near the shore at low tide ; the other two specimens were collected at Aberdeen and in Ross Channel respectively, the latter at a depth of 2-9 fms. All the three are parasites of *Periclimenes elegans* Paulson.

The condition of the posterior margin of the sixth abdominal segment in the female is different in the three specimens, as will be seen from the accompanying text-figures.



Text-fig. 28.—*Bopyrina andamanica*, sp. nov.
Dorsal view of posterior abdominal region of three female specimens, showing variation in posterior margin of terminal segment.
a. Type-specimen from North Bay : ×20. *b*. Specimen from Ross Channel : ×35.
c. Specimen from Aberdeen : ×18.

In the type this margin is straight and entire ; in the specimen from Aberdeen it is deeply bifid ; while in that from Ross Channel the condition is intermediate between the two—the posterior margin is slightly notched in the middle, but is otherwise entire. But for the last-mentioned specimen the difference between the sixth abdominal segments of the other two is so great that it might have been considered of specific importance. In all other essential respects the three specimens agree closely.

Bopyrina kossmanni, sp. nov.

(Plate XX, figs. 7–11.)

The *adult female* is markedly asymmetrical in form, one side of the body being much shorter than the other. The single female I have seen is 3·9 mm. long from the tip of the head to the posterior extremity of the body, and is about 2·7 mm. broad. The colouration of the species is different from that of *B. andamanica*, for the lateral margins of all the segments are to a greater or less extent pigmented. The colour-patches diminish in size towards the posterior thoracic segments, and on the last somite, especially on the deformed side, only a minute speck is visible. A small colour-patch covers the antero-lateral corners of the head also. On the ventral surface all the oostegites are coloured, and the pigment is denser than that in the foregoing species. There are a few irregular spots on the abdomen also. The pigment is dark brown and not black as it is in most species.

The head, seen from the dorsal surface, appears as a rounded mass with an anterior lamina projecting forwards. The latter is much

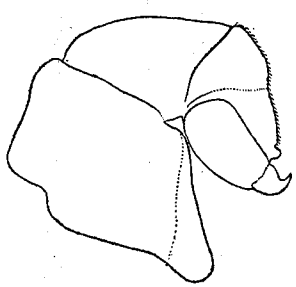
narrower than that of *B. andamanica* and its antero-lateral angles are not sharp. The posterior limit of the head is not entirely obliterated by its fusion with the thorax, but the line of demarcation between the two is faintly visible. Near the anterior margin is placed a pair of small eyes.

The thoracic segments are distinct from one another both dorsally and laterally. The first segment is the shortest of all, and in its mid-dorsal portion appears slightly more than half as long as the second. On both the sides the segments are deeply notched, and the margins of the first four are separated into two each by a slight cleft. I have not been able to see the ovarian bosses. The epimera are very poorly developed.

The abdomen shows marked differences from that of *B. andamanica*. The length is much less than the breadth and the dorsal fusion of its segments is much less complete than that in the preceding species, or in fact, in any known species. The lines of demarcation between some of the anterior segments, though somewhat indistinct, can be made out on the dorsal surface for a considerable distance. Both the lateral margins are notched with relation to the segments, but the notches on the shorter side of the body are much deeper than those on the other. The margins of the fifth segment extend beyond the posterior extremity of the sixth, but not to as great an extent as they do in *B. andamanica*. The backwardly projecting margins of the fifth segment are rounded instead of being pointed as is the case in the preceding species. The posterior margin of the sixth segment is entire and regularly rounded.

The anterior margin of the head is formed by the forwardly-projecting anterior lamina, while the posterior lamina, which is like that of *B. andamanica*, forms the posterior boundary. The antennules and antennae are greatly reduced, and the former appear to be shorter than the latter. The antennules are formed of three segments, with the basal segment swollen and the terminal greatly reduced. There appear to be no hairs on the terminal segment in both the pairs of antennae. All the other appendages are normal. The maxillipeds are like those of the preceding species, but are proportionately broader, and the palp, which carries seven hairs, is more rounded anteriorly.

The large incubatory cavity is only partially roofed over by the oostegites. Those of the first pair do not differ very much in shape from those of *B. andamanica*. The anterior margin, however, is not straight, but is convexly rounded. The internal crest also is not entire, for it is provided near its proximal end with two or three small lobes. The posterior lobe is somewhat pointed posteriorly. The remaining oostegites are small, the fifth pair extending well backwards, so as to cover a part of the ventral surface of the abdomen. The boss on the basal segment of the thoracic legs is not strongly developed,



TEXT-FIG. 23.—*Bopyrina kossmanni*, sp. nov.
Thoracic leg of female : × 150.

and the external margins of the merus and carpus, as in the preceding species, are covered with hairs.

The pleopods show a greater development than they do in *B. andamanica ;* each is a triangular plate with a pointed apex, covering a portion of the succeeding appendage. The fifth pair of pleopods and the uropods are absent.

The adult *male* also differs considerably from that of the preceding species. It is 0·7 mm. long and about 0·25 mm. broad. The body is whitish in colour, with the borders of the thorax slightly brownish. There is a streak of the same colour on each of the last three segments, and a few irregular spots scattered on the abdomen.

The head is semicircular in shape, with the anterior margin almost straight. A pair of prominent eyes is placed near the antero-lateral corners of the head. On the ventral surface the usual appendages are present.

The thoracic segments are distinct and their lateral margins are deeply notched. The legs are well developed and have strong claws. The propodus is proportionately large and carries a prominent projection, bearing hairs, against which the dactylus closes.

The abdomen is almost as broad as long, and, unlike the preceding species, the breadth diminishes gradually posteriorly, so that the last segment is about half as broad as the first. The segments are more or less completely fused dorsally, and even on the lateral margins only the first two are indicated by slight undulations. The terminal segment does not carry any anal spines. Pleopods and uropods are altogether absent.

Locality.—The two specimens of *Periclimenes elegans* Paulson found infected with Bopyrids, collected by Dr. S. W. Kemp at North Bay, Port Blair, Andaman Islands, carry two distinct species of *Bopyrina*. These specimens form part of a large collection made at low water during February, 1921. Of the two, one is the type-specimen of *B. andamanica*, while the other is the type (C 484/1) of the present species. Dr. Kemp, who has kindly named the hosts of the species described in this paper, has examined these two specimens with special care and has been unable to find any appreciable difference between them.

The parasite appears pinkish through the carapace of the host, the colour being due to the mass of eggs in the large incubatory cavity.

Bopyrina cochinensis, sp. nov.

(Plate XXI, figs. 1–5.)

The single *female* examined is about 3·6 mm. long and 2·5 mm. broad. In general shape and colouration the species resembles *B. kossmanni*.

The anterior lamina of the head is not developed to as great an extent as it is in the preceding form, and the posterior margin forms a sharper curve. A pair of eyes is present.

The thoracic segments are distinct throughout their length and the margins of the first four are each divided into two parts. The ovarian

bosses are indistinct; those on the longer side of the body seem to be oval in outline, while those on the other are more or less rounded. The epimera are poorly developed and occupy the usual position.

The lines of demarcation between the abdominal segments are not visible on the dorsal surface. Unlike *B. andamanica* or *B. kossmanni*, the greatest length of the abdomen considerably exceeds the greatest breadth. The segments are distinctly seen only along the shorter margin of the abdomen; on the other side they are somewhat fused. The margins of the fifth segment do not extend beyond the sixth, but the latter forms the posterior extremity of the body. The posterior margin of the sixth segment is entire and regularly rounded.

The maxilliped is like that of the preceding species, but the palp is shorter and carries only four or five setae.

The shape of the first oostegite is somewhat different, and the posterior lobe is shorter and slightly more pointed. The internal crest is well developed and entire throughout. The fifth incubatory plate extends well backwards and covers a part of the abdomen.

The four pairs of uniramous pleopods are moderately large; the fifth pair and the uropods are absent.

The *male* is somewhat shorter than that of *B. kossmanni*, but agrees with it in shape and proportions of the body. The head and thorax with their appendages are alike in the two species but the abdomen differs greatly. It is almost as long as broad, and tapers rapidly posteriorly, so that the last segment is many times less broad than the first. The segments, especially the first four, are distinct on the sides, though they are considerably fused dorsally. The sixth segment does not carry any anal spines, nor are there any pleopods and uropods.

Locality.—The single specimen (C 482/1) examined is a parasite of *Periclimenes grandis* Stimpson and was collected by Dr. F. H. Gravely in the Cochin backwater, near Ernakulam, on the Malabar coast of India in September 1914. The parasite is a left Bopyrid and both the male and female are present.

Bopyrina gracilis, sp. nov.

(Plate XXI, figs. 6–10.)

The *adult female* is strongly asymmetrical, and one side is much shorter than the other, so that the abdomen forms a sharp curve with the thorax on the shorter side of the body. The greatest length of the body is 4·5 mm. and the breadth at the level of the third thoracic somite is about 3 mm. The body is pale yellow in colour, with the head, sides of thorax and abdomen white. A few streaks of a light brown pigment are irregularly scattered on the dorsal surface. Ventrally all the oostegites are coloured brown.

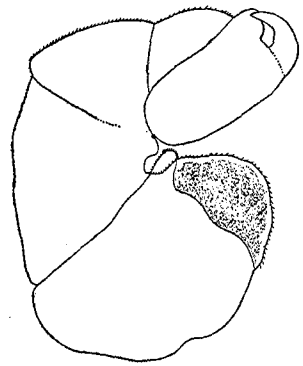
The anterior margin of the head is produced forwards in a large broadly rounded frontal lamina. The posterior margin is not clearly distinguishable. A pair of small eyes is present near the anterior margin.

The first thoracic segment in the mid-dorsal line appears to be about half as long as the second. The ovarian bosses are indistinct; on the

first two segments on the longer side of the body they seem to occupy the anterior half of the margins, on the third a little more than half, while on the fourth segment the boss occupies the anterior three-fourths. On the other side of the body the bosses are still less distinct and can hardly be made out. The epimera in the first four segments are placed lateral to the bosses; in the last three they occupy the entire margins.

The abdominal segments are fused on the dorsal surface, but are quite distinct on the sides. The margins of the fifth segment extend considerably beyond the sixth segment, and their posterior extremities are rounded. The posterior margin of the sixth segment is slightly rounded and entire.

The maxilliped is like that of the foregoing species; its palp carries six setae, all arranged along the inner and anterior margins. The remaining head appendages are extremely reduced.



Text-fig. 30.—*Bopyrina gracilis*, sp. nov.
Thoracic leg of female: ×135.

The incubatory cavity is only partially covered over by the oostegites. The first incubatory lamella is like that of *B. andamanica*, but the posterior lobe is more sharply curved. The internal crest is well developed and entire. On the basal segment of each of the thoracic legs there is a conspicuous boss covered with scales and hairs. The external margins of the carpus and merus are also hairy.

The greatest breadth of the abdomen slightly exceeds its length from its base to the posterior margin of the sixth segment. The four pairs of pleopods are well developed and uniramous. There are no appendages on the last two segments.

The *male* is about 1 mm. long and about 0·35 mm. broad. The antennules are two-segmented, with the basal segment swollen and the terminal carrying a number of setae. The antennae appear to be formed of three segments, but I have not been able to make out their structure clearly. The mandibles and the maxillae are normal. There is a pair of well-developed eyes on the dorsal surface.

The thoracic segments are distinct and their appendages are normal.

The abdomen is slightly broader than long, and tapers posteriorly more gradually than it does in *B. andamanica* or *B. cochinensis*, so that the first segment is a little over three times as broad as the last. All the six segments are clearly indicated along the margins, and on the dorsal surface the lines of demarcation between the anterior two or three are visible for some distance. The sixth segment is broad and rounded and does not carry any spines.

