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(A JOURNAL OF INDIAN ZOOLOGY)

Vol. XIV, 1918.

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1918

FAUNA OF THE INLE LAKE

EDITED BY

N. ANNANDALE, D.Sc., F.A.S.B.,

DIRECTOR,

ZOOLOGICAL SURVEY OF INDIA.

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LIST OF PLATES.

ERRATA.

In the fifteenth line from top of page on page 22 for "*Prittopus breddini*" *read* "*Perittopus breddini*"

In line 12 from top of page on page 51 and under *Microrasbora erythromicron* for "P. 2" *read* "P. 12"

In the twelfth line of the fourth paragraph on page 57 between the words "contrivance" and "of" *insert* the word "consists"

In the second line from bottom of page on page 60 before the words "of variable" *insert* the words "and is"

In the fourth line of the second paragraph on page 62 for the word "former" *read* "latter"

In the first line on page 111 for "arge" *read* "larger"

In the ninth line from bottom of page on page 184 for "Glocidium" *read* "Glochidium"

INDEX.

N.B.—An asterisk (*) preceding a line denotes a new variety or subspecies; a dagger (†) indicates a new species; a double dagger (‡) a new genus or subgenus; two asterisks (**) a new family: synonyms are printed in italics.

PREFATORY NOTE

TO VOLUME XIV OF

THE

RECORDS OF THE INDIAN MUSEUM.

THE collections and observations on which this volume of the *Records of the Indian Museum* is based were made in February and March 1917, by Dr. F. H. Gravely and myself. I have to thank him for much assistance in the field and since we returned to Calcutta. I am also greatly indebted to Mr. C. E. Browne, I.S.O., Political Adviser, Yawnghwe, who did his utmost to further the objects of our tour. I have to thank Mr. G. C. B. Stirling, C.I.E., Superintendent of the Southern Shan States, for valuable advice.

There is one point in connection with the Inlé Lake to which I would direct the attention of naturalists and others. It is the extraordinarily favourable site for biological investigation of many kinds that the lake affords. Not only are almost unique opportunities for the study of variation in aquatic molluscs, recent and fossil, to be found in the neighbourhood and many peculiar species and even genera to be discovered, but the water of the lake is so clear that it is possible to watch the fish and other animals under natural conditions; the climate is good, the place, even now, not inaccessible, being within forty miles of the railway by motor. The people are both interested and willing to assist—a state of affairs not to be found in all parts of the Indian Empire. A small laboratory built out in the lake would not be expensive; it would afford facilities not easily to be bettered for both zoological and botanical work, and I believe that more good would be done to Indian research and Indian practical science by the foundation of a laboratory of the kind than by a great deal of so-called economic work.

The illustrations for this volume have been prepared mainly by the artists attached to the Zoological Survey of India, Babu A. C. Chowdhary, Babu S. C. Mondul and Babu D. N. Bagchi. The photographs of fishing boats, etc., in the Shan States were taken by Dr. Gravely.

N. ANNANDALE,

Director.

Zoological Survey of India.

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Price Ten Rupees.

INTRODUCTORY ACCOUNT OF THE INLE LAKE.

By N. ANNANDALE, *D.Sc., F.A.S.B., Director, Zoological Survey of India.*

(With Map.)

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GEOGRAPHY OF THE LAKE.

Situation of the Lake.

The Inlé Lake[1] lies in the State of Yawnghwe on the Shan Plateau at a height of 3,000 feet above sea-level, in Lat. 20° 35′ N., Long. 96° 57′E. It is thus well within the Tropics but at an altitude that mitigates the violence of a tropical climate. The lake occupies the central part of a trough between two ranges of hills, which, like all the ranges of that part of Burma, run almost due north and south. At its two ends, and to a lesser extent on the western side, alluvial plains have been formed, and are gradually extending outwards into the water. Several streams run through the northern plain and combine in the swampy ground between land and water. None of these streams are of any great size. They come from the north and from the west ; one of the most important of them flows from a dried lake-basin situated only a few miles to the north-west of the Inlé Lake but 800 feet higher. This stream makes its way with a very sudden drop through a narrow gorge in the hills. The dried lake-basin, to which I shall have to refer frequently, is the He-Ho plain. On the western

[1] *Inlé* means the " Lake (*in*) of the Four " (*lé*). The name is said to be derived from a league of four villages which at some troublous period of history made themselves independent of the local Shan chief.

side a rather larger stream enters the lake by several mouths, coming also from the north-west, and rising in the high ground that separates the watershed of the Irrawaddy from that of the Salween. Before reaching the lake, and on the other side of a range of hills, it disappears, running for some miles at a great distance beneath the surface. This is a habit of rivers on the Shan Plateau, a habit that may have had considerable influence in the distribution of the fauna. On the eastern side a few hill-streamlets enter the lake ; many of them dry up in winter, and all are very short. From the south end of the lake a larger river makes its way southwards ; like the stream on the western side it disappears into the ground, but at some considerable distance south of the lake. Its subterranean wanderings are unknown, but there can be little doubt that much, if not all, of its water finally reaches a tributary of the Salween.

The lake is thus, in a sense, the centre of a closed system, without direct communication with any of the important river-systems of Burma, but, in a wider sense, it may be considered to belong to the system of the Salween.

Dimensions of the Lake.

For reasons that will be made clear shortly, it is impossible to state the dimensions of the Inlé Lake precisely. It is about 14 miles long, and about 4 miles broad. The depth varies with the seasons. In March it is nowhere greater than 12 feet, and the average depth is not more than 7 feet ; but at the end of the rainy season the greatest depth must be at least 20 feet.

Water.

The water is remarkable for its extreme clearness. It is thus possible, when there is no breeze, to watch the animals at the bottom almost as if they were in an aquarium. All the silt brought down by the streams is deposited before it reaches the middle of the lake. The clearness of the water is probably correlated with its chemical composition. Mr. R. V. Briggs has analysed a sample which came from the surface in the middle of the lake, with the following results :—

	Per litre.
Total Solids	0·1710
Organic matter	0·0160
Calcium	0·0222
Magnesium	0·0279
Chlorine	0·0017
Sulphate (SO_4)	0·0017
Silica	0·0010
Carbonic Acid (CO_3)	0·1030
Iron	Less than 1 part in 5 million.

No precise details are available as to the temperature of the water. We found it remarkably constant at the beginning of March, not varying more than 2 degrees Fahrenheit. The average surface temperature was about 71°F. (21·7° C.) at that season, and the average bottom temperature one degree Fahrenheit lower ; the average air temperature being about 73°F. (22·8° C.).

Nature of the shore.

I have already alluded to the impossibility of stating the exact dimensions of the lake. This is because of two facts, firstly because its size increases greatly in the wet season, secondly because it has not at any time of the year what may be called a solid margin, for it is completely surrounded by floating islands formed by the growth and decay of vegetation. These islands, which are massed together round the edge of the lake, are one of its most characteristic features. Many different kinds of plants take part in their formation, but those of primary importance are certain large grasses and sedges that send out long floating runners from which new upright stems arise. Floating plants such as duckweed become entangled amongst these runners, and at the same time submerged weeds, especially a species of *Ceratophyllum*, grow up to the surface, where their upper parts are killed by the heat of the sun or the growth of algae. The mass of vegetation thus entangled is further agglutinated by the luxuriant growth of an alga belonging to the family Rivulariaceae which forms large brownish masses. These elements of the island in the making both decay and grow. Their decay forms a kind of fen-peat, which is prevented from sinking by their floating and growing parts.

Floating Islands.

A floating island covered with rich soil is thus formed, and plants[1] of a great variety of species grow up upon it, forming dense entangled masses. Even conspicuously flowering orchids and small shrubs flourish in a little time. These islands not only afford shelter and food for a large part of the fauna, but are of great importance in practical agriculture. When a cultivator wishes to grow tomatoes, cucumbers, or indeed any kind of vegetable, he cuts off a piece of a floating island sufficiently large to form his field, and then ties a rope to it and tows it to a suitable situation. The next operation is to turn the island upside down, which is easily achieved as its equilibrium is by no means stable, to anchor it with a bamboo pole thrust through it into the bottom of the lake and then to pile up more peat from the bottom upon the exposed surface until it becomes solid enough for him to walk upon, and even to build a house or erect a pig-sty. The gardens thus formed are extremely fertile.

The presence of the floating islands, cultivated or in their natural state, causes a very distinct differentiation of the lake into two regions, an open central region and a swampy marginal zone. As we shall see, the fauna of these two regions is very distinct. I have also been able to recognize an intermediate zone, where the two regions meet.

At the ends of the lake, and especially at the southern end (to which floating matter is carried by a quite perceptible current), a considerable area is covered with floating islands, merging gradually into swampy land.

Nature of the bottom.

The bottom of the marginal zone, beneath the islands, is composed very largely of a black peaty substance somewhat inimical to animal life. That of the central region is of a very peculiar nature. Strictly speaking, indeed, the lake has not a solid bottom at all. Beneath the water there is a layer of semi-liquid consistency composed of extremely

[1] Large botanical collections were made and have been deposited in the herbarium of the Botanical Survey of India.

small particles of a greenish grey colour suspended at a constant level, but never in their natural position becoming consolidated even into real mud. These particles are largely of a calcareous nature, as is shown by the following analysis of a dried specimen from the bottom of the northern part of the central region. This analysis also was made by Mr. R. V Briggs :—

	Per cent.
Insoluble siliceous matter	0·98
Alumina	1·30
Oxide of Iron	2·25
Lime	45·31
Magnesia	1·25
Potash	0·12
Soda	0·46
Moisture	3·10
Carbonic acid .	33·15
Phosphoric acid	0·17
Sulphuric acid	0·41
*Organic matter and combined water by difference	11·50
	100·00
*Containing Nitrogen 0·619	

On being dried the pea-soup-like mass forms a grey, very friable clay in which fragments of vegetable matter are abundantly present.

At some places the bottom is almost bare, the only growth upon it being a scanty one of such plants as *Potamogeton crispus*, *P. pectinatus*, *Hydrilla verticillata* and a species of Characeae, but over the greater part of this region dense masses of *Ceratophyllum* flourish, binding the bottom together with their roots to some extent, but not sufficiently to make it solid. The submerged thickets thus formed rise up to a height of at least 7 or 8 feet, and sometimes almost reach the surface. In some places they are in a flourishing condition even when their growing parts are almost in contact with the surface film, but at others they exhibit towards their upper extremities all the symptoms of ill-health, probably because of the growth of algae of various kinds among them.

Structure of the Surrounding Country.

In order to understand the history and origin of the lake, and therefore of its fauna, it is necessary to consider the structure of the surrounding country. The lake lies in the great Limestone Zone of the Shan Plateau thus described by Middlemiss[1] :—

" In its essentials, and not considering the younger minor zones that are inlaid with it, it is a rugged, rocky country. The dark grey limestone frequently weathers almost black into sharp-edged honey-combed masses, into pinnacled crags and weather-beaten towers and walls : into deep basins and swallow-holes (often as regular and circular in outline as a gigantic amphitheatre, but sometimes funnel-shaped) : into strange valley systems without connection one with the other, and that often end mysteriously either as underground passages down which streams precipitate themselves and become lost, or as marshes and lakes where evaporation helped out no doubt by subterranean percolation causes a disappearance of the waters : into innumerable caves and passages beneath the ground, some now high and dry from the waters that caused them and which are locally mined for the nitrates that have accumulated upon the floors from the decomposition of cave animal deposits, others used as show places and temples ; others again unknown to fame and rich in their virgin beauty of stalactitic growths."

[1] *General Report of the Geological Survey of India for 1899-1900* : " Report on a Geological Reconnaissance in parts of the Southern States and Karenni," p. 130.

