

FAUNA OF THE CHILKA LAKE
AQUATIC INSECTS, OTHER THAN COLEOPTERA, WITH NOTES
ON SOME MARGINAL SPECIES.

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ODONATA *by* F. F. LAIDLAW, *F.Z.S.*

(Plate XI.)

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AQUATIC AND MARGINAL INSECTS.

By N. ANNANDALE and STANLEY KEMP.

In the case of the insects it is particularly difficult to draw a line between aquatic and terrestrial species. Strictly speaking, indeed, all those that occur in water or on its surface should be called amphibious rather than either aquatic or terrestrial, for all insects, at any rate in adult life, are air-breathing animals. Moreover, though many species and larger groups are specialized for peculiar modes of life, the class as a whole is remarkably tolerant and not easily deterred from occupying all situations available. In considering the fauna of any body of water, the doubtful status of a number of insects that can hardly be rejected as terrestrial animals or claimed as true aquatic species must, therefore, be decided—the status, that is to say, of forms that frequent the damp margins, concealing themselves under stones and jetsam, burrowing in sand or mud, or crawling on damp rocks. Some of these species are essentially moisture-loving terrestrial forms, found also in other situations, while a few occur only at the edges of rivers, lakes, ponds or lagoons.

In discussing the insect fauna of the Chilka Lake we have found it convenient for this reason to devote a section of our paper to “ marginal ” species, in addition to annotating the insects that may legitimately be called aquatic. We are indebted to Mr. F. F. Laidlaw for an account of the only dragon-fly that breeds habitually¹ in the lake.

I. AQUATIC INSECTS.

Apart from Coleoptera,² which we are unable to consider at present, the aquatic insects of the Chilka Lake include at least twenty species, the majority of which (15 species) belong to the order Rhynchota. Only a very small minority of these insects can be regarded as anything but casual visitors. Except for a moth, a dragon-fly and three Diptera, the only species that we know to complete its metamorphosis in the lake is the Hydrometrid bug *Euratas formidabilis*, and it is quite clear that all the former deposit their eggs indifferently either on the surface of the lake or on any other body of water they may chance to encounter in their flight.

There are thus only six forms that we know to breed in the Chilka Lake ; particulars of these species are given in the following table :—

¹ We found cast nymphal skins of two other species, an Aeschnid, probably *Anax guttatus* (Burm.), and a Libellulid, adhering to rocks at the edge of the lake, but the species of these families that are often seen flying over its surface usually breed elsewhere.

² About six species of Dytiscidae, ten of Hydrophilidae and one of Gyriinidae are found in the lake.

	Breeds in water of sp. gr.	General distribution.
Odonata .. <i>Pseudagrion microcephalum</i>	1'001—1'008	India and Malaysia.
Rhynchota .. <i>Euratas formidabilis</i> ..	1'000—1'0265	Bay of Bengal.
Diptera <i>Eristalis arvorum</i>	1'0035—1'007	Oriental region.
<i>Palpomyia</i> sp	1'008	Tropical and subtropical countries.
<i>Anopheles rossii</i>	1'000—1'015	
Lepidoptera .. <i>Nymphula diminutalis</i>	1 008	Northern India to Celebes.

Unlike the other groups of animals with which we have to deal in this volume, the insects are for the most part immigrants from fresh water and drift or fly into or on to the lake from the neighbouring ponds or rice-fields. *Euratas formidabilis* is possibly the only exception, belonging to a marine group and having been taken at sea in the neighbourhood of land.

A phenomenon that exercises considerable influence on immigration in the case of both surface-living and sub-aquatic species is the periodic growth and decay of a weed of the genus *Potamogeton* that forms dense submerged thickets during the dry season in certain sheltered bays of the main area of the lake, dying down almost completely in the "rains." The dry season is also the season at which the water of the lake has the highest specific gravity, that is to say, is saltest; but increase of salinity seems to be of less importance than the existence of adequate shelter. The only situation in which we found insect life at all vigorous was in thickets of this weed, in water of specific gravity varying from 1'001 to 1'008. Both submerged and surface forms were abundant in or over the weed, the latter including *Hebrus bengalensis*, *Mesovelia mulsanti*, *Hydrometra vittata* and several species of *Gerris* among the Rhynchota, the former *Micronecta proba*, and *Sphaerodema rusticum* of the same order, as well as a number of small beetles of the families Dytiscidae and Hydrophilidae, the larvae and pupae of the flies *Anopheles rossii* and *Palpomyia* sp., of the moth *Nymphula diminutalis* and of the dragon-fly *Pseudagrion microcephalum*.