Locality.—A single adult specimen (C 483/1) obtained from the left branchial cavity of *Urocaridella gracilis* Borradaile, was collected by Dr. S. W. Kemp at Port Blair, Andaman Islands, in February, 1915.

Bopyrina giardi Bonnier.

1893. *Bopyrina virbii*, Stebbing, *Hist. Crust.*, p. 417 (*partim*).
1900. *Bopyrina giardi*, Bonnier, *Trav. Stat. Zool. Wimereux* VIII, pp. 365-368, pls. xxxviii, xxxix, xl.
1906. *Bopyrina virbii*, Tattersal, *Fisheries, Ireland, Sci. Invest.* for 1904. part ii, p. 54.
1907. *Bopyrina giardi*, Norman, *Ann. Mag. Nat. Hist.* (7) XX, p. 363.
1912. *Bopyrina virbii*, Tattersall, *Proc. Roy. Irish Acad.* XXXI, part 43, p. 5.

Prof. M. Caullery of Paris has kindly sent me from Wimereux a number of specimens of *Hippolyte varians* Leach, infected with *Bopyrina giardi*.[1]

The two Indian specimens that I refer to Bonnier's species agree closely with Wimereux specimens, as also with the detailed description and excellent figures given by the author.

Both the *females* in my collection are adult and measure 2·2 by 1·3 and 2·0 by 1·4 mm. respectively. The general colour of the body is white, and the pigment spots are arranged more or less regularly as shown in Bonnier's figures. The spots on the abdomen seem to be less conspicuous.

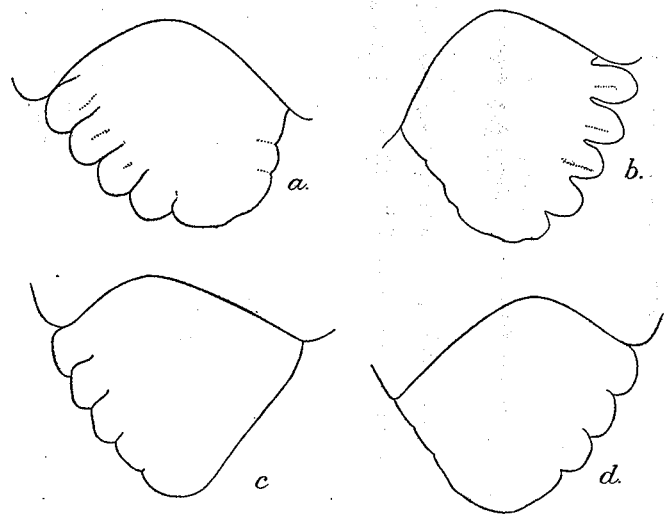
The anterior lamina of the head is somewhat poorly developed and the antero-lateral corners are blunt. The posterior margin is distinct and is regularly rounded. A pair of large eyes is present. The head appendages and the mouth-parts are greatly reduced. The maxilliped is as shown in Bonnier's figure, and the palp is almost absent, being represented by a small rounded process not fringed with setae. The secondary lobes of the posterior lamina are entire and the outer is bluntly pointed.

The incubatory cavity is large and the ventral surface of the thorax is considerably swollen. The first oostegite agrees with Bonnier's description, but the anterior segment is slightly less convex. The posterior segment is rounded distally, but it does not carry any distinct posterior lobe. The internal crest is very poorly developed. The remaining oostegites are normal and agree with Bonnier's account. The boss on the basal segment of the leg is well developed, and is markedly scaly, as are also the margins of the merus, carpus and propodus. The dactylus is large and forms a sharp curved claw.

The abdomen is short, being about a fourth of the total length of the body, and is markedly broader than long. The segments are almost completely fused on the dorsal surface and along the shorter margin of the body. Along the longer side four segments are clearly visible. In Bonnier's figures of the adult female (Pl. xxxix, figs. 3 and 4) only three segments are shown as distinct along the longer margin of the body, but in some of the Wimereux specimens I have examined four segments can be clearly made out along this side. From the accompanying text-figures it will be seen that the abdomens of the European and the Indian forms are essentially similar. The posterior margin is irregularly rounded.

[1] The specimens are labelled only as *Bopyrina* sp., but their examination and comparison with Bonnier's figures of *B. giardi* show them to belong to the latter species The specimens from which Bonnier described his species were also collected at Wimereux

Ventrally the abdomen is considerably encroached upon by the swollen marsupium. The pleopods are reduced and only the first two pairs can



Text-fig. 31.—*Bopyrina giardi* Bonnier.

Dorsal view of abdomen of four female specimens, showing similarity in shape between specimens from India and France; drawn to same magnification: × 45.
a, b. Specimens from India. *c, d.* Specimens from Wimereux, France.

be distinctly recognised; the other two seem to have been replaced by fleshy ridges.

The *male* also agrees closely. The pigment on the dorsal surface is a little denser than that in the Wimereux specimens. The antennules also appear to be proportionately longer, for they project a little beyond the anterior margin of the head. The abdomen is large and is considerably longer than broad. The first two or three segments are more or less distinct, the remainder are completely fused. The last segment carries a number of spines posteriorly.

Locality.—The two females and one male that I have examined were collected by Dr. S. W. Kemp, at Port Blair, Andamans. They are branchial parasites of *Hippolyte ventricosus* Milne-Edwards. The species was hitherto known from the European waters only, having been recorded from the coast of France and Great Britain, where it lives on the very closely allied *Hippolyte varians* Leach. These two species of *Hippolyte*, though resembling each other closely, are, I am informed by Dr. Kemp, beyond doubt specifically distinct, and the presence on them both of identically the same parasite is interesting, especially in view of the fact that the European form does not occur in Indian waters nor does the Indian species extend so far west. It is, however, possible that one or other of these species of *Hippolyte* or a related species may occur on the African coasts and this, if found to be true, will help to account

for such an unusual distribution in a highly specialized parasite such as this *Bopyrina*.

B. giardi very closely resembles Miss Richardson's *B. abbreviata*, and from the published description of the latter it appears somewhat doubtful if the two forms are distinct. The form of the abdomen on which the American species is principally based is exactly like that of *B. giardi*. The shape of the first oostegite, and the maxilliped and the great reduction of the pleopods are all characters that Miss Richardson's species shares with the European form. The only difference that I can find between the two is in the male. The abdomen in *B. abbreviata* is proportionately shorter and in one specimen all the six segments are said to be more or less defined along the sides. The anal spines are also probably absent.

The present species may be distinguished from the remaining Indian forms by the extremely reduced pleopoda of the female and the absence of the posterior lobe of the first oostegite. The ventral surface of the thorax is greatly swollen and the fusion of the abdominal segments is more marked than in any other Indian species. The abdomen of the male is also proportionately shorter. Some of the characters mentioned in the comparative table given on page 524 will further help in distinguishing this species.

Genus **Bopyroides** Stimpson.

1838. *Bopyrus*, Krôyer, *Skrift. K. Dansk. Vidensk. Selsk.* VII, p. 306.
1840. *Bopyrus*, Milne-Edwards, *Hist. Nat. Crust.* III, p. 283 (*partim*).
1864. *Bopyroides*, Stimpson,[1] *Proc. Acad. Nat. Sci. Philadelphia*, p. 156.
1868. *Gyge*, Bate and Westwood, *Brit. Sessile-Eyed Crust.* II, pp. 230, 231 (*partim*).
1893. *Bopyroides*, Stebbing, *Hist. Crust.*, p. 497.
1899. *Bopyroides*, Sars, *Crust. Norway* II, p. 198.
1900. *Bopyroides*, Bonnier, *Trav. Stat. Zool. Wimereaux* VIII, p. 373.
1904. *Bopyroides*, Richardson, *Proc. U. S. Nat. Mus.* XXVII, pp. 64-66 (*partim*).
1905. *Bopyroides*, Richardson,[2] *Bull. U. S. Nat. Mus.* LI, p. 566.
1905. *Bopyroides*, Norman,[3] *Museum Normanianum, Crust.* p. 17.
1907. *Bopyroides*, Norman, *Ann. Mag. Nat. Hist.* (7) XX, p. 363.
1909. *Bopyroides*, Richardson, *Proc. U. S. Nat. Mus.* XXXVII, p. 122.
1916. *Bopyroides*, Hansen, *Danish Ingolf Exped.* III, part 5, p. 203.
1916. *Bopyroides*, Deriugin,[2] *Mem. Ac. Sci. Petrograd* XXXIV, p. 437.

The genus may be defined as follows :—

Branchial parasites.

Female. Body broad, flattened, slightly asymmetrical.

Head deeply sunk in thorax, but distinct.

Thoracic segments distinct, with lateral margins not deeply notched. Ovarian bosses well developed. Oostegites covering the incubatory cavity only partially.

Abdominal segments distinct both dorsally and laterally. Pleural lamellae absent. Pleopoda wanting, replaced by small fleshy lobes. Uropoda absent.

[1] A reference to Gissler's (1882) *Bopyroides* is not included in the above synonymy, for Miss Richardson (1905) has shown that *B. latreuticola* Gissler possesses five pairs of biramous pleopods. For reasons given on pages 537, 538, I, however, do not agree with Miss Richardson in including it in the genus *Probopyrus*.

[2] Further references are given by Miss Richardson.

[3] I have not seen these publications.

Male. Thoracic segments distinct.

Abdominal segments completely fused. Pleopoda and uropoda totally absent.

Type-species :—Bopyrus hippolytes Krôyer.

Leaving aside *B. furcata* Norman (1905), the genus *Bopyroides* is known from a single species, *B. hippolytes*, all the others hitherto described having been considered synonymous with it. I am not in a position to discuss Norman's species as I have not been able to consult his work. So far as I am aware no description of the species has uptil now been given either by the author of it or by any subsequent worker and it is, therefore, very doubtful if the species *B. furcata* is to be recognised at all. *B. hippolytes*, on the other hand, has been recorded and described in detail under various names by several authors.

I have referred to this genus, with grave doubts, a Bopyrid parasitic on an Alpheid collected at Port Blair in the Andamans. It agrees with the generic definition given above in the absence of all abdominal appendages in both sexes ; in the fusion of the abdominal segments in the male ; and, in fact, in all other essential points except that the abdominal segments in the female are completely fused both dorsally and laterally, whereas they are described as distinct in *B. hippolytes*. In this last respect the abdomen of the Indian species greatly resembles that of *Bopyrella thomsoni* Bonnier, in which also the segments are so fused as to be almost completely indistinguishable from one another. The differences, however, between the two forms are too great to suggest any close relationship. On the other hand, the complete, or almost complete, absence of abdominal appendages in the female is not known to occur in any genus except *Bopyroides*, and other characters also, such as the sunken condition of the head, the straight lateral margins of the body, the absence of pleural lamellae, and the complete fusion of the abdominal segments in the male seem to show that the Indian species has more affinity with the genus *Bopyroides* than with any other. Though it goes beyond the confines of the genus in having the abdominal segments of the female fused I hesitate to construct a new genus on the basis of this character alone when there are so many other points of agreement.

That the Indian species is different from *B. hippolytes* is almost certain, as will be seen from the description given below.

The genus *Bopyroides* has a very wide range of distribution, *B. hippolytes* having been recorded from several places both in the Atlantic and the Pacific oceans. In the Atlantic it occurs along the eastern coast of North America (Richardson, 1905), south coast of Baffin Island (Ohlin), south and west coasts of England (Bate and Westwood, 1868 and Scott, 1895), all along the coasts of Norway (Sars, 1899), in the Barents Sea (Hoek, 1882) and even as far north as the west coast of Greenland in Lat. 81° 44′ N. (Hansen, 1916). In the Pacific Miss Richardson has recorded it from Puget Sound, the Bering sea and later (1910a) from the Japan sea. The species is a parasite of a large number of species of *Spirontocaris*, some species of *Pandalus* and one species of *Pandalopsis*. The Indian species has been found only once, at the Andamans, and is a parasite of an Alpheid.