The age of the rocks is uncertain, but it is sufficient for our purpose to know that they are of marine origin, and very ancient, and that their formation must have long preceded the hollowing out of the Inlé basin.

Superficial deposits.

The superficial deposits of the district have great interest in relation to the living fauna in that they prove the former existence of lacustrine molluscs at places now devoid of water, particularly in the He-Ho plain and in smaller valleys among the hills of Yawnghwe. The shells from the deposits will be discussed later in a paper dealing primarily with the living forms.

The deposits are of four kinds :—(*i*) Red Soil, (*ii*) Peaty Deposits, (*iii*) Grey Clay and (*iv*) Recent Tufa.

Red Soil.

La Touche [1] has shown that the red soil which covers a great part of the Shan Plateau is the insoluble debris of limestone rocks dissolved by water. Soil of this kind covers most of the He-Ho plain and also of the flat ground at the head of the Inlé Lake. In a small valley, that of the Hsin-Dawng stream, about three miles east of the town of Yawnghwe and at several hundred feet above the level of the plain, there are two small limestone caves, the floor of which is formed of red soil and contains fossil shells and mammalian remains. The shells are closely related to but distinctly different from those both of the He-Ho and the Inlé basins.

Peaty Deposits.

An enormous amount of peaty matter is always being formed round the Inlé Lake and in other damp situations on the Shan Plateau. Together with the silt brought down by the streams that flow into the lake, it must in the end fill up the basin completely. On the He-Ho plain, especially round the margin of the old lake, there are considerable deposits of this origin. They contain numerous shells in a fossil or subfossil condition. These shells belong to the same genera and in many cases to the same species as those now living in the Inlé Lake.

Grey Clay.

At the western end of the He-Ho plain, between two small limestone spurs, a short distance above the point at which the He-Ho stream begins to descend through its gorge into the Yawnghwe valley, there is a deposit of grey clay exactly similar to that which is formed when the semi-liquid substance from the bottom of the existing lake is dried. The stream has cut through this deposit to a depth of at least 20 feet. It is full of shells differing in some cases from those found in the peaty deposits of the same neighbourhood but closely allied to them.

Recent Tufa.

One of the most extraordinary phenomena to be observed in the Shan States is the formation of calcareous tufa owing to the deposition of lime from solution in water. This phenomenon is thus described by La Touche [2] :

Calcareous Dams.

"The enormous extent to which the limestone of the plateau is being removed in solution by percolating waters has already been alluded to, and it is not surprising to find that, when the water comes again to the surface in springs and rivers, and is either evaporated or loses the carbonic acid which keeps the carbonate of lime in solution, the deposits thrown down should reach correspondingly huge dimensions. Indeed I doubt whether any other limestone tract

[1] *Mem. Geol. Survey Ind.*, Vol. XXXIX, p. 322.
[2] *Mem. Geol. Survey Ind.* Vol. XXXIX, p. 325.

can show deposits of this kind of such magnitude, at least in the open air. In the ordinary "Karst" region the evaporation usually takes place as the water trickles into the caverns and hollows worn out of the rock, with the formation of stalactites and stalagmite; but in the Shan States there are no open caverns in the great bulk of the limestone, owing to its universally shattered condition, which causes the mass to settle down as underground solution proceeds; though in the superjacent, more compact, Permo-Carboniferous limestones caverns are common enough. Thus the carbonate of lime which would ordinarily be deposited on the walls of the caverns and fissures is in this region brought to the surface and thrown down in the open. The brecciated structure of the rock also allows water to percolate freely through the mass in all directions, and this no doubt adds to the rapidity with which it is dissolved."

One can watch the formation of rocks where the lime-laden water is trickling over masses of leaves and roots. At the head of the He-Ho pass what appears at first sight to be a fossil coral-reef is actually in process of formation owing to water dripping upon the roots exposed when a bank of earth is washed away by heavy rain. The lime is deposited in concentric layers round each root, the organic matter of which gradually decays and disappears, leaving a hollow tube. On the He-Ho plain Dr. Gravely found curious ridges of tufa running for considerable distances some feet above the surface of the soil and clearly representing the beds of now perished streams. They were full of shells of the same species as those found in the peaty deposits.

Even from this brief description, which should be read in connection with the papers by La Touche and Middlemiss already cited, it will be clear that the surface of the Shan Plateau has been, and still is, subject to great changes with which the waxing and the waning of the Inlé Lake are intimately connected.

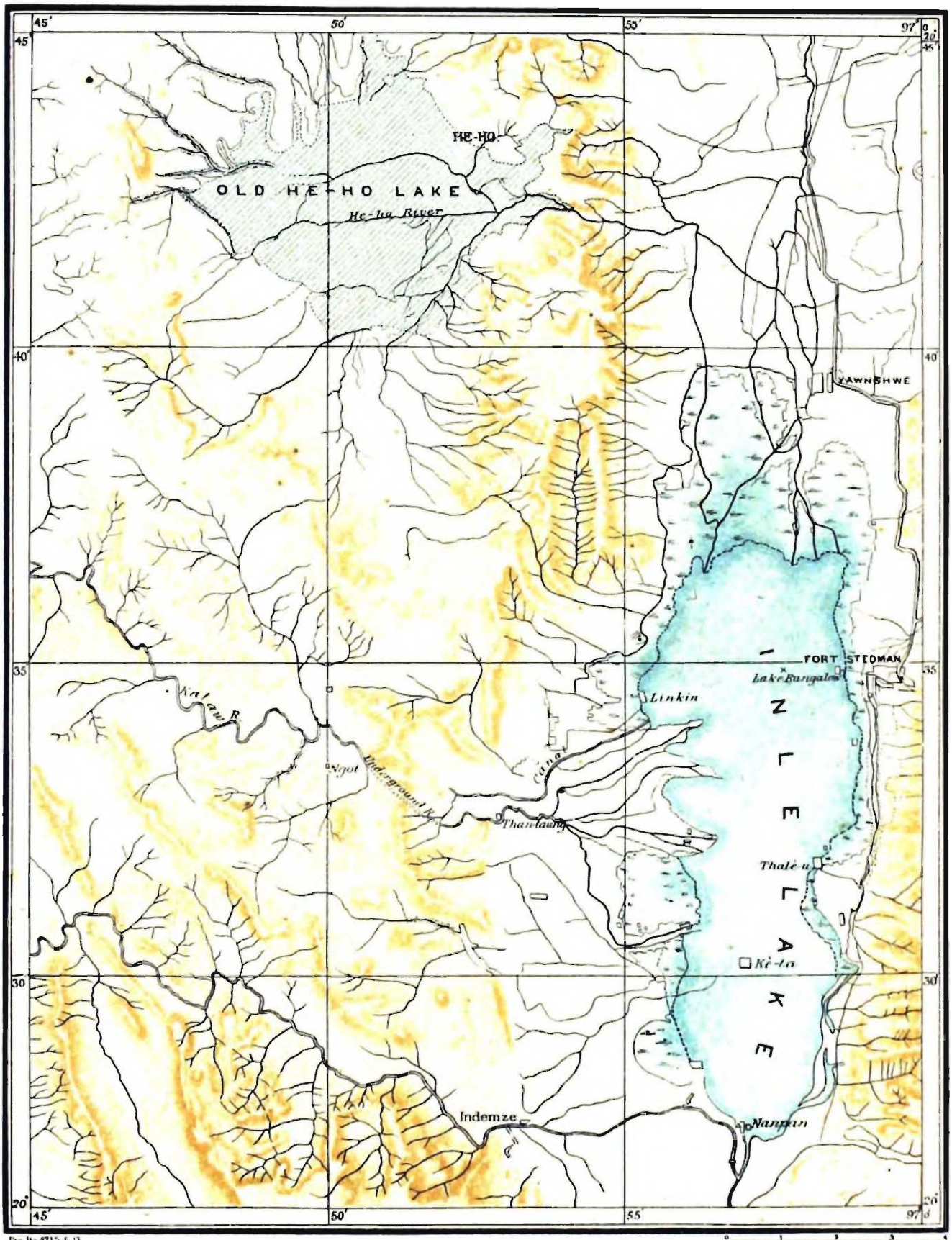
ORIGIN AND HISTORY OF THE LAKE.

The lake belongs to the type known as solution lakes—lakes with their basins hollowed out of limestone by the dissolving action of water. A common feature of such lakes is the presence somewhere in their bottom of a "sink" or deep pit down which the whole or a part of the water is liable to disappear. No "sink" exists in the Inlé Lake at present, but the point at which the river that flows out of it disappears underground may very possibly have, at one period, been beneath its waters. I have not seen this place and can, therefore, only point out again that a very large tract of country to the south of the lake must at one time have been covered by its waters, and have been gradually filled in by the two processes referred to above, *i.e.*, by the deposition of silt and the formation of peat, especially by the latter agency.

The lake must thus at one time have covered a much greater area than it does at present, and it must have been much deeper, though we have no evidence as to the height to which its waters reached. It may have been over a hundred miles long and several hundred feet deep. Moreover it is by no means the only lake that once existed in the neighbourhood. Indeed, superficial deposits in the emptied basins scattered amongst the hills of the Shan Plateau make it evident that the country was once a regular lake country. Some of the lakes must have disappeared at a remote period, but others have dried up recently, perhaps even in historical times. There are traditions which seem to point to this having occurred at He-Ho. The deposition of silt and the form-

ation of peat have not been the only factors that have led to the disappearance of water from the basins. Another cause has been the eating through of limestone rocks by water rendered acid by the decay of vegetation. The He-Ho stream makes its way down into the lower plain through an ancient limestone ridge, and it is not improbable that the water may have been finally drained from the upper plain by its cutting through this ridge in a comparatively short time under exceptionally favourable conditions.

It is not surprising, therefore, to find that the fauna of the Inlé Lake is a very highly specialised one, differing from any other aquatic fauna yet discovered. The lake is merely the last, shrunken relic of a once extensive system, the connections of which may have been greatly different at different periods in its history. It has, however, been isolated for a considerable time, and evolution has taken place rapidly and widely. To illustrate these facts the different groups of animals must be considered separately, and then the whole summarized. To do this is the object of the present volume.



Fire No. 4715 E. 12

MAP OF INLE LAKE AND DISTRICT.

Scale in Miles.

Heliolithographed at the Survey of India Offices, Calcutta

AQUATIC OLIGOCHAETA OF THE INLE LAKE.

By J. STEPHENSON, *D.Sc., Lt.-Col., I.M.S., Professor of Zoology, Government College, Lahore.*

Of the small but interesting collection of Oligochaeta made by Dr. Annandale at the Inlé Lake in the Southern Shan States, and kindly handed over by him to me for examination, the most remarkable specimens are a series of *Branchiura sowerbyi*. These have enabled me to demonstrate the existence of a penis (perhaps a pseudopenis, according to Michaelsen's definition, 5), and to show that in this form also, as well as in *Kawamuria japonica* (11), the muscular coelomic chamber is the apparatus for its extrusion. The amount of variation shown by these specimens in such features as length of body and length and number of gills is surprising.

I have taken this opportunity of also referring to two varieties of *Nais communis* from the Punjab which have recently come into my hands, though these are not part of the Inlé collection.

Family NAIDIDAE.

Genus **CHAETOGASTER.**

Chaetogaster annandalei, Stephenson.

Inlé Lake, S. Shan States. In Sponge (*Ephydatia fluviatilis*) ; 28th February, 1917. N. Annandale. Several specimens, none sexually mature. (No. W. 113-1.)

The identification rests on a comparison with individuals of the original batch of specimens from L. Biwa in Japan (11). The present specimens are about one-fourth larger ; in length a chain of two individuals is ·89 mm., the first being ·63 and the posterior ·26 mm. ; the diameter is ·175 mm. ; the setae of segment ii are 90μ and of more posterior segments 60μ in length.

