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FAUNA OF THE CHILKA LAKE.

FISH.

PART II.

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(With 8 text-figures.)

CONTENTS.

FISH. (*PART II.*)

By B. L. CHAUDHURI.

This part contains a systematic treatment of the suborders Apodes, Haplomi and Catosteomi of the Order Teleostei. The total number of specimens examined and recorded is 245. They belong to only nine species. Of these one (*Ophichthus chilkensis*) is new to science, while one (*Hippocampus brachyrhynchus*) has recently been described in the *Records of the Indian Museum*. The nine species fall into seven genera and five families.

Suborder *APODES.*

Family ANGUILLIDAE.

Genus **MURAENESOX**, M'Clelland.

Muraenesox cinereus (Forskål).

1775. *Muraena (Toto) cinerea*, Forskål, *Descrip. Anim.*, pp. x, 22.
1801. *Muraena arabica*, Bloch and Schneider, *Syst. Ichthyol.*, p. 488.
1803. *Muraena sp.* [*Taloopaum*], Russel, *Fish. Vizag.*, I, No. 36, p. 25.
1822. *Muraena bagio*, Hamilton Buchanan, *Fish. Gang.*, pp. 24, 364.
1843. *Muraenesox tricuspidata*, M'Clelland, *Cal. Journ. Nat. Hist.*, IV, p. 409, pl. xxiv, fig. 1.
1844. *Congrus tricuspidatus*, Richardson, *Ichthyol. Voy. Sulphur*, p. 105, pl. li, fig. 2.
1845. *Muraenesox hamiltoniae*, M'Clelland, *Cal. Journ. Nat. Hist.*, V, p. 182, pl. viii, fig. 3.
1845. *Muraenesox bengalensis*, M'Clelland, *ibid.*, V, p. 182.
1846. *Conger hamo*, Temminck and Schlegel, *Faun. Jap. Poiss.*, p. 262, pl. cxiv, fig. 2.
1849. *Conger bagio*, Cantor, *Journ. Asiat. Soc. Bengal*, 1849, p. 1298.
1856. *Muraenesox bagio*, Kaup, *Cat. Apod. Fish*, p. 116, pl. xiv, fig. 73.
1870. *Muraenesox cinereus*, Günther, *Brit. Mus. Cat. Fish.*, VIII, p. 45.
1878. *Muraenesox cinereus*, Day, *Fish. Ind.*, p. 662, pl. clxviii, fig. 4.
1889. *Muraenesox cinereus*, Day, *Faun. Brit. Ind. Fish.*, I, p. 91.
1909. *Muraenesox cinereus*, Günther, *Fisch. Sudsee*, III, p. 395.

There is one specimen in the collection. It was obtained in the lake at the end of July, 1913. It measures two feet and nine inches in length. The specimen is of a somewhat "shining golden colour" as described by Russel, though some of the later writers disputed the correctness of his description.

Hamilton Buchanan's specimen was probably a young one—hence his conclusion that the fish grew only to eighteen inches or two feet in length, the difference of colour being probably also due to difference in age. Other slight inaccuracies in his description were due to his not having his original drawings with him at the time of writing. He had left them behind in India along with others. Plate XXIX of the one

hundred and forty-four coloured figures of the manuscript volume of his drawings, now in possession of the Asiatic Society of Bengal, is the original drawing of this species.[1] The name first written on the plate was "*Ophisuroides.*" This was afterwards altered by Buchanan in his own handwriting to *Muraenophis bagi*. There is an indifferent reproduction of this plate by M'Clelland in which all the proportions are inaccurate and the apertures of the nostrils are incorrectly copied.

Measurements of the specimen from the Chilka Lake are given below:—

Length of head	135 mm.
Distance from snout to vent.	370 ,,
Distance from vent to end of tail	480 ,,
Length of snout	36 ,,
Length of pectoral fin	45 ,,

The dorsal fin begins 27 mm. in front of the branchial opening.

This fish is probably only a stray visitor to the lake; a curious fact, however, is that in the present instance the specimen was found in water that was almost fresh.

Distribution:—Coasts of Arabia and Africa, and seas and estuaries of India, the Malay Archipelago, Australia, China and Japan.

Family MURAENIDAE.

Genus **RHABDURA**, Ogilby.

Rhabdura macrura (Bleeker).

1854. *Muraena macrurus*, Bleeker, *Ichth. Bant. Nat. T Ned. Ind.*, VII, p. 324.
1856. *Thyrsoidea longissima*, Kaup, *Cat. Apod. Fish*, p. 82.
1864 *Thyrsoidea macrurus*, Bleeker, *Atl. Ich.*, IV, p. 111, t. clxvi, f. 2.
1878. *Muraena macrura*, Day, *Fish. Ind.*, p. 672, pl. clxx, fig. 5.
1889. *Muraena macrura*, Day. *Faun. Brit. Ind. Fish.*, I, p. 81, fig. 32.
1907. *Rhabdura macrura*, Ogilby, *Proc. Roy. Soc. Queensland*, XX, p. 13.
1909. *Muraena macrurus*, Günther, *Fisch. Sudsee*, III, p. 421.
1910. *Evenchelys macrurus*, Jordan and Richardson, *Mem. Carneg. Mus.*, IV, p. 175.

There is one specimen in the collection. It was secured near Satpara in the month of March, 1914. The specimen measures nearly four and a half feet in length.

The word "twenty" in Kaup's description, stating that the length of the head is contained twenty times in the length, is probably a mistake for "ten." The species, however, is exceedingly elongate and the tail is more than double the length of the trunk. The colour is uniformly blackish brown. The lateral line runs higher up than the middle line and commences in this specimen about 50 mm. anterior to the gill-slits. It consists of a series of detached elongated dashes on each side. The following measurements of the specimen are of interest:—

[1] This volume of manuscript drawings of Dr. Buchanan (afterwards Hamilton), consisting of 144 coloured figures of fishes executed by Indian painters under his supervision, was deposited in the library of the Royal Botanic Gardens at Sibpur in 1815. It was transferred from there to the library of the Asiatic Society of Bengal by Mr. W. Griffith in 1843. This drawing (plate xxix) of the fish is therefore the earliest figure of the species extant.

Length of head	130 mm.
Distance between end of snout and vent	525 ,,
Distance between vent and end of tail (tail)	850 ,,
Length of snout	13 ,,
Long diameter of the eye	6 ,,
Interorbital space	11 ,,
Length of upper jaw	44 ,,
Length of lower jaw	46 ,,

The fish is a casual visitor to the outer channel of the lake during the period of maximum salinity.

Distribution:—Indian Ocean, seas of India, Ceylon and the Malay Archipelago. Also reported from Natal, Australia and Formosa.

Family OPHICHTHYIDAE.

Genus **OPHICHTHUS**, Ahl.

Ophichthus chilkensis, sp. nov.

(Text-figures 12, 13.)

The length of the head is 17·7 % of the distance between the end of the snout and the vent, the length of the snout is 2·5 %, the diameter of the eye is 1·25 %, the length of the upper jaw is 5·6 %, the length of the lower jaw is 3·3 %, the depth (*i.e.* the height of the body) at the gill openings is 5 %, the length of the pectoral fin is 4·6 %, the girth behind the pectoral fins is 11·4 %, the free portion of the caudal extremity is 2·5 % of the same distance, which is nearly half (*viz.* $\frac{10}{19}$) the length of the tail (*i.e.* the length of the fish behind the vent), and nearly one-third of the total length.

The fish is round, long, and scaleless; the end of the tail projects beyond the dorsal and the anal fins; this free portion is without even a rudiment of a caudal fin. The head is slightly depressed, but the rest of the profile is even.

The length of the head is comparatively small and is contained five and half times in the distance between the end of the snout and the vent. The upper jaw is much the longer, being one and a half times as long as the lower. The anterior tubular nostrils are placed on the upper lip, directed downwards and are thus placed on the inferior side of the end of the snout; the posterior nasal openings, which are patent, are placed right in front of the eyes. The eyes are very small; they are lateral though somewhat superior; the diameter of the eye is contained twice in the length of the snout; the interorbital distance, which is slightly convex, is equal to the length of the snout; the opening of the mouth is horizontal and the angle of the jaws is one diameter of the eye behind the postorbital vertical. The teeth on the vomer are globular and those on the jaw are granular; in the maxilla they are arranged in two rows on each side, the innermost row being serrated; they

[1] The text-figures are numbered in continuation of those that appeared in Part I of the paper.

are in two rows also in the mandible; there are no canine teeth (text-fig. 13). The lips are not fringed. The tongue is fully adnate to the floor of the mouth.

The gill-openings are low down and are oblique slits, wide apart anteriorly; the posterior ends of these slits are somewhat closer; the opercular flaps (*i.e.* margins of the slits) are slightly concave; the length of these slits is equal to the length of the snout. The opercular covering becomes continuous with the loose and the swollen integument over the accessory branchial cavity. The pectoral fin is slightly elongated and fan-shaped and is supported by fourteen branching rays; the length of this fin almost equals that of the upper jaw. The dorsal fin is rather low, though it is higher than the anal fin; it begins behind the opening of the gill-slits at a distance of one-third of the length of the head and continues the whole length of the back, stopping short only at the free end of the caudal extremity, and is thus not continuous with the anal fin. The anal fin is slightly lower than the dorsal fin above and commences close behind the vent at a distance of one diameter of the eye; it continues along the

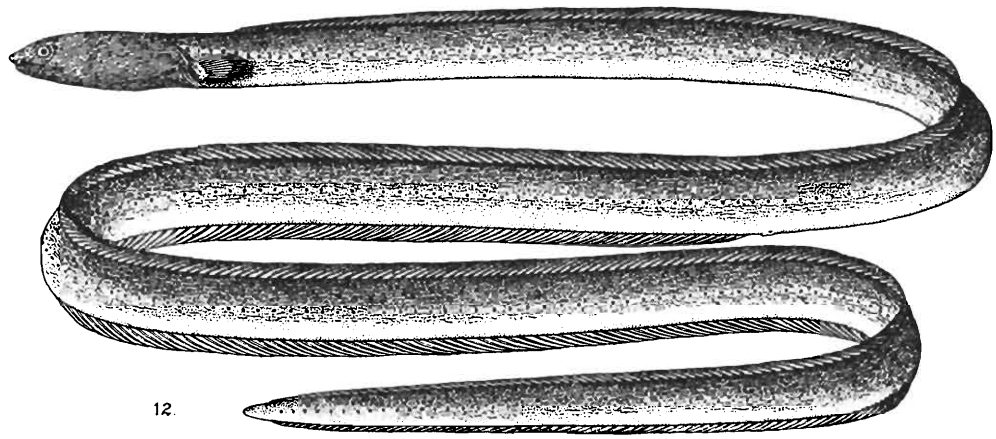


FIG. 12.—*Ophichthus chilkensis*, Chaudhuri × $\frac{2}{3}$.

mid-ventral line to the free caudal extremity, stopping directly under the end of the dorsal fin above.

The lateral line is well marked throughout the length and appears to be continuous with the system of openings of the muciferous glands on the head; it runs along the side slightly above the middle line.

The colour of the body is dark olive-brown, but it is lighter about the abdomen. The fins are dull white except in the last third of the anal fin, this portion being entirely black.

The generic name *Ophichthus* has priority over *Ophisurus*, which has been used also in other groups. The name *Ophichthys* is of course the more correct form philologically and this corrected spelling was first introduced by Bleeker, who has been followed by recent authors generally. Priority however demands the restoration of the generic name in its original spelling as used by Ahl in 1789.

The new species appears to be intermediate between *Ophichthus boro* (Ham. Buch.)

and *Ophichthus microcephalus* (Day) so far as the length of the head is concerned. The length of the head in the new species is five and a half times in the length from the end of the snout to the vent, whereas in that of *O. boro* it is three and a half to four times and in *O. microcephalus* it is seven and one-third to eight. With respect to the length of the tail the new species approaches *O. microcephalus* rather than *O. boro*.

The new species differs considerably from recently described species of *Ophichthus*, *viz. O. miyamotonis*, Tanaka,[1] *O. asakusae*, Jordan and Snyder[2]; *O. tsuchidae*, Jordan and Snyder[3]; all from Japanese waters. All of these have much longer heads. The new species in this respect somewhat resembles *O.* (*Bascanichthys*) *hemizona*, Ogilby[4] of the Australian seas (Port Jackson), but differs from it in all other proportions and in colouration. It also greatly differs from *O. frontalis* (Garman)[5] and *O. biserialis* (Garman).[6]

In the shortness of its head the new species resembles *Ophicthus rhytidoderma* (Bleeker), which is the same as the *Pisoodonophis rutidermatoides* referred to by Kaup, but differs from it totally in the character of its teeth and in other particulars.

There are two specimens in the collection, measuring twenty-seven and a half inches (type) and thirty-two and a half inches (co-type) in total length. Both are from Rambha Bay. Some of the important measurements of the two specimens are given below:—

	Rambha Bay. 22-vii-14.	Rambha Bay. 11-iv-14.
Length of head (snout to gill-opening)	42 mm.	66 mm.
Snout to vent	237 ,,	345 ,,
Tail	455 ,,	550 ,,
Diameter of eye	3 ,,	5 ,,
Length of snout	6 ,,	10 ,,
Interorbital distance	6 ,,	10 ,,
Gill-opening to origin of dorsal fin	13 ,,	24 ,,
Free portion of tail	6 ,,	8 ,,

The type-specimen, which was collected on 22nd July, 1914, measures 692 mm. in total length and is entered under No. $F\frac{9177}{1}$ in the register of the Indian Museum. The co-type, which was collected on 11th April, 1914, is 895 mm. in total length. The fish is a permanent inhabitant of the main area of the lake, being obtainable during the period when its water is almost fresh as well as in the period of its maximum salinity. It does not however breed in the lake. In fact none of the eels do so, for no Leptocephalus larvae have been collected during the survey though they are plentiful on the Puri coast.