Bopyroides wood-masoni, sp. nov.

(Plate XXI, figs. 11, 12.)

The adult *female* is slightly asymmetrical in form, the right side in the specimen I have seen being somewhat longer than the left. The animal is about 3 mm. long and over 2 mm. broad. It is pale in colour with the middle of the thorax on the dorsal surface somewhat darker than the rest of the body.

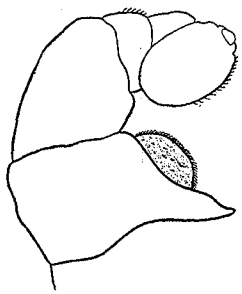
The head is somewhat longer than broad and its anterior margin is rounded. It is deeply sunk in the thorax, but its posterior boundary which extends much further back than it does in *B. hippolytes*, is quite distinct. A pair of small but distinct eyes, reddish in colour, is placed near the anterior margin of the head.

The seven thoracic segments are quite distinct, but the marginal indentations, usually so well developed in most genera, are not well marked. The first two segments are very short in the mid-dorsal region, being, as it were, pushed back by the head. The ovarian bosses are distinct and occupy the anterior portions of the margins of the first four segments. Lateral to these are the epimera in the form of very narrow plates. In the last three segments the epimera occupy the entire margins.

The abdominal segments are fused both on the dorsal surface as well as along the sides, so that the abdomen presents continuous margins. On the dorsal surface the lines of demarcation between some of the anterior segments are indistinctly seen. The pleural parts are completely absent.

The head appendages are greatly reduced and it is difficult to make them out clearly. The maxillipeds are unfortunately damaged, and the palps of both the sides are missing, but the anterior segment seems to be very large in proportion to the posterior.

The ventral surface of the thorax is raised in ridge-like structures as shown in Bonnier's (1900) figure of *B. sarsi* (=*B. hippolytes*). The distal portions of the first pair of oostegites have the posterior margin produced in a well-developed lobe rounded at its extremity. The remaining oostegites have the usual shape. The thoracic legs have each a prominent boss, covered with scales and hairs, on the basal segment; the merus is hairy and the propodus is also partly covered with hairs.



Text-fig. 32.—*Bopyroides wood-masoni*, sp. nov. Thoracic leg of female: × 140.

The ventral surface of the abdomen is raised in a number of ridges which are frilled at their free margins. The rudiments of some of the anterior pleopods are present in the form of extremely reduced fleshy lobes; the rest are totally absent. The uropods are, as usual, wanting.

The *male* is short and thick, its length being hardly twice its breadth. The antennules appear to be triarticulate and the antennae are composed of four (or perhaps five) segments. The thorax has the usual seven free segments each carrying its legs. The abdomen is proportionately small and its segments are all fused into a single mass, posteriorly tapering to almost a point. There are no pleopoda or uropoda.

I have not been able to give a figure of the male as it was accidently lost before a figure had been prepared.

Locality.—The single specimen (C 487/1) I have examined was collected by Mr. J. Wood-Mason at Port Blair, Andaman Islands. It is a parasite of an undetermined species of *Synalpheus*, very closely resembling *S. neomeris* (de Man).

The principal points of difference from *B. hippolytes* may be summed up as follows :—

1. The head in the female is more deeply sunk in thorax.
2. The posterior portion of the first incubatory plate is produced in a well-developed lobe.
3. The abdominal segments of the female are fused.
4. The male is short and stout, its breadth being over half the total length of the body.

"Bopyroides latreuticola" Gissler.

1882. *Bopyroides latreuticola*, Gissler, *Amer. Naturlist* XVI, p. 591.
1888. *Bopyrus latreutes*, Spence Bate, *Challanger Report* XXIV, p. 584.
1900. *Bopyrina latreuticola*, Bonnier, *Trav. Stat. Zool. Wimereux* VIII, p. 370.
1901. *Bopyroides latreuticola*, Richardson, *Proc. U. S. Nat. Mus.* XXIII, p. 579.
1904. *Bopyroides latreuticola*, Richardson, *Proc. U. S. Nat. Mus.* XXVII, p. 65.
1905. *Probopyrus latreuticola*, Richardson, *Bull. U. S. Nat. Mus.* LI, p. 560.

I have not included references to this parasite in the synonymy of any of the four genera to which it has so far been referred, for I am of opinion it does not belong to any of them. The possession of five pairs of biramous pleopods in the female, as Miss Richardson has shown it to possess, excludes it from *Bopyroides*, *Bopyrus* and *Bopyrina*, in which Gissler (and Miss Richardson), Spence Bate and Bonnier have respectively placed it. I differ also from Miss Richardson's view that it is a *Probopyrus*, for it differs from this genus (*i*) in the complete fusion on the dorsal surface of the abdominal segments in the female, (*ii*) the total absence of the abdominal appendages in the male, (*iii*) the absence of ovarian bosses and epimera in the female, and (*iv*) the fact that one side of the body is swollen and that on the shorter side of the abdomen all indications of the segments are wanting. Though the presence of eyes in the female is not regarded as a character of any great importance, it is a significant fact that eyes have not so far been recorded in any species of *Probopyrus*.

It will thus be seen that the parasite of *Latreutes ensiferus* (Milne-Edwards) does not really belong to any of the four genera to which it has hitherto been assigned, and in my opinion, the combination of characters that it presents is not met with in any other genus of the family Bopyridae. I have in my collection two Bopyrids, parasitic on two different species of *Latreutes*, which in their principal characters agree with the American form, but are in an unsatisfactory condition, being both considerably damaged and one unaccompanied by its male. An examination of these two forms and a careful comparison with the description and

figures of Gissler's parasite leads me to believe that all are congeneric and that a new genus is required for their reception. The genus may be based on the following characters :—

Branchial parasites.

Female. Body highly asymmetrical, one side considerably swollen, especially on the ventral surface.

Head deeply set in the thorax and distinct from it, produced anteriorly in a narrow frontal lamina. A pair of small but distinct eyes present.

Thoracic segments well defined dorsally. Margins of the segments on longer side of the body separate and expanded, those on shorter side almost continuous. Ovarian bosses and epimera not visible. Oostegites small and only partially roofing over the incubatory cavity. Peraeopods of both sides present.

Abdomen proportionately short, broader than long. Pleural lamellae totally absent. Segments fused dorsally, but indicated clearly, along the longer margin of the body ; margin on the shorter side almost continuous. Pleopods reduced, biramous, one ramus small or even vestigial. Sixth segment large, triangular, with its posterior margin entire or slightly notched. Uropoda wanting.

Male. Form of body slightly asymmetrical.

Thoracic segments all distinct.

Abdominal segments fused dorsally, without pleopoda or uropoda.

The two forms in my collection are parasites of *Latreutes mucronatus* (Stimpson) and *L. pygmaeus* Nobili, and were both collected by Dr. S. W. Kemp, the first at Pamban at the northern end of the Gulf of Manaar, near the shore, while the second was captured by him in Ross Channel, Port Blair, Andaman Islands.

The forms included in this group show a great resemblance to *Bopyrina*, especially *B. giardi* Bonnier, in which also the ventral surface of the female is swollen. In the extreme asymmetry of the body the genus resembles *Hemiarthrus* (=*Phryxus*).

ADDENDUM.

Since the preceding report went to the press, a very valuable addition has been made to our knowledge of the Epicaridea, especially the Bopyridae, by the publication of Messrs. Nierstrasz and Brender à Brandis's (1923) memoir on the group in the series of the Siboga Expedition Reports. As at the present stage of the passage of my paper through the press it is not desirable to make extensive additions and alterations in the text, I have thought it best to add a short note embodying my comments on this recent publication.

I am highly indebted to my colleague Dr. Baini Prashad for the very great help he has given me by translating from German into English all the necessary passages.

Certain descriptive terms have been used by the Dutch authors which require some remark. The lateral portions of the first four free thoracic somites, which are generally designated pleural plates, pleura, or epimera, have been called by them "Coxalplatten" or the coxal plates,

because they are supposed to represent the coxopodites of the corresponding thoracic legs. As pointed out by these authors, there is nothing new in this view, for Sars (1899) uses the same term for these structures. The evidence adduced in support of this view, however, is, in my opinion, somewhat inconclusive, and until the question of homology of these structures is definitely settled, I think it will be best to call them "anterior lateral plates" as opposed to posterior lateral plates ("hinteren Seitenteile" or "Seitenplatten") a name proposed by Nierstrasz and Brandis for the posterior portion of the thoracic margin behind the so-called coxal pate. I have, however, myself referred to the structures both as pleura and as epimera, simply because these terms are the most commonly used, and not because of any supposed homology with similar structures in other groups.

Another point worth noticing in this connection is the numbering of thoracic segments. Though the first thoracic somite in Isopoda, as also in several other groups of Crustacea, is believed to have completely coalesced with the head, leaving no trace behind either as tergum or sternum, it is customary, at least in systematic works, to regard the true second somite as the first segment. The thorax is thus considered to be formed of seven segments instead of eight. Nierstrasz and Brandis, however, have departed from this rule, and have called the first free somite the second segment, thus considering the thorax to be formed of eight somites. This practice unless universally followed is, I am afraid, likely to cause unnecessary confusion.

Before passing on to the systematic part I will say a word about the geographical distribution. The question of similarity between the fauna of the Atlantic ocean and that of the Indo-Pacific region has already been referred to on pp. 422, 423. My views receive a strong support from the observations made by the Dutch authors, for they too have pointed out this marked similarity, and have given numerous examples illustrating it. The occurrence of genera like *Pleurocryptella*, *Ergyne*, *Metathelges*, *Stegias*, *Bopyrella*, *Bopyrus* and *Bopyrina*—besides the instances that have already been mentioned——shows that a remarkable similarity exists between the Indo-Pacific Epicaridean fauna and that of the Atlantic ocean, especially along the coast of North America.

The range of several genera has been considerably extended.

I make here observations on those genera only that are represented in my collection and have been dealt with in the preceding memoir, or have a direct relationship with them.

Hemiarthrus Giard and Bonnier.

1923. *Phryxus,* Nierstrasz and Brandis, *Siboga Exped. Rep.* XXXIIb, Isopoda Epicaridea, p. 108.

The name *Phryxus* has been employed by Nierstrasz and Brandis only because it is widely used, though they admit Giard has rightly replaced it by *Hemiarthrus*. As I have pointed out on pp. 428, 429 it will be necessary in order to save further confusion to stick to the proper name *Hemiarthrus*, though it is to be regretted that such a well-known name has to be discarded.

Orbione Bonnier.

1923. *Orbione*, Nierstrasz and Brandis, *op. cit.*, p. 64.

Besides the somewhat doubtful *O. incerta* Bonnier, the genus is now known from five good species, the Siboga Expedition having brought back two new forms. Both the Siboga species are distinguished by their large size and the peculiar arrangement of their pleural plates. They are parasites of two species of *Haliporus*, a genus not hitherto known to be infested by *Orbione*.

Regarding the generic position of *O. incerta*, my views have been confirmed by Nierstrasz and Brandis (*vide* pp. 68, 69 under *Rhopalione* Pérez) in so far as I disagree with Pérez in not including this species in the genus *Rhopalione* and considering it a true *Orbione*.

Parapenaeon Richardson.

1904. *Parapenaeon*, Richardson, *Proc. U. S. Nat. Mus.* XXVII, pp. 43, 44.
1923. *Parapenaeon*, Nierstrasz and Brandis, *op. cit.*, p. 66.