Chaetogaster limnaei ? V. Baer.

In same tube as the above ; several specimens, none sexually mature. (No. W. 135-1.)

The length of these specimens is no greater, in the preserved condition, than that of *C. annandalei*, with which they occur ; but the other proportions are quite different ;—they are about twice as thick, and the setae also are markedly larger. So far as I can see, the only distinction between these specimens and *C. limnaei* is the rather smaller number of setae in these,—6 or 7 in segment ii and 3, 4, or 5 behind. *C. limnaei* has up to 8—12, according to Vejdovsky (12), who also remarks that the hinder segments have commonly more than the anterior ; this is not the case here, but it is pretty certain that the above numbers do not represent the actual state in the living animal, and that a number of setae

have fallen out ; in some segments I cannot discover any setae, and in one bundle I saw only one, though succeeding segments had four or five. The identification is however by no means above doubt.

C. limnaei is a European species which is parasitic on and in fresh-water Gastropods, or is occasionally free-living. It has not hitherto, I think, been recorded as living in sponges.

Chaetogaster bengalensis, Annandale.

Small canal and flooded rice-fields near Than-taung on W. Side of Inlé Lake, Southern Shan States ; in *Ephydatia fluviatilis*. 28th February, 1917. N. Annandale. A number of specimens, none sexually mature. (No. W. 114-1.)

The identification rests on a comparison with the types of the species, kindly sent to me by Dr. Annandale. The species was originally obtained by him from water snails in Calcutta (1). I may supplement the original account by a few additional particulars, based on an examination of the present specimens.

The length of a chain of two individuals in the preserved condition is 1·8 mm. or more ; of the first individual of a chain measured separately, 1 or 1·2 mm. The diameter at the widest part is ·35—·38 mm. The comparatively short length just given does not conflict with Annandale's statement that the animal measures at least 10 mm. when fully expanded ; the type specimens are the same length as these.

$N=10$ or 11.

The setae of segment ii are in length 85μ, 90μ, and 104μ in three different specimens. The main portion of the shaft is straight, the prongs are almost equal in length and thickness as a rule, even to the oil immersion lens ; sometimes the proximal prong appears slightly thicker at the base. The position of the nodulus varies from the middle of the shaft to frankly distal (distal to nodulus : proximal to nodulus : : 2 : 3).

In more posterior segments the setae are shorter, 68μ—74μ in length ; in thickness they are about 1·7μ. Here again the greater part of the shaft is straight, the distal end being hooked, and the proximal gently curved ; no difference can be regularly made out between the terminal prongs, though sometimes the distal seems to be rather longer and thinner. The nodulus varies in position in the setae of the same bundle,—from the middle of the shaft to distinctly distal ; where the disposition could be minutely examined, the innermost seta of the bundle has the nodulus nearest the middle, and the most external seta has it most distally placed on the shaft (*cf.* Stephenson, 9*a*).

The number of setae in a bundle is, as Annandale has remarked, very large ; I counted 16 (as well as lesser numbers) both in the bundles of segment ii and in those further back (Annandale, 15—17). The much-curved line of insertion of the setae of a bundle is very striking.

The prostomium is practically absent,—it is merely the anterior lip of the mouth ; this is a large circular orifice, ventro-terminal, looking obliquely forwards and downwards. The section of the alimentary canal which succeeds the pharynx, usually called oesophagus, is short but quite distinct. The beginning of the next part of the canal, the swollen crop, is marked by a number of cells, arranged in a fairly broad ring

around the opening of the oesophagus into the crop ; these are part of the lining epithelium, as is seen in longitudinal sections, where they appear as prominent cells projecting into the lumen, almost constituting a circular valve.

There is a considerable granular more opaque mass in the cerebral ganglion, as in some other species of the genus (*cf.* Stephenson, 6).

Remarks.—The species is a well marked one, the large number of setae being very characteristic. In addition, the practical equality in length and thickness of the terminal prongs of the setae, even to the highest powers (correctly shown in Annandale's figure), with the short but distinct oesophagus, will also serve as good marks of distinction.

Not having noticed, in those species of *Chaetogaster* which occur in the Punjab, any specially curved line of insertion of the setae, I was much struck by this very marked feature in the present specimens ; the curvature seemed to me to be even more accentuated than in Annandale's figure. It is not, however, peculiar to this species ; Miss Davies, in describing *C. australis* (3), which has resemblances to the present species, mentions that the setae are arranged in the form of a semicircle, except in the case of those of segment ii ; Mdlle. Dehorne mentions it in her study of *C. diaphanus* (4), and adds that this arrangement is even more distinct in *C. limnaei.*

I do not add to the list of distinctive features of *C. bengalensis* the presence of a posterior sucker (the anterior sucker of Annandale is the margin of the mouth, as in the case of the leech). The posterior sucker is mentioned by Annandale in his original account ; in *C. australis*, Miss Davies says, " at the posterior end there is no definite sucker, but the animal seems capable of slightly flattening its body so as to somewhat resemble one " ; and for *C. victoriensis*, " movement takes place by means of a series of contractions and expansions with the aid of anterior and posterior suckers, somewhat like a leech." I have not been able to see the posterior sucker in the types of *C. bengalensis*, nor in the present batch of specimens ; in Annandale's figure it appears to be merely the margin of the anus,—but this aperture is not provided with any special musculature discoverable either in the examination of mounted specimens or in longitudinal sections. Notwithstanding the more or less definite statements I have quoted above, I do not think there will be found in any species of *Chaetogaster* a posterior sucker, that is, a definite muscular organ, whether including the anus or not. I believe that the attachment of the animal at the posterior end takes place by means of the hinder setal bundles, the hooked ends being turned forwards and taking hold of the substratum (as in the case of backward progression, *cf.* Stephenson, 6, p. 237) and that Mdlle. Dehorne (on *C. diaphanus*) correctly likens the mode of progression to that of a caterpillar,– " l'animal se déplace à la façon des chenilles arpenteuses, les soies bucco-pharyngiennes jouant le rôle de harpons, les soies moyennes et postérieures fixant la chaîne au substratum."

If I might venture an additional word of criticism, it is that sections do not show any special thickness of the pharyngeal wall ; nor is there any peculiarity, as Annandale supposes, in the manner of insertion of the setae of segment ii.

Genus **NAIS.**

Nais communis, Piguet var. **punjabensis,** Stephenson.

Kasauli ; July, 1915. Baini Prashad. Several specimens, none sexually mature.

Nais communis, Piguet var. **caeca**, Stephenson.

Along with the above. Several specimens, none sexually mature.

It is interesting to find the blind variety of this worm along with the one possessing eyespots, as was the case in the material from Travancore from which the var. *caeca* was first described (Stephenson, 7).

Family TUBIFICIDAE.

Genus **BRANCHIURA.**

Branchiura sowerbyi, Bedd.

Inlé Lake, Southern Shan States. In very soft mud in the open lake in 7 feet of water ; green plants abundant. Several batches, 19th February to 5th March, 1917. N. Annandale. (No. W. 103-4—1.)

Kaung-daing, Yawnghwe State, Southern Shan States. In soft mud at edge of stream of warm water issuing from hot sulphur spring ; surface of mud barely covered with water ; no vegetation. Several specimens ; February, 1917. N. Annandale. (No. W. 111—1.)

Inlé Lake, Southern Shan States. In black mud at edge of lake in about 1 foot of water ; much decaying vegetation present. Several specimens ; 28th February, 1917. N. Annandale. (No. W. 112—1.)

Of the specimens collected at the various stations a number were sexually mature ; and a preliminary examination showed in some a feature not hitherto recorded,—a penis-like projection from the male orifice. This was however not present in all the sexual animals ; one showed a projecting penis on one side and not on the other ; a few showed two, the majority no penis at all. Three specimens were sectioned,—with none, one, and two penial projections respectively.

In those cases where there is no projecting penis the various structures have much the arrangement described by Michaelsen (5). Michaelsen divides the male deferent apparatus into the following parts :—

(*i*) the funnel ;

(*ii*) the vas deferens, which enters the wall of the next portion, the atrium, near the apex of the latter, and runs in that wall, in a direction away from the external aperture, to its very tip ;

(*iii*) the ental [1] portion of the atrium, a moderately wide tube surrounded by a thick layer of modified peritoneal cells ;

(*iv*) the middle portion of the atrium, a narrow continuation of the above, which soon enters the coelomic sac, in the upper part of which it winds about, accompanied by the paratrium ; the lumina of the atrium and paratrium finally unite ;

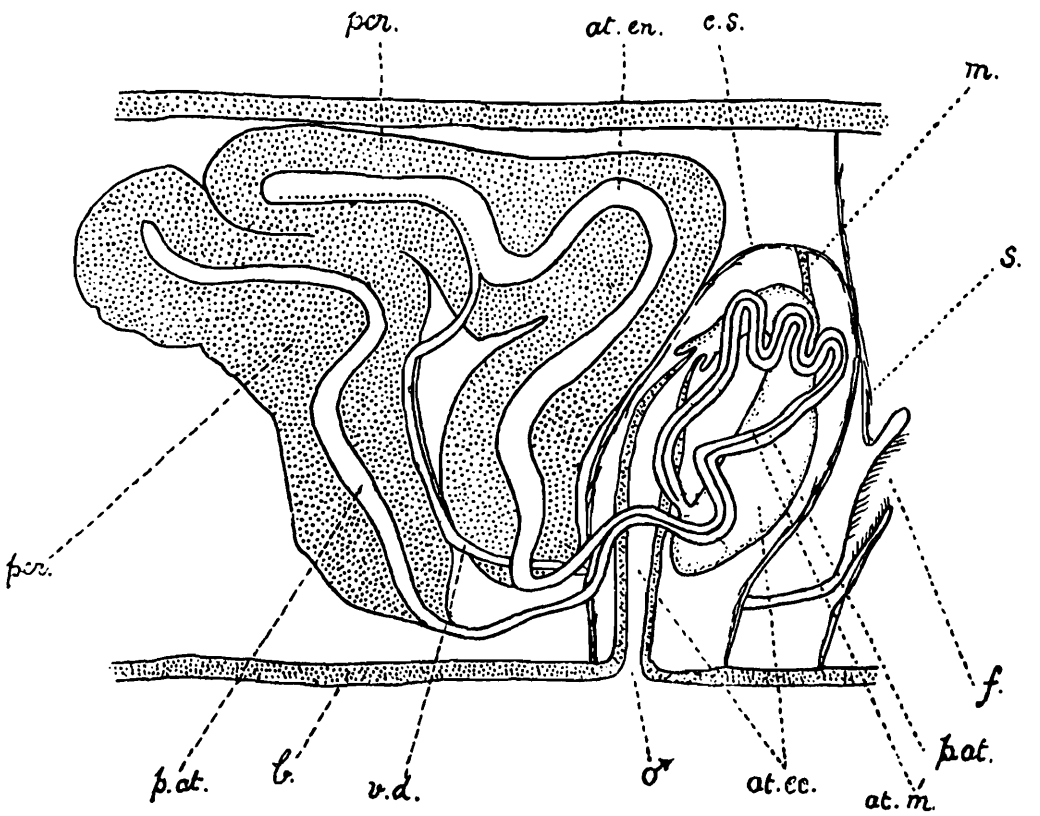
[1] Different authors use the terms " proximal " and " distal " in different senses in describing, for example, such a structure as the atrium, or a spermatheca. The more usual practice amongst English writers seems to be to take the fixed end,—that which is united with the bodywall,—as the proximal ; but Michaelsen calls the internal end proximal and the outer distal. To obviate confusion I use the terms " ental " and " ectal."