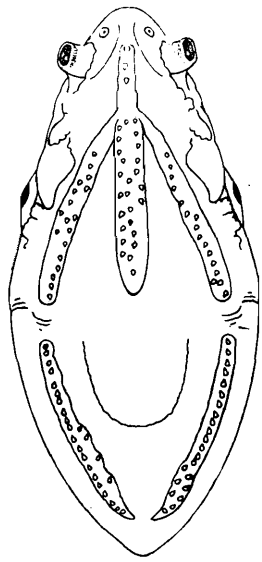
[1] Tanaka, *Fishes of Japan*, XI, p. 195.
[2] *Proc. U. S. Nat. Mus.*, XXIII, p. 872, fig. 18.
[3] *Ibid.*, XXIII, p. 873, fig. 19.
[4] *Proc. Linn. Soc. New South Wales*, XXII, p. 248 (1897).
[5] *Mem. Mus. Comp. Zool. Harvard*, XXIV, p. 309.
[6] *Ibid.*, XXIV, p. 311.

Ophichthus hijala (Hamilton Buchanan).

(Text-figure 14.)

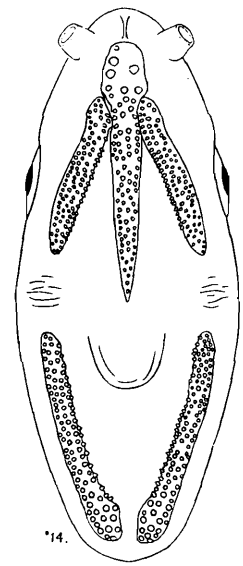
1822. *Ophisurus hijala*, Hamilton Buchanan, *Fish. Gang.*, pp. 20, 363, pl. v, fig. 5.
1832. *Ophisurus hyala*, Cuvier, *Reg. Anim. Poiss.*, p. 317.
1845. *Ophisurus rostratus*, M'Clelland, *Cal. Jour. Nat. Hist.*, V, pp. 184, 211.
1845. *Ophisurus vermiformis*, M'Clelland, *ibid.*, V, pp. 184, 212, pl. xii, fig. 2.
1845. *Ophisurus minimus*, M'Clelland, *ibid.*, V, pp. 185, 212, pl. x, fig. 3.
1845. *Ophisurus caudatus*, M'Clelland, *ibid.*, V, p. 185, pl. xii, fig. 3.
1845. *Ophisurus hijala*, M'Clelland, *ibid.*, V, p. 211.
1849. *Ophisurus grandoculis*, Cantor, *Jour. Asiat. Soc. Bengal*, 1849, p. 1306, pl. v, fig. 3.
1856. *Pisoodonophis boro* (in part), Kaup, *Cat. Apod. Fish Brit. Mus.*, p. 17.
1870. *Ophichthys hyala*, Günther, *Cat. Fish. Brit. Mus.*, VIII, p. 60.
1878. *Ophichthys boro* (in part), Day, *Fish. Ind.*, 664.
1889. *Ophichthys boro* (in part), Day, *Faun. Brit. Ind. Fish.*, I, p. 95.

There is only one specimen in the collection, secured on the 31st August, 1913, at Balugaon. It is twenty-two inches in length. The round dark grey blotches



13.

FIG. 13.—*Ophichthus chilkensis*, Chaudhuri.
Teeth of upper jaw, palate and lower jaw.



14.

FIG. 14.—*Ophichthus hijala* (Ham. Buch.).
Teeth of upper jaw, palate and lower jaw.

(larger than the eyes) on the anterior portion of the lateral line, which are characteristic markings of the species, are very conspicuous along the lateral lines; they begin a little in front of the gill-opening and continue to the region of the vent, and are twenty-four in number.[1] These markings are not found in *O. boro* (Ham. Buch.) in any stage of development. The position of the eyes is lateral in the specimen, but

[1] Similar ovate or elliptical spots, twenty-six in number, have been noticed in a recently described species belonging to the genus, *i.e. Ophicthus biserialis* (Garman) from Chatham Island, Galapagos. The spots are placed above and along the lateral line. This species, however, differs from *O. hijala* (Ham. Buch.) in almost all other particulars (*Mem. Mus. Comp. Zool. Harvard*, XXVI, p. 311).

they are visible from below and not when looked at from above, not as in *O. boro*, in which the eyes are superior. The teeth in *O. hijala* are pointed and not granular or globular as in *O. boro*. Kaup thought that "*O. hijala* (H. B.) was the young fish with less-developed teeth" (p. 17). The full grown specimen in the collection falsifies this contention. Hamilton Buchanan thought "*O. hijala* did not grow above eighteen inches in length." The present specimen which is longer by four inches than the stated average length cannot therefore be said to be young. Day sunk the specific name *hijala* (which he spells as "*hyala*" after Cuvier) in the synonymy for *O. boro*, though in the body of his description of the fish under *O. boro* he admits the distinctive character of the teeth in *O. hijala* by saying that the "teeth are conical in the young, which character may be retained in the adult age as in *O. hiyala*." It should also be noted that in Hamilton Buchanan's work (*Fishes of the Ganges*) the description of *O. hijala* precedes that of *O. boro* and is supported by a figure in the published plates, whereas *O. boro* follows *O. hijala* and is not supported by any figure. If therefore these two names of Hamilton Buchanan stand for one and the same species, the name *O. boro* should lapse and not *O. hijala*. However, as has been shown above, *O. hijala* is quite a distinct species.

Hamilton Buchanan's published figure of *O. hijala* is however defective (Plate V, fig. 5). The pair of tubular nostrils (the tag-like organs on the snout) are shown to be attached on the superior surface of the snout and are directed upwards in the figure, whereas they are on the underside of the snout, are lateral and inferior and are directed downwards. The eyes are shown to be above the angle of the jaw, whereas they are actually situated about the middle of the opening of the mouth.

There is a figure of this snake-eel in Hamilton Buchanan's manuscript drawings (p. 443 *ante*) on plate No. 27 of the set. The name on the back of the plate in Hamilton Buchanan's own handwriting is *Ophisurus rostrata*. This is the original and perhaps the only source of the name and description of "*Ophisurus rostratus*" of M'Clelland in volume V of the *Calcutta Journal of Natural History*, pp. 184 and 211. Hamilton Buchanan chose to alter his manuscript name "*rostrata*" to "*hijala*" in his published work "*The Fishes of the Ganges*." It is this rejected manuscript name of Hamilton Buchanan that was restored by M'Clelland through mistake. He says "I have not met with this species."

The following measurements of this unique specimen are of interest:—

Length of head	52 mm.
Length of snout	7 ,,
Diameter of eye	5 ,,
Interorbital space	7 ,,
Length of upper jaw	11 ,,
Length of lower jaw	9 ,,
Snout to vent	215 ,,
Tail	350 ,,
Free portion of tail	4 ,,
Distance between gill-openings and the origin of dorsal fin	32 ,,
Length of pectoral fin	12 ,,

This snake-eel is probably a permanent inhabitant of the main area, only going out to the sea to breed.

Distribution:—Estuaries of Bengal and the sea of Penang.

Ophichthus boro (Hamilton Buchanan).

1822. *Ophisurus boro*, Hamilton Buchanan, *Fish. Gang.*, pp. 20, 363.
1822. *Ophisurus harancha*, Hamilton Buchanan, *ibid.*, pp. 21, 363.
1845. *Ophisurus boro*, M'Clelland, *Cal. Jonrn. Nat. Hist.*, V, p. 211, pl. xii, fig. 4.
1845. *Ophisurus caudatus*, M'Clelland, *ibid.*, V, p. 185, pl. xii, fig. 3.
1849. *Ophisurus boro*, Cantor, *Journ. Asiat. Soc. Bengal*, 1849, p. 1304, pl. v, fig. 2.
1856. *Pisoodonophis potamophelus*, Kaup, *Cat. Apod. Fish Brit. Mus.*, p. 20.
1856. *Pisoodonophis boro* (in part), Kaup, *ibid.*, p. 17.
1865. *Pisoodonophis boro*, Day, *Fish. Malabar*, p. 248.
1870. *Ophichthvs boro*, Günther, *Cat. Fish. Brit. Mus.*, VIII, p. 77.
1878. *Ophichthys boro* (in part), Day, *Fish. Ind.*, p. 664, pl. clxxi, fig. 2.
1889. *Ophichthys boro* (in part), Day, *Faun. Brit. Ind. Fish.*, I, p. 94, fig. 41.

There are four specimens of different sizes in the collection varying from sixteen inches to twenty-five inches, all from the main area of the lake.

Hamilton Buchanan had three drawings made of the snake-eels of the Bengal estuaries and they are all preserved in the set of his manuscript drawings (plates xxvi to xxviii) which he had to leave behind him in India (p. 443, *ante*). He however was able to publish the figure of *O. hijala* (corresponding to pl. xxvii of the MSS. Drawings). Of the remaining two, *viz. O. boro* and *O. harancha*, reproductions were published in the year 1834 by Gray,[1] but that of *O. hijala* (pl. xxvii of the MSS. Drawings named thereon as *O. rostrata* in ink) was omitted as it had been already published as fig. 5 of pl. v, in the *Fishes of the Ganges*. The published copies of these illustrations were, however, more widely circulated and became better known than the *Fishes of the Ganges*. *O. harancha*, however, is the same as *O. boro*, as was, in a manner, admitted by Hamilton Buchanan,[2] and subsequently also pointed out by Kaup.[3] This was perhaps not fully realized by Gray, who reproduced both the drawings thinking them to be distinct species. In the *Fishes of Malabar*, Day, following Kaup, sunk *O. harancha* in the synonymy of *O. boro*. It is evident from Day's account of *O. boro* in this work that he then believed *O. hijala* to be quite a distinct species. Günther and others also regarded it as such. In the *Fishes of India*, however, Day, again following Kaup, stated that *O. hijala*, *O. boro* and *O. harancha* were all one and the same species. In doing this he erroneously sunk the prior name *O. hijala* for the later name, evidently being misled by Kaup, who mentioned the two names of Hamilton Buchanan in the reverse order—(probably for the sake of euphony), *i.e.* "*Ophisurus boro* et *hijala*, Ham., *Gang. Fish*, pp. 20, 21, 363"—in his note. This reverse order in his note led Kaup also to mistake the later name for the

[1] *Illustrations of Indian Zoology from the collection of Major-General Hardwicke* by J. E. Gray, Vol. I, pl. xcv, figs. 1 and 2.

[2] *The Fishes of the Ganges*, p. 21.

[3] *Catalogue of Apodal Fishes in the collection of the British Museum*, pp. 20, 21.

species. Day evidently followed Kaup when, by so doing, he found that he could use the more popular name—the *O. boro* of Gray and the *P. boro* of his own *Fishes of Malabar*. Thus *O. boro*, as understood by Day after 1865 and by Kaup from 1856, includes also *O. hijala* of Hamilton Buchanan, and *O. boro* of Kaup and Day represents, in part only, *O. boro* of Hamilton Buchanan.

The Chilka collection comprises specimens of *O. boro* of different sizes, none of which show any of the characters believed to be specific in *O. hijala*.

The following list gives the distribution of *O. boro* in the Lake.

1 specimen	Rambha Bay	——	measuring 400 mm.	in length
1 ,,	Balugaon	.. 31-viii-13	,, 410 ,,	,,
2 specimens	Barkul	Sept., 1914...	,, 540 ,,	and 610 mm

The fish appears to be a permanent inhabitant of the lake in the main area, but it does not breed there.

Distribution:—Seas and estuaries of India and the Malay Archipelago, ascending large rivers above tidal reach; also in the river of the Sambas.

Suborder *HAPLOMI.*

Family CYPRINODONTIDAE.

Subfamily APLOCHEILINAE.[1]

Genus **PANCHAX**, Cuvier and Valenciennes.

Panchax panchax (Hamilton Buchanan).

(Text-figures 15, 17.)

1822. *Esox panchax*, Hamilton Buchanan, *Fish. Gang.*, pp. 211, 380, pl. iii, fig. 69.
1839. *Aplocheilus chrysostigma*, M'Clelland, *Asiat. Research*, XIX, pt. 2, pp. 301, 426, pl. xlii, figs. 2*a*, 2*b*.
1839. *Aplocheilus panchax*, M'Clelland, *ibid.*, XIX, pt. 2, p. 302.
1846. *Panchax buchanani*, Cuvier and Valenciennes, *Hist. Nat. Poiss.*, XVIII, p. 383.
1846. *Panchax kuhlie*, Cuvier and Valenciennes, *ibid.*, XVIII, p. 384.
1849. *Panchax panchax*, Cantor, *Journ. Asiat. Soc. Bengal*, 1849, p. 1234.
1853. *Panchax buchanani*, Bleeker, *Nalez. Ichthyol. Beng. Hind.*, p. 144.
1859. *Panchax buchanani*, Blyth, *Journ. Asiat. Soc. Bengal*, XXVII, p. 288 (1858).
1863. *Panchax buchanani*, Bleeker, *Atl. Ich. Ind. Orient. Neerland.*, III, p. 141, tab. cxliv, fig. 3.
1866. *Haplochilus panchax*, Günther, *Cat. Fish. Brit. Mus.*, VI, p. 311.
1873. *Haplochilus panchax*, Day, *Rep. Fr. Fish. Ind. Burma*, p. cclxxvi.
1878. *Haplochilus panchax*, Day, *Fish. Ind.*, p. 523, pl. cxxi, fig. 3.
1889. *Haplochilus panchax*, Day, *Faun. Brit. Ind. Fish.*, I, p. 427.
1895. *Haplochilus panchax*, Garman, *Mem. Mus. Comp. Zool. Harvard*, XIX, p. 124, pl. iii, fig. 7 (teeth).
1912. *Haplochilus panchax*, Sewell and Chaudhuri, *Ind. Fish. Mos. Dest.*, p. 3, fig. 2.

