XII MALLOPHAGA FROM BIRDS (MOSTLY CORVIDAE AND PHASIANIDAE) OF INDIA AND NEIGHBOURING COUNTRIES

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(Plates xiv, xv.)

At the suggestion of Mr. C. W Beebe, Curator of Birds in the New York Zoological Park, who visited the Indian Museum of Calcutta in 1910, Superintendent N. Annandale of this Museum sent to us a collection of Mallophaga taken from bird skins of the Museum. These Mallophaga were taken from the skins of crows, jays and pheasants, most of which had been collected in India. Some, however, had come from China, Persia, Tibet, the Malay Peninsula and elsewhere. The specific determinations of the birds may of course be accepted without question, and the localities are given for most of the specimens with admirable definiteness.[1] The determinations of the Mallophagan parasites, together with descriptions of the new species found among them, are presented in this paper.

The collecting of dead parasites from dry bird skins in Museums would, at first sight, seem to be a proceeding attended with a dangerous lack of certainty concerning the relation of parasite and host. A good deal of straggling might be expected. As a matter of fact, this danger is not a serious one. The comparison of host records based on collections made from dried skins with records based on collections from freshly obtained hosts in the field, show that on the whole the records from the dried skins are not misleading. Indeed a great majority of the records in Piaget's " Les Pediculines ", which is the monumental basis for all of our knowledge of the Mallophaga and their host relations, were made on a basis of the examination of skins in European museums. The lack of danger from straggling comes about from the sedentary habits of the parasites themselves and their early death after the host's death.

The collection of Mallophaga described in this paper is of particular interest because it offers a rather intensive study of the parasites of the Indian Corvidae and Phasianidae. The collection of Indian birds in these two families is particularly large in the Indian Museum, and parasites have therefore been taken from many species in the two families and from many individual speci-

[1] Specimens labelled " no history " are, with few exceptions, the skins of birds that have died in captivity in India.—*N. A.*

mens of the host species. It is on the basis of such intensive collections as these that anything like an inclusive knowledge of the relation of the Mallophaga to any given host must be based.

The types of the new species described in this paper are in the Indian Museum, Calcutta.

The writers wish to express their recognition of the courtesy of Superintendent Annandale in permitting them to examine so interesting a Mallophagan collection.

I. MALLOPHAGA FROM PHASIANIDAE.

Nirmus nigromarginatus, Piaget.

One female from *Gallus sonnerati* (no history, India).

Goniocotes indicus, n. sp

(Plate xiv, fig. 4.)

One male specimen from *Arboricola rufigularis* (Jorpokri, East Himalayas). A bright-coloured, prettily patterned new form with rounded lateral margins and conspicuous, straight, backward-projecting posterior angles on the head. The figure represents the insect as somewhat too dull, the abdomen especially appearing considerably brighter in the specimen. This is a large species for *Goniocotes*.

Description of male: Head rounded, inflated, with broadly rounded front whose sides are somewhat flattened. General colour a rather bright yellow with reddish brown mandibles and markings. Antennal bands pale, continuous around the front, where they are widest, and turning in, as usual, before the antennae, though not much darkened at this point. Six fine hairs on each side on the front, the forward two being submarginal. There is a clearly defined, dome-shaped, semi-transparent space in front of the mandibles. Antennae well developed with second segment longest and fourth shortest; third and last segments about equal, basal second in length and thickened; colour a little paler than head. Triangular projecting area directly before antennae with surface appearing as though finely pitted. Eye large, but slightly protruding with a fairly long hair and large, granular fleck; ocular blotch quite dark with distinct margins. Temples convex in front, concave behind, with posterior angles acute and projecting straight backward nearly half the length of the prothorax and bearing a minute spine. Two long, pustulated hairs on the lateral margins of the temples behind the widest part and a short spine nearer the eye. Marginal bands little coloured, except close to the eye, and completely interrupted for the reception of the marginal hairs. Occiput sinuous, with marginal band, darker at each side, where it forms the ocular blotches. Occipital bands and signature lacking.

Thorax shorter than head and narrower, also slightly darker in general tone with rather broad marginal bands. Prothorax with

anterior angles rounded, sides diverging and slightly concave with posterior angles protruding somewhat and bearing a pustulated hair. Posterior margin but slightly concave, bare. Metathorax with rounded angles, especially the anterior, and sides parallel; posterior margin obtusely angled on the abdomen. Two long hairs on each side, rising from a large, prominent, protruding pustule situated midway on the lateral margin; two other shorter ones on each side near the posterior margin, arising from a submarginal pustule at a point about three-fifths the distance from the meson to the side. Legs pale with a number of heavy spines.

Abdomen broadly elliptical, somewhat flattened toward the front and widest at the third segment. First segment much longer than any of those following, with straight, diverging sides, and broad slightly coloured marginal bands. Second to seventh segments with pale marginal bands giving rise to internal appendages, turning inward along the anterior margins and appearing as sharp, transversely linear lateral abdominal blotches dark in colour; these transverse appendages are produced forward into the segment preceding in the form of semicircular, plate-like processes. Segments one to seven with a transverse row of short hairs, limited between the lateral blotches above mentioned, the more lateral ones on segments two to six forming a group of long hairs, varying in number from four on the second to seven on the fourth and fifth; also the usual group of long hairs in each posterior lateral angle, except the first, most of them projecting from the ventral surface. Last segment rounded; entire, with numerous dorsal and ventral hairs. Genitalia prominent, extending nearly the length of the abdomen, with long, sharp appendages.