As has been mentioned above (p. 445, foot-note) Miss Richardson in 1904 described uniramous uropods in the female of the genus, but she seems to have found out later (1910) that these structures were really biramous. She even went further than this by considering Nobili's (1906*a*) figure of *Orbione bonnieri* incorrect in so far as the uropoda were shown there to be uniramous and transferred this species to *Parapenaeon* as amended by her—a position which, as has been pointed out (p. 446), cannot be maintained. Nierstrasz and Brandis have now shown that the uropoda in *Parapenaeon* are uniramous as originally described by Miss Richardson, for in the Siboga species these structures are seen to be formed of one ramus only. Relying upon Miss Richardson's later statement, I have in the preceding pages described the uropoda as biramous. Further the Dutch authors also point out, as I have done, that *O. bonnieri* has been rightly included in *Orbione*, and that Miss Richardson was wrong in considering it a *Parapenaeon*.

Bopyrella Bonnier.

1923. *Bopyrella*, Nierstrasz and Brandis, *op. cit.*, p. 95.

The generic diagnosis proposed by Nierstrasz and Brandis agrees in all material respects with the one that I have given in the account of this genus. From these diagnoses it will be seen that Hay's *Synsynella* cannot stand as a distinct genus, but must be sunk in the synonymy of *Bopyrella*. The fact that forms very closely resembling Hay's *Synsynella deformans*, have been described in the Siboga Report under *Bopyrella* confirms my view that the genera are really synonymous. The principal character on which *Synsynella* is based is the fusion of the head with the first thoracic somite, but as Nierstrasz and Brandis have also shown this character is equally shared by *Bopyrella*. This question has been gone into at some length on p. 468.

It will thus be seen that the somewhat incomplete fusion of the abdominal segments, which Nierstrasz and Brandis consider so peculiar in two of the Siboga species, is nothing really unusual. In *B. deformans* (Hay), as in both the Indian forms described by me, the abdominal segments though fused on the dorsal surafce are free along the margins. The condition of the abdomen in the Indian forms and of that in the Siboga species is indeed very similar, as can be seen by comparing the figures given by me (pl. xiv, figs. 1, 2, 7, 8) and by Nierstrasz and Brandis (figs. 20*a*, 21*a*) respectively.

Of the three new species described in the Siboga Report one—*B. bonnieri*—resembles very closely, especially in the characters of the female, the American *B. deformans* (Hay), particularly its Indian subspecies, that I have described under the name *indica*. If it were not for material differences in the male, especially in the shape of the abdomen, I would not feel justified in retaining *indica* as a distinct form.

Palaegyge and **Probopyrus** Giard and Bonnier.

1923. *Palaegyge*, Nierstrasz and Brandis, *op. cit.*, p. 89.
1923. *Probopyrus*, Nierstrasz and Brandis, *op. cit.*, p. 93.

I have not much to say under these genera for the observations made by Nierstrasz and Brandis agree substantially with my views as expressed on pp. 481 and 509. These two genera, though perhaps widely different in their genetic relationship, are so like one another that it is sometimes very difficult to distinguish one from the other. Thus the generic position of the species described in the Sibogo Report as *Probopyrus latilamellaris*, nov., is, in my opinion very doubtful, for it seems to resemble more *Palaegyge* than *Probopyrus*. In fact the description and figures agree closely with specimens of immature *Palaegyge buitendijki* Horst, the host of which also is *Palaemon carcinus* Fab. Besides other characters, the posteriorly bifid sixth abdominal somite (pleotelson), though not a constant feature of the genus *Palaegyge* is still, as a rule, very characteristic. The only authentic exception, so far known, to this rule is the American *P. panamensis* Richardson, in which the terminal segment is slightly notched posteriorly.

Palaegyge plesionikae Barnard, as pointed out on p. 486, is probably incorrectly placed in the genus, for in *Palaegyge* the incubatory cavity is never quite closed, nor are the uropods ever so well developed. The host also belongs to a different family of Caridea.

The occurrence of *Palaemon lar* Fab., far out in the sea—though this point, as remarked by Nierstrasz and Brandis, is not free from considerable doubts—infested by *Palaegyge bonnieri* is very interesting, for this Palaemon has been found far inland, even at considerable altitudes, carrying a *Probopyrus*.

Bopyrus Latreille.

1923. *Bopyrus*, Nierstrasz and Brandis, *op. cit.*, p. 97.

Nierstrasz and Brandis have retained Giard and Bonnier's name *fougerouxi* for the species generally referred to as *squillarum*. For reasons given above I am of opinion that the older name *squillarum* should replace the one proposed by the French authors.

A number of species have been recognized in the Siboga Report which I have thought best to sink in the synonymy of *B. squillarum*. Giard and Bonnier's *B. helleri* and *B. rathkei* (and probably *B. treillia-*

nus, also, of which no satisfactory description has hitherto been given) cannot stand as distinct species, for a careful examination of the first and figures and description of the other has revealed no material difference which could justify their separation from *B. squillarum*. The case of *B. xiphias* is, however, different, for, among other characters, the male of this form is distinct from that of *B. squillarum*.

The form described in the Siboga Report as *B. stebbingi*, sp. nov., based on a single female, the male and host of which are unknown, is probably a good species.

Bopyrina Kossmann.

1923. *Bopyrina*, Nierstrasz and Brandis, *op. cit.*, p. 98.

The Dutch authors divide the genus into two groups, the first being characterized by a complete fusion of the head with the first (second according to their terminology) thoracic somite, and the partial fusion of some of the thoracic segments in the mid-dorsal region; in the second group the head and all the thoracic segments are free. They attach so much importance to these characters that they consider the second group —comprising Miss Richardson's three species, *B. abbreviata*, *B. thorii* and *B. urocaridis*—could well be separated into a distinct genus. The first group, which these authors think represents the true *Bopyrina*, is formed by *B. virbii* (Walz), *B. giardi* Bonnier, and *B. ocellatus* (Czerniavsky).

I am, however, unable to agree with this grouping, for the characters relied upon show a regular gradation in the genus. The partial fusion of the head with the first thoracic somite is a rule in the genus and is observable in most of the species. In some species it has gone further than in others, and there are forms in the genus in which the fusion is at such a stage that it is difficult to place them in one group or the other. I have not had the opportunity of seeing any of the American species; and Miss Richardson's figures cannot be generally relied upon for such fine details as the partial fusion of the head with the first thoracic somite. I am, however, of opinion that even in these forms the head cannot be entirely free, and that there must be at least some little fusion.

Nierstrasz and Brandis have perhaps wrongly attributed completely fused head to Bonnier's *B. giardi*, for his figures clearly show a distinct and unbroken line of demarcation between it and the thorax. In specimens of this species that I have examined, I have also found the head quite distinct. In the remaining two species of the first group, as pointed out by the Dutch authors, the condition of the head has not been mentioned by Kossmann, while Czerniavsky describes quite a different condition in *B. ocellata*. From the figures of these species, however, the head is seen to be fused with the first thoracic somite.

In the Indian species described in this paper the head shows different stages of fusion. In *B. andamanica* it is fused to a considerable extent; in *B. gracilis* the fusion is a little less marked; in *B. kossmanni* the line of demarcation is very faintly visible; while in *B. cochinensis* the head is almost free.

Regarding the other character—the fusion of some of the thoracic segments—the three species mentioned in the first group seem to be

clearly marked off from the rest. This, no doubt, is a good character, but these species resemble so closely the other species of *Bopyrina*, that separating them off from the rest into another genus would be taxanomically unsound.

The two new Siboga species seem to be based on good characters. *B. gigas* is not, however, an extraordinarily large species, for two of the Indian species also, namely, *B. andamanica* and *B. gracilis*, both new, attain a length of 4·5 mm. Further it is not in *B. brachytelson* alone that the fifth abdominal segment extends beyond the sixth (pleotelson), for in three of the Indian species—*B. andamanica*, *B. kossmanni* and *B. gracilis*—also the same condition is observable.

The Siboga species are parasites of two genera of hosts not hitherto known to be infested by *Bopyrina*. *B. gigas* lives on *Gelastocaris*, while *B. brachytelson* is a parasite of *Anylocaris*.

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EXPLANATION OF PLATE XI.

Hemiarthrus nigrocinctus, sp. nov.

FIG. 1.—Female, dorsal view, thoracic legs not shown: × 27.
FIG. 2.—Same, ventral view: × 27.
FIG. 3.—Male, dorsal view: × 88.

Hemiarthrus filiformis, sp. nov.

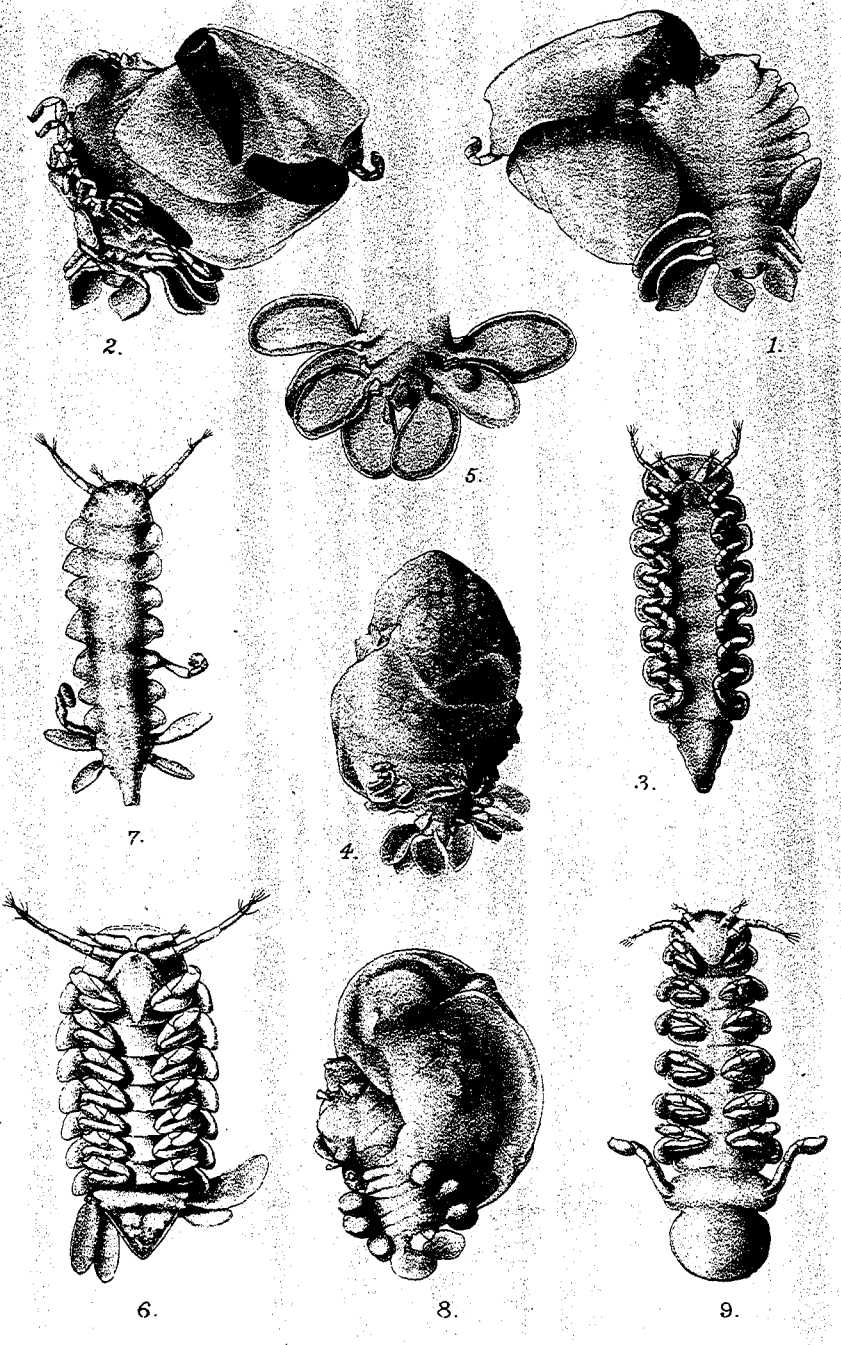
FIG. 4.—Female, ventral view: × 14.
FIG. 5.—Abdominal region of same, dorsal view: × 27.
FIG. 6.—Male, ventral view: × 50.