There are altogether sixteen specimens in the collection, all from the main area of the lake. The list given below will show the time and place of their occurrence in the lake.

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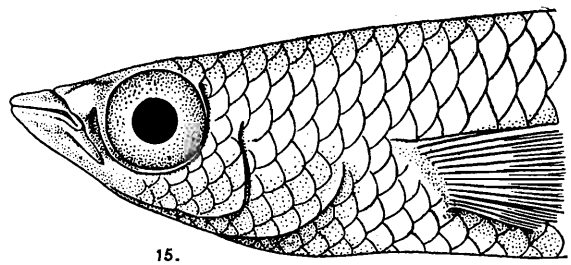
[1] Bleeker, *Atl. Ichth. Ind. Orient. Neerland.*, III, p. 140.

8 specimens	..	Off Barkul	..	..	9—13-xi-12	..	measuring	18 mm.	to	38 mm.
2 ,,	..	Barkul Point	..	..	2-iii-14	..	,,	25 ,,	and	34 ,,
2 ,,	..	Off mouth of Barkul Bay		..	18-ix-14	..	,,	27 ,,	,,	29 ,,
2 ,,	..	Nalbano Island	..	..	25-xi-14	..	,,	36 ,,	,,	41 ,,
1 ,,	..	Rambha Bay	..	..	xii-13	..	,,	25 ,,		
1 ,,	..	Rambha	..	..	ii-14	..	,,	24 ,,		

The jaws are subequal, the upper one is slightly longer and protractile (text-fig. 15). The mouth is large and its opening horizontal; the contour of the opening is convex in front and extends beyond the breadth of the upper jaw to nearly half the



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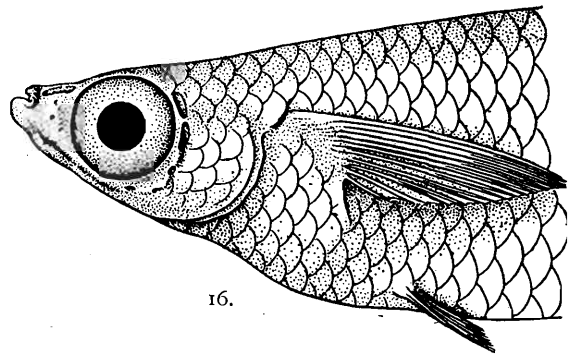


16.

FIG. 15.—*Panchax panchax* (Ham. Buch.).
Side view of the head and a portion of the trunk, showing the lateral and horizontal opening of the mouth and the position of the pectoral fin.

FIG. 16.—*Aplocheilus melastigma*, M'Clell.
Side view of the anterior part of the fish, showing the small and terminal opening of the mouth and the position of the pectoral fin

length of the snout (text-figs. 15 and 17). The teeth in the upper jaw are villiform and are distinctly banded; in the lower jaw they are in two to three rows and also villiform and banded. In both the jaws there are an outer and a more or less distinct inner series of enlarged teeth. In most specimens the vomerine teeth are present. The margin of both the jaws is coloured dark brown. The white occipital spot is very conspicuous in some specimens, in others it is indistinct and in rare cases wanting. The presence or absence of this spot appears to have no reference to age, locality, or time of the year when the specimen was collected. The black blotch at the root of the dorsal fin, which is well marked in all the specimens, is in some surrounded by a white halo. In some of the larger specimens the margin of the anal fin and in

some cases that of the caudal fin is coloured black with a yellow band inside. Most of the specimens have twenty-six scales from the end of the snout to the origin of the dorsal fin, and five scales between the post-orbital line and the origin of the pectoral fin. Generally there are three to four scales from the top of the pectoral fin to the mid-dorsal line of scales, and three scales also between the lower margin of the root of the pectoral fin and the mid-ventral line (text-fig. 15). The ventral fins cover the vent and almost reach the anal papila, which is thin. In adult specimens, collected in November, mature eggs of one millimeter in diameter were found.

The species occurs near the edge everywhere in the main area of the lake, but appears to be entirely absent from the outer channel. It breeds freely in the main area.

Distribution :—Fresh waters (extending to estuaries) in Bengal, Behar, Orissa, Assam, Burma, Siam, the Malay Peninsula and Archipelago and the Andamans. The species has also been reported from Sind, Cutch and the Central Provinces of India.

Genus **APLOCHEILUS** M'Clelland.

Aplocheilus melastigma, M'Clelland.

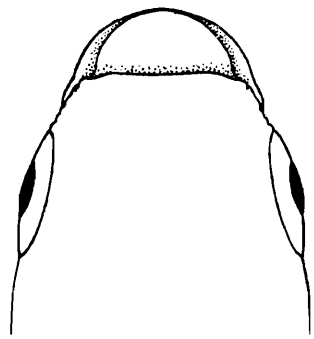
(Text-figures 16, 18.)

1839. *Aplocheilus melastigma*, M'Clelland, *Asiat. Research.*, XIX, pt. 2, pp. 301, 427, pl. xlii, fig. 3.
1839. *Aplocheilus* sp., M'Clelland, *ibid.*, XIX, pt. 2, p. 302, pl. lv, fig. 4.
1846. *Poecilia latipes*, Temminck and Schlegel, *Faun. Japon. Pisc.*, p. 224, pl. cii, fig. 5.
1849. *Aplocheilus carnaticus*, Jerdon, *Madras Journ. Lit. Sc.*, XV, p. 331.
1854. *Aplocheilus macclellandi*, Bleeker, *Nat. Tijd. Ned. Ind.*, VII, p. 323.
1858. *Panchax cyanophthalma*, Blyth, *Journ. Asiat. Soc. Bengal*, XXVII, p. 288.
1860. *Panchax cyanophthalma*, *id.*, *ibid.*, XXIX, p. 111.
1860. *Aplocheilus latipes*, Bleeker, *Act. Soc. Sc. Indo-Neerl.* VII, Japan, VI, p. 99.
1866. *Haplochilus latipes*, Günther, *Cat. Fish. Brit. Mus.*, VI, p. 311.
1866. *Haplochilus cyanophthalmus*, Günther, *ibid.*, VI, p. 312.
1867. *Panchax argenteus*, Day, *Proc. Zool. Soc.*, p. 706.
1873. *Haplochilus argenteus*, *id.*, *Rep. Fr. Fish. Ind. Burma*, p. cclxxvi.
1878. *Haplochilus melastigma*, *id.*, *Fish. Ind.*, p. 522, pl. cxxi, fig. 4.
1889. *Haplochilus melanostigma*, *id.*, *Faun. Brit. Ind. Fish.*, I, p. 415.
1895. *Haplochilus melastigma*, Garman, *Mem. Mus. Comp. Zool. Harvard*, XIX, p. 127.
1895. *Haplochilus latipes*, *id.*, *ibid.*, XIX, p. 128.
1901. *Aplocheilus latipes*, Jordan and Snyder, *Proc. U. S. Nat. Mus.*, XXIII, p. 350.
1907. *Oryzias latipes*, *id.*, *ibid.*, XXXI, p. 289, text-fig. (p. 290).
1912. *Haplochilus melastigma*, Sewell and Chaudhuri, *Ind. Fish. Mos. Dest.*, p. 4.
1913. *Oryzias latipes*, Jordan, Tanaka and Snyder, *Journ. Coll. Sc. Univ. Tokyo*, XXXIII, p. 91, fig. 67.
1913. *Oryzias latipes*, Jordan and Metz, *Mem. Carnegie Mus.*, VI, p. 24, fig. 21.
1916. *Haplochilus melanostigma*, Sundara Raj, *Rec. Ind. Mus.*, XII, p. 293, pl. xxv, figs. 1 and 10.

There are altogether one hundred and eighty-four specimens in the collection. This fish has been found near the edge all over the lake including the outer channel. The following table gives the distribution of the species in the lake.

21	specimens	Barkul	.9—13-xi-12	measuring from	10	mm.	to 20 mm.
12	,,	Barkul Point	2-iii-14 ..	,,	11	,,	to 22 ,,
2	,,	Balugaon	6-iii-14	,,	14	,,	and 17 ,,
37	,,	Chiriya Island	13-ii-14	,,	6	,,	to 17 ,,
35		Maludaikuda	24-xi-14	,,	8	,,	to 22 ,,
1	specimen	Manikpatna (Long Island)	7-ix-14	,,	17	,,	
27	specimens	Nalbano	25-xi-14	,,	15	,,	to 26 mm.
2	,,	Nalbano Channel	11-ix-14	,,	17	,,	and 19 ,,
9	,,	Rambha Bay (Breakfast Island)	xi-14	,,	12	,,	to 24 ,,
15	,,	Satpara	ix-13	,,	15	,,	to 25 ,,
13	,,	Do.	x-13	,,	12	,,	to 24 ,,

As Blyth observed, this species is less of a surface-fish than *Panchax panchax* (Ham. Buch.). The following peculiarities should be noted. The opening of the mouth is very small, horizontal and transverse, and is not broader than the end



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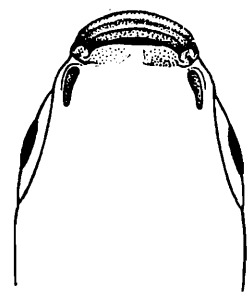

18.

FIG. 17.—*Panchax panchax* (Ham. Buch.).
Anterior part of the head seen from above, showing the form of the snout with premaxillary.

FIG. 18.—*Aplocheilus melastigma*, M'Clell.
Anterior part of the head showing the small and somewhat superior opening of mouth.

of the upper jaw. Its contour is like a much flattened ellipse; the lower jaw, however, is slightly longer and broader and this makes the mouth appear to be somewhat superior and round (text-figs. 17 and 18.) The mouth is not protractile. The teeth are simple and pointed and are in two rows in the jaws, but those in the posterior row are very minute and often difficult to detect. There are no vomerine teeth. The eyes are lateral and their superior borders bulge out slightly on the surface of the head. There are three to four scales between the upper border of the pectoral fin and the mid-dorsal line; there are nearly seven scales between the inferior border of the root of the pectoral and the mid-ventral line (text-fig. 16); the number of scales in front of the dorsal fin is twenty-eight only; there are three scales between the post-orbital line and the root of the pectoral fin. The base of the pectoral fin is very muscular and swollen. The caudal fin is truncated and square-cut. In some specimens there are two black lines about the middle of the anal fin running parallel to its edge, besides the black lines running along the middle of the fish and along the border of the anal fin. In some specimens there are numerous black spots over the

upper corner of the base of the pectoral fin, over parts of the operculum and on the sides of the abdomen. Many of the bigger specimens are full of mature eggs. One specimen collected from the edge of the lake at Satpara in the month of September, measuring twenty-five millimeters in length, had a cluster of about forty eggs with growing embryos inside most of them. This egg-cluster was attached between the ends of the ventral fins and the beginning of the anal fin. There are numerous hooklets round each of the capsules of the eggs, which give them a characteristic appearance somewhat like a miniature model of the fruits of the well-known *Datura*. The anal papila is flat, thick and leaf-like, with a notch in the middle.

As Tate Regan has conclusively shown (*Ann. Mag. Nat. Hist.*, (8), VII, p. 324) the genus *Oryzias* of Jordan and Snyder is a synonym of *Aplocheilus*, M'Clelland, afterwards definitely restricted by Bleeker to the group to which it is now applied. Examination of a large number of *A. melastigma* has led me to suspect that *A. latipes* (Temminck and Schlegel), the type of the genus *Oryzias* of Jordan and Snyder, is in all probability identical with *A. melastigma*. This suspicion has been confirmed by the same species being found among a collection of small fish made by Dr. N. Annandale, in September 1915, in the outskirts of Shanghai. Günther, in a manner, long ago comprehended the identity of these two species. Though he omitted *A. melastigma*, M'Clelland, from his *Catalogue of Fishes in the British Museum* as a doubtful species, he adopted its synonym *H. cyanophthalmus*, Blyth, as a valid one. The collection, on the examination of which he based his identification of Blyth's species, came from Calcutta, but his difficulty was that the fin had nineteen anal rays only as in *A. latipes* and not twenty-two. Though most of the Chilka specimens have twenty-two anal rays, I find that some have eighteen, twenty or twenty-one. In other respects they are almost alike. Recently this Museum has received a valuable collection of representative fish from Lake Biwa, Japan, in excellent condition, from the Rinko Zikkensho of Otsu. In this collection there is one specimen labelled *Oryzias latipes* (Temm. and Schleg.) which appears to us to be a perfectly typical example of *A. melastigma*, M'Clelland. The acquisition of specimens from Lake Biwa and Shanghai has given us an opportunity to institute a close comparison between the Japanese specimen and those from Shanghai and the Chilka Lake. The result of this examination is tabulated below :—

	Lake Biwa. Japan.	Shanghai.		Chilka Collection.		
		A.	B.	Rambha Bay.	Nalbano Island.	Barkul Point.
Number of rays in the anal fin	18	20	19	22	18	21
Number of scales along the lateral line	31	30	31	30	29	30
Number of scales along the mid-transverse line.	9	9	9	9	9	9
Length of head	6 mm.	5 mm.	5 mm.	7 mm.	6 mm.	5 mm.
Depth of body	5·5 mm.	4·5 mm.	4·5 mm.	7 mm.	5·5 mm.	4·7 mm.
Number of scales above the pectoral fin	4	3	4	4	4	4
Number of scales below the pectoral fin.	7	6	7	7	7	7

The proportion between the length of the head and the depth of the fish varies slightly according to sex, as well as in individuals during the breeding season and also owing to other causes; no very great value, therefore, should be attached to slight differences in the depth. Jordan and Snyder appear to have ignored the generic character of *Aplocheilus* (*s. s.*) in instituting their genus and do not allude to the fact that in *A. javanicus*, Bleeker, the anal fin is even longer than in the specimens of the species they examined, having twenty-five rays.