The great majority of the aquatic insects of the lake are species of very wide distribution in the Oriental region, if they do not even extend beyond its borders.

Order ODONATA.

By F. F. LAIDLAW.

Family Agrionidae.

Pseudagrion microcephalum (Ramb.).

1890. *Pseudagrion microcephalum*, Kirby, *Cat. Odonata*, p. 153.
 1900. " " Ris, *Arch. Naturgesch.*, p. 198.
 1902. " " Laidlaw, *Proc. Zool. Soc. London*, p. 388.
 1904. " " Martin, *Mission Pavie*, p. 18 (sep)

Adult specimens have been examined from off Balugaon and Barkul on the Chilka Lake; the majority were taken in March, but I understand that the species is common at all times of the year. Others are from Balighai on the Sar Lake in the Puri district of Orissa and from Calcutta. Larvae and larval exuviae were sent both from the Chilka Lake and from the Museum tank, Calcutta, in several cases with adults which had been reared in an aquarium.

The species is evidently very abundant in Bengal and Orissa. I believe it to be the true *P. microcephalum* of Rambur. To facilitate identification I have figured the terminal part of the abdomen of the male, as seen from above, and also the colour pattern of the dorsum of the second abdominal segment of the same sex (text-figs. 1A, B).

The superior anal appendages of the male are about equal in length to the tenth segment, whereas in the closely allied *P. australasiae* the corresponding appendages are not more than one-half the length of the segment, and differ in shape.

The colouring of young males of *P. microcephalum* is identical with that of the females.

Larva.—Very similar in general to that of European *Erythromma najas* (Hausmann). Body slender, of a pale sandy gray colour.

Total length at time of emergence about 22 mm., of this the caudal lamellae take up about 8 mm.

Head pentagonal, antennae 7-jointed. Mask long (text-fig. 1C), its anterior border gently rounded, extending when folded beyond the insertion of the second pair of legs. Its outer margin carries a few small spines, and there is a single large seta on either side of the body. The palpi bear four stout setae directed inwards and the movable hooks are long and overlap (text-fig. 1C).

The caudal lamellae have nearly parallel sides and are bluntly rounded at their apices. Each is divided into two parts at about its middle by a transverse fold or joint. Of these two parts the proximal has its margins spiny and there is a distinct notch on the lower margin (of the lateral lamellae) between the proximal and distal parts. The last spine on either margin before the transverse fold is the largest of the series. The apical part has its margins smooth.

There are two main tracheal trunks in each lamella. These cross and recross one another; their branches are arborescent near the margins and are marked with a dark brown colour giving the lamella a mottled appearance.

The larvae from Lake Chilka were collected in water which was distinctly brackish, the specific gravity (corrected) of the water being 1.008. I believe no Agrionid larva has been recorded from brackish or salt water. Amongst the Libellulinae

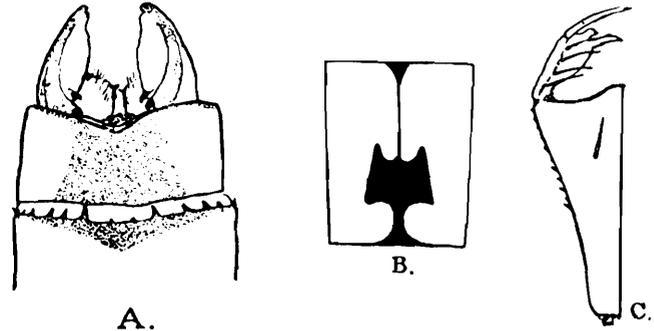


FIG. 1.—*Pseudagrion microcephalum* (Ramb.).

- A. Apex of abdomen of male, from above.
 B. Pattern on dorsum of 2nd abdominal segment of male.
 C. "Mask" of larva.

