MEMOIRS OF THE INDIAN MUSEUM, VOL. V.

FAUNA OF THE CHILKA LAKE

No. 12.

JULY, 1924.

Calcutta:
PUBLISHED BY THE DIRECTOR, ZOOLOGICAL SURVEY OF INDIA

1924

Price Ten Rupees.

FAUNA OF THE CHILKA LAKE.

CRUSTACEA COPEPODA.

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CRUSTACEA COPEPODA.

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INTRODUCTION.

The collection of Copepoda obtained in the Chilka Lake is one of great interest, partly by reason of the various species that occur and partly also from the very marked changes that take place in the local conditions from season to season and from year to year.

As Annandale and Kemp have pointed out in the introduction to this volume, the lake communicates on the one hand with the Mahanaddi river and on the other, in any normal year, with the open waters of the Bay of Bengal. At the northern end tributaries of the Mahanaddi pour their flood-waters into the lake during the rainy season from June to August, whereas during the dry winter months the level of the lake, owing to the great amount of evaporation that takes place, tends to fall below sea-level and in consequence we get an inflowing current of sea-water through the entrance channel. Each of these influxes in turn will carry with it a representative collection of its planktonic forms. We should, therefore, expect to find at different seasons of the year and in different parts of the lake great variation in the composition and relative numbers of the inhabitants.

It has further been shown [Sewell and Annandale, 1922] that the degree of salinity of the lake water may vary very considerably from year to year and this again must have a profound influence on the general character of the planktonic fauna (*loc. cit.*, p. 696).

In several instances species are represented in the collection by either single or only very few specimens, and not uncommonly the only locality in which these were obtained was in or near the entrance channel. When once the inflowing current of sea-water has become established any littoral-haunting form is liable to be swept in by it through the channel, and a tow-netting or other collection made in this area at the crucial moment will reveal its presence in the lake ; and the greater the influx, the larger will be the number of such species that are likely to occur. The same of course equally applies to purely fresh-water forms that may be washed out of the Mahanaddi river system by the monsoon floods, and since these processes alternate with the changing seasons one would expect to find a corresponding change in the type of fauna present.

The present collection includes in all sixty-nine samples—tow-nettings, weed-washings, etc.—of which, however, twelve contained no Copepoda. The remainder revealed the presence in the collection of fifty-seven species. In view of the comparatively little systematic work that has been carried out on the Copepoda of Indian waters, it was only to be expected that a number of new species and varieties would be discovered. In a

previous paper (Sewell, 1919) I have described five forms that had up till then been unknown, namely :—

Pseudodiaptomus annandalei,
Pseudodiaptomus tollingeri,
Acartia chilkaensis,
Acartiella major, and
Acartiella minor.

In the following pages I give descriptions of seven further species which appear to me to be new ; *viz.* :—

Isias tropica, sp. nov.,
Halicyclops tenuispina, sp. nov.,
Cyclopina intermedia, sp. nov.,
Cyclopina longifurca, sp. nov.,
Harpacticella lacustris, sp. nov.,
Laophonte quinquespinosa, sp. nov.,
Cleta secunda, sp. nov.,

and in addition I have described what I believe to be varieties of five other species :

Harpacticus gracilis Claus, var. *orientalis*, nov.
Parategastes sphaericus (Claus), var. *similis*, nov.
Idyaea ensifera (Fischer), var. *indica*, nov.
Nitocra spinipes Boeck, var. *orientalis*, nov.
and *Nitocra typica* Boeck, var. *lacustris*, nov.

The types of these species and varieties have been deposited in the Indian Museum.

A detailed analysis of the contents of the different samples shows that the permanent lake-dwellers, upon whose presence in any given series of samples one can rely with any degree of certainty, are comparatively few. Indeed out of all the species now recorded from the lake the only ones that have any claim to be regarded as permanent inhabitants, as opposed to fortuitous visitors, are but fourteen in number, namely :—

Paracalanus crassirostris Dahl,
Pseudodiaptomus annandalei Sewell,
Pseudodiaptomus binghami Sewell,
Pseudodiaptomus hickmani Sewell,
Labidocera pavo Giesbrecht,
Acartia centrura Giesbrecht,
Acartia chilkaensis Sewell,
Acartiella major Sewell,
Acartiella minor Sewell,
Oithona nana Giesbrecht,
Oithona brevicornis Giesbrecht,
Parategastes sphaericus (Claus) var. *similis*, nov.,
and possibly *Amphiascus scotti*, nom. nov. [=*Dactylopus propinquus* T. Scott].

Many of these species are already well known to be inhabitants of brackish water. *Paracalanus crassirostris* Dahl, for instance, has been found in the estuarine waters of the Congo and Amazon Rivers and I have previously recorded *Acrocalanus inermis* and *Pseudodiaptomus hickmani* from the Rangoon river estuary, in water whose specific gravity was as low as 1002 at 27·6°c.[1] The genera *Pseudodiaptomus* and *Acartiella* as a whole seem to prefer brackish water as their habitat, but it is interesting to find that such typical marine species as *Labidocera pavo* Giestrecht, *Acartia centrura* Giestrecht, *Parategastes sphaericus* (Claus) and the two species of *Oithona* have been able to persist, though in some cases with a certain degree of modification of structure, under the very variable conditions of salinity that occur in the lake.

With the onset of the monsoon rains a great change occurs in the lake. Owing to the inrush of river water at the north end the normal inhabitants of the lake are swept towards

[1] Throughout this paper the specific gravity of distilled water is taken as = 1000.

the southern end and many are undoubtedly carried out to sea by the outflowing current, but at the extreme south end of the lake in Rambha Bay and to a certain extent in the deeper waters of the body of the lake the change in density of the water is not so great as in other parts and here the permanent inhabitants can survive until the subsidence of the flood waters again enables them to populate the lake as a whole. During this inrush of river water large numbers of purely fresh-water inhabitants are swept into the lake and the character of the copepod fauna changes to a marked extent. We now find present numbers of such species as :—

Pseudodiaptomus lobipes Gurney,
Diaptomus blanci deGuerne and Richard,
Diaptomus cinctus Gurney,
Diaptomus contortus Gurney,
Diaptomus pulcher, Gurney,
Diaptomus strigilipes Gurney,
Cyclops bicolor Sars,
Cyclops buxtoni Gurney,
Mesocyclops obsoletus (Koch) and
Mesocyclops oithonoides Sars.

Similarly during the winter months there is an influx of sea-water that raises the density of the lake as a whole. In consequence of this all the above species once again disappear and we now get a number of true marine forms that are being steadily carried into the lake by the inflowing current from the Bay of Bengal. Many of these species, however, appear never to get beyond the limits of the outer channel. Of these we find such species as :—

Pseudodiaptomus serricaudatus (T. Scott),
Canuella furcigera Sars,
Harpacticus littoralis Sars,
Idyaea furcata (Baird),
Idyaea ensifera (Fischer) var. *indica*, nov.,
Dactylopusia brevicornis (Claus), and
Mesochra nana Brady.

Other marine forms that are carried in seem to possess somewhat greater powers of adaptation and are able to persist, at any rate for some time, at the south end of the lake, though in the present state of our knowledge it is almost impossible to draw any line between this last group and those which have become permanently established. Examples of this type are :—

Acrocalanus inermis Sewell,
Isias tropica, sp. nov.,
Acartia spinicauda Giesbrecht,
Longipedia coronata Claus,
Nitocra typica Boeck var. *lacustris*,
and *Nitocra spinipes* Boeck var. *orientalis*.

It is among those that we may term casual visitors to the lake that one is most likely to find the greatest amount of variation in the species that occur in a succession of years. Up to the present time no systematic study has been made of the Copepoda of the littoral zone in Indian waters. The work of Thompson and A. Scott on the Copepoda of the Ceylon Pearl Banks resulted in the discovery of a number of forms that were previously unknown to us, but a comparison of the total number of species obtained by them with the profusion of forms described from the coasts of Great Britain and Norway by Brady, T. Scott, Norman and G. O. Sars sufficiently illustrates the extreme paucity of our knowledge. Even so these authors have recorded the occurrence in Indian waters of a number of species that have previously only been known from the colder waters of the North Atlantic and Mediterranean Seas. During the past two years I have been carrying out investigations on the copepod fauna of the littoral zone in various regions of the Indian Empire lying within a zone extending from 10° N. to 20° S. of the equator and I have been somewhat surprised to

find how many species that one has hitherto regarded as being typical inhabitants of North Temperate and even Arctic seas are present in tropical waters. Undoubtedly further research will reveal many more such cases.

Chilton (1921, p. 522) in his account of the Amphipoda of the lake has shown that out of a total of seventeen species five are known to occur in the North Atlantic Ocean and its offshoots the North Sea and Mediterranean, while one has even extended its habitat to the Arctic Seas. A very similar state of affairs exists among the Copepoda. I have found present in the collection examples of such species as (1) *Canuella furcigera* Sars, hitherto only recorded from the coast of Norway, (2) *Harpacticus littoralis* Sars, from the British and Norwegian coasts, (3) *Ectinosoma melaniceps* Boeck, from the British and Norwegian coasts and the Arctic Seas, and (4) *Dactylopusia brevicornis* (Claus), from the Norwegian coast, British Isles and the Mediterranean. Other so-called northern species, as *Nitocra typica* Boeck, *Nitocra spinipes*, Boeck and *Idyaea ensifera* (Fischer), are represented in the collection by varieties, and *Ectinosoma normani* T. and A. Scott and *Parategastes sphaericus* (Claus), originally known only from the North Atlantic and Arctic Seas, have already been recorded by Thompson and Scott (1903) from the coast of Ceylon.

Murray and Hjort (1912, p. 225), discussing the conditions that exist in the Oyster-basins of Norway, remark: "In these oyster-basins absolutely tropical conditions are developed in summer. It is significant that Gran once found in one of them a small crustacean which according to G. O. Sars belongs to the Guinea Coast." It is much more significant that so many of the species of Crustacea present in the Chilka Lake and therefore living under tropical conditions are already known from North Temperate and Arctic regions. Mere priority of discovery in northern areas is no ground for concluding that such a species is, *ipso facto*, northern or Arctic in character, though one is very liable to do so. A study of the ocean currents shows how easily tropical forms may be carried from East to West. Commencing from a centre of distribution in the tropical belt of the Indian Ocean individuals may be swept westwards by the equatorial and North-East monsoon currents to the South African region; from here their further distribution westwards may be brought about by the Benguela current and the drift of the South-East Trades. In this connection it is interesting to note that *Amphiascus scotti*, nom. nov. [=*Dactylopus propinquus* T. Scott], which has previously only been recorded from the Gulf of Guinea, has now been found in the Chilka Lake. Finally, by means of the North Atlantic drift, individuals may be swept across to the coasts of Europe and so make their appearance and establish themselves on the coasts of the British Isles and Norway. All that is required is that these individuals should possess a certain degree of adaptability to changes of temperature and salinity; and no very great powers would be necessary since the changes that occur in such a mass of moving water as forms these currents will be of a very slow character. Our knowledge of the littoral fauna of the South Temperate and Antarctic regions may be said to be still in its infancy. Even so we find representatives in the Chilka Lake: *Mesochra nana* Brady has hitherto been recorded only from the Antarctic, and *Laophonte chathamensis* Sars was only known from Chatham Island in the South Pacific Ocean. It is possible, however, that this latter species may eventually prove to be synonymous with *Laophonte mohammed* Blanchard and Richard, in which case the species will have a wide

distribution-record ranging over almost the whole of the Eastern hemisphere. It appears probable that a great number of species of Copepoda are cosmopolitan in their distribution—that a wide distribution is the rule rather than the exception—and that where we at the present time only have records of occurrence in restricted areas, this limitation of habitat is merely apparent and not real, and is due merely to our ignorance.

A general survey of the collection shows that a number of species were breeding in the lake. It was only to be expected that the breeding phase of those species, which have managed to establish themselves in the lake, would be discovered in the collection, but in addition to these, females of certain other species, which appear at present to be only casual visitors brought either by the monsoon floods or swept in by the current from the Bay of Bengal, were found during their temporary residence to be carrying egg-sacs, though it is impossible to say whether these eggs ever develop.

The main breeding season occurs during the months September to December, that is to say, at a time when the salinity of the lake water is at its lowest. It is probable that the season actually commences somewhat earlier in the year, but I have no collections made in the month of August.

I give below month by month the various species that were known to be breeding, either by the females carrying egg-sacs or in the case of such genera as *Acartia* and *Acartiella*, in which the ova are pelagic, by the females having spermatophores attached to the genital segment of the abdomen.

In the month of September breeding was in full swing and the species concerned were :—

Pseudodiaptomus annandalei Sewell, ovigerous females obtained.
Pseudodiaptomus hickmani Sewell, ovigerous females obtained.
Pseudodiaptomus lobipes Gurney, ovigerous females obtained.
Pseudodiaptomus tollingeri Sewell, ovigerous females obtained.
Acartia chilkaensis Sewell, spermatophore-bearing females obtained.
Acartiella major Sewell, spermatophore-bearing females obtained.
Cyclopina intermedia, sp. nov., ovigerous females obtained.
Cyclopina longifurca, sp. nov., ovigerous females obtained, and
Nitocra spinipes Boeck var. *orientalis*, nov., ovigerous females obtained.

In addition to these the collection contained large numbers of nauplii and copepodid stages belonging to the species—

Paracalanus crassirostris Dahl,
Acrocalanus inermis Sewell,
Acartia southwelli Sewell, and
Mesocyclops obsoletus (Koch).

Unfortunately no collections were made in the month of October, but in November several of the above species were still breeding, namely :—

Pseudodiaptomus annandalei Sewell, ovigerous females obtained.
Pseudodiaptomus hickmani Sewell, ovigerous females obtained.
Acartiella major Sewell, spermatophore-bearing females obtained.
Mesocyclops obsoletus (Koch), ovigerous females obtained, and
Cyclopina intermedia, sp. nov., ovigerous females obtained.

By the month of December the season was nearly over though three other species were now found to be breeding namely :—

Pseudodiaptomus binghami Sewell, | *Harpacticus littoralis* Sars, and *Harpacticella lacustris*, sp. nov.

The breeding season of this last species continues on into January, while in February copepodid stages of *Labidocera pavo* Giesbrecht were present in the collection, showing that this species too had recently been breeding.

From March to June we appear to have a second breeding season, which in this case is associated with a rise in the salinity of the lake-water ; but the number of species undergoing reproduction at this period of the year is considerably smaller than during the autumn.

In March the species found to be breeding were :—

Pseudodiaptomus annandalei Sewell, ovigerous females obtained. | *Pseudodiaptomus hickmani* Sewell, ovigerous females obtained, and *Longipedia coronata* Claus, ovigerous females obtained.

In April only one species was found to be actually breeding, namely :—

Amphiascus scotti, nom. nov., ovigerous females obtained [*Dactylopus propinquus* T. Scott],

but in addition I again found numerous copepodid stages of *Labidocera pavo* Giesbrecht, showing that this species too had recently been breeding, probably in the previous month.

Of the month of May I have no records, but in June ovigerous females of *Parategastes sphaericus* (Claus) var. *similis*, nov. were obtained, and in July examples of young *Acartia* were also obtained, showing that this genus too had been recently breeding probably in the previous month.

The number of observations are not sufficiently large to enable one to be certain that these months represent the only periods of the year during which breeding occurs in the various species mentioned and further research will also probably show that several other species breed in the lake and have two breeding seasons. It is probable that the times of these two seasons varies somewhat from year to year according to existing meteorological conditions, but there seems no doubt that the two seasons are correlated with a rise and fall respectively of the salinity of the lake-water.

Systematic list of the species recorded in the collection.[1]

CALANOIDA.

AMPHASCANDRIA.

PARACALANIDAE.

Genus *Paracalanus* Boeck.

1. *Paracalanus crassirostris* Dahl.

Genus *Acrocalanus* Giesbrecht.

2. *Acrocalanus inermis* Sewell.

HETERARTHRANDRIA.

CENTROPAGIDAE.

Genus *Isias* Boeck.

3. *Isias tropica*, sp. nov.

CALANOIDA—*contd.*

HETERARTHRANDRIA—*contd.*

DIAPTOMIDAE.

Genus *Pseudodiaptomus* Herrick.

4. *Pseudodiaptomus annandalei* Sewell.
5. *Pseudodiaptomus binghami* Sewell.
6. *Pseudodiaptomus hickmani* Sewell.
7. *Pseudodiaptomus lobipes* Gurney.
8. *Pseudodiaptomus serricaudatus* (T. Scott).
9. *Pseudodiaptomus tollingeri* Sewell.

[1] I have throughout this paper followed the classification given by G. O. Sars in his " Crustacea of Norway."

Systematic list of the species recorded in the collection—contd.

CALANOIDA—*concld.*

HETERARTHRANDRIA—*concld.*

DIAPTOMIDAE—*contd.*

Genus *Diaptomus* Westwood.

10. *Diaptomus blanci* de Guerne and Richard.
11. *Diaptomus cinctus* Gurney.
12. *Diaptomus contortus* Gurney.
13. *Diaptomus pulcher* Gurney.
14. *Diaptomus strigilipes* Gurney.

PONTELLIDAE.

Genus *Labidocera* Lubbock.

15. *Labidocera pavo* Giesbrecht.

ACARTIIDAE.

Genus *Acartia* Dana.

16. *Acartia centrura* Giesbrecht.
17. *Acartia chilkaensis* Sewell.
18. *Acartia southwelli* Sewell.
19. *Acartia spinicauda* Giesbrecht

Genus *Acartiella* Sewell.

20. *Acartiella major* Sewell.
21. *Acartiella minor* Sewell.

CYCLOPOIDA.

GNATHOSTOMA.

OITHONIDAE.

Genus *Oithona* Baird.

22. *Oithona brevicornis* Giesbrecht.
23. *Oithona nana* Giesbrecht.

CYCLOPINIDAE.

Genus *Cyclopina* Claus.

24. *Cyclopina intermedia*, sp. nov.
25. *Cyclopina longifurca*, sp. nov.

CYCLOPIDAE.

Genus *Halicyclops* Norman.

26. *Halicyclops magniceps* (Lilljeborg).
27. *Halicyclops tenuispina*, sp. nov.

Genus *Cyclops* Claus.

28. *Cyclops bicolor* Sars.
29. *Cyclops buxtoni* Gurney.

Genus *Mesocyclops* G. O. Sars.

30. *Mesocyclops obsoletus* (Koch).
31. *Mesocyclops oithonoides* Sars.

CYCLOPOIDA—*contd.*

POECILOSTOMA.

CLAUSIDIIDAE.

Genus "*Saphirella*" T. Scott.

32. *Saphirella indica*, sp. nov.

CORYCAEIDAE.

Genus *Corycaeus* Dana.

Sub-genus *Onychocorycaeus* M. Dahl.

33. *Corycaeus* (*Onychocorycaeus*) *giesbrechti* F. Dahl.

ERGASILIDAE.

Genus *Ergasilus* Nordman.

34. *Ergasilus* sp.

ACHIROTA.

LONGIPEDIIDAE.

Genus *Longipedia* Claus.

35. *Longipedia coronata* Claus.
36. *Longipedia rosea* Sars.

Genus *Canuella* T. Scott.

37. *Canuella furcigera* Sars.

ECTINOSOMIDAE.

Genus *Ectinosoma* Boeck.

38. *Ectinosoma melaniceps* Boeck.
39. *Ectinosoma normani* T. and A. Scott.

Genus *Microsetella* Brady and Robertson.

40. *Microsetella norvejica* Boeck.

CHIROGNATHA.

HARPACTICIDAE.

Genus *Harpacticus* M. Edw.

41. *Harpacticus littoralis* Sars.
42. *Harpacticus gracilis* Claus var. *orientalis*, nov.

Genus *Harpacticella* Sars.

43. *Harpacticella lacustris*, sp. nov.

TEGASTIDAE.

Genus *Parategastes* Sars.

44. *Parategastes sphaericus* (Claus) var. *similis*, nov.

Systematic list of the species recorded in the collection—concld.

CYCLOPOIDA—*contd.*

CHIROGNATHA—*contd.*

IDYIDAE.

Genus *Idyaea* Phillipi.

45. *Idyaea furcata* Baird.

46. *Idyaea ensifera* Fischer var. *indica*, nov.

THALESTRIDAE.

Genus *Dactylopusia* Norman.

47. *Dactylopusia brevicornis* (Claus).

DIOSACCIDAE.

Genus *Amphiascus* Sars.

48. *Amphiascus scotti*, nom. nov. [=*Dactylopus propinquus* T. Scott].

Genus *Stenhelia* Boeck.

49. *Stenhelia inopinata* (A. Scott).

CYCLOPOIDA—*concld.*

CANTHOCAMPTIDAE.

Genus *Mesochra* Boeck.

50. *Mesochra nana* Brady.

Genus *Nitocra* Boeck.

51. *Nitocra spinipes* Boeck var. *orientalis*, nov.

52. *Nitocra typica* Boeck var. *lacustris*, nov.

53. *Nitocra yahiai* Blanchard and Richard.

LAOPHONTIDAE.

Genus *Laophonte* Philippi.

54. *Laophonte chathamensis* Sars.

55. *Laophonte quinquespinosa*, sp. nov.

Genus *Cleta* Claus [=*Laophontopsis* Sars].

56. *Cleta secunda*, sp. nov.

TACHIDIIDAE.

Genus *Euterpina* Norman.

57. *Euterpina acutifrons* (Dana).

CALANOIDA.

AMPHASCANDRIA.

Family CALANIDAE.

Genus **PARACALANUS** Boeck.

Paracalanus crassirostris Dahl.

?*Paracalanus pygmaeus*, T. Scott 1893, p. 27, pl. i, figs. 1-8.
Paracalanus crassirostris, Dahl, 1894, p. 21, pl. i, figs. 27-28.
Paracalanus crassirostris, Giesbrecht and Schmeil, 1898, p. 24.
Paracalanus crassirostris, Thompson and A. Scott, 1903, p. 243.
Paracalanus crassirostris, Sewell, 1913, p. 339.

This species appears to be widely distributed in tropical and sub-tropical waters. It has now been recorded from the mouth of the Amazon River, the Gulf of Guinea, the coast of Ceylon and the Chilka Lake, and I have also found it present in the littoral waters of the Nicobar Islands.

In the Chilka Lake collection it is by far the most common species ; out of a total of 68 stations at which tow-nettings were made, 12 contained no Copepoda at all, and in the remaining 56 *Paracalanus crassirostris* was present, often in very large numbers, in 39. As I have already shown, the water of the Chilka Lake varies very considerably in density at different seasons and in different years and the frequency of occurrence of this species shows that it is

capable of existence under widely differing conditions of temperature and salinity. In the Chilka Lake the density of the water in which it was living was found to vary from 1001·93 at 15° C. to 1028·25 at 15° C.

The Chilka Lake examples are on the whole small in comparison with specimens obtained from other localities, but this difference in size appears to be correlated with the density of the water; thus examples from the Nicobars measured 0·5 mm. in length and the density of the water was 1026·25 at 15° C., Dahl's specimens, from the mouth of the Congo river, measured 0·5 mm. and the density of the water varied from 1009·46 to 1010·28 while the average length of the Chilka Lake examples was only 0·43 mm. and the density of the water varied from 1001·93 to 1028·25. Moreover the size of the present examples shows a small though distinct variation at different periods of the year. Thus at Station 8 in the month of February the average length was 0·415 mm.; at Station 65 in March it was 0·428 mm.; in July in a tow-netting taken off Pigeon Island it was 0·468 mm.; and in September at Station 143 B it had dropped again to 0·420 mm. As Annandale and Kemp have shown the density of the water during this period rose steadily from the beginning of the year until July and then, when the monsoon rains set in, it fell rapidly till September.

As is only to be expected in a species that has a wide distribution slight variations are to be found between specimens from different localities, and it is possible that both the form described by T. Scott under the name *Paracalanus pygmaeus* from the Gulf of Guinea and *Paracalanus dubia*, described by me (1912, p. 330, pl. xv, figs. 1-5) from the mouth of the Rangoon River, will eventually have to be incorporated with the above. Giesbrecht and Schmeil consider that T. Scott's form is identical but as it shows certain small though definite differences from the Ceylon and Chilka Lake specimens I prefer for the moment to regard their identity as doubtful.

Genus **ACROCALANUS** Giesbrecht.

Acrocalanus inermis Sewell.

Acrocalanus inermis, Sewell, 1912, pp. 334-336, pl. xvi, figs. 1-9.
Acrocalanus similis, Sewell, 1914, pp. 211-213, pl. xvii, figs. 3-5.

Numerous examples of this species occur in the collection during the month of March.

In my original description, based on specimens obtained from the coast of Upper Burma, I stated that all five segments of the thorax were separate. I was, however, mistaken. This species agrees with other members of the genus in having the first thoracic segment fused with the cephalon, and thoracic segments 4 and 5 fused together, though in most examples the line of demarcation between the segments can be clearly seen running across the dorsal aspect of the body.

This species is of common occurrence throughout the littoral waters of the Bay of Bengal, and I have obtained examples from the Pearl Banks of Ceylon, the coast of Burma and from the Nicobar Islands. In the Chilka Lake collection it was only obtained close to the entrance or in the outer channel, where the water had a density of 1026 and over. It is essentially a marine species. I have quite recently examined numerous examples of this species from a brackish-water lake in Verlatan Island, Malay Archipelago.

HETERARTHRANDRIA.

Family CENTROPAGIDAE.

Genus **ISIAS** Boeck.

Isias tropica, sp. nov.

Plate XLIV fig. 1.

The occurrence in this collection of what appears to be a new species of *Isias* is of considerable interest. Up to the present time this genus has been represented by a single species, *I. clavipes* Boeck, which appears to be restricted in its distribution to the North Atlantic Ocean and its offshoots, the North Sea and the Mediterranean.

♀. Total length 1·26 mm.

The proportional lengths of the cephalothorax and abdomen are 47 : 21. The head and first thoracic segment are separate : thoracic segments 4 and 5 are partially fused together but the line of demarcation between them can be detected. The posterior thoracic margin is rounded.

The abdomen consists of three segments, having with the furcal rami the following proportional lengths ; 50 : 21 : 29 : 38. The genital aperture is situated on a moderate projection on the ventral aspect of the 1st abdominal segment, and is protected laterally by a curved plate, the margins of which are armed with three small backwardly directed spines. The posterior margins of all the abdominal segments are smooth and devoid of spines. The furcal rami are three and-a-half times as long as broad, and bear five apical setae, the second of which is the longest. The dorsal seta is short and spine-like. On the external margin, proximal to the point of origin of the fifth apical seta, the furca is armed with a transverse row of small needle-like spines.

The 1st antennae reach back to the 2nd abdominal segment. Each consists of twenty-two joints, segments 8 and 9, 11 and 12, and 24 and 25 being respectively fused together. The various joints have the following proportional lengths :

Segments	1	2	3	4	5	6	7	8-9	10	11-12	13	14	15	16	17	18	19	20	21	22	23	24-25
	34	20	8	7	9	9	9	20	10	26	22	22	26	28	28	32	32	24	24	24	28	30

The first segment is armed with a long curved spine that projects as far as the distal margin of the second segment.

The 2nd antennae, mouth-parts and swimming legs resemble those of *Isias clavipes* Boeck.

Of the 5th pair of legs each consists of a two-jointed exopod and a rudimentary endopod that is fused with the 2nd basal segment. The first joint of the exopod consists of two segments (exopod 1 and 2) that are fused together and on its inner margin distally, from that part of the joint that corresponds to exopod 2, arises a stout, slightly-curved spine that is finely serrated along both margins. The terminal joint of the exopod bears two marginal spines and an end-spine, and four delicate setae spring from its inner border. The endopod forms a conical projection that terminates in a single seta.

The structure of the 5th pair of legs at once serves to separate this form from the only other species in the genus *I. clavipes*. In the Atlantic species this leg in the adult possesses an exopod in which all three segments are separate and the endopod is also articulated and not fused with the basal segment. Canu (1888, p. 236, pl. xviii, figs. 2 and 4) has pointed out that in the young immature stage of *I. clavipes* the exopod of the 5th leg consists of only two separate joints, but in this case it is segments 2 and 3 that have not yet separated, whereas in the present form, as I have pointed out above, it is the proximal two segments that are fused.

♂. The cephalothorax resembles that of the female.

The abdomen consists of five segments and the furcal rami, which have the following proportional lengths :—

Abdomen	1	2	3	4	5	Furca.
	23	30	26	20	20	26

This species differs from *Isias clavipes* in having no projecting process on the right side of the 3rd abdominal segment, but there is a small round projection crowned with small spines on the right side of the 2nd segment.

The 1st antennae are asymmetrical, that on the right side being modified to form a grasping organ.

The left antenna resembles that of the female, and consists of 22 separate joints, having the following proportional lengths :—

Segements	1	2	3	4	5	6	7	8-9	10	11-12	13	14	15	16	17	18	19	20	21	22	23	24-25
	18	15	6	4	6	6	7	14	8	18	16	17	18	21	21	23	23	17	16	14	18	16

As in the female, the first segment bears a curved spine on its anterior aspect.

The right antenna forms a grasping organ, and the knee-joint is situated between segments 18 and 19. Segments 7 and 8 are fused together and distal to the knee-joint are three separate joints consisting respectively of segments 19-21, 22-23 and 24-25. The various joints of the antenna have the following proportional lengths :—

Segments	1	2	3	4	5	6	7-8	9	10	11	12	13	14	15	16	17	18	19-21	22-23	24-25
	19	17	8	7	7	8	11	7	8	8	7	12	18	22	25	19	36	53	40	13

According to Giesbrecht (1892, p. 327) in *Isias clavipes* the portion of the grasping antenna beyond the knee-joint is equal to the combined lengths of segments 15-18 and the same holds good for the present species. Segments 13 to 17 are expanded and swollen and segments 15 and 16 each bear a slender spine on the anterior border near the middle of their length : segment 16 also bears near its distal end a sickle-shaped spine that is furnished on its posterior border with a row of fine needle-like spines ; this spine extends distally as far as the articulation between segments 17 and 18. Segment 17 bears a marginal row of delicate needle-like spines. Segment 18 is provided with a tooth-plate that extends along the proximal three-fourths of its length and terminates distally in an upcurved projection. Segment 19 bears a tooth plate that is armed in its proximal half with needle-like spines but is quite smooth distally.

The mouth-parts and swimming legs closely resemble those of *Isias clavipes*.

The 5th pair of legs are asymmetrical. In each the exopod consists of two-segments and the endopod is fused with the 2nd basal joint, forming a projecting process. On the right side, the 2nd basal joint bears a small spine near its distal external angle and the conical process on its inner margin, which I take to be the rudiment of the endopod, terminates in a single small seta. The 1st joint of the exopod bears a single marginal spine, and the 2nd joint bears three marginal spines and an end-spine, and its distal end is somewhat expanded. On the left side, the 2nd basal joint is produced internally to a rounded point which bears two recurved claws, and distally its inner margin is produced in an elongate process that represents the endopod. The exopod is two-jointed; the proximal joint bears a single marginal spine, and the distal joint is elongate and slender and bears on its outer margin four setae, of which the distal pair are the longer; its apex is bilobed.

Examples of *Isias tropica* were taken at three different stations, *viz.*, stations E, 15 and 48, and in each case it was associated with a distinctly marine type of fauna. The period of the year during which it occurs in the collection is from February to April and in consequence it appears probable that the species is, like *Isias clavipes*, an inhabitant of the littoral zone and was bought in to the lake by the inflowing sea-water; if this be so, further research should reveal its presence along the coasts of the Bay of Bengal.

Family DIAPTOMIDAE.

Genus **PSEUDODIAPTOMUS** Herrick.

This genus is one of the most characteristic inhabitants of the estuarine waters of tropical and sub-tropical rivers. It is therefore not surprising that it is represented by several species in the Chilka Lake, which at its northern end is connected with the Mahanaddi River.

No less than six species are present, namely, *Pseudodiaptomus serricaudatus* (T. Scott), *P. hickmani* Sewell, *P. binghami* Sewell, *P. lobipes* Gurney, *P. annandalei* Sewell and *P. tollingeri* Sewell. Up to the present time these last two species are known only from this locality.

The species of this genus appear to fall into two groups, characterised by the relative length of the terminal spine on the 5th leg of the female :—

In group 1 these spines are all of approximately equal length and are, in comparison with the length of the leg itself, short. In the present collection examples of this group are *Pseudodiaptomus serricaudatus* (T. Scott) and *P. hickmani* Sewell: with these we must include *Pseudodiaptomus salinus* Giesbrecht (1896, p. 322, pl. vi, figs. 23-28), *P. stuhlmanni* (Poppe and Mrázek, 1895, p. 125, pl. i, figs. 1-9) and *P. clevei* A. Scott (1909, p. 116, pl. xxxvii, figs. 1-8). All these species seem to have a distinct tendency towards a purely marine habitat.

In group 2 we find that one of the spines on the terminal segment of the 5th leg is much longer than the others and is nearly equal in length to the whole limb. In this group are *Pseudodiaptomus lobipes* Gurney, *P. binghami* Sewell, *P. annandalei* Sewell, and *P. tollingeri* Sewell from the Chilka Lake, and with these we must group *Pseudodiaptomus richardi*, *P. acuta* and *P. gracilis*, described by

Dahl (1894) from the estuarine waters of the Amazon River, *P. forbesi* (Poppe and Richard, 1889, p. 396, pl. x) from fresh water of the Whangpoo River and from Lake Sitai and the neighbouring sea, and *P. aurivilii* Cleve (1901, p. 48, pl. vi, fig. 11-22 and pl. vii, fig. 1-2) from the Malay Archipelago. In the majority of the members of this group the habitat tends to be brackish or even fresh water though the last-named species appears to be an exception.[1]

Poppe and Mrázek (1894, p. 126) have called attention to an interesting modification that is present in the outer seta of the third last segment of the 1st antennae of the female and the unmodified antenna of the male in *Pseudodiaptomus serricaudatus*, *P. stuhlmanni* and *P. hessei* and Mrázek (1901, p. 14) has found the same in *P. richardi*. In all these examples the seta is considerably thickened and elongated and bears along the middle of its length a number of fine teeth forming a comb. I have found this modification to be present in *Pseudodiaptomus hickmani*, but in *P. annandalei*, *P. binghami* and *P. lobipes* I have been unable to detect any such structure.

Williams (1906, p. 641, figs. 1-7) has described a species *Pseudodiaptomus coronatus* from both salt and brackish water in Narragansett Bay, U. S. A. This form exhibits several points of difference from other members of the genus both as regards the segments of the 1st antenna and in the segmentation of the body. It would seem probable that it should be referred to a separate genus.

Pseudodiaptomus serricaudatus (T. Scott.)

Heterocalanus serricaudatus, T. Scott, 1894, p. 39, pl. ii, figs. 43-48 and pl. iii, figs. 1-7.
Schmackeria serricaudatus, Poppe and Mrázek, 1895, p. 127.
Pseudodiaptomus serricaudatus, Giesbrecht and Schmeil, 1896, p. 66.
Pseudodiaptomus serricaudatus, A. Scott, 1902, p. 404, pl. i, fig. 6.
Pseudodiaptomus serricaudatus, Cleve, 1903, p. 368.
Pseudodiaptomus serricaudatus, Thompson and A. Scott, 1903, p. 248.
Pseudodiaptomus serricaudatus, Cleve, 1904, p. 196.
Pseudodiaptomus serricaudatus, Tollinger, 1911, p. 177.
Pseudodiaptomus serricaudatus, Sewell, 1914, p. 226.

This species, which was first described by T. Scott from the Gulf of Guinea and the West Coast of Africa, has now been recorded from South Africa, the Gulf of Suez, the West Coast of India and the Pearl banks of Ceylon, and its occurrence in this collection increases its known range eastward to the Bay of Bengal.

T. Scott remarks that this species " seems capable of existing under varied conditions as regards the density of the water, having been obtained in water varying in specific gravity from 1·02511 to 1·00870." Its occurrence in the Gulf of Suez, on the Pearl banks of Ceylon and around Cape Colony seems to indicate that it is on the whole a marine rather than a brackish-water form.

[1] I have unfortunately been unable to refer to the original description of *Pseudodiaptomus hessei* (Mrázek) but, judging from the short description given by Giesbrecht and Schmeil (1898, p. 65), it would appear to belong to group 2. Its habitat in the Congo estuary would agree with this.

T. Scott (1894) in his original description states that the right antenna of the male resembles that of the Pontellidae and he figures it as consisting of four separate segments. Giesbrecht and Schmeil (1896) also describe the terminal portion, distal to the knee-joint, as consisting of four segments, but in the specimen from the Chilka Lake the terminal three joints, consisting of segments 22 to 25, were fused into one, so that the end portion of the antenna consisted of only two joints as in other members of the genus.

A single specimen (♂) was obtained at station 91 in the month of March : the density of the water in which it was living was 1·02825, and the locality was near the entrance channel. It had undoubtedly been swept into the lake by inflowing currents.

Pseudodiaptomus hickmani Sewell.

Pseudodiaptomus hickmani, Sewell, 1912, p. 364, pl. xxii, figs. 1-7.

Numerous examples of this species were present in the collection at stations A, B, G 48, 106, 133, 136, 165 and 166, and during the months of March, September, and November many of the females were bearing egg-sacs. These specimens were on the whole slightly smaller than those obtained by me from the coast of Burma, measuring in length only 1·26 mm. as compared with 1·37 mm.

Like *Pseudodiaptomus serricaudatus* (T. Scott), *P. hessei* Mrázek and *P. stuhlmani* Poppe and Mrázek, the present species possesses a comb-like modified seta on the third last joint of the antenna.

Pseudodiaptomus lobipes Gurney.

(Plate XLV, fig. 1.)

Pseudodiaptomus lobipes, Gurney, 1907, p. 27, pl. i, figs. 3-5.
Pseudodiaptomus lobipes, Tollinger, 1911, p. 178.

This species was described by Gurney from specimens obtained from tanks in Calcutta. Numerous examples of both sexes were obtained at stations 133 and 137 in September, when the density of the water in the lake was at its lowest : at the former station some of the females were bearing egg-sacs.

It seems highly probable that these specimens had been brought into the lake by the flood waters of the Mahanaddi River.

Pseudodiaptomus binghami Sewell.

(Plate XLV, fig. 2.)

Pseudodiaptomus binghami, Sewell, 1912, pp. 337-8, pl. xvii, figs. 8-11.
Pseudodiaptomus binghami, Sewell, 1919. pp. 7-9.

This species was first described by me from a single specimen (♀) obtained from the Rangoon River estuary. Numerous examples of both sexes occur in the present collection at stations C, 75, 134 and 137 ; among those obtained at the first of these stations in the month of December were several ovigerous females.

Pseudodiaptomus binghami and *P. lobipes* are very closely related to each other, and, as regards the males, the resemblance is so close that the greatest care has to be exercised in determining the specific identity.

♀. The females agree very closely both in bodily shape and in size, but *P. binghami* can always be recognised at once by the presence of a dilated middle seta (seta 3) on the distal border of the furcal ramus.

The 1st antennae show considerable agreement in the proportional lengths of the various segments, and I give below measurements from these two species for the purpose of comparison :—

Segments	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
P. binghami	78	30	19	28	28	39	22	22	28	39	48	50	59	62	64	62	53	56	59	67	78
P. lobipes	84	40	16	28	28	36	24	24	32	40	48	52	60	60	64	64	56	60	60	68	80

The 5th pair of legs show a distinct difference. In *P. binghami* the proximal joint of the exopod is produced at the distal end of its inner border in a small spinous process : in *P. lobipes* on the other hand at this point the joint bears a flat oval lamella that is *hinged* to the segment.

♂. The resemblance between the males of these two species is even closer.

The proportional lengths of the joints of the grasping antenna are as follows :—

Segments.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20-21
P. binghami	82	55	20	17	17	19	20	31		27	21	21	31	62	68	75	62	103	103	171
P. lobipes	80	55	20	15	20	15	18	37		35	25	25	30	70	70	75	60	95	90	185

There is a slight difference in the size of the teeth on the proximal part of the tooth-plate on segment 19 : in *Pseudodiaptomus binghami* these are straight and needle-like, whereas in *P. lobipes* they are curved and claw-like.

The 5th pair of legs are also very similar in these species : almost the only points of difference being (1) that in *Pseudodiaptomus binghami* the terminal joint of the right leg is broadly oval, whereas in *P. lobipes* it is long and narrow, and (2) the middle joint of the exopod of the left leg is oval and bears a small rounded projection on its inner margin in *P. binghami*, whereas in *P. lobipes* it is pyriform in shape.

In neither species does the male show any differentiation of the middle furcal seta.

Pseudodiaptomus annandalei Sewell.

(Plate XLIV, fig. 2.)

Pseudodiaptomus annandalei, Sewell, 1919, pp. 5-7, pl. x, fig. 9.

This species was present in comparatively large numbers at stations B, C, K, 75, 126, 133, 139, 165, 166.

I have already (*loc. cit.*) published a description of this species but I take this opportunity of figuring the whole animal and certain of its appendages.

Several females obtained during the months of March, September and November were ovigerous.

Pseudodiaptomus tollingeri Sewell.

(Plate XLV, fig. 3.)

Pseudodiaptomus tollingeri, Sewell, 1919, pp. 2-5, pl. x, fig. 8.

Examples of this species were obtained at stations K and 128. I have also obtained examples from Port Canning, Lower Bengal.

Genus **DIAPTOMUS** Westwood.

The genus *Diaptomus* is essentially a freshwater one, and it is interesting to note that all the species found in the Chilka Lake were collected at two stations only, **133** and **137**. The time of year when these particular tow-nettings were taken was the month of September when the density of the water in the lake is at its lowest. It is clear that all the specimens had been carried in by the monsoon floods. All five of the species present have already been recorded from Chakradharpur by Gurney (1907) and *Diaptomus blanci* de Guerne and Richard appears to be widely distributed throughout Central Asia.

Diaptomus blanci de Guerne and Richard.

Diaptomus blanci, de Guerne and Richard, 1896, pp. 53-56, 5 text-figures.
Diaptomus blanci, Giesbrecht and Schmeil, 1898, p. 87.
Diaptomus blanci, v. Douwe, 1905, p. 687.
Diaptomus blanci, Gurney, 1907, p. 29.
Diaptomus blanci, Tollinger, 1911, p. 112.
Diaptomus blanci, Gurney, 1921 (*a*), p. 841.

This species is widely distributed throughout Central Asia and has been recorded from Turkestan, Mesopotamia and India. A few examples were obtained at stations **133** and **137**.

Diaptomus cinctus Gurney.

(Plate XLV, fig. 4.)

Diaptomus cinctus, Gurney, 1907, p. 29, p. i, figs. 11, 12.
Diaptomus cinctus, Tollinger, 1911, p. 109.

Several examples were taken at station **137**. Gurney's original description of this species is very brief and he gives no figures of the male. I therefore take this opportunity of illustrating the grasping antenna and the fifth pair of legs.

Diaptomus contortus Gurney.

(Plate XLV, fig. 5.)

Diaptomus contortus, Gurney, 1907, p. 28, figs. 9, 10.
Diaptomus contortus, Tollinger, 1911, p. 110.

Examples of both sexes were obtained at station **137**. As Gurney gives no figure of the male or its appendages, I take this opportunity of figuring the grasping antenna and 5th pair of legs in this sex.

Diaptomus pulcher Gurney.

Diaptomus pulcher, Gurney, 1907, pp. 29, 30, figs. 13-17.
Diaptomus pulcher, Tollinger, 1911, p. 47.

Examples were obtained at station **137**.

Diaptomus strigilipes Gurney.

Diaptomus strigilipes, Gurney, 1907, p. 30, figs. 18-20.
Diaptomus strigilipes, Tollinger, 1911, p. 111.

A few examples were obtained at station **137**.

Family PONTELLIDAE.

Genus **LABIDOCERA** Lubbock.

Labidocera pavo Giesbrecht.

Labidocera pavo, Giesbrecht, 1889, p. 27.
Labidocera pavo, Giesbrecht, 1892, p. 282.
Labidocera pavo, Giesbrecht, 1893, p. 446, pl. xxv, fig. 34, and pl. xli, figs. 18 and 38.
Labidocera pavo, Cleve, 1901, p. 7.
Labidocera pavo, Thompson and A. Scott, 1903, p. 251.
Labidocera pavo, Cleve, 1903, p. 364.
Labidocera pavo, Giesbrecht and Schmeil, 1898, p. 138.
Labidocera pavo, Sewell, 1914, pp. 234-236, pl. xxi, figs. 1-3.

Numerous examples were obtained during the months of January to April, July and September at stations D, E, F, G, H, I, 15, 92, 100, 101, 142. In some of the tow-nettings in February and April large numbers of immature forms were present and it appears certain that this species, which hitherto has only been recorded from true marine areas, namely, the African Coast, Red Sea, Ceylon Pearl Banks, and Malay Archipelago, was not only living in, but was actually breeding in the brackish water of the lake.

The total length of mature individuals of both sexes is considerably less than in examples taken in the open sea; probably this decrease in size is correlated with the lower density of the water.

Family ACARTIIDAE.

Genus **ACARTIA** Dana.

Acartia spinicauda Giesbrecht.

Acartia spinicauda, Giesbrecht, 1889, p. 25.
Acartia spinicauda, Giesbrecht, 1893, p. 508, pl. xxx, figs. 16, 21, and 35 and pl. xli i, figs. 4 and 11.
Acartia spinicauda, Cleve, 1901, p. 4.
Acartia spinicauda, Cleve, 1903, p. 355
Acartia spinicauda, Carl, 1907, p. 17.
Acartia spinicauda, Giesbrecht and Schmeil, 1908, p. 155.
Acartia spinicauda, A. Scott, 1909, p. 188.
Acartia spinicauda, Sewell, 1912, pp. 315 and 377.
Acartia spinicauda, Sewell, 1914, p. 241.