Measurements:

♂, Length	2·75mm.	Width.
Head	·83	·83
Prothorax	·23	·57
Metathorax	·34	·74
Abdomen	1·53	1·20

Goniocotes nirmoides, n. sp.

(Plate xiv, figs. 5, 5*a*, 5*b*, 5*c*, and 5*d*.)

Several males and females from *Lophophorus impeyanus* (Zoological Garden, Calcutta). This well-marked form is characterized by the shape of the head, which is short and rounded in front with round, not angulated, temples.

Description of female: Head about as broad as long, subpentagonal in shape with broadly rounded front, flattened on the sides, and converging temples. Antennal bands entire, pale and widened in front with two dorsal hairs near the meson; also six marginal hairs on each side, the third being long. As

usual the bands turn inward before the antennae, forming a prominent, partly blackish blotch on either side. Space before the mandibles not so distinct as in many species. Antennae pale with first joint short, equal in length to the adjacent trabecular angles; second segment longest, about as long as the two following together; third and last nearly equal and the fourth but little shorter (fig. 5*a*). Eye prominent with a long hair. Temples with a rounded anterior angle behind the eye, then considerably flattened and converging to the rounded posterior angles, in front of which is a slight emargination giving rise to a long hair (fig. 5*c*); on the anterior angles is a short hair and a little behind this a long one, another short one occurring midway on the flattened sides. Temples slightly darker than frontal or occipital regions of head. Occiput deeply emarginate with dark marginal band and slightly darker blotches at either end.

Thorax much shorter than head, with dark marginal bands. Prothorax with sides rounded and protruding, bearing a pustulated hair. Metathorax but little longer than prothorax, with diverging sides and acute posterior lateral angles bearing a pustule with three long hairs; another pustule with two long hairs a short distance in from these on the slightly convex posterior margin. Metathorax similar to first segment of abdomen. Legs well developed, lighter in colour than body.

Abdomen elliptical with prominent lateral angles and dark, heavily chitinized marginal bands; darkish transverse blotches, leaving a narrow light space on the meson, this space not so apparent in some specimens, however. A series of about six hairs across the middle of each segment, limited to the central portion of the abdomen, and a long hair on the posterior margin near the side on segments three to six; the usual long hairs in the lateral angles, increasing in number and length posteriorly. Last segment truncate, entire.

Male much shorter than the female. Antennae with first joint considerably enlarged, protruding, with numerous long hairs (fig. 5*d*).

Measurements:

	♂, Length 1·69 mm.	Width.	♀ Length 2·06 mm.	Width.
Head	·54	·54	·57	·64
Prothorax	·13	·33	·16	·34
Metathorax	·17	·50	·17	·52
Abdomen	·85	·87	1·18	·95

Goniocotes chrysocephalus, Giebel.

Specimens from *Argusianus argus* (Perak, Federated Malay States), *Lophura diardi* (no history, India), *Gennaeus andersoni* (no history), *Gennaeus albicristatus* (Mundali, Garhwal, 8500 ft., W Himalayas, India), *Phasianus soemmeringi scintillans* (no history).

Goniocotes hologaster, Nitzsch.

Specimens from *Gallus gallus* (Gaya dist., Bihar).

Goniocotes rectangulatus, Nitzsch.

One male from *Pavo nigripennis* (no history, India).

Lipeurus variabilis, Nitzsch.

Specimens from *Gennaeus melanonotus* (Darjiling, Bhutan, India), *Gennaeus swinhoii* (no history), *Argusianus argus* (no history), *Phasianus torquatus* (birds in captivity, Calcutta, India), *Pavo nigripennis* (no history, India); also specimens which can be assigned to *variabilis*, but constitute one or more varieties of the specimens from *Chrysolophus pictus* (China), *Lophura ignita* (Zoological Garden, Calcutta, India), *Pavo nigripennis* (Zoological Garden, Calcutta, India) and a domestic fowl, (Calcutta, India).

Lipeurus rubrofasciatus, Piaget.

One female from *Arboricola rufigularis* (Jorpokri, 7000 ft., E. Himalayas).

Lipeurus intermedius, Piaget.

Male and female from *Pucrasia macrolopha* (Near Simla, W. Himalayas, India).

Goniodes neumannia, n. sp.

(Plate xv, figs. 6, 6*a*, 7 and 7*a*.)

Two males, eighteen females and two young from a single specimen of *Argusianus argus* (no history) and three females from another specimen of the same host from Perak, Federated Malay States. This is a curious new form lying rather between *Lipeurus* and *Goniodes*, and which in some future revision of the Mallophagan genera should probably be made the type of a new genus, but which we shall for the present include in *Goniodes*.