Dr. Ris suspects that the larval forms of the two species of *Macrodiplax* may inhabit salt water (Muttkowski, *Bull. Publ. Mus. Milwaukee*, I, p. 183 note). I can detect no differences between the examples from Lake Chilka and those from Calcutta which were taken in pure fresh water.

In addition to *Pseudagrion microcephalum*, I have received specimens of the following species collected by Dr. Annandale and Mr. Kemp in the neighbourhood of the lake.

AGRIONINAE.

Ceriagrion coromandelianum (Fabr.): Barkuda Id., 2 ♂♂, 1 ♀

“Abdomen gamboge yellow, brownish at tip. Legs and face paler; dorsal surface, side of thorax and head, including eyes, emerald green. Ventral surface of thorax whitish.”

Ischnura senegalensis, Ramb.: common; probably breeds in the lake.

LIBELLULINAE.

Potamarcha obscura (Ramb.): Satpara, 16-ix-13, 1 ♀; Barkuda Id., 17-vii-14, 1 ♂

Brachydiplax sobrina (Ramb.): Barkuda Id., 17-vii-14, 2 ♂♂

Diplacodes trivialis (Ramb.): Barkuda Id., 17-vii-14, 3 ♂♂; Cherria Id., 1 ♀; Patsahanipur, i-14, 1 ♂, 1 ♀

Crocothemis servilia (Drury): Barkuda Id., 17-vii-14, 1 ♂, 1 ♀ The male has a deformed wing, with abnormal venation; I hope subsequently to figure the specimen.

Pantala flavescens (Fabr.): Barkuda Id., 18-19-vii-14, 2 ♂♂, 2 ♀♀

With the possible exception of *Brachydiplax sobrina* all the species are exactly the forms one would expect to meet with in such a locality as the shores of Lake Chilka. In addition I have just received from Dr. Annandale the cast skin of a nymph belonging in all probability to *Anax guttatus* (Burm.). I have not access to Cabot's account of the larval stages of the Aeschninae at the present moment, but I have little doubt but that the identification is correct; the specimen agrees substantially with Needham's description and figure¹ of a nymph from Buitenzorg which he regards as belonging to Burmeister's species. The skin was “found on a rock at the edge (of the lake) near Patsahanipur” and Annandale remarks that the dragon-fly must breed in the lake. This view is further supported by the fact that the skin has attached to it some six very small shells, evidently the young of a species of *Modiola* very likely *M. striatula*, Hanley.

Lastly the series includes two females of a species of *Agriocnemis* taken at Barkuda Id., 17-vii-14,—another genus likely to be represented in coastwise country.

¹ *Proc. U. S. Nat. Mus.*, XXVII, p. 695, pl. xl, fig. 2 (1904).

Order RHYNCHOTA.

The aquatic Rhynchotal fauna of the lake comprises fifteen species, representing eleven genera and six families. The majority (8 species, 5 genera) belong to the Hydrometridae; there are three species (2 genera) of Corixidae, while the Hebridae, Nepidae, Belostomatidae and Notonectidae have each a single species.

The aquatic species of this order, to judge from the large number described in Distant's supplement (vol. V, 1910) to his account of the Rhynchota in the *Fauna of British India*, are still imperfectly known so far as the Oriental region is concerned. It is therefore noteworthy that there is only one species in our collection from the Chilka Lake that we have not been able to identify. It is a small apterous Hydro-metrid belonging to the subfamily Veliinae and bearing some resemblance to *Rhago-velia nigricans* (Burmeister); but as we have only a single specimen, which is probably immature, we refrain from discussing the species further.

Euratas formidabilis is the only species which we believe to undergo its full metamorphosis in, or rather on, the lake; the only other form of which we found an immature stage was a *Gerris*, probably *G. spinolae*, of which a single larva was obtained.

Descriptions of all the species here discussed will be found in Distant's volumes in the *Fauna of British India and Ceylon*, the volumes in which aquatic families are described being II (1904), III (1906) and V (1910); our references are to this work. The only form on which we have any remarks to offer as to structure or systematic position is *Euratas formidabilis* (see p. 183)

Family Hebridae.

Hebrus bengalensis, Distant, vol. V, p. 132, fig. 70.

Mr. Distant has been kind enough to identify specimens of this species. It is not uncommon among rocks and on wet sand at the edge of the lake, occurring both in the main area and in the outer channel at all times of the year. Its original locality is recorded as Lower Bengal.

