FURTHER NOTES ON INDIAN FRESH-WATER ENTOMOSTRACA

By ROBERT GURNEY.

In a short paper published last year in the *Journal of the Asiatic Society of Bengal*, I gave an account of certain Entomostraca in the collection of the Indian Museum. Dr. Annandale has been good enough to send me further collections of freshwater Entomostraca, and it was my intention to continue to work at the Indian species from material supplied by him. Unfortunately pressure of work and other engagements prevents me from fulfilling my part of the task, so that I think it advisable to communicate now the results so far achieved.

The material with which the following notes are concerned consists of twelve bottles containing collections made in Lower Bengal and Chota Nagpur. As my work may subsequently be incorporated in the extended study on the Bengal tanks which, I understand, Dr. Annandale has in hand, I think it best to give the full list of the contents of each sample, together with those of certain others received before, and already mentioned in my previous paper.

Feb. 5th, 1907.

LIST OF THE COLLECTIONS.

1. CALCUTTA—Museum (*Kyd Street*) tank. Deep at centre, shallow at sides; stiff clay bottom; much vegetation. April 5, 1905.
   Simosa elizabethæ (King) (abundant).

2. CALCUTTA—Museum tank. Jan. 21, 1906.
   Simosa elizabethæ (King) (rare).
   Scapholeberis kingi, Sars (abundant).
   Cyclops leuckarti, Claus (common).
   ,, *prasinus*, Fischer (common).
   ,, *phaleratus*, Koch (one specimen).

3. CALCUTTA—Aquarium in the Museum. Oct. 16, 1904.
   Stenocypris malcolmsoni, Brady

4. The same. April 10, 1905.
   Ceriodaphnia rigaudi, Richard.

5. PORT CANNING, Ganges delta—Edge of a brackish pond, water very dirty; vegetation scanty. Jan. 29, 1906.
   Ceriodaphnia rigaudi, Richard.
   Cyclops leuckarti, Claus.

6. PORT CANNING, Ganges delta—Edge of a small brackish pond. *Naias* and *Lemna* fairly abundant. Jan. 28, 1906.
   Ceriodaphnia rigaudi, Richard (a few; some females with ephippia; no males).
   Cyclops leuckarti, Claus (abundant).
   Also many Amphipods, a few Ephemerid larvæ and *Corixa*.

7. CALCUTTA—Museum tank. Feb. 8, 1906.
   Simosa elizabethæ (King) (common).
   Ceriodaphnia rigaudi, Richard (abundant).
   Scapholeberis kingi, Sars (abundant; some females with ephippia).
   Dunhevedia crassa, King (one specimen).
   Cyclops prasinus, Fischer (a few).
   Diaptomus contortus, n. sp. (common).
   Cyclops leuckarti, Claus.

8. CALCUTTA—Museum tank. Nearly dried up at edges. Feb. 20, 1906.
   Diaphanosoma, sp.
   Simosa elizabethæ (King) (common).
   Ceriodaphnia rigaudi, Richard.
   Scapholeberis kingi, Sars (abundant; some females with ephippia).
   Chydorus globosus, Baird, var. *sculptus*.
   Cyclops leuckarti, Claus.
   ,, *prasinus*, Fischer.
   Diaptomus contortus, n. sp.
   Atya, sp.

9. CALCUTTA—Museum tank. March 3, 1906.
   Diaphanosoma, sp.
   Simosa elizabethæ (King).
   Ceriodaphnia rigaudi, Richard (common).
   Scapholeberis kingi, Sars (common).
   Cyclops leuckarti, Claus.
   Diaptomus contortus, n. sp.

10. CALCUTTA—Museum tank. Washings of *Spongilla carteri*.
   Macrothrix goeldi, Richard.
   Cyclops fimbriatus, Fischer.
   ,, *varicans*, Sars.

11. CALCUTTA—Small artificial tank on the Maidan; vegetation rather scanty. Feb. 23, 1906.
   Scapholeberis kingi, Sars (one specimen).
   Cyclops leuckarti, Claus.
   ,, *serrulatus*, Fischer.

12. CALCUTTA—Tank on the Maidan. Feb. 26, 1906.
   Lynceus guttatus (Sars) (rare).
   ,, *rectangulus* (Sars) (rare).

Cyclops leuckarti, Claus (common).
,, *varicans*, Sars (rare).
,, *prasinus*, Fischer (a few).
Diaptomus contortus, n. sp. (several young, but only two adults).
Pseudodiaptomus lobipes, n. sp. (common, but all females).
Caridina, sp.