The female of this species is what Taschenberg (*Die Mallophagen*; 1882, pp. 32-34) mistakenly describes as the female of *Goniodes curvicornis*, Nitzsch, on the basis of a single specimen taken by Nitzsch, with a male of *curvicornis*, from "*Argus giganteus*" (which is *Argusianus argus*), and five specimens taken by Ruy, also with a male of *curvicornis*, from a dried skin of the same host. The males of *curvicornis* differ so much from these specimens that Taschenberg says that "males and females of *curvicornis* differ so much from each other that one could scarcely guess their relation if one did not take them from the same host." Our males, however, do unmistakably resemble the females and are entirely different from the males of

curvicornis. It is simply an unusual coincidence that males of *curvicornis* without females of the same species, and females of another species (our new one) have been taken without the males, but the pheasants are so heavily parasitized, *Argusianus argus* already having four Mallophagan species recorded from it, that the coincidence is not at all an impossible one. Fortunately we have found several females of *G. curvicornis*, together with males, in the present lot. They were taken from *Argusianus argus*, and, as described in this paper under the proper species caption, are unmistakably like the males in species characteristics.

The new species is characterized by its short straight abdomen, which instead of being elliptical or sub-spherical in the male as is usual in *Goniodes*, is parallel-sided in both sexes. The abdomen of the male is not as long as the head and thorax together. The head of the male has shallow, concave temporal margins, and the antennae are very large and bear forked processes on the first segment, and the appendage of the third segment is strongly chitinized, very long and pointed so as to be almost claw-like; the last two segments appear as appendages to the third. The genitalia of the male are large, and in both specimens that we have are exserted. This exsertion is probably unnatural but may, because of the small size of the abdomen and unusual size of the genitalia, be natural. The general colour of both sexes is pale yellow with but few darker red-brown markings.

Description of male: Head sub-quadrilateral with rounded front, sides not expanding, the width across the temples but little exceeding that across the base of the clypeus. Front rather prominent and evenly rounded with a light brownish marginal band, terminating in two antennal blotches; a rather long hair and four short ones on the clypeus on each side The antennae (plate xv, fig. 6*a*) are set in rather deep emarginations; the first joint is very large, as long as all the succeeding together, and bears midway on its posterior margin a most prominent forked appendage bearing a stout spine between the two forks; the second segment is half as long as the first and bears a smaller appendage on its inner margin; the third segment is practically all appendage, is long, curved and claw-like and bears the last two segments of the antenna near its base, having the appearance of an appendage of the third; of these last two the first is very short and the last about half as long as the second; a few short hairs are present. The eye is prominent with an inconspicuous fleck and a short spine. Behind the eye the sides of the head are slightly concave and bear a short spine; on the rounded temples are two long, stout hairs, a short spine behind them and a prickle between, and farther back on the blunt posterior angle is a stout spine. The occiput is concave and the occipital band prominent, forming two pale blotches.

The thorax is longer than the head and broader; colour rather darker than head or abdomen, but with few markings. Prothorax semicircular, with rounded diverging sides and straight posterior margin; posterior lateral angles with a prominent hair. Metathorax longer than the prothorax, triangular-shaped, with broadly rounded anterior angles and convergent sides meeting in an angle on the abdomen; three prominent hairs arise on the anterior angles and a number of shorter ones along the posterior sides. Legs ordinary, pale in colour with a few hairs.

Abdomen pale, short and almost parallel-sided, shorter than head and thorax together. There are but few dorsal hairs. A slightly coloured submarginal band runs the length of the abdomen on each side and is broken at each suture, leaving a clear space in which is a darker, narrow blotch running crosswise. The posterior margin is deeply emarginate and the last segments are compressed on the meson. The genitalia, as before mentioned, are very large, with long rectangular basal portion and two pairs of prominent appendages, the external pair being flattened and blade-like and less chitinized than the other two; the strong muscles reach almost to the thorax.

The female (plate xv, fig. 7), at first sight, seems to be very different from the male, but upon closer observation, it is seen that this difference is caused by the lack, in the female, of the abnormal developments of the male. Compared to the male, the female is almost characterless. The only breaks in the continuity of the outline of the head in this sex are the slight antennal emarginations, the almost imperceptible protrusion of the eyes and the concave occiput. The front extends further forward than in the male and the two long clypeal hairs are replaced by short ones. The antennae (plate xv, fig. 7*a*) are ordinary with the second segment the longest. The hairs that appear on the posterior margin of the metathorax in the male, are apparently lacking in the female. The abdomen is much longer in proportion to the rest of the body than in the male, being longer than the head and thorax together, and is almost parallel-sided, this being a characteristic of the species, as before noted The last segment is entire with four long hairs; no dorsal hairs are visible.

Measurements:

♂, Length[1]	1·7 mm.	Width.	♀, Length 1·95 mm.	Width.
Head	·50	39	·52	·47
Prothorax	·22	·48	·16	·47
Metathorax	·26	·52	·25	·52
Abdomen	·86	·76	1·09	·70
Gentalia, exposed portion.	·37	·19		

[1] Not including genitalia.

Goniodes sectus, n. sp.

(Text-figs. 1 and 2.)

Males and females from *Catreus wallichii* (Garhwal, Darjiling and Kumaon, Himalayas, India). Species with head of male small, flattened in front, with temples rounded and female with conspicuous lateral, temporal angles.