The species occurs all round the edge of the lake including the outer channel. It is a permanent inhabitant and breeds freely in the lake.

Distribution:—Madras, Orissa, Bengal, Burma, the Kiangsú Province of China, Formosa, Korea and Japan.

Suborder *CATOSTEOMI.*

Family SYNGNATHIDAE.

Genus **ICHTHYOCAMPUS**, Kaup.

Ichthyocampus carce (Hamilton Buchanan).

1822. *Syngnathus carce*, Hamilton Buchanan, *Fish Gang.*, pp. 13 and 362.
1832. *Syngnathus carce*, Gray, *Illust. Ind. Zool. Hardwicke*, I, pl. lxxxi, fig. 1.
1853. *Syngnathus carce*, Bleeker, *Nalez. Ichth. Faun. Beng. Hindost.*, p. 161.
1856. *Ichthyocampus carce*, Kaup, *Cat. Lophob. Fish Brit. Mus.*, p. 30.

1856. *Ichthyocampus ponticerianus, id., ibid.*, p. 31.
1865. *Ichthyocampus ponticerianus*, Day, *Fish. Malabar*, p. 263.
1870. *Ichthyocampus carce*, Günther, *Cat. Fish. Brit. Mus.*, VIII, p. 176.
1878. *Ichthyocampus carce*, Day, *Fish. Ind.*, p. 670, pl. clxxiv, fig. 2.
1889. *Ichthyocampus carce*, Day, *Faun. Brit. Ind. Fish.*, II, p. 464.

There are altogether fifteen specimens in the collection, of which nine are males and six females. In all the female fish, on the inferior side of the rostrum, there are two longitudinal series of black dots, one on each side of the middle line and running parallel to it. The following list gives the distribution of the species in the lake.

Female specimens.

1 specimen	Off Barkul	..	25-i-14	measuring	120 mm.
1 ,,	Domkuda	..	18-vii-14	,,	100 ,,
3 ,,	Off Samal Island	..	22-ix-13	,,	100, 110 and 115 mm.
1 ,,	Satpara	..	..	,,	100 mm.

Male specimens.

1 specimen	Between Chiriya Island and mainland	28-vii-14	measuring	95 mm.	Pouch full of fertilized eggs but no free embryo.
1 ,,	Eight miles off Kalupara Ghat	16-ix-14	,,	95 mm.	Pouch empty.
1 ,,	Ten miles east of Patsahanipur	10-iii-14	,,	130 mm.	Pouch empty.
2 ,,	Patsahanipur	8-iii-14	,,	40 and 58 mm.	Pouch not fully developed.
1 ,,	Rambha Bay	22-vii-14	,,	61 mm.	Pouch not fully developed.
1 ,,	Satpara	——	,,	117 mm.	Pouch full of developing embryos.
2 ,,	Chilka Lake	——	,,	95 and 120 mm.	Pouch full of developing eggs and a few free embryos.

Distribution:—Seas, estuaries and fresh waters of India and the Malay Archipelago.

Genus HIPPOCAMPUS, Rafinesque.

Hippocampus brachyrhynchus, Duncker.

(Text-figure 19.)

1914. *Hippocampus brachyrhynchus*, Duncker, *Rec. Ind. Mus.*, X, p. 295.

The number of abdominal truncal rings (annuli) is eleven and that of the caudal rings varies from thirty-three to thirty-seven. The number of rings below the dorsal fin (annuli subdorsalis) is $2(-3)+1$. The number of rays in the dorsal fin varies from seventeen to nineteen and that in the pectoral fin from thirteen to fifteen. The number of rays in the anal fin is four. The number of rings in the region of the brood pouch varies from six to eight.

The rings are provided with blunt spines which are nearly uniform, except on the seventh truncal ring and also on the fourth, the seventh, the eleventh and the fourteenth caudal rings, where they are dorsally a little enlarged. The abdominal crista are prominent, in the males they are provided with a black cutaneous fringe (dewlap). There are no cutaneous appendages, except the simple papillae on the breeding-pouch, which are more closely arranged in the posterior half of the pouch. The coronet is scarcely developed. The rostrum is very short and is half to three-fourths in the post-orbital length of the head and up to one and a half times in the orbital diameter. The colour is uniformly dark; there are light radiating stripes from the eye. Total length up to 70 mm.

Fig. 19.—*Hippocampus brachyrhynchus*, Duncker, × 2.

Types:—There were altogether nine specimens from Rambha Bay in the series that Dr. George Duncker examined in describing the species, five males and the remaining four females. The type male specimen is registered under No. F $\frac{8508}{1}$ and the type female under No. F $\frac{8509}{1}$ in the register of the Indian Museum.

Besides these nine specimens, there are in the collection twelve more specimens of the species from different parts of the lake, as follows:—

1	specimen	..	♂	..	Domkuda	..	18-vii-14	measuring 45 mm.
1	,,	..	♂	..	Mahosa	..	10-ix-14	,, 38 ,,
1	,,		♂		Rambha		15-ii-14	,, 70 ,,
3	,,		♀		Rambha		15-ii-14	,, 55, 65 and 72 mm.
5	,,	..	(young)		Rambha	..	14-ii-14	,, 10, 12, 16, 18 and 23 mm.
1	,,		♀		Seruanaddi	..	8-ix-14	,, 43 mm.

The species is a permanent inhabitant of the lake and breeds in it.

Duncker records it from the Mekran coast (Arabian Sea) as well as the Chilka Lake.

FAUNA OF THE CHILKA LAKE.

SOME TERRESTRIAL ISOPODA FROM THE SHORE OF THE LAKE.

CHAS. CHILTON, *M.A., M.B., C.M., D.Sc., LL.D., F.L.S., C.M.Z S., Professor of Biology, Canterbury College, University of New Zealand.*

(With 36 text-figures.)

CONTENTS.

SOME TERRESTRIAL ISOPODA FROM THE SHORE OF THE LAKE.

By CHAS. CHILTON.

INTRODUCTION.

Among the Isopoda and Amphipoda collected during the Chilka Lake Survey, and kindly handed over to me by Dr. Annandale for examination and report, there are four species of Terrestrial Isopoda collected on the shores of the lake. As these are the only representatives of the Oniscoidea[1] in the collection sent to me, and as they differ from the other Isopoda in being terrestrial, it will be convenient to deal with them in a separate report.

Naturally the number of species is small, since the Survey dealt with the lake itself, and only those terrestrial forms found near the shore were collected. Of the four species *Ligia exotica* is the only one that can be looked upon as strictly belonging to the Lake Chilka Fauna. It is a maritime species never found far from the sea-shore. Specimens were obtained during the Survey from two localities near Barkul and from Barkuda Island,[2] where the water is somewhat brackish even during the season when the main area of the lake is filled with fresh water. Most species of *Ligia* live near enough to the sea-shore to be affected by high tides or by the salt spray, but in some cases, where conditions are favourable, they have been found in moist places at some considerable distance from high tide mark. As the margin of Lake Chilka varies considerably during the different seasons and as the salinity of the soil at the southern end is greater than that nearer the mouth of the Mahanaddi, it would probably afford a good opportunity of showing how a maritime species, such as *L. exotica*, may become gradually adapted to more purely terrestrial conditions, but the specimens at present in my hands do not throw any light on this question.

Ligia exotica is a widely distributed species, found on the sea-shore of many parts of the Indian, Atlantic and Pacific Oceans.

The other three species appear to be purely terrestrial forms. The type specimens of *Hemiporcellio carinatus*, previously described by Mr. Collinge (1915, p. 145), were collected "under stones and dead water weeds at the edge of Chilka Lake" at Rambha, and speaking of it Dr. Annandale says, "apparently an amphibious

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[1] *Arhina barkulensis*, Collinge (*Rec. Ind. Mus.*, XI, p. 147, pl. viii) was also taken at the edge of the Chilka Lake.

[2] For the position of these places and for information on the geography, hydrography, etc., see the "Introduction" to the "Fauna of the Chilka Lake" by N. Annandale and S. Kemp (1915, pp. 1-20).

species." The specimens sent to me are from Barkuda Island, but without any indication as to whether they were found on the edge of the lake or not. The species, however, is closely allied to *H. hispidus*, Collinge, which is described as a terrestrial species and its occurrence on the shore of the lake is probably only accidental, as several species of the Oniscidae, though really terrestrial, are sometimes found quite close to high water mark on the sea coast.

Hemiporcellio carinatus, Collinge and *Cubaris granulatus*, Collinge, are as yet known only from certain localities near Lake Chilka, though they probably occur in other parts of India. The remaining species, *Alloniscus pigmentatus*, Budde-Lund, if my identification of it is correct, occurs, according to Budde-Lund, also in Madagascar, where it is common, and in many localities in the East Indies.

I have referred the four species to species already described but in each of them, particularly in the case of *Ligia exotica*, I have endeavoured to give information additional to that already published.

I am much indebted to my assistant, Miss E. M. Herriott, M.A., for the care with which she has drawn the figures illustrating the paper.

The references are made by the year of publication to the Bibliographical list on p. 480.

Ligia exotica, Roux.

(Figs. 1 to 22).

Ligia exotica, Roux, 1828, '*Crust. Medit.*'. livr. 3, pl. xiii, f. 9.
" " Budde-Lund, 1885, p. 266.
" " Dollfus, 1893A, p. 3 (of separate copy).
" " Dollfus, 1893B, p. 189.
" " Dollfus, 1898, p. 381.
" " Stebbing, 1904, p. 718.
" " Stebbing, 1905, p. 57.
" " Budde-Lund, 1912, p. 391.
Ligia gaudichaudii, Milne-Edwards, 1840, III, p 157.
" " Nicolet, 1849, p. 265.
" " Dana, 1852, p. 741, pl. xlix, fig. 6 *a-h*.
Ligyda exotica, Richardson, 1905, p. 676.

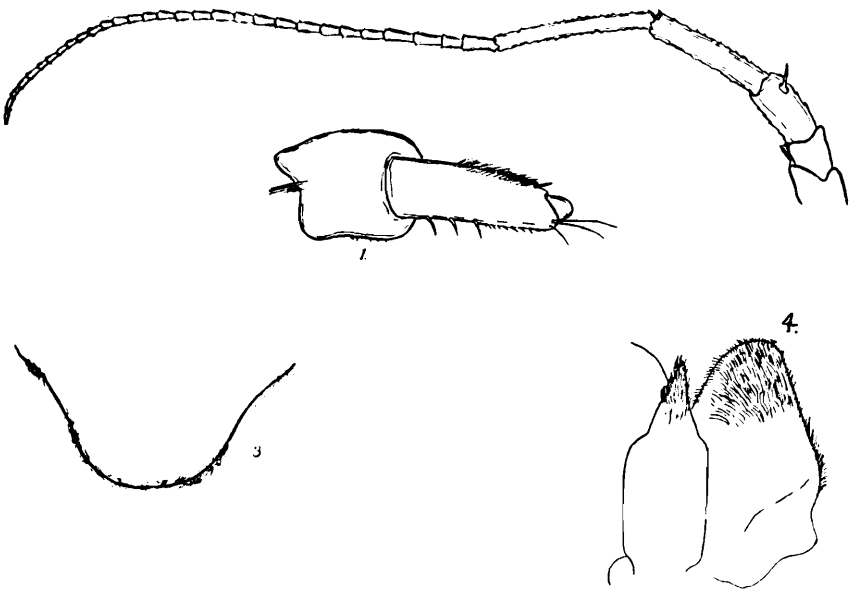
Specimens were obtained from the following localities :—

Barkul, Lake Chilka, Orissa, 9—13-xi-12 (*F. H. Gravely*). Several. Serial Number 7.
Off Barkul, Lake Chilka, Orissa, 21—31-vii-13 (*N. Annandale*). Seven. Serial Number 10, "$\frac{8}{10}\frac{6}{2}$."
Barkuda I., under stones just above water level. Feb. 1914. Eleven. Station No. 16, "$\frac{8}{10}\frac{7}{3}\frac{9}{3}$."