As the above list of references shows this species is widely distributed and has now been recorded from the Pacific Ocean, the Malay Archipelago, the Burma Coast, the Pearl Banks of Ceylon and the Arabian Sea. It is therefore not surprising that a few examples should be found in the present collection. Examples were obtained at stations 8, 53 and 100.

Acartia centrura Giesbrecht.

Acartia centrura, Giesbrecht, 1889, p. 25.
Acartia centrura Giesbrecht, 1889, p. 282.
Acartia centrura, Giesbrecht, 1893, p. 508, pl. xxx, figs. 26 and 31 and pl. xliii figs. 9 and 16.
Acartia centrura, Giesbrecht and Schmeil, 1898, p. 155.
Acartia centrura, Thompson and A. Scott, 1903, p. 254.
Acartia centrura, v. Breemen, 1908, p. 159, figs. 177.
Acartia centrura, Sewell, 1913, p. 340.
Acartia centrura, Sewell, 1914, p. 240.

This species is also one of wide distribution and has now been recorded from the Atlantic Ocean, the Red Sea, and the Pearl Banks of Ceylon. Its occurrence in the present collection carries its range eastward into the Bay of Bengal.

Specimens were obtained at stations 84, 92 and 101.

As I have previously pointed out (1913, p. 340) examples from the Chilka Lake are smaller than those taken at sea. Giesbrecht gives the length of examples from the Red Sea as ♀ 1·20—1·24 mm. and ♂ 1·03 mm. Examples from the Chilka Lake measured ♀ 1·13 and ♂ 1·028 mm. Associated with this decrease in size which is doubtless correlated with the lowered salinity of the water, there is a marked reduction in the size of the spines on the posterior thoracic margin and on the posterior borders of the abdominal segments.

Acartia southwelli Sewell.

(Plate XLV, fig. 6.)

Acartia southwelli, Sewell, 1914, pp. 244-245, pl. xix, figs. 8-9.

This species was originally described by me from specimens obtained on the Pearl Banks of Ceylon, and numerous examples occur in the Chilka Lake collection at stations D, F, I, M, 2, 8, 15, 34, 53, 90, 92, 142, 143-B, 145 and 148. During the month of March it was found near the outer channel or at the entrance to the lake, where the water is salt; during the remainder of the year its area of distribution is limited to the south end of the lake, where the water never under normal conditions becomes fresh, and at the time the collections were made had a density of about 1·006. This species appears to possess a very considerable power of adaptation and correlated with the alteration of density of the water in which it was living is a change in size, for specimens taken from the lake measure in length 0·726 mm. (♀) and 0·712 mm. (♂), whereas examples from Ceylon measured 0·80 mm. (♀) and 0·75 mm. (♂). Other examples of the same species have been obtained from Cochin Harbour on the West Coast of India.

Acartia southwelli is very closely related to, though apparently quite distinct from, *Acartia ensifera* Brady, *Acartia bifilosa* Giesbrecht, *Acartia denticornis* Brady, *Acartia plumosa* T. Scott and *Acartia simplex* G. O. Sars.

Acartia chilkaensis Sewell.

Acartia chilkaensis, Sewell, 1919, pp. 9-10, pl. ix, figs. 1-5.

This species was particularly well represented in the collection and examples were obtained at stations B, 103, 108, 126, 133, 136, 139, 140, 152, 157, 164, 165 and 166. Its

distribution in the lake is peculiarly interesting in that it seems to be confined entirely to fresh water. It first occurred in the collection in September and from then on to December it is obtained throughout the northern end. It appears never to penetrate to the southern end of the lake where the water is brackish, but during September examples are swept out with the outflowing current and occur in the outer channel. One can only conclude that it is a true fresh-water form.

Genus **ACARTIELLA** Sewell.

Acartiella major Sewell.

(Plate XLVI, fig. 1.)

Acartiella major, Sewell, 1919, pp. 13-15, pl. ix, fig. 8 and pl. x, figs. 2, 3 and 6.

Examples of this species were obtained at stations B, M, 103, 106, 108, 126, 136, 139, 142, 145, 148, 152, 157, 164, 165 and 166. The species appears to be widely distributed throughout the lake during the months of September—December, and is found in both fresh and brackish water. At several stations during the months of September and November many of the females were bearing spermatophores attached to the ventral aspect of the genital segment: it seems clear that the species breeds in the lake.

Acartiella minor Sewell.

(Plate XLVI, fig. 2.)

Acartiella minor, Sewell, 1919, pp. 15-17, pl. ix, fig. 6 and pl. x, fig. 7.

Examples were obtained at stations B, 101, 103, 126, 136, 137, 152, 157, 165 and 166. The distribution of this species in the lake is the same as that of *Acartiella major* and as a rule they were obtained together.

CYCLOPOIDA.

GNATHOSTOMA.

Family OITHONIDAE.

Genus **OITHONA** Baird.

Oithona nana Giesbrecht.

Oithona helgolandica, Claus, 1863, p. 105, pl. xi, figs. 11-13.
Oithona nana, Giesbrecht, 1893, p. 538, pl. iv, fig. 8, pl. xxxiv, figs. 10, 11, 20, 24-26, 34, 35 and 42, and pl. xliv, figs. 2, 4 and 6.
Oithona nana, Cleve, 1901, p. 7.
Oithona nana, Thompson and A. Scott, 1903, p. 255.
Oithona nana, Cleve, 1904, p. 192.
Oithona nana, Cleve, 1905, p. 192.
Oithona nana, Esterly, 1905, p. 209.
Oithona nana, Norman and Scott, 1906, p. 185.
Oithona nana, Wolfenden, 1906, p. 1023.

Oithona nana, v. Breemen, 1908, p. 170, fig. 186.
Oithona nana, Steuer, 1910 (*a*), p. 7.
Oithona nana, Steuer, 1910 (*b*), p. 28.
Oithona nana, Farran, 1913, p. 186.
Oithona nana, Rosendorn, 1917, p. 40, 4 text-figures.
Oithona nana, Früchtl, 1920, p. 29.

This species is widely distributed throughout the world.

Numerous examples were obtained at stations M, 65, 78, 84, 90, 92, 142, 143 B, 145, 148, 152, 164, 165 and 166. During March it is found in or near the entrance to the lake and in the later months of the year, September and November, it still can be found persisting at the southern brackish end of the lake.

Oithona brevicornis Giesbrecht.

(Plate XLVI, fig. 3.)

Oithona brevicornis, Giesbrecht, 1893, p. 546, pl. xxxiv, figs. 6, 7.
Oithona brevicornis, Cleve, 1901, p. 7.
Oithona brevicornis, Cleve. 1903, p. 365.
Oithona brevicornis, Rosendorn, 1917, p. 34, 7 text-figures.

This species appears to be widely distributed and has now been recorded from the Pacific Ocean, the Malay Archipelago, the Arabian Sea, and the South Atlantic Ocean. I have also examined specimens from a brackish-water lake in Verlaten Island in the Sunda Straits.

Numerous examples occurred in this collection at stations D, I, 2, 8, 15, 34, 53, 61, 62, 65, 78, 94, 100, 101, 142 and 145. As is the case with the preceding species, this form occurs in the outer channel in March, when a strong inflowing current of sea-water is pouring into the lake, and for the rest of the year it appears to be confined to the brackish water at the southern end.

Family CYCLOPINIDAE.

Genus **CYCLOPINA.**

Cyclopina intermedia, sp. nov.

(Plate XLVII, fig. 1.)

♀. Total length 0·51 mm.

The proportional lengths of the anterior and posterior regions of the body are 22 : 15.

The head and first thoracic segment are separate : the forehead is broadly rounded.

The body is oval in shape, and its greatest width is about the middle of its length.

The abdomen tapers slightly towards the posterior end ; it consists of four segments of which the first is equal in length to the combined lengths of the three following segments. The anterior region of the genital segment shows several grooves, giving one the impression that it consists of several segments which have become fused. The furcal rami are slightly divergent : they are equal in length to the anal segment and bear four distal setae, of which the second and third are the longest, and the 5th seta arises from the external border about

one-third of the length of the joint from the distal end. The proportional lengths of the abdominal segments and furcal rami are as follows :—

Abdomen	1	2	3	4	Furca.
	25	9	6	10	10×5

The first antennae reach back nearly to the posterior margin of the cephalon. Each is composed of fifteen joints having the following proportional lengths :—

Segments	1	2 3	4 5 6 7	8	9 10 11 12	13 14	15 16 17 18	19	20	21	22	23	24 25
	20	14	18	3	5 18	13	6 25	8	8	9	8	8	10

The second antenna consists of a single branch of four segments, of which the third is the shortest.

The mouth-parts closely resemble those of other members of the genus.

The first swimming leg is of the usual type. The exopod and endopod are each composed of three segments and the exopod is considerably the longer of the two. The distal segment of the exopod is larger than the two preceding segments and is nearly circular in outline.

The fifth pair of legs closely resembles the corresponding appendage in the genus *Euryte*. It consists of a basal portion of two segments and a terminal joint, that is approximately three times as long as broad. The second basal joint bears a single marginal seta. The distal segment bears three spines, as in *Cyclopina euacantha* Sars. One of these arises from the external margin a little beyond the middle of its length ; the other two arise from the distal border and between them arises a delicate seta ; the inner spine is the larger and stouter of the two. The inner border of the segment bears numerous short spinules throughout its distal two-thirds.

Several examples were ovigerous, bearing two small ovisacs each containing 3-4 ova.

♂. Total length 04·0 mm.

The proportional lengths of anterior and posterior regions of the body are 17 : 12.

The abdomen consists of five segments, having with the furcal rami the following proportional lengths :—

Abdomen	1	2	3	4	5	Furca.
	23	18	10	8	14	13

The genital segment is dilated and its posterior ventral border is slightly produced and is armed with three setae.

The first antenna is modified to form a grasping organ on each side of the middle line. It appears to consist of fifteen segments. The middle portion of the appendage is slightly swollen and the terminal part beyond the knee-joint consists of two imperfectly-divided segments.

The second antennae, mouth parts and the first four pairs of swimming feet resemble the corresponding appendages in the female.

The fifth pair of legs are, however, somewhat different. In general form they resemble those of the female, but the spine arising from the outer margin is smaller, and the inner distal spine is longer and more slender.

Examples of this species were obtained at stations B, 133 and 166.

Cyclopina longifurca,[1] sp. nov.

(Plate XLVII, fig. 2.)

♀. Total length 0·59 mm.

The proportional lengths of cephalothorax and abdomen are 25 : 19.

The body is robust and in general appearance closely resembles the preceding species. The posterior region of the body is slightly tapered.

The abdomen consists of four segments having with the furcal rami the following proportional lengths :—

Abdomen	1	2	3	4	Furca.
	29	11	7	15	19×5

In this form the furcal rami are distinctly longer than the preceding anal segment and are nearly four times as long as broad. The furcal setae are similar to those of *Cyclopina intermedia* but the marginal seta appears to arise nearer to the middle of the length of the ramus.

The first antenna consists of fifteen joints, having the following proportional lengths :—

Segments	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
	20	11		16				3	4		12			11	6		21		8	7	9	6	6	9	

The first antenna reaches back to the posterior margin of the cephalic region.

The second antenna consists of four joints, of which the two terminal ones are equal in length. The basal joint is by far the longest and bears a row of minute spinules on its posterior margin.

The mouth-parts and first four pairs of swimming legs agree closely with the corresponding appendages in *Cyclopina intermedia.*

The fifth pair of swimming legs consist of a basal portion that bears a single external seta and a single free segment, that is short and broad. This distal joint bears on its outer margin a single stout spine and on its distal border a pair of spines with an intervening seta between them. Of these two spines the outer is much the larger. The inner border of the segment is armed with a few small spinules.

Several ovigerous females were found, each carrying a pair of ovisacs. Each egg-sac contained 11-12 ova. No males corresponding to this form were identified.

These examples were obtained at stations C and 128.

At first sight these two species of *Cyclopina* are liable to be confused with each other. Although *Cyclopina longifurca* is slightly the larger, the difference is so small as to be no guide to their separation; and in the general shape of the body, the proportions of the various parts and the length and segmentation of the first antennae the two species are identical.

A careful examination shows, however, that there are certain definite differences, which I give below :—

(1) The second antenna in *Cyclopina intermedia* has the distal two segments of unequal length, the third joint being much shorter than the distal one, whereas in *C. longifurca* the two joints are equal.

---

[1]This name was given, and printed on the plate, before Sars's reference to a "*Cyclopina longifurca*" (*Crust. Norway*, Vol. VI, p. 11) was noticed. The latter is a mere *nomen nudum* and was, moreover, applied to specimens which have been lost; I have thought it best to leave my own name as it was printed on the plate. Less confusion will probably be caused by this course than by changing the name now. It is impossible to say whether my specimens belong to the same species as that named, but not described by Sars, and in any case his name has no valency.

(2) In the fifth pair of legs in *C. intermedia* the free segment is long and narrow, and of the three spines the inner distal one is the largest; in *C. longifurca* the segment is short and broad and the outer distal spine is the largest.

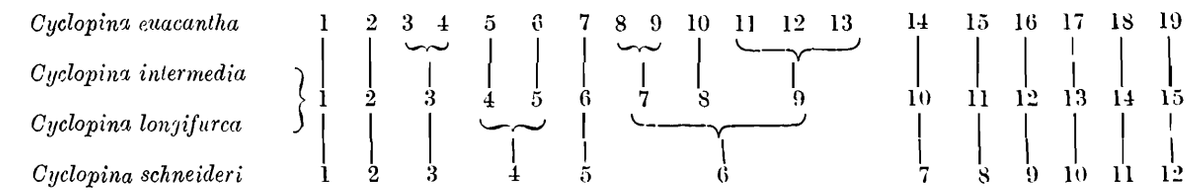
(3) The furcal rami in *C. intermedia* are as long as the anal segment of the abdomen and are only $2\frac{1}{2}$ times as long as wide; whereas in *C. longifurca* the furcal rami are longer than the anal segment and are nearly four times as long as wide.

Including the two species described above the genus *Cyclopina* now comprises eleven species and its distribution ranges all over the world.

These different species exhibit *inter se* very considerable differences in structure, both as regard the segmentation of the first antenna and the character of the fifth leg in the female. In the closely-related genus *Cyclops*, using the term in its widest sense, the number of segments present in the first antenna differs considerably in different groups of species, and exhibits a tendency to decrease owing to fusion. The members of the genus *Cyclopina* show an exactly similar tendency, as is illustrated below :—

Species.	Number of antennal segments.
Cyclopina longicaudata T. Scott	26
Cyclopina elegans T. Scott	20
Cyclopina euacantha Sars	19
Cyclopina longicornis Boeck	18
Cyclopina belgica Giesbrecht	17
Cyclopina pusilla Sars	
Cyclopina intermedia, sp. nov.	15
Cyclopina longifurca, sp. nov.	
Cyclopina schneideri T. Scott	12
Cyclopina gracilis Claus	10
Cyclopina pygmaea Sars	

The two Indian species have only fifteen joints in the antenna and the arrangement and mode of fusion of the segments appears to place these species in close relationship to and intermediate between *Cyclopina euacantha* Sars and *C. schneideri* T. Scott. In the table below I give the various antennal joints in these species and indicate the manner in which fusion has taken place :—



As regards the structure of the 5th pair of legs in the female the Indian species agree closely with *Cyclopina euacantha* Sars.

It is interesting to note that the two nearest allies of the Indian forms are species that are found in North Temperate and Arctic regions.

Family CYCLOPIDAE.

Genus **HALICYCLOPS.**

Halicyclops magniceps (Lilljeborg).

Cyclops aequoreus, Fischer, 1860, p. 654, pl. xx, figs. 26-29.
Cyclops aequoreus, Brady and Robertson, 1873, p. 127.
Cyclops aequoreus, Brady, 1878, pp. 119-20, pl. xix, figs. 8-10.
Cyclops aequoreus, Thomson, 1883, pp. 97-98, pl. xi, figs. 16-18.
Cyclops aequoreus, Blanchard and Richard, 1891, p. 515.
Cyclops aequoreus, Lilljeborg, 1902, p. 102, pl. vi, figs. 17-19.
Halicyclops aequoreus, Norman and Scott, 1906, p. 191.
Cyclops aequoreus, Marsh, 1910, p. 1106.
Halicyclops magniceps. Sars, 1913-18, pp. 29-30, pl. xv.

This species has now been recorded from Europe, North America, Algeria, Madeira and New Zealand.

Examples occurred at Stations B, 34, 92, and 128. These agree closely with the description and figures given by previous authors.

Halicyclops tenuispina, sp. nov.

(Plate XLVII, fig. 3.)

Two examples of what appears to be a new species of *Halicyclops* was obtained in the lake. Originally the genus included only a single species *Halicyclops magniceps* Lilljeborg [=*Cyclops aequoreus* Fischer] but G. O. Sars (1905, p. 395, pl. xviii, figs. 135-149) has described a second species, *H. propinquus*, from Chatham Island in the Pacific.

The present specimens, while agreeing with the generic characters, yet show certain points of difference from both these forms and I therefore conclude that they represent a third and hitherto unknown species.

♀ Total length, 0·69 mm.

The proportional lengths of anterior and posterior regions of the body are 34 : 18.

The body is moderately stout. The anterior region is oval, with its greatest width about the middle of its length. The abdomen is slightly tapered and consists of four segments. The proportional lengths of the various segments are as follows :—

Abdomen	1	2	3	4	Furca.
	40	12	10	8	9

The genital segment is produced on eitherside about the middle of its length in a short process. The furcal rami are about $1\frac{1}{2}$ times as long as wide. A marginal seta arises from the outer border about the middle of the furcal length : from the distal border four setae arise, of which the inner and outer are small ; the 2nd seta is plumose, and is equal in length to the whole abdomen. A small seta arises from the dorsal aspect of the furca.

The first antenna is short and reaches back to about two-thirds the length of the cephalic segment : it consists of six segments that have the following proportional lengths :—

Segment	1	2	3	4	5	6
	15	8	7	20	11	14

The 2nd antenna consists of three segments, of which the terminal is twice as long as the preceding one.

The mandible I was unfortunately unable to examine.

The 1st maxilla consists of a toothplate bearing 3 (? 4) stout teeth and bears a small palp as in the other members of the genus.

The 2nd maxilla is stout, with a swollen basal segment and a distal portion composed of two smaller segments, the proximal of which bears a stout curved spine.

The maxilliped consists of two joints as in *Halicyclops magniceps*.

The swimming legs each consist of a two-jointed basal portion and three-jointed exopod and endopod of approximately equal length. In all the appendages the marginal spines of the exopod are club-shaped, but in other respects closely resemble those of the other members of the genus.

In the 1st swimming leg, basal 1 bears an inner seta ; basal 2 bears an outer seta and a long inner spine ; exopod 1 and 2 each bear a single marginal spine ; exopod 3 bears three marginal spines and a terminal spine and three setae on its inner border, the segment itself is short and broad. The distal segment of the endopod bears two spines and four setae.

In the 2nd and 3rd swimming legs, exopods 1 and 2 each bear a marginal spine ; and exopod 3 bears three marginal spines, a terminal spine and 5 setae. Endopod 3 bears 3 spines and 5 setae.

In the 4th swimming leg, exopod 1 bears a delicate, pointed spine, instead of the usual club-shaped one. Exopod 2 bears the usual marginal spine. Exopod 3 bears 2 marginal spines and a terminal spine, and on its inner border 5 setae. Endopod 3 bears 3 spines and 2 setae, which are very small.

With the exception of the seta arising from the proximal joints of the exopods all setae are plumose in their distal portions only, the basal part being smooth.

The 5th pair of legs differ very considerably from the corresponding appendage in either of the other two species. The basal portion is considerably produced and bears a slender seta. The distal segment is elongate oval in shape and bears 2 setae on the distal half of the outer border, 1 seta at the apex distally and a fourth on the inner border. The proximal three-quarters of the inner border is fringed with fine hairs.

Genus **CYCLOPS** Müller (*ex parte*).

Cyclops bicolor Sars.

Cyclops bicolor, Sars, 1863, p. 44.
Cyclops bicolor, Schmeil, 1892, p. 118, pl. vi, figs. 6-13.
Cyclops bicolor, Mrázek, 1893, p. 33.
Cyclops bicolor, Lilljeborg, 1902, p. 78, pl. iv, figs. 22-28.
Cyclops bicolor, v. Daday, 1904, p. 53.
Cyclops bicolor, Wolf, 1905, pp. 174, 298.
Cyclops bicolor, v. Daday, 1907, p. 180.
Cyclops bicolor, Marsh, 1910, p. 1102, pl. lxxx, figs. 7-9 and pl. lxxxi. figs. 1 and 2
Cyclops bicolor, Sars, 1913-18, p. 56, pl. xxxiv.
Cyclops bicolor, Gurney, 1921(a), p. 840.

This species is widely distributed throughout the globe. Examples were obtained at stations L, 142 and 145 : the first of these is a fresh-water pond on Barkuda Island the other two stations are in Rambha Bay at the south end of the lake, and the time of year was September-November. During these months the density of the water was at its lowest and never rose above 1·006. It seems probable that these specimens had been swept into the lake during the monsoon rains.

Cyclops buxtoni Gurney.

Cyclops buxtoni, Gurney, 1921(a), p. 840, pl. i.

This species was originally described from the Tigris River at Amara. Two examples—both males—were obtained at station 128 in the Chilka Lake.

Genus **MESOCYCLOPS** G. O. Sars.

Mesocyclops obsoletus (Koch).

Cyclops leuckarti, Claus, 1857, p. 35, pl. ii, figs. 13, 14.
Cyclops leuckarti, Claus, 1863, p.101.
Cyclops leuckarti, Sars, 1863, p. 269.
Cyclops leuckarti, Schmeil, 1892, p. 57, pl. iii, figs. 1-8.
Cyclops leuckarti, Mrázek, 1893, p. 26.
Cyclops leuckarti, Lilljeborg, 1902, p. 35, pl. ii, figs. 28-29.
Cyclops leuckarti, v. Daday, 1904, p. 54.
Cyclops leuckarti, Sars, 1904, p. 641.
Cyclops leuckarti, V. Douwe, 1905, p. 681.
Cyclops leuckarti, Wolf, 1905, pp. 151 and 230.
Cyclops leuckarti, Gurney, 1906, p. 279.
Cyclops leuckarti, Annandale, 1907, p. 4.
Cyclops leuckarti, Apstein, 1907, p. 220.
Cyclops leuckarti, v. Daday, 1907, p. 181.
Cyclops leuckarti, Gurney, 1907, p. 31.
Cyclops leuckarti, Marsh, 1910, p. 1081, pl. lxxiv, figs. 4-11 and pl. lxxv, figs. 1-3.
Cyclops leuckarti, Gurney, 1913, p. 231.
Mesocyclops obsoletus, G. O. Sars, 1913-18, p. 58, pl. xxxv.
Cyclops leuckarti, Gurney, 1921(a), p. 840.
Cyclops leuckarti, Willey, 1923, p. 8.

This species is of world-wide distribution, but is as a rule confined to fresh water. Annandale (1907, p. 40) has recorded its occurrence in brackish-water pools at Port Canning in Lower Bengal and its occurrence in the Chilka Lake is therefore not surprising. The stations at which it occurs are L, 90, 133, 137, 142 and 145. Station L is a small fresh-water pool on Barkuda Island : the remaining stations are, with one exception, at various parts of the lake and the season of the year was September-November, when the salinity of the water was at its lowest. The occurrence of this species at Station 90 is, however, extraordinary, for the station is close to the entrance to the lake and a strong current of sea-water was pouring in : the density of the water is given by Annandale and Kemp as 1·02825.

Mesocyclops oithonoides Sars.

Cyclops oithonoides, Sars, 1863, p. 32.
Cyclops oithonoides, Schmeil, 1892, p. 64, pl. iv, figs 6-11.
Cyclops oithonoides, Mrázek, 1893, p. 27.
Cyclops oithonoides, Lilljeborg, 1902, p. 42, pl. iii, figs 8-11.
Cyclops oithonoides, v. Daday, 1904, p. 54.
Cyclops oithonoides, Wolf, pp. 153 and 232.
Cyclops oithonoides, v. Daday, 1907, p. 184.
Cyclops oithonoides, Gurney, 1907, p. 91.
Mesocyclops oithonoides, Sars, 1913-18, p. 59, pl. xxxvi.

This species has a wide distribution and has now been recorded from North America, Northern Europe, Central Asia and India. It occurred in the collection at stations B and 137.

POECILOSTOMA.

Family CLAUSIDIIDAE.

Genus "SAPHIRELLA" T. Scott.

[? = *Paurocope* Brady]

This 'genus' was created by T. Scott (1894, p. 126) in order to include a somewhat peculiar form that he obtained from the Gulf of Guinea and which he termed *Saphirella abyssicola*. He defines the genus as follows:—"Anterior antennae nearly as in *Saphirina*, 5-jointed. Posterior antennae 3-jointed. Mandibles stout, each bearing a strong terminal conical tooth, serrate on both margins, and a stout plumose terminal spine. Maxilla broadly subquadrangular and furnished with a few terminal setae. Posterior foot-jaws stout, 3-jointed, and armed with a moderately stout terminal claw. The swimming feet are 2-branched, each branch consists of a single broadly foliaceous joint; fifth pair rudimentary or obsolete."

Brady subsequently (1899, p. 46, pl. xiii, figs. 1-9) under the name *Paurocope robusta* described and figured a very similar, if not identical, form from New Zealand and Wolfenden (1905, p. 1030, pl. xcix, figs. 12-17) has described a second species of *Saphirella*. *S. tropica* from the Maldive islands. Both Scott and Wolfenden were dealing with single specimens and Brady had only two. Brady admits that his specimens were very similar to *Saphirella abyssicola* in everything except the mouth-parts and Wolfenden on this ground has concluded that they must belong to a different genus. Not one of these authors seems to be aware that this peculiar form of copepod had already been described and very completely figured by Canu (1888, p. 417, pl. xxviii, figs. 15-24), who obtained a large number of specimens in the English channel off the French coast. I have also been fortunate enough to obtain a number of examples of the same or of a very closely related form in the Chilka Lake, as well as occasional examples in Nankauri Harbour, Nicobar Islands. The mouth parts of all the specimens that I have examined are very delicate and are difficult to dissect out; in consequence it is by no means an easy matter to be certain exactly which appendage one is studying. As an example of this I may refer to two papers by T. Scott: in his

original account of this genus ' (1894, p. 128 and pl. xiv, fig. 6) he describes and figures the " mandible " as consisting of " an elongate basal joint furnished with two long slender terminal setae," but the structure that he figures shows a basal plate and a smaller distal segment bearing a very strong terminal tooth and arising near it a short stout seta, while two other seta arise on the proximal side. In his second paper (1912, pl. iv, fig. 4) he refers to this structure as the ' maxilla, and the structure that he now terms the mandible ' is the same structure that Canu (1888, p. 414, pl. xxviii. fig. 7, *pr.* and fig. 19, *pr.*) terms the " paragnathe." Brady seems to have fallen into the same confusion and the structure that he figures (1901, pl. xiii, fig. 5) as the mandible is the paragnathe, ' while the part that he calls the maxilla (*loc. cit.*, fig. 6) is only a portion of this appendage, and the remainder he has confused with the 3rd maxilla and has figured the two parts together as the anterior foot-jaw (*loc. cit.*, fig. 7). If this be the case then *Paurocope robusta* falls into line with *Saphirella abyssicola* and *S. tropica* and *Saphirella* and *Paurocope* become synonyms.

My examples from the Chilka Lake show certain slight differences of detail from the forms previously described and in order to clear up the confusion that has arisen I have described them in detail and have provisionally assigned to them the name *Saphirella indica.*

Saphirella indica, sp. nov.

(Plate LIX, fig. 1.)

Total length 0·52 mm. to 0·60 mm. This is distinctly smaller than other forms. Scott's and Wolfenden's examples measured 1·2 mm., while Brady's examples were intermediate in size and measured 0·88 mm.

The body consists of an oval anterior region and a narrow posterior region, having the proportional lengths 29 : 16. In all cases the anterior region consists of a large cephalic segment, which is followed by two thoracic segments decreasing in breadth posteriorly. The cephalic segment is rounded anteriorly and the anterior margin is depressed and recurved, terminating in my examples in a central small rostral spine. Canu (*loc. cit.*, p. 417, pl. xxviii, fig. 22) remarks that in his examples " La tête présente un repli pleural bien développé et un long rostre terminé par une épine pointue." The last of the segments of the anterior region is produced backwards in the ventro-lateral regions and is armed on each side with an inner serrated spine and an outer simple seta. The posterior region of the body consists of two segments, of which the posterior is much the longer. The anterior segment is slightly broader than long and its ventro-lateral region is produced backwards in a short spine. Wolfenden (*loc. cit.*, p. 1030) states that this segment is longer than broad but he figures it correctly. The second segment is much longer than broad and has parallel lateral borders. In both my examples and Canu's (*loc. cit.*, pl. xxviii, figs. 15 and 24) this segment is armed with a transverse row of spines about one-third of the total length from the posterior end. The furcal rami are of moderate length, and are nearly twice as long as broad. A stout seta arises from the external margin and a more delicate one from the dorsal surface. From the truncated distal border arises a stout marginal seta and immediately internal to this two small setae and a long stout inner seta. This inner seta, as in Wolfenden's example, is spear-shaped and consists of a stout straight stem, which about half way along its length becomes expanded laterally ; in my specimens this expansion has

a finely crenated border. In *Saphirella abyssicola* Scott the lateral expansion begins much nearer to the base of the seta, while Canu (*loc. cit.*, pl. xxviii, fig. 24) figures the seta in his examples as being plumose in the distal two-thirds of their length. The proportional lengths of the segments of the hind region are as follows :—

Segment	1	2	Furca
	9	16	7×4

Previous writers have assumed that both segments of the hind body belong to the abdomen and Wolfenden has described what he considers to be the genital orifice as being on the ventral aspect of the anterior segment. He remarks (*loc. cit.*, p. 1030) " the genital opening is in the middle of the segment, the latter forming a flap." In my examples there was no sign of any opening, but the posterior margin of this segment was slightly notched in the middle ventral line, the posterior border on either side being crenated, but so equally was the posterior border of the preceding segment. At the anterior end of the long posterior segment, however, about one-fourth its length from the margin, there is a very small but distinct pair of crescentic flaps with a shallow notch between, and it is this that I take to be the genital orifice. The question arises are we correct in considering the anterior segment to belong to the abdomen ? Personally I think not. In all Copepoda of this type the first segment of the hind body is the last thoracic one, and I believe that in this form this segment belongs properly to the thorax and the abdomen consists of only a single segment.

The first antenna consists of five segments, which have the following lengths :—

Segments	1	2	3	4	5
	12	15	10	9	13

This agrees fairly clearly with the measurements given by T. Scott and Wolfenden, but the second segment seems to be somewhat shorter.

The second antenna consists of three segments, and agrees closely with the corresponding appendage in *Saphirella abyssicola*, *S. tropica*, and *Paurocope robusta*.

As I have already pointed out there seems to be considerable confusion regarding the identity of certain of the mouth-parts. This seems to have originated entirely from different observers having different views as to what constitutes the mandible. As a matter of fact the mandible appears to be absent, or if present, it is represented by a simple lobe without any definite structure, and is the structure referred to by Canu as the Paragnathe.

The first maxilla on the other hand is well developed, it consists of a basal plate and an unjointed palp. The basal plate is tapered towards its distal end and terminates in a strong conical tooth, which in the present species is not so completely serrated as in other species. Near the base of this tooth arises a smaller serrated spine and a little on the proximal side are, so far as I can make out, three delicate setae. Previous authors have taken this portion of the maxilla for the mandible. Wolfenden (*loc. cit.*, p. 1031) describes it quite correctly as possessing " a strong conical tooth under which is a stout broad plumose seta and internal to this two strong pointed plumose setae." Unfortunately the structure that he figures as the " mandible-palp " (*loc. cit.*, pl. xcix, fig. 16) is the maxilliped. The maxillary palp has by previous authors been regarded as the whole first maxilla. It is correctly figured by Scott (1894, pl. xiv, fig. 7) and Canu (1888, pl. xxviii, fig. 18 mx.). It consists of a flat plate bearing one sub-terminal and several terminal setae.

The second maxilla consists of a stout basal segment bearing two setae, one of which is stout and spine-like and has serrated margins, and a smaller distal segment from which arise two pairs of setae; in each pair one is stout and strong and the other is delicate and slender. Canu (*loc. cit.*, pl. xxviii, fig. 21) figures only three terminal setae.

The maxilliped forms a grasping organ. The basal segment bears a stout plumose seta and two smaller simple setae. The second segment is elongate and bears on its anterior margin a little beyond the middle of its length a long straight spine-like seta armed with a few needle-like spinules along both borders, and close to it arises a second simple seta. The distal segment is small and terminally carries a pair of long spines of which the proximal is perfectly straight and the distal, which is also the larger, is somewhat curved at its free extremity; both bear scattered needle-like spinules along their length. Wolfenden, as I have pointed out above, figures this appendage correctly but calls it the "mandible-palp(?)."

In all cases there are only two pairs of swimming feet, each consisting of a two-jointed basal portion and an inner and outer ramus of only one joint. In the present specimens the first swimming leg bears on its exopod five serrated spines, of which the distal is the largest; the inner margin of the exopod carries three setae. The endopod is oval in shape and bears seven setae. Both first and second basal segments carry a seta on their external margin.

The second pair of swimming legs have the same structure, but in this case the exopod bears only four serrated spines and three setae, while the endopod is armed with three serrated spines and three setae.

Here again there seems to have been considerable confusion among the earlier descriptions. Canu (*loc. cit.*, pl. xxviii, fig. 23) figures one of these appendages which, judging by its structure, is the second; it bears four spines and three setae on the exopod and three spines and three setae on the endopod. T. Scott, however, (*loc. cit.*, p. 127, pl. xiv, fig. 10) seems to have confused the two pairs, for that which he calls the first leg agrees exactly with the structure of the second in my specimens, and he remarks that in the other appendage the three dagger-like spines arising from the endopod are replaced by plumose setae, which agrees with the condition present in the first swimming leg. Brady and Wolfenden both describe the two pairs of feet as having a similar structure, they both figure one of the feet, in which the exopod has five spines and three setae and the endopod seven setae, so that in this respect this appendage agrees with the anterior pair of legs in my examples. It is possible that they both overlooked the fact that the legs are different, but on the other hand they may have been dealing with forms that are closely related to but not identical with my specimens.

Examples of *Saphirella indica* occurred in the Chilka Lake collection at stations K, 89 and 148; of these one is in the outer channel and the other two are at the south end of the lake. From this and from the finding of other examples of the genus in areas so widely scattered as the English Channel, the Maldive Islands and the Nicobar Islands in the Indian Ocean, the South Atlantic Ocean and the coasts of New Zealand it appears that the 'genus' is marine and moreover has a very wide distribution.

Scott, Brady and Wolfenden seem to have considered that this peculiar little animal is an adult form and is closely related to *Saphirella*. Canu, who first described it, regards it as a young form in the first copepodid stage, and in my opinion he is right in so doing. The general structure of the animal clearly points to its being immature. Lebour (1916) has

shown that in the first copepodid stage of development *Calanus finmarchicus* (Gunnerus) possesses a body of exactly this type and that the mouth-parts are already well-developed although the swimming legs, of which there are only two pairs, are each composed of a single ramus. In the present examples the cephalothorax, composed of a large fused cephalic and 1st thoracic segments, the three free thoracic segments and the single-jointed abdomen all point to the conclusion that Canu was correct, and, as in *Calanus finmarchicus*, we find well developed mouth-parts with only two pairs of swimming legs, all of which have unjointed rami.

Canu provisionally regarded it as the first post-larval stage of a member of the genus *Giardella*, which he created to accommodate the single species *G. callianassae*, and a study of the structure of the appendages and especially the absence of any properly-developed mandible indicates that the form must be referred to the section Poecilostoma and the family Clausidiidae.

Family CORYCAEIDAE.

Genus **CORYCAEUS** Dana.

Sub-genus **Onychocorycaeus** M. Dahl.

Corycaeus (Onychocorycaeus) giesbrechti F. Dahl.

Corycaeus venustus, Giesbrecht, 1892, p. 674, pl. li, figs. 32-34.
Corycaeus giesbrechti, F. Dahl, 1894 (*b*), p. 72.
Corycaeus venustus, Esterly, 1905, p. 225, fig. 61.
Corycaeus (*Onychocorycaeus*) *giesbrechti*, M. Dahl, 1912, p. 88, pl. xii, figs. 1-9.

There appears to have been a considerable confusion of various forms that have been described under the name *Corycaeus venustus*. I have, therefore, followed for the moment the views expressed by F. and M. Dahl (*loc. cit.*).

A single specimen was obtained in the Chilka Lake at station 92 in the outer channel in March, 1914. It had in all probability been swept in from the open waters of the Bay by the inflowing current.

Family ERGASILIDAE.

Genus **ERGASILUS** Nordman.

Ergasilus sp.

(Plate xlix, fig. 2.)

♂. A single example of a male *Ergasilus* was found in a tow-netting from station 166.

Total length 0·75 mm.

The proportional lengths of anterior and posterior regions of the body were 38 : 17.

The anterior end is rounded. The cephalic segment is large and is equal in length to the three following segments together. The free thoracic segments gradually decrease in width posteriorly and the fifth segment is quite small. The abdomen consists of five segments, of which the last two are only partially separated. The genital segment is large and somewhat rectangular in shape with parallel lateral borders; in length it equals the rest of the

abdominal segments together. The furcal rami are as long as broad and at the distal end each bears four setae, of which the inner is the longest.

The first antenna consists of six segments, of which the first and second appear to be partially fused. The terminal segment is as long, if not slightly longer than the preceding one.

The second antenna is claw-like. It consists of the usual three segments and a terminal curved claw. The second segment is by far the longest and carries a single seta on its anterior border a little beyond the middle of its length. The third segment is less than half the length of the second, it bears a longer proximal seta near the base and a short seta distally : it is armed with a row of minute spinules.

The maxilliped closely resembles that of *Ergasilus sieboldi* Nordm., but the second joint bears a row of spines on its anterior border and a second row along the surface of the joint. The dactylus is long and slender and is bluntly rounded at its distal extremity.

The swimming legs closely resemble those of *Ergasilus sieboldi.* The first three pairs of legs each consist of a three-jointed exopod and endopod. The fourth pair of legs has a two-jointed exopod and a three-jointed endopod. The endopod considerably exceeds the exopod in length in this appendage.

The fifth pair of legs are composed of a single free segment about twice as long as broad, which bears at its distal end two unequal setae.

Up to the present time three species of *Ergasilus* have been recorded from females captured in Indian waters. Southwell and Prashad (1918, pp. 352-355, pls. xiii, xiv) have described two, *E. bengalensis* and *E. hamiltoni*, from *Wallago attu* (Bl. Schn.) and *Anabas scandens* (Daldorf) respectively, and a third species, *E. scotti*, has been described by Sundara Raj (1923, p. 45), also from *Wallago attu* (Bl. Schn). In the present state of our knowledge it is impossible to say definitely whether this male corresponds to one of these species or to some unknown form of female, but on the whole its structure comes very near to that of *Ergasilus bengalensis* Southwell and Prashad.

ACHIROTA.

Family LONGIPEDIIDAE.

Genus **LONGIPEDIA** Claus.

Longipedia coronata Claus.

(Plate xlviii, fig. 1.)

Longipedia coronata, Claus, 1863, p. 111, pl. xiv, figs. 14-24.
Longipedia coronata, Sars, 1903-11, p. 10, pls. iii and iv.
Longipedia coronata, Thompson and A. Scott, 1903, p. 257.
?*Longipedia coronata*, Williams, 1906, p. 651.
Longipedia coronata, A. Scott, 1909, p. 195, pl. lix, figs. 5-8.

This species has a wide range of distribution and has now been recorded from the coast of Norway, Heligoland, the Mediterranean Sea, the Gulf of Suez, the Pearl Banks of Ceylon and the Malay Archipelago. I have also obtained specimens from the Nicobar islands.

It was not until the publication of Sars' work in 1903 that the two forms *Longipedia coronata* and *L. scotti* were recognised as being specifically distinct; and it is therefore doubtful to which form records in the literature prior to that date refer. Williams (1906) has recorded the occurrence of *Longipedia coronata* from Rhode Island, United States of America, but as he refers to Brady's account of *L. coronata*, published in 1880, which is now recognised to be a description of *L. scotti*, it is doubtful whether he was correct in his identification of the species with which he was dealing.

The present collection contained several examples of a *Longipedia* that I have referred to this species. These examples showed *inter se* a considerable range of variation, both as regards size and the shape of the 5th pair of legs.

♀. The specimens could be divided into two groups according to their size.

(*a*) In the first group the general body shape was long and comparatively slender. The average length of the specimens was 1·12 mm., which agrees very fairly well with the size given by Sars of the Norwegian forms, namely 1·30 mm. Scott on the other hand gives the size of his examples as being only 0·8 mm. The proportional lengths of the anterior and posterior regions of the body were 48 : 30. The operculum of the anal segment of the hind body was armed with the usual spines, the central one being about twice as long as those on either side of it, and the tip of the spine reached to a very little beyond the level of the furcal rami. The endopod of the second pair of legs only reached back to the posterior margin of the second abdominal segment. In these respects therefore these specimens agree closely with Scott's figure of *Longipedia weberi*.

(*b*) In the second group the body was much shorter and the animal appeared to be more robust, though this may have been due to the shortening in total length. The length of members of this group was only 0·96 mm. and the proportional lengths of the anterior and posterior regions of the body were 42 : 22. This defference in the proportions of the body is apparent rather than real, for examination showed that the segments of the abdomen were telescoped into each other owing to muscular contraction. This telescoping action also affected the furcal rami. The operculum of the anal segment had the same spinous armature as in the preceding group, though the central spine seemed in proportion to the ones on each side of it to be rather longer. The central spine reached well beyond the level of the distal border of the furcal rami as far as the articulation of the two middle setae. The endopod of the second pair of legs also reached well beyond the tips of the furcal rami. This group in their general shape agrees with Scott's figure of *Longipedia coronata*.

It is interesting to note that most, if not all, examples of the first group were ovigerous, whereas not a single member of the second group possessed an egg-sac. Possibly this difference between the specimens accounts for the presence or absence of abdominal contraction, and thus gives rise to the differences noted above.

All the appendages, with the exception of the fifth pair of legs, agree closely with the figures given by Sars; the terminal joint of the exopod of the first leg, however, possesses two setae on its inner border, where Sars only figures one, and the central spine on the distal end of endopod 3 of the second leg usually bears about the middle of its length a subsidiary spine that gives it a Y-shaped appearance, but in occasional specimens this is absent and the

spine is then identical with that of the European form. The fifth pair of legs, however, in these examples exhibits a considerable range of variation that does not seem in any way to be correlated with the difference in size. I give in pl. xlviii, fig. 1 ♀ p. 5, *a-c* the three types of appendage found and it is obvious that two of these (figures *b* and *c*) agree respectively with the figures given by Sars and A. Scott for this appendage. The third type (*a*), however, much more nearly approximates to the form of the appendage as described by A. Scott (1909, p. 96, pl. lix, fig. 11) in *Longipedia weberi*.

♂. Several males that agree exactly with the European form are present in the collection.

Examples were obtained at stations C, E, K, 75.

Longipedia rosea G. O. Sars.

(Plate XLVIII, fig. 2.)

?Longipedia rosea, Sars, 1903-11, p. 13, pl. v, fig. 3.

Associated with the examples of *Longipedia coronata* were a few forms that at first I took to be merely immature specimens, but a further examination revealed several structural differences, and I have referred these forms to the above species.

♀. Total length 0·96 mm.

The proportional lengths of anterior and posterior regions of the body were 13 : 9.

The abdomen consists of four segments, of which the first has the appearance of being divided transversely, while the distal two segments are almost indistinguishable from each other. The posterior borders of the first and second segments are provided with a transverse row of minute denticles. The furcal rami are rounded posteriorly and bear a row of needle-like spines across their inner and dorsal aspects. The two middle setae on each ramus are plumose. The operculum of the anal segment is armed with a short median spine and on either side is a group of minute denticles apparently three in number but they are difficult to make out.

The first pair of legs in structure resemble those of *Longipedia coronata*, but the marginal spine of the second joint of the exopod is much shorter. The endopod is slightly longer than the exopod and of the three segments the second is by far the longer and is produced in a spinous process at its outer distal angle. The terminal segment is short and bears three spines and two setae.

In the second pair of legs the terminal joint of the endopod bears two outer and one inner spine and distally is armed with three spines that are equal and are all uniformly serrated. The inner spine arises from a point slightly distal to the point of origin of the proximal outer spine, and in this respect these specimens differ from the description and figures given by Sars, who shows them as arising opposite each other.

The fifth pair of legs agree exactly with Sars' description.

Judging from the appearance of the abdomen and the thinness of the cuticular covering I should judge that these examples are immature.

Genus **CANUELLA** T. Scott.

Canuella furcigera G. O. Sars.

(Plate XLIX, fig. 1.)

Canuella furcigera, Sars, 1903-11, p. 18, pl. x.

A few examples of this species occur in the Chilka Lake collection. Their occurrence in Indian waters is particularly interesting in view of the fact that up to the present time this species has only been recorded from the coasts of Norway. Sars unfortunately gives no detailed description of the species, but the present specimens agree very clearly with his account and with the figures that he gives. I have also compared them with examples of *C. furcigera* in the collection of the Natural History Museum, South Kensington, and I am unable to detect any differences sufficiently marked to warrant the creation of a separate species.

♀. The Chilka Lake examples are distinctly smaller than those from the Norwegian coast, and only measure 0·90 mm. in length as compared to 1·40 mm.

The proportional lengths of the anterior and posterior regions of the body are 38 : 30.

The abdomen consists of four segments, having the proportional lengths as follows :—

Abdomen	1	2	3	4	Furca
	28	9	5	3	17

The genital segment is divided into two regions, anterior and posterior, by a transverse suture.