(*v*) the wider, ectal portion of the atrium has a generally vertical course to the exterior through the coelomic sac ;

(*vi*) the paratrium, a narrow tube ending blindly at its ental end and joining the atrium at the other ; it is also covered by a thick layer of modified peritoneal cells.

In all the cases hitherto observed the male orifice was quite simple (Beddard, 2 ; Michaelsen, 5 ; Stephenson, 9).

I may observe, first, that the ectal portion of the atrium is here divisible into two distinct sections,—a lower, the terminal part of the whole deferent apparatus, and an upper ; the distinction is, I believe, of some importance from the point of view of the protrusion of the penis. The upper section makes several bends in the upper part of the coelomic sac ; the epithelium lining the lumen is cubical, and the peculiarity of the cells is that the inner portion stains slightly or not at all,—less deeply than the basal part ; the hyaline appearance of the part of the cells which is towards the lumen gives them a distinctive character ; the nuclei are spherical, and stain rather lightly, showing scattered grains of chromatin in their interior. This section is divided from the lower usually by a distinct narrowing, and sometimes the walls of the tube appear folded here. The lower section has a generally vertical position in the sac ; its muscular coat is thick, and the epithelium is columnar, though of irregular height ; the nuclei are oval, and stain densely.



1.—*Branchiura sowerbyi ;* male genital apparatus, diagrammatic. *at. ec.*, *at. en.*, *at. m.*, the ectal, ental, and middle portions of the atrium ; *b.*, bodywall ; *c.s.*, coelomic sac ; *f.*, funnel ; *m.*, muscular band ; *p. at.*, paratrium ; *per.*, mass of peritoneal cells ; *s.*, septum 10/11 ; *v. d.*, vas deferens ; ♂ male aperture.

There are also a few other minor differences between these specimens and those investigated by Michaelsen. Thus the middle does not

suddenly become swollen where it passes into the ectal portion of the atrium,—the enlargement is gradual. The atrium extends as far as, and may extend further back in segment xii than the paratrium ; both atrium and paratrium may be confined to segment xi. The portion of the vas deferens which is contained within the atrial wall is considerably greater than is shown in either of Michaelsen's figures (see the dotted line in fig. 1), and indeed the length of the ental portion of the atrium as a whole is here much greater, and its course more winding ; it is here a much more conspicuous feature of the anatomy than the paratrium, though the reverse would seem, from the figures, to have been the case in Michaelsen's specimens. The lower (ectal) portion of the paratrium, of considerable length, has here a well-marked lumen and is lined by cubical cells ; it has here escaped from the voluminous peritoneal investment. Michaelsen seems to be right in denying a muscular coat to the paratrium, at any rate to that part which is enclosed in the thick covering of peritoneal cells. Fig. 1 gives a diagrammatic representation of the male apparatus in the present specimens.

The penis, where it occurs, appears as a pear-shaped or cylindrical projection, sometimes twisted, from the male orifice. It is an evagination of the ectal portion of the atrium ; and it is here that the distinction of the ectal portion into two sections, an upper and a lower, is of use ; the lower part forms, when protruded, the outer wall of the penis, and the upper the axial canal which traverses the projection (text-figs. 2 and 3) ; the aperture of the protruded penis is thus the junction

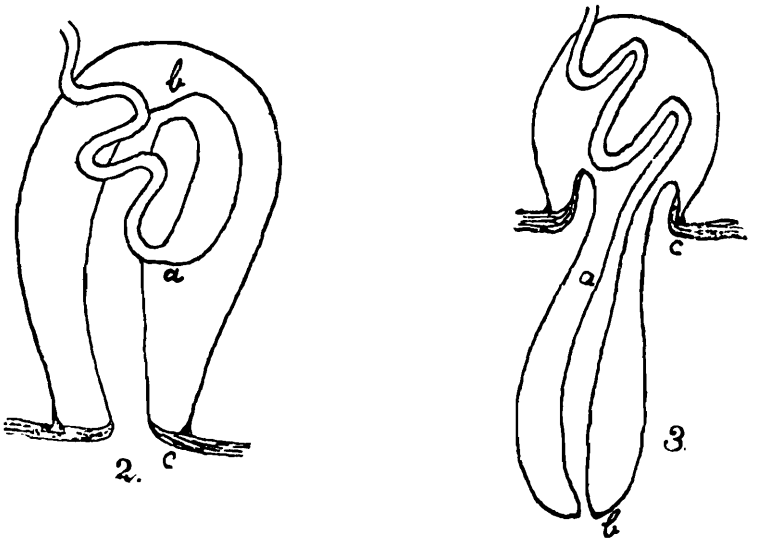


FIG. 2.—*Branchiura sowerbyi* ; penis not protruded.
„ 3.— „ „ penis protruded.
a, *b*, *c*, corresponding points.

between the upper and lower sections. This is borne out by the characters of the epithelium ; the central tube is lined by cells of a cubical shape with a more lightly staining inner portion ; but it is not so easy to recognize in the outer covering of the penial projection the characters of the cells lining the lower part of the atrium, since these are for the most part much flattened in their new situation.

When the penis is protruded the coelomic sac extends to only about half the height of the segment, and contains only the winding portions

of the conjoined atrium and paratrium ; the evagination of the terminal section of the atrium seems never to be complete, so that there is in full protrusion still a deep groove round the base of the penis, which thus projects from within the male aperture (text-fig. 3).

I was at one time inclined to doubt whether the " coelomic sac " was really coelomic,—whether its cavity was really a cut-off portion of the coelom. It seemed to me that the most terminal portion of the male duct,—that part which was originally included in the parietes,—might have hypertrophied to produce the penis, and in so doing might have raised up the inner part of the muscular layer of the bodywall so as to form the sac. On this supposition the cavity of the sac would not be coelomic, but only an enlarged split in the muscular wall of the body. In the same way the cavity of the gills is a space, not coelomic in origin, between the two muscular layers of the parietes ; there the outer muscular layer carrying the superficial epithelium projects outwards as a gill, here the inner layer carrying the peritoneal investment would project inwards as the sac-wall.

However, the atrium within the sac has an (apparently) peritoneal covering, well-marked in places, and consisting of cubical clear cells ; and a much flattened cell-layer can also be seen on the inner side of the sac-wall. The cavity and its contents appear therefore to be lined and covered respectively by peritoneal epithelium, and the space to be really coelomic.

The above condition is remarkably similar to that which I have recently described in *Kawamuria* (11). It is curious that the penial projection in *B. sowerbyi* has not previously been observed ; there is however nothing, in the more usual condition of the orifice, to indicate the possibility of such a protrusion,—the canal ends quite simply on the surface of the body. It is true that I recognized the function of the coelomic sac in *Kawamuria*,—to cause, by contraction of its walls, the extroversion of the contained tube ; but in *Branchiura*, which has the sac but, so far as I then knew, no protrusible penis, I considered the sac to have lost its function, and to be a rudimentary organ ; it is evidently at times fully functional.

The distance between *Branchiura* and *Kawamuria* is thus reduced ; the separation must now depend on the presence or absence of gills. I will not further discuss at present whether generic distinction is still justifiable, but may refer to what I wrote in my former paper.

The specimens showed much variation. In length one batch consisted of worms of 30, 28, 25 or fewer mm. ; in another the individuals were 45—70 mm. ; in others they were 90 or 100 mm., and one specimen reached the great length of 185 mm.

The number of pairs of gills was 40—47 in the shorter worms, and 90 in the longest ; but this was not the maximum. In one fragment 140 pairs were found, but the total length of the animal cannot be known. As many as 110 were found in an individual only 70 mm. long.

Sometimes nearly all the gills were well developed, only a few at the anterior end of the series being represented by mere tubercles ; in others a large number of the anterior gills were only tiny projections. But variation in this point seems to have no relation to the number of

gills or the size of the animal ; in a posterior fragment with 118 pairs, 43 were mere tubercles, and indeed all but the last 20 were little more ; in a specimen 100 mm. long, with 92 pairs, all but a few were well developed ; in the longest specimen, with 90 pairs, about half were tubercles only.

The length of the gills also varies. In an ordinary specimen they are perhaps somewhat shorter than the diameter of the body ; but in two examples of the present series they were very long,—about three times as long as usual,—filamentous, tangled together and hence difficult to count. In a third specimen of the same batch they were about twice as long as usual ; but in the fourth and last in the tube they were not noticeably longer than the ordinary.

As can be seen, these variations seem to be independent of each other ; nor can I connect them with the habitat except in a small degree. The specimens just mentioned, with the very long gills, were all taken from black mud at the edge of the lake, in about one foot of water, where much decaying vegetation was present ; the length might be correlated with deficiency of oxygen,—but one specimen had gills of only normal length. The length of the animals may however have a relation to the nature of the bottom in which they live ; thus those living in soft mud at the edge of a stream were the shortest (the stream was warm, and issued from a hot sulphur spring,—conditions which might perhaps have checked growth) ; lengths of 45—70 mm. were found in one foot of water in relatively stiff, peaty mud ; and specimens 90, 100, and 185 mm. were contained in the catches from the open lake, in seven feet of water. These very long specimens were taken on a bottom of extreme softness, indeed of semi-liquid consistency, in which it would be necessary for cylindrical bodies to be of great length in order to maintain a vertical position.

Family MEGASCOLECIDAE.

Perionyx fulvus, Stephenson.

Inlé, Yawnghwe State, Southern Shan States ; soft mud in muddy stream in 1½—3 feet of water. 6th March, 1917. N. Annandale. Four specimens. (No. W. 108-1.)

The species was hitherto only known from a single specimen taken in Calcutta. I must here correct a mistake which has crept into my original account (10) ; the male pores are there said to be " not very close together on segment xviii." I do not know how the word " not " crept in ; my original notes have " male apertures very close together," and the figure of the male area in my notes (which I did not reproduce in the paper) is practically a facsimile of the one I give here (fig. 4), drawn from the present specimens, except that the apertures are there even rather nearer together.

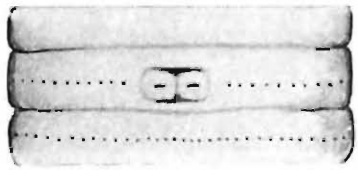


Fig. 4.—*Perionyx fulvus ;* region of male apertures.

As the type specimen is incomplete posteriorly, I may give the following measurements :—length 175 mm., thickness 4 mm. (max. 4·5) in

the case of the largest example; the others are smaller,—one which is only 98 mm. long and 2·5 to 3·25 mm. in thickness has well marked male apertures though no clitellum. The largest specimen had 178 segments.

The only notable difference of the specimens from the type is the colour; most species of *Perionyx* are distinguished by a rich purple colour dorsally, and the fact that the type specimen was yellowish brown and almost unpigmented suggested the specific name. The present examples however are a deep brownish purple above, pale below. The aquatic habitat is interesting.

An immature *Perionyx* was also obtained from the Inlé Lake, Southern Shan States, from black mud at the edge of the lake, in about one foot of water where much decaying vegetation was present. The locality, and the fact that it was also aquatic, suggest that the specimen belongs to the same species; and this is borne out to some extent by the commencing change in the male area, where the transverse grooves before and behind the male apertures, characteristic for *P. fulvus*, are beginning to appear. I mention it because of its colour, which seems to represent an intermediate condition between the fulvous and purple. To the naked eye it appeared a dusky purple dorsally in the anterior part, becoming increasingly lighter behind, and in the posterior half it is merely buff or tawny. Under the binocular dissecting microscope the colour is uniform at the anterior end; but behind this, longitudinal streaks of pigment are seen in each segment, purple on a yellow background, interrupted by the intersegmental furrows and not always corresponding in position from one segment to the next; the streaks are still present, but increasingly lighter, up to the hinder end, but there they only suffice to modify the yellow background to a buff tint (fig. 5). The deposition of pigment thus appears to take place in streaks, and not uniformly, a uniform tint being produced by expansion and coalescence of the streaks.