Description of male: Colour golden brown, with thorax darker and with red-brown markings. Head small, rounded, about as broad as long, with flattened, though evenly rounded, front

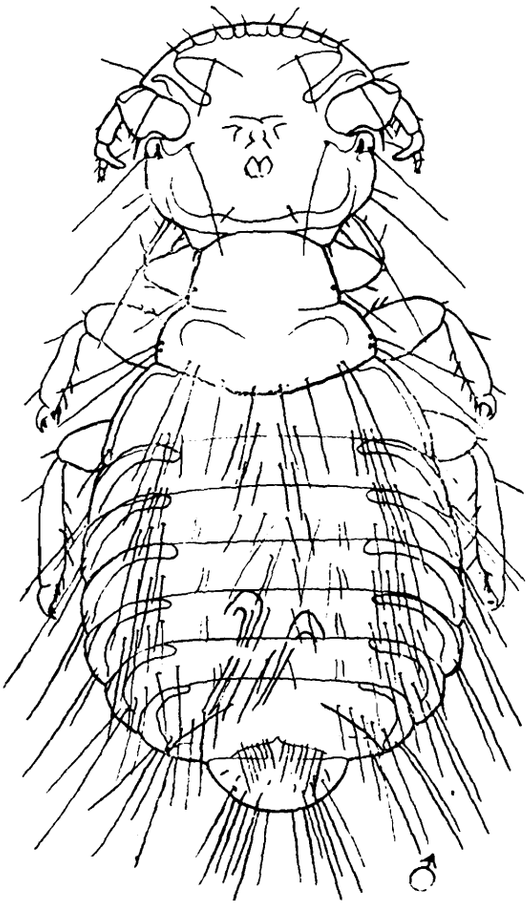

FIG. 1.—*Goniodes sectus*, Kellogg and Paine; Male.

and deep antennal emarginations; clypeus with marginal band widest in the centre and turning in before the antennae to form the long, narrow, red-brown antennal blotches, and with six hairs on each side, of which the second and last are the longest; on the anterior edge of the antennal emarginations is a long hair. Antennae with heavy first segment bearing a prominent protuberance on its posterior margin, from which arises a sharp spine; second segment as long as the third with its appendage, the appendage being quite long and continuous with the segment proper; last two segments about equal, much reduced, appearing as a two-jointed appendage of the third segment. Eye occupying the prominent posterior angle of the antennal emarginations, with an elongate ocular fleck, a long hair, and small,

rounded, ocular blotch. Head widest before the antennae and narrowing at once behind the eye, or straight for a short distance as is the case in some specimens (see figure); temples compressed, rounded, terminating in two rounded projections behind, each bearing a spine, and into which the marginal band of the concave occiput does not enter; occipital blotches wanting. Temples with two long hairs, one short one before the others and a prickle behind them; dorsal surface of head with four unusually long hairs, two on the clypeus and one near each ocular blotch; also two short ones on the occiput.

Thorax small, much shorter than head and darker. Prothorax quadrangular with sides straight and slightly divergent, bearing a long hair just before the posterior lateral angles.

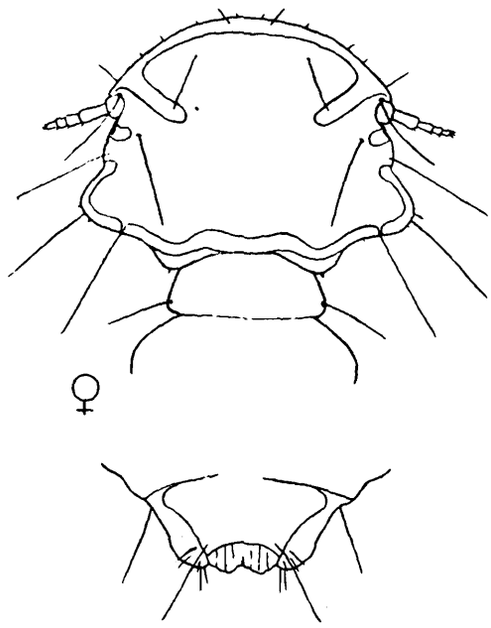

FIG. 2.—*Goniodes sectus*, Kellogg and Paine; Head and last segments of abdomen of female.

Metathorax but little narrower than head, with sides rounding inward anteriorly, each bearing two long hairs, and posterior margin convex on the abdomen bearing eight long hairs, the outer two on each side being paired. Posterior pair of legs with long tibiae.

Abdomen round, in older specimens much more so than is shown in the figure, nearly as broad as long; entire surface a clear golden brown, except the lateral bands which are red-brown these latter are long and turn in along the anterior margin of each segment. The dorsal hairs arise along the middle of each segment, rather than along the posterior margin as is usual; those hairs near the horizontal portion of the lateral bands are grouped and longer. Last segment rounded, protruding and entire, bearing numerous long hairs and a few short spines. Genitalia slightly chitinized, indistinct even in old specimens.

Female with head widest across the temples, which protrude laterally forming prominent angles; antennae weak, set in shallow emarginations. Abdomen somewhat tapering behind with last segment divided.