Hemiarthrus filiformis var. *attenuata*, nov.

FIG. 7.—Male, dorsal view: × 35.

Hemiarthrus brevicauda, sp. nov.

FIG. 8.—Female, dorsal view: × 14.
FIG. 9.—Male, ventral view: × 69.



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EXPLANATION OF PLATE XII.

Orbione kempi, sp. nov.

FIG. 1.—Female, dorsal view : × 13.

FIG. 2.—Abdominal region of same, pleopods removed, ventral view : × 16.

FIG. 3.—Left maxilliped and outer lobe of posterior lamina of head outer face : × 46.

FIG. 4.—First left oostegite, inner face : × 35.

FIG. 5.—Male, ventral view : × 53.

Epipenaeon elegans, sp. nov.

FIG. 6.—Female, dorsal view : × 3·5.

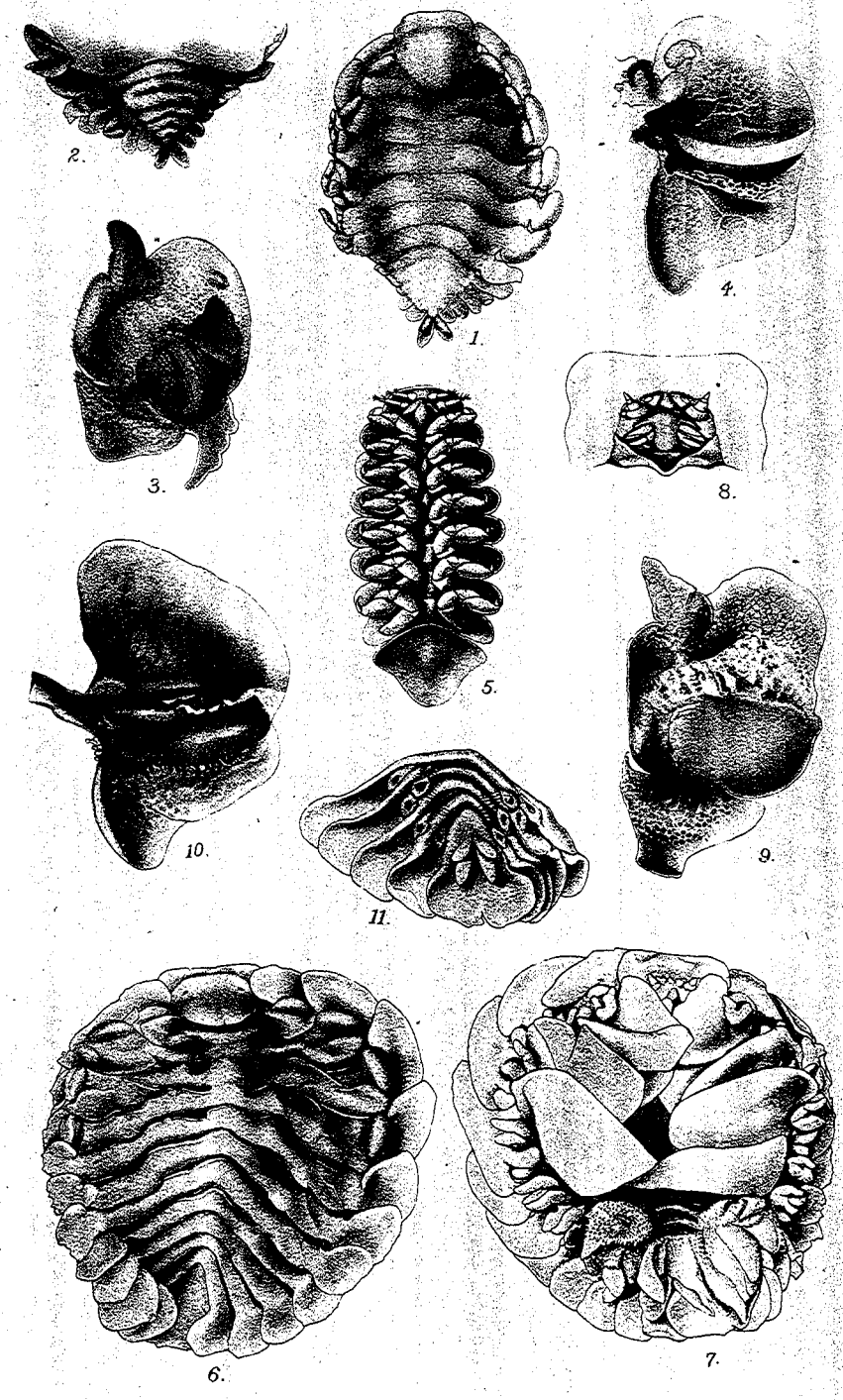
FIG. 7.—Same, ventral view : × 3·5.

FIG. 8.—Head appendages and mouth parts of female : × 5·5.

FIG. 9.—Left maxilliped, outer face : × 11.

FIG. 10.—First left oostegite, inner face : × 7.

FIG. 11.—Ventral view of abdominal region of female, pleopoda removed : × 4.



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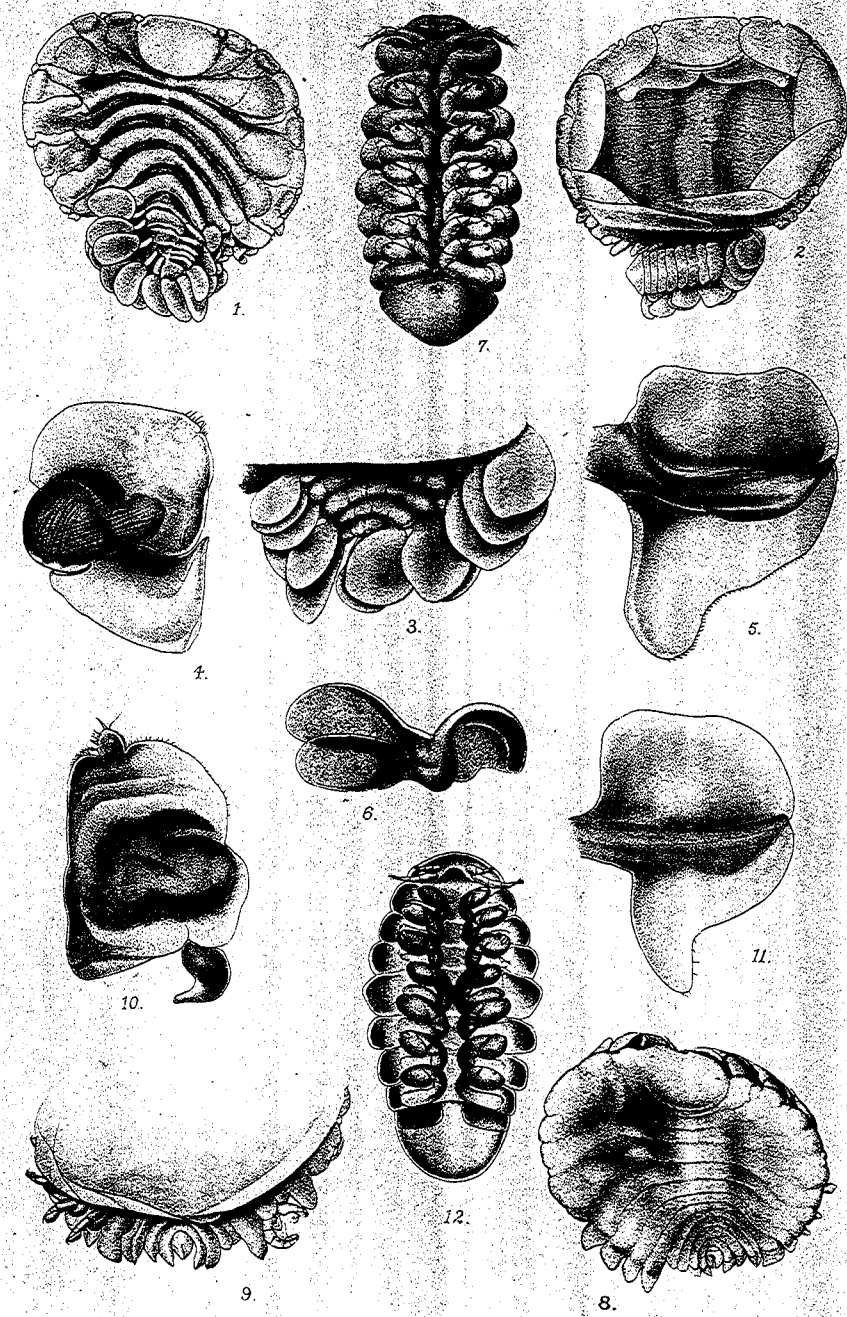
EXPLANATION OF PLATE XIII.

Stegoalpheon kempi, gen. et sp. nov.

FIG. 1.—Female, dorsal view : × 9.
FIG. 2.—Same, with male in situ, ventral view : × 9.
FIG. 3.—Abdominal region of same, ventral view : × 20.
FIG. 4.—Right maxilliped, outer face : × 40.
FIG. 5.—First left oostegite, inner face : × 32.
FIG. 6.—Third right pleopod : × 47.
FIG. 7.—Male, ventral view : × 28.

Parapleurocrypta alphei, gen. et sp. nov.

FIG. 8.—Female, dorsal view : × 14.
FIG. 9.—Posterior region of same, ventral view, with second and third pleopoda of one side removed : × 16.
FIG. 10.—Left maxilliped, and outer lobe of posterior lamina of head, outer face : × 62.
FIG. 11.—First left oostegite, inner face : × 47.
FIG. 12.—Male, ventral view : × 47.