The furcal rami are as long as the preceding three segments of the abdomen together, and they diverge somewhat from each other. A well marked carina runs along the upper and outer margin of the ramus.

The antennae, mouth parts and swimming legs closely resemble the corresponding appendages in *Canuella perplexa* T. and A. Scott with a few slight differences in details; thus in the first pair of legs the terminal joint of the endopod bears three marginal spines and three setae, whereas according to Sars *C. perplexa* has two spines and four setae; and in the fourth pair of legs the setae on the inner margin of both exopod and endopod are spine-like in character in the Chilka Lake examples.

♂. In this sex also the Chilka Lake specimens are smaller than the Norwegian examples and measure only 0·75 mm. in length as compared with 1·25 mm.

The lengths of the anterior and posterior regions of the body are nearly identical.

The abdomen consists of five segments having the following proportional lengths :—

Abdomen	1	2	3	4	5	Furca
	31	18	14	8	8	30

The furcal rami in this sex are very slightly shorter in the Chilka Lake examples than in the Norwegian specimens. The measurements of one of the latter were 31 : 14 : 14 : 9 : 7 : 31.

The first antenna is modified to form a grasping organ.

The second antennae, mouth parts and swimming legs are as in the female.

The arrangement and general structure of the genital orifice appears to be identical with the condition described by Sars.

Canuella furcigera has hitherto not been recorded from any locality except the Christianiafyord, where it was obtained by Sars. In addition to specimens in the Chilka Lake collection, I have been able to obtain and examine other examples from the Nicobar Islands, which agree exactly except in point of size; the Nicobar specimens being larger and measuring ♀ 1·15 mm., which is much nearer to the size of the Norwegian examples. On the other hand *Canuella perplexa* T. and A. Scott has been recorded from both Norway and the coasts of Great Britain, while Thompson and Scott record obtaining a specimen in the Suez Canal. Thompson and Scott (1903) obtained three other species of this genus, namely, *Canuella curticauda*, *C. inopinata*, and *C. longipes* from the Pearl Banks of Ceylon. In their original description these forms were all referred to the genus *Sunaristes* but A. Scott (1909, p. 197) subsequently transferred them to *Canuella*. Of these Ceylon forms *C. longipes* is the only one that might be mistaken for this present species, but the proportional lengths of the branches of the fourth pair of swimming legs are quite different. Willey has recently described, under the name *C. canadensis*, a further form that closely resembles, if it is not actually identical with *C. longipes*. His forms were obtained from brackish water at the head of the Bay of Fundy in Nova Scotia. It is obvious therefore that the genus is one of wide distribution.

The present specimens were obtained at stations 78, 90 and 133, all of which lie near the entrance or in the outer channel; it would appear probable that they had been swept into the lake from the littoral waters of the Bay of Bengal.

Family ECTINOSOMIDAE.

Genus **ECTINOSOMA** Boeck.

Ectinosoma normani T. and A. Scott.

Ectinosoma normani, T. and A. Scott, 1896, p. 435, pl. xxxvi, figs. 21, 29 and 39, pl. xxxvii, figs. 12, 26, 34 and 51, and pl. xxxviii, figs. 5, 18, 42 and 45.
Ectinosoma normani, T. Scott, 1899, p. 95.
Ectinosoma normani, Sars, 1903-11, p. 35, pl. xix, fig. 2.
Ectinosoma normani, T. Scott, 1903, p. 9.
Ectinosoma normani, Thompson and A. Scott, 1903, p. 257.
Ectinosoma normani, Norman and T. Scott, 1906, p. 137.

Single examples were obtained in the Chilka Lake at both stations 36 and 78. This species has previously been recorded from the British coasts, Arctic seas and from the coasts of Ceylon.

Ectinosoma melaniceps Boeck.

(Plate XLVIII, fig. 3.)

Ectinosoma melaniceps, Boeck, 1864, p. 254.
Ectinosoma melaniceps, Brady, 1880, p. 11, pl. xl, figs. 17-20.
Ectinosoma melaniceps, Thompson, 1893, p. 192, pl. xxi, fig. 2 *a*.

Ectinosoma melaniceps, T. and A. Scott, 1896, p. 484, pl. xxxvi, figs. 13, 28 and 45, pl. xxxvii, figs. 11, 22, 40 and 49, pl. xxxviii, figs. 2, 21, 41 and 46.
Ectinosoma melaniceps, T. Scott, 1899, p. 95.
Ectinosoma melaniceps, Sars, 1903-11, p. 34, pl. xix, fig. 1.
Ectinosoma melaniceps, Steuer, 1912, p. 66, figs. 1 to 5.

Several examples of what I believe to be this species were obtained by Dr. Annandale in the Chilka Lake in June, 1923. The examples differ from the European form in that they show no trace of any dark pigmentation on the cephalic segment; on the contrary they were uniformly tinted a pale green. Structurally I can detect no difference from the European form.

The specimens were obtained by washing algae from the stones of the pier of Barkuda I. The lake was approximately at its saltest at the time.

Genus **MICROSETELLA** Brady and Robertson.

Microsetella norvegica (Boeck).

Setella norvegica, Boeck, 1864, p. 281.
Ectinosoma atlanticum, Brady, 1880, p. 13, pl. xxxviii.
Ectinosoma atlanticum, Brady, 1883, p. 100, pl. iv, figs. 10-14.
Microsetella atlantica, Giesbrecht, 1893, p. 550, pl. xliv, figs. 33, 34, 36, 42, 44 and 45.
Ectinosoma atlanticum, Thompson, 1893, p. 192, pl. xix, fig. 1.
Microsetella atlantica, T. Scott, 1894, p. 91.
Ectinosoma atlanticum, T. and A. Scott, 1896, p. 437, pl. xxxvi, figs. 17 and 40, pl. xxxvii, figs. 6, 23, 35, and 50 and pl. xxxviii, figs. 11, 16, 38 and 53.
Microsetella atlantica, Giesbrecht, 1897, p. 319.
Ectinosoma atlanticum, T. Scott, 1899, p. 96.
Microsetella atlantica, Thompson, 1900, p. 285.
Microsetella atlantica, Cleve, 1901, p. 7.
Microsetella atlantica, Giesbrecht, 1902, p. 32.
Microsetella atlantica, Mrázek, 1902, p. 518.
Ectinosoma atlanticum, A. Scott, 1902, p. 409.
Microsetella atlantica, Cleve, 1903, p. 364.
Ectinosoma atlanticum, T. Scott, 1903, p. 10.
Ectinosoma atlanticum, Thompson and A. Scott, 1903, p. 257.
Microsetella norvegica, Sars, 1903-11, p. 44, pl. xxiv.
Microsetella atlantica, Farran, 1905, p. 46.
Microsetella norvegica, Norman and T. Scott, 1906, p. 137.
Microsetella norvegica, v. Breemen, 1908, p. 173, fig. 188.
Microsetella norvegica, A. Scott, 1909, p. 199.
Microsetella norvegica, Steuer, 1910, p. 29.
Ectinosoma atlanticum, Wolfenden, 1911, p. 364.
Microsetella norvegica, T. Scott, 1912, p. 542.

This species appears to be universally distributed throughout all the oceans. A single specimen was obtained in the Chilka Lake.

CHIROGNATHA.

Family HARPACTICIDAE.

Genus **HARPACTICUS** Milne-Edwardes.

Harpacticus littoralis Sars.

(Plate L, fig. 1.)

Harpacticus littoralis, Sars, 1903-11, p. 363, Suppl. pl. viii.

There has been in the past great confusion regarding the correct identity of certain species in this genus, and a study of the literature indicates that various authors have at different times included more than one species under the name *Harpacticus chelifer*. Giesbrecht (1892, p. 38) pointed out that there was considerable need of investigation whether all the forms described under this name really belonged to one species and, *vice versa*, whether several forms described under other specific names were not in reality merely varieties of *H. chelifer*. He himself appears to have inclined towards the latter view. Sars. (*loc. cit.*), claims that the species described by Giesbrecht as *H. chelifer* is in reality *H. gracilis* Claus, while the form described as *H. chelifer* by Brady (1880, p. 146, pl. lxiv, figs. 19, 20 and pl. lxv, figs. 1-15) is a different species to which he has given the name *H. littoralis*. Personally I am of opinion that Brady has confused more than one species in his description.

Several examples of a Harpacticid, that very closely resembles *H. littoralis* and yet differs in small details, were obtained in the Chilka Lake ; the differences are, however, in my opinion not sufficiently marked to warrant the creation of a new species.

♀. The total length of these specimens was 0·55 mm. ; they are, therefore, much smaller than the Norwegian form, which measures 0·97 mm.

The first antennae consist of nine segments, of which the first four are considerably stouter than those forming the end-portion of the appendage. The proportional lengths of the various segments are as follows :—

Segments	1	2	3	4	5	6	7	8	9
	24	20	22	25	9	11	5	4	5

Sars gives as characteristics of this appendage in *H. littoralis* that the fourth segment exceeds the third in length and the end part of the appendage is less than half the length of the proximal portion, so that in this respect the Chilka Lake specimens agree exactly.

The second antennae, mouth parts, and the first four pairs of swimming feet have the structure characteristic of the genus and seem to agree closely with the condition present in *Harpacticus littoralis*. In the first pair of legs the endopod reaches well beyond the distal border of the first joint of the exopod : the distal segment shows traces of division into two segments and bears two curved claws. The exopod consists of two joints which are sub-equal in length, the proximal being slightly the longer : distally the second joint bear four claw-like spines of which the outer is much smaller than the other three.

The fifth pair of legs consist of the usual basal and free segments. The distal, free segment is elongate oval in shape and bears on its outer margin near the distal end two serrated spines ; at the extreme apex it bears an outer serrated spine and an inner seta, and

a single serrated spine arises from the inner border distally. Both inner and outer borders are finely denticulate. The proximal segment of the appendage is produced on its inner half in a rounded process that bears four serrated spines. In its general shape this appendage agrees more nearly with the Antarctic form, described by Giesbrecht (1902) under the name *H. chelifer*—but the arrangement of the spines near the distal end of the free segment is more characteristic of the northern form.

♂. Associated with the above females were a few males, that also agree closely with the European form.

The first antenna forms a powerful grasping organ, and is composed of six joints, of which the second and fourth are small, and the fifth is widely expanded : the sixth or terminal joint is produced distally in a blunt process.

The second and third legs show the usual sexual modification. In the second leg the second joint of the endopod is produced in a spinous process that is about $1\frac{1}{3}$ times the length of the distal segment of the limb, and reaches to about the distal end of the exopod. The distal segment of the exopod is modified and is somewhat broader than in the female. In the third pair of legs the terminal segment of the exopod is broader than in the female and is oval in shape : it bears three marginal spines that are long and thickened, and a slightly curved end-spine.

The fifth pair of legs closely resembles in shape the appendage in the European form and bears two spines on the outer border distally, a spine and a seta on the distal border and a single serrated spine internally at the distal end of the inner border

The above examples were obtained at station 36 in February and station C in December. In the latter case several females were ovigerous. In both cases the type of copepod fauna was marine. I have subsequently obtained further specimens from Nankauri Harbour in the Nicobar Islands in weed-washings and the species is probably widely distributed through the littoral waters of the Indian seas.

Harpacticus gracilis Claus var. **orientalis,** nov.

(Plate L, fig. 2.)

Harpacticus gracilis, Claus, 1863, p. 135, pl. xix, fig. 20.

Harpacticus chelifer, T. Scott, 1899, p. 111, pl. viii, figs. 10-13.

There is in the Chilka Lake collection a single specimen of a male Harpacticid that differs from the preceding species. I was subsequently fortunate enough to obtain further specimens of both sexes in the littoral waters of Nankauri Harbour in the Nicobar Islands.

♀. Total length 0·55 mm.

The proportional lengths of anterior and posterior regions of the body are 24 : 15. The body is rather slender and the abdominal segments are considerably narrower than those of the anterior region. They are slightly expanded laterally and all are fringed on their posterior margins with fine denticles. The rostrum scarcely projects at all when the animal is viewed from the dorsal aspect.

The proportional lengths of the abdomen and furca are as follows :—

Abdomen	1	2	3	4	Furca
	24	11	6	5	5

The furcal rami are nearly one and a half times as broad as they are long.

The 1st antennae are composed of nine segments, which have the following proportional lengths :—

Segments	1	2	3	4	5	6	7	8	9
	20	20	24	20	10	10	4	3	5

The terminal five segments are considerably more slender than the proximal four, and the proximal portion of the antenna is between two and a half and three times the combined length of the distal segments.

The 2nd antenna in its general shape closely resembles that of *H. gracilis*, but the spines on the terminal segments are longer and more slender than in that species.

The maxillipeds closely resemble those of *H. uniremis* and *H. gracilis*.

The 1st pair of legs have the usual structure. The endopod is considerably shorter than in most members of the genus and only just reaches to the level of the joint between the two segments of the exopod. The distal joint of the endopod is rounded and shows no sign of division into two : it is fringed on its outer margin with several small spinules and distally bears two curved claw-like spines. The distal segment of the exopod is shorter than the proximal segment and bears four slender claw-like spines distally. In its general appearance and proportions this appendage closely resembles that of *H. gracilis*.

The 5th pair of legs closely resemble the corresponding appendage in *H. gracilis*, but the prolongation of the proximal segment is somewhat narrower.

♂. Although the female closely resembles *Harpacticus gracilis* the male differs very considerably from the form described by G. O. Sars (1903-11, p. 52, pl. xxx, fig. 1).

The 1st antennae is modified to form a powerful grasping organ.

The 2nd antennae and mouth-parts are the same as in the female.

The 1st pair of legs have the same structure as in the female but appear to be more robust in character.

The 2nd pair of swimming legs are, as usual in this sex, modified. The basal joint of the endopod is long and slender and reaches nearly to the distal end of the 2nd segment of the exopod. The 2nd joint of the endopod is produced in a long spine-like process, that is nearly three times the length of the terminal segment, and projects far beyond the distal extremity of the exopod. The distal segment is slender and bears four setae, of which the inner one arising from the distal end is much smaller than the others.

The 3rd pair of legs are somewhat modified. The exopod is curved inwards and the terminal segment is oval in shape and bears three marginal spines, that are considerably thickened, and a long end-spine. On its inner margin arise four setae of which the proximal two are small and slender.

The 5th pair of legs is composed of two segments. The basal segment is hardly at all produced externally and is fringed with a row of spinules ; at its distal external angle it bears a small delicate seta. The distal segment is about twice as long as broad and bears four spines and one seta : two stout spines of equal length arise from the outer margin, a somewhat larger spine and a delicate seta arise distally and a serrated spine arises from the distal end of the inner margin. The outer margin is provided with numerous spinules and there are a few scattered denticles on the inner border.

The female of this form very closely resembles the description given by Sars (*loc. cit.*) of *Harpacticus gracilis*. The male, however, differs in several particulars, notably in the structure of the 2nd pair of swimming legs. T. Scott (1899, p. 111, pl. viii, figs. 10-13) has under the name *Harpacticus chelifer* recorded the occurrence from West Bay, Franz-Josef Land, of a species of *Harpacticus* that seems in reality to be *H. gracilis*. If this be so then *H. gracilis* is known to have a range of distribution extending from the Arctic Sea to the Mediterranean. It is also interesting to note that Brady (1880, pl. lxv, fig. 11) figures the endopod of the 2nd leg of a species, which he confused with *H. chelifer*, that exactly agrees with the form of leg in the present specimens. The Chilka Lake examples are smaller than the European form, but that seems to be almost invariably the case in species that are distributed throughout both tropical and temperate zones.

Genus **HARPACTICELLA** Sars.

This genus was created by Sars in 1908 to accommodate a single species that was clearly a member of the Harpacticidae but yet showed certain differences of structure from other genera in the group. The single species, *Harpacticella inopinata* Sars (1908, pp. 1-13, pl. i) with which he was acquainted was obtained from Lake Baikal. Several examples of a distinct but closely allied species were obtained in the Chilka Lake.

Harpacticella lacustris, sp. nov.

(Plate LI, fig. 1.)

♀. Total length 0·65 mm.

The proportional lengths of the anterior and posterior regions of the body are 32 : 15.

The body is somewhat depressed, and the anterior two segments of the abdomen are expanded laterally. The anterior end of the cephalic segment is produced in a short rounded rostrum. The segment itself is large and is equal in length to the three following segments together. The angles of the 2nd to 4th thoracic segments are slightly produced backwards and their margins are fringed with fine hairs. The abdomen tapers somewhat towards the posterior end. It consists of four segments and the furcal rami, which have the following proportional lengths :—

Abdomen	1	2	3	4	Furca
	31	11	14	9	9

The genital segment is incompletely divided into anterior and posterior regions. The furcal rami are considerably broader than long. They bear fine setae of which the two outermost and the inner one are short and delicate : the second inner seta is by far the stoutest and longest and is equal to three-fourths of the body in length. Both inner and outer margins of the furcal rami bear needle-like spines.

The 1st antenna in its general structure agrees closely with that of *Harpacticella inopinata*. It is comparatively short and only reaches back to between one-third and one-half the length of the cephalic segment. It consists of a stout basal portion composed of four segments and a short distal portion of three segments. As usual the fourth segment carries

on its distal produced angle a stout sensory filament. The various joints of this appendage have the following lengths :—

Segments	1	2	3	4	5	6	7
	10	11	9	8	3	2	3

The 2nd antenna is composed of two branches. The outer branch is slender and consists of only two joints, of which the proximal is much the longer and bears a single seta, and the distal is short and is produced into two unequal setae, which appear to be continuous with the segment and not articulated to it. The inner branch is well developed and consists of two segments. The terminal segment bears two claw-like spines on its anterior margin and distally it carries four geniculate setae.

The mouth parts agree exactly with the corresponding appendages in *Harpacticella inopinata.*

The 1st pair of legs are stout and strong and appear to be more heavily built than in the Lake Baikal species. The basal portion consists of two segments, and the distal segment bears both an inner and an outer spine. Both rami consist of three segments, but the exopod is considerably longer than the endopod. The distal joint of the exopod is small but is quite distinctly separated off from the longer middle joint. In this respect this genus comes near to the genus *Tigriopus* Norman. The proximal joint of the endopod is of the same length as the corresponding segment of the exopod. The distal part of the ramus is somewhat narrower and consists of two sub-equal segments, the distal of which bears a stout claw-like spine.

The 2nd to 4th pairs of swimming legs each consist of a three-jointed exopod and endopod. The outer margins of all the joints of the exopod are heavily armed with spinules.

The 5th pair of legs consist of the usual basal portion and free segment. The median expansion of the basal portion of the limb is comparatively broad and is produced as far as the level of the distal end of the free segment. It bears five setae on its rounded extremity, of which the outermost but one is by far the longest and the two inner ones are stout and spine-like. The free segment is somewhat quadrate in shape and bears on its truncated distal margin five setae of which the outer two and the inner one are spine-like and serrated : the innermost seta is by far the longest.

Mature females bear a single egg-sac.

♂. Total length 0·55 mm. to 0·48 mm.

The proportional lengths of the anterior and posterior regions of the body are 26 : 12.

The abdomen is proportionately more slender than in the female. It consists of the usual five segments, which have with the furcal rami the following lengths :—

Abdomen	1	2	3	4	5	Furca
	11	9	7	5	5	5

The posterior margin of the genital segment is produced in each ventro-lateral region in a lobe that bears two stout serrated spines and an external seta.

The 1st antenna is well developed and forms a powerful grasping organ. It consists of six segments, of which the first three increase in length distally ; the fourth is short and is succeeded by a large and dilated fifth segment. The hinge lies between the fifth and sixth segments. The distal sixth segment is produced in a pair of blunt processes.

The 2nd antenna, mouth-parts and swimming legs have the same structure as in the female. As Sars has pointed out in the case of *Harpacticella inopinata* the endopod of the second swimming leg in this genus differs from the corresponding appendage in both genera *Harpacticus* and *Tigriopus*, in that the middle joint is completely unmodified and is not in any way produced to form a spinous process. In this respect this genus approximates to the genus *Zaus*.

The 5th pair of legs are small and the basal segment is but ill-defined, externally it forms a nipple-like projection from which a simple seta arises. Internally there is a rounded prominence which, however, is totally devoid of spines. The free segment is almost triangular in shape and bears three setae of which the innermost is stout and serrated.

Examples of this species were obtained at stations B, D, 101, 133 and 142. Dr. Annandale has recently obtained further examples in weed-washings taken at Barkuda in June, 1923. There seems to be no doubt that the animal is living and breeding in the lake.

Family TEGASTIDAE.

Genus **PARATEGASTES** G. O. Sars.

Parategastes sphaericus Claus, var. **similis,** nov.

(Plate LI, fig. 2 and plate LII, fig. 2.)

Amymone sphaerica, Claus, 1863, p. 114, pl. xx, figs. 1-9.
Amymone sphaerica, Boeck, 1864, p. 256.
Amymone sphaerica, Brady, 1880, p. 28, pl. xlix, figs. 1-11.
Amymone sphaerica, Thompson, 1893, p. 193.
Amymone nigrans, T. and A. Scott, 1894, p. 137, pl. viii, figs. 1-7.
Amymone sphaerica, T. Scott, 1899, p. 96.
Tegastes sphaericus, Thompson and Scott, 1903, p. 258.
Tegastes nigrans, Thompson and Scott, 1903, p. 258.
Parategastes sphaericus, Sars, 1903-11, p. 73, pl. xliii.
Parategastes sphaericus, Norman and T. Scott, 1906, p. 141.

The genus *Parategastes* was created by Sars (1903-11, p. 72) to accommodate the form *P. sphaericus* (Claus), and he included in the same genus all four of the species of *Tegastes* described from the Pearl Banks of Ceylon by Thompson and A. Scott, namely *T imthurni*, *T donnani*, *T twynami* and *T. chalmersi*. Of these four the first species, *Tegastes imthurni*, appears to me to be synonymous with the species *Parategastes clausi* (Thompson), described (Thompson, 1883, p. 98, pl. v, figs. 1-8.) from New Zealand. *Parategastes sphaericus* (Claus) has been recorded from the Suez Canal and *Parategastes nigrans* (T. and A. Scott) from the Ceylon Pearl Banks, but Sars (1903-11, p. 73) regards these two latter species as synonymous, a view with which I agree. The genus is obviously one of wide distribution and it is therefore not surprising that specimens should have been obtained in the Chilka Lake. These examples, however, while closely resembling the European form, *P. sphaericus*, differ from it in certain details of structure. I have been able to compare both forms and I have come to the conclusion that the Chilka Lake examples are in all probability merely a variety of the European species.

♀. Total length 0·44 mm.

The cephalon is produced ventrally to a point and its anterior margin is furnished with a thin lamellar crest. The last thoracic segment is fused with the genital segment of the abdomen, as in all members of the genus, and is produced ventrally in a strong recurved hook.

The 1st antenna consists of seven segments, which have the following proportional lengths :—

Segments	2	1	3	4	5	6	7
	28	26	20	16	12	5	10

The fourth segment bears a long sensory filament.

The 2nd antenna closely resembles that of *P. sphaericus* but in the present specimens the short outer branch terminates in a tuft of three setae, instead of only two.

The mouth-parts appear to be identical with those of *P. sphaericus*.

The 1st pair of swimming legs show a very distinct difference from the condition found in the European form. In *P. sphaericus* the single-jointed endopod is very considerably dilated and is much wider than the exopod, whereas in these examples the two branches are equal in breadth. The exopod bears at its distal end a slender seta and two stout spines with serrated margins.

The 2nd and 3rd pairs of swimming legs conform to the generic type in having only two joints in the exopod, the endopod being three-jointed.

The 4th pair of legs have both endopod and exopod composed of three segments. As in *P. sphaericus*, the second seta of the third joint of the exopod, counting from the proximal end, is greatly thickened and elongated and has serrated margins : a minute hair-like seta arises midway between the base of the thickened seta and the distal end of the segment ; and the fourth seta arises distally close to the terminal spine.

The 5th pair of legs closely resemble those of *P. sphaericus ;* the basal segment is produced in a crescent-shaped plate which reaches as far as the distal end of the free segment, in shape this plate is narrower and more tapered distally than in *P. sphaericus*. It bears three plumose setae on its inner border and distally is armed with two stout serrated spines. The free segment is slightly curved and bears near the base a small simple seta ; about the middle of its length two stout serrated spines arise close together near the outer margin and distally it carries two stout serrated spines of unequal length.

♂. Total length 0·44.

The genital segment, as in *P. sphaericus*, is produced ventrally in a large spermatophore reservoir, that terminates in a pair of pointed lappets.

The 1st antenna consists of seven joints having the following proportional lengths :—

Segments	1	2	3	4	5	6	7-8
	49	49	18	34	5	14	12

The whole appendage is modified to form a feebly prehensible organ. The 4th segment is somewhat swollen and the hinge occurs between the 6th and 7th segments. The end portion appears to consist of only a single part owing to segments 7 and 8 having become fused together, whereas in *P. sphaericus* they are distinctly separated. Distally the joint is produced in a slender claw-like process.

The mouth-parts and swimming legs are the same as in the female.

The 5th pair of legs consist each of a single branch of two segments. The basal segment is short, whereas the distal segment is long and slender and is slightly curved. It bears on its margin two setae and distally carries a pair of unequal serrated spines.

A large number of specimens were obtained at stations B, E, F, G, 37 and 133. In April, when the density of the water in the lake is at its highest, it appears to be common throughout the southern end but at other seasons it was only obtained near the entrance channel. It seems fair to assume that it is a littoral marine form that has been swept into the lake and has, at any rate to some extent, become acclimatised to the lacustrine conditions prevailing.

Family IDYIDAE.

Genus **IDYAEA** Philippi.

Idyaea furcata (Baird).

Canthocamptus furcatus, Baird, 1850, p. 210, pl. xxv, figs. 1, 2 and pl. xxx, figs. 4, 5, 6
Tisbe furcata, Claus, 1863, p. 115, pl. xv, figs. 1-10.
Idya furcata, Boeck, 1864, p. 258.
Idya furcata, Brady, 1880, p. 172, pl. lxvii, figs. 1-11.
Idya furcata, Thompson, 1883, p. 108, pl. viii, figs. 1-8.
Idya furcata, Thompson, 1890, p. 152.
Idya furcata, Thompson, 1893, p. 205, pl. xxiv, fig. 4.
Idya furcata, Brady, 1899, p. 45.
Idya furcata, A. Scott, 1902, p. 417.
Idya furcata, Farran, 1905, p. 47.
Idya furcata, Sars, 1905, p. 380.
Tisbe furcata, Norman and T. Scott, 1906, p. 183.
Idya furcata, Williams, 1906, p. 654.
Idya furcata, Sharpe, 1910, p. 417.
Idya furcata, Sars, 1903-11, p. 88, pl. li and lii, fig. 1.
Idyaea furcata, Sars, 1903-11, p. 367.
Idyaea furcata, Willey, 1920, p. 34.

This species appears to have a world-wide distribution. A few specimens were obtained in the Chilka Lake collection at station E in the outer channel in the month of April. They had almost certainly been swept in from the sea.

Idyaea ensifera (Fischer), var. **indica**, nov.

(Plate LII, fig. 1.)

Tisbe ensifera, Fischer, 1860, p. 668, pl. iii, figs. 67-70.
Idya ensifera, Sars, 1903-11, p. 90, pl. liii, fig. 1.
Idyaea ensifera, Sars, 1903-11, p. 367.

Two examples of an *Idyaea*, that appear to me to belong to the above species, occurred in the collection. I have also occasionally met with other specimens in my collections

in the Nicobar Islands. In their general structure they agree closely with the description given by Sars, but as these specimens exhibit one or two points of difference from the Norwegian form I give a description of them below.

♀. Total length 0·86 mm.

The proportional lengths of the anterior and posterior regions of the body vary considerably, owing to certain of the specimens having contracted the abdominal muscles, very much in the manner described above in *Longipedia coronata* (*vide supra*, p. 805). When fully extended the proportional lengths are 35 : 28.

The body is an elongate oval in shape and is produced anteriorly in a small prominence.

The abdomen is considerably narrower than the anterior part of the body and consists of four segments, having the following proportional lengths :—

Abdomen	1	2	3	4	Furca
	45	18	15	7	7

The posterior margins of the first three segments are armed with small spines in the lateral region.

The 1st antenna reaches back about three-fourths of the length of the cephalic segment and appears to be rather shorter than in the Norwegian form. It consists of eight segments, of which the proximal four are comparatively stout. The third joint is slightly longer than the second, and the fourth is much shorter than either. The distal portion of the antenna, comprising the last four segments, is about one-third the length of the proximal part. The proportional lengths of the segments are as follows :—

Segment	1	2	3	4	5	6	7	8
	14	21	24	15	5	5	4	11

The 2nd antenna and mouth-parts have the usual structure. The 1st pair of legs consist of a three-jointed exopod and endopod. The endopod is vastly the longer of the two branches and its 2nd segment is somewhat longer than the first, the proportional lengths being 22: 24. The third joint is small and bears two spines the inner of which is tufted. The exopod reaches to a little beyond the joint between the first two segments of the endopod, and the marginal spines on the third segment are long and slender. The basal portion of the limb is rather more produced on its inner side than in the Norwegian form.

The 2nd to 4th pairs of legs are very similar to those of *Idyaea furcata*. Sars remarks that the terminal joint of the exopod in *Idyaea ensifera* is remarkably long and narrow, but this is not the case in the present specimens. In all the swimming legs the setae show a clear line of division into a stout proximal portion and a more flexible distal part.

The 5th leg is elongate and slender. It consists of the usual basal and free segments. The inner projection of the basal joint is small and bears three setae. The free distal segment reaches back well beyond the transverse furrow across the middle of the genital segment when the abdomen is relaxed ; but when the abdominal muscles are contracted it reaches almost to the posterior margin of the segment. It bears at its distal end five setae, four of which arise from the distal border, while the fifth arises close to the distal end of the outer margin. The whole segment is fringed with fine hairs.

In spite of the differences noted above I believe that these specimens belong to the same species as the Norwegian form described by Sars. It seems to me that the points of resemblance are sufficiently strong to warrant this opinion and I have therefore described these examples as a tropical variety.

Family THALESTRIDAE.

Genus **DACTYLOPUSIA** Norman.

Dactylopusia brevicornis (Claus).

(Plate LIII, fig. 1.)

Dactylopus latipes, Boeck, 1864, p. 270.
Dactylopus brevicornis, Brady, 1882, p. 118, pl. lvii, figs. 10-12 and pl. lviii, fig. 14.
Dactylopus brevicornis, Thompson, 1893, p. 202, pl. xxii, fig. 4, *e. f. g.*
Dactylopusia brevicornis, Sars, 1903-11, p. 130, pl. lxxx.
Dactylopusia brevicornis, Norman and T. Scott, 1906, p. 170.

A few examples of what appears to be this species were obtained in the Chilka Lake collection at station E, near the entrance channel, in the month of April.

As regards size these specimens are rather smaller than those from the North Atlantic Ocean and its offshoots. Sars gives the total length of examples measured by him as 0·78 mm., whereas the present specimens were only 0·57 mm.

Structurally these examples appear to be identical with the Atlantic form. All the specimens obtained in the Chilka Lake were females, but I have subsequently examined an example of a male, that was obtained in Nankauri Harbour in the Nicobars. This also agrees exactly with the description and figures given by Sars.

Up to the present time this species has only been recorded from the Mediterranean, the British coasts and from Norway. Its occurrence, therefore, in the present collection and in the Nicobar Islands is particularly interesting.

Family DIOSACCIDAE.

Genus **AMPHIASCUS** Sars.

Amphiascus scotti, nom. nov.

(Plate LIV, fig. 1.)

Dactylopus propinquus, T. Scott, 1894, p. 99, pl. x, figs. 44-52 and pl. xi, figs. 1-3.

Sars in his monograph on the Crustacea of Norway has split the old genus *Dactylopus* Claus into a number of separate genera, among which is the new genus *Amphiascus*. T. Scott, under the name *Dactylopus propinquus*, described a new species of copepod from the Gulf of Guinea, and in the Chilka Lake collection I have found a number of examples in various stages of development. A study of the structure of these individuals shows that they conform to the definition of the genus *Amphiascus*, as given by Sars: unfortunately the name *Amphiascus propinquus* is already pre-occupied by a form that Sars has himself

described from the Norwegian coasts, and the present species has therefore to be given a new name. I have renamed it *Amphiascus scotti* to commemorate its discovery by Mr. T. Scott in the Gulf of Guinea.

Examples occurred in the present collection at stations C, E, J, K, and 61. The animal was undoubtedly breeding in the lake and several stages in its development were obtained. At least three stages, all of which I believe belong to this species, were examined and as they show certain interesting changes in structure I propose giving an account of them.

In the smallest of the three stages, individuals of which are still immature, the body is robust, and the posterior margins of all the abdominal segments bear transverse rows of spinules.

♀. The 1st antenna consists at this stage of five joints, the slender distal portion comprising only two segments.

The 2nd antenna and mouth-parts appear to have already assumed the form and characters of the adult condition.

The 1st pair of legs consists of a two-jointed basal portion, but both exopod and endopod consist of only two joints instead of the usual three. The exopod reaches to the end of the proximal segment of the endopod.

The 2nd to 4th pairs of swimming legs each consist of a two-jointed exopod and endopod.

The 5th pair of legs have already assumed the adult type although the separation into basal and free distal segments has not yet taken place, and there appear to be fewer setae on the inner prolongation of the basal joint.

♂. The smallest examples of this sex seem to belong to a later stage than the females described above.

The abdomen consists of only four segments, all of which bear transverse rows of small spinules.

The 1st antenna is of the female type, consisting of only five segments, and shows no trace of any modification into a grasping organ.

The 1st pair of swimming legs consist of a two-jointed basal portion and a three-jointed exopod and endopod, the two distal segments in each branch together corresponding to the terminal joint in the female appendage. The last two joints of the endopod are short and of equal length, and the branch terminates in a stout claw-like spine and two setae of unequal length, the inner one being quite small.

The 2nd pair of legs already show a commencement of the modification that is characteristic of the males of this and closely-allied genera. The exopod and endopod are usually three-jointed, though in one specimen the division between the middle and distal segments of the endopod had not been completed. The distal joint of the endopod bears four setae, of which the distal pair are short and stout and correspond to the modified setae in the adult ; the pair arising from the inner border are of the usual slender type. In this stage of development the endopod of this limb exhibits a considerable degree of resemblance to the condition described and figured by Giesbrecht (1902, p. 35, pl. x, fig. 7) in the corresponding appendage of *Dactylopus antarcticus*. Here also the endopod consists of three segments and the terminal segment is described as follows :—" the terminal segment is pointed at the end and the setae arising from it are stilette-shaped ; on its inner border are two setae of which the longer and more distal is plumose."

The 3rd and 4th pairs of legs also consist of three-jointed exopods and endopods.

The 5th pair of legs show a combination of the characters of the appendages in the sexually mature adults. Each consists of a basal segment and a free joint. The basal segment is produced externally and bears a single seta; internally it is prolonged in a tongue-shaped process bearing two short spines, thus closely resembling the condition in the adult male. The free joint, however, bears three external marginal spines, the middle one of which is shorter than the others; from the distal border arise two setae and from the inner margin springs a single spine. The condition of this free segment thus corresponds closely with the form met with in the sexually mature female, though the spines are considerably shorter in the younger stage.

Sexually mature examples fall into two groups, which differ from each other both as regards size and in the shape of the fifth pair of legs.

♀. The body is stout and robust. The total length measurement is 0·60 mm.

The proportional lengths of the anterior and posterior regions of the body are 17:12.

The abdomen consists of four segments, all of which bear rows of spinules. The proportional lengths of the various segments and the furcal rami are as follows :—

Abdomen	1	2	3	4	Furca
	37	23	17	13	6

The 1st antenna consists of five segments, the terminal one of which is long and shows traces of division into two. The proportional lengths of the segments are—

Segments	1	2	3	4	5
	18	9	28	5	24

T. Scott in his original description of this form states that the antennae consist of six segments, but in my examples the division of the last joint into two is not complete Allowing for this difference, the proportional lengths of the joints in both T. Scott's examples and mine are extremely similar.

The 2nd antennae and mouth-parts appear to correspond with the description and figures given by Scott.

In the 1st pair of swimming legs the exopod seems to be slightly longer than in Scott's examples and reaches to the end of the first joint of the endopod.

The 5th pair of legs, while agreeing in the main with T. Scott's figures and description, show certain points of difference, the chief of which is that the inner prolongation of the basal segment is distinctly narrower, and the free segment is of a more oval shape. In the larger form to be described later, however, these differences disappear. The number and arrangement of the spines on the two parts of the appendage correspond exactly with T. Scott's description.

A certain number of females were carrying two ovisacs, each containing 13-14 ova.

♂. The corresponding males also agree fairly closely with T. Scott's description.

The total length measurement was 0·56 mm.

The body is, as in the female, stout and robust. The abdomen consists of five segments, having with the furcal rami the following proportional lengths :—

Abdomen	1	2	3	4	5	Furca
	12	10	13	12	11	5

The first antenna consists of seven segments, having the proportional lengths :—

Segments	1	2	3	4	5	6	7
	18	9	4	20	12	10	12

The appendage forms an efficient grasping organ and the knee-joint lies between segments 5 and 6. The fourth segment is the longest and is considerably dilated. Both segments 3 and 4 bear long sensory filaments.

The second antennae, mouth-parts and first pair of swimming legs resemble those of the female.

The second pair of legs are modified in the usual manner. The endopod differs somewhat from T. Scott's description, for in this stage this branch consists of three—not two—segments. The terminal segment bears on its outer margin near the base two setae, which have been modified to form spines, and from the distal end two plumose setae arise close together. The middle segment of the branch bears a single plumose seta on its inner margin.

The remaining appendage agree with T. Scott's descriptions.

Associated with the above examples were others that at first sight I took to belong to a different species of *Amphiascus*. Unlike the preceding form these specimens are long and slender in build, forming a marked contrast to the stout robust form just described. A study of their structure, however, revealed that the two forms are practically identical, such differences as do occur being in the main due to progressive development.

♀. *The length measurement of these examples is 0·79 mm. and the proportional* lengths of the two regions of the body are 17 : 12.

The abdomen consists of four segments all of which bear transverse rows of small spinules, and the proportional lengths of the segments and furcal rami are as follows :—

Abdomen	1	2	3	4	Furca
	40	23	19	13	7

The first antenna is now divided into six segments, the terminal joint having undergone division into two. The appendage thus corresponds exactly with T. Scott's description and the proportional lengths of the segments are also practically identical.

Segments	1	2	3	4	5	6
	8	5	8	2	4	7

The second antennae, mouth-parts and first to fourth pairs of legs are identical with the corresponding appendages in the smaller form, described above, and with T. Scott's examples, with again the single exception of the exopod of the first leg which is slightly longer than he figures it.

The fifth pair of legs have become slightly modified, both the free segment and the tongue-like prolongation of the basal joint being somewhat broader than in the preceding stage. The whole appendage now agrees exactly with T. Scott's description.

♂. A few males belonging to this type were also found in the collection. Here too I find certain slight modification in certain of the appendages.

The first and second antennae, mouth-parts and first pair of swimming legs agree exactly with the preceding form.

The second pair of legs shows an interesting modification. The second and third joints of the endopod have now become fused together, so that the appendage consists of only two joints and the limb in every way corresponds to the description given by T. Scott.

The fifth pair of legs show a slight change of shape, corresponding to the changes that we have already noted in the female. The prolongation of the basal joint has become somewhat narrower and the free segment is also more slender and is oval rather than triangular in shape. The number and character of the spines and their points of origin from the segments is identical in the two forms.

During the past few months I have been fortunate enough to discover at least two other examples of this interesting relationship. In all cases the larger form agrees exactly with the smaller except in small changes of shape of the 5th pair of legs, and it seems to me that these two forms, agreeing as they do so closely with each other, must be regarded as belonging to one and the same species and I have therefore come to the conclusion that they are examples of dimorphism.

A. Scott (1902, p. 410, pl. iii, figs. 6-10), under the name *Stenhelia irrasa* has very briefly described a copepod that he obtained in the Red Sea. This form, which must be removed to the genus *Amphiascus*, very closely resembles *Amphiascus scotti*. Like the above form the first antenna possesses only five segments and the characters of the first and fifth legs are also very similar. I am inclined to believe that he was dealing with the same species and that *Amphiascus irrasus* (A. Scott) should be regarded as a synonym. Unfortunately A. Scott's description and figures are not sufficient to solve the problem. Should these two forms subsequently prove to be identical A. Scott's name will, of course, have precedence.

Genus **STENHELIA** Boeck.

Stenhelia inopinata (A. Scott).

(Plate LIII, fig. 2.)

Delavalia inopinata, A. Scott, 1902, p. 411, pl. iii, figs. 19-22.

A single example of a male *Stenhelia* was obtained at station C. A study of its structure shows that in many respects it is closely related to though not identical with *Stenhelia palustris* (Brady). A. Scott, under the above name, has described from the Red Sea a female *Stenhelia* that also is closely related to this species and it appears probable that the present specimen is the hitherto unknown male of Scott's female.

♂. Total length 0·57 mm.

The anterior and posterior regions of the body are of equal length.

The anterior region is robust and terminates in front in a rostrum of moderate size. The rostrum tapers towards the anterior end and the extreme tip is produced in a bilobed process on each side of which a small hair arises. In its general form it closely resembles that of *S. palustris* (Brady) but is rather narrower in proportion to its length.

The abdomen is considerably narrower than the cephalothorax and the posterior segments are markedly tapered. The furcal rami are long and slender and the line of arti-

culation with the anal segment is armed with a transverse row of minute spinules. There are five abdominal segments, which have the following proportional lengths :—

Abdomen	1	2	3	4	5	Furca
	17	12	10	9	9	27

The first antennae are modified to form grasping organs. Each antenna consists of eight segments, of which the proximal two are stouter than the rest, and the fourth and fifth are somewhat dilated. The hinge-joint occurs between the sixth and seventh. The third and fourth segments each bear a long sensory filament. The proportional lengths of the segments are as follows :—

Segments	1	2	3	4	5	6	7	8
	10	6	2	5	2	6	6	7

The mandible bears a palp that has the general shape characteristic of the genus.

As in other members of the genus the maxillipeds are small and non-prehensile. The distal segment terminates in a curved claw-like seta.

The first pair of legs consist of a two-jointed basal portion, a three-jointed exopod and an endopod of two joints only. The two branches are of equal length. The proximal segment of the endopod is stout and bears at the distal end of the inner margin a short stout truncated process, instead of a seta. The distal basal segment bears a slender seta externally and a stout serrated spine on its inner margin.

As in all the males of this genus, the endopod of the second pair of legs is modified. In the present specimen it consists of two unequal segments. The proximal segment bears a stout spine-like process instead of a seta at its distal internal angle. The distal segment is about twice the length of the proximal and about the middle of its length is bent sharply outwards at an angle. The terminal portion of the joint is narrower than the proximal part. It bears five setae of which the proximal is small and the last but one is stout and serrated.

The third and fourth pairs of legs are of normal structure and each branch is composed of three segments. The two branches are of nearly equal length.

The fifth pair of legs is rudimentary. Each appendage is represented merely by spines and setae arising from the posterior border of the fifth thoracic segment. Near the middle line on each side is a long stout spine with a small spine immediately external to it. In the ventro-lateral region of the border arises a stout serrated spine, with two slender setae arising externally to it. Between the two stout spines the posterior margin of the segment is fringed with a row of fine needle-like spinules.

This single specimen was obtained at station C at the south end of the lake in the month of December.

Family CANTHOCAMPTIDAE.

Genus **MESOCHRA** Boeck.

Mesochra nana Brady.

(Plate LV, fig. I.)

Mesochra nana, Brady, 1910, p. 522, text-fig. xiv.

The genus *Mesochra* is one of wide distribution. Several species have been described from the coasts of Great Britain and Norway and even as far north as the Arctic

Seas. Sars has recorded the occurrence of a species from the Pacific Ocean and Brady described the present species from the Antarctic seas.

A single example of a female occurred in the Chilka Lake, and, in spite of the great distance from the original locality and the different conditions under which it was living, it seems to belong to Brady's species *M. nana*.

♀. Total length 0·30 mm.

The proportional lengths of the anterior and posterior regions of the body are 56 : 43.

The body is moderately robust, and tapers slightly towards the posterior end. The rostrum is ventrally deflexed and, when the animal is viewed from above, forms only a low rounded projection in the middle line anteriorly. The cephalic segment is large and is longer than the rest of the thoracic segments together. The postero-lateral angles of the fourth thoracic segment are produced backwards to a sharp point on each side. The abdomen consists of four segments, which have with the furcal rami the following proportional lengths :—

Abdomen	1	2	3	4	Furca
	14	8	7	5	4

The genital segment is large and is incompletely divided into two, and the posterior margins of all the abdominal segments are fringed with rows of needle-like spines.

The furcal rami are as broad as they are long, and both inner and outer surfaces are armed with rows of needle-like spines. At its distal end the ramus bears four setae of which the inner and outer are small and delicate : the other two setae arise close together and are long and stout, the inner of the two being by far the longer.

The 1st antenna is short and reaches back to about one-third the length of the cephalic segment. It consists of seven segments, of which the proximal four are stouter than the distal three. The fourth segment bears a long sensory filament.

The 2nd antenna consists of two branches, but the outer one is very short and consists of only a single segment bearing three setae. The terminal segment of the inner branch bears three spines, situated at equal intervals on its anterior margin, and between and proximal to these spines the border is armed with numerous small spinules.

The mouth-parts resemble those of other members of the genus.

The 1st pair of swimming legs consist of a two-jointed basal part and a three-jointed exopod ; but the inner ramus appears to consist of only two segments, a long proximal joint and a short cylindrical distal segment. The exopod is short and reaches only a short distance beyond the middle of the length of the proximal segment of the endopod : the first and second segments each bear a single slender marginal spine, and the distal segment bears two spines and two setae, which arise close together from its apex. The outer margins of all the joints are fringed with minute spinules. The proximal joint of the endopod is long and bears a single internal seta about half way along its length. The distal joint bears a long claw-like spine and a slender seta.