This species is very widely distributed on the warmer shores of the Atlantic, Pacific and Indian Oceans, and it has been recorded on the American coast as far south as Chili and Puntarenas. Though it is so common and has been known for many years, it has received only scanty attention at the hands of those who have recorded it, most observers having merely mentioned its occurrence without adding to previous descriptions. It was briefly described by Milne-Edwards in 1840 under the name of *Ligia gaudichaudii*, and Dana recorded it from various localities under the same name

in 1852. Budde-Lund gave a Latin diagnosis of the species in 1885. In 1893, in his account of the distribution of the genus *Ligia*, Dollfus briefly indicated the characters by which *L. exotica* is distinguished from other species and gave a figure of the posterior portion of the pleon and the uropoda (1893A, p. 3). The only other description that I am acquainted with is that given by Miss Richardson in 1905 in her monograph of the Isopoda of North America. She gives text-figures of the maxillipedes and first peraeopoda and a reproduction of Roux's original figure of the species. She also gives an analytical key to the American species of the genus.

Budde-Lund has called attention to the small process at the end of the propod of the first gnathopod of the male, and Dollfus (1890, p. 7) has referred briefly to the differences between the male and the female in the anterior peraeopoda, but these are



Ligia exotica, Roux.

FIG. 1.—1st antenna of male (highly magnified).
FIG. 2.—2nd antenna of male.
FIG. 3.—Upper lip.
FIG. 4.—Lower lip, seen from posterior side.

the only references I can find to the sexual differences, and the pleopoda do not appear to have been described or figured in either sex. Miss Richardson gives an outline drawing of the maxillipeds, but the other mouth-parts have not been figured nor described in any detail. I have thought it desirable, therefore, to give figures and descriptions of some of the more characteristic parts for comparison with Sars' account of *Ligia oceanica* (1898, p 156) and with that given by myself of *Ligia novaezealandiae* (1901, p. 107).

Specific Diagnosis. Body oblong oval, greatest breadth about half the length of body; dorsal surface minutely granular, the granulations becoming smaller and less evident on the segments of the pleon. Antennae about as long as the length of the body. Uropoda when fully developed more than half the length of the body. First

three pairs of legs in male having the merus and carpus dilated; the first pair having a small narrow process at the distal end of the propod. The terminal segment has the middle part of the posterior extremity produced into a subacute point; the postero-lateral angles are long and very acute; the inner angle of the notch for the insertion of the uropod is quadrate and has another quadrate angle near it.

Female differing from the male in having none of the joints of the anterior legs dilated and in the absence of the process on the propod of the first pairs, also in having the side-plates of segments 2, 3 and 4 separated from their segments by a distinct suture.

Length of body of largest male examined, 22 mm.; breadth, 11 mm.; length of antennae 20 mm., length of uropoda 12 mm.

Colour, slaty grey.

In Miss Richardson's key of the American species of the genus *Ligia*, *L. exotica* is placed next to *L. baudiniana*, which is distinguished from it mainly by having the

Ligia exotica, Roux.

FIG. 5.—Right mandible. FIG. 6.—Left mandible.

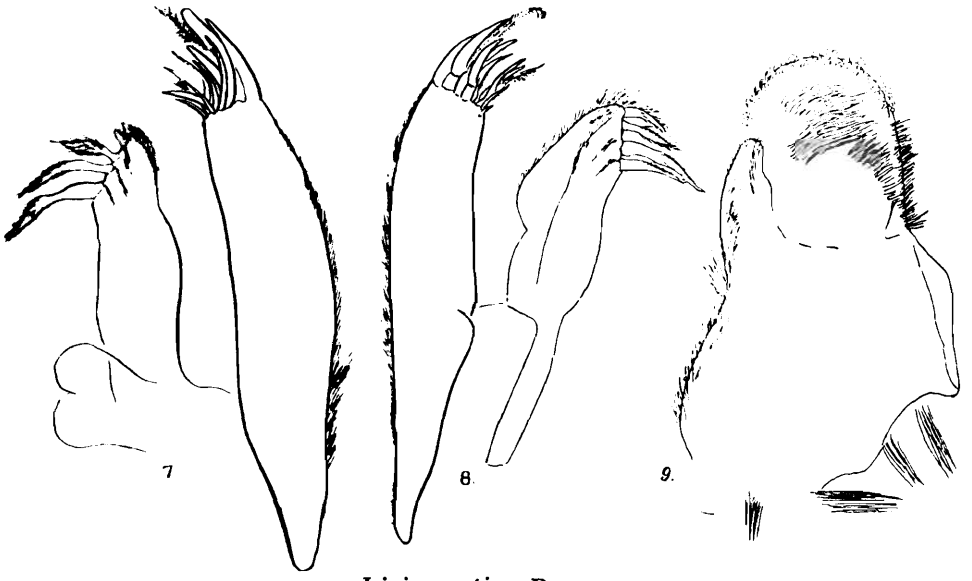
propod of the first pair of legs unarmed, and in having the merus and carpus furnished with a row of stiff hairs or bristles. The two species certainly seem to have many points in common, and, as I afterwards state, it may be difficult to find characters that will distinguish between them in all cases. *L. exotica* also seems to come close to *L. italica*, Fabr., which appears to be distinguished, however, by the shape of the posterior border of the terminal segment. I am not acquainted with any special description of the male of *L. italica*, and the few specimens in my collection are too small and immature to show the characters of the adult male.

In addition to this short diagnosis, the following fuller description of the Lake Chilka specimens may be given.

The head is short and broad; breadth 5 mm. and length 2·5 mm. It is regularly rounded in front and the whole of the lateral margins and a portion of the anterior margin are occupied by the large, rounded eyes which are separated in the centre by a distance less than the length of each eye. The part of the eye nearest to the median line is rectangular with the angle rounded and not acute as in *L. novae-*

zealandiae. On the surface of the head, parallel to the posterior margin, is a narrow furrow, making the posterior margin stand out distinctly, and there is a shallow and less well-marked furrow running outwards and backwards on each side parallel to the posterior margin of the eye. The side-plates of the first segment are completely united with the central portion of the segment, no suture being noticeable; in the 2nd, 3rd and 4th segments *in the female*, there is a distinct suture between the side-plates and the central portion; in the 5th, 6th and 7th, the side-plates are again united with the central portion without a distinct suture. In the male there is no distinct suture even in the 2nd, 3rd and 4th segments, and only an indistinct line or slight groove as in segments 5, 6 and 7.

The question as to whether the side-plates are coalesced with the segments or are separated by a suture is one that is not easy to decide without allowing the



Ligia exotica, Roux.

FIG. 7.—First maxilla of right side, taken from a male specimen with body 22 mm. long.
FIG. 8.—Left maxilla from same specimen showing *four* plumose setae on the inner lobe.
FIG. 9.—Second maxilla.

specimens to dry, and this is not always possible. There seems also to be considerable variation in this character in the different species, but there are a few cases which appear to show that the difference between the male and female in this respect holds for more than one genus of the Oniscoidea. For example, I have noted the same thing in *Deto aucklandiae* (1915, p. 438), where the side-plates in segments 2, 3 and 4 are separated from their segments in the female by a suture, while in the males they are quite continuous with the segments. In the other species of *Deto*, however, there appears to be no suture even in the females. Again, in establishing the genus *Anomaloniscus*, Dollfus (1893B, p. 187) gives as one of the chief characters, that there is a suture between the side-plates and the segments in segments 2, 3 and 4 in the female, but not in the male. Apparently it is impossible to lay down a general rule with regard to this sexual difference. Thus, though the difference holds in

the Lake Chilka specimens of *L. exotica* and also in Honolulu specimens of this species in my collection, it does not appear to apply to all the species of the genus; thus, in *L. oceanica*, according to Sars (1898, p. 156), the side-plates are defined "from the corresponding segments by a slight groove." This is certainly the case in the specimens of this species that I have been able to examine, but unfortunately there is no ovigerous female among them, though I presume Sars' description applies to both sexes. In speaking of *L. exotica*, Miss Richardson (1905, p. 677) says, the epimera are "not distinctly separated off from the dorsal portion of the segment, only a faint line, almost inconspicuous, indicates the place where the coalescence has taken place"; she makes no mention of sexual differences in this point, though, as I have said, in ovigerous females from Lake Chilka and from Honolulu, there is a distinct suture in segments 2, 3 and 4. For *L. baudiniana*, Miss Richardson (1905, p. 679) says, "the epimera are coalesced with the segments, faint depressed lines indicating the place of the union"; and she gives a similar description for *L. occidentalis* (p. 682), while in *L. pallasii*, she says, "the epimera of all the segments are broad plates, occupying the whole of the lateral margins of the segments and indicated by distinct lines" (p. 683), though in *L. olfersii* "there is not even any trace, such as a faint line to mark the place where coalescence has taken place" (p. 675). In *L. novae-zealandiae*, Dana, the side-plates in the male are all united with their segments, the union being indicated at most by a faint line; in the female the side-plates of segments 2, 3 and 4 are separated from the segments by a fairly distinct suture and, in most cases, there is on segment 5 a distinct groove corresponding to the suture in the preceding segment. There seems to be also the same want of uniformity in this character in *Deto*: for, while in *D. aucklandiae* there is the same difference between the sexes as in *Ligia exotica*, in the other species of *Deto*, the side-plates are continuous with the segments, and the junction of the epimera is not marked by a distinct groove or suture. In this connection it should be remarked that Dollfus (1893C, p. 343) established the genus *Geoligia*, chiefly on the character that all the side-plates were continuous with their segments. Although it is evident that this character in itself is not sufficient to distinguish the genus *Geoligia* from *Ligia*, the only species of that genus at present known are truly terrestrial, living far away from the sea, and in *Geoligia perkinsii*, Dollfus (1900, p. 525), the uropoda have the branches articulated into several joints instead of being undivided as in *Ligia*.

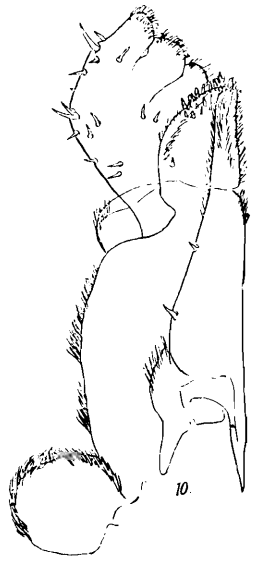
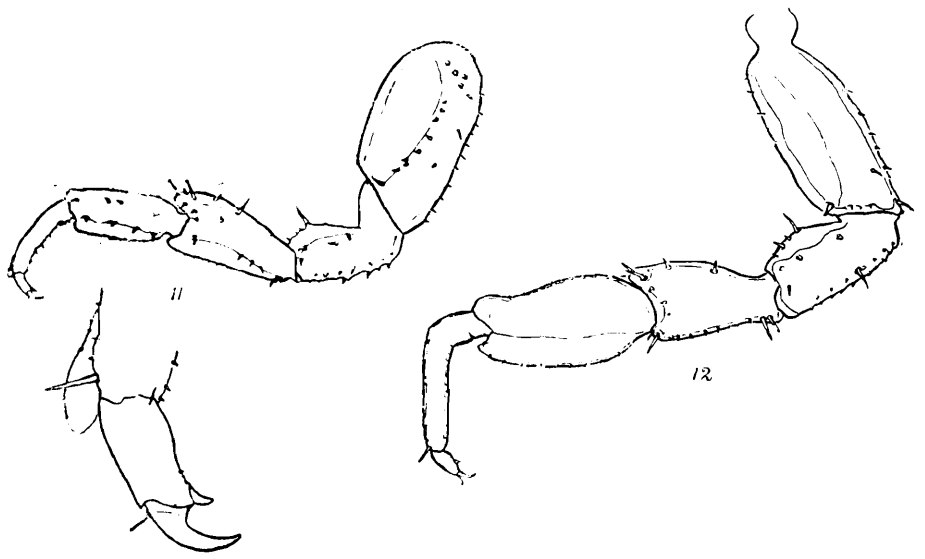


FIG. 10.—*Ligia exotica*, maxilliped, seen from inner or anterior side.

The whole dorsal surface of the segments of the peraeon is covered with numerous small granulations, some of which seem to be almost acute posteriorly; they are scattered irregularly over the segments without forming any definite rows. In the

1st—5th segments there is a slight furrow just in front of the posterior margin. In the pleon the granulations are smaller and less evident. The posterior border of the first segment is transverse, not being produced backwards at the postero-lateral angle. In the succeeding segments this angle of the side-plate is produced more and more backwards until in the seventh segment it forms an acute point reaching as far back as, or further than, the posterior border of the third segment of the pleon; the first and second segments of the pleon are short and without side-plates; the third, fourth and fifth have well-developed side-plates produced back into acute points, that of the fifth reaching about half way to the end of the terminal segment. The terminal segment is much broader than long, its lateral margins end acutely posteriorly and the posterior border is produced at the centre into an acute point as already described (fig. 20, p. 472).



Ligia exotica, Roux.

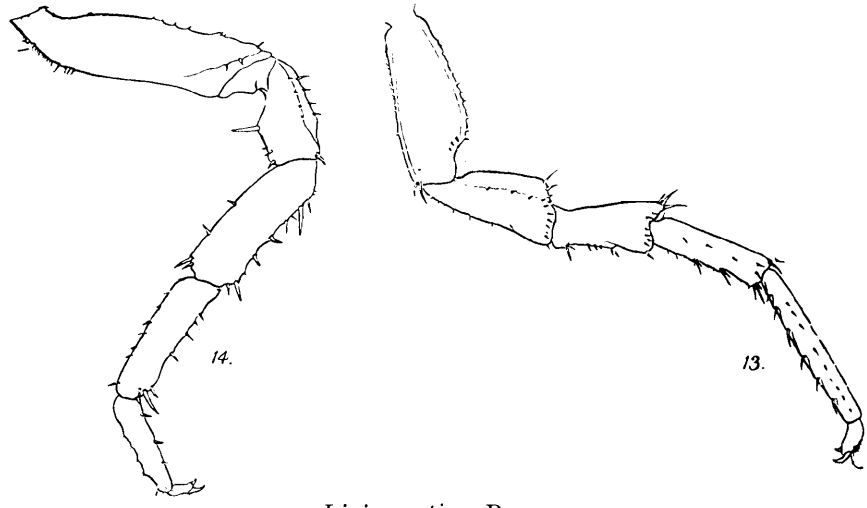
FIG. 11.—First leg of male, with terminal portion more highly magnified.
FIG. 12.—Second leg of male.