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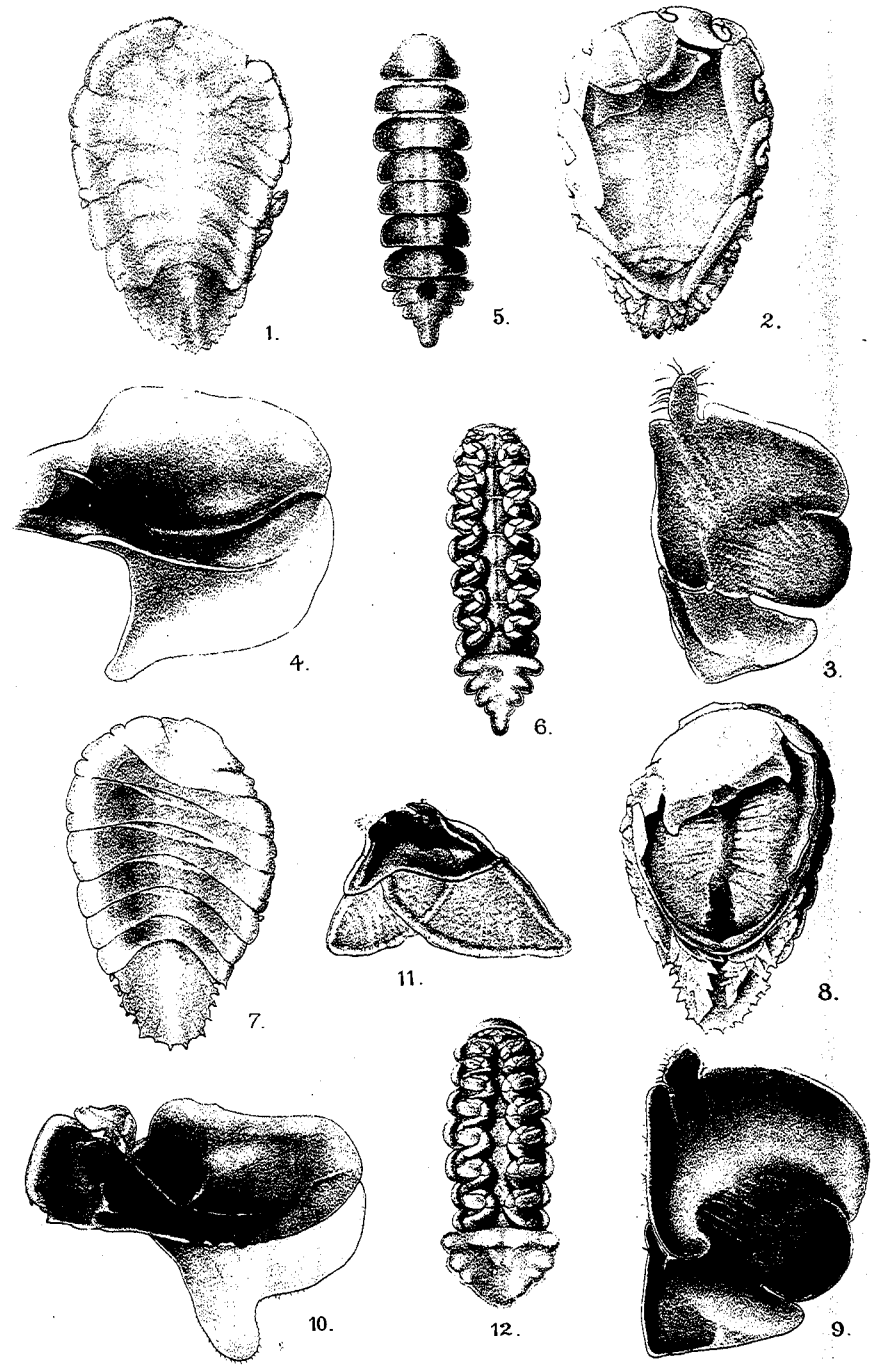
EXPLANATION OF PLATE XIV.

Bopyrella deformans subsp. *indica*, nov.

FIG. 1.—Female, dorsal view : × 8·5.
FIG. 2.—Same, ventral view : × 8·5.
FIG. 3.—Left maxilliped, outer face : × 43.
FIG. 4.—First left oostegite, inner face : × 43.
FIG. 5.—Male, dorsal view : × 33.
FIG. 6.—Same, ventral view : × 33.

Bopyrella hodgarti, sp. nov.

FIG. 7.—Female, dorsal view : × 9.
FIG. 8.—Same, ventral view : × 9.
FIG. 9.—Left maxilliped, outer face : × 50.
FIG. 10.—First left oostegite, inner face : × 36.
FIG. 11.—Pleopod : × 50.
FIG. 12.—Male, ventral view : × 33.



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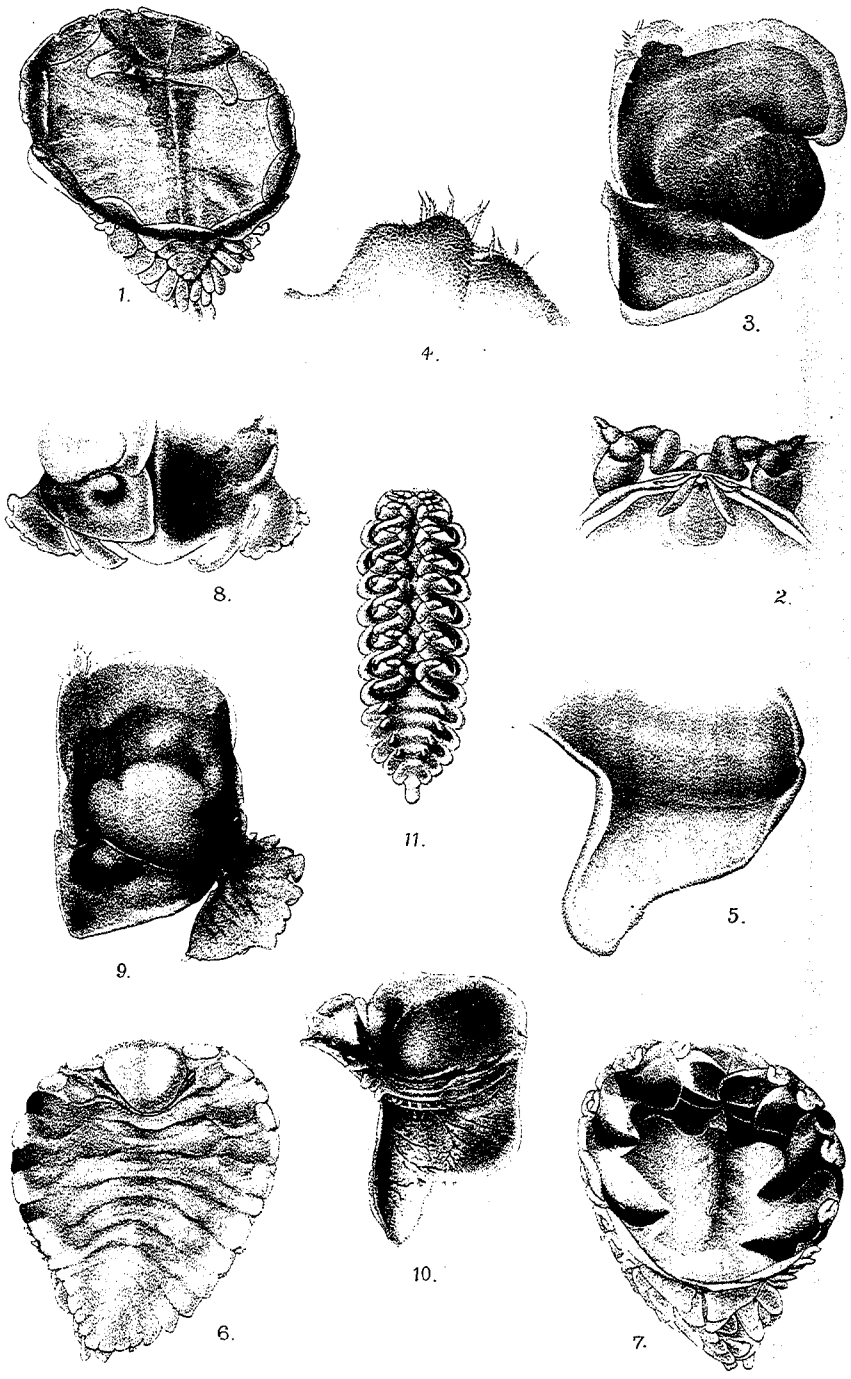
EXPLANATION OF PLATE XV.

Argeia lowisi, sp. nov.

FIG. 1.—Female, ventral view : × 8.
FIG. 2.—Head appendages of female : × 62.
FIG. 3.—Left maxilliped, outer face : × 50.
FIG. 4.—Palp of right maxilliped : × 135.
FIG. 5.—First left oostegite, inner face : × 50.

Palaegyge prashadi, sp. nov.

FIG. 6.—Female, dorsal view : × 5·5.
FIG. 7.—Same, ventral view : × 5·5.
FIG. 8.—Posterior lamina of head, with one maxilliped removed : × 15.
FIG. 9.—Left maxilliped and outer secondary lobe of posterior lamina of head : × 21.
FIG. 10.—First left oostegite, inner face : × 16.
FIG. 11.—Male, ventral view : × 53.



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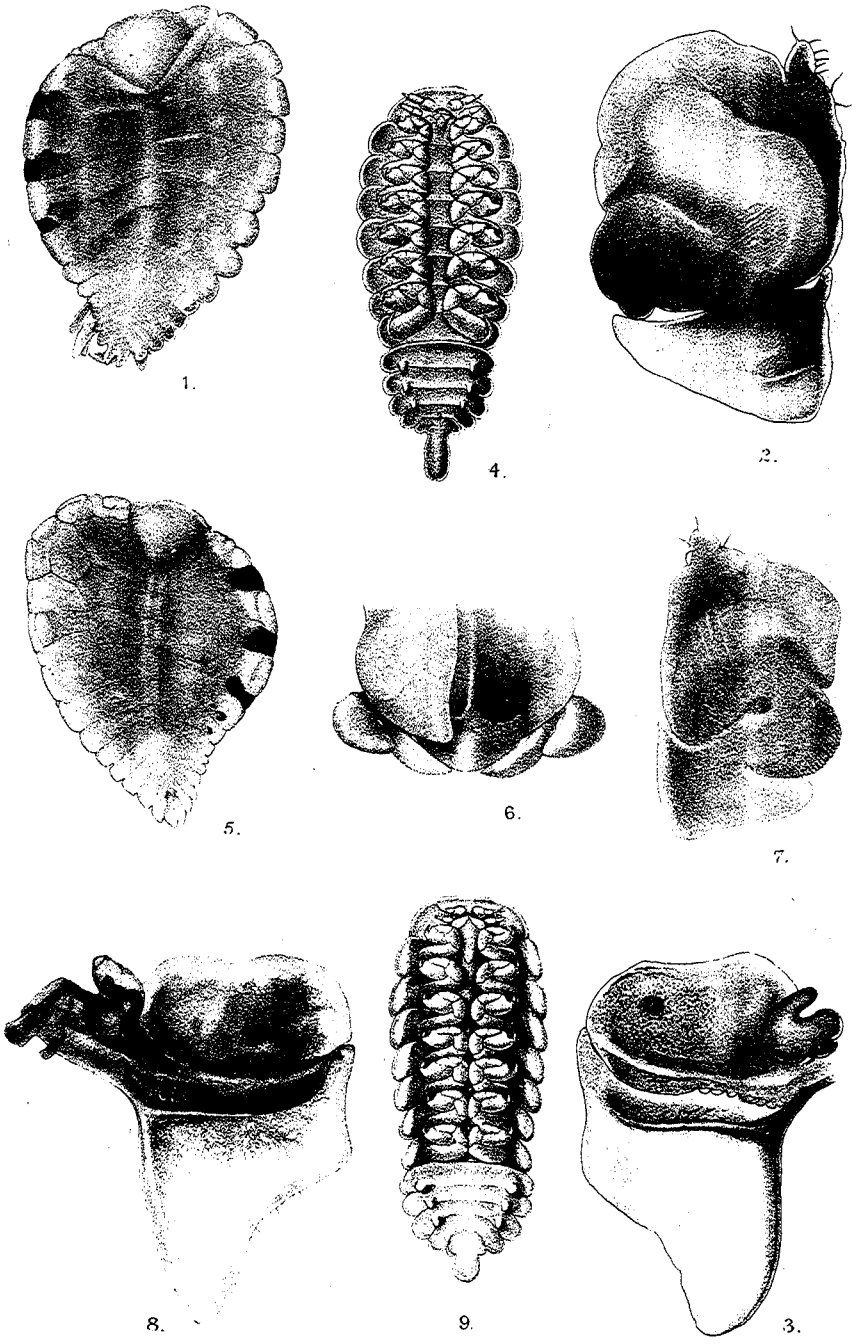
EXPLANATION OF PLATE XVI.

Palaegyge brachysoma, sp. nov.