Measurements:

	♂, Length 3·24 mm.	Width.	♀, Length 3·56 mm.	Width.
Head	·96	·97	·96	1·34
Prothorax	·28	·69	·28	·69
Metathorax	·39	·96	·41	·95
Abdomen	1·76	1·83	2·28	1·73

Goniodes processus, n. sp.

(Plate xv, figs. 9, 9*a* and 9*b*.)

Two males from *Arboricola rufigularis* (Jorpokri, East Himalayas). A quite distinct form with large head and small thorax.

Description of male: Colour yellowish brown, head and thorax darker with central portion of abdomen quite pale and with dark red-brown markings on head and thorax and lighter lateral abdominal bands.

Head as broad as long, somewhat octagonal with prominent clypeus, flattened in front and on the sides and produced back under the antennae into a well developed hook, or trabecula-like process on each side (plate xv, fig. 9*b*); these processes are visible from above, showing through the first antennal segment. Marginal band broad, pale, ending in long, narrow, antennal blotches which reach inward and backward to the mandibles, the latter being set well back of the antennae and indistinctly visible; six inconspicuous dorsal and marginal hairs on each side of the clypeus, with several others on the ventral side. Antennae with rather short segments, the first being broad, without appendage and set into deep emarginations of the head; second segment about as long as the first is broad, and the third shorter with an appendage given off at almost right angles to the segment; last two segments together, of which the last is the longer, not quite as long as the second; colour of antennae about the same as that of the head. Eye prominent, rounded, with a long hair and small fleck; temples widening but slightly behind the eye, being no wider than the head across the trabecular processes, and then soon narrowing concavely, ending in two sharp, well produced points, between which is included the concave, but slightly sinuous occiput; occipital band and rounded blotches prominent.

Thorax small, a little narrower and but little over half as long as the head. Prothorax very short and narrow, being almost entirely included between the two posterior points of the head; lateral margin with one hair. Metathorax quadrangular, short, not half as long as broad, with parallel sides bearing three hairs on

a prominent pustule; posterior margin obtusely angled on the abdomen, with four hairs, in groups of two. Legs pale, little developed.

Abdomen truncate, widest at the second and third segments, with first segment longest and last longest and protruding; lateral bands paler than head markings, turning inward and narrowing along the suture, with a narrow, horizontal blotch at that point; transverse blotches present, though but faintly visible; segments three to seven with two long hairs on the posterior margin on each side at the inner edge of the lateral bands; also a row of fine hairs across the central portion of each segment. Genitalia narrow, reaching nearly to the first segment and well chitinized with small appendages.

Measurements:

	♂, Length 3·08 mm.	Width.
Head	·96	·95
Prothorax	·24	·69
Metathorax	·37	·89
Abdomen	2·60	1·39

Goniodes megaceros, n. sp.

(Plate xv, figs. 8 and 8*a*.)

A single male specimen from *Lophophorus impeyanus* (Zoological Garden Calcutta). This is a well marked new species, most resembling *G. bicuspidatus* Piaget, but plainly different, having longer processes on the first antennal segment, the metathorax not two-pointed behind, and the abdomen with heavy transverse blotches In this species we find the highest development of the *Goniodes* male antenna. Colour golden brown, pale or almost transparent in some places, with dark reddish-brown markings, except the transverse abdominal blotches which are more of a chocolate brown.

Description of male: Head broader than long, squarish, with rounded but not prominent front. Clypeus with a long submarginal hair and five very short ones on each side. Marginal band narrow, turning in a short distance before the antennae to form the narrow, darker, antennal blotches; the clypeus at this point is slightly emarginate. The antennae (Plate xv, fig. 8*a*), set in emarginations of only moderate depth, are highly developed even for this genus. The first segment is large, almost as broad as long with a double-pointed appendage occupying the greater part of the posterior margin; this appendage is highly chitinized, the outer prong short and turned inward, the inner one very long, reaching well back on to the temples, narrowing near its extremity though terminating bluntly. Second segment a little shorter than the first and much narrower; third joint and its appendage appears as a single, curved, claw-like segment, with the greatly reduced fourth and fifth segments projecting from the outer margin, appearing as a two-jointed appendage; these last two segments are of

about equal length. The third antennal segment and its appendage do not, in this species, appear as such: in fact if one considered this species alone the reason for considering the appendage present at all would not be apparent, but if one would imagine the appendage of the third segment in a form such as *G. processus* (described elsewhere in this paper), which is visibly appendage-like, as enlarged so as to become continuous with the segment proper, and imagine the last two joints as much reduced, he would see just such a form as we are now describing, and see the origin of this type. Below the antenna is a rounded ocular blotch and the clear prominent eye which bears posteriorly a short hair. The temples are quite square and are rather darker coloured than the rest of the head, and the margin, which is bordered by a pale, broken band ending in a narrow blotch behind the eye, bears two long, stout hairs and three short spines. Occiput concave, slightly sinuous, bare.