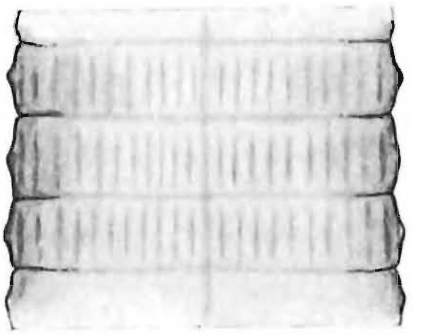


FIG. 5.—*Perionyx fulvus* (presumably); to show manner in which pigmentation develops.

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AQUATIC RHYNCHOTA FROM THE SOUTHERN SHAN STATES.

By C. A. PAIVA, *Assistant, Zoological Survey of India.*

The water-bugs collected by Drs. N. Annandale and F. H. Gravely in the Southern Shan States include many novelties and are of great interest on account of the unexplored state of the region in which the collection was made.

Although the families Hebridae, Pelogonidae and Naucoridae are unrepresented and only one species of Belostomatidae and two of Nepidae have been obtained, the remaining families are fairly represented. Of the thirty-three species listed below seven belong to the genus *Gerris* (Hydrometridae), three to the genus *Micronecta* Corixidae), two each to the genera *Microvelia* (Hydrometridae), *Enithares*, *Anisops*, *Plea* (Notonectidae) and *Corixa* (Corixidae), and one each to *Mesovelia*, *Velia*, *Perittopus*, *Ptilomera*, *Onychotrechus*, *Ventidius*, *Metrocoris*, *Naboandelus*, *Nacebus* (Hydrometridae), *Ranatra*, *Cercotmetus* (Nepidae), *Sphaerodema* (Belostomatidae) and *Nychia* (Notonectidae).

This is probably by no means a complete list of the Aquatic Rhynchota of the Southern Shan States, as further research may discover many more known as well as new forms.

From the Inlé Lake itself one species of *Microvelia*, five of *Gerris*, one of *Naboandelus*, one of *Nacebus*, one of *Ranatra*, one of *Sphaerodema*, one of *Enithares*, one of *Nychia*, two of *Plea* and one of *Micronecta* were obtained.

Amongst the most striking forms may be mentioned the beautiful *Velia Y-alba* and a new species of *Nychia*, a genus which is very scarce in the Oriental Region. The species of *Plea* too are very interesting.

In order to render this enumeration as convenient as possible for reference, I have followed the arrangement adopted by Mr. Distant in his volumes of the *Fauna of British India, Rhynchota.*

Fam. HYDROMETRIDAE.
- *Mesovelia mulsanti*, Buch. White.
- *Velia Y-alba*, sp. nov.
- *Microvelia diluta*, Dist.
- *Microvelia burmanica*, sp. nov.
- *Perittopus breddini*, Kirk.
- *Gerris anadyomene*, Kirk.
- *Gerris nepalensis*, Dist.
- *Gerris fossarum* (Fabr.)
- *Gerris nitida* (Mayr.).
- *Gerris tristan*, Kirk.
- *Gerris paludum*, Fabr.
- *Gerris spinolae*, Leth. and Sev.
- *Ptilomera laticaudata* (Hardw.)
- *Onychotrechus lyra*, sp. nov.
- *Ventidius distanti*, sp. nov.
- *Metrocoris nigrofasciatus*, Dist.
- *Naboandelus signatus*, Dist.
- *Nacebus dux*, Dist.

Fam. NEPIDAE.
- *Ranatra varipes*, Stal.
- *Cercotmetus pilipes* (Dall.)

Fam. BELOSTOMATIDAE.
- *Sphaerodema rusticum* (Fabr.)

Fam. NOTONECTIDAE.
- *Enithares templetoni* (Kirby).
- *Enithares intha*, sp. nov.
- *Anisops niveus*, Fabr.
- *Anisops sardea*, Herr.-Schaff.
- *Nychia infuscata*, sp. nov.
- *Plea quinquenotata*, sp. nov.
- *Plea areolata*, sp. nov.

Fam. CORIXIDAE.
- *Corixa unicolor*, sp. nov.
- *Corixa septemlineata*, sp. nov.
- *Micronecta substriata*, sp. nov.
- *Micronecta soror*, sp. nov.
- *Micronecta fulva*, sp. nov.

Family HYDROMETRIDAE.

Subfamily *MESOVELIINAE.*

Mesovelia mulsanti, Buch.-White.

Mesovelia mulsanti, Distant, *Faun. Brit. Ind., Rhyn.* II, 1904, p. 169 ; *id. ibid.*, V (Appendix), 1910, p. 137.

A number of specimens in various stages of development from the marginal zone of the Inlé Lake, Yawnghwe State, 2—3-iii-1917.

A very widely distributed Oriental species, occurring also in North and Central America and in the Antilles.

Subfamily *VELIINAE.*

Velia Y-alba, sp. nov.

(Plate VIII, fig. 1.)

Described from a single pinned specimen from the marginal zone of the Inlé Lake at Fort Stedman, Yawnghwe State, 28-ii-1917.

Head reddish-brown with a central, longitudinal, pale, impressed, smooth line on disk ; antennae hairy, ochraceous, the basal joint stout, curved, with sub-basal, submedial and apical fuscous annulations ; second joint a little shorter than first, broadly banded with fuscous a little beyond base and at apex ; third joint slender, subequal in length to second and fourth, almost entirely fuscous except at base, where it is pale ; 4th joint slender, with basal and apical fuscous annulations ; eyes black, deeply faceted, the facets appearing silvery in certain lights. Pronotum reddish-brown, the posterior area much darker, almost black and thickly covered with shallow punctures and short black hairs. On the anterior area there are two submarginal, bluish-grey, longitudinal fasciae widening posteriorly and extending from near the anterior lateral angles to a little beyond the junction of the anterior and posterior lobes ; sides of pronotum distinctly subangulate, the posterior angle rounded. Elytra dark brown with a large irregularly rectangular patch at basal angle, narrowed towards base, a small oblong one at about middle of inner margin and a reversed Y-shaped mark at apex, dull white. Dr. Annandale informs me that when the insect was alive these marks were of a bluish-grey tint. Underside light yellowish-brown, the prosternum and the mesopleura darker, a lateral series of silvery grey spots outwardly margined with black, extending from the prosternum to the sixth ventral segment, a suffusion of red on the underside of the connexivum and on the fifth, sixth and seventh ventral abdominal segments. Legs hairy, luteous, annulated with dark fuscous ; coxae and femora marked with red on the underside ; hind femora incrassated.

Rostrum ochraceous, with a broad, longitudinal, black band below.

Length 6 millim.

Type No. 7109/H. I. in the collection of the Zoological Survey of India.

Microvelia diluta, Dist.

Microvelia diluta, Distant, *Faun. Brit. Ind., Rhyn.* V (Appendix), 1910, p. 139.

I have identified this species with some doubt. All the specimens that were collected were preserved in alcohol, and in this state the markings, especially those on the elytra, appear more distinct than those in pinned specimens, in which they have a tendency to fade or become discoloured. In the alcohol specimens there is a distinct interruption in the ochraceous band at the anterior margin of the pronotum, whereas in the pinned specimens in the collection of the Zoological Survey of India this band appears to be entire, and is also figured as such by Distant in his description of the species. Furthermore, the colour of the antennal joints and that of the underside seem to vary to a very marked degree in the specimens in alcohol.

A large number of specimens, in all stages of development, were taken on the surface of a small puddle at the foot of Elephant Hill, near Yawnghwe, 17-ii-1917, and two specimens from the surface of the marginal zone of the Inlé Lake, 2—3-iii-1917 This species has been recorded from Calcutta and Rajshahi in the Province of Bengal.

Microvelia burmanica, sp. nov.

(Plate VIII, fig. 2.)

A single specimen (preserved in alcohol) of this species was obtained on a small stream at Hsamonghkam (Thamakan) 4,000—4,500 feet, Southern Shan States, 13—14-ii-1917, and a few from the Taung-gya Valley, Yawnghwe State, *ca.* 3,500 ft., 2-iii-1917.

I cannot identify this species with any described form. It resembles *M. albomaculata* most closely, but the position of the spots on the elytra is a little different, the relative length of the antennal joints and the colour of the legs, antennae and the underside are also different.

I have compared the Shan specimens with some specimens of *M. albomaculata* identified by Distant. The length he gives in his description of the latter is 2 mm., but the specimens he has identified are considerably smaller. The Shan specimens, though actually much larger than those of *M. albomaculata,* measure only 2 mm. in length.

In general colouration this species is very like *M. albomaculata.* A series of small deep black spots is situated within the marginal pubescent fascia near the inner margin of each eye, and there is a longitudinal, impressed, black line on the disk of the head not continued to the base or apex. The antennae are hairy, brownish ochraceous; the greater part of the basal joint posteriorly is much paler; the first joint is stout, curved outwards, longer than the second which is the shortest joint; second joint stout at apex and tapering at base; the third joint is slender, long, a little longer than the first; the fourth joint is very long, slender, about as long as the second and third together; eyes black.

The pronotum is as in *M. albomaculata,* except that there is a distinct, deep black, discal, longitudinal line extending from the anterior fascia to a little beyond the middle.

Hemelytra dull fuscous black with numerous greyish-white spots : a very large spot interrupted with fuscous occupies nearly the whole of the clavus ; corium with a small and a large basal marginal spot ; a large, centrally infuscate spot near inner margin, a smaller one near outer margin ; an elongate irregular subapical membranal spot, and a smaller elongate spot at inner angle. Body beneath black. Legs hairy, brownish ochraceous, darker towards the apices of the femora, tibiae and tarsi.

Length 1·9—2 millim.

In addition to the Shan specimens I have examined a number obtained by Dr. Gravely on the road from Thingannyinaung to Myawadi, Tenasserim, *ca.* 900 ft., 24—26-xi-1911.

Type No. 7106/H. I. in the collection of the Zoological Survey of India.

Perittopus breddini, Kirk.

Prittopus breddini, Bergroth, *Wien. Ent. Zeit.* XXV, p. 16.

There seems to be some doubt about the identity of this species. The genus was originally described from an apterous form by Fieber, in a very vague manner. Later on Kirkaldy defined it more fully and made *P. breddini,* a Javanese species, the type of the genus, the description being taken from an apterous form also. Bergroth described a macropterous form and placed it in this species. The only Burmese form as yet recorded, *P. rufus,* Distant, was described from an apterous insect. Dr. N. Annandale,[1] however, described a winged form from a small tributary of the Rangoon River, Burma, as that of *P. rufus.* The specimens from the Shan States, which are all winged, agree with the one described by Dr. Annandale as well as with Bergroth's description of *P. breddini* from Java, and apterous specimens from Sukli, east side of the Dawna hills, *ca.* 2,100 ft., Burma, agree with apterous specimens in the collection identified by Distant. Among those from Sukli there are also some winged forms which are exactly similar to the Shan ones. It seems probable that these all belong to one species, and as *P. breddini* was described before *P. rufus,* the Shan specimens must be placed under the former name.

A number of adult specimens were obtained from a small pool in the bed of a dry stream at He-Ho, *ca.* 3,800 ft., Yawnghwe State, 7—9-iii-1917 ; three specimens in the Taung-gya Valley, *ca.* 3,500 ft., 2-iii-1917, and six from Fort Stedman, *ca.* 3,500 ft., Yawnghwe State, 3-iii-1917. The species is common on small pools in streamlets in the State of Yawnghwe and also in the Dawna hills. The genus appears to be practically confined to a habitat of this kind.

