FAUNA OF THE CHILKA LAKE.

SOME TERRESTRIAL ISOPODA FROM THE SHORE OF THE LAKE.

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(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.

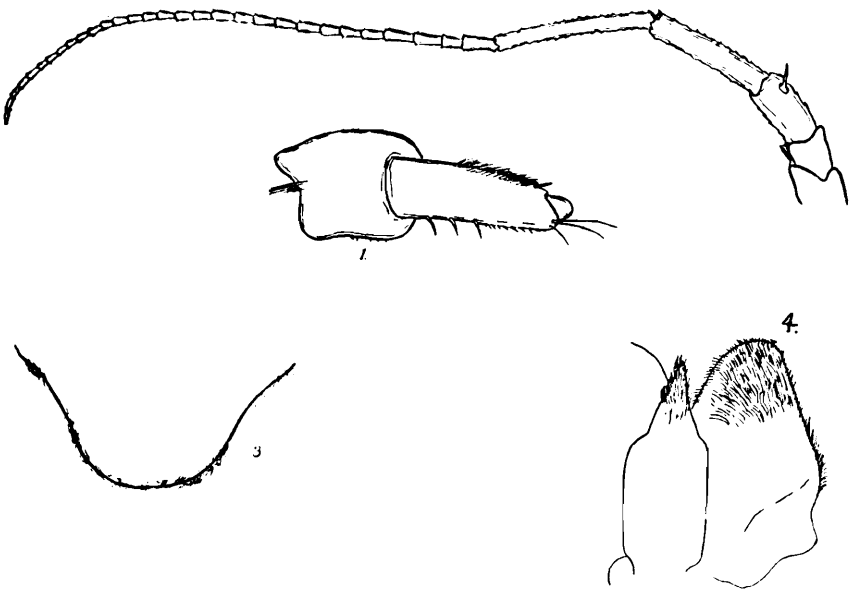
Specimens were obtained from the following localities :—

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.

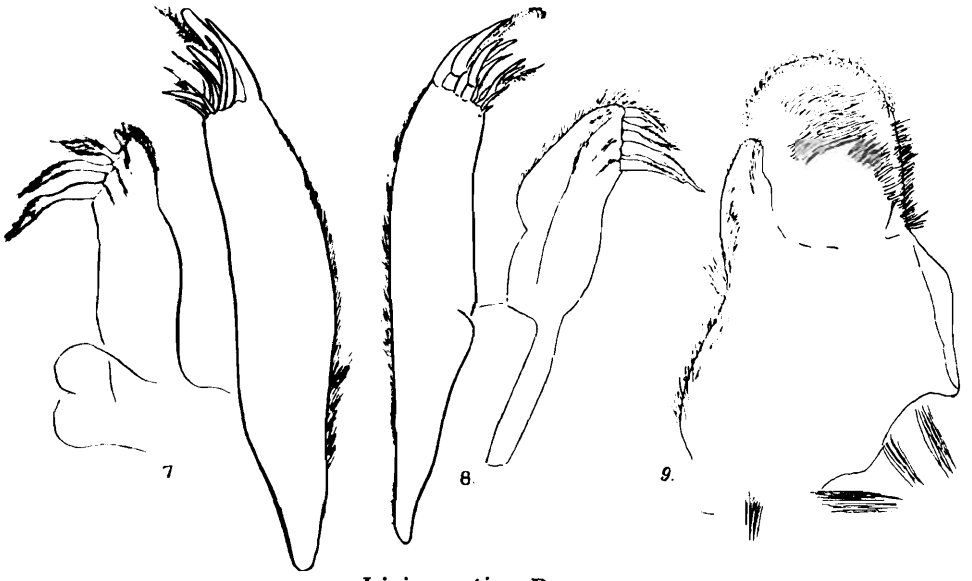
propod of the first pair of legs unarmed, and in having the merus and carpus furnished with a row of stiff hairs or bristles. The two species certainly seem to have many points in common, and, as I afterwards state, it may be difficult to find characters that will distinguish between them in all cases. *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*.