FIG. 1.—Female, dorsal view : × 7.
FIG. 2.—Right maxilliped, outer face : × 48.
FIG. 3.—First right oostegite, inner face : × 28.
FIG. 4.—Male, ventral view : ×34.

Palaegyge godaveriensis, sp. nov.

FIG. 5.—Female, dorsal view : × 9·5.
FIG. 6.—Posterior lamina of head, with one maxilliped removed.
FIG. 7.—Left maxilliped, outer face : × 40.
FIG. 8.—First left oostegite, inner face : × 36.
FIG. 9.—Male, ventral view : × 44.



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EXPLANATION OF PLATE XVII.

Palaegyge alcocki, sp. nov.

FIG. 1.—Female, dorsal view : × 4.

FIG. 2.—Posterior lamina of head, one maxilliped removed, upper face : ×10.

FIG. 3.—Left maxilliped, anterior region, outer face : × 14.

FIG. 4.—First right oostegite, internal crest : × 14.

FIG. 5.—Male, ventral view : × 17.

Palaegyge abhoyai, sp. nov.

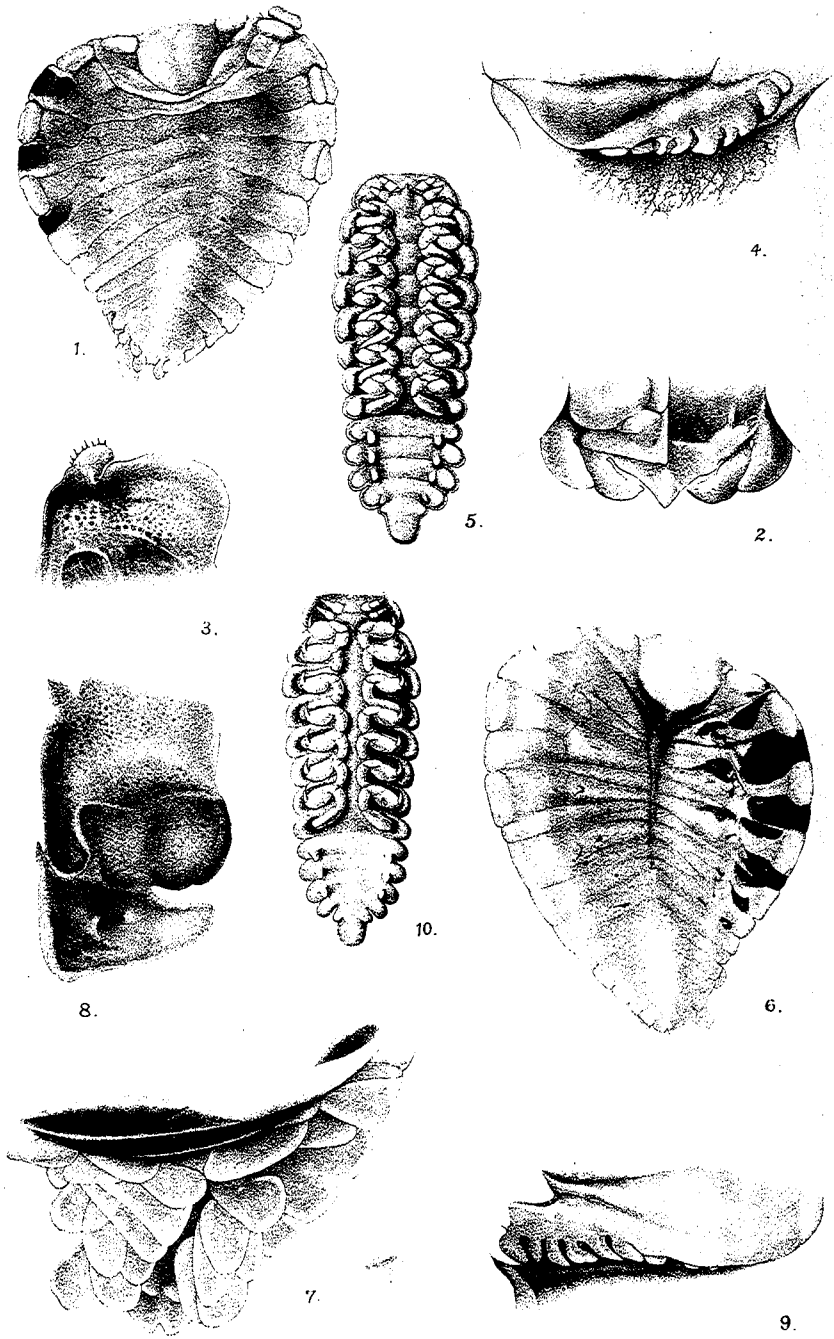
FIG. 6.—Female, dorsal view : × 8.

FIG. 7.—Abdominal region of same, ventral view : × 20.

FIG. 8.—Left maxilliped, outer face : × 24.

FIG. 9.—First left oostegite, internal crest : × 36.

FIG. 10.—Male, ventral view : × 34.



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EXPLANATION OF PLATE XVIII.

Palaegyge bengalensis, sp. nov.

FIG. 1.—Abdominal region of female, dorsal view : × 7.

FIG. 2.—Posterior lamina of head, with secondary lobes of one side removed, upper face : × 5.

FIG. 3.—First left oostegite, inner face : × 10.

FIG. 4.—Abdominal region of male, ventral view : × 45.

Palaegyge pica, sp. nov.

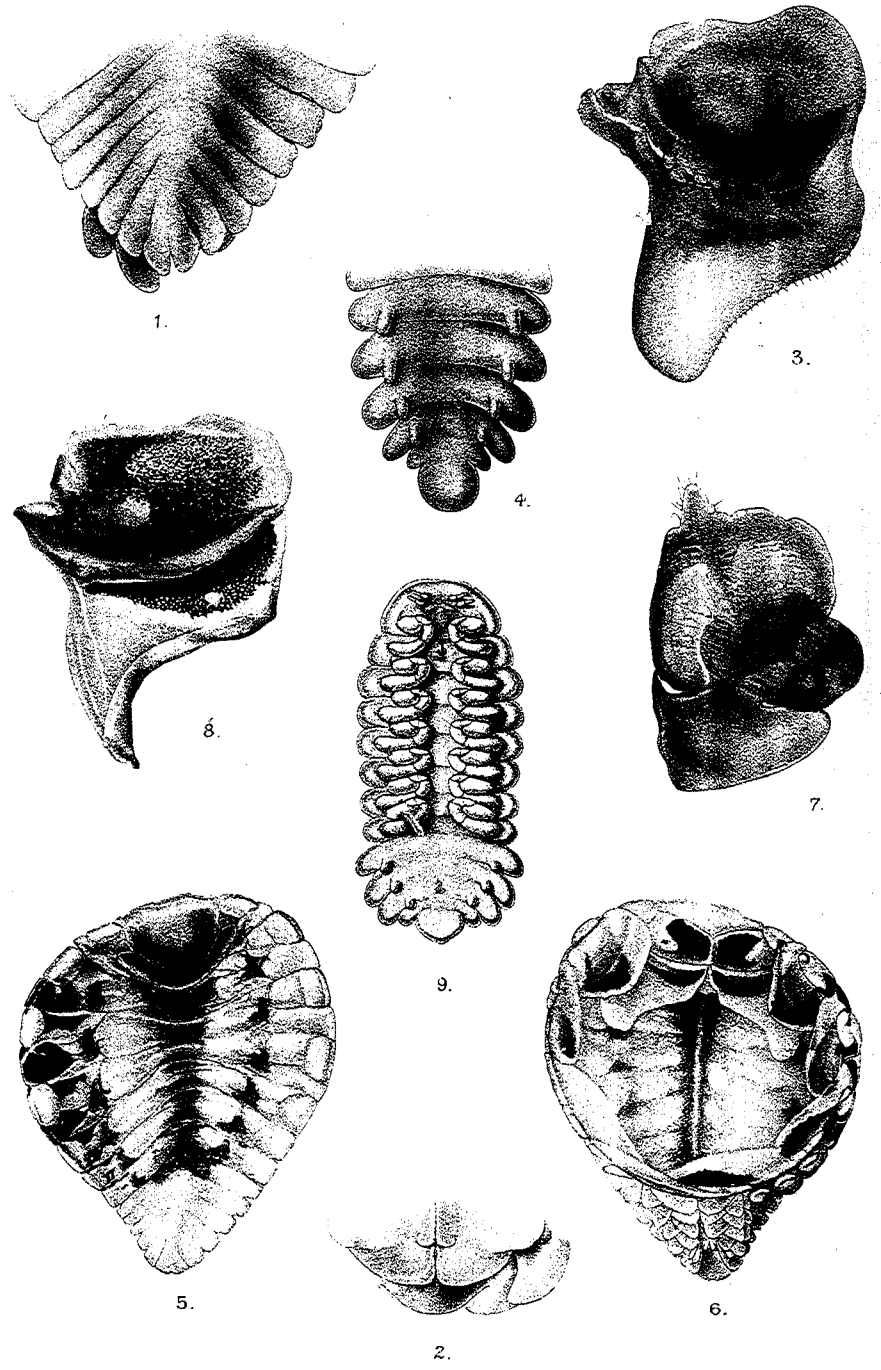
FIG. 5.—Female, dorsal view : × 8.

FIG. 6.—Same, ventral view : × 8.

FIG. 7.—Left maxilliped, outer face : × 36.

FIG. 8.—First left oostegite, posterior part somewhat folded, inner face : × 36.

FIG. 9.—Male, ventral view : × 48.



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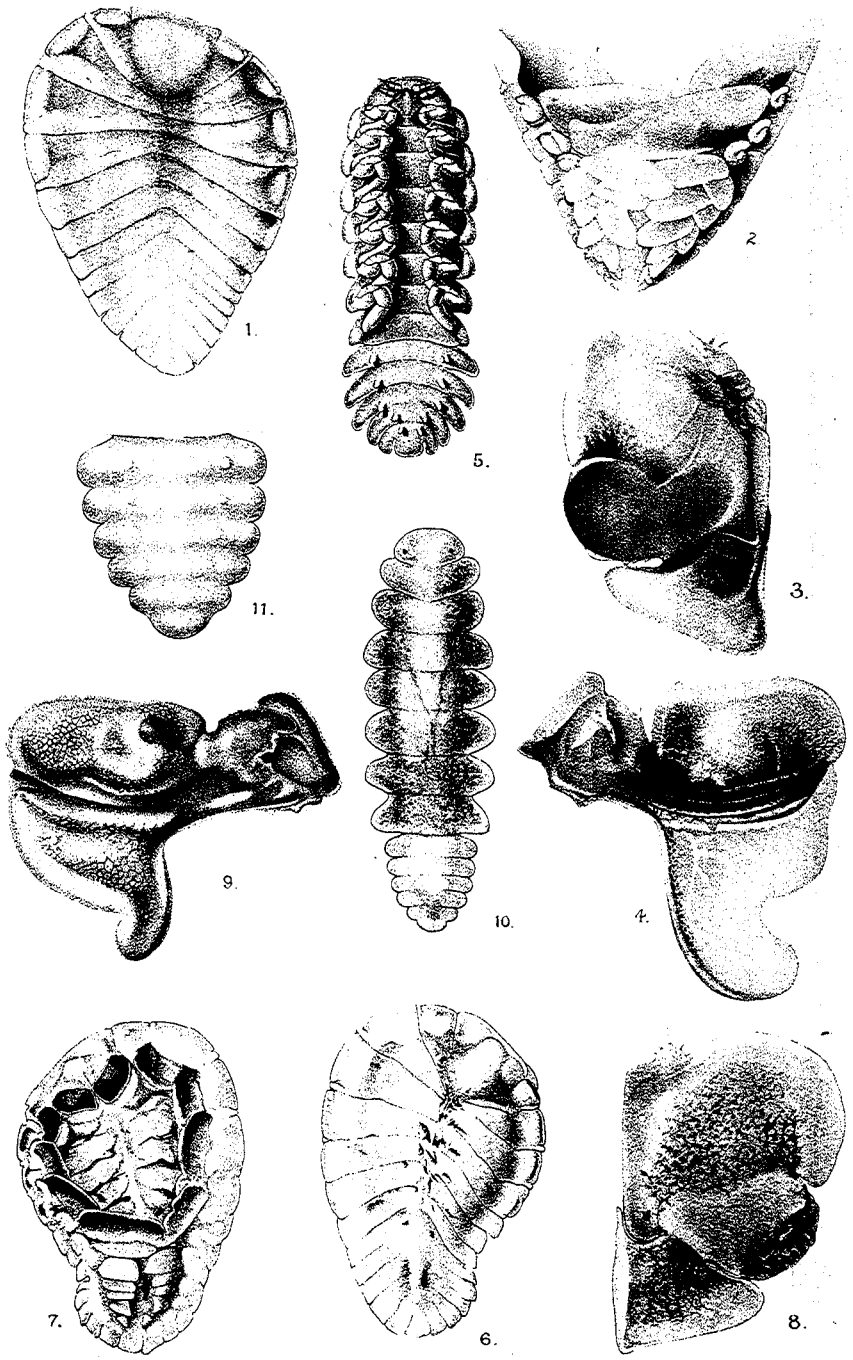
EXPLANATION OF PLATE XIX.