Subfamily *GERRINAE.*

Gerris anadyomene, Kirk.

Gerris anadyomene, Distant, *Faun. Brit. Ind. Rhyn.,* II, p. 177.

A number of specimens in various stages of development from a pool at the western foot of Pagoda Hill, He-Ho, *ca.* 3,800 ft., Yawnghwe State (7—9-iii-1917).

[1] *Rec. Ind. Mus. VI,* p. 112 (1912).

This species was originally described from Pundaluoya, Ceylon, and it has also been recorded from the Philippine Islands. It has not, however, hitherto been found in Continental India.

Gerris nepalensis, Dist.

Gerris nepalensis, Distant, *Faun. Brit. Ind., Rhyn.* V (Appendix), p. 143.

Several specimens, both pinned and in alcohol, from various localities as detailed below :—

Swamp at the head of the Inlé Lake, Yawnghwe State, 20-ii-1917.
Marginal zone of the Inlé Lake at Fort Stedman, Yawnghwe State, 28-ii-1917 and 2—3-iii-1917.
Canal, Than-taung, west side of the Inlé Lake, Yawnghwe State, 28-ii-1917.
Hsamonghkam (Thamakan), 4,000-4,500 ft., 13—14-ii-1917.

This appears to be a very common and widely distributed species. Specimens from various localities in Nepal, the United Provinces and from Kawkareik, Tenasserim, are in the collection of the Zoological Survey of India.

Gerris fossarum (Fabr.)

Gerris fossarum, Distant, *Faun. Brit. Ind., Rhyn.* II, p. 178 ; *id. ibid.*, V (Appendix), p. 142.

This species was rather common on the lake itself and several specimens were obtained on the 2—3-iii-1917 Some also were got in the canal at Than-taung, Yawnghwe State, 28-ii-1917

It has been previously recorded from Bombay and Bengal in India, and from Malacca, the Philippines, China and Australia.

Gerris nitida (Mayr.)

Gerris nitida, Distant, *Faun. Brit. Ind., Rhyn.* II, p. 178 ; *id. ibid.*, V (Appendix), p. 142.

Two specimens from the marginal zone of the Inlé Lake, 2—3-iii-1917 and one from the edge of the Inlé Lake at Fort Stedman, Yawnghwe State, 28-ii-1917.

This species is found nearly all over India, Burma and Ceylon.

Gerris tristan, Kirk.

Gerris tristan, Distant, *Faun. Brit. Ind., Rhyn.* II, p. 179 ; *id. ibid.*, V (Appendix), p. 144.

Seven specimens from the marginal zone of the Inlé Lake, Yawnghwe State, 2—3-iii-1917.

Originally described from Ceylon, but now known to occur in India and Burma also.

Gerris paludum, Fab.

Gerris paludum, Distant, *Faun. Brit. Ind., Rhyn.* II, p. 180.

Two pinned macropterous specimens from the canal at Than-taung, Yawnghwe State, 28-ii-1917, and two in alcohol from a small stream, Hsamonghkam (Thamakan), 4,000-4,500 ft., 13—14-ii-1917

I think I have identified this species correctly. The description given by Distant is very meagre. Douglas and Scott in their "British Hemiptera" have, however, given a more detailed description with which the specimens agree fairly well.

The only other example in the collection of the Zoological Survey has abbreviated elytra; it was taken in Palestine and was determined by Horvath.

Gerris spinolae, Leth. and Sev.

Of this very abundant species only a few specimens were obtained, *viz.*, two specimens from a swamp at the head of the Inlé Lake, Yawnghwe State, 20-ii-1917; two from the canal at Than-taung, Yawnghwe State, 28-ii-1917, and eight from the Inlé Lake, Yawnghwe State, 3,000 ft., 18—28-ii-1917

Ptilomera laticaudata (Hardw.)

Ptilomera laticaudata, Distant, *Faun. Brit. Ind., Rhyn.* II, p. 185.

Six specimens from Taung-gya Valley, Yawnghwe State, *ca.* 3,500 ft., 2-iii-1917; two specimens from Than-taung, Yawnghwe State, *ca.* 3,000 ft., 28-ii-1917. "Not uncommon on jungle streams in Burma, the Malay Peninsula and Siam; markedly gregarious. N. A."

Onychotrechus lyra, sp. nov.

(Plate VIII., fig. 3.)

Described from one pinned and several alcohol specimens from the Taung-gya Valley, Yawnghwe State, *ca.* 3,500 ft., 2-iii-1917.

Ochraceous with numerous black markings which are sometimes more or less reduced or almost absent. Most of these markings are densely covered with fine greenish pubescence. Head with the apex black (seen from beneath), with a silvery white pubescent spot on each side; a large V-shaped mark on disk of vertex, a small marginal spot on each side before eyes and a slightly curved fascia on the posterior area near the inner margin of each eye, black.

Pronotum with four black spots or marks; two discal, which are largest and converge on the anterior margin, and two smaller, lateral, submarginal, touching the anterior margin.

Mesonotum very large, more than twice as long as the pronotum. A large harp-shaped mark on disk, anteriorly clothed with greenish and posteriorly with bluish-grey pubescence; on each side of this is a lateral curved line extending from the anterior margin to about the middle of disk, a short broad band connects this with another curved line, the inner part of which extends to the base of the mesonotum, with the outer portion reaching the region of the intermediate acetabula. Abdomen blackish above, the three apical segments medially ochraceous. Connexivum marked with ochraceous.

Antennae piceous, basal joint ochraceous. Legs ochraceous, tarsi black.

Propleura with a black spot almost touching the lateral spot on the pronotum. Mesopleura with a black impressed line, silvery pubescent, slightly sinuate anteriorly, not reaching the posterior margin. All the acetabula with a silvery pubescent black spot at base.

Sternum pale ochraceous with scanty silvery pubescence; a central and two lateral black lines, the central line extending from the prosternum to the apical segment of the abdomen, the lateral lines from the front acetabula to near the intermediate acetabula.

Length 4·25 millim.

Type No. 7124/H. I. in the collection of the Zoological Survey of India.

Ventidius distanti, sp. nov.

(Plate VIII, fig. 4.)

Described from several specimens in alcohol, from the top of the gorge of the He-Ho River, Yawnghwe State, *ca.* 3,500 ft., 7-iii-1917.

Apterous form.—Head black with a large patch at base, and a transverse fascia at apex of face yellowish ochraceous; eyes silvery grey, with a black patch on the disk; antennae black, basal half of first joint yellowish.

Pronotum very short, black, a narrow ochraceous waved fascia at basal margin, anterior margin slightly concave, posterior margin almost straight. Mesonotum large, about as long as its greatest breadth, covered with decumbent hairs, disk obliquely striate on anterior area, ochraceous, with two broad lateral black fasciae curved inwards anteriorly and meeting narrowly on anterior margin, each extended posteriorly to meet a curved fascia on the intermediate acetabula; a large subtriangular patch at centre of posterior margin; the posterior lateral angles narrowly dull black.

Metanotum dull black with a small ochraceous spot near each basal angle.

Abdomen above dull white, the basal segment, a spot at lateral margin of each segment and the apical segment black.

Underside pale ochraceous; legs black, base of anterior femora ochraceous.

Length 3 millim.

Type No. 7125/H. I. in the collection of the Zoological Survey of India.

Metrocoris nigrofasciatus, Dist.

Metrocoris nigrofasciatus, Distant, *Faun. Brit. Ind., Rhyn.* V (Appendix), p. 159.

Several specimens from foot of Elephant Hill near Yawnghwe, 17-ii-1917, and 6-iii-1917.

A few from a pool at the western foot of Pagoda Hill, He-Ho, 3,800 ft., Yawnghwe State, 9-iii-1917 Four specimens from a small stream near Fort Stedman, Yawnghwe State, *ca.* 3,500 ft., 3-iii-1917

A somewhat variable species with a wide distribution having been recorded from the base of the Western Himalayas, Lower Burma, the Malay Peninsula and Siam. It probably also occurs in the Eastern Himalayas and Assam.

Naboandelus signatus, Dist.

Naboandelus signatus, Distant, *Faun. Brit. Ind., Rhyn.* V (Appendix), p. 164.

Several specimens from the marginal zone of the Inlé Lake, Yawnghwe State, 28-ii-1917, 2—3-iii-1917

Two specimens from a swamp at the head of the Inlé Lake 20, 28-ii-1917, and six from the canal at Than-taung, west side of the Inlé Lake, Yawnghwe State, 28-ii-1917.

This species was first found in the Calcutta tanks. It is possible that it may be found throughout India and Burma.

Nacebus dux, Dist.

Nacebus dux, Distant, *Faun. Brit. Ind., Rhyn.* V (Appendix), p. 165.

Three specimens preserved in alcohol from the marginal zone of the Inlé Lake, Yawnghwe State, 2—3-iii-1917.

This species has been recorded from Calcutta and Mudon, Amherst District, Tenasserim.

Family NEPIDAE.

Ranatra varipes, Stal.

Ranatra varipes, Distant, *Faun. Brit. Ind., Rhyn.* V (Appendix), p. 316.

One specimen from swamp at edge of the Inlé Lake, Yawnghwe State (24-ii-1917), preserved in alcohol.

Most of these bugs do not retain their natural colouration when preserved dry and colour markings are not very reliable when descriptions are made from dried specimens. This specimen, however, agrees with the structural characters given by Distant in his description of the species.

It is very widely distributed and has been recorded from Nepal, Bengal, Ceylon and Burma.

Cercotmetus pilipes (Dall.).

Cercotmetus pilipes, Distant, *Faun. Brit. Ind., Rhyn.* III, p. 23.

One specimen, preserved in alcohol, from the He-Ho Marsh, Yawnghwe State, 8—9-iii-1917.

This species was originally described from Bhutan and does not appear to have been recorded from elsewhere.

Family BELOSTOMATIDAE.

Sphaerodema rusticum (Fabr.)

Sphaerodema rusticum, Distant, *Faun. Brit. Ind., Rhyn.* III, p. 36.

Two specimens from the Inlé Lake, Yawnghwe State, 2—3-iii-1917 ; one specimen from the river at Yawnghwe, 6-iii-1917 ; one from the edge of the Inlé Lake at Fort Stedman, Yawnghwe State, 28-ii-1917, and one specimen from the canal at Than-taung, west side of the Inlé Lake, Yawnghwe State, 28-ii-1917.

A very common and widely distributed species, having been recorded by Distant from India, Burma, Ceylon, Siam, Malay Peninsula, Sumatra, Java, Philippines, China and Australia.

Family NOTONECTIDAE.

Enithares templetoni (Kirby).

Enithares templetoni, Distant, *Faun. Brit. Ind., Rhyn.* III, p. 43.

One adult and two immature specimens from a small stream above Fort Stedman, Yawnghwe State, *ca.* 3,500 ft., 3-iii-1917

This species appears to have a fairly wide range, occurring in Bombay, Ceylon and the Siamese Malay States.

Enithares intha, sp. nov.

(Plate VIII, fig. 5.)

Two specimens from the marginal zone of the Inlé Lake at Fort Stedman, Yawnghwe State, 28-ii-1917, 2—3-iii-1917.

Head varying in colour from pale stramineous to pale ochraceous, sometimes tinged with light green ; eyes dark castaneous or black.

Pronotum and elytra stramineous ; the former foveately excavated, anterior angles distinctly blackish ; sternum blackish. Extreme base of corium fuscous.

Legs stramineous, with the underside of the fore and hind tibiae and hind tarsi black at apex.