Family Hydrometridae.

Hydrometra vittata, Stål, Distant, vol. II, p. 170, fig. 23 and vol. V, p. 137.

H. vittata is common on the surface of the main area of the lake in winter months, occurring chiefly on thickets of *Potamogeton*. It is a common species all over India and has also been found in the Malay Archipelago and Japan. In the Gangetic delta it often occurs on pools of brackish water.

Mesovelvia mulsanti, Buch. White, Distant, vol. II, p. 169, fig. 122.

Another common species found over weeds and also among rocks in the main area of the lake, chiefly in the winter months. It probably occurs all over the Oriental region and has been found also in North and Central America and in the Antilles.

Gerris nitida (Mayr), Distant, vol. II, p. 178 and vol. V, p. 142.

A few specimens of this pond-skater were taken among rocks at the edge of the lake at Ganta Sila in December. It is widely distributed in India, Burma and Ceylon, ascending the Himalayas to an altitude of at least 7000 ft.

Gerris fossarum (Fabricius), Distant, vol. II, p. 178 and vol. V, p. 142.

Specimens were taken at Ganta Sila in winter and at Nalbano in the "rains." The species is common on pools of brackish water in the Gangetic delta and has a wide range in the Oriental region and Australia. It occurs in the Darjiling district at an altitude of 7000 ft.

Gerris tristan, Kirkaldy, Distant, vol. II, p. 179 and vol. V, p. 144.

A few specimens were obtained at Nalbano, Barkul and Ganta Sila in September and December. The species was described from Ceylon and has since been recorded from various localities in India and Burma. It is common on brackish water in the Gangetic delta.

Gerris spinolae, Leth. and Serv., Distant, vol. II, p. 180.

G. spinolae is occasionally found near the inner shore of the main area of the lake in winter; in the "rains" it enters this area in considerable numbers from ditches and flooded rice-fields, in which it is very abundant. The species occurs in many parts of India, Burma and Ceylon, and also in China.

Euratas formidabilis, Distant (see p. 183, *postea*).

Family **Nepidae.**

Ranatra sordidula, Dohrn, Distant, vol. III, p. 22.

A single specimen was taken at Ganta Sila in December. The species is widely distributed in India and neighbouring countries.

Family **Belostomatidae.**

Sphaerodema rusticum (Fabricius), Distant, vol. III, p. 36, fig. 23.

The species is found among weeds in the main area of the lake in the dry season. It is common in India and the surrounding countries.

Family **Notonectidae.**

Anisops? breddini, Kirkaldy, Distant, vol. V, p. 333, fig. 194.

There is some doubt as to the identity of the Indian species; our specimens from the Chilka Lake agree well with the one figured by Distant. They were taken at the northern end of the main area of the lake in the freshwater season, the only time at which we saw any Notonectid in the lake. The same species is, however, abundant in pools of brackish water at Port Canning in the Gangetic delta, as well as in fresh water at Calcutta. *A. breddini* was described, very imperfectly, from Madagascar.

Family **Corixidae.**

Corixa substriata, Uhle, Distant, vol. V, p. 340.

A single specimen, which apparently belongs to this species, was taken off Barkul Point in March. The species occurs both in the plains and hills of India, in Ceylon and also in Japan.

Micronecta minthe, Distant, vol. V, p. 347, fig. 208.

This species is common in the main area of the lake in the freshwater season and also occurs in the same season near Manikpatna in the outer channel, where it was found among vegetation submerged by the monsoon floods. *M minthe* was originally described from a number of localities in the plains of India and Ceylon.

Micronecta proba, Distant, vol. V, p. 348, fig. 210.

M proba was common among water-weeds in Balugaon Bay in March. It was described from the plains of Northern India and Upper Burma.

NOTE ON THE GENUS *EURATAS*, DISTANT.

The genus *Euratas* was described by Distant (vol. V, p. 154) from specimens long immersed in alcohol and then dried; they were obtained in the Andaman Sea. From the same collection and locality he also described (*loc. cit.*, p. 155) a second supposed genus, *Fabatus*, which, as he himself acknowledged, was based on immature specimens. An examination of co-types of both genera and also of much fresh material has convinced us that *Fabatus* is merely a nymphal stage of *Euratas*. The type specimens of the latter, being mature, suffered comparatively little from the treatment they had received; but the much softer specimens assigned to *Fabatus* had shrivelled considerably and in so doing had become distorted in such a way as to conceal their true generic characters.