Probopyrus gangeticus, sp. nov.

FIG. 1.—Female dorsal view : × 8.
FIG. 2.—Posterior region of same, ventral view : × 9½.
FIG. 3.—Right maxilliped, outer face : × 36.
FIG. 4.—First left oostegite, inner face : × 20.
FIG. 5.—Male, ventral view : × 24.

Bopyrus squillarum var. *bimaculatus*, nov.

FIG. 6.—Female, dorsal view : × 8.
FIG. 7.—Same, ventral view : × 8.
FIG. 8.—Left maxilliped, outer face : × 40.
FIG. 9.—First right oostegite, inner face : × 32.
FIG. 10.—Male, dorsal view : × 40.
FIG. 11.—Abdomen of same, ventral view : × 80.



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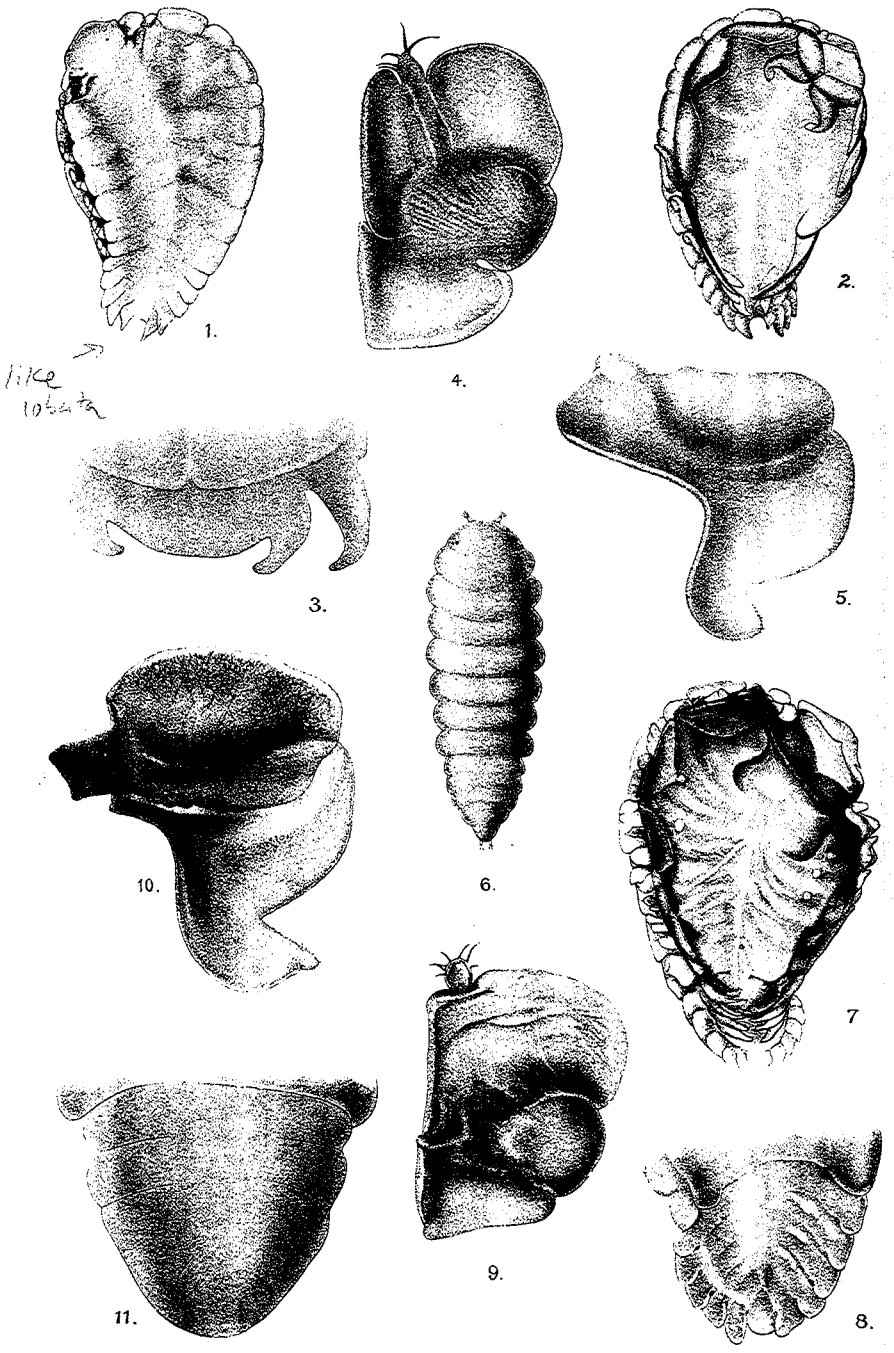
EXPLANATION OF PLATE XX.

Bopyrina andamanica, sp. nov.

FIG. 1.—Female, dorsal view : × 13.
FIG. 2.—Same, ventral view : × 13.
FIG. 3.—Posterior lamina of head, upper view : × 56.
FIG. 4.—Left maxilliped, outer face : × 72.
FIG. 5.—First left oostegite, inner face : × 48.
FIG. 6.—Male, dorsal view : × 65.

Bopyrina kossmanni, sp. nov.

FIG. 7.—Female, ventral view : × 16.
FIG. 8.—Posterior region of same, dorsal view : × 20.
FIG. 9.—Left maxilliped, outer face : × 60.
FIG. 10.—First left oostegite, inner face : × 52.
FIG. 11.—Abdomen of male, dorsal view : × 190.



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EXPLANATION OF PLATE XXI.

Bopyrina cochinensis, sp. nov.

FIG. 1.—Female, dorsal view : × 12.
FIG. 2.—Posterior region of same, ventral view : × 21.
FIG. 3.—Palp of left maxilliped : × 150.
FIG. 4.—First left oostegite, inner face : × 37.
FIG. 5.—Abdomen of male : × 150.

Bopyrina gracilis, sp. nov.

FIG. 6.—Female, dorsal view : × 12.
FIG. 7.—Same, ventral view : × 12.
FIG. 8.—Anterior portion of left maxilliped : × 75.
FIG. 9.—First left oostegite, inner face : × 45.
FIG. 10.—Abdomen of male : × 30.

Bopyroides wood-masoni, sp. nov.

FIG. 11.—Female, dorsal view : × 15.
FIG. 12.—Posterior region of first right oostegite : × 50.

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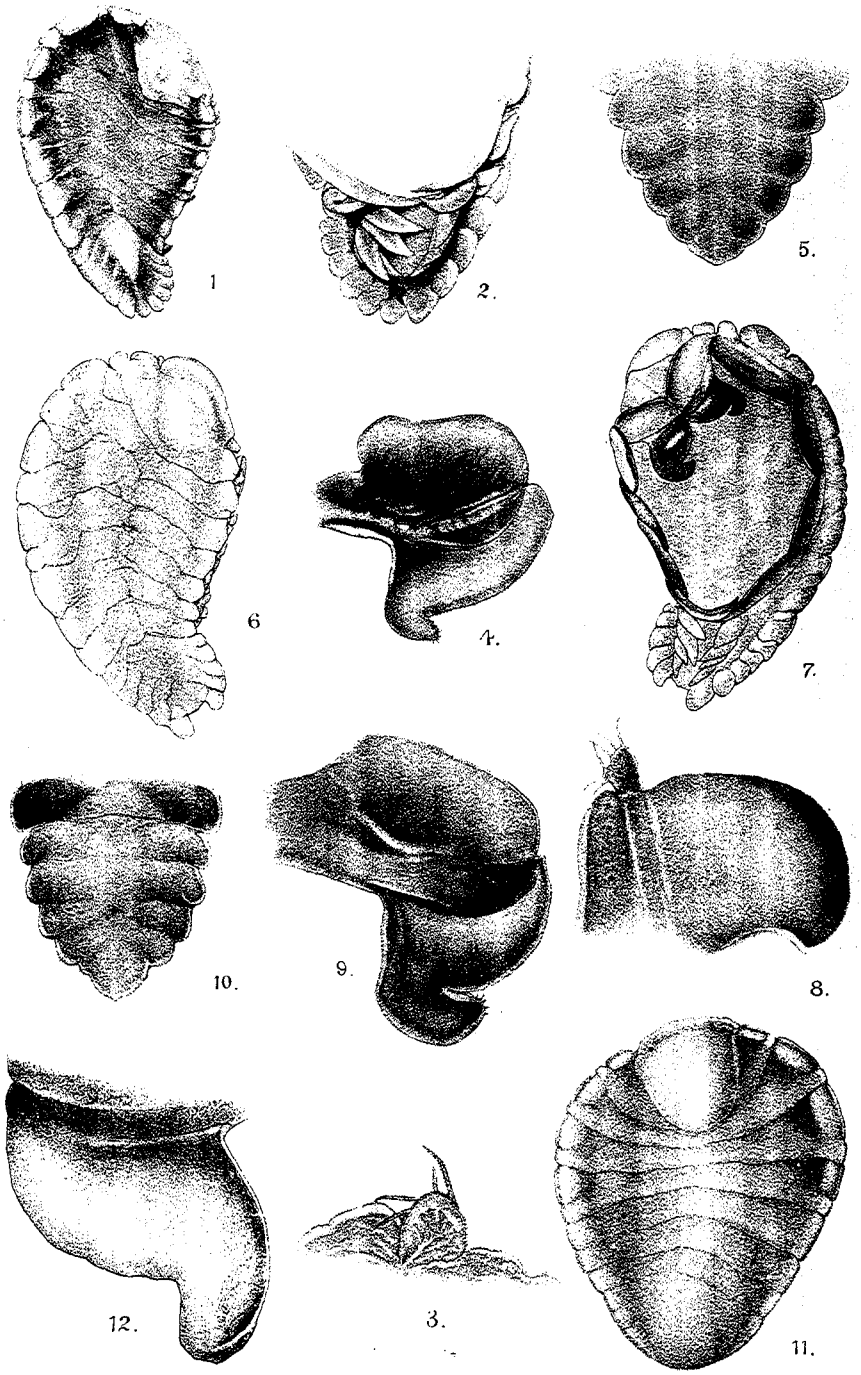

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