Head short, its vertex longer than its greatest breadth at apex, about equal in length to the pronotum ; its lateral margins convex and slightly attenuate towards base ; breadth at apex more than the width of the hind margin of the eye.

Pronotum more than twice as broad as length in middle. Scutellum much broader at base than long. Corium about as long as head, pronotum and scutellum together. Posterior tibia about two-thirds longer than posterior tarsus. Smaller than *Enithares indica*, from which it differs by the total absence of any dark markings on the upperside, as well as in proportion of head and pronotum.

Length 8—8·25 mm.

Type No. 7137/H. I. in the collection of the Zoological Survey of India.

Anisops niveus, Fab.

Anisops niveus, Distant, *Faun. Brit. Ind., Rhyn.* III, p. 46.

Several specimens from a large muddy pool without weeds, He-Ho, 3,800 ft., Yawnghwe State, 8-iii-1917

If I have identified this species correctly, it is a very variable one, as among the specimens in alcohol there are some with various black

marks on the pronotum and elytra, and others entirely devoid of any dark markings.

A. niveus has a very wide distribution.

Anisops sardea, Herr.-Schaff.

Anisops sardea, Distant, *Faun. Brit. Ind., Rhyn.* III, p. 45.

A single female specimen from He-Ho, *ca.* 3,800 ft., Yawnghwe State, 7—9-iii-1917.

I have identified this species from its size. In all other respects it is almost indistinguishable from *A. fieberi,* Kirk.

Nychia infuscata, sp. nov.

(Plate VIII, figs. 6, 6*a*.)

A number of specimens preserved in alcohol, from the marginal zone of the Inlé Lake, Yawnghwe State, 2—3-iii-1917.

This genus has not hitherto been recorded from continental India. Kirkaldy, however, records it from Ceylon. My description is taken from specimens in alcohol.

Head pale greenish, eyes light purplish. Pronotum white, with a lateral fuscous spot at each hind angle. Scutellum white. Elytra whitish, transparent; corium white, next to the embolium a broad longitudinal band extending the whole length and a short discal one (sometimes almost absent) united with the other at base, extending to a little before the middle of the corium, fuscous; the latter apically dull white. Embolium yellowish-white, the outer margin dark fuscous. Antennae pale white; second joint clothed with black hairs, fourth joint with silvery hairs and with a fine black longitudinal line below.

Clypeus fuscous brown, apical third of rostrum black.

Sternum pale ochraceous, sides and the acetabula covered with long, fine, black hairs.

Underside of abdomen pale ochraceous, with a distinct, central, longitudinal carination which does not extend to the base of the abdomen, clothed on each side with long, black hairs, which are also present on the lateral margins of the ventral abdominal segments. Hairs on the sides and apex of the abdomen long and silvery.

Legs pale yellowish-white; front and intermediate coxae and femora marked with dark fuscous; posterior femora with fine longitudinal fuscous lines; posterior tibiae with a black longitudinal line below, fringed with long black hairs; posterior tarsi also fringed with long black hairs; anterior and intermediate tarsi outwardly fringed with fine long white silky hairs; posterior tibiae and tarsi nearly subequal in length, posterior femora extending beyond apex of abdomen.

In some specimens there is a small black spot near the middle of the inner margin of each elytron. Structural characters as those of the genus.

Length 4—5 mm.

Type No. 7098/H. I. in the collection of the Zoological Survey of India.

Plea quinquenotata, sp. nov.[1]

(Plate VIII, figs. 7, 7*a*.)

One specimen from the edge of the Inlé Lake at Fort Stedman, Yawnghwe State, 28-ii-1917.

Dull greyish-white; head with a central, longitudinal, yellowish fascia extending from base to about the middle of the facial region, wider posteriorly than anteriorly; eyes purplish-red; head densely punctured.

Pronotum greyish-white, densely punctured; posterior lateral area slightly fuscous; five small black spots above, situated two a little behind anterior margin on disk, one near each lateral angle and one at the middle of the basal margin.

Scutellum yellowish, sparingly punctured. Elytra densely punctured with brown; clavus with the punctures darker near the base and apex; corium greyish-white with a transverse fuscous band near middle and a large fuscous patch on its posterior third.

Legs pale ochraceous, extreme apices of femora and tibiae annulated with black.

Underside dark brown or black.

Length 1·5 millim.

Type No. 7145/H. I. in the collection of the Zoological Survey of India.

Plea areolata, sp. nov.

(Plate VIII, figs. 8, 8*a*.)

One specimen from the top of the gorge of the He-Ho River, *ca.* 3,500 ft., 7-iii-1917, and two from the marginal zone of the Inlé Lake, Yawnghwe State, 2—3-iii-1917.

Head pale ochraceous with three dark brown spots, one central, longitudinal, rectangular, the others rounded and placed obliquely, one on each side and above the central spot; vertex sparingly punctured, disk impunctate; eyes black.

Pronotum fuscous, with the anterior margin brown and the anterior area and three lines (one broad, central, longitudinal, not reaching posterior margin and two indistinct lateral, oblique), pale ochraceous; the central line is laevigate; anterior area of pronotum almost impunctate, with a single line of punctures on anterior margin, the greater part of the posterior area with very deep black punctures which under a high power of the microscope appear like areola or deep pits, each pit with a short stiff hair. Scutellum yellowish-grey, dark along the basal margin, sparingly punctured.

Clavus and corium greyish-white with numerous deep black punctures, apex of clavus slightly fuscous.

Underside black or fuscous; the legs ochraceous, posterior tibiae with a series of fairly long spines beneath, and with a long stiff hair

[1] In the figure of this species the artist has raised each part of the insect in profile in order to show the markings more distinctly. Figure 7*a* gives a side view of the insect.

arising from the base and extending beyond middle, visible only from below.

Length 2·25 mm.

Type No. 7146/H. I. in the collection of the Zoological Survey of India.

Family CORIXIDAE.

Corixa unicolor, sp. nov.

(Plate VIII, fig. 10; pl. IX, fig. 2.)

Two specimens from He-Ho, *ca.* 3,800 ft., Yawnghwe State, 7—9-iii-1917, in a large muddy pool without weeds.

Moderately elongate, greatest breadth about half the length, pronotum without fasciae; the hemelytra not mottled with piceous.

Head smooth, ochraceous, with a brownish patch at base which is emarginate anteriorly, basal margin darker, length equal to breadth between eyes, a distinct tubercle at centre of basal margin, inner margins of eyes discally subparallel, converging slightly on the facial area, eyes greyish-black, large, subtriangular, extending posteriorly over the lateral angles of the pronotum, a few punctures on disk of vertex.

Pronotum pitchy black, its length in middle about half its breadth, very minutely punctured, shining, subcordate; lateral angles rounded anteriorly, acutely pointed posteriorly; anterior margin sinuate in the centre, posterior margin rounded, a faint, short, medial carina on disk.

Elytra light brown, densely punctured and covered with short stiff hairs; subcostal area opaque, dusky grey, hairy.

Sternum pale ochraceous.

Abdomen beneath yellowish. Legs testaceous. Clypeus transversely striate and with a faint medial longitudinal carina.

Palae large, with a fringe of long hairs externally and with a row of fine, closely-set teeth on the underside.

Length 6·5—7 millim.

Type No. 7143/H. I. in the collection of the Zoological Survey of India.

Corixa septemlineata, sp. nov.

(Plate VIII, fig. 9; pl. IX, fig. 1.)

One specimen from foot of Elephant Hill near Yawnghwe, 17-ii-1917, preserved in alcohol.

This species differs from all other allied species in the pronotum having seven distinct, regular, pale ochraceous fasciae on the disk. The lateral margins of the face are oblique. The pronotum is slightly broader than its medial length. The species is a slender one more than twice as long as its greatest breadth.

Length 4·5 millim.

Type No. 7099/H. I. in the collection of the Zoological Survey of India.

Micronecta substriata, sp. nov.

(Plate VIII, fig. 11; pl. IX, fig. 3.)

Five specimens from Fort Stedman, *ca.* 3,000 ft., Yawnghwe State, 24-ii-1917

Head pale ochraceous, with a brownish tubercle at centre of basal margin; pronotum and scutellum pitchy black (in pinned specimen): elytra olivaceous grey with irregular fasciate, fuscous lines and spots, which are situated as follows:—Clavus with a long submarginal broken fascia and indistinct fasciae near its scutellar margins; corium with discal irregular fasciae converging basally and apically; a small linear spot on inner margin, three elongate spots on costal margin, one subbasal, one medial and one subapical, and a large subtriangular patch at the inner angle of the right elytron.

Elytra densely and minutely punctured, each puncture bearing a minute stiff hair.

Head broader than long; shorter than pronotum; longer in the middle than at the margins near the eyes; posterior margin slightly concave.

Pronotum large; in the middle about half as long as broad; lateral margins about one-third the width of the hind margin of the eye; anterior and posterior margins strongly convex. Underside very pale ochraceous.

Length 2·75 millim.

Type No. 7149/H. I. in the collection of the Zoological Survey of India.

Micronecta soror, sp. nov.

(Plate VIII, fig. 12; pl. IX, fig. 4.)

One specimen from Fort Stedman, *ca.* 3,000ft., Yawnghwe State, 24-ii-1917.

Head about as long as space between eyes at base, longer in the middle than at the margins near eyes; ochraceous with a very pale brownish patch on disk of vertex and a line of the same colour within the margin of each eye; a distinct tubercle at the centre of the hind margin of the head; eyes black.

Pronotum short, about a quarter as long as broad; anterior and posterior margins slightly convex; lateral margins almost nothing, about a quarter the width of the hind margin of the eye; olivaceous brown with a central black, transverse fascia not reaching the lateral margins.

The markings on the elytra are nearly the same as those of the preceding species, except that the apex of the corium is broadly margined with fuscous and the discal markings are more united.

Posterior tarsi with a distinct black line above.

Length 2·5 millim.

Type No. 7150/H. I. in the collection of the Zoological Survey of India.

Micronecta fulva, sp. nov.

(Plate VIII, fig. 13; pl. IX, fig. 5.)

Three specimens from under floating islands, Inlé Lake, Yawnghwe State, 19-ii-1917.

The description has been taken from two specimens in spirit as the third specimen, which had been pinned, has shrunk.

Head, scutellum, anterior margin of clavus, legs and underside dull yellowish-white. A small angulate mark at middle of hind margin of head, fuscous; eyes black.

Head longer than space at base between eyes.

Pronotum fulvous, with the anterior margin narrowly fuscous; subtriangular, the anterior margin broadly rounded, posterior margin almost straight; about half as long as broad; lateral angles about a third of the width of the hind margin of the eye.

Scutellum with a short transverse discal streak and the apex broadly fuscous. Clavus excluding anterior margin fuscous. Corium fulvous with some dashes of fuscous on disk.

Length 2·25 millim.

Type No. 7155/H. I. in the collection of the Zoological Survey of India.

EXPLANATION OF PLATE VIII.

FIG. 1.—*Velia Y-alba*, sp. nov., enlarged.

,, 2.—*Microvelia burmanica*, sp. nov., enlarged.

,, 3.—*Onychotrechus lyra*, sp. nov., enlarged.

,, 4.—*Ventidius distanti*, sp. nov., enlarged.

,, 5.—*Enithares intha*, sp. nov. Head and pronotum, enlarged.

,, 6.—*Nychia infuscata*, sp. nov., enlarged.

,, 6*a*.— ,, ,, Dorsal view of head, enlarged.

,, 7.—*Plea quinquenotata*, sp. nov., enlarged

,, 7*a*.— ,, ,, (side view), enlarged.

,, 8.—*Plea areolata*, sp. nov., enlarged.