13. CALCUTTA—The Zoological Gardens A small tank with little vegetation ; shallow.
Simosa elizabethæ (King) (one specimen).
Ilyocryptus longiremis, Sars (?) (one decayed young specimen).
Lynceus rectangulus, Sars (common).
Leydigia acanthocercoides, Fischer (?) (one cast skin).
Cyclops leuckarti, Claus.
,, *prasinus*, Fischer (common).
,, *varicans*, Sars (rare).
,, *serrulatus*, Fischer (rare).
Pseudodiaptomus lobipes, n. sp. (common, but only one male).

14. CHAKRADHARPUR, CHAIBASSA DISTRICT, CHOTA NAGPUR—Swamp without shade ; not many plants. March 3, 1906.
Diaphanosoma sarsi, Richard (one specimen).
Simosa elizabethæ (King) (common).
Macrothrix triserialis, Brady (a few).
,, *tenuicornis*, n. sp. (one specimen).
Camptocercus australis, Sars (one specimen).
Lynceus cambouei, De Guerne and Richard (two specimens).
Alonella excisa (Fischer) (rare).
Chydorus sphæricus (O. F. Müller) (rare).
Cyclops oithonoides, Sars (rare).
,, *leuckarti*, Claus.
,, *varicans*, Sars (rare).
,, *serrulatus*, Fischer (rare).
Diaptomus doriai, Richard.
,, *cinctus*, n. sp.
,, *pulcher*, n. sp.
,, *strigilipes*, n. sp.

15. CHAKRADHARPUR—Pool in small stream, in open among water plants ; pool small, shallow, without shade. March 3, 1906.
Cyclops leuckarti, Claus.
,, *serrulatus*, Fischer.

16. CHAKRADHARPUR—Large, shallow tank without shade ; weeds abundant. March 6, 1906.
Diaphanosoma sarsi, Richard (common).
Simosa elizabethæ (King) (abundant ; some females with ephippia).
Ceriodaphnia rigaudi, Richard.
Macrothrix triserialis, Brady (rare).
,, *tenuicornis*, n. sp.

Leydigia australis, Sars (two specimens).
Alonella excisa (Fischer).
Chydorus sphæricus (O. F. M.).
Cyclops serrulatus, Fischer.
,, *diaphanus*, Fischer
Diaptomus doriai, Richard (common).
,, *contortus*, n. sp. (rare).
,, *cinctus*, n. sp. (rare).
Cyclestheria hislopi (Baird) (one specimen).
Stenocypris malcolmsoni (Brady).

17. CHAKRADHARPUR—The same as preceding. March 5, 1906.
Diaphanosoma sarsi, Richard.
Simosa elizabethæ (King).
Ceriodaphnia rigaudi, Richard.
Chydorus sphæricus (O. F. M.).
Cyclops leuckarti, Claus.
Diaptomus contortus, n. sp.
,, *blanci*, De Guerne and Richard.
,, *similis*, Baird.

LIST OF SPECIES.

PHYLLOPODA.

1. *Cyclestheria hislopi* (Baird).

In my first paper I recorded a single specimen of this interesting species from a tank in Calcutta. Another was found in a collection from Chakradharpur (No. 16).

CLADOCERA.

2. *Diaphanosoma sarsi*, Richard.

Chakradharpur (Nos. 14, 16, 17).

A species widely distributed in the Oriental Region, and also recorded from New Guinea and Brazil.

3. *Diaphanosoma*, sp.

Some specimens taken in the Museum tank (Nos. 8, 9).

This is a species which has certain resemblances to *D. singalensis*, Daday, but which appears to be distinct. I prefer for the present to leave it undetermined.

4. *Ceriodaphnia rigaudi*, Richard.

This species occurs in several collections from Chakradharpur and Calcutta (Nos. 6, 7, 8, 9, 16, 17).

5. *Simosa elizabethæ* (King).

This species appears to be the commonest Daphnid in the localities in which the collections were made, though *Ceriodaphnia*

rigaudi is a good second. (Occurs in collections Nos. 7, 8, 9, 13, 14, 16, 17.)

6. *Scapholeberis kingi*, Sars.

Abundant in the Museum tank in February and at that time a few of the females bore ephippia. In a collection taken in March the numbers had somewhat decreased. (Nos. 7, 8, 9, 11.)

So far this species had only been found in Sumatra and Siam.

7. *Macrothrix triserialis*, Brady.