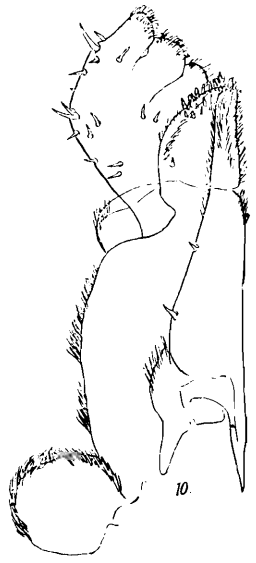
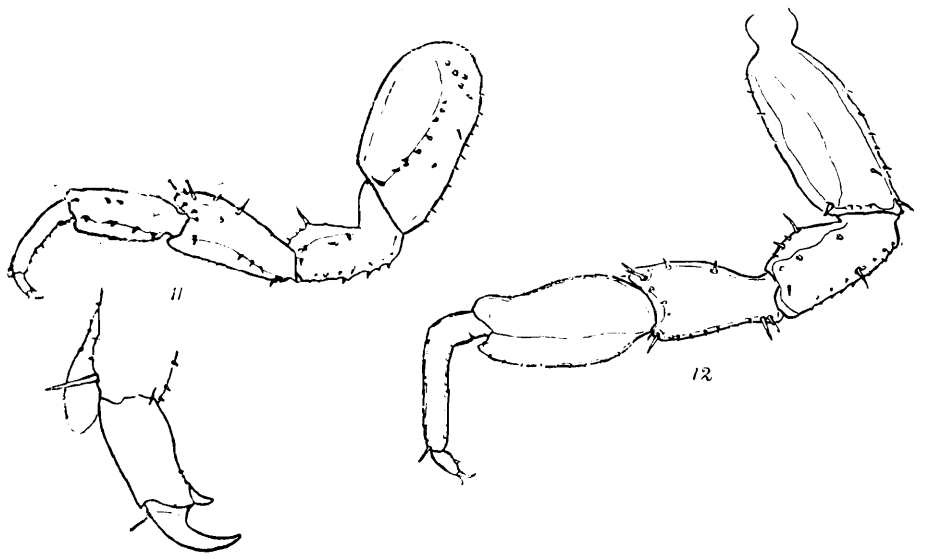


FIG. 10.—*Ligia exotica*, maxilliped, seen from inner or anterior side.

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.

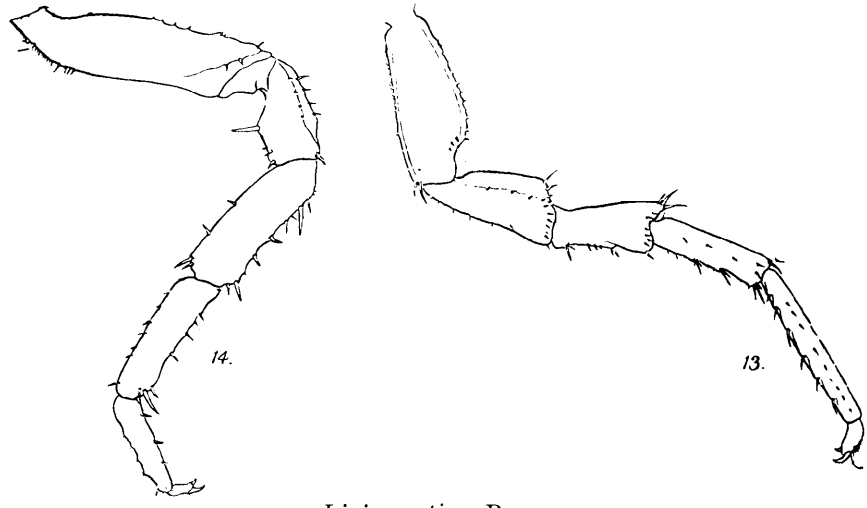
FIG. 11.—First leg of male, with terminal portion more highly magnified.
FIG. 12.—Second leg of male.