,, 8*a*.— ,, ,, Front view of head, enlarged.

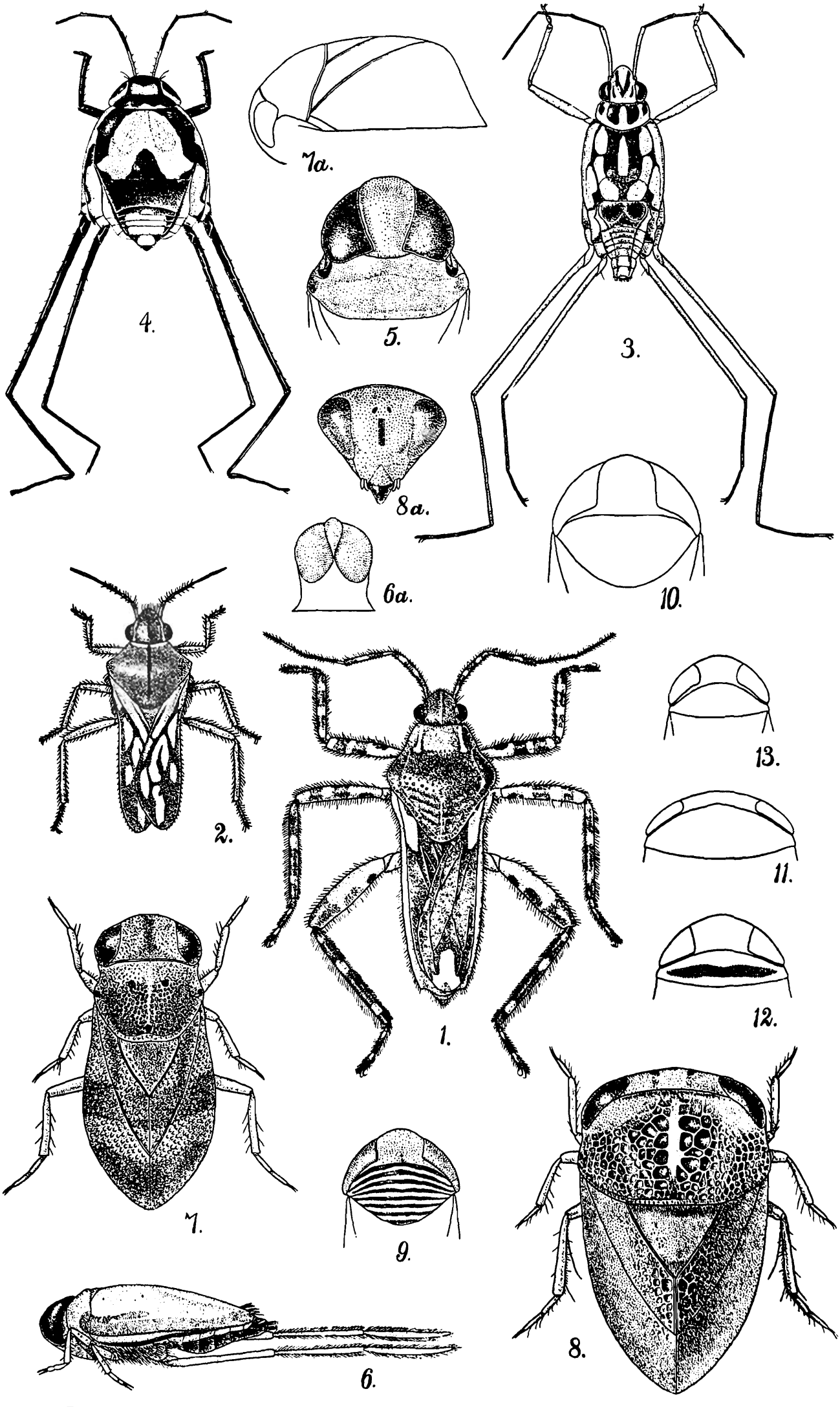
,, 9.—*Corixa septemlineata*, sp. nov. Head and pronotum, enlarged.

,, 10.—*Corixa unicolor*, sp. nov. Outline of head and pronotum, enlarged.

,, 11.—*Micronecta substriata*, sp. nov. Outline of head and pronotum, enlarged.

,, 12.—*Micronecta soror*, sp. nov. Outline of head and pronotum, enlarged.

,, 13.—*Micronecta fulva*, sp. nov. Outline of head and pronotum, enlarged.



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EXPLANATION OF PLATE IX.

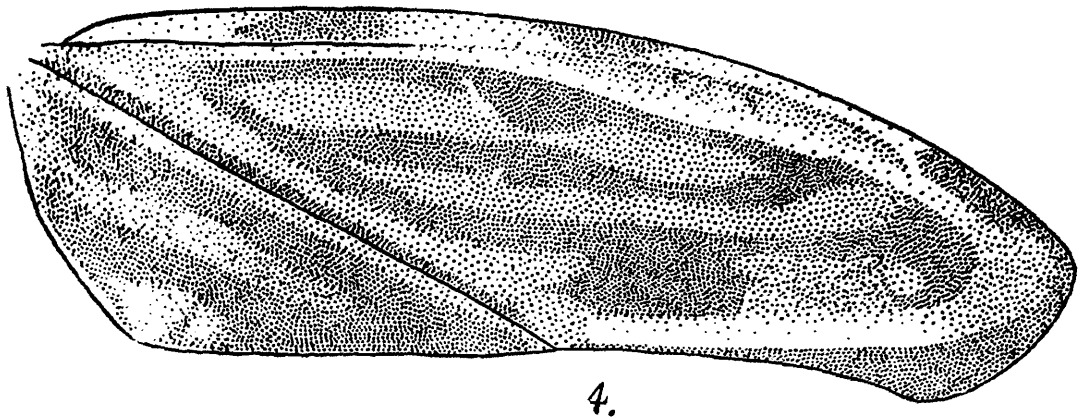
FIG. 1.—*Corixa septemlineata*, sp. nov. Right elytron, enlarged.

,, 2.—*Corixa unicolor*, sp. nov. Right elytron, enlarged.

,, 3.—*Micronecta substriata*, sp. nov. Right elytron, enlarged.

,, 4.—*Micronecta soror*, sp. nov. Right elytron, enlarged.

,, 5.—*Micronecta fulva*, sp. nov. Right elytron, enlarged.



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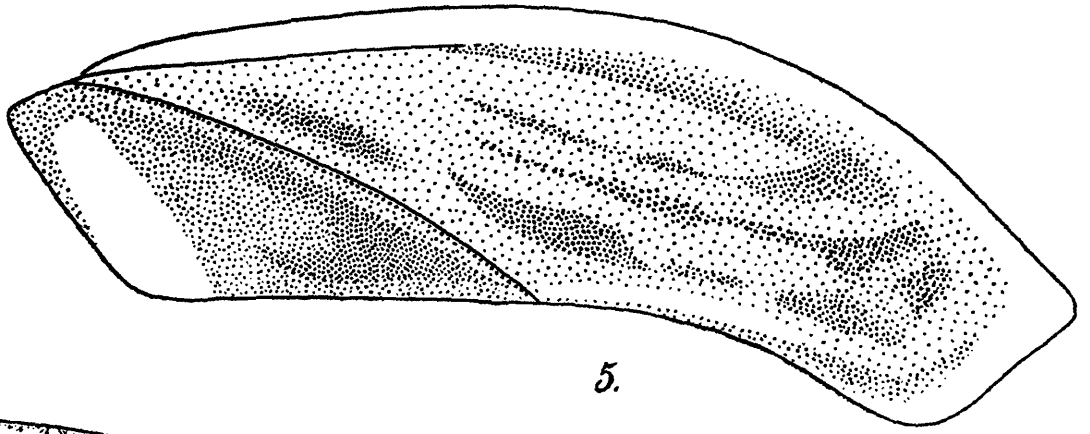

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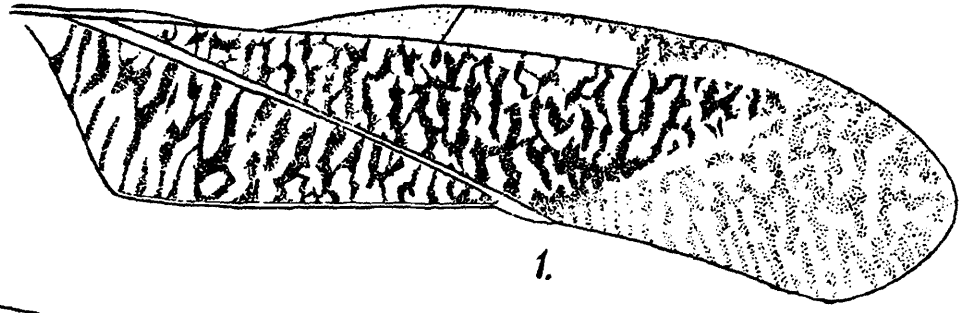

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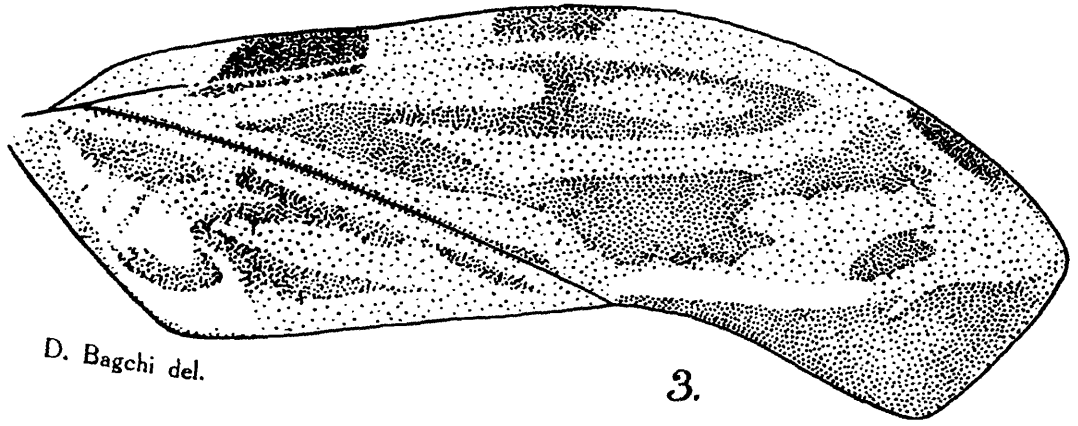

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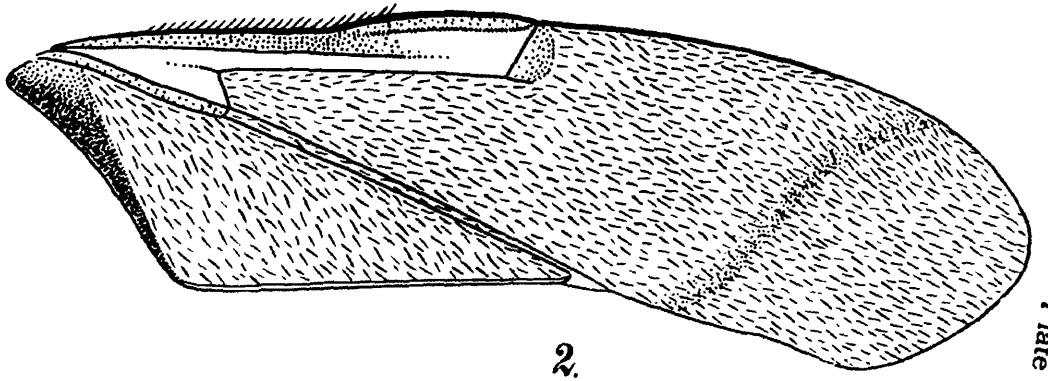

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