Antenna 1 (fig. 1, p. 463) is very small, as usual for this genus and is not visible in a dorsal view of the head; the first joint is nearly as broad as long, and about two-thirds the length of the second, and its margins are almost free from setae; the second is nearly three times as long as broad and is thickly covered on the distal portion with short fine setae, some of them almost scale-like, and there are a few longer setae at the extremity and on the lower margin; the third joint is very short, almost minute, and rounded at the end.

Antenna 2 (fig. 2, p. 463) is, in most cases, fully as long as the body, though the length varies with the development of the animal; the first two joints of the peduncle are short, and slightly grooved on the outer side to receive the third joint when reflexed; the third joint is about as long as the first and second together and bears near the inner distal angle a single, stout seta and is also grooved on the outer side towards the distal end; the fourth joint is about twice as long as the third, but shorter than

the fifth; both bear a few short setules; the flagellum is long and slender, containing about 30 joints and being rather longer than the peduncle.[1]

The second antenna in the male appears to be quite as slender as in the female, instead of being stouter, as in *Ligia oceanica*.



Ligia exotica, Roux.

FIG. 13.—Seventh leg of male.

FIG. 14.—First leg of female.

Mouth-parts. The *upper lip* (fig. 3, p. 463) is large and broad, covering in the anterior portion of the mouth and in the living animal projecting downwards and

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After this was in type I received Dr. H. J. Hansen's report on the Ingolf Isopoda ("The Danish Ingolf Expedition, Vol. III, 5. Crustacea Malacostraca. III"), in which he states (p. 201) that the peduncle of the antenna of *Ligia oceanica* is 6-jointed, though it has usually been described as 5-jointed. He says:

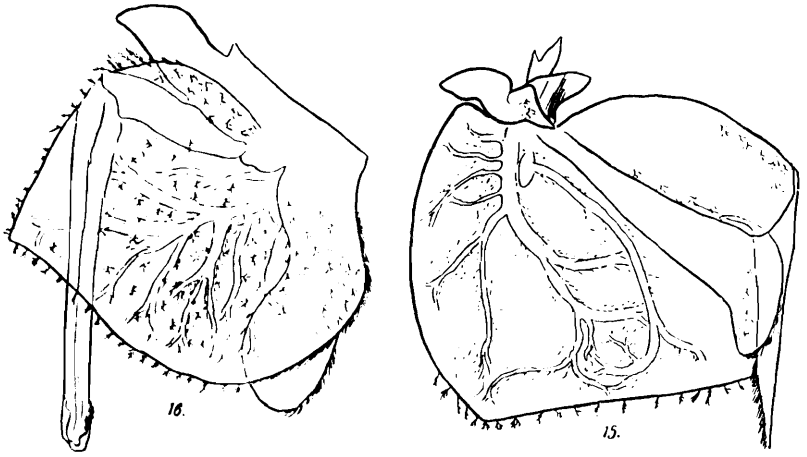
"When the head is inspected from above and somewhat from in front, and the antenna is bent downwards and turned in various directions, we find (fig. 10a) a transverse, movable piece of hard chitine (1) between the head and the major outer part of next joint (2); that transverse piece is the easily seen rudiment of first joint, and the remainder of the peduncle contains five joints. Furthermore a squama (*ex*) is observed on the outer side of third joint; this squama is somewhat broader than long, with its distal half subtriangular and freely protruding, while the proximal half has a semicircular outline and is anchylosed to the joint; it may be added that this suture between exopod and joint is very distinct, but in a very large specimen its median part is obscure."

In consequence of these statements I have re-examined the antennae of *L. exotica*, Roux and also of *L. oceanica*, Linné. I find little real difference between the two species in the points mentioned. In both there is the small movable piece of chitin between the head and the segment of the antenna which is usually looked upon as the first joint; this is very small and I am doubtful if the evidence that it is to be looked upon as a joint homologous to the succeeding one is convincing; neither do I feel sure about the squama on the third joint; the outer margin of this joint is slightly produced in the distal half in *L. exotica*, about as much as in *L. oceanica*, but as far as I can make out this portion is anchylosed to the rest of the segment, and I have previously looked upon it as a small projection forming a notch or groove into which the fourth joint is received when bent back upon the third, as described in the text above for the second joint.

forwards; its free margin is regularly rounded and fringed in the usual way with short, furry setae, mainly directed towards the median line.

The *left mandible* (fig. 6, p. 464) is large and strong, with a powerfully developed molar tubercle; the cutting-edge is coloured dark brown or almost black and consists of about 3 or 4 stout teeth; the secondary cutting-edge in the left mandible shows a structure similar to that of the outer cutting-edge and consists of 4 stout teeth. Between this and the molar tubercle lies the spine-row of about 15 plumose setae, those nearer the molar tubercle becoming progressively longer than the others; the molar tubercle which projects inwards somewhat obliquely from the body of the mandible is very broad and is thickly covered at its distal end with fine, short setae.

The *right mandible* (fig. 5, p. 464) is similar to the left, except that the inner cutting-edge is quite different in appearance from the outer cutting-edge, being much more



Ligia exotica, Roux.

FIG. 15.—First pleopod of male with male appendage, seen from the posterior side.
FIG. 16.—Second pleopod of male, seen from the anterior side.

delicate in structure and not coloured brown, and consisting of about 8 or 9 small and very acute teeth.

The *lower lip* (fig. 4, p. 463) shows the usual right and left lobes; they are irregularly rounded and thickly fringed with simple setae which also extend along the outer margin. On the posterior side there is a narrow median lobe projecting at right angles to the rest of the lip and in the natural position of the mouth-parts lying between the maxillae.

The *first maxilla* (fig. 7, p. 465) consists of the usual two lobes, the outer one being narrow oblong, about five times as long as broad; its outer margin is slightly convex and bears a fringe of fine setae throughout its whole length; the extremity is tipped with about 10 long spines, the outer ones being larger and darker than the inner, some of them being dark brown or almost black; the inner ones are finely serrate along the inner margin. In addition to these spines, there is a long, delicate, plumose seta, longer than any of the spines. The inner lobe is delicate and membranous, and on its outer margin it is produced into a thin flange, the more distal portions of which bear a thick fringe of setae; on the inner distal margin it bears three

large, plumose setae which increase in length proximally. In one specimen examined, a large male, there were 4 setae on the inner portion of the inner lobe of the left maxilla (see fig. 8, p. 465), while the right maxilla bore only the usual three plumose setae.

The presence of three plumose setae or bristles on the inner lobe of the first maxilla is so constant in the Ligiidae and Trichoniscidae, and the presence of only two is such a constant character of the Oniscidae and other families, that the presence of four on the one side of this specimen deserves more than a passing notice. Mr. Collinge's recent paper (1914) shows, however, that there is very considerable variation in the oral appendages of many of the terrestrial Isopoda.

The *second maxilla* (fig. 9, p. 465) is soft and membranous, broad and somewhat thick; its outer margin is sinuous and fringed with simple setae; there is a small outer lobe, much narrower and shorter than the inner lobe; the inner lobe is broadly rounded at the extremity, and has the whole of the distal margin thickly covered with short, curved setae, pointing inwards; on the surface of the inner lobe are many longer, simple setae. In *L. oceanica*, on the inner side of the second maxilla, there are two hairy bristles which are mentioned and figured by Sars (1898, p. 155), who includes them in the characters of the family Ligiidae. These bristles, which are also mentioned and figured by Hewitt (1907, p. 9), are certainly present in the specimens of *L. oceanica* that I have examined, but I can find no trace of them in *L. exotica*, and, as I pointed out in 1901 (p. 106), they are not present in *L. novae-zealandiae.*

The *maxillipeds* (fig. 10, p. 466) close in the mouth cavity behind and have the outer surface fairly smooth or even, while the inner margin is produced at right angles inwards, so as to lie between the bases of the maxillae and come nearly in contact with the median lobe of the lower lip. The epipod is of small size and is fairly well marked off from the rest of the maxilliped and is almost circular, with its margin fringed with fine setae; the palp is about half as long as the basal portion and is not clearly divided into separate joints; the inner lobe is stout and thick and closely fringed at its extremity with numerous short stout spines, the inner margin bearing numerous fine setae.

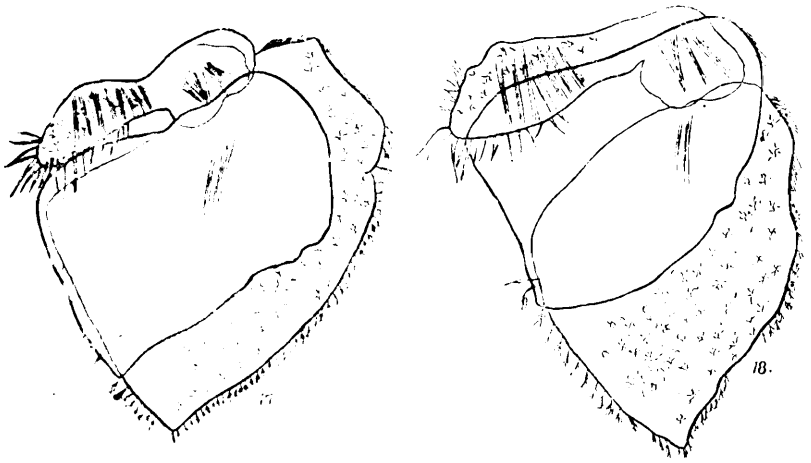
The legs show the usual characters, the anterior ones being somewhat shorter than the posterior, the seventh being the longest In the male the first three pairs are slightly modified and broadened, the propod and dactyl folding back upon the carpus, so as to form an imperfect subchelate appendage. The general shape and arrangement of the various joints can be readily seen from the figures.

In the male, in the first pair (fig. 11, p. 467) the merus and carpus are both somewhat widened and are of about equal length; the inner margin bears only a few rather small setae; the propod is not quite as long as the carpus, and is much more slender; at the extremity it is produced slightly beyond the base of the finger into the small oval lobe characteristic of the species. The dactylar seta is small, short, shorter than the terminal nail and is slightly thickened at the extremity, being on the whole very similar to the corresponding seta of *L. novae-zealandiae.* The second leg (fig. 12, p. 467) is slightly longer and stouter than the first and has the carpus longer and stouter than the merus; the propod is similar to that in the first, but is not produced into a

lobe at the end. The third leg is similar to the second. The remaining legs increase slightly in length up to the seventh (fig. 13, p. 468), and in all of them the merus and carpus are slender, not expanded, and of the usual form, the propod in each is considerably longer than the carpus.

In the female, the legs have the same general shape, but the anterior pairs show no broadening of the merus or carpus, and the propod of the first pair (fig. 14, p. 468) is unarmed. They have the same structure as that seen in the posterior legs of the male, except that in the anterior pairs in the female the propod is slightly shorter than the carpus.

The *pleopoda* on the whole resemble those of *L. oceanica* as described and figured by Professor Sars (1898) and myself (1899). In the first pleopod of the male (fig. 15, p. 469) the outer branch is very large, almost completely covering the inner branch and the male appendage; its inner margin is not produced so much as in *L. oceanica* and



Ligia exotica, Roux.

FIG. 17.—Third pleopod of male, seen from posterior side.
FIG. 18.—Fourth pleopod of male.

the outer angle is rather more rectangular. Its surface shows a branching structure, presumably of blood vessels. The endopod is short and is produced at the inner distal angle. The male appendage is slender, reaching slightly beyond the distal border of the exopod and narrows throughout its length to a rather acute point.

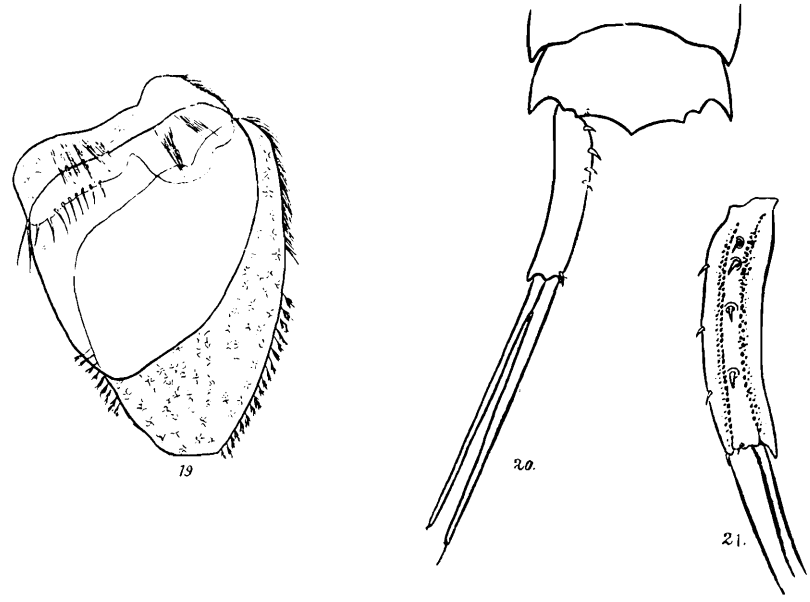
The second pleopod (fig. 16, p. 469) in the male has the exopod similar to that of the first, but with its inner distal angle rather more rectangular. The endopod is modified into a 2-jointed male organ, the first joint much the shorter and lying transversely, the second more than twice as long and extending considerably beyond the exopod; it is grooved throughout its length and ends with a slight irregular enlargement, portions of which are covered with thickly set, short setae, giving a roughened surface like that of a file.