The 3rd swimming leg consists of a three-jointed exopod and a two-jointed endopod. The endopod is much the shorter branch and only reaches to the end of the middle joint of the exopod. The terminal joint of the exopod is oval in shape and bears only two marginal spines. The end-spine is slender and equals the two distal segments of the limb in length. Three setae arise from the inner margin.

The 5th leg consists of a basal part and a free segment. The basal portion is produced internally in a broad triangular plate that extends slightly beyond the level of the distal end of the free segment. It bears five spine-like setae of which the distal one is by for the longest. The free segment is sub-triangular in shape and bears five setae.

This specimen agrees very closely with the description and figures given by Brady (*loc. cit.*) of the form which he discovered in the Antarctic and which he named *Mesochra nana*. In both cases the terminal joint of the exopod of the swimming legs bears only two marginal spines, a character that is also shared by *M. meridionalis* Sars (1905, p. 389, pl. xviii, figs. 87-102) and *M. aestuarii* Gurney (1921*b*, p. 238.) The 5th pair of legs agree exactly with Brady's descriptions. There is, however, one point of difference. Brady in his description states that the terminal portion of the endopod of the 1st leg consists of two segments, whereas in the present example this portion of the ramus appears to consist of a single slender joint as in *M. lilljeborgi* Boeck.

Mesochra sp.

(Plate LV, fig. 2.)

Associated with the female described above were two examples of a male, which, however, appear to belong to a different species.

♂. Total length 0·30 mm.

The proportional lengths of the anterior and posterior regions of the body are 54 : 43.

In general appearance the body closely resembles the female described above.

The 1st antennae are modified to form a grasping apparatus. Each consists of seven segments of which the 2nd to 4th are considerably dilated. The hinge-joint occurs between the 5th and 6th segments.

The 1st pair of legs consist of the usual two-jointed basal segment and both exopod and endopod are in these examples three-jointed. The exopod is comparatively short, as in the preceding female, and extends only a little beyond the middle of the proximal segment of the endopod. The terminal joint bears two delicate curved spines and two setae. The endopod consists of an elongate proximal segment, and two short equal distal segments. The proximal segment bears a single seta on its inner margin, but in these examples this arises from near the distal end of the joint instead of from near the middle of its length.

The 2nd to 4th pairs of legs each consist of a three-jointed exopod and a two-jointed endopod. The number of marginal spines on the last segment of the exopod is three, so that in this respect also these males differ from the female described above. The endopod of the 3rd leg shows the usual modification; the distal segment has a somewhat swollen basal portion and an elongate cylindrical distal region from which two setae arise. In this respect this form closely resembles *Mesochra hirticornis* (T. Scott.)

The 5th pair of legs consist of a basal joint and a free segment. The inner expansion of the basal joint is small and bears only two spines, of which the inner is the longer. The process is armed with a row of small spinules along its inner margin. The free segment is triangular or pyriform in shape and bears five spines, two on each border and one distally. In its general shape and armature this appendage agrees very closely with the correspond-

ing limb in *Mesochra pygmaea* (Claus), almost the only difference being in the spines, which are much coarser and stouter than in the European form.

All three specimens were obtained at station 37.

Genus **NITOCRA** Boeck.

Nitocra spinipes Bocek var. **orientalis,** nov.

(Plate LVI, fig. 1.)

Nitocra spinipes, Boeck, 1864, p. 274.
Canthocamptus palustris, Brady, 1880, p. 53, pl. xxxix, figs. 13-23.
Canthocamptus palustris, Norman and T. Scott, 1906, p. 155.
Nitocra spinipes, Sars, 1903-11, p. 212, pl. cxxxviii.
Nitocra spinipes, Gurney, 1920, p. 216, figs 1, 2 and 2B.

Sars in his great monograph on the Crustacea of Norway has identified *Canthocamptus palustris* Brady with *Nitocra typica* Boeck. In this I think he is wrong. Brady's figure of the 1st pair of legs shows the exopod reaching at least as far as the end of the 2nd joint of the endopod and the actual lengths of the two rami as figured are equal, though he describes the inner branch as being "rather longer than the outer." In *Nitocra typica* the inner branch is very much longer than the outer. Furthermore his figure of the 5th foot agrees exactly with the condition found in *Nitocra spinipes*. I have therefore, followed Gurney (*loc. cit.*) and regard *Canthocamptus palustris* as a synonym, not of *Nitocra typica* but of *N spinipes*.

Several examples of what appears to be only a variety of this species occur in the Chilka Lake collection.

♀. As regards the antennae and mouth-parts these specimens agree closely with the European form. The 3rd segment of the 1st antenna is shorter than either of the segments on either side of it, and the terminal segment is nearly twice the length of the preceding one.

In the 1st pair of swimming legs the exopod reaches nearly to the end of the endopod, the terminal two joints of which are subequal in length and are together equal to the proximal joint.

The 2nd to 4th pairs of legs agree exactly with the description and figures given by Sars.

The 5th pair of legs also closely resemble the corresponding appendage in the northern form.

♂. The corresponding males show several small points of difference from the European form.

In the 1st pair of swimming legs the marginal spine arising from the 1st point of the exopod is much longer than the marginal spines of the other joints, and the whole exopod only reaches to about the distal end of the second segment of the endopod. The 2nd basal joint bears on its inner margin a stout spine, that is curved at its distal extremity in the form of a claw.

The 2nd to 4th pairs of legs agree with the corresponding appendages in the northern form.

The 5th pair of legs exhibit certain small differences. The inner prolongation of the basal joint is slightly rounded and bears only two, instead of three, spines. Of these spines the inner is about twice the length of the outer and both are serrated. The distal joint is oval in shape and bears six setae, of which the outer three are slender, the fourth is long and stout and is coarsely serrated ; the fifth seta is small and the sixth or inner one is long and plumose. The appendage clearly resembles that of *N. simplex* Schmeil.

The Chilka Lake examples are of a pale brown colour with a very conspicuous red eye-spot.

While agreeing very closely with the northern form, these examples from the Chilka Lake exhibit certain points of difference, which, however, I do not think are sufficiently important to justify the creation of a new species. I consider that in all probability these specimens represent a local, possibly an oriental, variety correlated with the difference in environment. It is suggestive that in the only European species of this genus, whose habitat is slightly brackish water, namely, *Nitocra simplex* Schmeil, the fifth leg in the male exhibits the same peculiarity as the corresponding appendage in both this and the following varieties from the Chilka Lake. In all three forms the inner expansion of the basal joint bears only two spines.

In 1914 the only region of the lake where specimens of this variety were obtained was in the outer channel near the entrance, but last year in June Dr. Annandale procured specimens, including ovigerous females, in weed-washings from Rambha Bay.

Nitocra typica Boeck var. **lacustris**, nov.

(Plate LV, fig. 3 and plate LVI, fig. 2.)

Nitocra typica, Boeck, 1864, p. 274.

Nitocra oligochaeta, Giesbrecht, 1882, p. 116, pl. i, figs. 2, 15, pl. iii, fig. 17, pl. iv, figs. 3, 10, pl. v, fig. 10, pl. vi, fig. 3, pl. vii, fig. 17, pl. viii, fig. 3, pl. ix, fig. 15, pl. x, fig. 15, pl. xi, figs. 15, 21, 33, 34 and pl. xii, figs. 7-9.

Nitocra typica, Sars, 1903-11, p. 212, pl. cxxxviii.

Nitocra oligochaeta, Norman and T. Scott, 1906, p. 152.

Nitocra typica, Gurney, 1920, p. 217, figs. 1, i, and 2A.

Two males and one female that appear to me to belong to this species were found in the Chilka Lake collection.

♀. Total length 0·60 mm.

The body in its general shape and proportions seemed to agree very closely with the European examples of the species.

The posterior margins of the abdominal segments are fringed with fine spines and the anal operculum is also armed with a transverse row of spinules.

The 1st antenna consists of eight segments and the third segment was to a considerable extent telescoped into the second, thus giving to it a spurious appearance of shortness, but in actual length it was equal to the following segment. As in the European form the terminal portion of the antenna is shorter than the stouter proximal region.

The 2nd antenna has the form characteristic of the genus. The basal part is subdivided into two segments, and the outer ramus is very short, consists of only a single joint and bears one plumose seta and two smooth spine-like setae.

The mandible resembles that of other species and bears a two-jointed palp.

The maxillae and maxilliped resemble those of the European form.

The 1st pair of swimming legs agree exactly with the European form. The exopod is short and only reaches to the end of the proximal segment of the endopod.

The 5th pair of legs consists of a basal part and a free segment. The basal portion is produced on its inner side in a tongue-like process that bears five setae: it reaches to about half-way along the length of the free segment. The free joint is oval in shape and bears at its distal end six setae, as in the European form.

♂. There were two examples of this sex in the collection, and these exhibit a close degree of resemblance to the form described by Giesbrecht from Kiel.

The 1st antenna agrees closely with the description and figures of the European form.

The 1st and 2nd pairs of swimming legs resemble those of the female.

The 3rd pair of swimming legs also exhibit a marked resemblance to the corresponding appendage in the European form. The end spine on the distal segment of the endopod is modified and forms a hook-like structure that is very similar to the spine figured by Giesbrecht (*loc. cit.*).

The 5th pair of legs on the whole corresponds very well with the description of the corresponding appendage in the European form. It exhibits, however, one point of difference for the prolongation of the inner part of the basal joint bears only two spines instead of three.

Nitocra yahiai (Blanchard and Richard).

(Plate LVII, fig. 1.)

Canthocamptus yahiai. Blanchard and Richard. 1891. p. 516. pl. vi. figs. 42-54.

?Nitocra fragilis. Sars. 1905. p. 386. pl. xvi. figs. 70-86.

This species was first described by Blanchard and Richard from the waters of the Oasis of Yahia in Algeria. These authors included it in the genus *Canthocamptus*. but a study of the structure of the antennae and mouth-parts shows that it must be transferred to the genus *Nitocra*. Sars has subsequently described under the name *Nitocra fragilis* a copepod that was obtained in a brackish-water lake in the Chatham Islands, South Pacific Ocean. These two forms agree very closely in their main characters, though the two accounts differ from each other as regards certain details. In spite of these differences I am inclined to regard the two forms as belonging to one and the same species.

Dr. Annandale has recently made another small collection of Copepoda from the Chilka Lake, and among the individuals present were two that seem to me to belong to this species. They are from weed-washings from Barkuda Island and were taken in June.

♂. Total length 0·57 mm.

The body is more slender than in the preceding species. The abdomen is narrower than the anterior region of the body and is composed of four segments. Blanchard and Richard state that in their examples the abdomen possessed five segments, but this is probably an error due to their regarding the incompletely-divided genital segment as two. The

posterior margins of all the abdominal segments are fringed with transverse rows of delicate needle-like spines and the anal operculum is also provided with a transverse row of spines that are somewhat larger in size.

The rostrum is small and rounded.

The cephalic segment is rounded anteriorly and is somewhat shorter than the three following segments in length.

The 1st antenna is short and reaches back about half way to the posterior margin of the cephalon. It is composed of eight segments, of which the basal four are not markedly larger than the distal ones. The 1st, 2nd, 4th, 6th and 8th segments are longer than the others. The 4th segment is produced so as to overlap the 5th segment. It is from this prolongation that the sensory filament arises and not from the 5th segment, as Blanchard and Richard state.

The 2nd antenna has the usual form. The outer branch is short and consists of only one segment, which bears three setae, the internal of which is plumose and is longer than the two distal ones.

I was unable, unfortunately, to examine the mandible. Blanchard and Richard figure it as having a wide cutting edge, fringed with a number of small teeth. The figure, however, disagrees with their description, for they remark " La mandibule est munie d'un grand nombre de dents. Les deux premières sont fort, tout les autres petites et égales. La distance qui sépare les deux dents extrêmes est la largeur maxima de la mandibule." The palp according to them has the typical form.

The 1st pair of swimming legs are small. The two branches each consist of three segments and are of equal length. The proximal segment of the endopod is stout and is almost equal in length to the two distal segments together.

The 2nd to 4th pairs of swimming legs appear to be identical in structure with both accounts.

The 5th pair of legs have the usual structure, and consist of a basal and a free segment. This appendage in my examples agrees exactly with the figure given by Blanchard and Richard (*loc. cit*, fig. 51). The distal free segment is oval in shape and bears six setae. In the description of the Pacific form given by Sars, this segment is shown as being somewhat truncated at its distal end, although in the text he describes it as oval. He states that only five setae are present on the distal margin.

Family LAOPHONTIDAE.

Genus **LAOPHONTE** Phillipi.

Laophonte chathamensis Sars.

(Plate LVII, fig. 2.)

Laophonte chathamensis, Sars, 1905, p. 391, pl. xvii, figs. 103-118.

This form was described by Sars from the Chatham Islands. In the tow-netting taken at station 166 in the Chilka Lake was a single example of a *Laophonte* that seems certainly to belong to this species.

Total length 0·40 mm.

The rostrum is broadly rounded and has a small hair projecting on either side.

The 1st antenna is composed of only five segments, of which the 3rd is the longest and is followed by a very small 4th joint. The 3rd segment is produced distally so as to overlap the 4th and from this projection a slender sensory filament arises.

The 2nd antenna is two-branched. The outer ramus is short and almost triangular in shape; it bears four plumose setae. The inner ramus consists of two joints: the distal one is of moderate length and bears three spines on its margin and three geniculate setae at its distal end, and the proximal part of the inner margin is fringed with fine hair-like spines.

The mandible is of the usual type; it bears a short uniarticulate palp from which four setae arise.

The maxilla agrees exactly with the figure given by Sars (*loc. cit.* fig. 109).

The 1st pair of legs have markedly unequal rami. The exopod consists of two joints only, of which the distal is twice the length of the proximal. The endopod is twice as long as the exopod; it consists of a long and comparatively slender proximal segment and an oval short distal segment, which bears a long curved claw-like spine.

The 2nd and 3rd pairs of swimming legs each consist of a three-jointed exopod and a two-jointed endopod. The endopod is much the shorter branch and reaches to the level of the distal border of the middle joint of the exopod. The 4th leg has the same structure as the preceding two pairs, but the endopod is considerably shorter and only reaches as far as or very little beyond the distal end of the proximal segment of the exopod. The distal segment of the endopod bears only three setae.

The 5th pair of legs consist of a basal segment and a free joint. The basal segment is produced externally in a nipple-shaped projection, from the apex of which a single seta arises. Internally the basal plate is only slightly produced; from the distal end a single plumose seta arises and two more spring at equal intervals from the inner margin. The proximal part of the plate is beset with fine hairs. The free segment is long and slender. In the present specimen three fine setae arise from the distal half of the outer margin. Sars figures only two in his examples. The distal extremity of the segment is produced in a broad short conical projection. The outer margin is fringed with fine hairs.

So close is the resemblance between this example and the description and figures given by Sars that I have no doubt that it belongs to the same species.

Another species of *Laophonte* that structurally comes very near to the above is *Laophonte mohammed* Blanchard and Richard, which was found in Algeria. It has also been recorded by von Daday from Siam. In this latter species the posterior margins of the body-segments are decorated with rows of small rounded projections, which appear to be absent in the present form. The structure of the antennae, mouth-parts and swimming legs is extraordinarily similar in both forms. The 5th pair of legs show certain differences between the two forms. In *L. chathamensis* the free segment is markedly elongate and bears only a short thick projection at its apex instead of a setae. In the descriptions of this appendage in *L. mohammed* from different localities there is a considerable degree of variation. Thus in the early account by Blanchard and Richard (1891, fig. 12), this

segment is shown as being about one and a half times as long as wide and bearing three setae, the outer of which is coarse and plumose, and the authors remark that in some examples a fourth seta arises proximally from the outer margin. In specimens from Turkistan, described by von Daday (1904, p. 497, pl. ii, fig. 64) under the name *Onychocamptus heteropus*, the appendage is shown as exactly resembling the Algerian form, but an example from Siam (von Daday, 1907, p. 196, pl. xvi, fig. 16) shows a considerable difference in the shape of this free segment, for it is now twice as long as broad and bears three delicate setae on its outer margin and a long straight seta distally. It would thus appear that as one traces the species eastward there is a progressive elongation of the free segment.

It thus would appear possible that in reality *L. mohammed* and *L. chathamensis* may be synonyms of one another.

Laophonte quinquespinosa, sp. nov.

(Plate LVIII, fig. 1.)

Several examples of what appears to be a new species of *Laophonte* were taken at stations C, 128 and 166.

♀. Total length 0·70 mm.

The body is comparatively robust and tapers towards the posterior end. There is no sharp division between the anterior and posterior regions of the body. The proportional lengths of the two regions are 21 : 25.

The abdomen consists of four segments. The furcal rami are long and taper towards their posterior ends. The proportional lengths of the abdominal segments and furca are as follows :—

Abdomen	1	2	3	4	Furca
	30	14	10	15	28

The genital segment is traversed by an incomplete line of separation, which gives to it the appearance of being composed of two separate joints. The posterior margins of the first three abdominal segments are fringed along their posterior borders with transverse rows of small spines.

The furcal rami are longer than the two preceding segments. About the middle of their length a small seta arises from the dorso-lateral region and at about two-thirds of their length a pair of short setae arise close together from the lateral margin. Distally each ramus bears three setae, of which the middle one is by far the longest and stoutest, and has a bulbous swelling about one-third of the distance along its length.

The 1st antenna reaches to about two-thirds the length of the cephalic segment. It consists of only six segments, having their proportional lengths as follows :—

Segment	1	2	3	4	5	6
	30	24	22	8	7	25

The fourth segment is prolonged distally beyond the fifth and bears a short sensory filament.

The 2nd antenna consists of a two-jointed inner branch and a very short outer ramus. The outer branch bears four setae. The distal segment of the inner branch is armed with two slightly curved spines and from its distal end arise three geniculate setae. Both anterior and posterior borders are fringed with hairs.

The mouth-parts appear to resemble those of other members of the genus.

The 1st pair of swimming legs consist of a two-jointed basal portion and an inner and outer ramus, each composed of only two joints. The 2nd basal joint bears a slender seta on its outer margin and a row of spines runs across its surface. The 1st joint of the exopod is about one-half the length of the second, and bears a single marginal spine. The distal segment bears a marginal spine about two-thirds of the distance along its length and distally bears two spines and two setae. The endopod is about twice the length of the exopod and the proximal segment is stout and strong.

The 2nd and 3rd pairs of swimming legs are of the usual type.

In the 4th pair of legs the endopod is short and only reaches to about the middle of the second joint of the exopod. The distal segment bears only three setae.

The 5th pair of legs consist of a basal joint and a free segment. The basal joint is produced internally in a narrow tongue-shaped process that reaches nearly to the distal end of the free segment. It bears three delicate setae on its somewhat truncated distal end and two coarse serrated spines arise from the inner border; both inner and outer margins are fringed with hair-like spinules. The free segment is oval in shape and bears four setae on its outer margin, a single long seta from the tip of a conical projection at its distal end and a single seta on its inner border. The single external seta arising from the basal segment is situated at the extremity of a long finger-like process.

In many respects this form agrees with the description given by T. Scott (1894, p. 97, pl. x, figs. 31-37) of a species found in the Gulf of Guinea and named by him *L. brevicornis*. In both cases the exopod of the 1st leg is composed of only two joints, and the 1st antenna has only six segments. The proportional lengths of the antennal joints are also very similar. The shape of the 5th pair of legs is, however, different in the two forms, and in the present examples the furcal rami are much longer. I have therefore preferred for the present at any rate to regard the Chilka Lake examples as belonging to a different species hitherto unknown.

♂. Associated with these females were several examples of the male sex.

Total length: 0·66 mm.

In this sex the abdomen consists of five segments, which have the following proportional lengths :—

Abdomen.	1	2	3	4	5	Furca
	17	20	17	13	11	25

The 1st antenna is modified to form a powerful grasping organ. It consists of six segments, of which the third is small and the fourth enormously dilated. The hinge-joint occurs between the fourth and fifth joints, and the end segment terminates in a narrow finger-like process that is devoid of setae. The fourth segment bears a long sensory filament and its anterior margin is produced in two or more blunt processes which arise near the proximal end.

The 2nd antennae, mouth-parts and 1st pair of swimming legs are the same as in the female.

The 2nd pair of legs are somewhat modified. The exopod consists of three segments, of which the first two are subequal in length. The distal segment is shorter and is oval

in shape ; it is also attached at an angle projecting inwards towards the middle line. From the outer margin and distal end of this segment five stout spines arise, while two delicate setae spring from its inner margin. The endopod is short and only reaches to the distal end of the first segment of the exopod. It consists of two segments, the distal of which carries three setae, and is fringed on its outer and distal margin with numerous spinules.

The 3rd pair of legs is very similar to the 2nd but is not so heavily built. The endopod is proportionately longer and reaches to the middle of the second joint of the exopod. At its distal end the second segment is produced in a sharp process, and external to this two long plumose setae arise : from the inner margin two shorter setae arise the distal of which is thickened and spine-like. The 3rd segment of the exopod is much shorter than the first two segments and projects inwards : it bears five stout spines and two slender setae.

The 5th pair of legs are very rudimentary and consist merely of four setae arising from a curved base on the posterior margin of the segment, and a single external plumose seta arising independently from a cylindrical process.

In their general structure these males closely resemble the members of the corresponding sex in *Laophonte stromi* (Baird) and *L. minuta* (Boeck), but in each of these species the terminal modified segment of the exopod of the 2nd and 3rd legs bears only four stout spines, whereas in the present form there are five.

Genus **CLETA** Claus.

[=*Laophontopsis* Sars.]

The genus *Cleta* was originally founded by Claus (1863, p. 123) and in it he included three species, *Cleta lamellifera*, *C. serrata*, and *C. brevirostris*. Phillipi (1840, p. 189) had previously described the genus *Laophonte* to accommodate the single species *Laophonte cornuta*. Subsequent writers transferred the whole of Claus's species, including *Cleta lamellifera*, to Phillipi's genus and thus *Cleta* as a genus became merged in the earlier one. Sars in his great work (1903-11, p. 265) pointed out that *Cleta lamellifera* Claus exhibits certain rather striking differences from the other species of *Laophonte* and he therefore removed it from this genus and created a new genus *Laophontopsis* for it. Claus in his original description of the genus *Cleta* did not select any one particular species as the type of the genus, but as the first one that he describes is *Cleta lamellifera*, this must by the rules of priority of nomenclature be regarded as the type. It was therefore unnecessary to create a new genus for this species and the genus *Cleta* must be reinstated with *C. lamellifera* as the hitherto only known species.

In the Chilka Lake collection there was a single specimen of what appears to be a second and closely allied species. *Cleta lamellifera*, as far as our knowledge extends, seems to be confined to the littoral waters of the North Atlantic and Mediterranean Seas. The occurrence of a second species in tropical waters is therefore of considerable interest.

Cleta secunda, sp. nov.

(Plate LIX, fig. 2.)

♀. Total length 0·66 mm.

In its general appearance this example closely resembles *Cleta lamellifera*. The body is narrow and elongate and there is little or no distinction between the anterior and posterior regions of the body. The rostrum is broadly rounded.

The abdomen consists of four segments, which have with the furcal rami the following proportional lengths :—

Abdomen	1	2	3	4	Furca
	30	13	11	10	45

The furcal rami are, as in *Cleta lamellifera*, extraordinarily long, being four and a half times the length of the anal segment. They are flattened from above downwards and taper gradually to the posterior end. The external margin bears two small setae and a comparatively stout seta arises from the inner part of the distal margin.

The 1st antenna consists of only four segments, of which the third is the longest. The first segment is produced on its posterior aspect in a rounded chitinous boss. The third segment bears a stout sensory filament and the terminal joint, which shows indistinct traces of an incomplete division into two, bears on its anterior margin and distal end three stout serrated spines.

The 2nd antenna consists of two branches, of which the outer is extremely small and is uniarticulate. It bears three setae, the terminal one being large and serrated. The inner branch is of normal structure.

The mandible is furnished with a uniarticulate palp.

The 1st pair of legs consist of a 2-jointed basal part, a three-jointed exopod and a 2-jointed endopod. The exopod is the shorter of the two branches and all three segments are subequal in length. The terminal segment which is slightly the longest bears distally two spines and two setae. The endopod consists of a long and somewhat tapering proximal segment, from the inner border of which a long seta arises, and a short distal segment which bears at its tip a long seta and a single long spine.

The 2nd to 4th pairs of legs each have a 2-jointed endopod, which is considerably shorter than the exopod. These limbs are of slender build and the third joint of the exopod bears only two marginal spines.

The 5th pair of legs consists of a basal joint and a free segment. Both the inner tongue-like prolongation of the basal joint and the free segment are elongate, though not so linear in character as in *Cleta lamellifera*. The inner projection extends well beyond the distal limit of the free segment, and bears five setae, of which the proximal two are spine-like and serrated. The apical seta is much the longest. The free segment also bears five setae, three on the outer margin, one on its inner margin near the tip and one from the extreme distal end.

This specimen was obtained in a tow-netting taken off Satpara in the outer channel in the month of December. It seems certain that it has been swept into the lake from the littoral region of the Bay of Bengal.

Family TACHIDIIDAE.

Genus **EUTERPINA** Norman.

[=*Euterpe* Claus, nom. preoc.]

Euterpina acutifrons (Dana).

Harpacticus (?) *acutifrons*, Dana, 1852, p. 1192.
Euterpe gracilis, Claus, 1863, p. 110, pl. xiv, figs. 1-13.
Euterpe gracilis, Brady, 1880, p. 22, pl. xl, figs. 1-6.
Euterpe gracilis, Thompson, 1890, p. 151.
Euterpe acutifrons, Giesbrecht, 1893, p. 555, pl. xliv, figs. 16-31.
Euterpe acutifrons, Thompson, 1893, p. 193, pl. xix, fig. 3.
Euterpe gracilis, var. *armata*, T. Scott, 1894, p. 93, pl. xii, figs. 14-23.
Euterpe gracilis, Brady, 1899, p. 39.
Euterpe acutifrons, Thompson, 1900, p. 285.
Euterpe acutifrons, Cleve, 1901, p. 7.
Euterpe acutifrons, Cleve, 1903, p. 363.
Euterpina gracilis, Norman, 1903, p. 368.
Euterpina acutifrons, Thompson and A. Scott, 1903, p. 258.
Euterpe acutifrons, Esterly, 1905, p. 212, fig. 53.
Euterpe acutifrons, Wolfenden, 1905, p. 1034, pl. xcix, figs. 18-20.
Euterpina acutifrons, Norman and T. Scott, 1906, p. 139.
Euterpe acutifrons, Pearson, 1906, p. 7.
Euterpe acutifrons, van Breemen, 1908, p. 176, fig. 191.
Euterpina acutifrons, A. Scott, 1909, p. 229.
Euterpe acutifrons, Steuer, 1910, p. 29.
Euterpina acutifrons, T. Scott, 1912, p. 543.
Euterpina acutifrons, Früchtl, 1920, p. 32.

The species appears to have a world-wide distribution. A few specimens were obtained at stations 78, 84, 90 and 92, all of which are in or near the outer channel. It seems certain that they had been swept in by the inflowing current.

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LIST OF STATIONS AT WHICH COLLECTIONS OF COPEPODA WERE MADE.

Station A.—27th July, 1913.

Off Barkul.

Pseudodiaptomus hickmani Sewell.

Station B.—16th December, 1913.

At Satpara.

Acartia chilkaensis Sewell.
Acartiella major Sewell.
Acartiella minor Sewell.
Canuella furcigera Sars.
Cleta secunda, sp. nov.
Cyclopina intermedia, sp. nov.
Halicyclops magniceps (Lilljeborg).
Harpacticella lacustris, sp. nov.; females ovigerous.
Mesocyclops oithonoides Sars.
Nitocra spinipes Boeck, var. *orientalis*, nov.
Oithona brevicornis Giesbrecht.
Paracalanus crassirostris Dahl.
Parategastes sphaericus Claus, var. *similis*, nov.
Pseudodiaptomus annandalei Sewell.
Pseudodiaptomus hickmani Sewell.

Station C.—27th December, 1913.

Weed washings from Rambha.

Amphiascus scotti, nom. nov. [=*Dactylopus propinquus* T. Scott].
Cyclopina longifurca, sp. nov.
Harpacticus littoralis Sars; females ovigerous.
Laophonte quinquespinosa, sp. nov.
Longipedia coronata Claus.
Pseudodiaptomus annandalei Sewell.
Pseudodiaptomus binghami Sewell; females ovigerous.

Station D.—22nd January, 1914.

Rambha Bay.

Acartia southwelli Sewell.
Harpacticella lacustris, sp. nov.; one female ovigerous.
Labidocera pavo Giesbrecht.
Oithona brevicornis Giesbrecht; in large numbers.
Paracalanus crassirostris Dahl; adults and immature forms.

Station E.—12th April, 1914.
South side of Maludaikuda.
Amphiascus scotti, nom. nov. [=*Dactylopus propinquus* T. Scott].
Dactylopusia brevicornis (Claus).
Idyaea furcata (Baird).
Isias tropica sp. nov.
Labidocera pavo Giesbrecht.
Longipedia coronata Claus.
Mesochra nana Brady.
Nitocra spinipes Boeck, var. *orientalis*, nov.
Paracalanus crassirostris Dahl ; only few present.
Parategastes sphaericus (Claus), var. *similis*, nov.

Station F.—13th April, 1914.
Off Barkuda island.
Density of water 1009·75 at 15°C.
Acartia southwelli Sewell.
Labidocera pavo Giesbrecht.
Longipedia sp., juv.
Oithona sp., juv.
Paracalanus crassirostris Dahl.
Parategastes sphaericus (Claus), var. *similis*, nov.

Station G.—15th April, 1914.
Between Cherriakuda and Breakfast Island.
Density of water 1010·5 at 15°C.
Labidocera pavo Giesbrecht ; both adults and immature forms.
Paracalanus crassirostris Dahl.
Parategastes sphaericus (Claus), var. *similis*, nov.
Pseudodiaptomus hickmani Sewell.

Station H.—16th April, 1914.
Between Breakfast Island and Rambha.
Density of water 1010·75 at 15°C.
Labidocera pavo Giesbrecht ; both adults and immature forms.

Station I.—17th April, 1914.
S. W. of Barkuda Island.
Acartia southwelli Sewell.
Labidocera pavo Giesbrecht.
Oithona brevicornis Giesbrecht.
Paracalanus crassirostris Dahl.

Station J.—April, 1914.
Off Gantasila, Rambha Bay, in filamentous algae.
Amphiascus scotti, nom. nov. [=*Dactylopus propinquus* T. Scott].

Station K.—April, 1914.
Off Gantasila, Rambha Bay.
Amphiascus scotti, nom. nov. [=*Dactylopus propinquus* T. Scott]; females ovigerous.
Longipedia coronata Claus.
Pseudodiaptomus annandalei Sewell.
Pseudodiaptomus tollingeri Sewell.
Saphirella indica, sp. nov.

Station L.—22nd September, 1914.
Pond on Barkuda Island.
(Density of water on 19th July 1914, 1002·0 at 15°C.)
Cyclops bicolor Sars.
Mesocyclops obsoletus (Koch).

Station M.—8th November, 1914.
Off Samal Island.
Acartia southwelli Sewell.
Acartiella major Sewell.
Oithona nana Giesbrecht.
Paracalanus crassirostris Dahl.

Station 2.—12th February, 1914.
Off Chiriya Island; 1 mile N. E.×E. Mouth of Rambha Bay.
Density of water 1010·75 at 15°C.
Surface temperature 26·0°C.
Acartia southwelli Sewell.
Oithona brevicornis Giesbrecht.
Paracalanus crassirostris Dahl.

Station 8.—14th February, 1914.
Off Rambha Bay; 2·7 miles N. E. ½ E. of Breakfast Island.
Density of water 1010·00 at 15°C.
Surface temperature 26·4°C.
Acartia southwelli Sewell.
Acartia spinicauda Giesbrecht.
Labidocera pavo Giesbrecht; juv.
Oithona brevicornis Giesbrecht.
Paracalanus crassirostris Dahl.

Station 15.—15th February, 1914.
Rambha Bay, off Boat harbour.
Acartia southwelli Sewell.
Isias tropica, sp. nov.
Labidocera pavo Giesbrecht; many immature forms.
Oithona brevicornis Giesbrecht.
Paracalanus crassirostris Dahl.

Station 34.—23rd February, 1914.

Chiriya Bay towards Samal Island ; 1·6 miles. S. E. ½ S. of Barkuda
Density of water 1010·0 at 15°C.
Surface temperature 26·2°C.

Acartia southwelli Sewell ; few.
Halicyclops magniceps (Lilljeborg).
(?) *Longipedia rosea* Sars.
Oithona brevicornis Giesbrecht.

Station 37.—24th February, 1914.

Maludaikuda, along shore.

Ectinosoma normani T. and A. Scott.
Harpacticus gracilis Claus, var. *orientalis*, nov.
Harpacticus littoralis Sars.
Mesochra nana Brady.
Mesochra sp. ♂
Nitocra typica Boeck, var. *lacustris*, nov.
Paracalanus crassirostris Dahl.
Parategastes sphaericus (Claus), var. *similis*, nov

Station 48.—3rd March, 1914.

2·9 miles East of Barkul bungalow.
Density of water 1008·25 at 15°C.
Surface temperature 29°C.

Isias tropica, sp. nov.
Pseudodiaptomus hickmani Sewell ; females ovigerous.

Station 53.—4th March, 1914.

Off Barkul bungalow.

Acartia southwelli Sewell.
Acartia spinicauda Giesbrecht.
Oithona brevicornis Giesbrecht.
Paracalanus crassirostris Dahl.

Station 61.—7th March, 1914.

1 mile E. by N. of Patsahanipur.
Density of water 1006·75 at 15°C.
Surface temperature 28·7°C.

Amphiascus scotti, nom. nov. [=*Dactylopus propinquus* T. Scott.]
Oithona brevicornis Giesbrecht.
Paracalanus crassirostris Dahl.

Station 62.—7th March, 1914.

2·6 miles E. by S. ½S of Patsahanipur.

Oithona brevicornis Giesbrecht : few.
Paracalanus crassirostris Dahl ; in large numbers.

Station 65.—8th March, 1914.
1·5 miles N. by E. of Kalidai.
Oithona brevicornis Giesbrecht.
Oithona nana Giesbrecht.
Paracalanus crassirostris Dahl ; in large numbers.

Station 75.—13th March, 1914.
Satpara bay, along shore.
Density of water 1026·50 at 15°C.
Surface temperature 28·4°C.
Longipedia coronata Claus ; females ovigerous and juv.
Pseudodiaptomus annandalei Sewell ; females ovigerous.
Pseudodiaptomus binghami Sewell.

Station 78.—14th March, 1914.
In main channel, along North end of Barhampur Island.
Density of water 1026·25 at 15°C.
Surface temperature 29°C.
Acrocalanus inermis Sewell.
Canuella furcigera Sars.
Ectinosoma normani T. and A. Scott.
Euterpina acutifrons (Dana).
Oithona brevicornis Giesbrecht.
Oithona nana Giesbrecht.
Paracalanus crassirostris Dahl.

Station 84.—16th March, 1914.
In main channel, West of Satpara Island.
Acartia centrura Giesbrecht.
Acrocalanus inermis Sewell.
Euterpina acutifrons (Dana).
Oithona nana Giesbrecht.
Paracalanus crassirostris Dahl.

Station 89.—18th March, 1914.
Between Mahosa and Satpara, in main channel.
Acrocalanus inermis Sewell.
Paracalanus crassirostris Dahl.
Saphirella indica, sp. nov.

Station 90.—19th March, 1914.
Near outer bar, 1 mile S. W. of mouth.
Acartia southwelli Sewell.
Acrocalanus inermis Sewell.
Canuella furcigera Sars.
Euterpina acutifrons (Dana).
Mesocyclops obsoletus (Koch).
Oithona nana Giesbrecht.
Paracalanus crassirostris Dahl : a few examples.

Station 91.—19th March, 1914.
Outer bar, close to mouth.
Density of water 1028·25 at 15°C.
Surface temperature 31·7°C.
Pseudodiaptomus serricaudatus (T. Scott) a single male.

Station 92.—20th March, 1914.
West of Satpara Island.
Acartia centrura Giesbrecht.
Acartia southwelli Sewell.
Acrocalanus inermis Sewell.
Corycaeus (*Onychocorycaeus*) *giesbrechti* F. Dahl.
Euterpina acutifrons Dana.
Halicyclops magniceps (Lilljeborg).
Labidocera pavo Giesbrecht.
Oithona nana Giesbrecht.

Station 93.—20th March, 1914.
Mahosa, Barhampur Island ; along shore.
Paracalanus crassirostris Dahl ; very few present.

Station 94.—21st March, 1914.
Manikpatna Island ; along shore.
Acartia sp., juv.
Oithona brevicornis Giesbrecht.
Paracalanus crassirostris Dahl.

Station 97.—16th July, 1914.
Between Barkuda Island and mainland, to South of Barkuda Island.
Density of water (on 17th) 1015·00 at 15°C.
Acartia sp., juv.
Paracalanus crassirostris Dahl.

Station 100.—19th July, 1914.
South bay.
Density of water 1015·00 at 15°C.
Surface temperature 27·7°C.
Acartia spinicauda Giesbrecht.
Labidocera pavo Giesbrecht.
Oithona brevicornis Giesbrecht.
Paracalanus crassirostris Dahl.

Station 101.—20th July, 1914.
Between Cherria and mainland.
Acartia centrura Giesbrecht.
Acartiella minor Sewell.
Harpacticella lacustris, sp. nov.
Labidocera pavo Giesbrecht.
Oithona brevicornis Giesbrecht.
Paracalanus crassirostris Dahl.

Station 103.—2nd September, 1914.
Channel S. W. of Satpara promontory.
Acartia chilkaensis Sewell.
Acartiella major Sewell ; very few.
Acartiella minor Sewell.
Paracalanus crassirostris Dahl.

Station 106.—3rd September, 1914.
Outer channel, N. E. of Mirzapur.
Acartiella major Sewell.
Pseudodiaptomus hickmani Sewell.

Station 108.—3rd September, 1914.
Outer channel from Mirzapur towards Manikpatna.
Acartia chilkaensis Sewell ; females bearing spermatophores.
Acartiella major Sewell.
Paracalanus crassirostris Dahl.

Station 126.—9th September, 1914.
Channel from Satpura to Barnikuda.
Density of water 997·5 at 28·6°C.
Acartia chilkaensis Sewell.
Acartiella major Sewell.
Acartiella minor Sewell.
Paracalanus crassirostris Dahl.
Pseudodiaptomus annandalei Sewell

Station 128.—10th September, 1914.
Off Southernmost Island of Manikpatna series.
Density of water 997·0 at 31·5°C.
Cyclopina longifurca, sp. nov. ; females ovigerous.
Cyclops buxtoni Gurney.
Halicyclops magniceps (Lilljeborg).
Laophonte quinquespinosa, sp. nov.; females ovigerous.
Nitocra spinipes Boeck, var. *orientalis*, nov. ; females ovigerous.
Pseudodiaptomus tollingeri Sewell ; females ovigerous.

Station 133.—12th September, 1914.
Off Mahosa, main channel.
Acartia chilkaensis Sewell.
Canuella furcigera Sars.
Cyclopina intermedia, sp. nov. ; females ovigerous.
Diaptomus blanci de Guerne and Richard.
Harpacticella lacustris, sp. nov.
Mesocyclops obsoletus (Koch) ; both adults and immature forms.
Nitocra spinipes Boeck, var. *orientalis*, nov.
Parategastes sphaericus Claus, var. *similis*, nov.
Pseudodiaptomus annandalei Sewell ; females ovigerous.
Pseudodiaptomus hickmani Sewell ; females ovigerous.
Pseudodiaptomus lobipes Gurney ; females ovigerous.

Station **134.**—15th September, 1914.
1 to 1½ miles off Kalupara Ghat.
Pseudodiaptomus binghami Sewell.

Station **136.**—16th September, 1914.
About 8 miles S. E. of Kalupara Ghat.
Acartia chilkaensis Sewell.
Acartiella major Sewell ; females bearing spermatophores.
Acartiella minor Sewell.
Paracalanus crassirostris Dahl.
Pseudodiaptomus hickmani Sewell.

Station **137.**—16th September, 1914.
8 miles S. S. E. of Kalupara Ghat.
Density of water 997·0 at 28·5°C.
Acartiella major Sewell.
Diaptomus blanci de Guerne and Richard.
Diaptomus cinctus Gurney.
Diaptomus contortus Gurney.
Diaptomus pulcher Gurney.
Diaptomus striglipes Gurney.
Mesocyclops obsoletus (Koch).
Mesocyclops oithonoides Sars.
Pseudodiaptomus binghami Sewell.
Pseudodiaptomus lobipes Gurney.

Station **139.**—September, 1914.
Off Barkul.
Acartia chilkaensis Sewell.
Acartiella major Sewell ; females bearing spermatophores.
Pseudodiaptomus annandalei Sewell ; very few.

Station **140.**—21st September, 1914.
Off Kalidai.
Acartia chilkaensis Sewell (?) ; only males and immature forms.
Oithona sp., juv.
Paracalanus crassirostris Dahl.

Station **142.**—23rd September, 1914.
Along Barkuda Island.
Density of water 1·0065.
Surface temperature 28·1°C.
Acartia southwelli Sewell ; adults and immature forms.
Acartiella major Sewell.
Cyclops bicolor Sars.
Harpacticella lacustris, sp. nov.
Labidocera pavo Giesbrecht.
Mesocyclops obsoletus (Koch).
Oithona brevicornis Giesbrecht.
Oithona nana Giesbrecht.
Paracalanus crassirostris Dahl : in fair numbers.

Station 143.—23rd September, 1914.
Canal Bay.
Acartia southwelli Sewell.
Oithona nana Giesbrecht.
Paracalanus crassirostris Dahl.

Station 145.—17th November, 1914.
Across the mouth of Rambha Bay.
Acartia southwelli Sewell.
Acartiella major Sewell.
Cyclops bicolor Sars.
Mesocyclops obsoletus (Koch).
Oithona brevicornis Giesbrecht.
Oithona nana Giesbrecht.
Paracalanus crassirostris Dahl.

Station 148.—19th November, 1914.
Chiriya Island to near Barkuda Island.
Acartia southwelli Sewell ; few.
Acartiella major Sewell ; few.
Oithona nana Giesbrecht ; in large numbers.
Paracalanus crassirostris Dahl ; in large numbers.
Saphirella indica, sp. nov.

Station 152.—22nd November, 1914.
Kalidai to Samalkuda.
Acartia chilkaensis Sewell.
Acartiella major Sewell ; females bearing spermatophores.
Acartiella minor Sewell.
Oithona nana Giesbrecht.
Paracalanus crassirostris Dahl ; in large numbers.

Station 157.—25th November, 1914.
About 1 mile off N. and E. of Nalbano Island.
Acartia chilkaensis Sewell.
Acartiella major Sewell.
Acartiella minor Sewell.
Paracalanus crassirostris Dahl.

Station 164.—28th November, 1914.
About $\frac{1}{2}$ mile off Parikudh.
Acartia chilkaensis Sewell.
Acartiella major Sewell.
Oithona nana Giesbrecht ; only very few present.
Paracalanus crassirostris Dahl.

Station 166.—29th November, 1914.

Anchorage at Barkul due east.

Acartia chilkaensis Sewell.
Acartiella major Sewell.
Acartiella minor Sewell.
Cyclopina intermedia, sp. nov. ; females ovigerous.
Laophonte chathamensis Sars.
Laophonte quinquespinosa, sp. nov.
Oithona nana Giesbrecht.
Paracalanus crassirostris Dahl ; in large numbers.
Pseudodiaptomus annandalei Sewell ; females ovigerous.
Pseudodiaptomus hickmani Sewell ; a few females ovigerous.

Station 167.—June, 1923.

Weed washings from Rambha Bay.

Amphiascus scotti, nom. nov. [= *Dactylopus propinquus* T. Scott.]
Ectinosoma melaniceps Boeck.
Harpacticella lacustris, sp. nov.
Nitocra yahiai Blanchard and Richard.
Parategastes sphaericus Claus, var. *similis*, nov. ; females ovigerous.

EXPLANATION OF THE PLATES.