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:

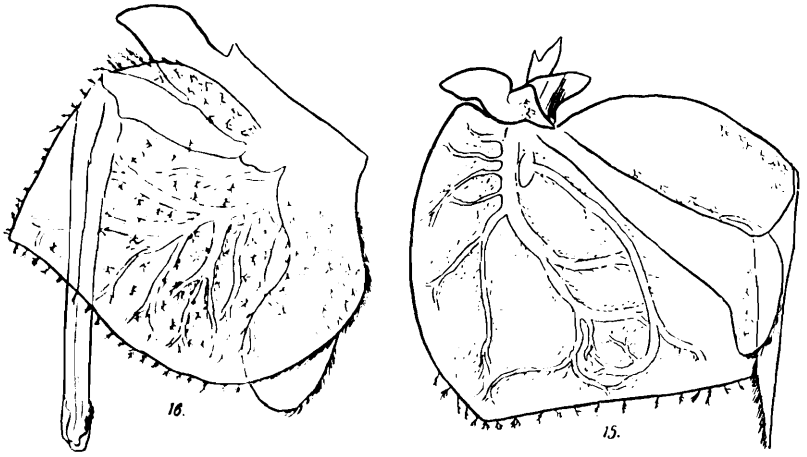
"When the head is inspected from above and somewhat from in front, and the antenna is bent downwards and turned in various directions, we find (fig. 10a) a transverse, movable piece of hard chitine (1) between the head and the major outer part of next joint (2); that transverse piece is the easily seen 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.

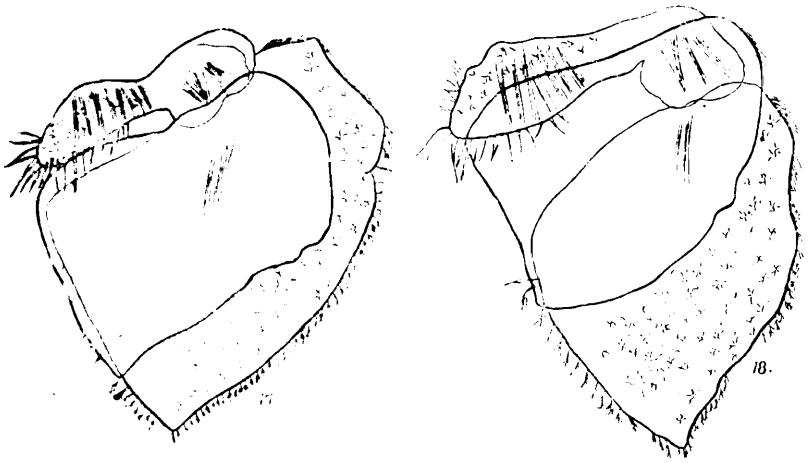
The legs show the usual characters, the anterior ones being somewhat shorter than the posterior, the seventh being the longest In the male the first three pairs are slightly modified and broadened, the propod and dactyl folding back upon the carpus, so as to form an imperfect subchelate appendage. The 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.

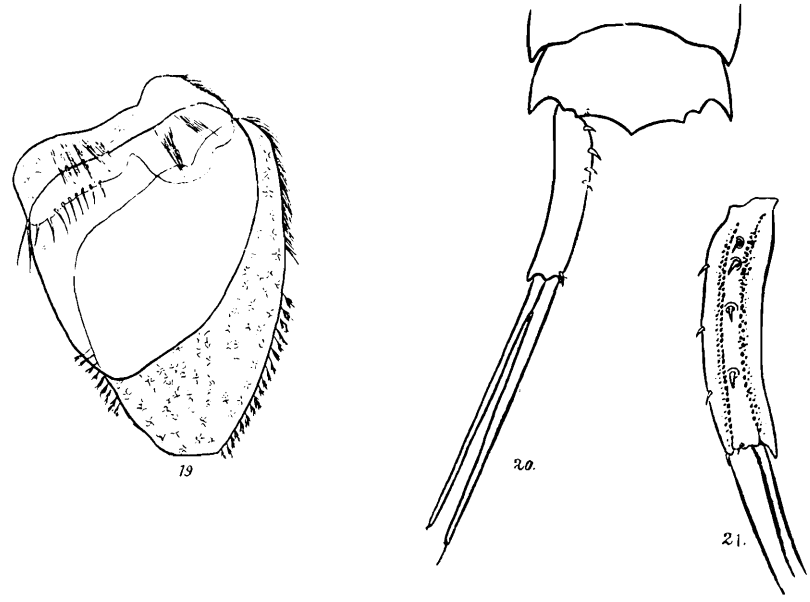
The second pleopod (fig. 16, p. 469) in the male has the exopod similar to that of the first, but with its inner distal angle rather more rectangular. The endopod is modified into a 2-jointed male organ, the first joint much the shorter and lying transversely, the second more than twice as long and extending 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.