The third, fourth and fifth pleopods (figs. 17, 18, 19) are similar to one another, but the third and fourth are slightly larger than the fifth; in all the exopod is much larger than the endopod and, as in the first and second, has its margins fringed with

fine plumose setae. The endopod is completely branchial in structure and has the margins free from setae. The shape and relative proportions of the different parts of these pleopods will be best learnt from the figures.

In the female the first and second pleopods are on the whole similar to the third, but with the endopods smaller. They are closely similar to those of *L. oceanica* and call for no special description.

The *uropods* (figs. 20 and 21) in the adult are nearly two-thirds the length of the body; the basal joint is nearly straight but with a slight curve outwards; it is triangular in section, the upper surface being flat and the under surface somewhat keeled, both the inner and lower margins bear 3 or 4 short setules in slight serrations, the last one being situated at the extremity, but the number and position of these



Ligia exotica, Roux.

FIG. 19.—Fifth pleopod of male.

FIG. 20.—Terminal segment with uropod, seen from above.

FIG. 21.—Under surface of peduncle of uropod from another specimen.

setules seem to vary considerably in different specimens; the outer margin is thin and bears no setules but is produced into an acute tooth at the distal end. The two branches are long, slender, tapering, subequal in length and considerably longer than the basal joint; the inner one bears at the extremity a long seta, about one-eighth of the length of the inner branch itself, but longer in proportion in very young specimens.

The length of the uropods varies to a considerable extent with the development of the animal, but in the Lake Chilka specimens does not appear to be ever very much greater than half the length of the body. These appendages are, however, so easily detached from the body that it is difficult to get many specimens for which precise measurements can be given. In some of the Honolulu specimens of the species the uropods are rather longer, being fully two-thirds the length of the body;

this is the proportion given by Miss Richardson who makes use of this character in her analytical key of the species of the genus.

The young taken from the incubatory pouch (fig. 22) of the female is 3 mm. long and 1·5 mm. broad. The eyes occupy the whole lateral side of the head and are larger in proportion to the body than in the adult. The seventh segment of the peraeon is short and only partially developed and bears no appendages. The first antennae are larger in proportion than in the adult and can be seen projecting slightly beyond the anterior margin of the head, while the second antennae are short, being less than half the length of the body. The uropoda are also less than half as long as the body, being only about one-third, and have the two branches equal in length, the inner one bearing a long seta at the extremity, nearly half as long as the inner branch itself. The posterior margin of the terminal segment is regularly rounded and not produced into a point in the middle as in the adult.

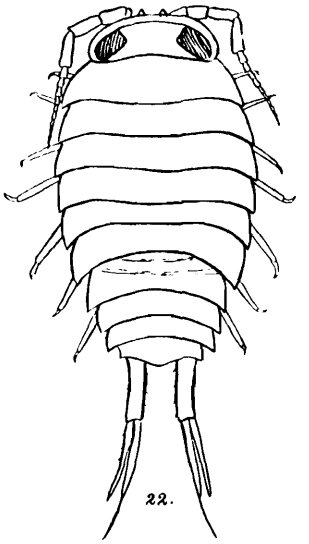


FIG. 22.—*Ligia exotica*, dorsal view of young taken from incubatory pouch of female.

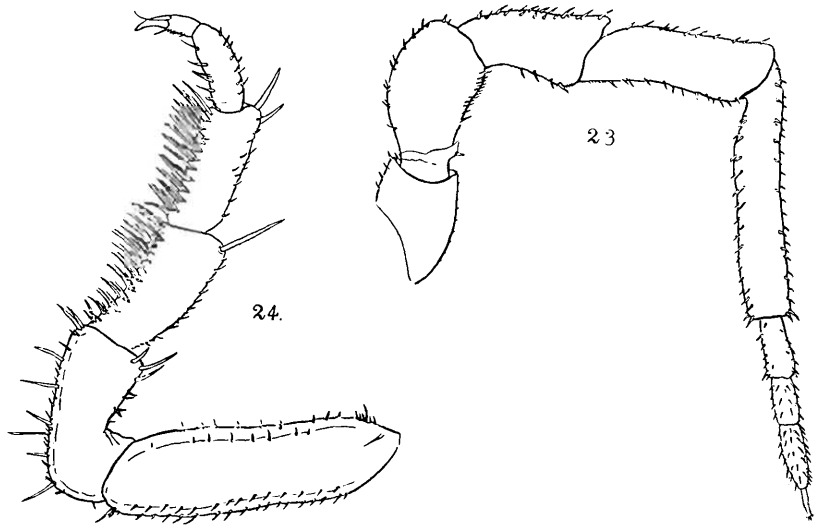
I have been able to compare the Lake Chilka specimens with specimens from Honolulu, Hawaiian Islands, sent to me some years ago by the late G. W. Kirkaldy. These Honolulu specimens agree in all the points given in the short specific diagnosis above with those from Lake Chilka, and must undoubtedly be referred to *L. exotica*, which had already been recorded from Honolulu by Miss Richardson (1905, p. 676); they differ, however, slightly in that the inner margins of the carpus and merus of the first, second and third legs of the male bear more numerous setae than in the Lake Chilka specimens. Some of the specimens also are slightly more slender and have the antennae a little shorter in proportion to the length of the body, though in others the uropoda are longer in proportion and more slender.

In some of these points the Honolulu specimens appear to approach *L. baudiniana*, Milne-Edwards, a species common on the eastern coasts of America as far south as Rio de Janeiro, and at the Bermudas, Bahamas, etc.; and it is possible that when full series of both species are examined, it may be difficult to find characters separating them in all cases. In *L. baudiniana*, however, the propod of the first leg in the male has no process at its distal end. This is present in some of my Honolulu specimens of *L. exotica*, though in some of the younger males it is small and hardly distinguishable. Probably, however, it is only developed to a full extent in fully mature males. In *L. baudiniana*, it seems to be replaced, as it were, in fully developed males by the distinctly marked row of setules on the inner margin of the carpus of the first leg.

In 1890 in his account of the terrestrial Isopoda collected by the 'Challenger,'

Dollfus referred specimens from the Bermuda Islands to *Ligia exotica*, Roux, but distinguished them as a variety *hirtitarsis*, owing to the series of bristles on the carpus of the anterior legs of the male. These specimens, however, would no doubt more properly be referred to *Ligia baudiniana*, with which Miss Richardson has united them.

Collectors' Note. "This species is found in boats and on the shore, where there are stones or rocks, all over the lake. On Barkuda I. it is enormously abundant. Though individuals may be found running on the shore at all times of the day and night, even on rocks heated by the midday sun, the species is most active in the morning and evening. It may then be seen in great droves, numbering sometimes hundreds of individuals, all of which move in the same direction. It is also found on tree-trunks at some little distance from water, but never in dense jungle. When a drove, in its peregrinations by the margin of the lake, comes to a pool of water



Alloniscus pigmentatus, Budde-Lund.

FIG. 23.—Second antenna. FIG. 24.—First leg of male.

the animals do not hesitate to swim across it, but otherwise they avoid water, whether fresh or brackish. In the heat of the day large numbers take shelter under the masses of dead weed that are thrown up on the beach and beneath large stones."

Alloniscus pigmentatus, Budde-Lund.

(Figs. 23 to 28).

Alloniscus pigmentatus, Budde-Lund, 1885, p. 227.
,, ,, Budde-Lund, 1908, p. 297, pl. xv, figs. 23-38.
,, ,, Budde-Lund, 1912, p. 385, pl. xxii, fig. 7.

Barkul Point, Lake Chilka Survey, Station No. 47. No. $\frac{5}{1}\frac{7}{0}\frac{9}{0}$. About 20 specimens.[1]

[1] I have no information as to the circumstances under which these specimens were collected, but in the tube in which they were sent were several small specimens of an *Aega* or allied genus very similar in colour, size and general appearance to the *Alloniscus pigmentatus*.

Although I have not been able to consult Budde-Lund's paper published in 1908 in which he gives figures of this species, I feel little doubt that the Lake Chilka specimens belong to it. According to Budde-Lund, the species is very common in Madagascar, and is also found in many localities in the East Indies.

In general appearance, the specimens agree well with the short description given by Budde-Lund in 1885. In most respects too, it evidently comes very near to Dollfus's *Anomaloniscus ovatus*, a species which Budde-Lund considers to be identical with *Alloniscus pallidulus*, Budde-Lund. In establishing his genus, Dollfus called attention to the fact that in the second, third and fourth segments of the body, *in the female*, the side-plates were separated from the central portion of the segments by a well-marked suture which was not observable in the males. In the Lake Chilka specimens, even in females, there is no definite suture, only a somewhat indistinct line on the second and third segments. The lateral processes of the head appear much smaller and narrower than those represented by Dollfus for his species, and

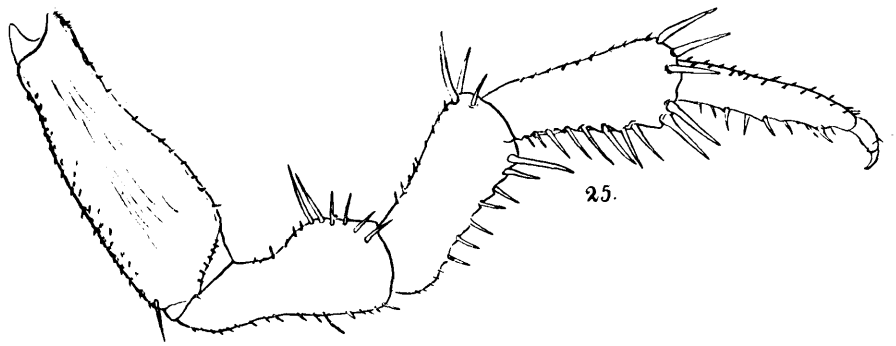


FIG. 25.—*Alloniscus pigmentatus*, seventh leg of male.

for these two reasons I refer the specimens to *A. pigmentatus* rather than to *A. pallidulus*, although the two species seem pretty closely allied.

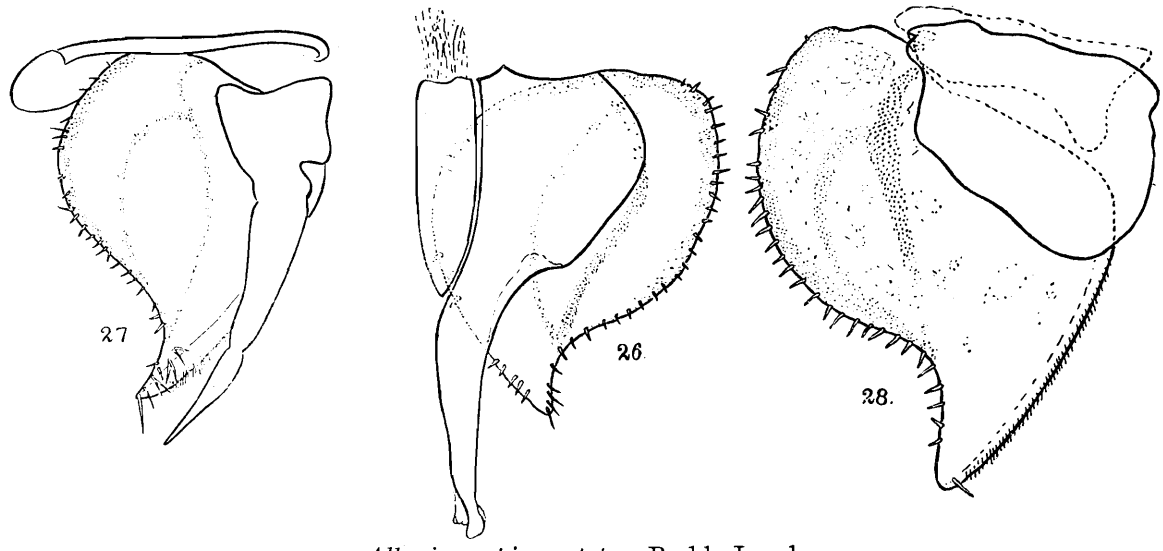
Under the circumstances it is not necessary to give a full description of the Lake Chilka specimens, but as I have been able to examine male specimens, I give figures of the parts of the male that differ from the female and of some of the other appendages.

The second antennae which are the same in both sexes are shown in figure 23; the flagellum is rather shorter than the fifth joint of the peduncle, and has the three joints subequal. In the mouth-parts, the first maxilla corresponds closely with the figure given by Budde-Lund for this species in 1912 (pl. xxii, fig. 7), although I am not clear what he means by saying that the exterior lobe "bears a little appendix not before observed." The exterior lobe appears to present the usual characters, and several of the inner spines of those at its extremity bear a small tooth near the apex, as shown in Budde-Lund's figure; this, however, is a character probably common to other species of the group.