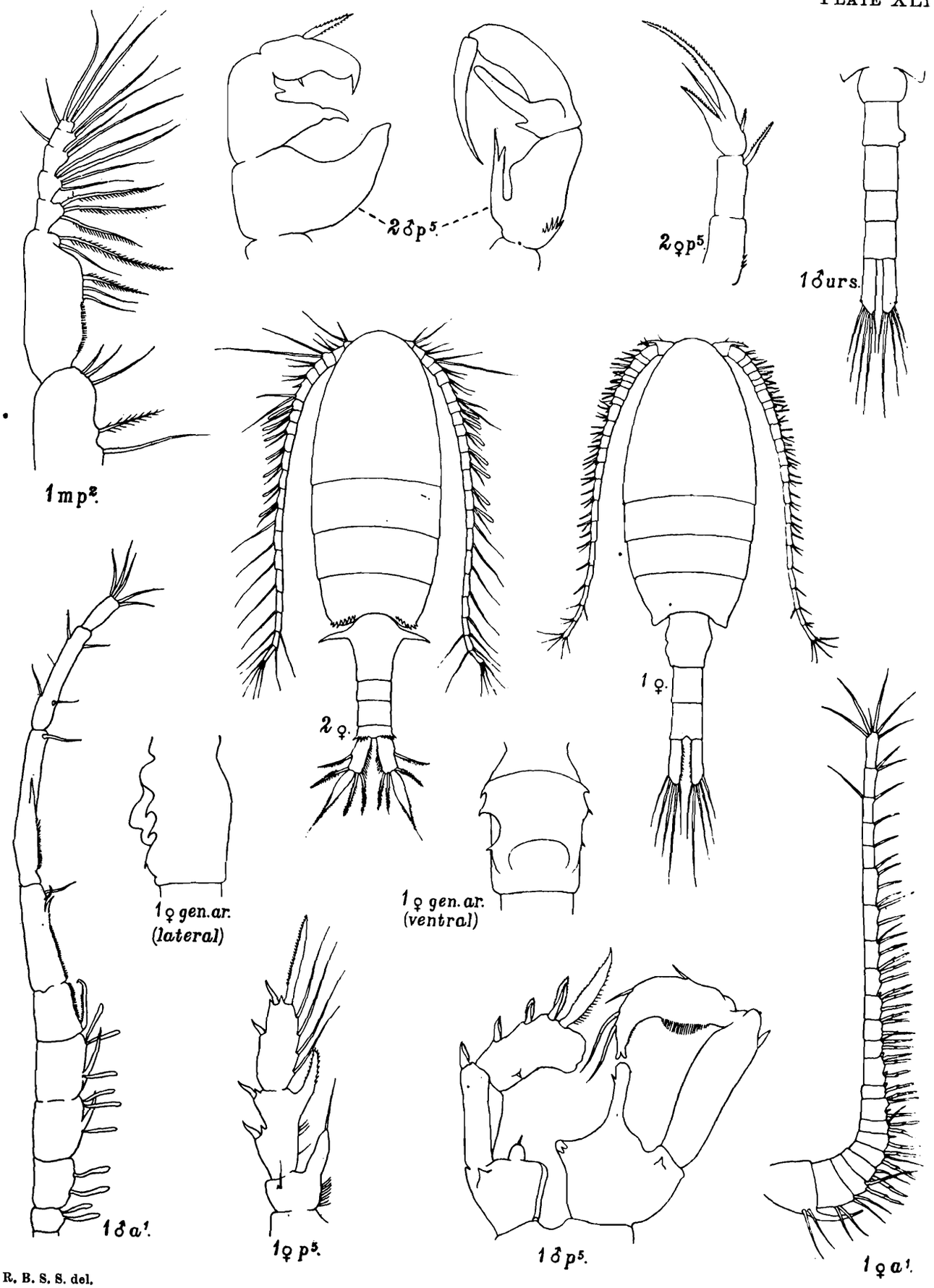
In arranging the plates to illustrate this paper I have followed the system adopted by G. O. Sars in his monograph on the Crustacea of Norway. Each species is given a number and the various appendages belonging to that species are denoted by the number with the addition of an abbreviation corresponding to the appendage.

ABBREVIATIONS.

♀	female.	a^1	anterior antenna.
♂	male.	a^2	posterior antenna.
c.	cephalic segment.	M.	mandible.
urs.	urosoma.	Mp.	mandibular palp.
gen. ar.	genital area.	m	1st maxilla or maxillary palp.
gen. ar.	genital armature of male.	mp^1	2nd maxilla or 1st maxilliped.
F.	furcal joints.	mp^2	2nd maxilliped.
R.	rostrum.	p^1—p^5	legs of the 1st to 5th pairs.

EXPLANATION OF PLATE XLIV.

Fig. 1. *Isias tropica*, sp. nov.
Fig. 2. *Pseudodiaptomus annandalei* Sewell.

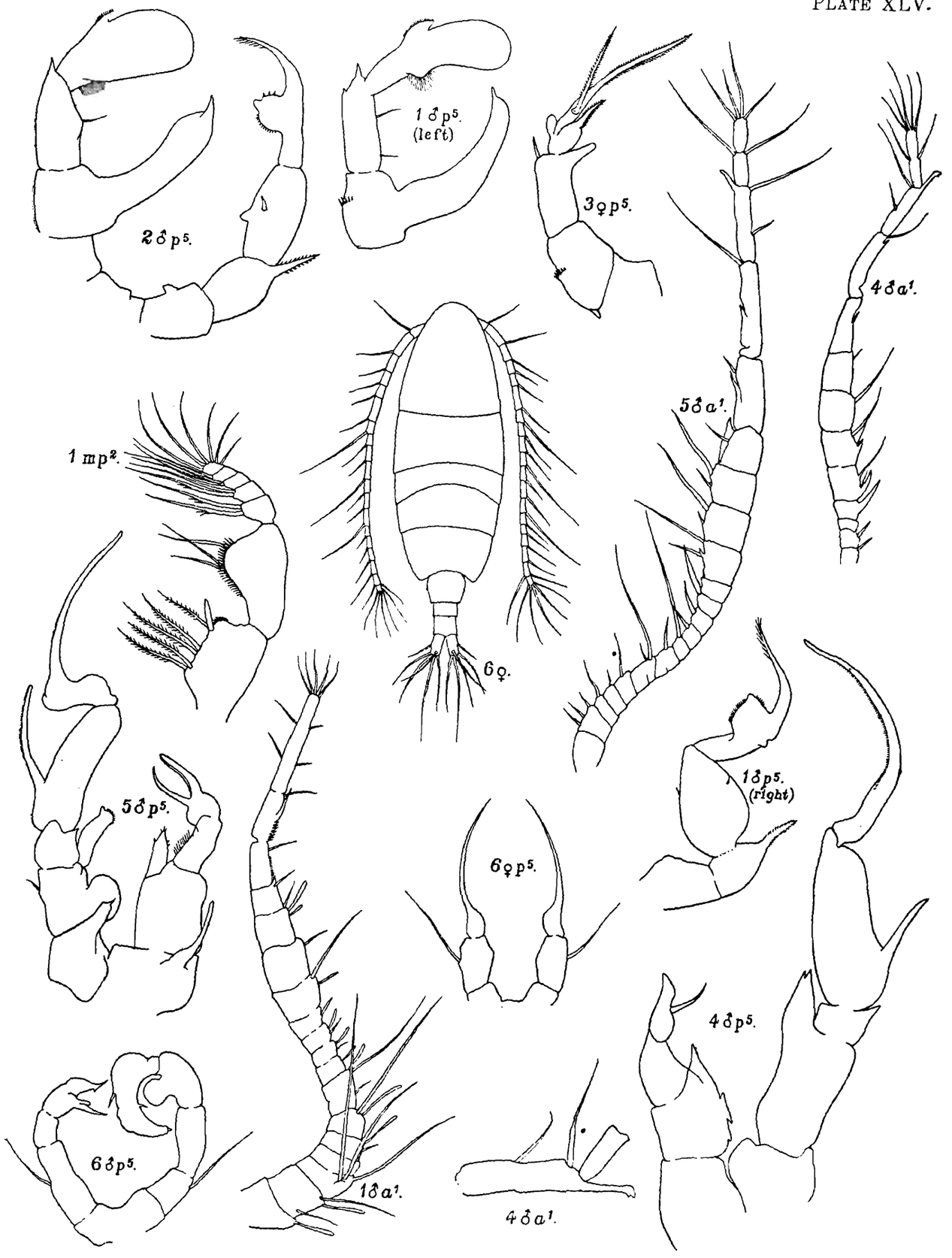


R. B. S. S. del.

Fig. 1. *Isias tropica*, sp. nov. Fig. 2. *Pseudodiaptomus annandalei* Sewell.

EXPLANATION OF PLATE XLV.

Fig. 1. *Pseudodiaptomus lobipes* Gurney.
Fig. 2. *Pseudodiaptomus binghami* Sewell.
Fig. 3. *Pseudodiaptomus tollingeri* Sewell.
Fig. 4. *Diaptomus cinctus.* Gurney.
Fig. 5. *Diaptomus contortus* Gurney.
Fig. 6. *Acartia southwelli* Sewell.

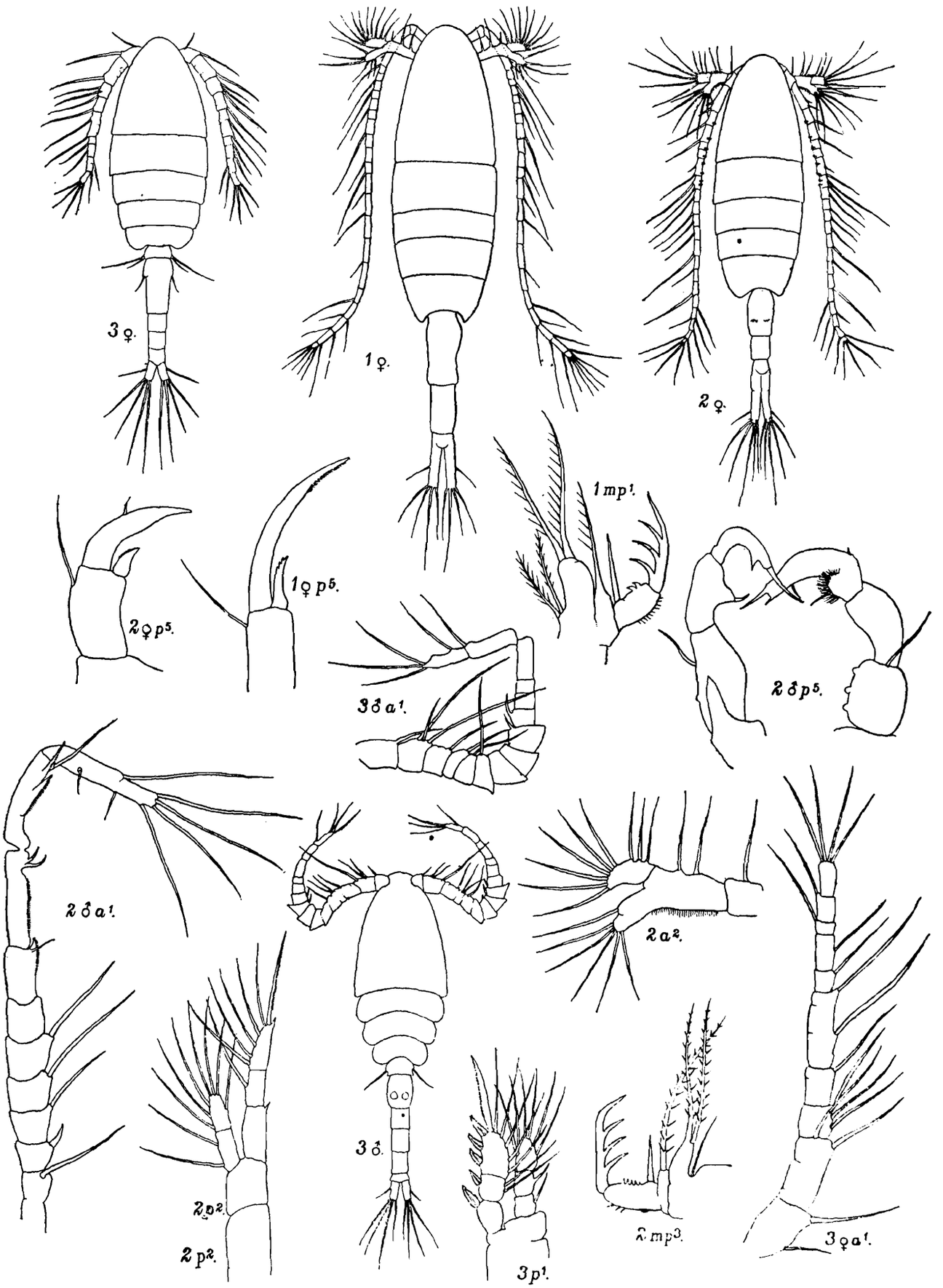


R. B. S. S. del.

Fig. 1. *Pseudodiaptomus lobipes* Gurney.
Fig. 2. *Pseudodiaptomus binghami* Sewell.
Fig. 3. *Pseudodiaptomus tollingeri* Sewell.
Fig. 4. *Diaptomus cinctus* Gurney.
Fig. 5. *Diaptomus contortus* Gurney.
Fig. 6. *Acartia southwelli* Sewell.

EXPLANATION OF PLATE XLVI.

Fig. 1. *Acartiella major* Sewall.
Fig. 2. *Acartiella minor* Sewell.
Fig. 3. *Oithona brevicornis* Giesbrecht.

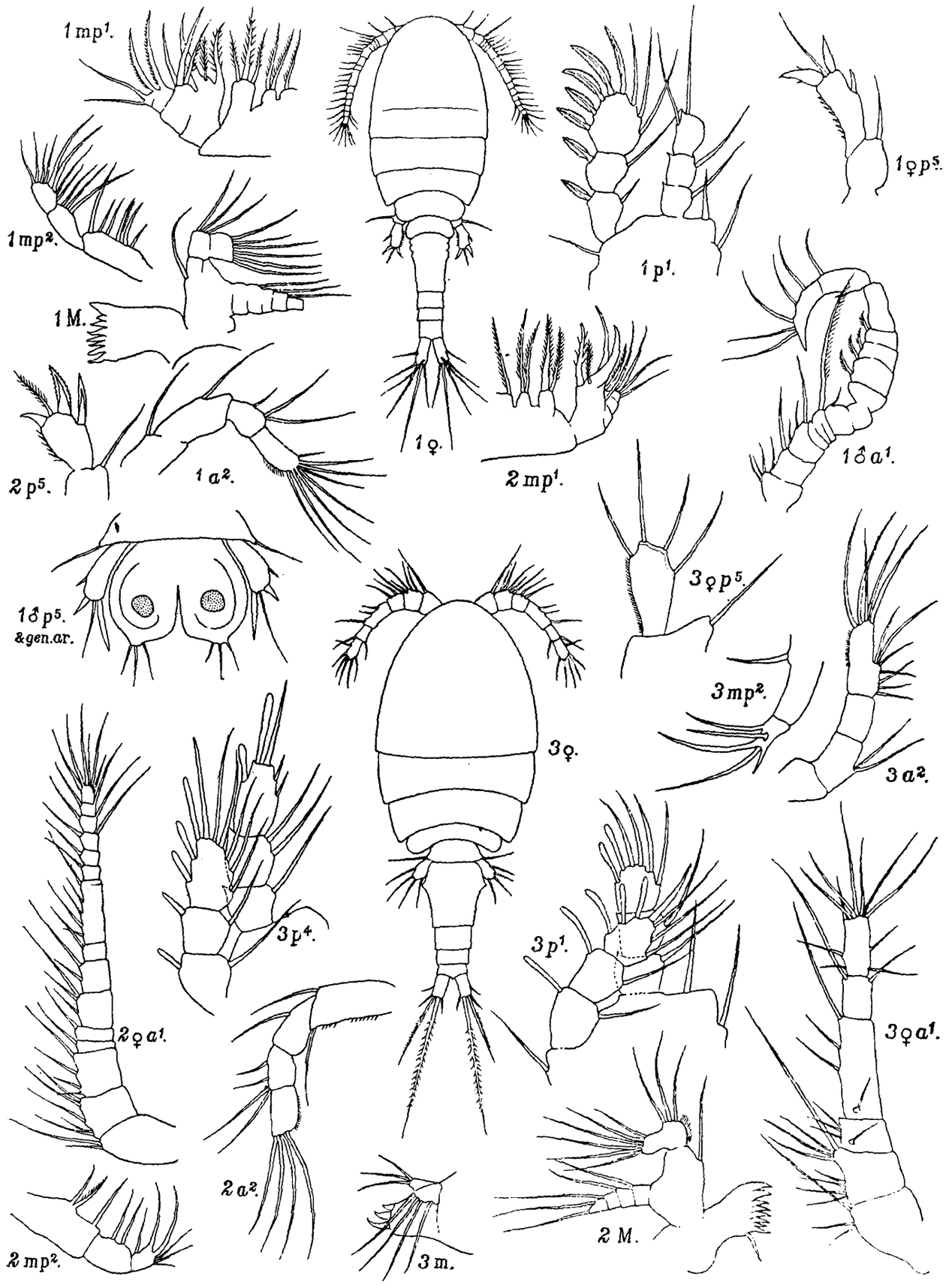


R. B. S. S. del.

Fig. 1. *Acartiella major* Sewell. Fig. 2. *Acartiella minor* Sewell. Fig. 3. *Oithona brevicornis* Giesbrecht.

EXPLANATION OF PLATE XLVII.

Fig. 1. *Cyclopina intermedia*, sp. nov.
Fig. 2. *Cyclopina longifurca*, sp. nov.
Fig. 3. *Halicyclops tenuispina*, sp. nov.

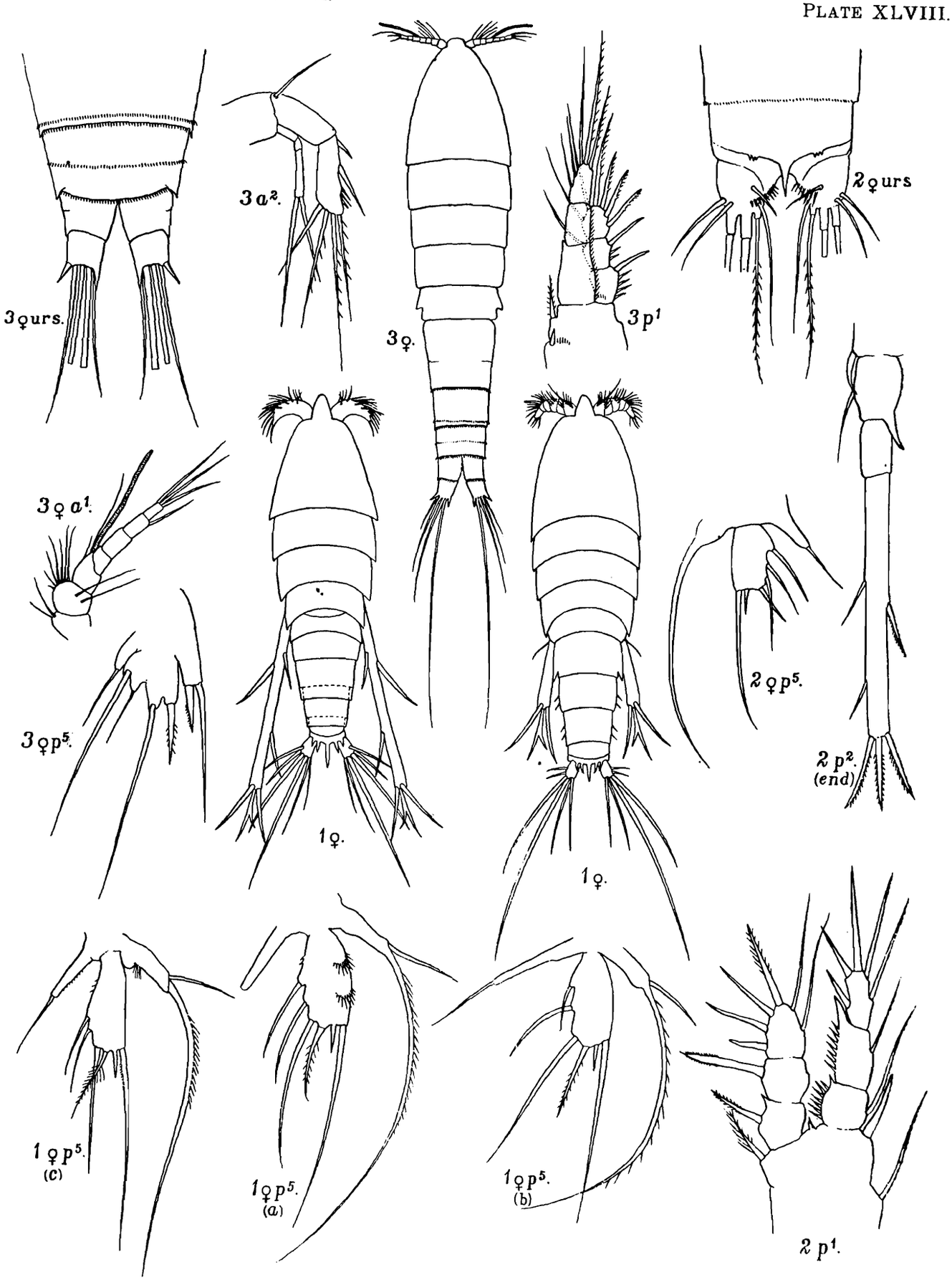


R. B. S. S. del.

Fig. 1. *Cyclopina intermedia*, sp. nov. Fig. 2. *Cyclopina longifurca*, sp. nov.
Fig. 3. *Halicyclops tenuispina*, sp. nov.

EXPLANATION OF PLATE XLVIII.

Fig. 1. *Longipedia coronata* Claus.
Fig. 2. *Longipedia rosea* Sars.
Fig. 3. *Ectinosoma melaniceps* Boeck.

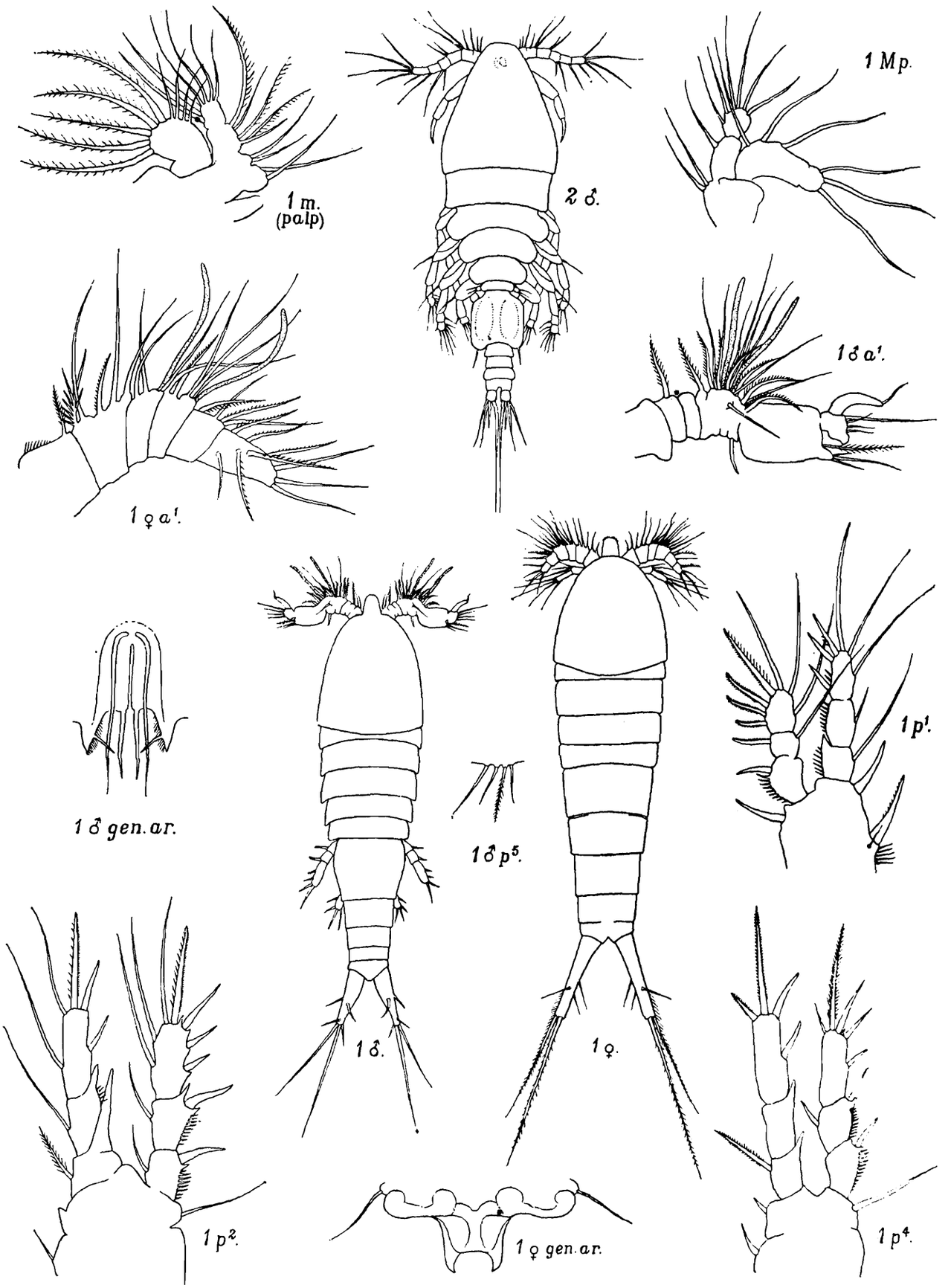


R. B. S. S. del.

Fig. 1. *Longipedia coronata* Claus. Fig. 2. *Longipedia rosea* Sars. Fig. 3. *Ectinosoma melaniceps* Boeck.

EXPLANATION OF PLATE XLIX.

Fig. 1. *Canuella furcigera* Sars.
Fig. 2. *Ergasilus* sp. ♂



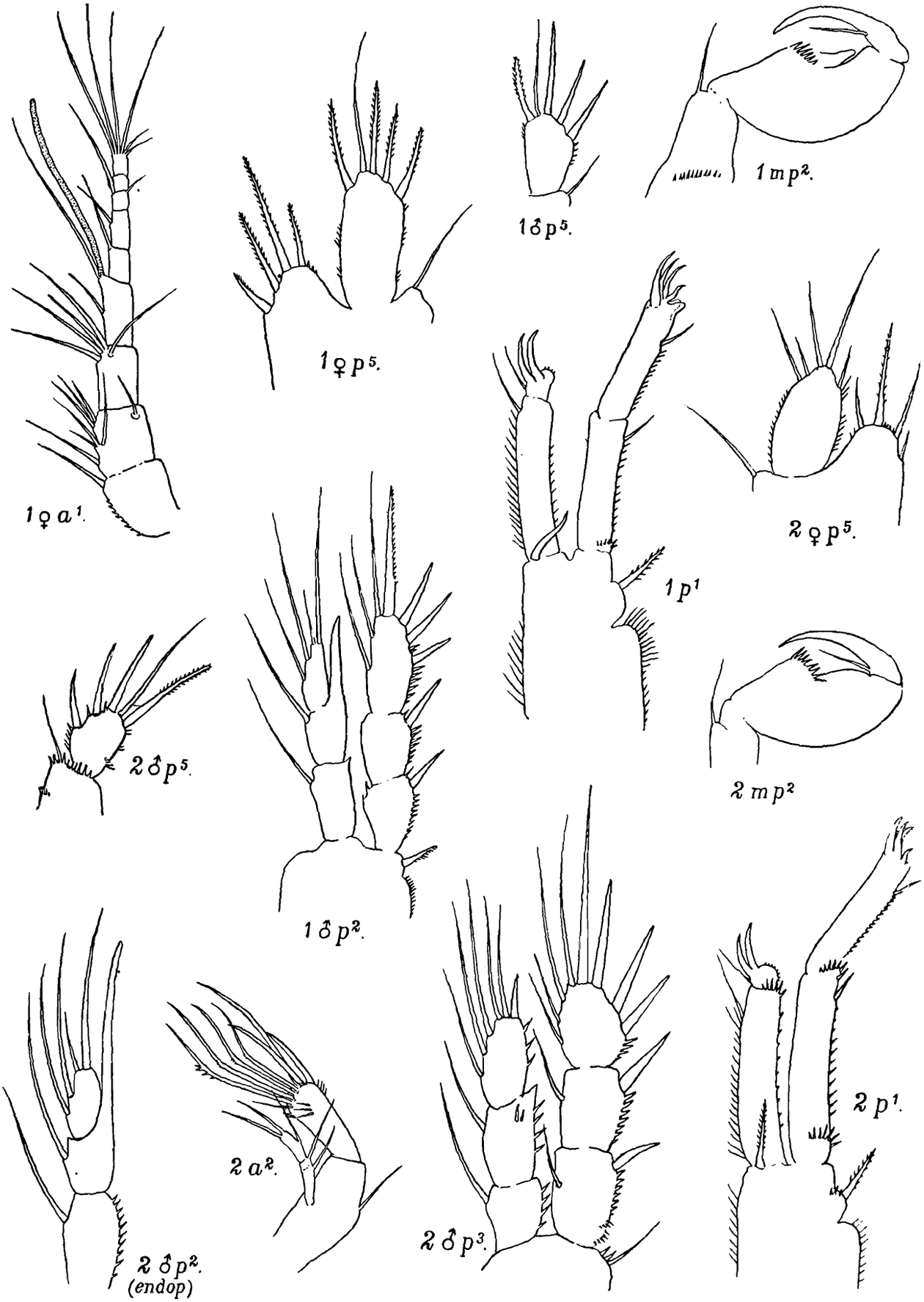
R. B. S. S. del.

Fig. 1. *Canuella furcigera* Sars. Fig 2. *Ergasilus* sp.

EXPLANATION OF PLATE L.

Fig. 1. *Harpacticus littoralis* Sars.

Fig. 2. *Harpacticus gracilis* Claus, var. *orientalis*, nov.



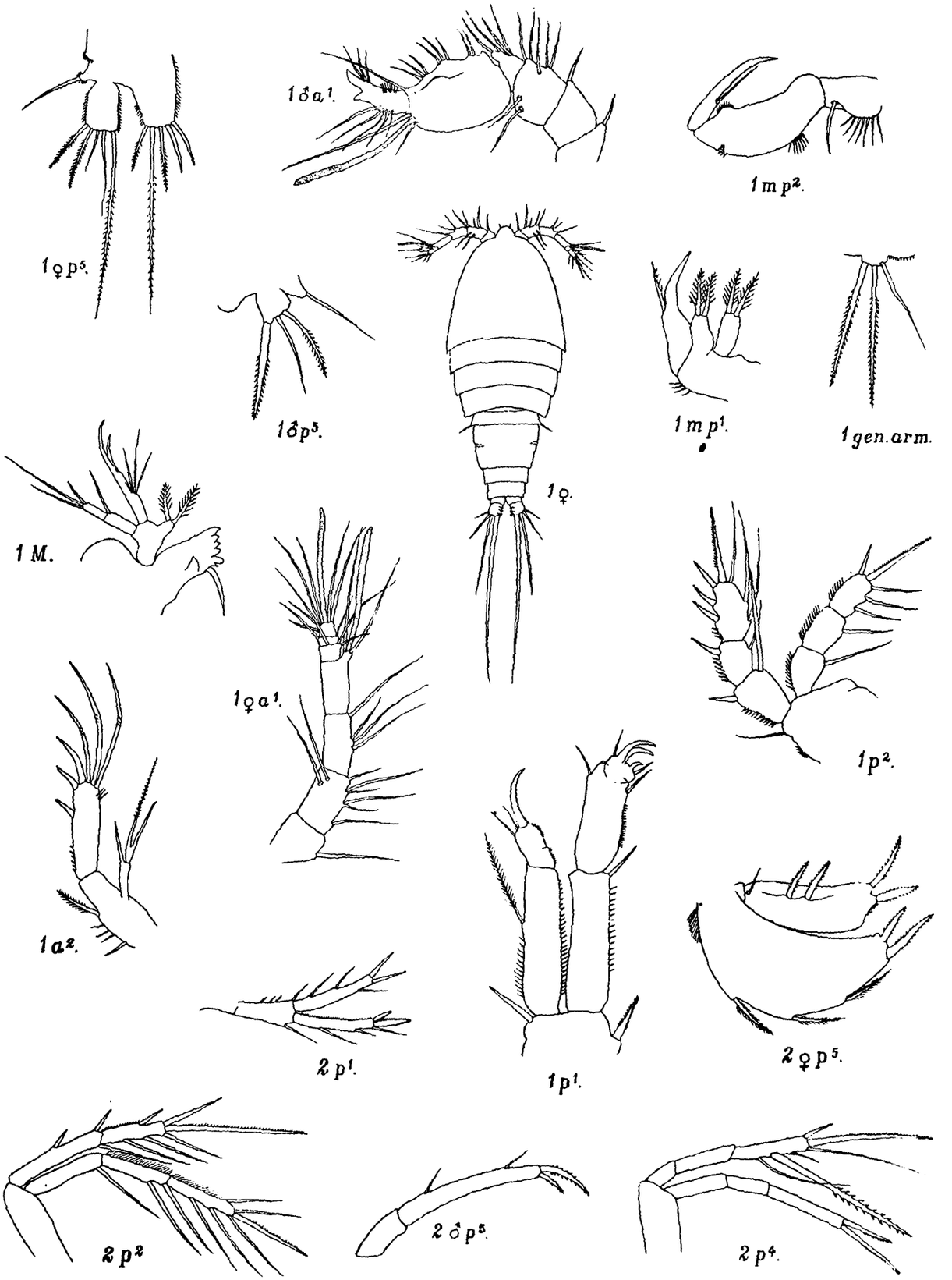
R. B. S. S. del.

Fig. 1. *Harpacticus littoralis* Sars. Fig. 2. *Harpacticus gracilis* Claus, var. *orientalis*, nov.

EXPLANATION OF PLATE LI.

Fig. 1. *Harpacticella lacustris*, sp. nov.

Fig. 2. *Parategastes sphaericus* (Claus), var. *similis*, nov.

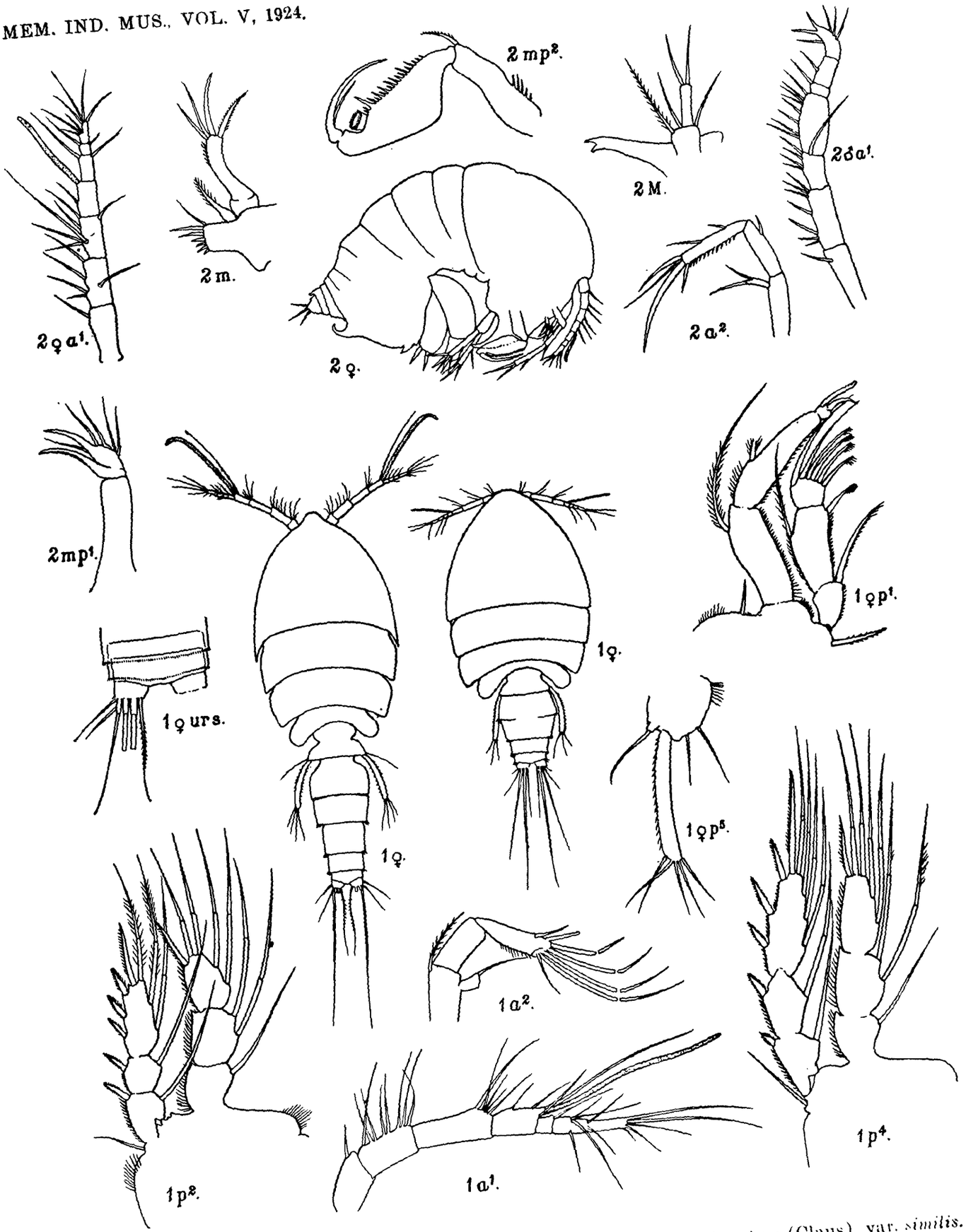


R. B. S. S. del.

Fig. 1. *Harpacticella lacustris*, sp. nov. Fig. 2. *Parategastes sphaericus* (Claus), var. *similis*, nov.

EXPLANATION OF PLATE LII.

Fig. 1. *Idyaea ensifera* (Fischer), var. *indica*, nov.
Fig. 2. *Parategastas sphaericus* (Claus), var. *similis*, nov.

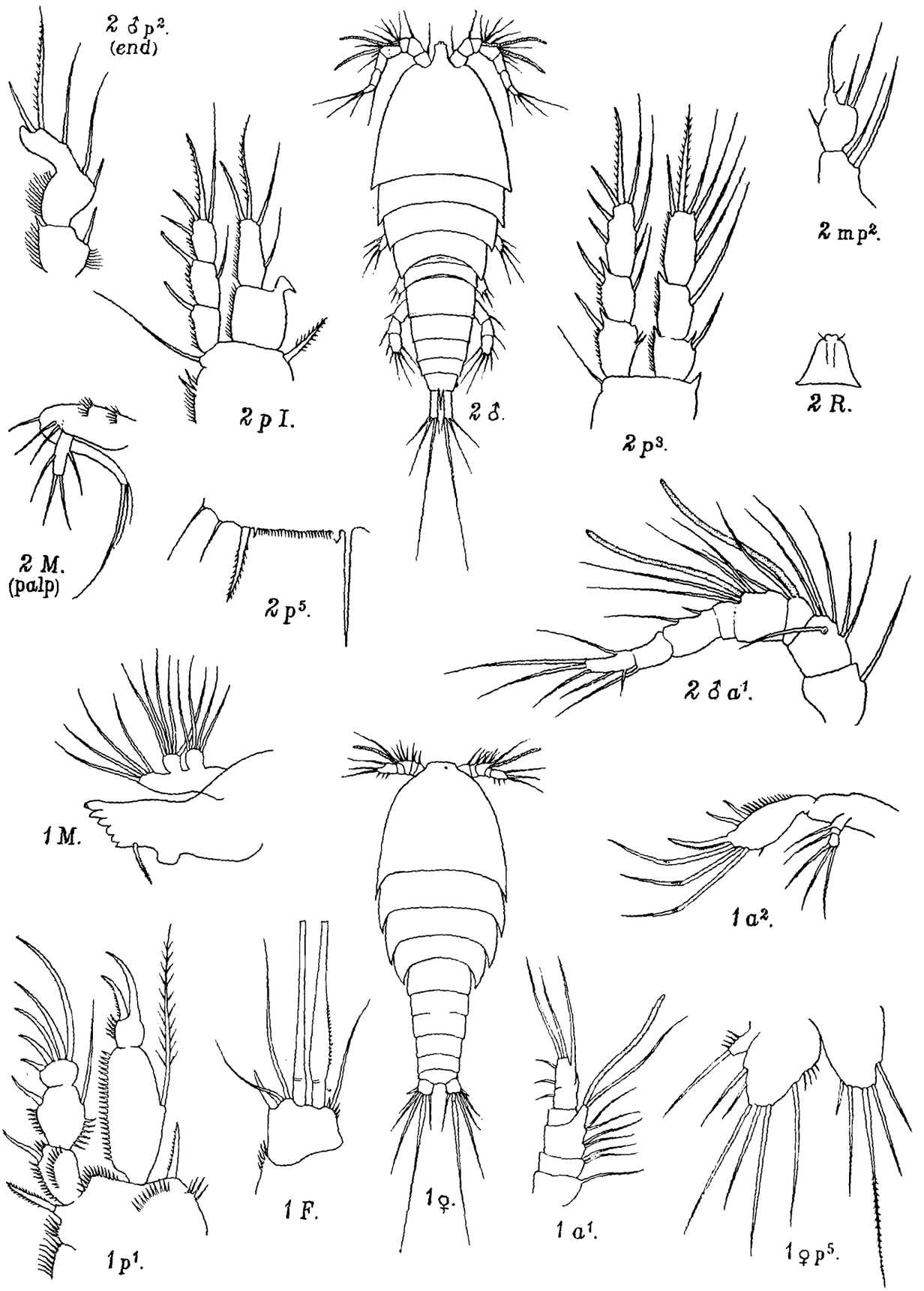


R. B. S. S. del.

Fig. 1. *Idyaca ensifera* (Fischer), var. *indica*, nov. Fig. 2. *Parategastes sphaericus* (Claus), var. *similis*, nov.

EXPLANATION OF PLATE LIII.

Fig. 1. *Dactylopusia brevicornis* (Claus).
Fig. 2. *Stenhelia inopinata* (A. Scott).



R. B. S. S. del.

Fig. 1. *Dactylopusia brevicornis* (Claus). Fig. 2. *Stenhelia inopinata* (A. Scott).

EXPLANATION OF PLATE LIV.

Fig. 1. *Amphiascus scotti*, nom. nov. [=*Dactylopus propinquus* T. Scott].

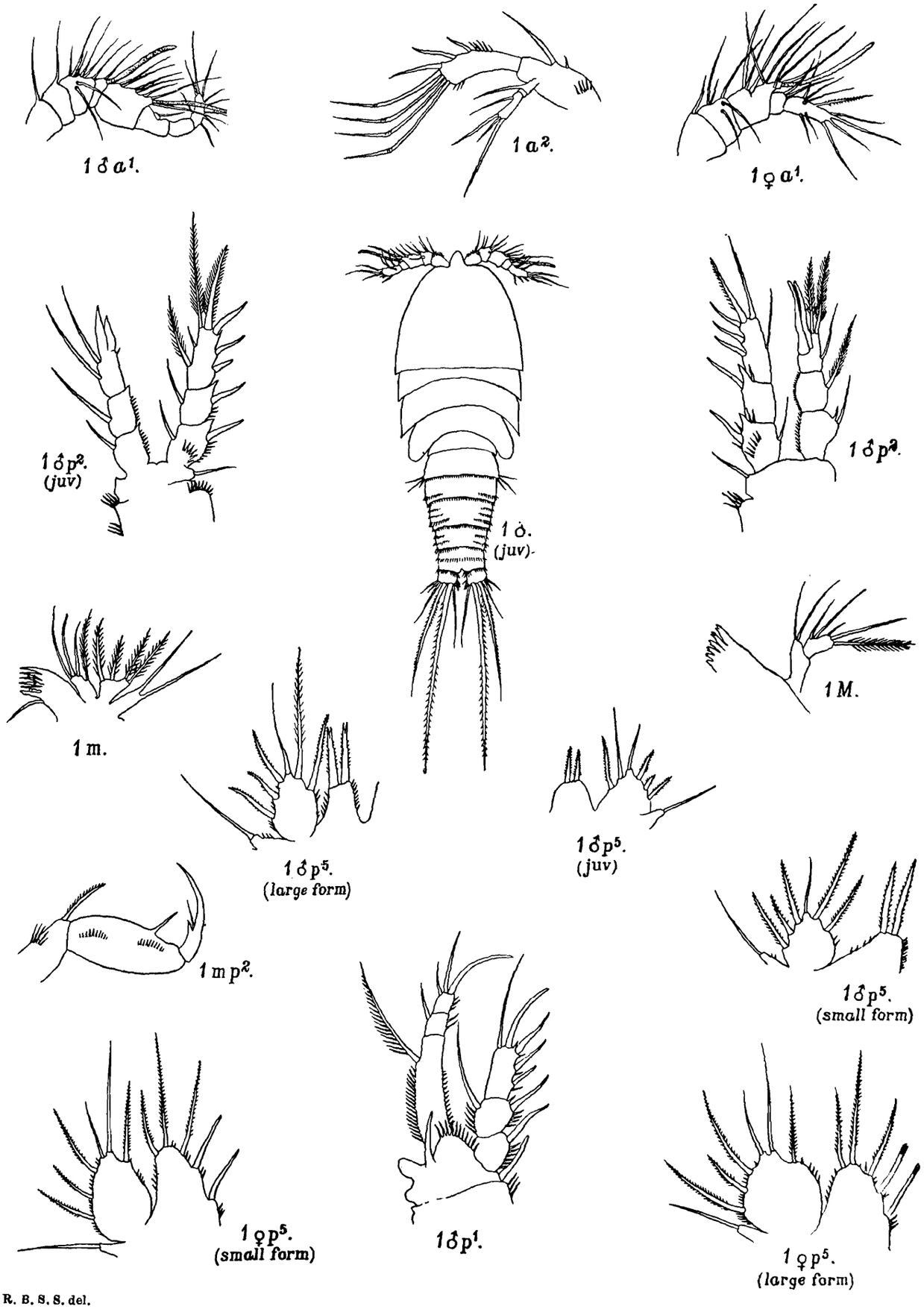
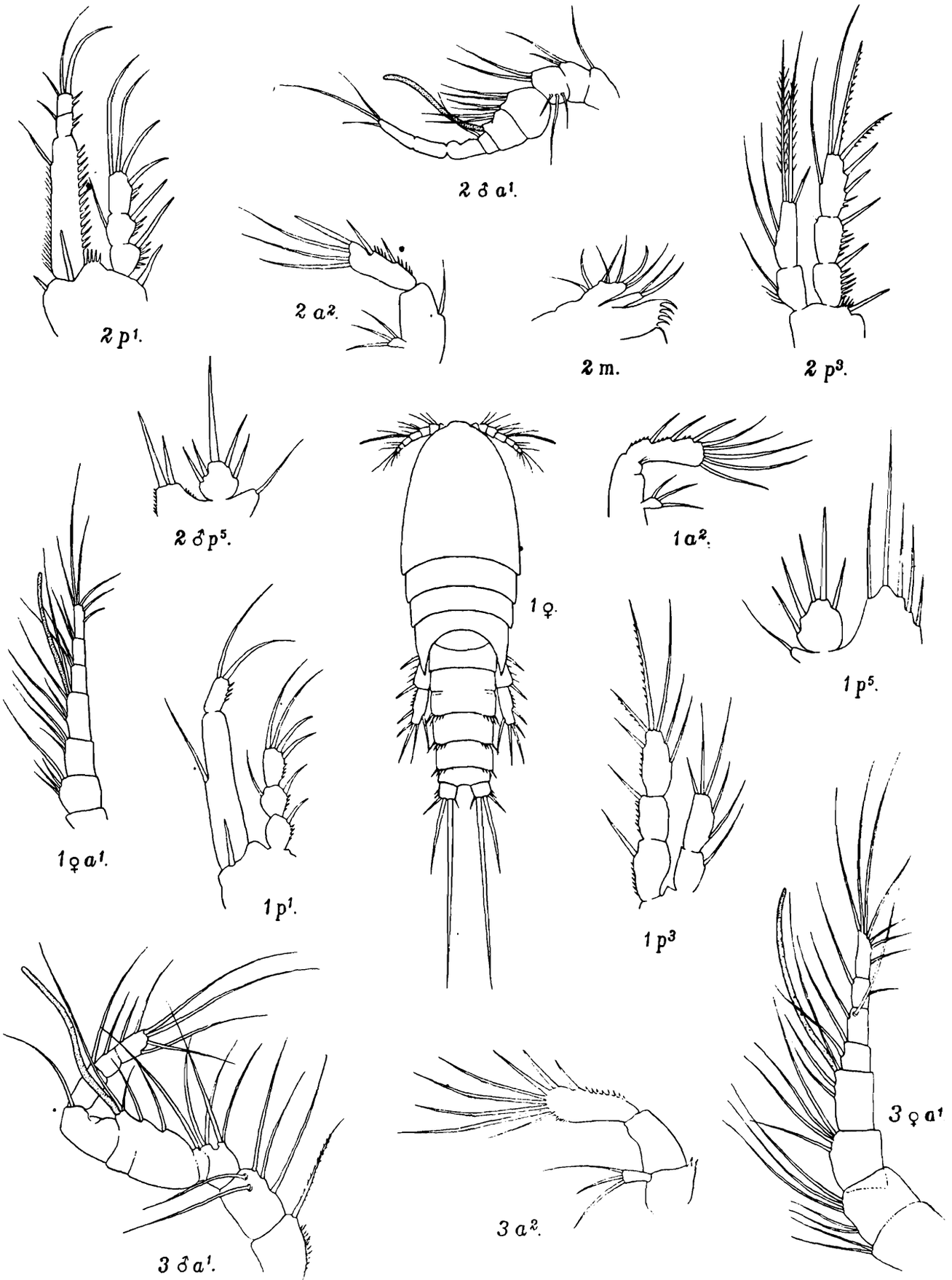


Fig. 1. *Amphiascus scotti*, nom. nov. [= *Dactylopus propinquus* T. Scott].