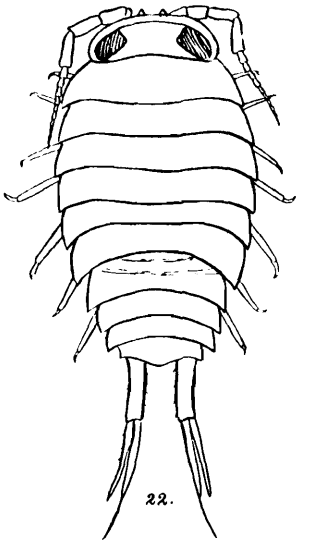


FIG. 22.—*Ligia exotica*, dorsal view of young taken from incubatory pouch of female.

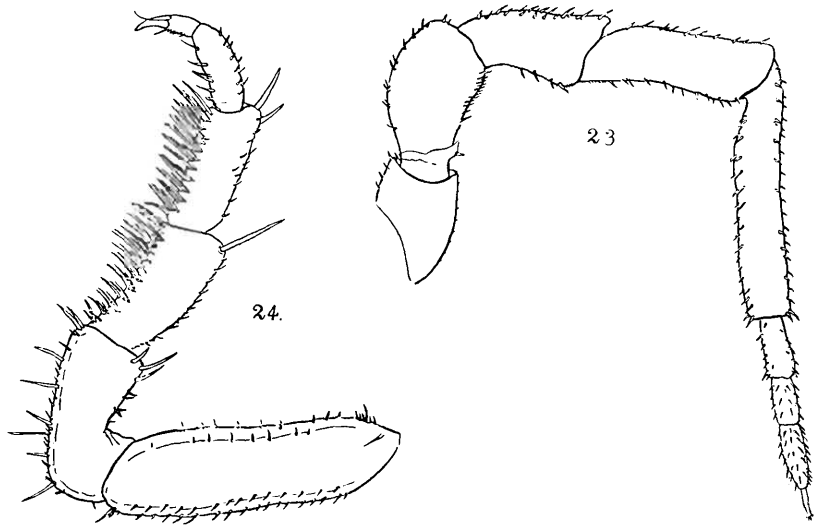
I have been able to compare the Lake Chilka specimens with specimens from Honolulu, Hawaiian Islands, sent to me some years ago by the late G. W. Kirkaldy. These Honolulu specimens agree in all the points given in the short specific diagnosis above with those from Lake Chilka, and must undoubtedly be 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

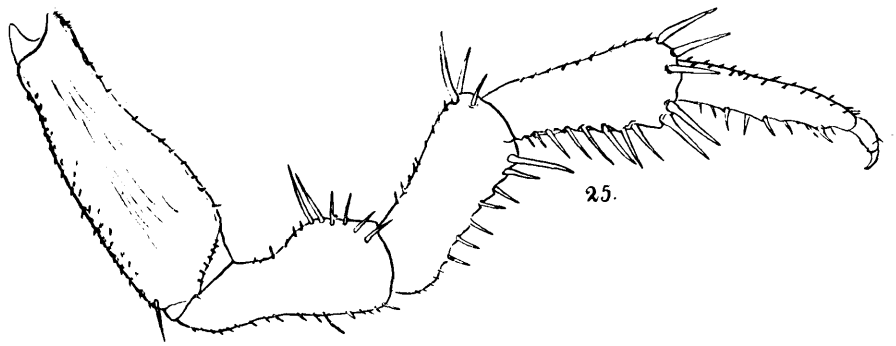


FIG. 25.—*Alloniscus pigmentatus*, seventh leg of male.