Mr. Distant has recently informed us in a letter that his chief reason for regarding *Fabatus* as generically distinct was the emargination of the eyes, that is to say the concavity of their posterior margin. In fresh specimens, however, that agree in all other structural features with co-types of *F. servus*, no such concavity is apparent, but in some specimens that have been preserved for even a few hours in alcohol, shrinkage of the integument of the head and prothorax causes the eyes to protrude in the manner shown in pl. xi, fig. 4. The emargination of these organs is therefore artificial.

***Euratas formidabilis*, Distant.**

(Plate XI, figs. 1—7.)

1910. *Euratas formidabilis* and *Fabatus servus*, Distant, vol. V, pp. 154, 155, text-figs. 82, 83.

1911. *Euratas formidabilis* and *Fabatus servus*, Annandale, *Rec. Ind. Mus.* VI, pp. 111, 112.

Distant's description of the adult of this species is excellent so far as it goes; but unfortunately he makes no mention of the structure of the external genitalia, while, owing perhaps to the position in which they are drawn, his figures of the anterior legs do not fully illustrate their peculiar structure. As regards colour, his specimens in this stage had suffered little and the only shrinkage apparent is in the prothorax in which his figure exaggerates the discal foveations.

At the distal end of the anterior tibia on its proximal side, there is in both sexes a stout blunt process about as long as the segment is wide; it fits into a groove on the ventral surface of the femur when the two segments are approximated. On the process we can find no trace in either sex of the "file" figured by Carpenter in his account of *Halobates herdmani*¹; but in the male, immediately in front of it at the distal end of the segment, there is, as in that species, a group of slender spines, graduated in length.

The external genitalia do not differ in any important respect from those of *Halobates*. In the male (pl. xi, fig. 5) the horns of the eighth abdominal segment are symmetrical, reaching about to the middle of the ventral plate; they taper regularly to a blunt apex, which is slightly reflected outwards. Their distal ends are covered with scattered thorns that extend further forwards on the external surface than elsewhere. Dorsally, on the posterior margin of the eighth segment, there is a large rounded prominence and at each posterior angle there is a small papilla on which the spiracle opens. The ventral plate is broadly oval, convex below. The sclerite of the ninth abdominal segment is large and has the usual form; the postero-lateral margins are strongly sinuous and on each side behind the lateral prominences there is a patch of about twelve coarse spinules. We figure the female genitalia as seen from the side in an extruded condition and also, as seen from above, when retracted (pl. xi, figs. 6, 7). They resemble those of *Halobates herdmani* as figured by Carpenter (*loc. cit.*), but the ovipositor (outer posterior gonapophysis) is longer and the inner branch of the anterior appendage of larger size, while the posterior appendages extend much further beyond the basal membrane.

The egg is sausage-shaped and very long. One removed from the abdomen of a female is 1.88 mm. in length and fully three times as long as broad.

There appear to be three larval instars. In the first (pl. xi, fig. 1) the thoracic and abdominal sclerites have not yet appeared, except that there is a small chitinous plate at the extreme tip of the abdomen. The tarsus of the first leg is short and relatively broad and is composed of a single segment. The first segment of the antenna is also relatively short.

In the next instar (pl. xi, fig. 2) the prothoracic sclerite is well developed, forming a transverse bar interrupted in the middle line. On each side of the mesothorax there is a large longitudinally oval chitinous plate, while on the meta-thorax there is a pair of much smaller obliquely transverse plates, widely separated in the middle line. The tergites of the first five abdominal segments are represented by small patches of chitin placed laterally on either side and decreasing in size from before backwards. On the sixth and seventh segments these patches are scarcely distinguishable, but on the eighth there is a pair of larger plates, round and approximated to one another. The apex of the abdomen is in the same condition as in the former instar. The tarsus of the first leg has increased in length, but still consists of a single segment; the femur bears a small projection on the lower surface at

¹ Carpenter, *Ceylon Pearl Fisheries*, V, plate, figs. 5-7 (1906).

its apex, but the sexual characters of this limb are not yet apparent. The first segment of the antenna has increased in relative length.