Thorax much longer than head. Prothorax trapezoidal with sides divergent and bordered by a dark band; posterior angles acute, bearing a long hair; posterior margin indefinite. Metathorax slightly broader than head, triangular, with apex forming a slightly obtuse angle on the abdomen; anterior lateral margins curved, with marginal bands which curve in toward the meson; the coxal bands appear within, parallel to those just mentioned. Each of the rounded lateral angles bears two hairs on a pustule, while on the posterior margin on each side are three submarginal hairs, two together near the lateral angles and one near the meson. Legs pale, ordinary.

The abdomen is shorter than the head and thorax together, is short and rounded, widest at the third segment; on each segment are lateral marginal bands, well chitinized, those behind the first entering into the segment preceding and curving inward. The large, dark, transverse blotches do not meet in the centre, the space left being uncoloured; dorsal hairs occur on the first five segments, confined to the central area, and on these segments, near the inner termination of the lateral marginal bands below the spiracles, arises a group of three or four hairs. The last three segments are compressed, the last entire and not reaching back as far as the one before, nor that one as far as the one before it; there is a fringe of about twenty-two long hairs across the dorsal surface of the last segment and the usual ones in the lateral angles of the other segments. The genitalia are prominent with heavily chitinized rods reaching to the second abdominal segment.

Measurements:

	♂, Length	4·40 mm. Width
Head	1·33	1·58
Prothorax	·58	1·20
Metathorax	1·00	1·75
Abdomen	2·08	2·46

Goniodes colchicus, Denny.

Many specimens from *Gennaeus albocristatus* (Mundali, Garhwal, 8500 ft. India, Simla, W. Himalayas), and *Gennaeus leucomelanus* (Nepal), *Gennaeus melanonotus* (Bhutan, E. Himalayas), *Phasianus humiae* (Ruby Mines, Burma). *Chrysolophus pictus* (China).

Goniodes dissimilis, Nitzsch.

Many specimens from *Phasianus principalis* (Morghal, Herat, Central Asia), *Phasianus torquata* (birds in captivity, Calcutta, India), *Phasianus soemmerringi scintillans* (no history), *Ithagenis cruentus* (Sikkim, E. Himalayas), *Gallus sonnerati* (Bangalore, S. India), and domestic fowl (Calcutta, India).

Goniodes eurygaster, Piaget.

Many specimens from *Lophophorus impeyanus* (Mussoorie, Kumaon, W. Himalayas; Sikkim, Darjiling, E. Himalayas).

Goniodes latifasciatus Piaget.

Many specimens from *Lophura ignita* (no history, India), *Polyplectron bicalcaratum* (no history, India), *Acomus erythrophthalmus* (no history, India).

Goniodes curvicornis, Nitzsch.

Numerous males and females from *Argusianus argus* (no history, India).

The females of this species, wrongly described by Taschenberg [1] (see our account, in this paper, of *Goniodes neumannia*, n. sp.) have a broadly elliptical abdomen, broad head, widest at posterior margin with angulated postero-lateral angles. The head is wider than that of the male and not so flattened and has the clypeal margin less flattened and more nearly parabolic in outline. The markings of head and body and the distribution and character of the hairs are like those of the male.

Goniodes cervinicornis, Giebel.

Males and females from *Lophura diardi* (no history, India).

Goniodes bicuspidatus, Piaget.

Numerous males and females from *Tragopan blythi* (Naga, Haka, and Mishmi Hills, Assam), *Tragopan caboti* (China), *Tragopan satyra* (Kumaon, W Himalayas).

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[1] *Die Mallophagen*, 1882, pp. 32-34.

Goniodes falcicornis, Nitzsch.

Two females from *Pavo nigripennis* (Zoological Garden, Calcutta, India).

Colpocephalum thoracicum, n. sp.

(Text-fig. 3.)

A single female from *Pavo muticus* (Burma). An extremely small species, but from blotches, etc., certainly an adult. But five

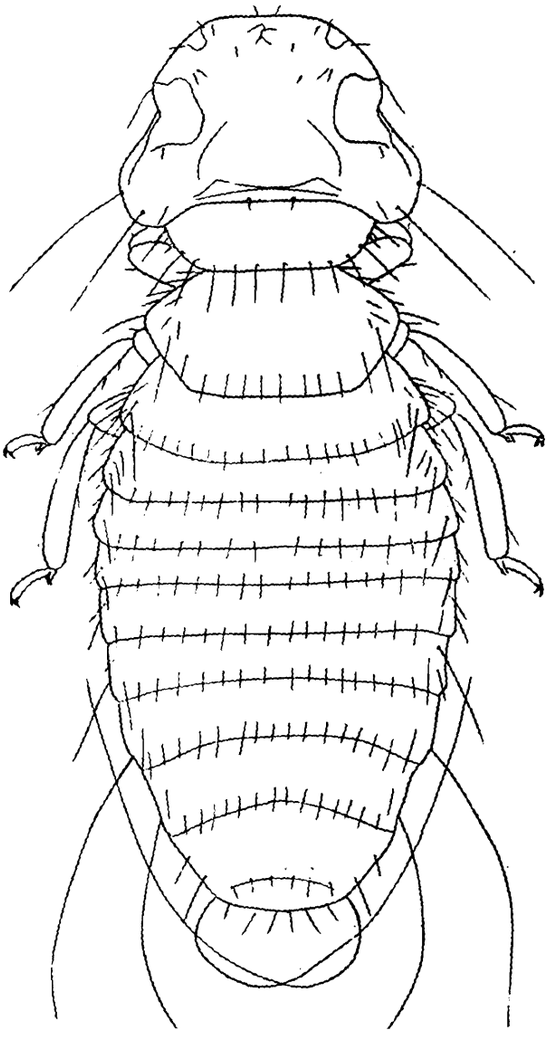


FIG. 3.—*Colpocephalum thoracicum*, Kellogg and Paine; Female.

other species of *Colpocephalum* have been recorded from the *Phasianidae*.