EXPLANATION OF PLATE LV.

Fig. 1. *Mesochra nana* Brady.
Fig. 2. *Mesochra* sp. ♂
Fig. 3. *Nitocra typica* Boeck, var. *lacustris*, nov.

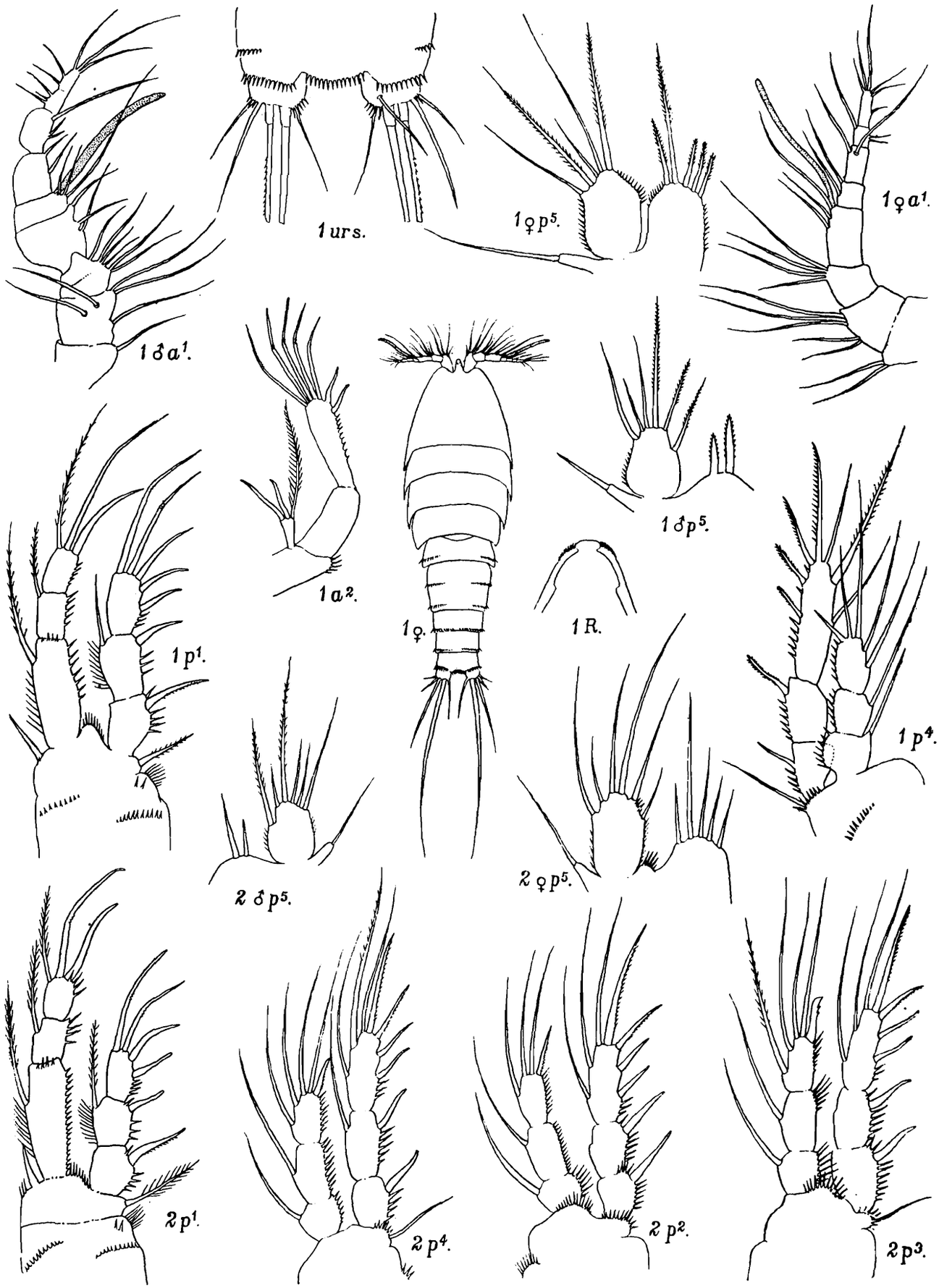


R. B. S. S. del.

Fig. 1. *Mesochra nana* Brady. Fig. 2. *Mesochra*, sp., ♂ Fig. 3. *Nitocra typica* Boeck, var. *lacustris*, nov.

EXPLANATION OF PLATE LVI.

Fig. 1. *Nitocra spinipes* Boeck, var. *orientalis*, nov.
Fig 2. *Nitocra typica* Boeck, var. *lacustris*, nov.



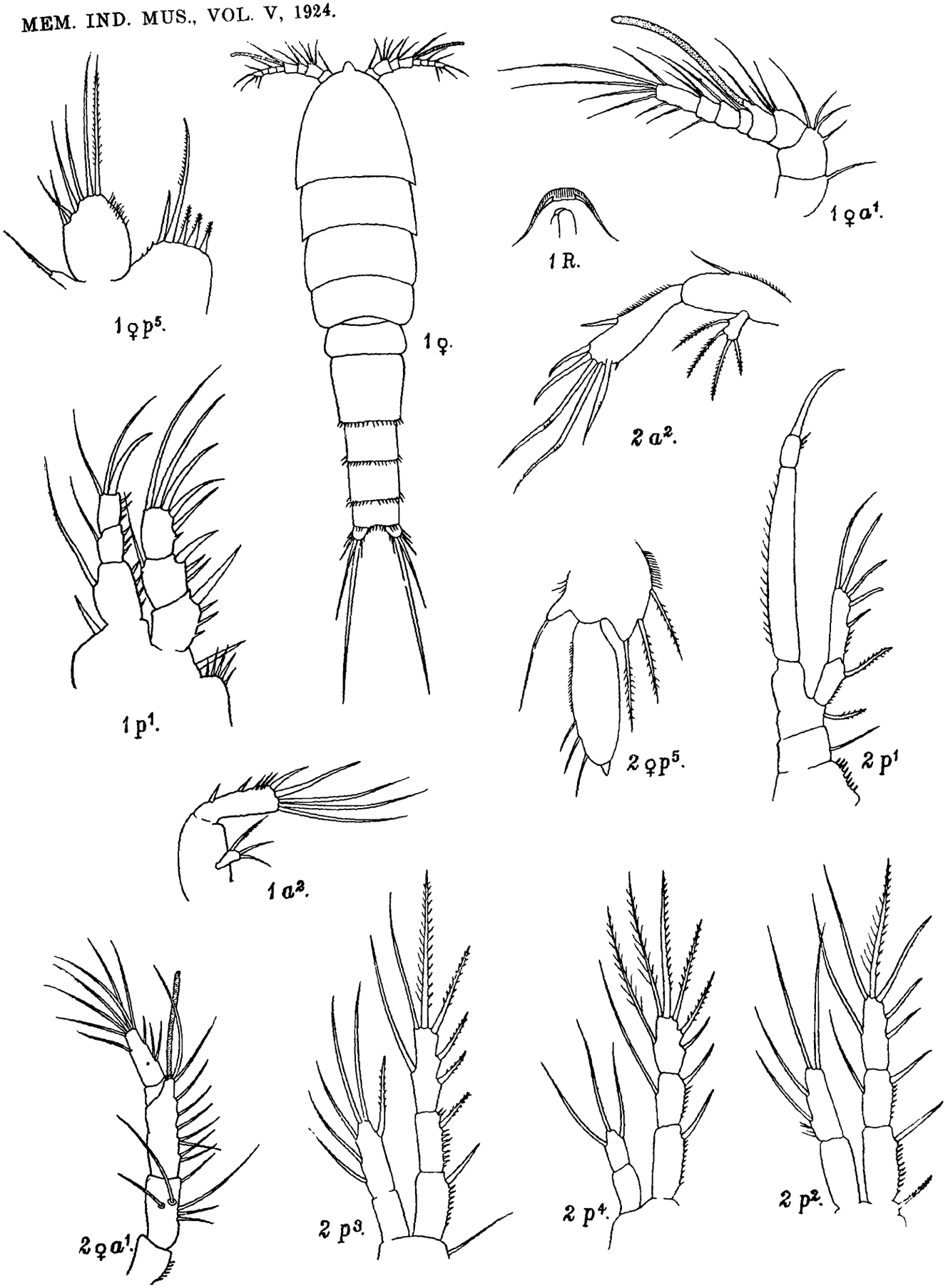
R. B. S. S. del.

Fig. 1. *Nitocra spinipes* Boeck, var. *orientalis*, nov.

Fig. 2. *Nitocra typica* Boeck, var. *lacustris*, nov.

EXPLANATION OF PLATE LVII.

Fig. 1. *Nitocra yahiai* (Blanchard and Richard).
Fig. 2. *Laophonte chathamensis* Sars.



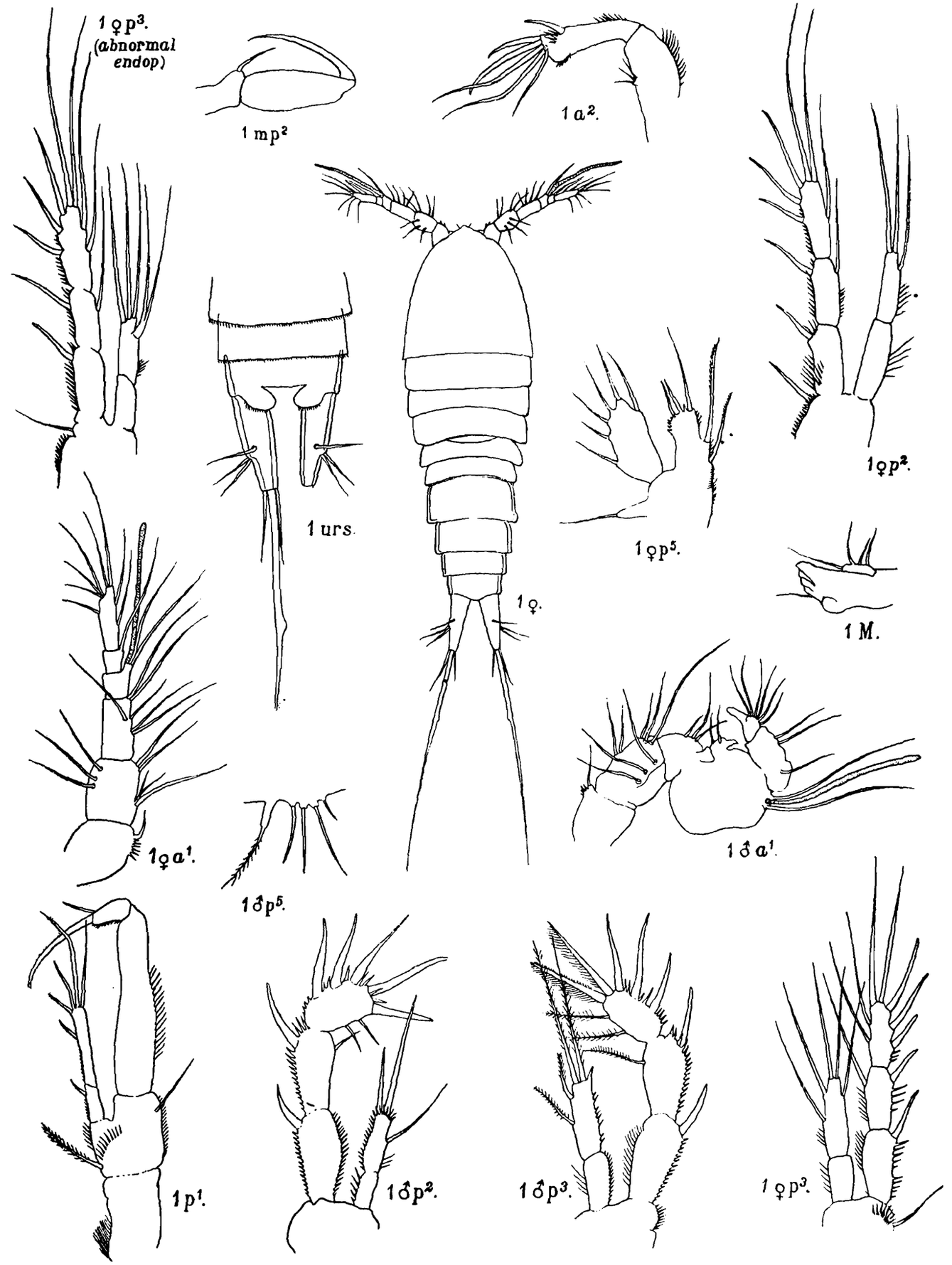
R. B. S. S. del.

Fig. 1. *Nitocra yahiai* (Blanchard and Richard).

Fig. 2. *Laophonte chathamensis* Sars.

EXPLANATION OF PLATE LVIII.

Fig. 1. *Laophonte quinquespinosa*, sp. nov.



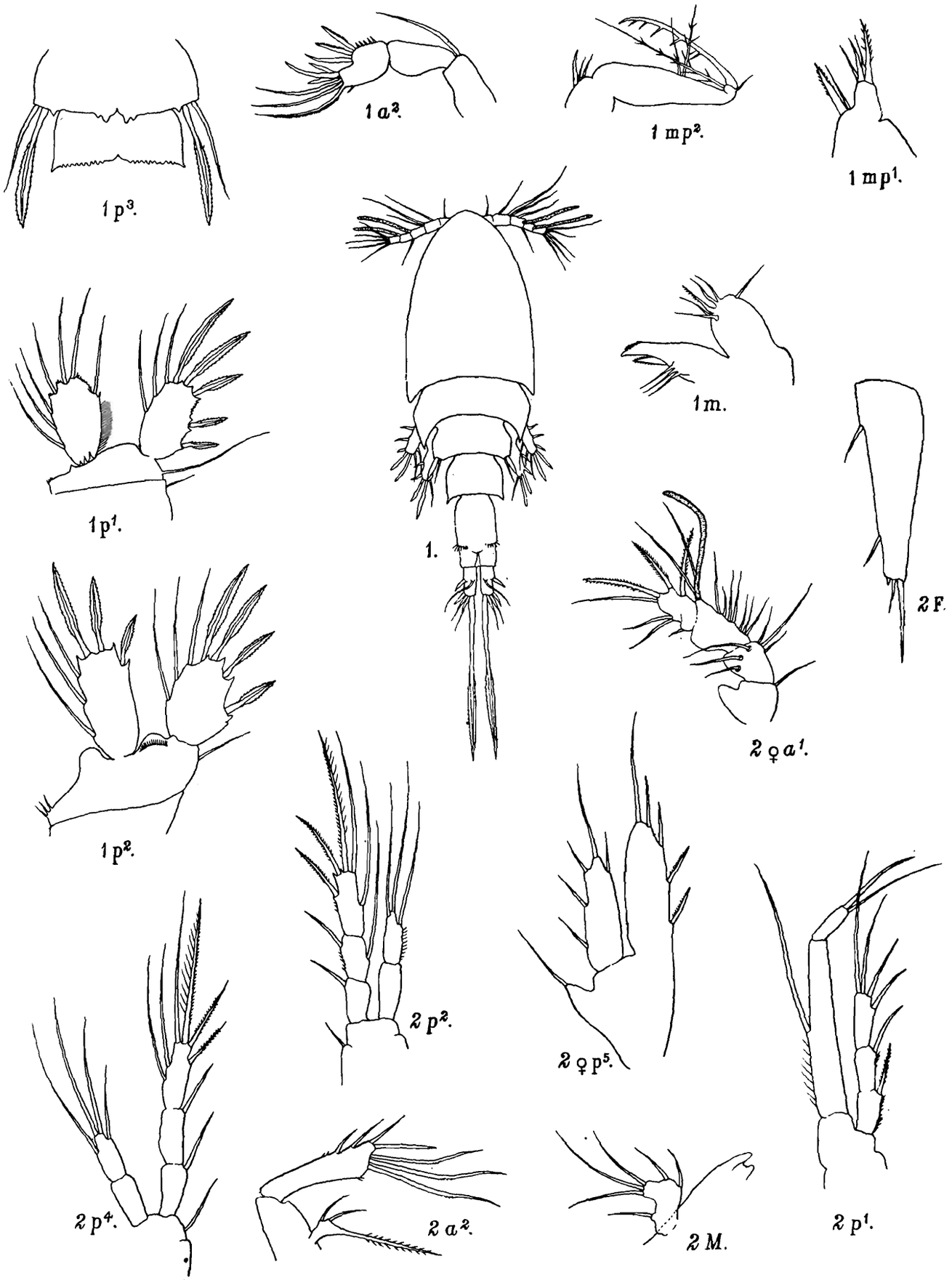
B. B. S. del.

Fig. 1. *Laophonte quinquespinosa*, sp. nov.

EXPLANATION OF PLATE LIX.

Fig. 1. *Saphirella indica*, sp. nov.

Fig. 2. *Cleta secunda*, sp. nov.



R. B. S. S. del.

Fig. 1. *Saphirella indica*, sp. nov.

Fig. 2. *Cleta secunda*, sp. nov.

FAUNA OF THE CHILKA LAKE.

MOLLUSCA GASTROPODA (REVISION).

By the late N. ANNANDALE, *D.Sc., C.I.E., F.R.S., Director, Zoological Survey of India.*

(With 16 text-figures.)

CONTENTS.

MOLLUSCA GASTROPODA (REVISION).

By N. ANNANDALE.

INTRODUCTION.

In the former report on the Mollusca, published in this "Fauna" in 1916 (pp. 329-366 by Dr. Kemp and myself, we made no attempt to revise the gastropods. With the exception of the nudibranchs, which were described by Sir Charles Eliot, the collection had been worked out in the British Museum by Mr. H. B. Preston, whose identifications we accepted. Since 1916 circumstances have compelled me to undertake the taxonomic study of the gastropods myself and I have re-examined the Chilka collection. I regret to say that I find myself unable to accept a large proportion of Mr. Preston's determinations. Out of 31 names indeed, I am able to retain only 12, and several of these belong to empty shells of which I have no new data to offer. The reasons for these changes are three :—(1) in the first place I find that the radula and soft parts do not always support the taxonomic position assigned on conchological grounds to small shells of obscure genera, (2) in the second place individual variability is seen to be much greater in larger series of shells than those examined by Mr. Preston and (3) the literature on the subject does not seem to have been consulted with sufficient care in some instances, too much reliance having been placed on the mere matching of shells with specimens "authoritatively named." In saying all this I do not wish to criticize Mr. Preston personally, but rather to animadvert on the unsatisfactory method of working out collections of molluscs which seem to be common in England and other European countries. I have, however, had access to type-specimens in the Indian Museum which were not available in Europe—and Mr. Preston was merely asked to name the shells.

The following are the actual changes proposed. In the first column I give the names approximately in the order used in our former report, the numbers after them being those of the pages in which they are cited in that paper; while the second column contains the names here used.

Tornatina estriata Preston (341)	becomes	*Didontoglossa estriata* (Preston) gen. nov.
Thais carinifera (Lam.) (346)	,,	*Cuma disjuncta* Annandale.
Nassa orissaensis Preston (343)	,,	*Pygmaeonassa orissaensis* (Preston) gen. nov.
Nassa denegabilis Preston (343)	,,	*Pygmaeonassa denegabilis* (Preston).
Potamides fluviatilis P. & M. (344)	,,	*Potamides cingulatus* (Gmelin).
Potamides fuscum Schum. (344)	,,	*Telescopium telescopium* (Linn.).
Vanesia rambhaensis Preston (345)	,,	*Turbonilla rambhaensis* (Preston).
Litiopa copiosa Preston *Litiopa kempi* Preston (345)	,,	*Fenella virgata* (Phil.).
Stenothyra blanfordiana Nev. *Stenothyra chilkaensis* Preston *Stenothyra orissaensis* Preston *Stenothyra obesula* Preston *Stenothyra trigona* Preston (346)	,,	*Stenothyra minima* (Sow.).

Hydrobia miliacea Nev. (346) becomes *Stenothyra miliacea* (Nev.)
Chrysallida ecclesia Preston (347) ,, *Pyrgulina ecclesia* (Preston).
Chrysallida nadiensis Preston (347) ,, *Pyrgulina nadiensis* (Preston).
Neritina souverbiana Montr. (347) ,, *Smaragdia mamilla*, sp. nov.
Cyclostrema innocens Preston (347) ,, *Tubiola microscopica* (Nev.).

I have to describe two new genera and a new species here, and have already described another new species (*Cuma disjuncta*) elsewhere. In only one instance (that of *Tubiola microscopica*) have I proposed a change without examining the animal. Unfortunately, however, I have not had before me in most cases either the living mollusc or even well-preserved specimens, but have been obliged to extract the dried animal from the shell. In only a few species, therefore, has any proper anatomical investigation been possible, for I have been unable for financial and other reasons to collect much new material. The radula has been examined in most species and is figured in the following pages.

The following is a complete list of the gastropod fauna of the lake, omitting shells obviously introduced from the sea by hermit-crabs, etc., into the outer part of the outer channel. I follow the order adopted by Pelseneer in his volume in Lankester's *Treatise on Zoology*.

Fam. Trochidae
Umbonium vestiarium (Linn.).
Solariella satparaensis Preston.
Fam. Cyclostrematidae.
Tubiola microscopica (Nevill).
Tinostoma variegatum Preston.
Fam. Neritidae.
Smaragdia mamilla sp. nov.
Fam. Fossaridae.
Chilkaia imitatrix Preston.
Fam. Rissoidae.
Stenothyra minima (Sowerby).
Stenothyra (*Gangetica*) *miliacea* (Nev.)
Fenella virgata (Philippi).
Fam. Cerithiidae.
Potamides (*Tympanotonos*) *cingulatus* (Gmelin).
Telescopium telescopium (Linn.).
Fam. Scalariidae.
Epitonium hamatulae Preston.
Fam. Pyramidellidae.
Pyrgulina humilis (Preston).
Pyrgulina ecclesia (Preston).
Fam. Pyramidellidae—*contd.*
Pyrgulina nadiensis (Preston).
Turbonilla rambhaensis (Preston).
Odostomia chilkaensis Preston.
Fam. Nassidae.
Nassa sistroidea G. & H. Nevill.
Nassa marrattii Smith.
Nassa (*Eione*) *labecula* A. Adams.
Pygmaeonassa orissaensis (Preston), gen. nov.
Pygmaeonassa denegabilis (Preston).
Fam. Muricidae.
Cuma disjuncta Annandale.
Fam. Tornatinidae (=Ratusidae).
Didontoglossa estriata (Preston), gen. nov.
Fam. Bullidae.
Haminea crocata Pease.
Fam. Eolidiidae.
Cuthona henrici Eliot.
Fam. Hermaeidae.
Stiliger pica Annd. & Prashad.
Fam. Elysiidae.
Elysia chilkensis Eliot.

Fifteen families, with twenty-two genera and twenty-eight species, are represented in the list. A number of species, genera and even families, however, have not penetrated into the main area of the lake. The Trochidae, Cyclostrematidae and Neritidae (all the Rhipidoglossa in fact) are found only in the outer channel and this is also true of the Fossaridae, Scalariidae, Bullidae and Elysiidae. Only eight families occur in the main area.

The genera completely at home in this area are *Stenothyra* (with its subgenus *Gangetica*), *Turbonilla*, *Potamides*, *Pygmaeonassa*, *Cuma*, *Didontoglossa*, *Cuthona* and *Stiliger*. Two other genera (*Nassa* in its subgenera *Eione* and *Pyrgulina*) frequent the outer part of the main area as well as the outer channel, but do not commonly penetrate into the further parts of the former. I take the eight genera, therefore, to represent the true semi-lacustrine Chilka fauna. It is noteworthy as illustrating the eclectic character of this fauna that six of the eight genera are represented by single species each and two by two species each. No true fluviatile or lacustrine families are represented,[1] but the genera *Stenothyra* and *Potamides* include species found occasionally or even habitually in fresh water, and *Pygmaeonassa* is, so far as we know, a brackish-water genus. The others are all marine but physiologically adaptable.

The list is remarkable as a whole mainly on account of the absence of many genera and even families characteristic of brackish water, for example the Littorinidae, Assimineidae and Auriculidae. All genera of Neritidae except the marine *Smaragdia* are also lacking, while the Cerithiidae are represented by only two species. All these molluscs are however, amphibious or almost terrestrial in habits and are at home mainly in mangrove-swamps, where they attach themselves to the roots or trunks at low water, and there are no mangrove-swamps round the Chilka Lake.

The families now best represented on the list are the Pyramidellidae, with five species belonging to three genera, and the Nassidae, also with five species which, however, belong to only two genera. The former are mud-dwellers, the latter actively predaceous or carrion-feeders.

I have nothing new to say about the nudibranchs, which have already been described adequately, or about the Fossaridae and Scalariidae, about two species of *Nassa* (*N. marrattii* and *N sistroidea*) or about the Trochid *Solariella satparaensis*, of all of which I have only empty shells.

I have to thank Dr. Baini Prashad and my assistant Mr. H. Srinivasa Rao for much help in extracting radulae and making preparations. To the former I am also indebted for valuable suggestions. Babu D. N. Bagchi has prepared the anatomical figures under my supervision with his usual skill. Those of living animals were drawn by Babu A. C. Chowdhury from molluscs brought alive to Calcutta.

Remarks on Species.

Fam. TROCHIDAE.

Umbonium vestiarium (Linn.).

1893 (?) *Rotella vestiaria*, Troschel, *Geb. der Schencken*, II, p. 220, pl. xxi, fig. 5 (radula).

This is a common and widely spread mollusc which makes its way into the outer channel of the lake. Its radula has been figured by Troschel, whose figure, though not actually in-

[1] In the flood-season the shallow margins of the lake often contain fresh water at certain places and are even joined on to the rice-fields. In such places and occasions freshwater forms (*e. g. Indoplanorbis exustus*, *Viripara bengalensis* and *Pachylabra virens*) are to be found, but they do not enter any permanent part of the lake.

correct, is misleading owing to its insufficient magnification. The formula is approximately 37. 2. 7. 2. 37, but it is very difficult to count the marginals (fig. 1) as they are all closely

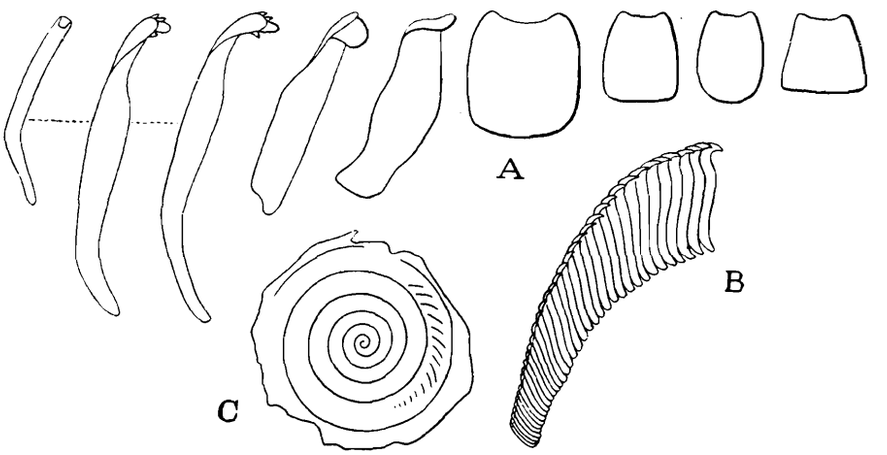


FIG. 1.—Radula and operculum of *Umbonium vestiarium*.

A, Radular teeth, ×500. B, Lateral series of teeth, ×167. C, Operculum, ×7.

pressed together in each transverse row in an oblique curved line. The centrals are simple, more or less quadrate plates without cusps and with the free upper margin concave. The two laterals on each side are considerably longer and narrower and have a simple lobe-like cusp. The marginals decrease in size and complexity from within outwards. The inner teeth of the series have four small cusps, the second of which from the outer margin is somewhat enlarged. The outer teeth are narrower and shorter and have a simple lobe-like cusp.

Fam. CYCLOSTREMATIDAE.

Tubiola microscopica (Nevill).

1877. *Valvata* (?) *microscopica*, Nevill, *Cat. Moll. Ind. Mus.*, fasc. E., p. 21.

1915. *Cyclostrema* (*Tubiola*) *innocens*, Preston, *Rec. Ind. Mus.* XI, p. 296, fig. 9.

Preston's type-specimen, as Dr. Kemp and I were inclined to think (p. 347), is a small denuded shell of Nevill's species, as to the taxonomic position of which Nevill himself was very doubtful. He collected it in a pool of brackish water at Port Canning in the Gangetic delta and noted that the operculum was horny and circular, of comparatively rather thick substance and apparently multispiral. Unfortunately I have only empty shells.

The true Valvatidae probably do not occur in the Oriental Region, although they are found in Kashmir and in other places on its northern frontiers.

Tinostoma variegatum Preston.

Dr. Baini Prashad has extracted the radula and operculum from a dried specimen of this minute species and has given me much help in examining them. The operculum (fig. 2c) is nearly circular and of very thin, transparent substance. The margin is, indeed, quite membranous. There are several concentric whorls and a distinct notch occurs at one side.

The radula (figs. 2A, 2B) is so minute that it has been impossible to mount it quite straight without losing it altogether. Certain features are, however, quite clear. The teeth

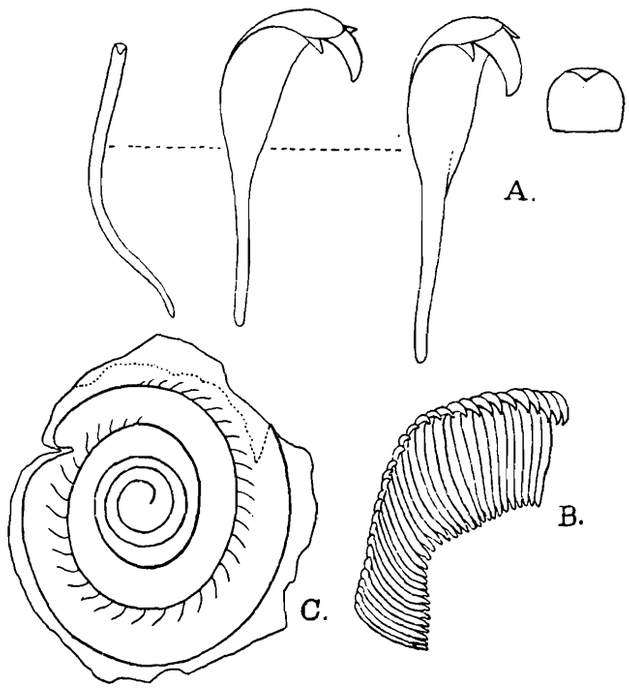


FIG. 2.—Radula and operculum of *Tinostoma variegatum*.

A, Radular teeth, ×1125. B, Lateral series of teeth, ×500. C, Operculum, ×75.

are arranged in three transverse series, two lateral and one central. There are over thirty teeth in each of the former and apparently eleven in the other. In the central series the central tooth is subcircular, but broadly truncate at the base. It has a small, simple, sharp, triangular cusp. The five teeth on each side are similar but considerably longer, becoming more elongate from within upwards. The teeth of the lateral series are curved and oblique and consist of closely adpressed, elongate, narrow processes, which show gradual differentiation from without inwards. The outermost members are almost hair-like, with a simple overturned cusp; but this cusp gradually becomes longer, sharper and more curved as the series proceeds towards the centre and a smaller cusp of similar form appears on each side of it. The shaft also becomes somewhat inflated in the middle. The exact form of the teeth is well shown in the figure.

Fam. NERITIDAE.

Genus **SMARAGDIA** Issel.

1869. *Smaragdia*, Issel, *Mal. Mar. Ross.* (Pisa), p. 212.

1879. *Smaragdia*, von Martens, *Conch-Cab.*, *Neretina*, p. 245.

The radulae of the type-species and of the form described here (fig. 3) are so different from those of the Neritinae of fresh and brackish-water habitat that *Smaragdia* deserves generic rank. Issel originally set up the genus to include all marine species of the facies of the true freshwater forms. He states that *S. viridis*, the type-species of his genus, differs from the freshwater forms in having completely sessile eyes.

The radula of *S. viridis* has been figured by Troschel,[1] who has, however, evidently misundertstood the relations of the different teeth and has, therefore, misrepresented their

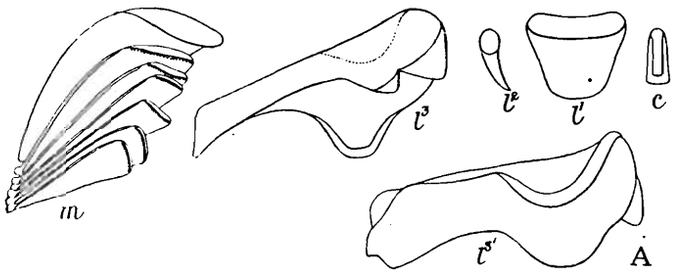


Fig. 3.—Radula of *Smaragdia mamilla* (× 500).

A, Umbrella tooth from below. *c*, central. l^1 l^2 l^3, 1st. 2nd. and 3rd. laterals. *m*, marginals.

outlines. They are so closely interlocked that they must be dissected out and examined from the lower as well as the upper surface. Allowing for errors of observation, it is evident that *S. viridis* and *S. mamilla*, my new species, have important features in common. These features are the loss of one of the smaller lateral teeth of which a pair is normally present on each side, and the peculiar shape of the outermost lateral or " umbrella tooth." This tooth in *Smaragdia* is bicuspid, of large size and distinctly transverse and has not the umbrella-like outline characteristic of *Neritina*. The most interesting feature of the radula, however, lies in the manner in which the marginals combine with the outer lateral of their own row and with the corresponding teeth of the preceding and succeding rows to form a rigid structure, which we may call the outer ridge of the radula. This is brought about mainly by the modification of the umbrella tooth, which consists of three parts, *viz.*, (*a*) a thin, transverse flattened shaft, (*b*) a strong bicuspid cutting lobe and (*c*) an almost spherical highly convex lower boss or projection, which projects from the shaft outside and below the cutting lobe. Above it on the shaft there is a semicircular concavity surrounded below by a thick ridge. The boss of the tooth in each row fits into the concavity on that of the corresponding tooth in the succeeding row, while its shaft lies obliquely across those of the marginals of its own row. The marginals are further bound together by the innermost of their own series, which is broader than the rest and fits over them like a roof. This description is based on *S. mamilla*, but is, I believe, also applicable to *S. viridis*. Troschel apparently did not realize that one of the two small, claw-like laterals had disappeared and apparently thought that one of the cusps of the umbrella tooth was this missing tooth. He also confused the innermost marginal with the umbrella tooth. His figures of the upper and lower views of the umbrella tooth are, therefore, inconsistent. In my own figure, however, the apparent inconsistency between the two series of this tooth is only apparent for it depends on the fact that the upper view is oblique and the lower view direct.

Smaragdia mamilla, sp. nov.

1915. *Neritina souverbiana*, Preston (*nec* Montrouzier), *Rec. Ind. Mus.*, XI, p. 296.

The shell (fig. 4) resembles that of *N souverbiana* Montrz. in some respects but differs in the form and the structure of the spire. In that species the apex is apparently acuminate

[1] *Geb. der Schencken*, II, pl. xvi, fig. 21.

and situated at the extreme tip of the shell, but in *S. mamilla* the whole spire is a rounded tubercle with the suture marked merely as a fine spiral line. This line, moreover, does not

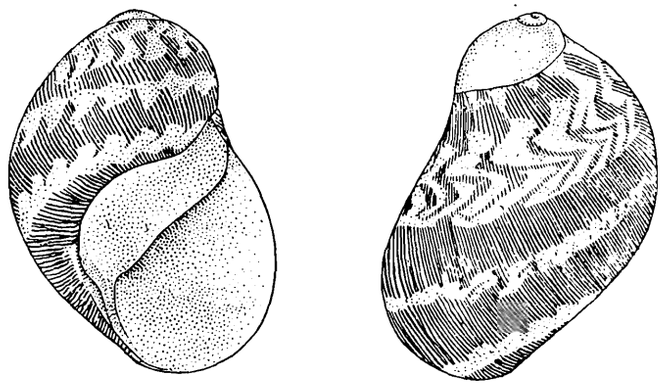


FIG. 4.—Shell of *Smaragdia mamilla*.

run in quite the same direction as the suture just above the body-whorl and the whole spire is, therefore, tilted somewhat towards the dorsal surface, so that its apex is distinctly visible when the shell is held with its main axis horizontal. There is, further, a broad, shallow depression round the body-whorl outside the suture. The margin of the columellar plate is slightly concave, not at all sinuate, and although it is minutely serrated in young shells the serrations almost disappear in the adult. The plate, moreover, narrows abruptly just above the exposed columella, thus providing a very distinctive feature. The colouration is also different from that of the shell of *S. souverbiana*. The surface is dull white ornamented with numerous fine, almost straight vertical lines of a bright green colour. These are interrupted by four spiral rows of diamond or Z-shaped white spots, the two uppermost rows sometimes combining to form a series of zig-zag vertical marks. The interior of the shell and columellar plate are white. The surface is smooth but not at all polished. The measurements of the type-specimen (M $\frac{12360}{2}$) are height 5·3 mm.; max. diam. 4·0 mm.; height of mouth 2·8 mm.; max. diam. of mouth 2·5 mm.

The operculum is unfortunately broken in the only specimen in which it remains. It is colourless and thin but only feebly translucent and has a strong fold running obliquely across its disc. The articular region is missing.

The form of the radular teeth is shown in fig. 3. Even allowing for errors in observation on Troschel's part, the central and the first and third laterals must differ considerably from those of the allied *S. viridis*, though I believe the structure of the whole radula to be very similar.

The species has been found so far only in the outer channel of the Chilka Lake, but doubtless exists also in the Bay of Bengal, and it is evidently a marine form.

Fam. RISSOIDAE.

The limits of this family and of the closely allied if distinct family Hydrobiidae (= Paludestrinidae or Amnicolidae) are obscure. Probably the older conchologists were right in uniting the two. The only distinction appears to be ultimately one of habitat, the Hydrobiidae being fluvitile and lacustrine, the Rissoidae marine and estuarine; but there are ex

ceptions even to this. I include in the latter family the Stenothyrinae, which are mainly estuarine but are also found in fresh water.

Subfam. *STENOTHYRINAE.*

Only one genus, including two subgenera, can with certainty be attributed to this subfamily. It is *Stenothyra* Benson with the subgenus *Gangetica* Ancey (=*Astenothyra* A. & P.). The Indian species of this genus have recently been revised by Dr. Baini Prashad and myself, but a further examination of large numbers of specimens in the field convinces me that our methods were not sufficiently drastic, some of the species, which are often markedly gregarious, exhibiting very great individual variability. All the forms found in the Chilka Lake can, in my opinion, be included in two species, one representing each of the subgenera.

Genus **STENOTHYRA** Benson.

1921. *Stenothyra*, Annandale & Prashad, *Rec. Ind. Mus.* XXII, p. 121.

Subgenus **Gangetica** Ancey.

1896. *Gangetica*, Ancey, *Bull. Soc. Mal. France* VIII, p. 168.

1921. *Astenothyra*, Annandale & Prashad, *op. cit.* p. 133.

I have to thank Dr. Baini Prashad for calling my attention to Ancey's name which escaped our notice when we proposed the name *Astenothyra* in 1921.

The absence of a terminal filament to the foot is not a constant subgeneric character. This structure may be either present or absent in either of the two subgenera, in both of which its absence is probably traumatic.

Stenothyra (Gangetica) miliacea (Nevill).

1921. *Stenothyra* (*Astenothyra*) *gangetica* with var. *subangulata*, Annandale and Prashad, *op. cit.*, p. 134, fig. 3 and p. 126, fig. 1 b (radula).

This is a very variable form enormously abundant with *S. minima* on *Potamogeton pectinatus* in the Chilka Lake. We have figured the radula in the paper cited.

Subgenus **Stenothyra** (s. s.).

A curious feature of this subgenus is the existence of certain forms (*echinata* and *ornata* A. & P.) which bear a spiral row of short spines in place of one of the rows of little pits with which the shells of many species are sculptured. Examination of a good series of the form *ornata*, which seems to be identical in other respects with some specimens of *S. deltae* Blf., convinces me that the character is not necessarily specific. Shells with spines are always very perfect at the apex and have been found only on a soft muddy bottom where no friction is exercised on the periostracum by foreign bodies. It seems to me at least probable that the spines are always produced on young shells, just as spiral rows of chaetae are produced on those of young Viviparidae, but are liable to be worn off, leaving only the pits from which they originated. Spines, however, have not been found on any of the Chilka shells.

Stenothyra minima (Sowerby).

1921. *Stenothyra minima* and *S. blanfordiana* Annandale and Prashad, *op. cit.*, p. 129.

I now believe that all the specimens of *Stenothyra* (s.s) collected in the Chilka Lake belong to one species. Shells taken in a single handful of weed often exhibit great diversity of shape and size and it is often impossible to separate them out into the various "species" recognized by Preston. The type-specimen of *S. obesula*, which is unique, looks rather different from the others, but is perhaps abnormal.

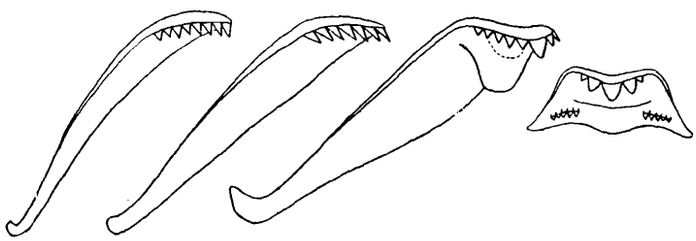


FIG. 5.—Radula of *Stenothyra minima* (×750).

I figure the radula here (fig. 5). It is distinguished mainly by the great relative breadth of the central and by the fact that the row of basal denticulations on each side of this tooth is situated only a very short distance above the basal margin. Other differences, likely to be less constant, are readily seen by a comparison with the figures of the teeth of *S. deltae* f. *ornata* and *S.* (*G.*) *miliacea* given by Dr. Baini Prashad and myself in our revision of the Indian species of the genus (*op. cit.*, *p.* 126).

Subfam. *RISSOINAE.*

Genus **FENELLA** A. Adams.

1860. *Finella*, A. Adams, *Ann. Mag. Nat. Hist.* (3) VI, p. 336 (*lapsu*).
1864. *Fenella*, *id. ibid.* (3) XIII, p. 39.
1902. *Alabina*, Dall, *Nautilus* XV, p. 127.
1923. *Alabina*, *id. ibid.* XXXVII, p. 33.

Dall (1923) proposes to change the name of this genus to *Alabina* on the ground that *Fenella* was preoccupied, but he gives no particulars.

Very few of the numerous species have been figured and it is probably impossible to recognize some of them without reference to Adams's original collection. I have to thank Lt. Col. A. J. Piele and Mr. Tomlin for naming the species here discussed. Their identification agrees with Nevill's.

Fenella virgata (Philippi).