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

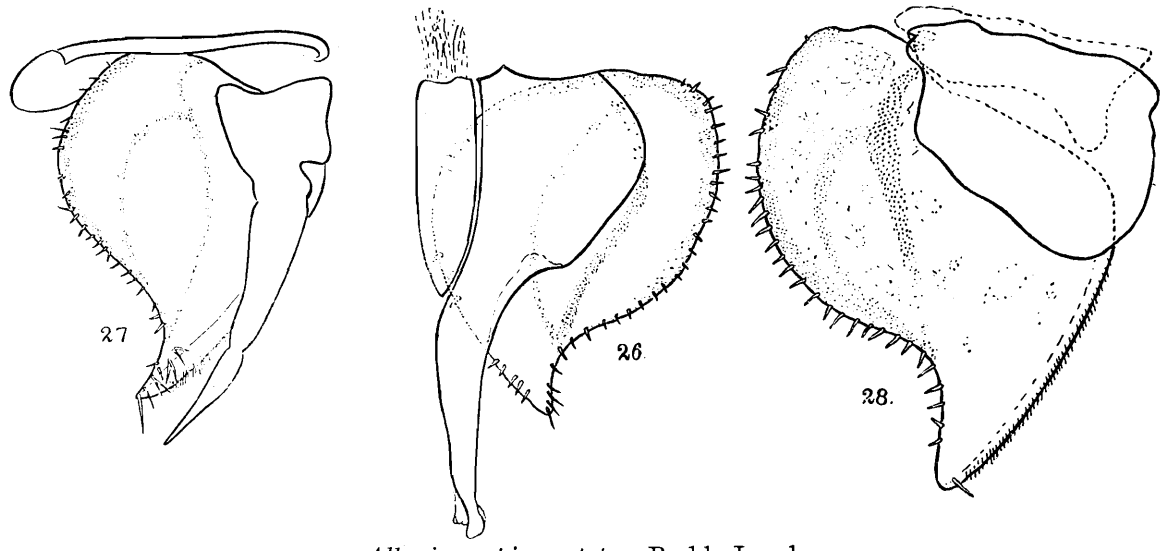
Under the circumstances it is not necessary to give a full description of the Lake Chilka specimens, but as I have been able to examine male specimens, I give figures of the parts of the male that differ from the female and of some of the other appendages.

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.

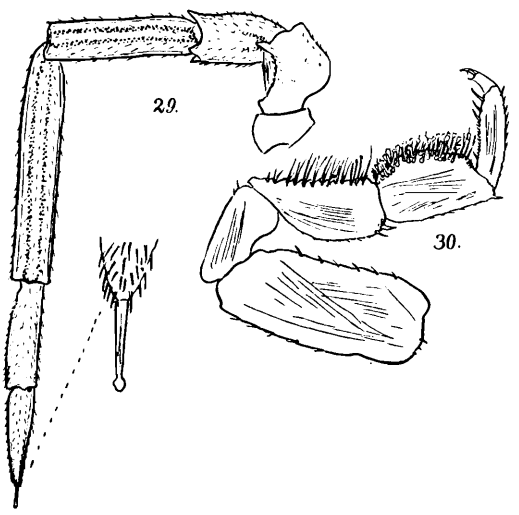
(Figs. 29 to 32).

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.

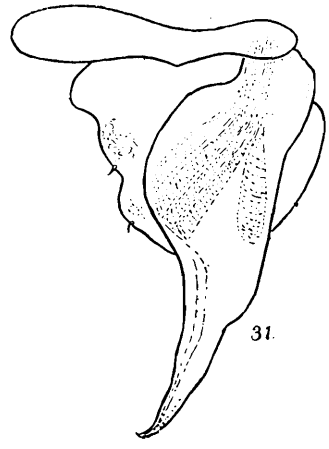
FIG. 30.—First leg of male.

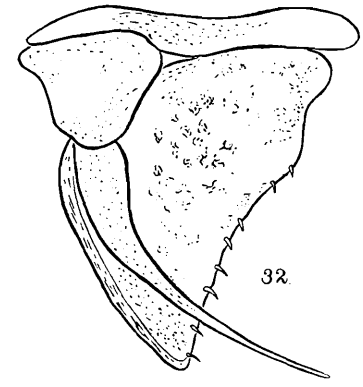
The two specimens now under consideration agree well with the description and figures given by Collinge. One that I have partially dissected proves to be a male, and I am therefore able to give the sexual characters.