The first thoracic leg in the male (fig. 24) is somewhat long and slender and has the merus and carpus subequal and considerably longer than the propod; both merus

and carpus have the inner margins thickly fringed with tufts or short transverse rows of spinules, as in the case of many other species. The second and third pairs are similar to the first and have the inner margin of the merus and carpus almost or quite as thickly fringed with spinules. The remaining legs increase slightly in length posteriorly, the seventh (fig. 25) being the longest; in all of them there are several large spinules at the outer distal angle of the ischium, merus and carpus, and others on the inner margins especially of the merus and carpus, but these are comparatively few, and well separated, instead of being densely crowded together as in the first three pairs of legs.

In the female the thoracic legs bear only a small number of setae on the various joints as described for the seventh leg of the male. In the first pair the basal joint



Alloniscus pigmentatus, Budde-Lund.

FIG. 26.—First pleopod of male.
FIG. 27.—Second pleopod of male.
FIG. 28.—Third pleopod of male.

is rather long, narrowed at its base, and on the outer side shows clearly the flattened surface or groove which is present on all the legs of this and of many other species.

In the first pleopod of the male (fig. 26) the exopod is large, subtriangular, with its outer margin at first convex and then concave near the subacute apex. The whole of this outer margin and a portion of the inner margin near the apex are fringed with a regular row of rather stout spinules, and the exopod appears to be thickened along this margin and also along two other lines nearer the centre as shown in the figure; this thickening also extends along the basal portion of the inner margin. The endopod is enlarged at the base, having its outer margin very convex, and then narrows somewhat abruptly and curves inwards, gradually narrowing towards the irregularly-shaped extremity; it is strongly chitinised throughout. The male organ proper is single, about half as long as the exopod and narrows regularly with

slightly convex sides to the subacute apex. The second pleopod of the male (fig. 27) has the exopod similar to that of the first, but with the apex rather more acute and with a fringe of fine setae on the inner margin near the apex in addition to the spinules; the endopod has a fairly broad base and narrows abruptly at about one-fourth its length from the base, and then tapers gradually to the very acute point with a constriction about one-third its length from the extremity, which reaches slightly beyond the apex of the exopod.

In the 3rd, 4th and 5th pleopods (fig. 28), the exopods are similar in general appearance to those of the 1st and 2nd, and the endopods show the usual branchial structure and have the margins free from setae.

In none of the exopods is there a special respiratory tree-like structure or "trachea," but probably there are special modifications which enable them to act as organs for breathing dry atmospheric air as is the case in *Oniscus* (see Stoller, 1899, p. 24).

The terminal segment and the uropods agree with the description given by Budde-Lund and are on the whole similar to the figure given by Dollfus for his ***Anomaloniscus ovatus***.

Hemiporcellio carinatus, Collinge.

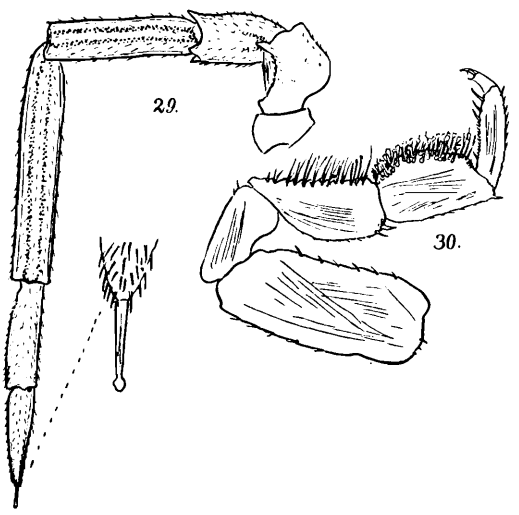
(Figs. 29 to 32).

Hemiporcellio carinatus, Collinge, 1915, p. 145, pl. vi, figs. 1-10.

Barkuda Island, Lake Chilka Survey, Station 26. No. $\frac{8}{10}$. Two specimens.

I have no hesitation in referring these two specimens to the above species, the type of which was collected at Rambha under stones, etc., at the edge of Lake Chilka.

The species is placed by Collinge in the new genus *Hemiporcellio*, which includes a closely allied species *H. hispidus*, Collinge, also from Lake Chilka district, and *H. immsi* (Collinge) from Allahabad. As yet, however, no diagnosis of the genus as distinct from the species has been given.



Hemiporcellio carinatus, Collinge.

FIG. 29.—Second antenna.

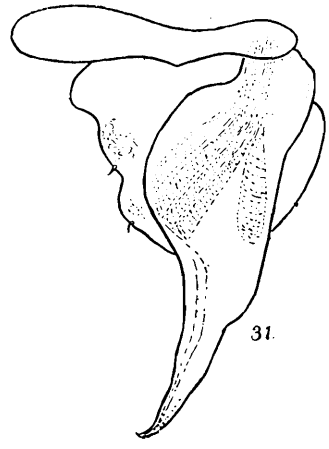
FIG. 30.—First leg of male.

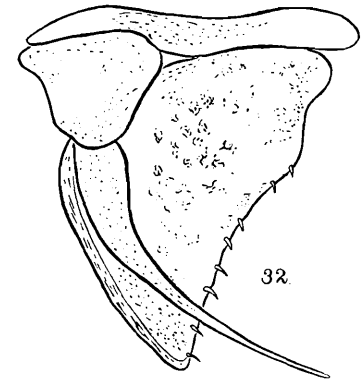
The two specimens now under consideration agree well with the description and figures given by Collinge. One that I have partially dissected proves to be a male, and I am therefore able to give the sexual characters.

The legs are all nearly of the same length, the seventh pair being only slightly longer than the first. In the first (fig. 30) the carpus is slightly expanded and bears on the inner margin a very dense covering of setae, most of which are slightly

thickened and irregularly dentate at the end, ending in 2 or 3 points; the inner margin of the merus is also thickly covered with setae, but most of these are more normal in appearance, ending acutely; the propod bears only a few setae of normal structure. The second leg is similar to the first, but more slender and the setae on the carpus are fewer and end more acutely in the usual way, while in the third leg there is still less modification, the joints bearing only a few more than the ordinary normal supply of setae. It is probable that the male of *H. hispidus* has similar characters, for Collinge states that "the three terminal joints are fringed with stout spines with trifid terminations," though he does not say whether this is common to all the legs or not.

The first and second pleopoda of the male of *H. carinatus* show characters on the whole similar to those found in other species of *Porcellio*. In the first pleopod (fig. 31) the endopod is nearly twice as long as the exopod, its basal half is broadened,





Hemiporcellio carinatus, Collinge.

FIG. 31.—First pleopod of male. FIG. 32.—Second pleopod of male.

while the distal half narrows to an acute point, the broadened basal portion being filled with an extremely powerful muscle. The second pleopod (fig. 32) has the exopod somewhat more triangular and longer than in the first, its outer margin bears a number of short spinules; the endopod consists of a broad basal joint, subtriangular in shape, followed by a second joint curving outwards to a very acute point and reaching considerably beyond the end of the exopod.

In the antenna the 3rd, 4th and 5th joints of the peduncle are carinated as described by Collinge, and the 2nd, 3rd and 4th have indentations at the end with tooth-like processes between them, as shown in fig. 29. These are apparently similar to those in *H. immsi*, the figure and description of which I had not specially noted until after my figure had been drawn. The 4th joint has a distinct groove on the outer side into which the 5th joint fits when bent back in the usual position. The small process at the end of the terminal joint of the flagellum ends in a slight enlargement.

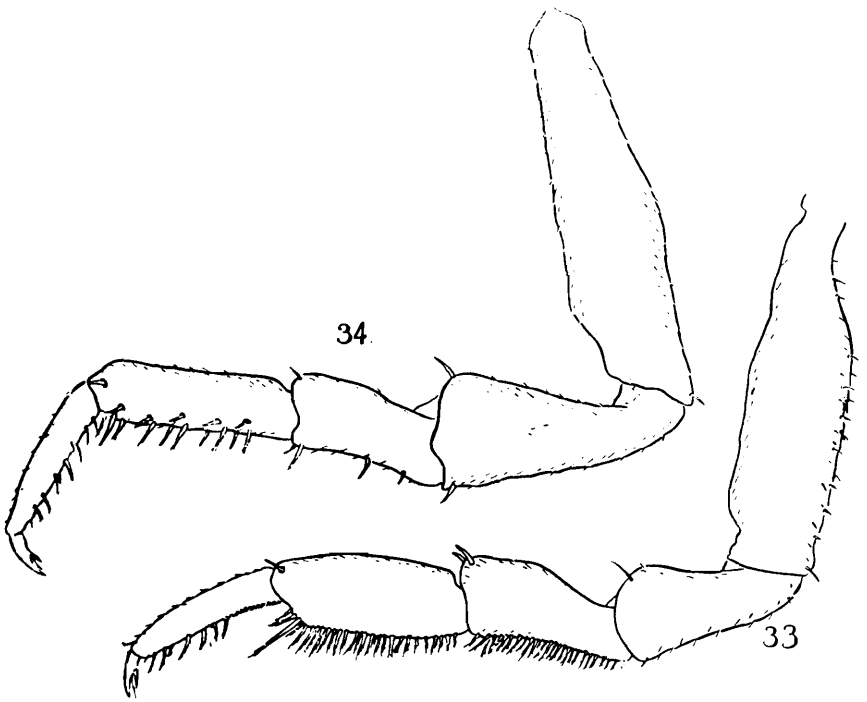
Cubaris granulatus, Collinge.

(Figs. 33 to 36).

Cubaris granulatus, Collinge, 1915, p. 151, pl. xii, figs. 1-11.

Patsahanipur Hill, off Balugaon, Lake Chilka, Orissa, 26-i-14 (*F. H. G.*). Two specimens. No. $\frac{8803}{10}$.

I have little doubt that these two specimens belong to this species, the type specimens of which were collected at Rambha, Lake Chilka. They agree generally with the description and figures given by Mr. Collinge. The surface is nearly smooth, being very finely granular, and the irregular rugosities on the head are not very distinct. The colour (in spirit) is a light olive brown, with the usual lighter markings near the median line.



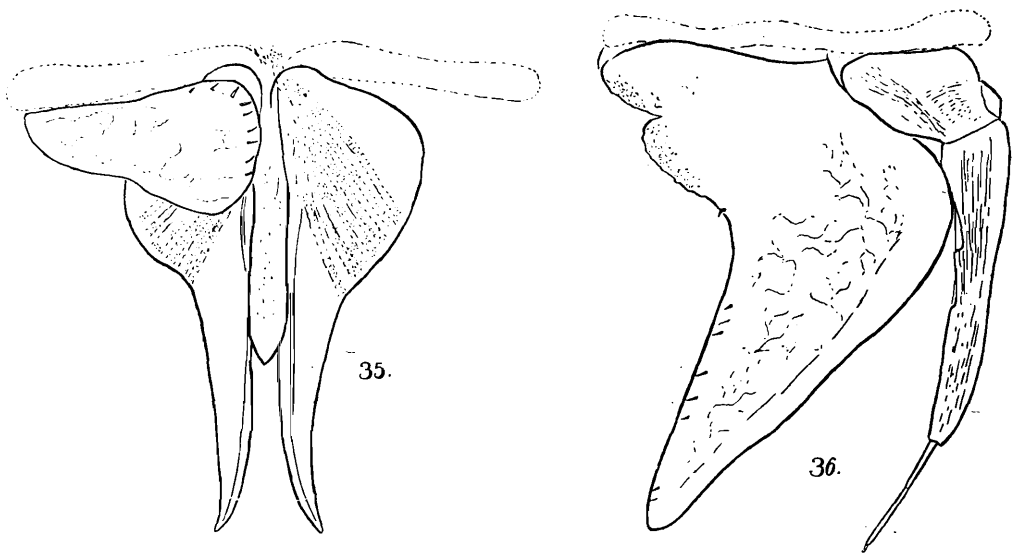
Cubaris granulatus, Collinge.

FIG. 33.—First leg of male. FIG. 34.—Seventh leg of male.

The dense mass of setae on the third and fourth joints of the thoracic appendages described by Mr. Collinge are found only in the male, and on the anterior legs. One of my specimens is a male and shows these setae well developed on the merus and carpus of the first leg (fig. 33), nearly all of the setae being bifid or trifid at the extremities. In the second leg there are similar groups of setae on the two corresponding joints, but they are not quite so numerous as in the first leg, while in the third they are still less numerous and are hardly more noticeable than the ordinary setae on the succeeding pairs of legs, as shown in fig. 34, which represents the seventh leg.

The other specimen is a female and shows only the ordinary number of setae, even on the anterior pairs of legs.

The first and second pleopods of the male are shown in figures 35 and 36, and on the whole correspond with those found in allied genera. In the first pleopod (fig. 35) the exopod is quite small, while the endopod is developed into a very large, strongly chitinised and powerful appendage, swollen at the base, which is occupied by a large muscle, and ending distally in an acute point curving slightly outwards; the male organ proper is only about half as long as the endopod, has the sides nearly parallel and ends in a subacute point. In the second pleopod (fig. 36) the exopod is much larger, being as long as the modified endopod, and tapers to a long triangular process distally; it is lobed on the outer margin near the base at the position of the air cavity, the lobes apparently having a roughened surface; there are a few, very small, setae along the distal portion of the outer margin. The endopod has the shape shown in figure 36, its terminal portion being very narrow.



Cubaris granulatus, Collinge.

FIG. 35.—First pleopod of male. FIG. 36.—Second pleopod of male.

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