A few specimens taken at Chakradharpur (Nos. 14, 16).

The ventral margin of the shell is closely serrated anteriorly, but posteriorly the teeth are arranged, as described by Prof. Brady (1886), in groups of three. These grouped teeth are of a somewhat remarkable nature. They appear to me to be of the nature of small hyaline scales overlapping each other somewhat in the manner of a hood. The sculpture of the shell is not alluded to by Prof. Brady, but in the figures given by Prof. Daday (1898), the shell is shown covered with lines enclosing lozenge-shaped areas. In my specimens the shell is marked with conspicuous ridges which do not intersect at all, though they may bifurcate here and there. The form of the upper lip, with its transverse ridges, is characteristic (fig. 21).

8. *Macrothrix tenuicornis*, n. sp.

Carapace of the female nearly round in outline, the posterior angle very slight or altogether absent (fig. 1). The shell is marked with hexagonal or pentagonal reticulations which are so faint as to be seen only with great difficulty. The dorsal margin of the shell is quite smooth. The ventral margin is slightly serrated anteriorly, but posteriorly is rendered uneven by minute, blunt teeth, rather irregularly disposed, and is fringed with long setæ. The head is erect and rounded, with a conspicuous ridge over the eye (fig. 22). The large upper lip begins anteriorly with a marked ridge and is ridged transversely as is the case in *M. triserialis*. The eye and ocellus are small. The first pair of antennæ are long and nearly straight, not dilated at their extremity; along the inner edge are three large spines, while at the extremity there are two semi-rings of small spines. The tail is of the usual shape, the part anterior to the anus densely setiferous, the setæ apparently not arranged in any definite plan (fig. 2). The anus is guarded by a pair of peculiar flaps. Posterior to the anus the ventral edge of the tail is armed with a row of very minute teeth.

Length of female, ·8—·95 mm.
Width, ·55— ·65 mm.

Found at Chakradharpur (Nos. 14, 16).

9. *Macrothrix goeldi*, Richard.

A single specimen of a Macrothrix was found in some washings from *Spongilla carteri* taken in the Museum tank, Calcutta.

It agrees in all respects with the description given by Richard except in point of size, my specimen, which has no eggs in its brood-pouch and is perhaps not fully grown, being smaller than the type. The species has only been recorded from Chili (Richard, 1897).

10. *Thyocryptus longiremis*, Sars.

A very decayed young specimen, which I refer doubtfully to this species, occurred in a collection in Calcutta (No. 13).

11. *Camptocercus australis*, Sars.

A single female specimen was contained in one of the collections from Chakradharpur (No. 14).

Distribution.—Sumatra, Australia, South America (Argentine and Patagonia).

12. *Lynceus cambouei* (De Guerne and Richard).

Two specimens only in a collection from Chakradharpur (No. 14).

Distribution.—Madagascar, German East Africa, Palestine, Tonkin, Hawaii, Chili, Patagonia.

13. *Lynceus guttatus* (Sars).

A few specimens from the Calcutta maidan and Zoological Gardens (Nos. 12, 13).

Distribution.—Europe, North and South America, Asia and North Africa.

Not uncommon in Calcutta (Nos. 12, 13).

14. *Leydigia australis*, Sars.

Two specimens of this species were taken at Chakradharpur (No. 16).

Distribution.—Ceylon and Australia (Queensland).

15. *Leydigia acanthocercoides*, Fischer.

With some doubt I refer to this species portions of a moulted skin found in a collection from a tank in the Zoological Gardens at Calcutta (No. 13). The form of the postabdomen is in agreement, but I cannot speak for the rest of the body.

16. *Alonella excisa* (Fischer).

A few specimens only, found at Chakradharpur (Nos. 14, 16).

This species appears to occur in every part of the world except Africa.

17. *Chydorus sphæricus* (O. F. Müller).

A very few specimens of this species were taken at Chakradharpur (Nos. 14, 16, 17).

18. *Chydorus globosus*, Baird.

Two somewhat immature specimens of this species were found in a collection from the Museum tank at Calcutta (No. 8).

19. *Dunhevedia crassa*, King.

A single specimen was found in the Museum tank.

If the identity of this species with *D. setigera* (Birge) is accepted (Stingelin, 1904), then its distribution is practically world-wide.

COPEPODA.

20. *Pseudodiaptomus lobipes*, n. sp.