1885. *Fenella virgata*, Nevill, *Hand. List. Moll. Ind. Mus.* II, p. 115.
1914. *Litiopa* (*Alaba*) *kempi*, Preston, *Rec. Ind. Mus.* X, p. 300, fig. 3.
1915. *Litiopa* (*Alaba*) *copiosa*, Preston, *ibid.* XI., p. 292, fig. 2.

This is an extremely variable species, of which I have examined large series of shells not only from the Chilka Lake, in which specimens are somewhat dwarfed and decoloured, and the Ennur backwater near Madras, but also from various parts of the Indian Ocean.

I figure the protoconch (fig. 6A). Nevill is certainly wrong in suggesting that it is identical with Adams's *F. pupoidea*, the type-species of the genus, and it does not agree with any other species from Adams's collection with which I have been able to compare it. The colouration is distinctive, though it may be obscured in dead or worn shells, I can find traces of it even in those from the Chilka Lake. Two forms of shell occur commonly in the same series, one considerably shorter and broader than the other.

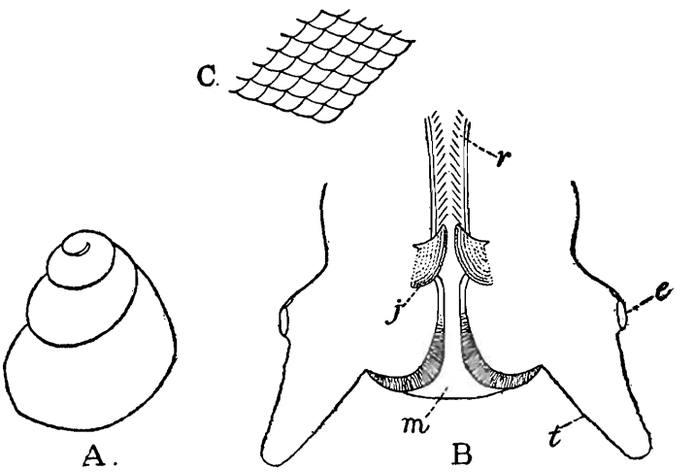


Fig. 6.—*Fenella virgata* (×50).

A, Protoconch, ×75. B, Head seen in optical section (×50), with part of surface of jaw further enlarged (×233). *e*, eye. j, jaw. *m*, mouth. *r*, radula. *t*, tentacle.

The animal is not that of a Litiopid, but conforms to Adams's description of *Fenella* (1864). Dr. Gravely, who has sent me large number of specimens from the Ennur backwaters, tells me that the exposed parts are bright green in life but become rose-pink in formalin. He also informs me that the anterior part of the pharynx can be thrust out in the form of a proboscis. This is confirmed by the position of the jaws (fig. 6B) in contracted specimens. They lie far within the head at the base of a tubular passage leading from the mouth. Their form and position are shown in the accompanying figure ; they are composed of numerous columnar bodies and thus have a tesselated appearance on the surface.

Fig. 7.—Radula of *Fenella virgata* (×500).

The radula (fig. 7) is probably characteristic of the genus. The central is transverse and has a complicated outline, the upper margin being biconvex and the base, which is truncate as a whole, having distinct lateral angles and a small projection in the centre. There are five large denticulations above, of which the central denticulation is considerably enlarged. The disc is sculptured vertically. There appear to be two laterals on each side,

each with an enlarged cusp as well as several smaller but comparatively large denticulations. The lobe of the marginals is finely and evenly serrated.

Fam. CERITHIIDAE.

The radula of the members of this family, a considerable number of which I have examined, has two outstanding peculiarities:—(1) each of the two marginals on each side is produced externally into a membranous flap or lobe which originates a short distance below the cusp and extends down the edge of the tooth almost to the base and (2) the lateral consists of two parts, (*a*) a horizontal basal plate and (*b*) an oblique shaft which bears the cusps at its upper extremity. The basal plate varies in shape in the different species but in the larger forms is a thickened leaf-shaped structure. It is connected with the base of the shaft at one end by a fine membranous band, only visible if the tooth is properly displayed.

Major R. B. Seymour Sewell has discovered that in one species of the family (*Pyrazus palustris*) interesting changes take place in the radular structure with the growth of the individual, but this does not occur in the two species discussed here.

I am doubtful about generic limits in the family but regard *Telescopium* as distinct.

Telescopium telescopium (Linn.).

It is not impossible that Troschel (*op. cit.* 1, pl. xii, fig. 2) has figured the radula (fig. 7) of a young individual of this species as that of *Potamides fluviatilis* (=*cingulatus*). The central is remarkable for its produced triangular base, which contains a concavity into which the corresponding tooth of the next series fits. There are 5 denticulations on the cusp

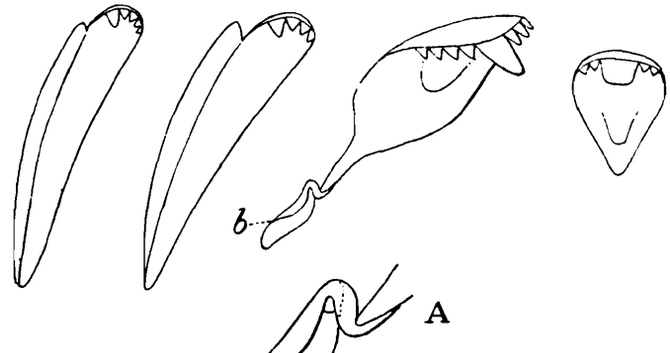


FIG. 8.—Radula of *Telescopium telescopium* (×150).
A, Basal part of lateral (×250)

of this tooth and the central denticulation is quadrate and enlarged. The laterals have 8 denticulations, the fifth from the outer margin being enlarged, elongate and bluntly pointed. The inner marginal has four and the outer marginal five denticulations, the outermost in each being slightly enlarged. The connection between the narrow shaft of the lateral and its basal plate (*b*) is shown in fig. 8A.

T. telescopium, which is usually an inhabitant of mangrove-swamps, is found in one or two of the muddy islands of the outer channel.

Potamides (Tympanotonos) cingulatus (Gmelin.)

This species, which is found in suitable localities in Rambha Bay as well as in the outer channel of the lake, frequently exhibits an abnormality of the shell, the body-whorl of which is rendered coarsely angulate in a vertical direction by the formation of a thick, more or less polished varix.

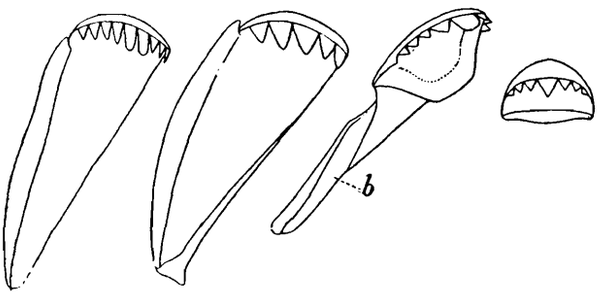


FIG. 9.—Radula of *Potamides cingulatus* (×166).

The radular teeth (fig. 9) differ considerably from Troschel's figure. The base of the central is transverse and only slightly sinuate and there are three small denticulations on each side of the enlarged, triangular central denticulation. The cusp of the lateral is much wider than in *T telescopium* and the large denticulation is quadrate, but the arrangement and number of the denticulations is the same. The connection with the basal plate (*b*) is obscure and I am not quite convinced that the structure is precisely that shown in my figure, which represents only the apparent structure. The marginals are rather broad, the inner with five or six and the outer with nine denticulations. The outermost of these in both teeth is rather smaller than those that follow.

Fam. PYRAMIDELLIDAE.

Fischer in his *Manuel de Conchyliologie* (p. 786), after pointing out the superficial nature of the generic characters in this family, observes " Il n'est done pas étonnant que quelques auteurs. .aient ces genres sous le titre commun de *Turbonilla* ou *Odostomia*" Both genera and species, indeed, stand in need of revision. Large numbers of the latter continue to be described, often without figures or with figures of little practical utility, and many of the descriptions are quite useless for purposes of identification. It seems not improbable that some species are polymorphic in shell-characters and the absence of a radula renders precise determination still more difficult. I am obliged to recognize no less than five species among the Chilka forms and to place them in three genera, but cannot feel by any means sure that they are really distinct one from another or from forms previously described.

Genus **TURBONILLA** Leach.

This genus seems to be in particular need of revision from an anatomical point of view. Two types of shells occur among the species commonly referred to it, one much thicker than the other, with a more contracted mouth and with a thicker collumella, in which there is a slight twist. The European *T lactea* (= *elegantissima*) is an example of this type, to which I also assign a species from the Chilka Lake.

Turbonilla rambhaensis (Preston).

1914. *Terebra rambhaensis*, Preston, *Rec. Ind. Mus.* X, p. 297, fig. 5.
1915. *Vanesia rambhaensis*, *id.*, *ibid.* XI., p. 289.

The shell of this species is not dissimilar to that of *T lactea* (Linn.). There is a slight fold in the columella as there is in that species. The apex is eroded in all the specimens examined.

I have extracted the dried animal from a shell from Rambha Bay and after due treatment have been able to detect the following characters :— (*a*) the tentacles are broad and flat, (*b*) an introverted proboscis exists, (*c*) the eyes are situated between the tentacles and (*d*) there is no trace of a radula or jaws. In a rough sketch of the living animal by Dr. Kemp the tentacles are shown as broadly triangular and situated so close together that their bases almost meet in the middle line of the head. The mentum is long and narrow, extending beyond the foot and rounded at the tip. The antero-lateral angles of the foot are angulate but not produced.

Genus **PYRGULINA.**

To this genus I assign three of the Chilka " species " which I would not be surprised to find ultimately merging into one another. The shells differ considerably in shape and sculpture but exhibit considerable individual variability. The only one of which I have seen the living animal (fig. 10) is *P. humilis*, of which I dredged a specimen in Rambha Bay. The following is a description of it. The figure was drawn in Calcutta from the living specimen.

" The snout (mentum) is broad, bilobed and extended beyond the foot. It is slightly expanded and bilobed in front and deeply grooved on the surface. The eyes are small, black and sessile, situated close together between the tentacles, which are short, pointed and directed somewhat backwards. The foot is comparatively short, pointed behind and expanded and truncate in front with the lateral angles acute but not produced." Later examination shows that the mouth is situated at the base of the mentum in a deep groove. I have not seen the proboscis extruded. The colour of the animal is described in my notes thus, " Foot and head opaque white, with black markings on snout," *i.e.* on the mentum.

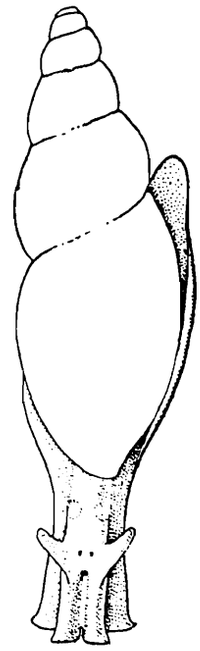


FIG. 10.—Living animal of *Pyrgulina humilis* (enlarged).

I have nothing further to say about the species assigned to this genus or to *Odostomia*.

Fam. NASSIDAE.

This family is represented in my list by no less than five species, all of which have been placed in the genus *Nassa*. Two of these (*N. denegabilis* and *N. orissaensis*) are among the most abundant and most generally distributed of the members of the lake-fauna, while one (*N. labecula*) is not uncommon in the outer channel and the outer part of the main area.

The other two (*N. sistroidea* and *N. marrattii*) are rare and have been found only in the outer channel.

The classification of the unwieldy genus *Nassa* and its close allies is in a most unsatisfactory state. Various conchologists have set up a number of subgenera and divisions and some attention has been given to the form of the operculum but none of the attempts at subdivision have been altogether satisfactory and it is clear that no permanent arrangement will be achieved until some attention is given to the anatomy of the different forms. Even in external structure there is a great difference between the animal of such a species as *Nassa stricta*[1] and that of any of the three discussed here. These three are *N. denegabilis*, *N. orissaënsis* and *N. labecula*. The animals of all three are very similar externally. The foot is comparatively small, the antero-lateral angles are little produced and the postero-lateral angles not at all. The posterior extremity is, indeed, almost truncate, with merely a slight excavation. The opercula of *N. orissaënsis* and *N. denegabilis* on the one hand and of *N. labecula* on the other are very different. Those of the two former species are ovate with the nucleus near the inner border, paucispiral and very thin, with smooth margins, while that of *N. labecula* is more elongate, much thicker, serrated on its outer margin and anterior extremity, marked with stout curved longitudinal ridges and having the nucleus on the outer margin. A difference is also to be observed in the shells. Those of *N. orissaënsis* and *N. denegabilis* are small, comparatively thin, with the lip thin and the callus little developed, while that of *N. labecula* is much larger and thicker, with a thick lip and an exceptionally well developed callus. There is even a certain difference in the radula, for while in *N. labecula* the central is that of a typical *Nassa*, in the other two the number of denticulations is reduced and the lateral processes of the tooth feebly developed.

The peculiarities of the shell, operculum and radula and especially those of the operculum seem to me amply sufficient for the separation of the two small Chilka species (with *N. ennurensis* Preston, a closely allied form) from the genus *Nassa*. I propose for them the new generic name:

Pygmaeonassa, gen. nov.

The animal has a comparatively long and narrow foot with parallel sides and not expanded anteriorly. Its antero-lateral angles are produced into short filaments and its posterior extremity is truncate or broadly rounded with a slight excavation. The siphon is as long or nearly as long as the shell. The anterior margin of the head is broadly truncate; the tentacles are comparatively short and slender and have the eyes situated on their external surface at some distance from their base.

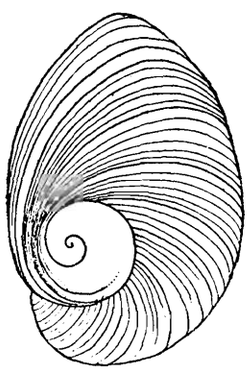


FIG. 11.—Operculum of *Pygmaeonassa orissaensis* (×33).

The operculum (fig. 11) is thin, horny and paucispiral resembling that of many Rissoidae and Melaniidae. It is relatively large.

The radula is normal, but the number of denticulations on the central is relatively small and the lateral projections of its base feebly developed. The laterals resemble those of *Nassa*.

[1] Fischer, *Man. Conchyl.*, p. 655, fig. 389. Compare this figure with the one of *Nassa orissaënsis* here reproduced.

The shell is small[1] and comparatively fragile but strongly sculptured, with vertical ribs, of a narrowly ovate form. The mouth is large, narrowly ovate and a little contracted above; the outer lip is sharp but thickened within, the columella devoid of folds but sometimes with a slightly developed tubercle. The callus is narrow and confined to the columellar margin.

Type-species.—*Nassa orissaënsis* Preston.

Geographical Range.—Many small species assigned to *Nassa* may belong to this genus, but the only three that can at present be referred to it are known only from brackish water on the Indian coasts.

Pygmaeonassa is perhaps allied to *Canidia* Adams, but there are distinct differences[2] in the radula and operculum.

Genus **NASSA** Martini.

Subgenus **Eione** Risso.

The subgenus is distinguished by the great development of the callus. I have already referred to the peculiarities of the foot and operculum. The radula is in every respect normal.

Nassa (Eione) labecula A. Adams.

This is a common species on the east coast of India, mainly in brackish water. The radula (fig. 13) and opercula (fig. 12) are figured from specimens taken in the Ennur back-

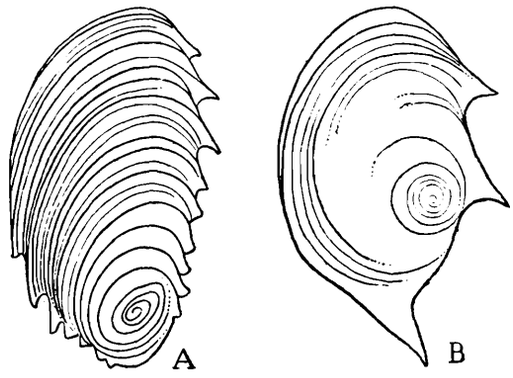


FIG. 12.—Operculum of *Nassa* (*Eione*) *labecula*.

A, Operculum of adult, ×12. B, Operculum of half-grown individual, × *ca.* 14.

water near Madras. The foot is broader than in *Pygmaeonassa* but its extremities are similar. The siphon is relatively shorter.

The operculum undergoes a remarkable change in the course of growth. Fig. 12A shows that of the adult. In the young (fig. 12B) it is much thinner and more transparent,

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[1] The best figure of the shell is that of *N. ennurensis* var. *depauperata*, A. & P., *Rec. Ind. Mus.* XVI. pl. xx. fig. 9 (1919). For the radula see the same paper, p. 253, text-fig. 6 (c).

[2] See Brot, *Journ. Conchyl.* XXIV, p. 346, pl. xii (1876).

the anterior extremity is smooth and the outer margin bears only three relatively large serrations, which are situated near the posterior extremity. This is the condition in a half

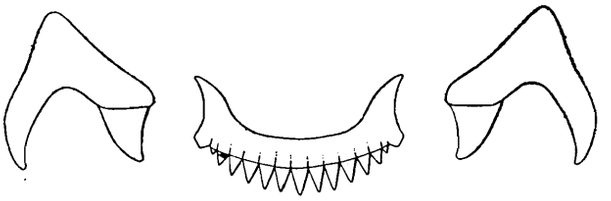

FIG.13.—Radula of *Nassa* (*Eione*) *labecula* (×166).

grown individual ; in still younger individuals there would probably be no serration at all, for they are correlated with the curved ridges on the surface and these are apparently growth-lines.

Fam. MURICIDAE.

Cuma disjuncta Annandale.

1916. *Thais carinifera* Preston, *Rec. Ind. Mus.* x. p. 299.

1922. *Cuma disjuncta*, Annandale, *Mem. Asiat. Soc. Bengal* VII, p. 266, fig. 2.

This is probably the representative in brackish water of *C. carinifera* Lam., from which the main structural difference in the shell lies in the change in direction of the spiral above the body-whorl. This results in the production of a conspicuous notch in the profile as seen in dorsal view. In the normal form of the species, which I have seen from both the the Bombay and the Madras coasts and also from the Andamans and the Maldives, the notch is to some extent obscured by the great development of the upper row of prominences on the body-whorl. It can, however, always be seen in ventral view and is quite constant in a very large series of specimens. The form found in the Chilka Lake is usually smaller and has the prominences and other sculpture much less well developed. For this form (B in the figure cited) I propose the name:

var. **obliterata,** nov.

Dead and probably subfossil shells, usually of small size, are very abundant on the shore of Barkuda and I have seen similar shells, inhabited by hermit-crabs, in the Ennur back-waters near Madras. For some time after the unusually low salinity of the water in 1919 to 1920 (*v.* Sewell, *antea*, p. 688) had disappeared the species remained very scarce as a living mollusc in Rambha Bay, if it was not altogether exterminated, but in August, 1923 and January, 1924 I found living young individuals at Barkuda.

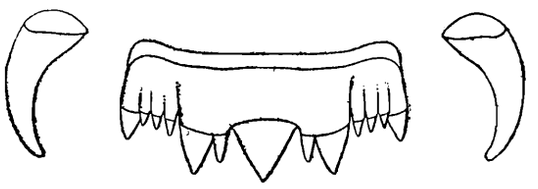

FIG. 14.—Radula of *Cuma disjuncta* (×500).

The radula, here figured (fig. 14) from a young individual, offers no point for special comment. It differs from that of the allied *C. kiosquiformes* as figured by Troschel (*op.*

cit., II, pl. xiii, fig. II) chiefly in the much shorter central cusp of the central. The laterals are also narrower at the base.

Fam. TORNATINIDAE.

Didontoglossa, gen. nov.

The new genus consists of small species with a cylindrical shell very much like that of *Tornatina* (=*Ratusa*) but differing considerably in anatomy. The shell is smooth on the surface and bears a thin colourless periostracum.

The cephalic disc (fig. 15A) is of moderate size and narrower than the foot. It is rounded in front and produced behind into a pair of narrow, flat, truncate processes. The eyes are small but conspicuous. The foot is rounded behind, without parapodia or epipodia extending over the shell, into which the whole animal can be retracted, but with the anterior margins slightly retroverted.

The jaws are large, thin, angular and serrated. The radula (fig. 15B) is of moderate length and resembles that of *Philine*. It has two rows of teeth, the formula being 1. 0. 1. The laterals (fig. 15B) are relatively large, uniform and serrated, the central is absent or extremely vestigial.

The gizzard (fig. 15C) is compressed and armed internally with two large valve-like reniform plates containing some calcareous matter and bearing small tubercles on their internal face. There is a mere vestige of a third plate between them.

There is no penial stylet.

Type-species. *Tornatina estriata* Preston.

I leave the genus in the Tornatinidae in spite of its possessing a radula because the shell and the external structure of the animal are very similar to those of *Tornatina*. The structure of the gizzard is, moreover, in some respects similar, though very different in others.

It is probable that other small species with a shell like that of *Tornatina* will be found to belong to this genus, for example Nevill's *Cylichna lactuca* and *C. involuta* from Indian seas. These species, so far as the shell is concerned, come very near *T estriata* but are much larger.

Didontoglossa estriata (Preston).

1914. *Tornatina estriata & soror*, Preston, *Rec. Ind. Mus.* X, p. 303, figs. 7, 8.

1916. *Retusa estriata, id. ibid.* XII. p. 27.

The minute size of the species and the fact that my specimens were preserved in a highly contracted condition makes a detailed anatomical study difficult and hardly worth the time it would involve. The points noted in the generic description are, however, quite clear. I have been unable to find any central tooth in the radula but there is perhaps a vestige of it in the form of an extremely thin irregular plate between the two laterals.

The gizzard is relatively very large and reniform in outline (fig. 15C). The œsophagus enters it in a depression on the ventral surface (fig. 15D) in the middle, while the exit of the intestine (fig. 15E) is subterminal on the dorsal surface. The muscles are arranged in two fan-shaped fascicles one on each side of the compressed organ. These meet on the dorsal

surface towards the middle. On the ventral surface they are broadly excavated to admit of the entry of the œsophagus. Their outline is similar to that of the calcareous plates,

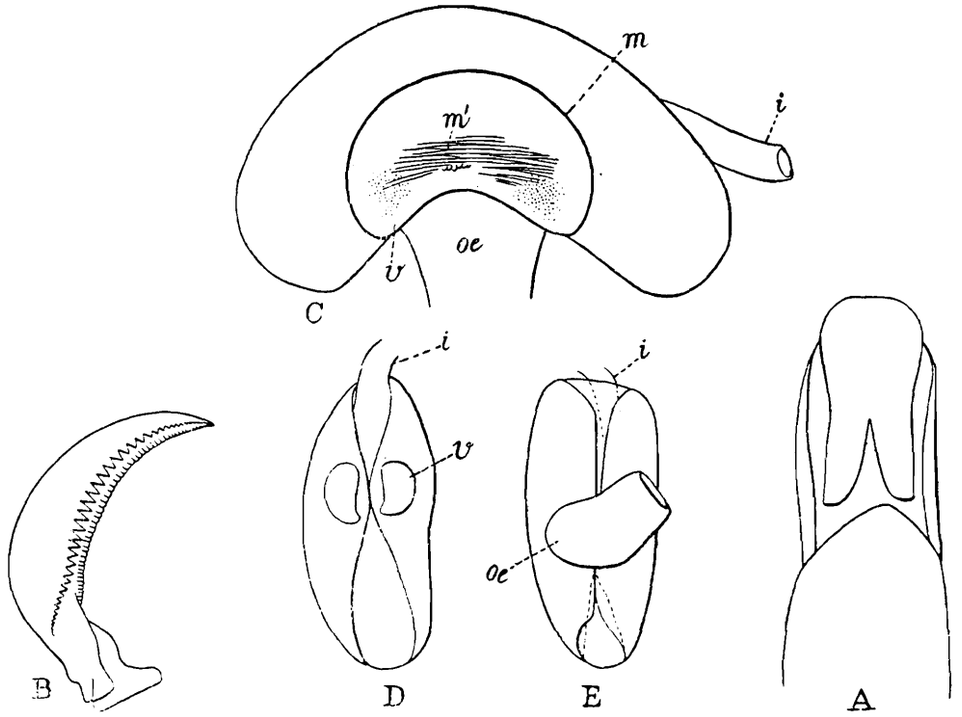

FIG. 15.—*Didontoglossa estriata.*

A, Anterior part of living animal (enlarged). B, Radular tooth, ×500. C, D, E, Gizzard (enlarged). *i*, intestine. *m*, radiating muscles. m^1, longitudinal muscles. *oe*, œsophagus. *v*, calcareous plate.

which lie one on each side of the œsophagus and are considerably smaller than the fascicles. The vestige of a third plate, which lies between the convex margins of the other two, consists of a fine ridge which forms one side of an ill-defined triangle. Transverse muscles are attached to a roughened area on the external surface of each of the two plates. The type of gizzard seems to be derived from one of the type found in *Tornatina* by a compression in the transverse axis and a rotation in the longitudinal plane and by an increase in size and slight change of shape of the two lateral plates with a reduction of the median plate.

The external characters of the living animal (fig. 15A) agree in most respects with those of *Utriculus* as figured by Sars,[1] by Fischer,[2] Kobelt[3] and other authors; but the cephalic disc is smaller and narrower and its tentacular processes are closer together and truncate instead of pointed. In 1885 Vayssière[4] placed *Utriculus* in the Scaphandridae, but in his later work[5] follows Fischer in placing it with *Ratusa* (=*Tornatina*) in the Tornatinidae. Moreover, he removed the species (*truncatula*) figured by Kobelt from *Utriculus* to *Ratusa*. It seems to be clear that in this family the anatomy as well as the shell and the external characters of the animal must be examined for a satisfactory diagnosis.

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[1] Sars, *Moll. Asit. Norvegiae*, pl. xi, figs. 6-9 (Christiania, 1878).

[2] Fischer, *Man. Conchyl.*, pp. 550, 555, figs. 307, 308, 314 (1887).

[3] Kobelt, *Conch. Cab., Bullidae*, pl. A, fig. 3 (1896).

[4] Vayssière, *Ann. Mus. Hist. Nat. Marseilles* II, p. 30 (1885).

[5] Vayssière. *Moll. France* I in *l'Encyclop. Scient.*, p. 157, pl. xviii, fig. 2 (1913).

Fam. BULLIDAE.

Genus **HAMINEA** Leach.

1913. *Haminea*, Vayssière, *Moll. France* I, p. 163.

Haminea crocata Pease.

1860. *Haminea crocata*, Pease, *Proc. Zool. Soc.*, p. 19 (shell) and p. 432 (animal).

1896. *Haminea crocata*, Kobelt, *Conch. Cab., Bullidae*, p. 109, pl. xvi, fig. 1.

The animal agrees, so far as can be seen from highly contracted specimens, with Pease's brief description. It appears to be that of a true *Haminea*, but the radula (fig. 16 C) does not altogether agree with Vayssière's description. Its formula may be stated as 5. 1. 1. 1. 5, but the outer marginal is rather more differentiated than the single lateral and it would be almost equally correct to state the formula as 1. 5. 1. 5. 1. The form of the teeth is best shown in the figure. The gizzard (fig. 16A) is more normal, but the three horny plates with which it is armed internally are very large and have a peculiar sculpture, while the three pairs of narrow horny ridges at their base are somewhat obscure. The plates (fig. 16B) have the usual cornucopia-like outline and bear a number of transverse-shaped ridges. Behind each ridge is a parallel row of minute spines and at the base of the plates these spines replace the ridges. The genitalia and nervous system are not well preserved in my material, but there is certainly no penial stylet.

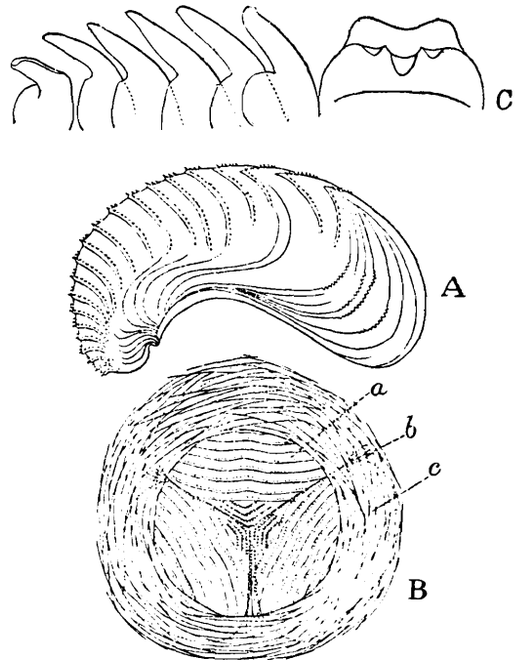


FIG. 16.—*Haminea crocata.*

A, Gizzard as seen from below after being rendered transparent (× *ca.* 26). B, Horny plate in lateral view (×50). C, Radular teeth (highly magnified).

Shells from the Chilka Lake are rather larger than those from the Sandwich Is. and have the spiral striae better developed and the columellar callus thinner and less porcellaneous In these respects, however, they differ also from specimens from Natal and Ceylon. and the differences are probably due to local conditions.

FAUNA OF THE CHILKA LAKE.

TANAIDACEA AND ISOPODA.

By CHARLES CHILTON, *M.A., M.B., C.M., D.Sc., LL.D., F.L.S., C.M.Z.S., Professor of Biology, Canterbury College, New Zealand.*

(Plate LX.)

CONTENTS.

TANAIDACEA AND ISOPODA.

By CHARLES CHILTON.

INTRODUCTION.

It is convenient to include the Tanaidacea in the same report as the Isopoda for they have often been considered a sub-order of the Isopoda and are represented by a single species in the fauna of the Chilka Lake. The differences between the two groups are, however, very great and more important than those between the Isopoda and the Amphipoda and I agree with Calman (1909, p. 190) that the Tanaidacea should be ranked as a separate order.

The four terrestrial Isopods from the shore of the lake have already been reported on (Chilton, 1916, p. 461), but the names are included in the list below in order to make it complete, and some additional information is given with regard to two of the species.

The total number of species is small, *viz.* :—

Tanaidacea 1, Isopoda 14 but the Isopoda represent nine families, *viz.* :— Anthuridae. 2 species ; Cirolanidae, 3 ; Aegidae, 1 ; Cymothoidae, 1 Sphaeromidae. 2 ; Idoteidae, 1 ; Oniscidae, 2 ; Armadillididae, 1 ; Ligiidae, 1.

These families differ so much from one another that the work of identifying species is out of proportion to their number, and is rendered more difficult because the literature is very scattered and no general revision of the whole Isopoda is available. Sars' account of the Isopoda of Norway and Harriet Richardson's Monograph of the Isopoda of North America are, however, very useful.

It will be seem from the list of species with the distribution given below that four are described as new species, the rest being referred to species already described from India, the East Indies, etc., and that the geographical distribution of the species will be useful in checking results arrived at from other groups.

I have given only those references which seem necessary for the purpose, others can readily be obtained from those here quoted.

For the fine figures illustrating the paper I have to thank Miss E. M. Herriott, assistant in the Biological Laboratory of Canterbury College, and Miss Beryl Parlane, one of my students.

I desire also to express my grateful thanks to Dr. Annandale for the privilege of reporting on the Isopoda collected under his direction in Chilka Lake.

LIST OF SPECIES WITH DISTRIBUTION.

TANAIDACEA.

1. *Apseudes chilkensis* Chilton, sp. nov. Chilka Lake.

ISOPODA.

1. *Apanthura sandalensis* Stebbing. Chilka Lake ; Loyalty Is.
2. *Calathura borradailei* Stebbing. Chilka Lake ; Maldive and Laccadive Archipelagoes.
3. *Cirolana pleonastica* Stebbing. Chilka Lake ; New Britain.
4. *Cirolana parva* Hansen. Chilka Lake ; Ceylon ; Florida ; Gulf of Mexico ; W. India Is. ; Bahamas, etc.
5. *Cirolana nigra* Chilton, sp. nov. Chilka Lake.
6. *Rocinela orientalis* Sch. & M. Chilka Lake ; Ceylon ; Philippine Is. ; etc.
7. *Cymothoa indica* Sch. & M. Chilka Lake ; Bangkok.
8. *Cassidina pulchra* Chilton, sp. nov. Chilka Lake.
9. *Exosphaeroma parva* Chilton, sp. nov. Chilka Lake.
10. *Synidotea variegata* Collinge. Chilka Lake ; Gulf of Manaar.
11. *Alloniscus pigmentatus* Budde-Lund. Chilka Lake ; Madagascar, East Indies.
12. *Hemiporcellio carinatus* Collinge. Chilka Lake.
13. *Cubaris granulatus* Collinge. Chilka Lake.
14. *Ligia exotica* Roux. Chilka Lake ; widely distributed on warmer shores of the Atlantic, Pacific and Indian Oceans.

Order TANAIDACEA.

Tanaidacea, Calman, 1909, p. 190.
Tanaidacea, Tattersall, 1921, p. 197.
Isopoda Anomala, Tribe Chelifera, Stebbing, 1905, p. 2, and 1910, p. 85.
Isopoda Chelifera, Sars, 1899, p. 4.
Isopoda Chelifera, Niestrasz, 1913, p. 1.

It will be seen from the references given above that there is a difference of opinion as to whether this group should be ranked under the Isopoda or as a separate order. While it may be convenient to place them under the Isopoda their characters are, I think, sufficiently different to entitle them to rank as an Order of equal systematic importance with the Isopoda.

Niestrasz (1913) discusses the homologies of the various appendages and the names which should be used for them.

The Order contains two families, the Apseudidae and the Tanaidaceae but only the first is represented in the Chilka Lake fauna.

Family APSEUDIDAE.

Apseudidae, Norman and Stebbing, 1886, p. 79.
Apseudidae, Sars, 1899, p. 5.
Apseudidae, H. Richardson, 1905, p. 37.

Genus **APSEUDES** Leach.

A description of the genus is given in each of the works quoted under the family.

Apseudes chilkensis, sp. nov.

(Plate LX, fig. 1.)

Localities.

1—3 miles S. E. by E. ½ E. of Patsahanipur. Three specimens.

1 mile E. by N. of Patsahanipur. Many specimens.

2—6 miles E. by S. ½ S. of Patsahanipur. Several specimens.

Nalbano Island, Chilka Lake. Several specimens. "Stomach of *Trygon imbricata.*"

Station 158. "Chief food of *Trygon imbricata.*" Several specimens.

Off Barkul, Chilka Lake. Three specimens.

Off Samal Island, 8—15 feet. One specimen.

[This crustacean is very abundant in the Chilka Lake on a bottom of fine mud, in which it probably buries itself. The stomach of the little sting-ray *Trygon imbricata* usually contains large numbers of individuals. *N.A.*]

Specific Diagnosis.—Body rather slender, narrowing posteriorly. Rostrum triangular, rounded anteriorly, sides arched. Free segments of mid-body defined by deep constrictions, without lateral teeth; coxal plates small, rounded; posterior margin of last segment of mid-body bearing a fringe of setae; pleon narrow, epimera of five anterior segments produced downwards into small acutely pointed spiniform projections not visible in dorsal view. Ocular lobes not distinct, eyes apparently absent. Superior antennae elongated, first joint of peduncle as long as the next two together, bearing on the inner side four tufts of long hairs and on the outer a row of long hairs; flagella subequal, each with about 12 to 15 joints. Inferior antennae with the peduncular joints short, exopod oval, fringed with long setae. Cheliped elongated, basal joint widening distally, inner margins without teeth; propod greatly elongated, rather longer than basis; margins without teeth; a row of small hairs on the inner margin; fixed finger with wide emargination at the base, followed by a well defined tooth; movable finger arched, with dentiform projection at base. Second trunk legs nearly as long as the chelipeds, the last three joints flattened and fringed with very long hairs in addition to the usual spinules. Uropods elongated, basal joint short, inner ramus composed of about 24 joints, outer ramus of 8 joints.

Length.—About 7 mm.

Colour.—Whitish.

Remarks.—This species appears to be a true *Apseudes* agreeing with the characters of the genus as set out by Sars. It differs markedly from other species in the second pair of trunk limbs which are not fossorial, but apparently adapted for swimming. The usual spinules are present, but are small and largely obscured by the greatly elongated hairs fringing the last three joints. The optic lobes are barely discernible and apparently fused with the head and there is no sign of the eyes. The absence of eyes in this form which seems to live in surface or shallow waters is rather remarkable; it may be mentioned, however, that the amphipod, *Niphargus chilkensis,* found in Chilka Lake also has imperfect eyes; probably the blind condition of these two species was developed in some locality occupied by them before they came to live in Chilka Lake.

The mouth parts, as far as observed, appear to present no marked peculiarity. The structure of the trunk limbs and the arrangement of the setae thereon can be best learnt from the figures given.

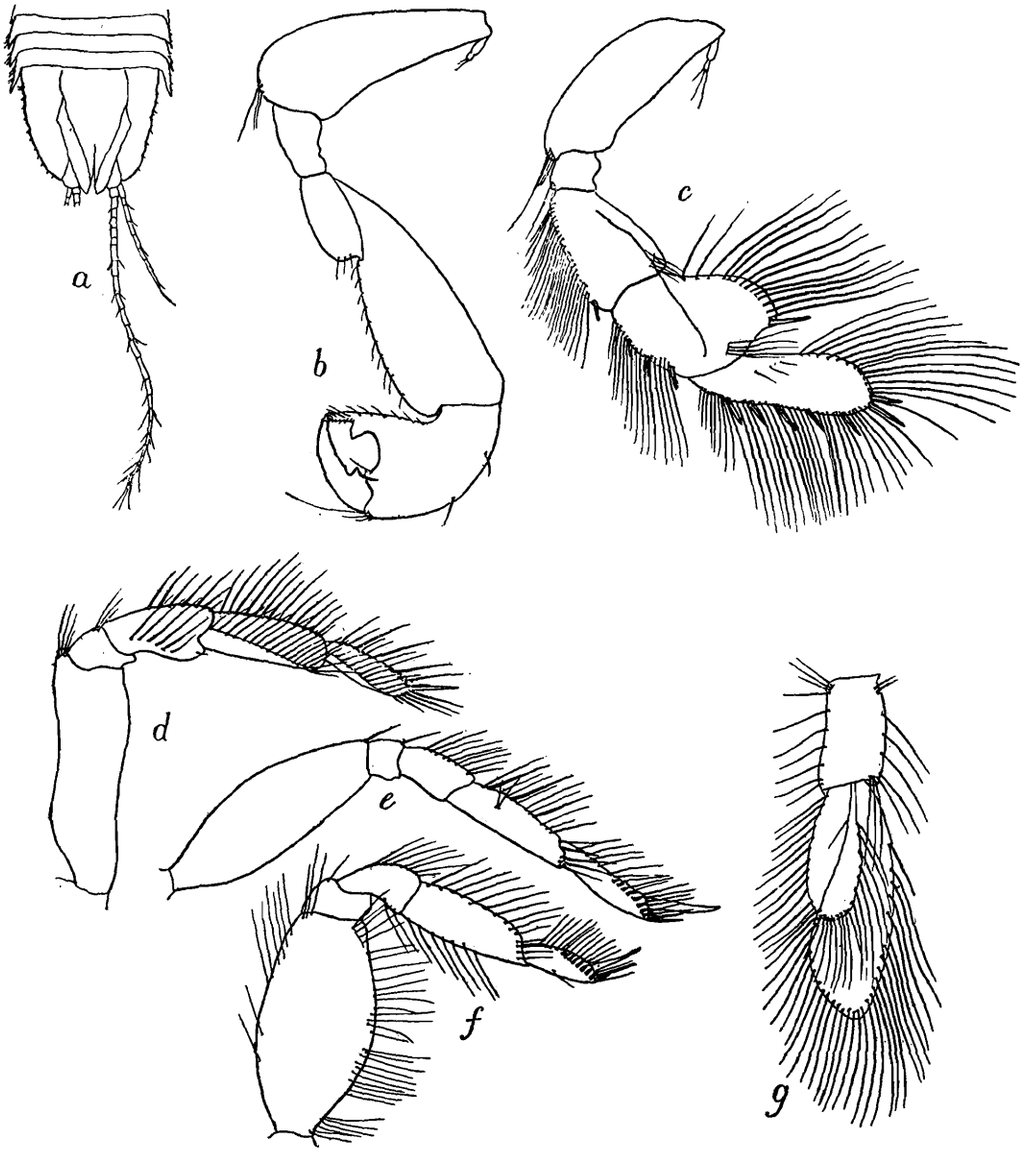


FIG. 1.—*Apseudes chilkensis*, sp. nov.

a. Terminal portion of body with uropoda.
b. Cheliped
c. Second trunk limb.
d. Third trunk limb.
e. Fifth trunk limb.
f. Seventh trunk limb.
g. Pleopod.

Order ISOPODA.

Family ANTHURIDAE.

Anthunidae, Harriet Richardson, 1905, p. 62.

Genus **APANTHURA** Stebbing.

Apanthura, Stebbing, 1900 C, p. 621.

This genus, which was established for the species given below, is characterised by the mouth parts and by the last four pairs of peraeopods in which the fifth joint under-rides the sixth.

Apanthura sandalensis Stebbing.

Apanthura sandalensis, Stebbing, 1900 C, p. 621, pl. lxv A.

Localities.

Main Channel, W. of Satpara Island. One specimen.
Station 157. Several specimens.
Kalupara Ghat, near shore. Two specimens, one an ovigerous female.
Between Barnikuda and Nalbano Island, depth 10 feet. One specimen.
1—5 miles N. by E. of Kalidai. One specimen.
On swamp inside bar, N. of Barhampore Island. One specimen.

This genus and species were established by Stebbing for specimens obtained by Dr. A. Willey at Sandal Bay, Lifu, Loyalty Islands.

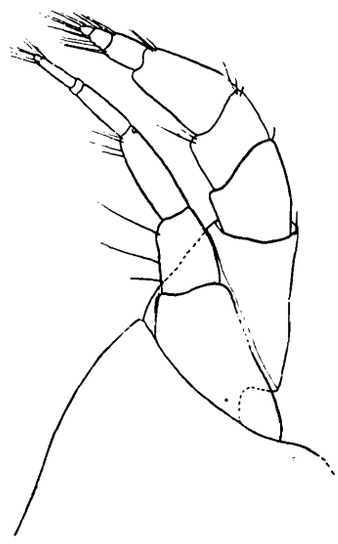


FIG. 2.—*Apanthura sandalensis* Stebbing, antennae, seen from above.

The Chilka Lake specimens agree well with the description given. I give a figure of the antennae showing that the first or upper antennae lie in a groove running obliquely across the large basal joint of the lower antenna just as it does in the form I described in 1883 under the name *Anthura affinis* (1883, p. 72, pl. i, fig. 4a).

Genus **CALATHURA** Norman and Stebbing.

Calathura, Norman and Stebbing, 1886, p. 131.

Calathura borradailei Stebbing.

Calathura borradailei, Stebbing, 1904, p. 700, pl. xlix A.

Localities.

Station 157. One ovigerous female.
2—8 miles N. E. ½E. of Kalidai. Several specimens.
Off Nalbano; 4—5 miles S. E. by E. of Patsahanipur. One specimen.
1—9 miles N. E. by E. of Kalidai. One specimen.
8 miles S. S. W. of Kalidai. One specimen.
Off Samal Island, 8—15 feet. One specimen.

This species has been fully described and figured by Stebbing from a single male specimen collected at Fadifolu Atoll in the Maldive-Laccadive Archipelagos. The Chilka Lake specimens agree well with his description in all important characters. I give a figure of the head and antennae of a male and also one of the mandible to show the structure of the palp which was not clearly seen in Stebbing's specimen.

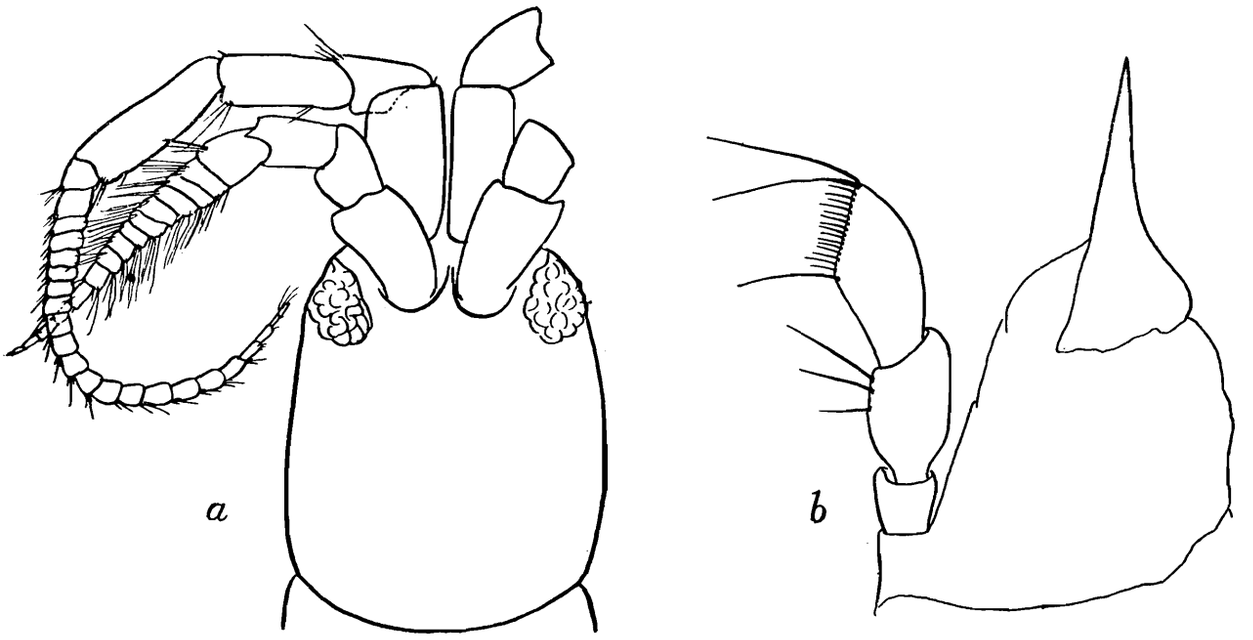


FIG. 3.—*Calathura borradailei* Stebbing.

a. Head and antennae of male, seen from above. *b*. Mandible of male.