The third instar (pl. xi, figs. 3, 4) is that described by Distant under the name of *Fabatus servus*. The sclerites are now well developed, although each is still distinctly divided into two halves and separated from those next it by a membranous interspace. The tarsus of the first leg is much longer but still consists of one segment. The tibia exhibits the secondary sexual characters, the large tooth characteristic of the male being well developed. The femur, however, is not yet incrassated. One of us has described the colouration of this instar elsewhere; but we may note that specimens preserved in spirit give as it were a negative picture of those pinned and dried, the latter preserving to a considerable extent the natural colour of the species (*cf.* figs. 2 and 3, pl. XI)



FIG. 2.—*Euratas formidabilis*, Distant.
Tarsus of 1st leg of 3rd larval instar, showing the two segments of the adult tarsus within the single larval segment (from co-type of "*Fabatus servus*," Distant): $\times 30$.

We have mounted one of Distant's co-types in Canada balsam, after clearing it with caustic potash, but we can find in it no trace of a joint in the tarsus at a level with the claws (see Distant's fig. *loc. cit.*, p. 156). The specimen was evidently just about to undergo its final ecdysis and the true position of the joint, as it occurs in adults considerably behind the base of the claws, can be detected internally (text-fig. 2). The form of the genital appendages can also be made out, although there is no external trace of them.

Euratas formidabilis occurs at all times of the year both in the main area and in the outer channel, but is perhaps more abundant in the former than in the latter. It has also been found in backwaters at Vizagapatam and Ennur on the Madras coast and was originally described from the Andamans, where it is common in sheltered bays.

It was noticed in an aquarium that disturbance of the surface of the water caused both young and adults to dive. They were, however, apparently unable to remain below for long and floated up again immediately in spite of vigorous efforts. In calm weather the adults were seen chiefly in the middle of the lake, as a rule singly or in pairs; but when the wind was high they congregated among rocks near the edge and in other sheltered spots. The young are markedly gregarious and were, as a rule, found among rocks and weeds.

The food of the species consists largely of insects that fall or are blown into the water. We have seen several individuals sucking a dead dragon-fly, but small insects are seized by single bugs. Fish-fry that swim on the surface, particularly those of *Haplochilus melanostigma*, are also eaten. Prey is held not between the femur and tibia of the first legs, but between the inner surfaces of the two femora.

The male clasps the female with his anterior femora immediately behind her front legs, the spines on the femora assisting in maintaining a hold. It is noteworthy that in *Asclepios annandalei*¹, in which the spine characteristic of the male is situated on the femur instead of on the tibia, the female is gripped much further back, immediately in front of the third pair of legs.

¹ Distant, *Ann. Mag. Nat. Hist.* (8) XV, p. 504, text-figs. (1915).

Order *DIPTERA*.

A large number of species of this order breed during the rains, and especially after their cessation, when the water-level of the lake is sinking, in small pools near the margin of the lake. In the waters of the lake itself we found, however, the immature stages of only three flies—*Eristalis arvorum*, *Anopheles rossii* and a species of *Palpomyia*. All of these were common in the right season at suitable localities, the larvae of *E. arvorum* in decaying weed at the edge, those of the two Nematocera among thickets of *Potamogeton*. The larvae of all three species are evidently able to endure considerable changes in salinity.

Family *Syrphidae*.

1915. *Eristalis arvorum*, Fabricius, Brunetti, *Rec. Ind. Mus.* XI, p. 228 (pl. XI, figs. 8, 9).

We have to thank Mr. Brunetti for identifying flies of this species, which he states to be the commonest Indian representative of the genus.