Body slender and more or less cylindrical, the head fused completely with the first thoracic segment (fig. 3). The last segment of the thorax is rounded at the angles and bears on each side a small spine, but no cilia. The abdomen, in the female, consists of four segments; the genital segment is scarcely at all dilated. Dorsally it bears minute spines arranged in three transverse rows, the two anterior rows broken in the middle (figures 23 and 24). Laterally there are two groups of larger spines, about four in each group. The posterior edges of the two succeeding segments bear each a row of teeth. The last segment is much shorter than the preceding ones. The furcal rami are divergent, and about four times as long as wide, with long cilia fringing the inner edge. In the male the abdomen consists of five segments, the second, third and fourth toothed along their posterior edge.

The antennæ are scarcely as long as the thorax and consist of twenty-one joints. In the male the terminal section of the prehensile antenna consists of three joints, the line of division between the second and third not very distinct.

The fifth foot of the female is one-branched and made up of three joints (fig. 4). The second joint, which is the longest, is produced at its distal external angle into a strong spine. On its inner face, towards the end, it bears two hyaline membranes the distal one very large. The last joint is produced distally into a long strong spine, and at the base of it there are three short ones. Of these three one is stouter than the others and is toothed on each side; the other two are toothed along one side only.

In the male the right foot of the fifth pair is one-branched and consists of six joints in all, apparently a two-jointed basal part and a four-jointed exopodite (fig. 6). The second joint of the exopodite is produced into a strong spine. The terminal joint is broad and flattened at the base, but continued as a curved spine (fig. 7). The left foot (fig. 8) consists of a basal portion bearing a long laminal process corresponding to the endopodite, and a distal part of two joints representing the exopodite. The second joint of the exopodite is broad and flattened, with a small hyaline membrane on its outer edge.

Length of female, ·35 mm.
,, ,, male, ·95 mm.

Numerous females of this species were found in two collections made in Calcutta (Nos. 12, 13), but it was only after prolonged search that I was able to find a single male. This is all the more remarkable inasmuch as most of the females bore long, slender spermatophores.

21. *Diaptomus contortus*, n. sp.

The form of the body in both sexes is slender, tapering considerably in front, and with the greatest breadth somewhat behind the middle (fig. 9). In the female the division between the fourth and fifth segments of the thorax is marked by a ring of fine denticles. In the male the ring is incomplete dorsally. The fifth segment is scarcely at all expanded laterally and is armed on either side with two teeth, those on the left being larger than those on the right. The first segment of the abdomen is very short, scarcely longer than the second, and bears a long and very stout spine on the left and a shorter and smaller one on the right. In the male the first segment bears a long, slender spine on the right side. The antennæ of the female reach, when reflexed, considerably beyond the end of the furcal setæ. In the male the antepenultimate joint of the prehensile antenna is produced into a short process, recurved at the end, less than half the length of the succeeding joint The last joint has no process.

In the last pair of legs of the female the basal joint bears a very large, spine-like, cuticular process, which appears to be generally larger on the right leg than on the left (fig. 10). The endopodite reaches nearly to the end of the first joint of the exopodite, and is pointed at the end, with a ring of cilia, but no setæ. The second joint of the exopodite bears a very large lateral tooth, at the base of which the vestigial third joint may be detected in the form of a minute tubercle bearing two setæ, one long and one short.

In the male the right leg of the fifth pair is conspicuous for the number and arrangement of the hyaline membranes borne by it. The basal joint bears one pointed process ; the second basal joint bears a large rounded hyaline membrane on its inner face, while the first joint of the exopodite bears two hyaline membranes, one of which has a peculiar semi-lunar outline. The endopodite is slender and cylindrical, longer than the first joint of the exopodite. The second joint of the exopodite bears a large lateral spine rather proximal of the middle. The apical claw is long and much curved, being swollen at the base and peculiarly twisted. In the left leg the terminal joint of the exopodite has a peculiar chela-like shape, owing to the long spine borne by it opposing itself to the very much produced joint itself.

Length of female, 1·25 mm.
,, ,, male, 1·0 mm.

This species occurs in considerable numbers in several collections both from Calcutta and Chakradharpur (Nos. 7 8, 9, **16,** 17).

22. *Diaptomus cinctus*, n. sp.