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.

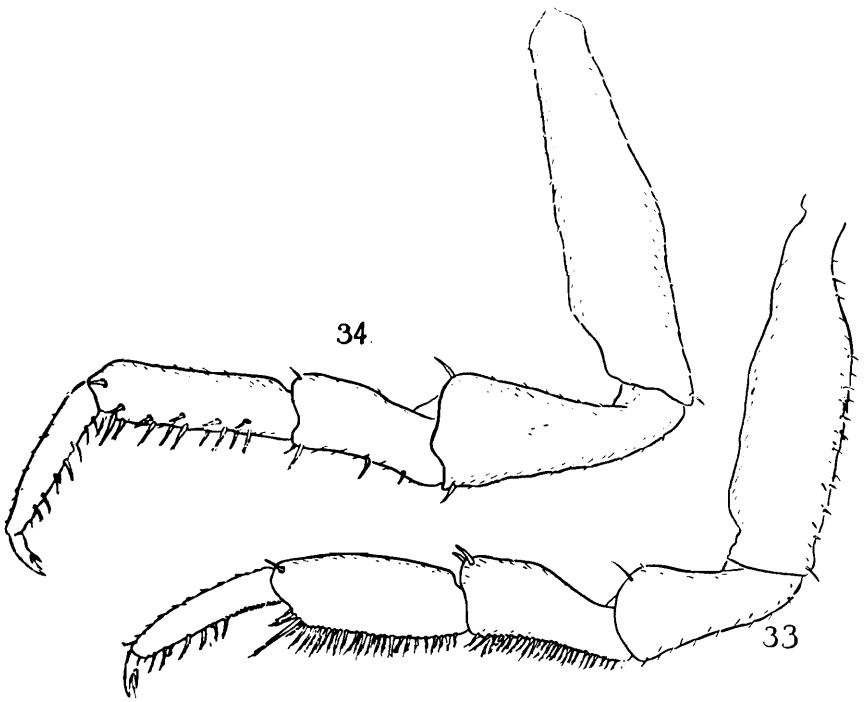
Cubaris granulatus, Collinge.

(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.



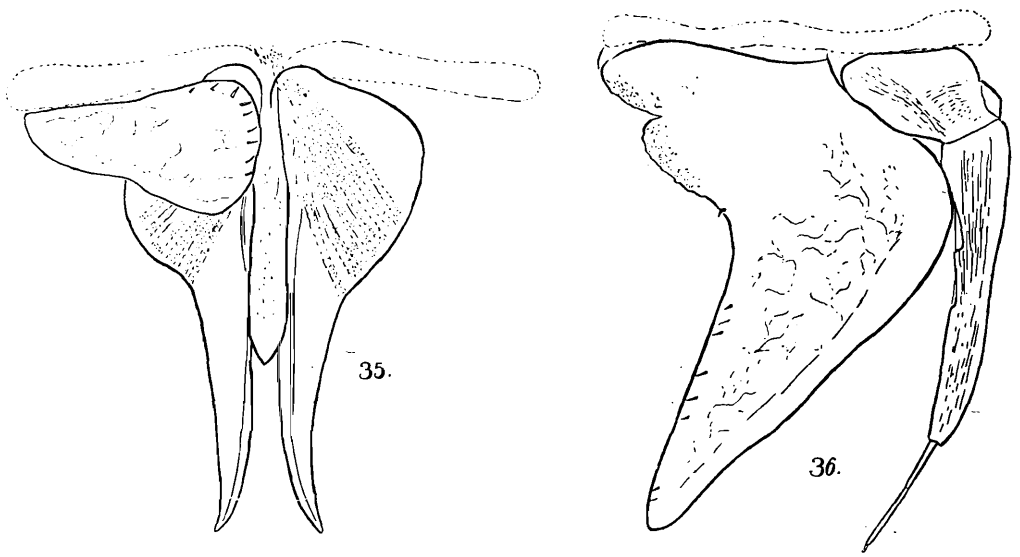
Cubaris granulatus, Collinge.

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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