The larva (pl. xi, figs. 8, 9) resembles the European species figured by Miall¹, but differs in the following points,—(i) the inner branch of the terminal part of the

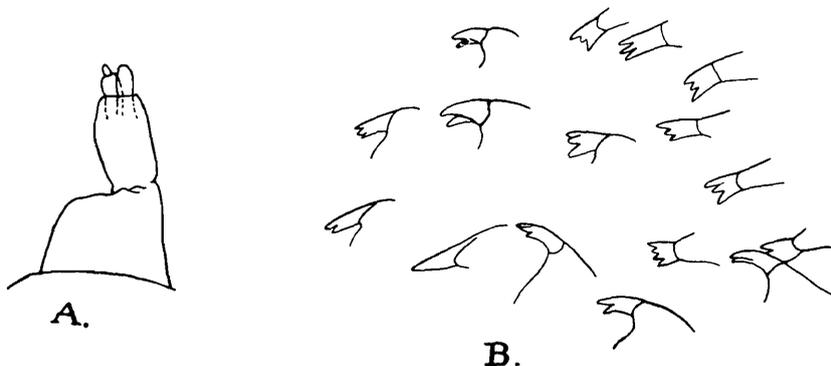


FIG. 3.—*Eristalis arvorum*, Fabricius.

- A. Lateral view of sensory papilla of larva : $\times 75$.
 B. Spines on anterior extremity of body of larva : $\times 250$.

sensory papillae consists of two barrel-shaped segments, of which the basal one is considerably the larger (text-fig. 3 A); (ii) the spines at the anterior extremity of the body are bifid or trifid, except on the posterior part of the area they cover, where they are simple (text-fig. 3 B); (iii) there are about eleven chitinous ridges on each side of the antechamber of the pharynx; (iv) the posterior part of the body is more densely covered with hair which extends on to the base of the tail; (v) the processes at the base of the tail are shorter and concealed by the hair.

Flies of this species were observed in large numbers on two occasions, flying round rocks at the margin of the lake and settling at the edge of the water, in March near Patsahanipur and in November on Kalidai Id. The larvae were found among rotting weed on both occasions. The species is widely distributed in the Oriental region.

¹ Miall, *Nat. Hist. Aquatic Insects*, p. 198, figs. 70-77 (1895).

Family Chironomidae.

It is probable that several species of this family breed in the lake during the freshwater season, and we have frequently seen large numbers of larval skins floating on the surface of the main area at this time of year; many species certainly breed in small pools near the edge. This is probably the case with at least one blood-sucking form (*Culicoides peregrinus*, Kieff.) very common at Barkul in July and September.¹ Immature stages of only one Chironomid were, however, taken in the lake itself.

The species belongs to the genus *Palpomyia*, but seems to be distinct from any of those described from India. It is perhaps allied to *P. polysticta*, Kieffer,² which it resembles in the colour of its thorax, but all the femora and tibiae are dark brown, only slightly pale at the joints, while the tarsi are white with black rings at the joints and with the distal segment brownish. The abdomen of the female is white below, at any rate in spirit, except for the last two segments, and the dorsal surface appears to be brownish with ill-defined white spots.

Although the pupal stage, of which we give a figure (pl. xi, fig. 10) was common in the *Potamogeton* thickets of Balugaon Bay in February and March, we did not succeed in finding the larva. The fly was seen in considerable numbers on the surface of the water and a few specimens were hatched out in an aquarium.

Family Culicidae.

Major A. B. Fry in reference to the Chilka Lake writes as follows³:—"Villages are built on the very borders of the lake, and though most of them have a few patches of rice cultivation the vast perennial mosquito population comes from the lake itself. In situations sufficiently protected by weeds and algae from the attacks of fish, anopheline larvae and nymphs are in veritable swarms. The majority were *Pm. rossi* and *N. fuliginosus*, but *M. listoni* were present. My second visit was to look for *Pm. ludlowi*, in consequence of Christophers' observations in the Andamans; but I found none, but discovered *M. fowleri* and *M. nigerrimus*."

Notwithstanding a careful search at many localities, the only mosquito larvae we were able to find in the lake were those of *Anopheles rossii*, Giles, which were abundant among weeds off Barkul in February and July in water of specific gravity 1.0075 to 1.008 and also off Nalbano in September in fresh water. The absence of *A. ludlowi* is somewhat remarkable, as it is the common Anopheline in brackish water in the neighbourhood of Calcutta.

Major Fry's visits to the lake were made in January; in March and September we failed to find even *A. rossii* off Satpara, and our impression is that most of the mosquitos breed in small pools of water near the edge rather than in the lake itself.

We have to thank Major Christophers for confirming our identification of *A. rossii*.