Form of the body slender, of almost equal width throughout, the head marked off from the thorax by a constriction (fig. 11). The line of division between the last two thoracic segments is marked by a ring of minute teeth. In some specimens the ring appears to be incomplete, no denticles being visible on the dorsal surface. In the female the last thoracic segment is asymmetrical; on the right it is simply rounded and bears a single small spine, while on the left it is produced into a peculiar rounded lappet bearing two short spines. In the male this segment is also slightly asymmetrical, being somewhat produced on the right, bearing a spine on this side, but being simply rounded on the left. The abdomen of the female consists of three segments, of which the first is as long as the other two and the furca together. This segment is not much dilated and bears a spine on each side, that on the left being a little posterior to and larger than that on the right. In the male the first abdominal segment bears a long, slender spine on the right side.

The antennæ reach, when reflexed, considerably beyond the furcal setæ. The prehensile antenna of the male is scarcely at all dilated; the antepenultimate joint has a narrow hyaline lamella, and is prolonged into a curved process about two-thirds as long as the succeeding segment and minutely bifid at the tip.

The fifth leg of the female has the endopodite about three quarters the length of the first joint of the exopodite, one-jointed and slender fig. 12). The third joint of the exopodite is absent, its place being taken by two short spines with a seta between them. The second joint seems to be variable in length, in some specimens, and in one case in one leg of the two, it is shorter and stouter than in the one regarded as typical. In the male the basal joint of each leg bears a hyaline lamella on its inner face. The endopodite of the right leg is short and conical, longer than the first joint of the exopodite The endopodite of the left leg is rather long and slender and the exopodite is finger-shaped, with a long inner seta. The second joint of the exopodite of the right leg bears a short lateral spine very near its base. The terminal spine is relatively short and blunt at the tip.

Length of female, 1·15 mm.
,, ,, male, 1·0 mm.

A few females and two males occurred in a swamp at Chakradharpur and one or two specimens in a tank at the same place (Nos. 14, 16).

23. *Diaptomus blanci*, De Guerne and Richard.

Several specimens taken at Chakradharpur (No. 17).

24. *Diaptomus pulcher*, n. sp.

Body rather stout, the greatest width about the middle, tapering anteriorly (fig. 13). The last thoracic segment of the

female but little expanded, and slightly asymmetrical in both sexes. In the female the left side is produced rather more than the right, the reverse being the case in the male. In the male each wing of this segment ends in a sharp point. The abdomen of the female consists of three segments, the first being longer than the last two and the furca combined. It is of nearly equal width throughout and bears on either side, a short delicate spine. In the male the abdomen consists of five segments. The first bears a rather long, slender spine on the right side, while the fourth is slightly asymmetrical, being produced somewhat backwards to overlap the succeeding segment on the right, in this respect resembling *D. doriai*, Richard. The furcal rami are not divergent and are ciliated in the female on both sides.

The antennæ extend, when reflexed, somewhat beyond the furcal setæ. In the male the prehensile antenna is not much expanded (fig. 14). The antepenultimate joint has a narrow hyaline lamella and a series of teeth (fig. 15). Of these teeth one is large and directed forward and outward beyond the end of the joint. Behind this tooth there are three or four smaller ones springing from the edge of the joint. In one specimen the two posterior teeth appeared to form part of the hyaline lamella, and not to spring from the joint itself.

In the fifth foot of the female (fig. 16) the basal joint has a large spine on its external face; the endopodite is little more than half as long as the first joint of the exopodite, and its end is fringed with hairs. The third joint of the exopodite is quite distinct and bears two setæ.

The right leg of the fifth pair in the male (fig. 17) has a small hyaline lamella on the second basal joint, and the endopodite is barely as long as the first joint of the exopodite. The second joint of the latter is narrow and curved, bearing a large lateral spine very near its base. The left leg has two small hyaline lamellæ on the second basal joint; the endopodite is relatively long, about two-thirds as long as the exopodite.

Length of female, 1·9—1·95 mm.
,, ,, male, 1·75 mm.

Occurrence.—Swamp at Chakradharpur (No. 14).

25. *Diaptomus doriai*, Richard.

Fairly common at Chakradharpur (Nos. 14, 16).

A species so far only known from the Oriental Region, but widely distributed within that Region.

26. *Diaptomus similis*, Baird.

A few specimens found at Chakradharpur (No. 17).

Distribution.—Palestine and Turkestan.

27. *Diaptomus strigilipes*, n. sp.

Body stout and cylindrical, the last two segments of the thorax completely fused (fig. 18). In the female the last segment of the

thorax is expanded into rather large wings, each with two very small, blunt teeth. In the male this segment bears a slender sensory spine on either side. The abdomen of the female consists of three segments, of which the first, or genital, segment is longer than the rest of the abdomen. It is somewhat asymmetrical, bearing a short sensory spine on the left, but being produced on the right (fig. 18*a*) into a finger-shaped process bearing a minute sensory tooth at the apex and one on the dorsal face.