Family CIROLANIDAE.

Cirolanidae, Harriet Richardson, 1905, p. 81, (with the characters of the genus and an analytica key to the genera).

Genus **CIROLANA** Leach.

Cirolana, Harriet Richardson, 1905, p. 82.

Cirolana, Stebbing, 1900 C, p. 629.

Harriet Richardson gives an analytical key to the North American species.

Cirolana pleonastica Stebbing.

(Plate LX, fig. 2.)

Cirolana pleonastica, Stebbing, 1900 C, p. 629, pl. lxvii A.

Localities.

Off Samal Island, 8-15 ft., Chilka Lake. Many specimens of varying sizes up to 10 mm. in length.

North side of Chirriya Island. One specimen.

Barkul Point. Two specimens.

Manikpatna, Chilka Lake, from crevices in oyster shells. Five specimens.
Eight miles W by S. of Breakfast Island.
Six miles S. S. W. of Kalidai.
Ennur Backwater, near Madras, 45 feet. One specimen.

This species was taken in abundance at Samal Island and I have no hesitation in identifying it with Stebbing's species, owing to the close resemblance of the spinous tubercles on the dorsal surface to the description given by him. It will be seen from plate XL, figure 2, that on each of the three posterior segments there is a transverse row of small pointed tubercles near the posterior margin. On the third, fourth and fifth segments of the pleon the tubercles are fewer in number but larger and more conspicuous. On the terminal segment there is a pair of fairly large tubercles near the anterior border and further back three smaller ones diminishing in size posteriorly ; the whole being so arranged that they form two small ridges with a furrow between them. The size of the larger specimens is about 10 mm. In these the tubercles are more easily seen than in specimens of the same size as Stebbing's, *viz.*, 8·5 mm. In smaller specimens the tubercles are much less conspicuous.

In the male the fine hairs on the uropods are far more numerous than in the female, see fig. 4 C.

Distribution.—Chilka Lake ; New Britain.

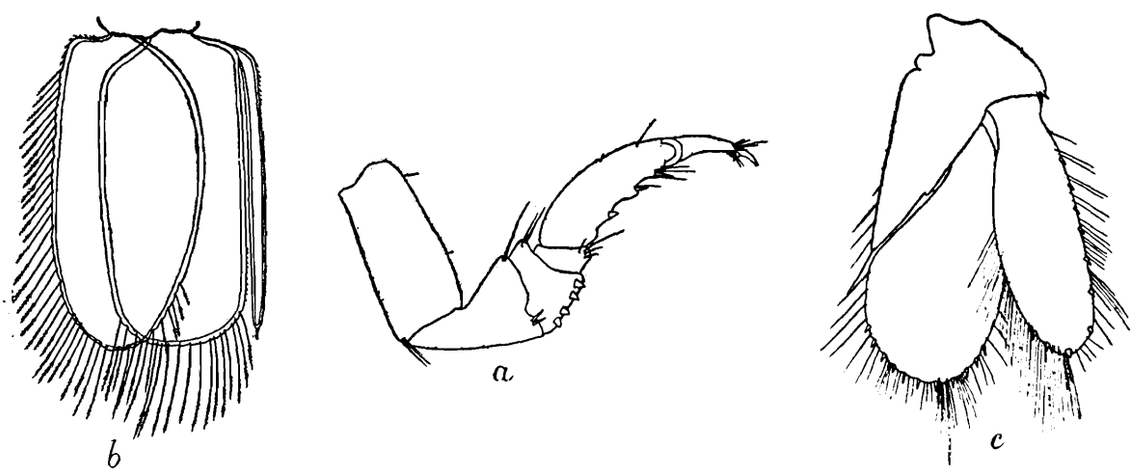


FIG. 4.—*Cirolana pleonastica* Stebbing.

a. First peraeopod. *b*. Second pleopod of male. *c*. Uropod of male

Cirolana parva Hansen.

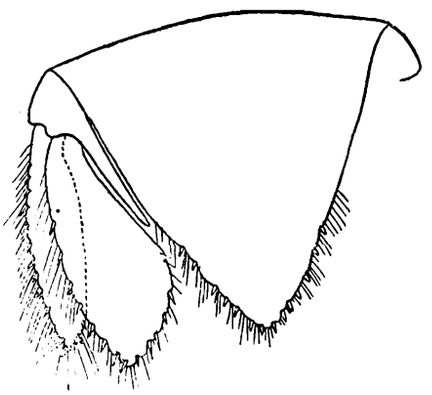
Cirolana parva, Stebbing, 1905, p. 12.
Cirolana parva, Richardson, 1905, p. 111.

Localities.

One mile N. N. E. of Breakfast Island. One specimen.
Off north shore of Samal Island. One specimen.
Six miles S. S. W. of Kalidai. Several specimens.
Main channel, W. of Satpara Island. Several specimens.

Main channel, between Satpara and Barnikuda. Four specimens.
Off Barkul, Chilka Lake. One specimen.
Eight miles W. by S. of Breakfast Island. Two specimens.
Four to seven miles E. ½ S. of Barkul bungalow. One specimen.

I refer these specimens to *C. parva* with considerable hesitation but that species has been already recorded from Ceylon by Stebbing, who says that it is probably somewhat variable, and on the whole my specimens agree fairly well with the description given by Hansen. The dorsal surface of the whole body smooth, the terminal segment (*see* fig. 5) is not so rounded as in Stebbing's specimens, and bears about 14 stout setules as well as fine hairs; the outer ramus of the uropod is slightly shorter and much narrower than the inner. In the antennae the joints of the flagella are more numerous but in the mouth parts and other appendages I can find no distinct point of difference between them and Stebbing's descriptions. This species appears to come quite close to *C. harfordi* Lockington (=*C. californica* Hansen) but in that species, of which I have been able to examine specimens from California, the terminal segment has the extremity more rounded and bears numerous setae placed close together, with few or no long hairs.



5.—*Cirolana parva* Hansen, terminal segment and uropod.

Distribution.—Chilka Lake; Ceylon; Gulf of Mexico; West Indies, &c.

Cirolana nigra, sp. nov.

(Plate LX, fig. 3.)

Localities.

Chirriya Island. Two specimens.
Maludai Kuda Island. Several.
Barkul Point. Four specimens. Found along with the terrestrial Isopod, *Alloniscus pigmentatus*, B. L., under stones at the edge of the lake.

Specific diagnosis.—Body oblong ovate, about two and a half times longer than wide, rather convex. General surface of the body smooth but with some small tubercles on the pleon segments, forming a transverse row along the posterior margin, poorly marked on the second and third segments, on the fourth the median tubercle is moderately large with two smaller ones on each side, on the fifth the median tubercle is larger and more prominent, with one on each side only, less well marked; terminal segment triangular with rounded extremity, fringed with nine setules and numerous fine hairs. Its surface bears two slightly raised ridges with a groove between them, this structure being fairly well marked on the anterior part of the segment. Eyes moderately large. The first antenna rather elongated, peduncle longer than flagellum, apparently composed of three joints, the third being much longer and more slender than the second; flagellum of about nine joints, with sensory setae on those

towards the end. The second antenna about twice as long as the first, last joint of peduncle rather longer than the preceding, flagellum longer than peduncle, about 25 jointed. First pair of trunk limbs stout, with six stout setules on the merus and two towards the end of the propod. Second and third legs similar, fourth, fifth, sixth and seventh progressively longer, the seventh having the basal joint rather expanded ; propod longer than the carpus, the joints bearing setae as shown in fig. 6 d.

Uropoda with base produced acutely to about the middle of the last segment, outer branch shorter and narrower than the inner, both obscurely serrate and bearing stout setules and numerous fine hairs.

Length.—5 mm.

Breadth.—2 mm.

Colour.—Almost black, the dorsal surface thickly covered with dark pigmented areas of varying pattern with lighter areas between them.

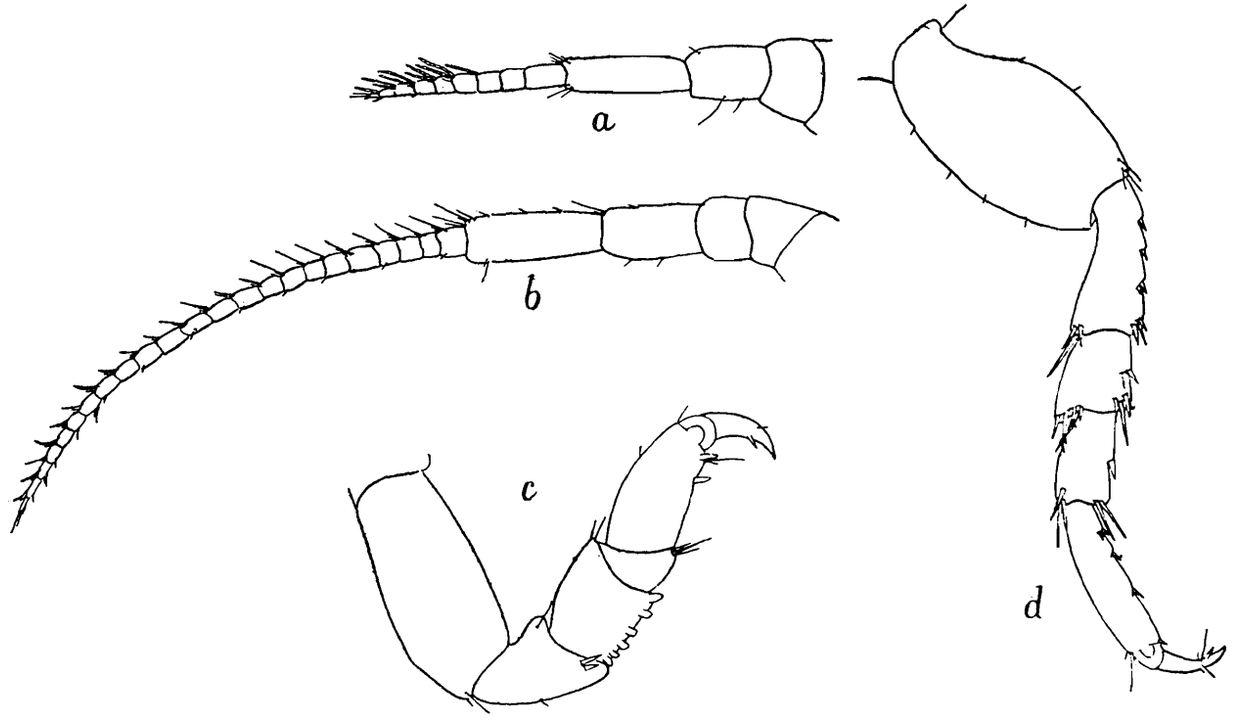


FIG. 6.—*Cirolana nigra*, sp. nov.

a. First antenna.
b. Second antenna.
c. First peraeopod.
d. Seventh peraeopod.

Family AEGIDAE.

Aegidae, Harriet Richardson, 1905, p. 166, (with characters of the family and analytical key to the genera).

Aegidae, Stebbing, 1910, p. 422.

Genus **ROCINELA** Leach.

Rocinela, Harriet Richardson, 1905, p. 190, (with analytical key to the North American species).

Rocinela orientalis Sch. & M.

Rocinela orientalis, Stebbing, 1905, p. 24, pl. vi (C).

Locality.

Station 84. Main Channel, W. of Satpara Island. One specimen, 9 mm. long.

This specimen is small and immature, the seventh pair of thoracic legs being only about half the length of the sixth and not fully developed, but I have little doubt that it belong to this species. The antennae, maxillipeds, the terminal segments and uropods agree closely with the description and figures given by Stebbing. The trunk limbs also agree with the description except that in the first three the propod is armed with only one or two very small spinules instead of three or four spines, this being doubtless due to the immaturity of the specimen.

Rocinela orientalis appears to be pretty close to *R. australis*, of which I have New Zealand specimens, but in that species the propod of the anterior limbs is said by Schiodte and Meinert to bear 5 or 6 spines, and in one specimen examined by me there are actually 9 spines. In

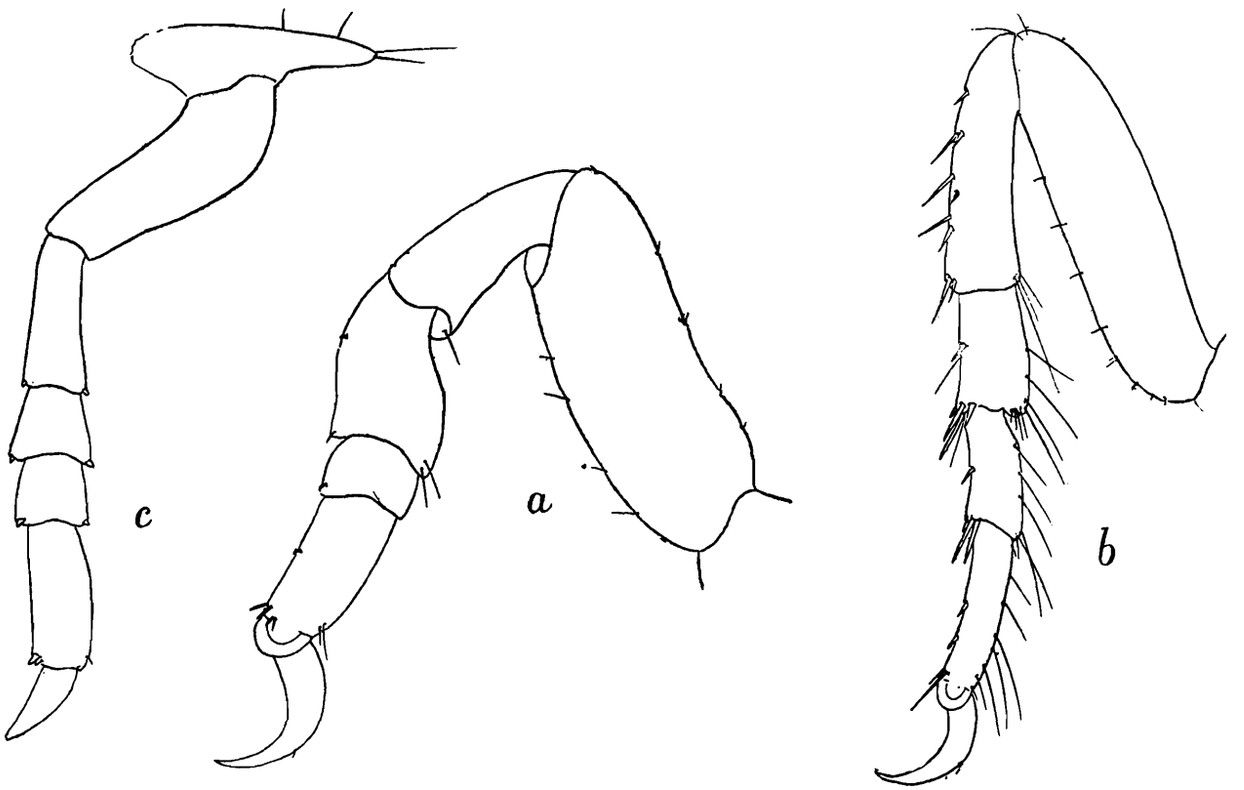


FIG. 7.—*Rocinela orientalis* Sch. & M.

a First peraeopod of immature specimen. *b*. Sixth peraeopod of immature specimen.
c. Seventh peraeopod of immature specimen.

other respects there is close resemblance between the Chilka Lake specimens of *R. orientalis* and New Zealand specimens of *R. australis*.

Distribution.—Chilka Lake ; Ceylon ; Philippine Islands, etc.

Family Cymothoidae.

Cymothoidae, Stebbing, 1900 A, p. 55, and 1900 C, p. 639.
Cymothoidae, Harriet Richardson, 1905, p. 214.

The characters of the family and its synonymy are discussed by Stebbing (1900 A, p. 55) and an analytical key to the genera is given by Harriet Richardson.

Genus **CYMOTHOA** Fabricius.

Cymothoa, Richardson, 1905, p. 247, with analytical key to the North American species.
Cymothoa, Thielemann, 1910, p. 39.

Cymothoa indica Sch. & M.

Cymothoa indica, Schiodte and Meinert, 1884, p. 250, pl. viii, figs. 1-4.

Localities.

Chilka Lake. Sta. 47, Barkul Point. "From the mouth of *Glossogobius giuris*" 21-7-13. Several specimens of different ages; the largest 15 mm. long.
Barkul Point. One ovigerous female; about 20 mm. long.

[Not uncommon in the mouth of the large goby *G. giuris* in which it causes a deformation of the tongue. *N. A.*]

I have little hesitation in referring these specimens to the species named above, the type specimens of which were collected in waters connected with the Indian Ocean at Bangkok[1] and are in the Berlin Museum. The Chilka Lake specimens agree closely with the description of the ovigerous female and adult male given by Schiodte and Meinert; in some of the young specimens the eyes are quite distinct, but in the adults they are scarcely or not at all distinguishable. In general appearance, and in the structure of the appendages the species is very similar to *Meinertia imbricata*, but the first antennae are not greatly flattened, being only slightly compressed, and are rather widely separated at their bases as stated in the description of the genus *Cymothoa*.

Cymothoa borbonica Sch. & M. probably occurs in the Maldive and Laccadive Islands, for Stebbing assigns to this species with some hesitation two small males obtained from Hulule, at the same time mentioning some points in which they differ slightly from the description given. His specimens were not more than 10 mm. long and were probably not fully mature.

C. amurensis Gerstfeldt, a species which according to its author is nearly related to *C. oestrum* Linn., has been recorded from the Amur River, occurring on a freshwater fish *Cyprinus lacustris* (see Thielemann, 1910, p. 41).

Family Sphaeromidae.

Genus **CASSIDINA** Milne-Edwards.

Cassidina, Milne-Edwards, 1840, III, p. 223.
Cassidina, Hansen, 1905, p. 112.

Some of the isopods which resemble *Cassidina* in the depressed flattened body and reduced outer branch of the uropods do not really belong to the genus but the species

[1] The fauna of the R. Menam at Bangkok is euryhaline. *N. A.*

described below appears to agree with the characters of the genus in the mouth parts, pleopoda, etc.

The genus *Cassidisca* Richardson, 1905, is said to differ from *Cassidina* M.-Edw. in not having the second, third and fourth joints of the palp of the maxillipeds produced into lobes. No information is given about the pleopoda of *Cassidisca* so that it is impossible to say whether it comes under Hansen's section Cassidinini or not. If it does, it is probably very near *Cassidina* for the differences in the maxillipeds are not great or of much importance.

Cassidina pulchra, sp. nov.

(Plate LX, fig. 4.)

Localities.

Eight miles W. by S. of Breakfast Island. One specimen.

Off Samal Island, 8-15 ft. Several specimens.

Diagnosis.—Body oval, length about 20 mm., breadth 11 mm., much depressed, margins fringed with setae, surface smooth, but with a pair of rather pointed tubercles on each of the body segments and on the first (combined) segment of the pleon, on the terminal segment the tubercles are continued as two longitudinal ridges lying close together. Head considerably broader than long, produced into flat lateral expansions. Uropods large, inner branch fitting closely against terminal segment and reaching back to about the middle of the terminal segment, outer branch nearly half the total length of uropod.

Frontal plate large, triangular. First antenna with basal joint not flattened but large, swollen, somewhat constricted near the middle, rather longer and much narrower than the second ; flagellum of about seven joints. Second antenna with third, fourth and fifth joints of peduncle subequal, flagellum of about six joints, first two subequal and much longer than the others.

Mouth parts normal. Maxillipeds with the inner margins of the second, third and fourth segments of palp produced inwards into small rounded lobes fringed with setae.

Legs short and not visible in dorsal view, subequal in length.

Pleopoda apparently normal (*see* fig. 8 *h*, *i*, *j*, *k*).

Size.—Length about 20 mm.

Colour.—Brownish.

Remarks.—This species presents very close resemblance to *C. typa* which is found in New Zealand, but in that species the joints of the peduncle of the first antenna are distinctly produced into a flat flange and the outer branch of the uropods is much smaller in proportion.

Cassidisca lunifrons Richardson, from New Jersey, North America, shows a general resemblance to the present species in the shape of the body, the antennae and even the maxillipeds but the outer branch of the uropod is only one-fourth as long as the inner branch and, as stated above, there is no information as to the structure of the pleopoda.

From a comparison of figs. 8 *e* and 8 *f* it appears that the lobes of the palp-joints may vary in size ; the differences between the figures in this and other points are partly due to the different positions in which the maxillipeds were lying when drawn.

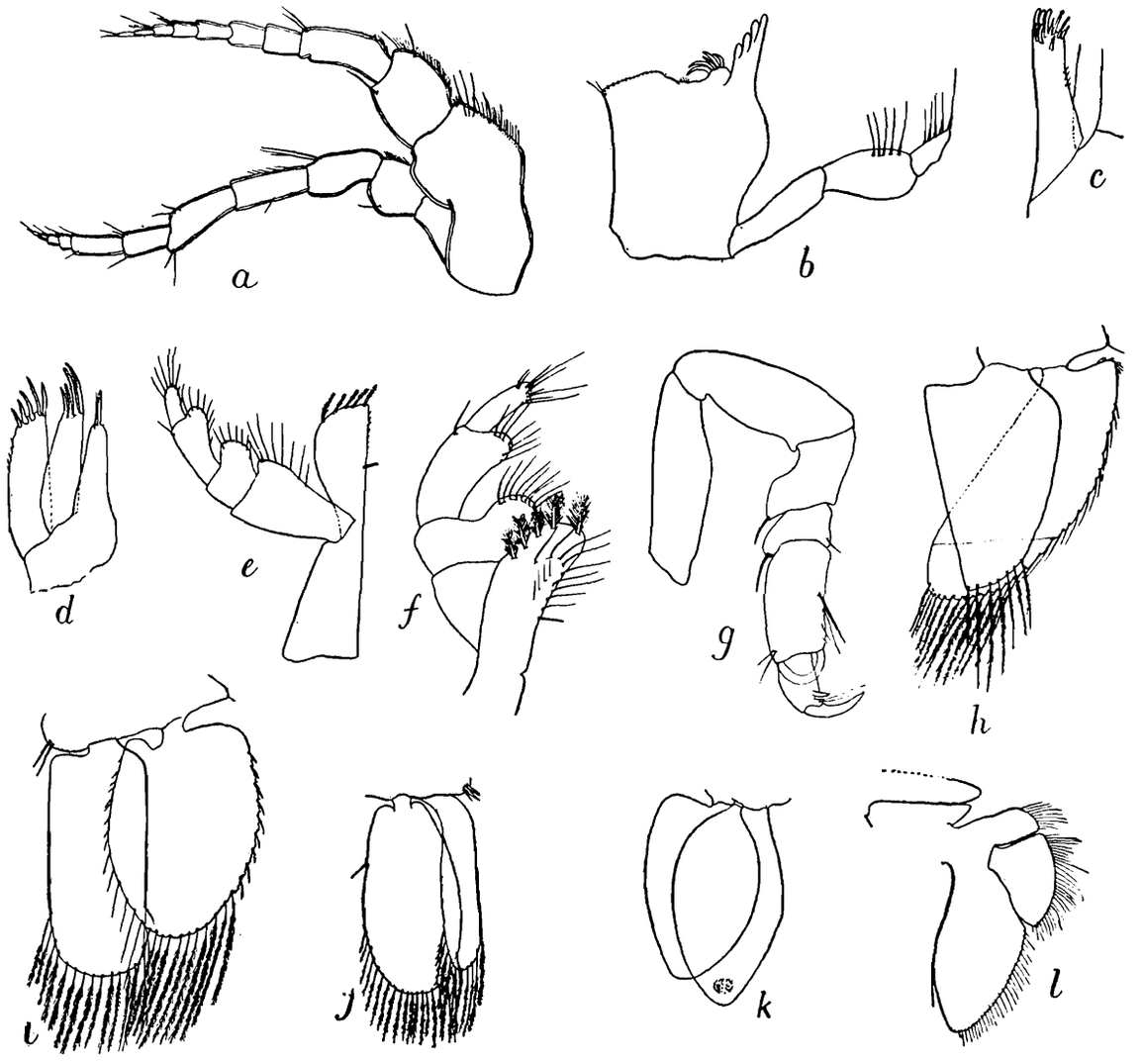


FIG. 8.—*Cassidina pulchra*, sp. nov.

a. Antennae, upper and lower.
b. Mandible.
c. Maxilla 1 (inner lobe imperfect).
d. Maxilla 2.
e. Maxilliped.
f. Maxilliped, from another specimen.
g. Trunk limb.
h. First pleopod.
i. Second pleopod.
j. Third pleopod.
k. Fifth pleopod.
l. Uropod.

Genus **EXOSPHAEROMA** Stebbing.

Exosphaeroma, Stebbing, 1900 B, p. 553.
Exosphaeroma, Richardson, 1905, p. 287.

Miss Richardson distinguishes this genus from *Sphaeroma* by the following characters :—

1. Second, third and fourth joints of palp of the maxilliped produced into lobes.
2. Outer branch of uropod not denticulate on its exterior margin.

Exosphaeroma parva, sp. nov.

(Plate LX, fig. 5.)

Localities.

Maludai Kuda Island. Two specimens.
Off Samal Island, 8-15 ft. Several specimens.
Rambha. 22-9-13 Several specimens.

This species in many respects is very like *E. gigas* (Leach) except in size. It differs, however, in having the body less flattened, the epimeral portions of the segments being directed nearly vertically downwards. The terminal segment is broadly rounded or truncate posteriorly. The whole dorsal surface is smooth. The mouth parts, the body limbs and pleopods

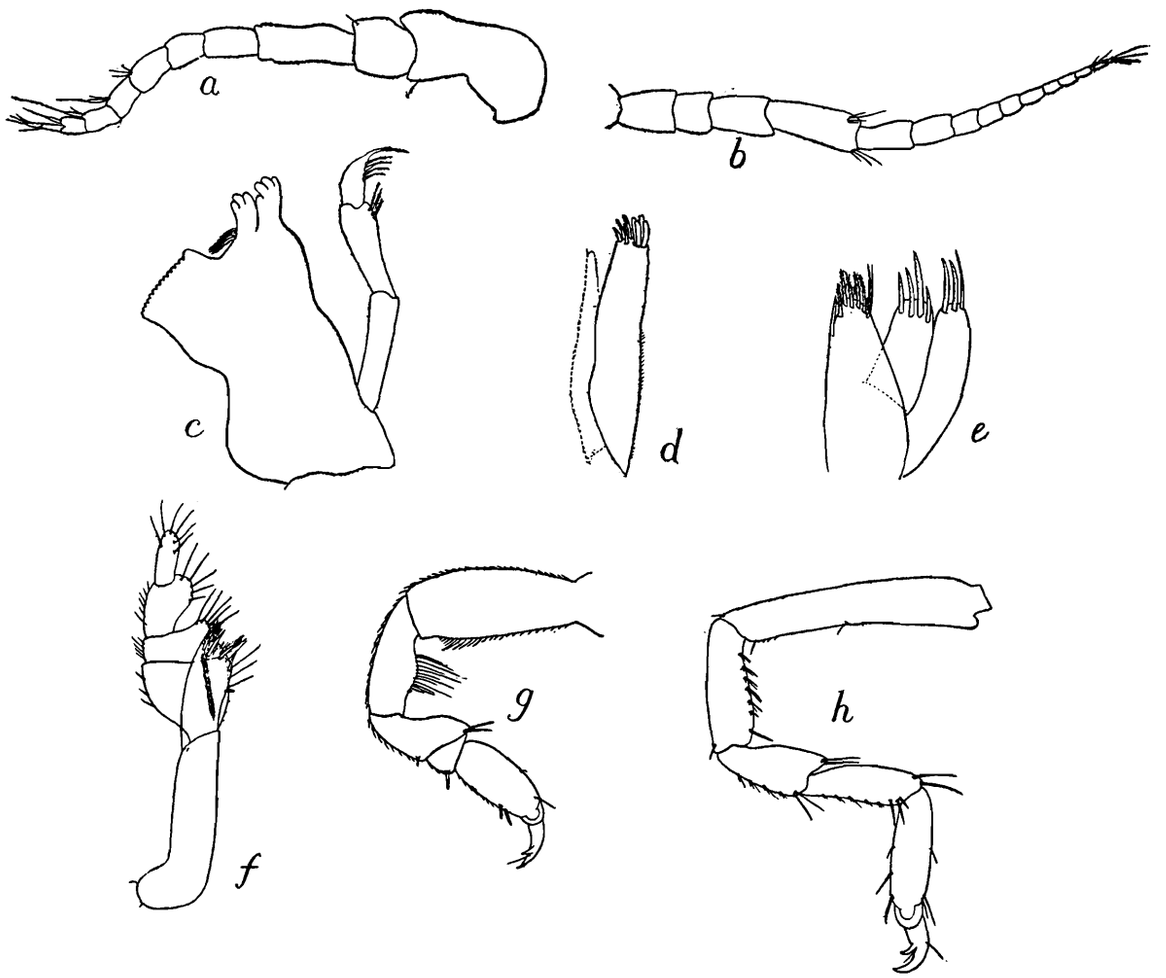


Fig. 9.—*Exosphaeroma parva,* sp. nov.

a. Upper antenna.
b. Lower antenna.
c. Mandible.
d. Maxilla 1.
e. Maxilla 2.
f. Maxilliped.
g. Peraeopod 1.
h. Peraeopod 7.

present no distinctive feature but are on the whole like those of *E. gigas.* In the uropods the branches are subequal in length and breadth, both reaching as far as the end of the terminal segment and being fringed with small setules.

Colour.—Dark slaty coloured.

Size.—About 4 mm. in length.

Remarks.—I have some hesitation in describing this as a new species for I have not seen any specimen that I could be quite sure was the male, and in many allied species the male is distinctly different from the female and marked by some striking character. If in *E. parva* the male is similar in general appearance to the female, it will make the species approach still nearer to *E. gigas*, although a comparison of this minute species from India with the large forms of *E. gigas* from Macquarie Island and other subantarctic localities would at first appear very striking. *E. gigas*, however, is not only found on all subantarctic shores but extends along the shores of New Zealand right up to the north in Lat. 35° S. and also on the coasts of Australia to even lower latitudes. The forms inhabiting these more temperate regions are very much smaller in size than those in the higher latitudes but I can find no difference in other respects and in regard to size there is a gradual transition between the two extremes. A form very similar if not identical with *E. gigas* is found in Cape Colony, South Africa. This is of moderate size, about 10 mm. It would not therefore be very astonishing if the same species in reduced size were actually found in Chilka Lake, but as there appears to be a slight difference in the shape of the terminal segment I prefer to give the species a name to itself in the meantime.

The structure of the mouth parts and other appendages can be readily learnt from the figures given.

Family IDOTEIDAE.

Genus **SYNIDOTEA** Harger.

Synidotea, Richardson, 1905, p. 376.

Synidotea variegata Collinge.

(Plate LX. fig. 6.)

Synidotea variegata, Collinge, 1917, p. 1, pl. 1.

Localities.

Manikpatna, Chilka Lake (oyster-beds).
Off Satpara, Chilka Lake, 4-6 ft.
Off Samal Id., 8-15 ft., Chilka Lake.
Barkul, Chilka Lake.
Off Barkul, Chilka Lake.
East side of Rambha Bay.
Eight miles W by S. of Breakfast Id.
East side of Rambha Bay.
Barkuda Id.
One to nine miles N. E. by E. of Breakfast Id.
Six miles S. S. W of Kalidai.
Off north shore of Samal Id.
One to eight miles N. of W of Samal Point.

One to five miles E. S. E. of Barkul bungalow.
Main Channel, W. of Satpara Id.

[The species is common amongst *Potamogeton pectinatus* and the stouter algae all over the lake. *N.A.*]

I have no hesitation in referring these specimens to Collinge's species, the type specimens of which were obtained from coral reefs in the Gulf of Mannar. The Chilka Lake specimens agree in practically all characters with Mr. Collinge's description as regards the shape of the body, relative length of segments and even the small arcuate depression near the anterior margin of peraeon segments two to four. The terminal segment of the pleon has the emargination on the posterior margin rather wider and more distinct than is shown in his figure.

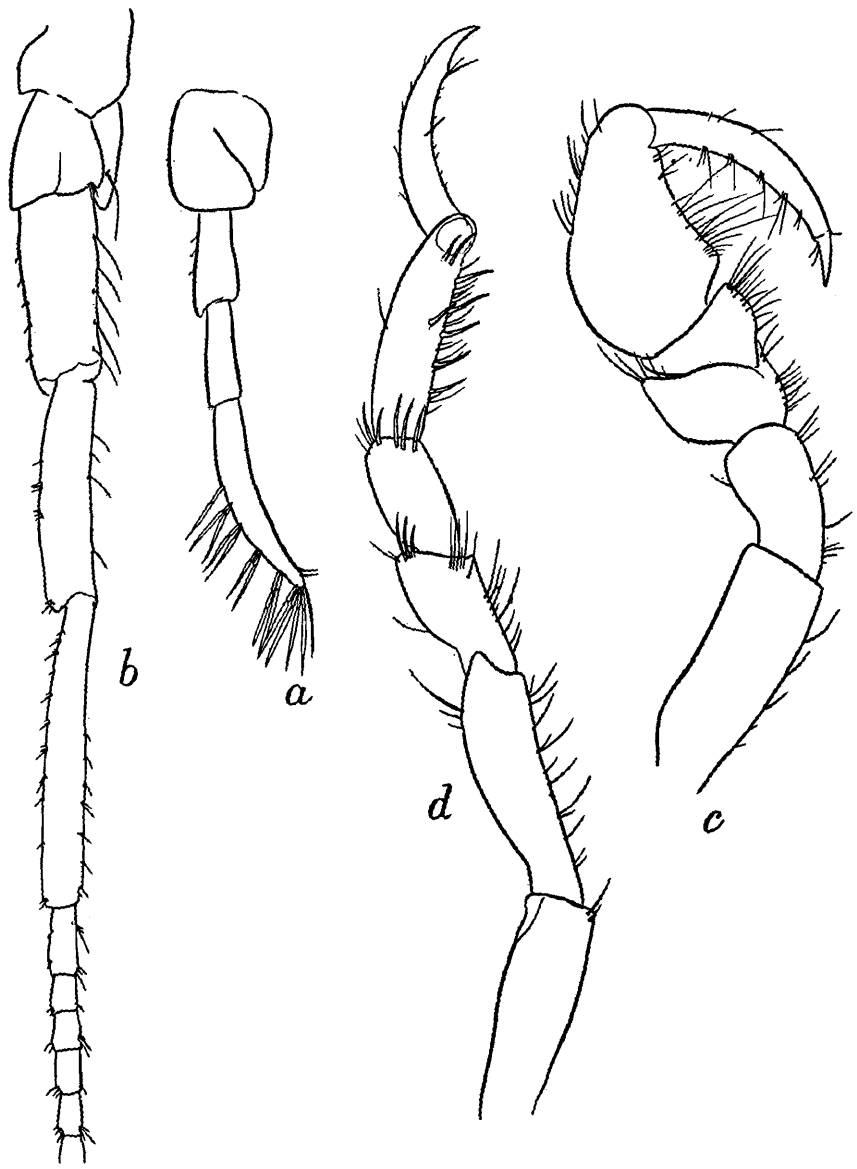


Fig. 10.—*Synidotea variegata* Collinge.

a. Upper antenna.
b. Lower antenna.
c. First trunk limb.
d. Seventh trunk limb.

I give a figure of the first antennae which shows that it is rather more slender than that of the type specimen. The last joint bears six tufts of ordinary and olfactory setae, showing it is probably to be considered as a flagellum with the joints coalesced. In the specimen

examined the first maxilla bears ten to eleven denticulate spines at the apex and there is only one plumose spine at the end of the other lobe.

This species was taken in considerable numbers at many localities in the lake.

Order ONISCOIDEA.

Oniscoidea, Harriet Richardson, 1905, p. 583.

Family ONISCIDAE.

Oniscidae, Harriet Richardson, 1905, p. 592, with analytical key to the genera.

Genus **ALLONISCUS** Dana.

Alloniscus, Richardson, 1905, p. 593.

Alloniscus pigmentatus Budde-Lund.

Alloniscus pigmentatus, Chilton, 1916, p. 474.
Arhina barkulensis, Collinge, 1915, p. 147, pl. viii, figs. 1 to 10.

I find that the specimens which I identified with some hesitation as *Alloniscus pigmentatus* Budde-Lund are the same as those described under the name of *Arhina barkulensis* by Dr. Collinge, a species which unfortunately I had at the time overlooked. Dr. Collinge has been good enough to send me specimens of his species collected at Barkul, Chilka Lake, and they are without doubt the same as those examined by me, but which is the more correct name it is difficult to decide as Budde-Lund's classification and descriptions are difficult to follow. It is hoped that an examination of the types in Budde-Lund's collection will solve this question.

Genus **HEMIPORCELLIO.**

Hemiporcellio carinatus Collinge.

Hemiporcellio carinatus, Chilton, 1916, p. 477.

Locality.

Barkuda Island. Two specimens.

Family ARMADILLIDIDAE.

Genus **CUBARIS** Brandt.

Cubaris, Harriet Richardson, 1905, p. 639.

Cubaris granulatus Collinge.

Cubaris granulatus, Chilton, 1916, p. 479.

Locality.

Patsahanipur Hill, off Balugaon. Two specimens.

Family LIGIIDAE.

Ligydidae, Harriet Richardson, 1905, p. 673.

Genus **LIGIA** Fabricius.

Ligia exotica Roux.

Ligia exotica, Chilton, 1916, p. 462, figs. 1 to 22 (with synonymy and detailed description).
Ligia exotica, Jackson, 1922, p. 693.

A description of this species is given by Jackson in his valuable revision of the genus *Ligia* based on Budde-Lund's collection now in the British Museum. He gives the distribution of the species and the names of the localities from which Budde-Lund's specimens were obtained. These include Singapore, Pulo Milo, Tonga (Malay Archipelago). In my collection there is a male specimen undoubtedly belonging to this species from New Caledonia, thus extending the distribution further to the south-west Pacific.

In my report on the terrestrial Isopoda of Chilka Lake, I stated (1916, p. 462) that most species of *Ligia* live near the sea-shore, but in some cases where conditions are favourable they have been found in moist places at a considerable distance from high water mark. Dollfus in 1893 instituted t e genus *Geoligia* for a terrestrial species found at a height of 1,200 metres in Venezuela and afterwards referred to this genus a species (*Geoligia perkinsi* Dollfus) found at similar heights in the Hawaiian Islands. I have shown (1921, p. 1) that the genus *Geoligia* is bas d on incorrect observations and that the species described under it really belong to *Ligia*. Jackson had quite independently come to the same conclusion about the same time. *L. exotica* is found on the shores of the Hawaiian Islands and it is highly probable that the form described by Dollfus as *Geoligia perkinsi* has been derived from *Ligia exotica* through the animal's extending further and further from the sea-shore and becoming more adapted to terrestrial life. Apparently no corresponding change has as yet taken place in its structure as it probably confines itself to moist places where branchial breathing is still possible. I had considered it to be the same as *Ligia exotica*. Jackson, however, prefers to look upon it as a distinct species, *L. perkinsi* (Dollfus). Similar phenomena are observed in Lord Howe Island, off the coast of Australia. On the sea-shore the form known as *L. australiensis*, found also on the mainland of Australia, is common, and a form which I consider to be the same as *L. australiensis* is found at varying heights up to 500 metres, where Mr. A. R. McCulloch of the Australian Museum collected several specimens, describing it as a long tailed Isopod sunning itself on the rocks and when alarmed rapidly making its way into the water of the stream or lake.

[Several years' observation fully confirm my statement as to the seasonal occurrence of this species on the shores of the Chilka Lake (*Rec. Ind. Mus.* XXII, p. 321). Young are hatched in the rainy season (June to October) from eggs carried by the female. As soon as the weather becomes dry and cool both young and adults disappear. When it grows warm again in spring the young reappear, having concealed themselves for some months without any perceptible increase in size. The adults do not reappear and the life of the individual is evidently limited to about one year. In individuals hatched at the end of the wet season it is probably much shorter. Half-grown individuals, which reappear in spring, grow fairly rapidly but do not apparently become mature until the rainy season. At this season the Crustacean is abundant on tree-trunks and posts about a hundred feet or a little more from the edge of the lake as well as on the shore, but I have near seen it in the interior a few hundred yards away. *N.A.*]

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EXPLANATION OF PLATE LX.

FIG. 1.—*Apseudes chilkensis*, sp. nov., dorsal view of whole animal with antennae.

FIG. 2.—*Cirolana pleonastica* Stebbing, side view of whole animal.

FIG. 3.—*Cirolana nigra*, sp. nov., pleon with terminal segment and uropods.

FIG. 4.—*Cassidina pulchra*, sp. nov., whole animal, dorsal view.

FIG. 5.—*Exosphaeroma parva*, sp. nov., terminal segment with uropoda.

FIG. 6.—*Synidotea variegata* Collinge, whole animal, dorsal view.

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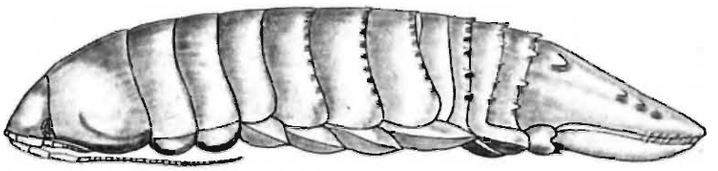

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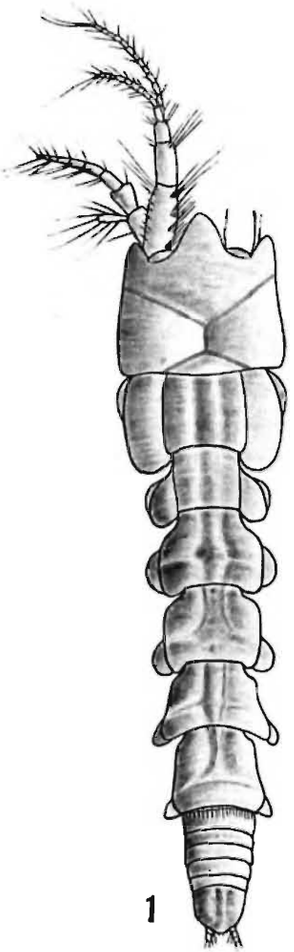

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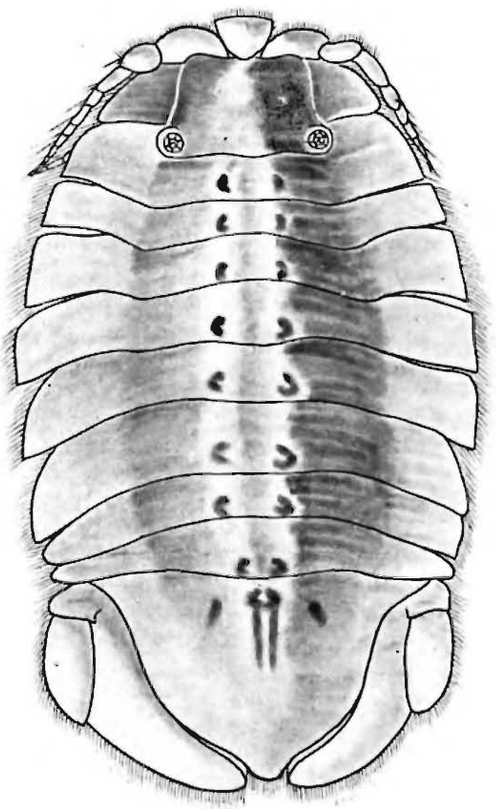

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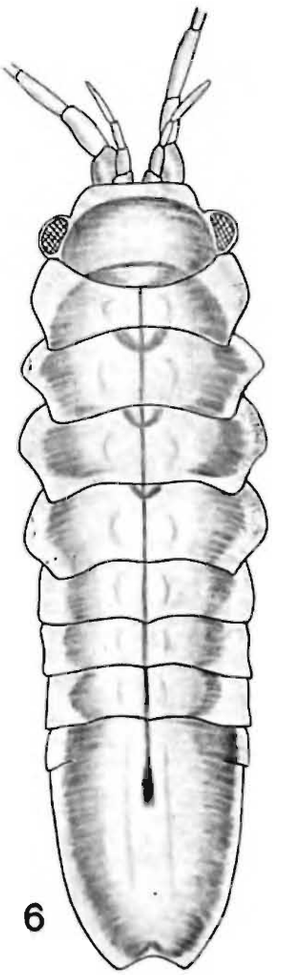

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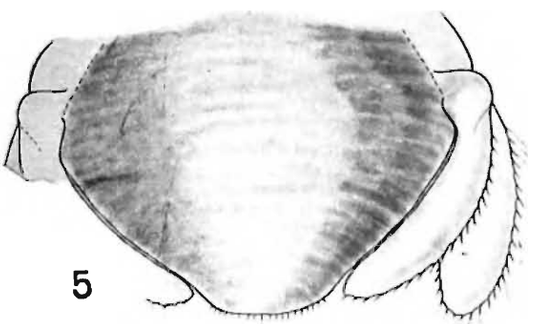

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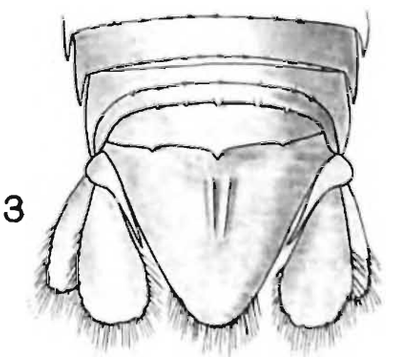

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TANAIDACEA AND ISOPODA.