Description of female: Color pale yellow, uneven, in some places transparent, with blackish blotches on head. Head broader than long, widest across the temples; front flattened, straight; sides before the notch-like lateral emarginations slightly

rounded, but flattened, with a small dark blotch near the front. Lateral emarginations shallow with anterior angles rounded and surrounded by a large, dark chestnut to black blotch. Temples rounded, with indication of an angle behind, bearing a long marginal hair and, probably, a long surface hair, a distinct pustule being present. Occiput concave, with two short hairs and marginal blotches but little colored. Mandibles small but heavily chitinized; surface of head with a number of short hairs.

Thorax about as long as head. Prothorax short, flattened behind, with ten hairs; there are also two short spines at the sides and a long spine in the anterior angles. Metathorax quite large, hexagonal, broader than long; on the anterior lateral margins are several spines, while behind is a series of about twelve marginal hairs; there are also several lateral surface hairs. Legs pale in color, with narrow tibiae; mesothoracic pair missing in the specimen at hand.

Abdomen elliptical with yellowish transverse bands, interrupted submarginally, leaving a clear space running parallel to the margin of the abdomen; continuations of these transverse bands, laterad of the clear space, form indefinite lateral blotches; lateral blotches on last segment lacking, the median band nearly covering the entire surface. Last segment longer than the preceding, rounded, bearing two extremely long hairs, shown curved forward in the accompanying figure, and several short marginal ones; the two preceding segments also bear a long hair on each side; dorsal hairs on each segment weak.

Measurements:

	♀, Length 1·33 mm.	Width.
Head	·31	·43
Prothorax	·12	·30
Metathorax	·16	·36
Abdomen	·83	·56

Colpocephalum longicaudum, Nitzsch.

Males and females from *Argusianus argus* (no history) and domestic pigeon (Calcutta, India).

Colpocephalum appendiculatum, Nitzsch.

One female from *Argusianus argus* (Perak, Federated Malay States).

Menopon productum, Piaget.

Many specimens from *Acomus erythrophthalmus* (no history), *Acomus pyronotus* (no history, India), *Lophura diardi* (no history, India), *Phasianus seommerringi scintillans* (no history, India), *Phasianus ellioti* (Zoological Garden, Calcutta, India),

Lophura ignita (Zoological Garden, Calcutta, India), *Gallus sonnerati* (Bangalore, S. India), *Chrysolophus pictus* (China).

Menopon subequale, Piaget.

Males and females from *Acomus erythrophthalmus* (no history), *Gennaeus melanonotus* (Bhutan, E. Himalayas).

Menopon brevipes, Piaget.

Males and females from *Crossoptilon mantchuricum* (no history).

Menopon unicolor, Piaget.

One female from *Phasianus torquatus* (bird in captivity Calcutta, India).

Menopon ventrali, Nitzsch.

Three females from *Argusianus argus* (no history).

Menopon pallidum, Nitzsch.

Males and females from domestic fowl (Calcutta, India).

II. MALLOPHAGA FROM CORVIDAE.

Docophorus thryptocephalus, n. sp.

(Plate xiv, figs. 1 and 1*a*.)

Several males and females from *Graculus graculus* (Chitral and Gilgit, N.W India). This species resembles *D. atratus*, N., and *D. extraneus*, Piag., but differs from the former in having a shorter clypeus, and broader, more rounded temples, and from the latter in having a narrower clypeus; it also differs from both in having a three-lobed clypeal signature and in the fact that the head is much broader than long. The abdominal blotches are also darker and broader.

Description of female: Head, shape of an equilateral triangle with rounded angles Clypeus narrow, with clear anterior margin slightly convex or irregular. Lateral edges before antennae straight, diverging; antennal bands indefinite, irregular, interrupted at the suture, leaving a small clear space on the margin from which a very long hair arises; before the trabeculae the bands turn inward to join the occipital bands, becoming quite indefinite before they do so, however; that portion of bands near antennae very black A fine hair arises at the anterior termination of the antennal bands, also a hair on the dorsal surface at the middle of the inner edge of the anterior portion before the sutural interruption, and two more arising on the ventral surface and passing the margin behind that point. Signature with three lobes, the centre one pointed, reaching well down on to the mandibles; central and

anterior portions of signature pale. Space in front of the mandibles pale, divided by the signature. Trabeculae well developed, reaching beyond first segment of the antennae (fig. 1a) and slightly curved backward. Antennae long, first segment thick and about equal in length to the second; last three about equal in length, each half as long as the second; first segment light in colour with narrow black margins, the three following with dark transverse bands, the last lighter. Eye prominent, clear, with a very long hair on the dorsal surface. Ocular band narrow, curving inward, black near the margin at the anterior edge of the eye. Temples broadly and regularly rounded with a narrow, black, marginal band, interrupted by three pustules from which rise the long marginal hairs, and ending in contact with a black ocular fleck; a fourth marginal hair just below the eye, shorter than the others. Temples of a uniform dark chestnut colour. Occiput almost straight; occipital blotches blackish and occipital bands definite, extending forward, becoming somewhat indefinite before meeting the antennal bands. Occipital signature prominent, pointed in front. Space between occipital bands pale yellowish in colour.