The antennæ are very much longer than the whole body. The prehensile antenna of the male is not much expanded; the antepenultimate joint has no hyaline lamella and is produced into a long, slightly curved process.

In the fifth leg of the female (fig. 19) the basal joint bears a very large tooth on its external face: the endopodite is nearly the same length as the first joint of the exopodite, pointed and ciliated at its extremity. The second joint of the exopodite, or claw, has a conspicuous jagged edge, with a variable number of teeth, and may have, in addition, two little teeth on its external face. The third joint is distinct and bears two slender spines.

In the male the second basal joint of the fifth pair of legs bears a small hyaline lamella (fig. 20). The endopodite of the right leg is very much longer than the first joint of the exopodite and is constricted at the end. The second joint of the exopodite is curved and tapering, with a very large lateral spine. The terminal joint is long and sickle-shaped. In the left leg the endopodite is long and slender and the exopodite terminates in a rounded knob bearing an inner short process.

Length of female, 1·3—1·4 mm.
,, ,, male, 1·25—1·3 mm.

Found at Chakradharpur (No. 14).

28. *Cyclops oithonoides*, Sars.

A few specimens taken at Chakradharpur (No. 14).

Distribution.—Europe, Asia Minor, Central Asia, Malay Archipelago, New Guinea, Egypt, North America.

29. *Cyclops leuckarti*, Claus.

By far the commonest Cyclops in these districts.
Collections Nos. 6, 7, 8, 9, 11, 12, 13, 14, 17.

30. *Cyclops serrulatus*, Fischer.

This species appears in several collections (Nos. 11, 13, 14, 15, 16) but does not seem to be abundant. It is a species of world-wide distribution.

31. *Cyclops fimbriatus*, Fischer

Only found in the Museum tank (No. 10). It seems to occur in every part of the world.

32. *Cyclops prasinus*, Fischer.

Common both in Calcutta and Chakradharpur (Nos. 10, 12, 13, 14).

33. *Cyclops diaphanus*, Fischer.

A few specimens found at Chakradharpur (No. 16).

Distribution.—Europe, Palestine and Central Asia.

34. *Cyclops varicans*, Sars.

Calcutta and Chakradharpur (Nos. 10, 13, 14, 16).

Distribution.—Europe, Palestine, North and South America, Patagonia.

OSTRACODA.

35. *Stenocypris malcolmsoni*, Brady.

Chakradharpur (No. 16).

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DESCRIPTION OF PLATES I and II.

Fig. 1. *Macrothrix tenuicornis*, n. sp.—Side view of female. × 482
Fig. 2. ,, ,, Postabdomen × 150
Fig. 3. *Pseudodiaptomus lobipes*, n. sp.—Dorsal view of female. × 51
Fig. 4. ,, ,, Fifth foot of female. × 260
Fig. 5. ,, ,, Maxilliped of female. × 260
Fig. 6 ,, ,, Right fifth foot of male. × 260
Fig. 7 ,, ,, Terminal joint of same.
Fig. 8. ,, ,, Left fifth foot of male. × 260

Fig. 9. *Diaptomus contortus*, n. sp.—Dorsal view of female. × 26
Fig. 10 ,, ,, Fifth foot of female. × 260
Fig. 11. *Diaptomus cinctus*, n. sp —Dorsal view of female. × 70
Fig. 12. ,, ,, Fifth foot of female. × 260
Fig. 13. *Diaptomus pulcher*, n. sp.—Dorsal view of female. × 48
Fig. 14. ,, ,, Prehensile antenna of male × 100
Fig. 15. ,, ,, Terminal joints of the same. × 440
Fig. 16. ,, ,, Fifth foot of female. × 260
Fig. 17. ,, ,, Fifth feet of male. × 150
Fig. 18. ,, *strigilipes*, n. sp.—Dorsal view of female. × 64
Fig. 18*a*. ,, ,, Right-hand process of genital segment.
Fig. 19. ,, ,, Fifth leg of female. × 260
Fig. 20. ,, ,, Fifth feet of male. × 150
Fig. 21. *Macrothix triserialis*, Brady.—Head. × 150
Fig. 21*a*. ,, ,, ,, Margin of shell. × 260
Fig. 22. ,, *tenuicornis*, n. sp.—Head. × 150
Figs. 23, 24. *Pseudodiaptomus lobipes*, sp. n.—Genital segment highly magnified.