¹ *Rec. Ind. Mus.*, IX, p. 246 (1913).

² *Rec. Ind. Mus.*, VI, p. 116 (1911).

³ *First Report on Malaria in Bengal*, p. 35 (Bengal Secretariat, Calcutta, 1912).

Order LEPIDOPTERA.

Family Pyralidae.

In thickets of *Potamogeton* off Barkul the larvae of a small moth, *Nymphula diminutalis*, Snell, was abundant in the dry season, being able to endure a salinity equivalent to a specific gravity of 1.008. The same species breeds in brackish water in the Gangetic delta, but is found also in many inland localities, having a wide distribution in the Oriental region and beyond.

The caterpillar constructs its case, which closely resembles that of a Caddis-worm, out of the narrow leaves of various water plants, arranging them parallel to one another in a longitudinal direction.

Mr. Meyrick has been kind enough to identify a moth of this species reared from a caterpillar found feeding on *Nais* in brackish water at Port Canning.

II. MARGINAL INSECTS.

The insects to be considered under this heading include three species of Dermaptera, one Orthopteron and three Rhynchota. At least two species of Collembola were also obtained in damp sand at the edge of the lake, but we are unable to express any opinion as to their identity. We may also refer to the curious Heterocerid beetle (*Heterocerus maindroni*, Grouvelle)¹ which burrows in sand and sandy mud to a point well below the water-level of the lake, taking to its wings at night and often flying to the lamps of bungalows in the neighbourhood. It occurs at the margin in places where the water is as salt as that of the Bay of Bengal near the lake, as well as where it is fresh.

The three earwigs are *Labidura bengalensis*, Dohrn, *L. riparia* (Pallas) and *Forcipula quadrispinosa*, Dohrn. Of these the two former are doubtfully distinct. All occur commonly under stones and particularly under alga that has dried on rocks; the *Forcipula* is a good swimmer, while *Labidura* can endure immersion in both fresh and salt water. The species are also found in similar situations at the edges of streams and ponds. *L. riparia* is a cosmopolitan species, while *L. bengalensis*, if it is distinct, is widely distributed in India and Ceylon; *F. quadrispinosa* is found also in Burma and the neighbouring countries.

The Orthopteron is a mole-cricket that agrees in every respect with the specimens identified by the late Mr. Kirby as *Curtilla* (= *Gryllotalpa*) *africana*, Beauv. It is nocturnal in its habits and usually burrows in mud at the edge of water. At Satpara it was found burrowing well below water-level in the salt-water season and its song may be heard at all parts of the lake in the evening. *Gryllotalpa africana* is the common species of the plains of India; its distribution is given as "Africa, Asia, Australia, N. Zealand (introd. ?)"²

Grouvelle, *Ann. Soc. ent. France*, LXXII, p. 345, fig. (1903).

² Kirby, *Syn. Cat. Orthopt.*, II, p. 6 (1906).

The three species of Rhynchota that may be classed as marginal forms are *Ochterus marginatus*, Latr., of the family Ochteridae or Pelogonidae, *Pirates lepturoides* (Wolff) of the family Reduviidae and *Leptopus assuanensis*, Costa, of the family Saldidae. The first of these is a diurnal species, often very common on mud at the edge of lakes and ponds. It is abundant in this situation at the Sar Lake in the Puri district, but at the Chilka Lake we only obtained one specimen, found on the surface of floating weeds in Gopkuda Bay. *Ochterus marginatus* occurs in Central Europe and South Africa and is doubtless widely distributed in the Oriental region. *Pirates lepturoides* apparently resembles *Gryllotalpa africana* in its habits. It was found in considerable numbers in damp sandy mud near Barhampur Id. in March and under stones near Barkul in the same month. The species has been recorded from several localities in India, Ceylon, Burma, Java and Borneo. *Leptopus assuanensis* is an active diurnal species very abundant among rocks in the main area; it flies about rapidly from rock to rock and settles just above the water-level. The species was described from Egypt and occurs also in Nubia and Madagascar as well as in many Indian localities, some of which are situated far inland.

From the foregoing notes it is clear that the marginal insects of the Chilka Lake, like most of the aquatic forms, are species of very wide distribution, capable of surviving temporary immersion in salt as well as in fresh water.