Thorax shorter than head. Prothorax ordinary, with a long hair on the dorsal surface in each posterior lateral angle, arising from a clear pustule. Lateral margins with dark bands connecting with the internal chitinous structures. Metathorax diamond-shaped, with rounded lateral angles and prominent posterior angle. Posterior margin with a series of about eighteen pustulated hairs arising from the edge of the broad submarginal band, this band is interrupted on the meson and is continuous with the narrower lateral marginal bands. Legs well developed, dark in colour, with black markings on the femora and tibiae.

Abdomen elliptical, widest at the fourth segment. Ground colour light, almost transparent in some specimens, with dark chestnut abdominal blotches; blotches rounded, overlapping in front and behind, with the spiracles showing as clear spaces. Dorsal hairs evenly spaced across each segment, the series varying from ten to twenty-four in number. Genital blotch with two large, clear pustules.

Male much smaller than female, with abdomen more rounded. Last segment of abdomen entire.

Measurements:

♂, Length 1·61 mm.		Width.	♀, Length 2·01 mm.	Width.
Head	·50	·54	·54	·67
Prothorax	·12	·29	·12	·29
Metathorax	·14	·45	·26	·23
Abdomen	·89	·78	1·25	·71

Docophorus atratus, Nitzsch.

Many specimens from *Corvus cornix* (Kashgar, Chinese Turkestan; S. E. Persia), *Corvus splendens* (Calcutta, Guna and Trivan-

drum, S. India), *Corvus insolens* (Katha and Mergui, Burma), *Corvus macrorhynchus* (Upper Burma; Gilgit, N.W India), *Corvus corax* (Ladak, Little Tibet), *Corvus corone* (Yarkand, Chinese Turkestan), *Corvus sharpi* (Yarkand), *Corvus umbrinus* (Baluchistan), *Corvus scapulatus* (Abyssinia), and *Corvus danuricus* (Pekin, China).

The specimens from some of these hosts merit being distinguished under varietal names, but we shall not so designate them at present.

Docophorus fulvus, Nitzsch.

Many specimens from *Urocissa flavirostris* (Kashmir; Murree, W Himalayas; Ghoom, 7500 ft., E. Himalayas), *Dendrocitta rufa* (Cachar, Assam and Calcutta, India), *Dendrocitta himalayensis* (Darjiling; Perak), *Dendrocitta formosae* (N. Formosa), *Garrulus lanceolatus* (Murree, W Himalayas), *Nucifraga multipunctata* (Gilgit, N.W India), and *Pica rustica* (Ladak).

Docophorus leontodon, Nitzsch, var. **graculae,** Piaget.

Males and females from *Urocissa occipitalis* (Nepal Valley, E. Himalayas), and *Dendrocitta sinensis* (Foochow, China).

Docophorus crassipes, Nitzsch.

One female from *Pica rustica* (Punjab, India).

Docophorus superciliosus, Nitzsch.

One male and two females from *Graculus graculus* (Little Pamir).

Docophorus platystomus, Nitzsch.

One male from *Corvus cornix* (Gilgit, N.W India).

Docophorus rotundatus, Piaget.

One male and two females from *Corvus splendens* (Nepal Valley, E. Himalayas).

Docophorus guttatus, Nitzsch.

Males and females from *Corvus monedula* (Gilgit; Yarkand, Chinese Turkestan), and *Corvus macrorhynchus* (Nepal Valley).

Nirmus biguttatus, n. sp.

(Plate xiv, figs. 2, 2*a* and 2*b*.)

Males and females from *Graculus graculus* (Gilgit, Sarhad and Little Pamir, N. W Frontier of India; Khambajong, Tibet), also from *Nucifraga multipunctata* (Gilgit). Differs from

other Corvine Nirmi in heavy chitinization of head and body, showing as heavy, broad, transverse abdominal bands.

Description of male: All coloured portions quite dark with spaces between markings pale or transparent. Head bluntly conical, semi-parabolic before the antennae with sides of front flattened. Antennal bands blackish, continuous around the clypeus, but uncoloured where they meet in front, narrow, turning in before the antennae to form a black-edged blotch on each side. A median, inverted goblet-shaped clear space in front of the mandibles, bounded on each side by narrow, dark, not black, internal bands, losing their colour forward where they meet the transparent portion of the marginal band. Remaining area of head in front of antennae of a uniform, rather dark brown. Four evenly spaced clypeal hairs on each side of the central clear space; another smaller one on the angle before the antennae and two more in front, quite long, extending from the ventral surface. Antennae differing in the two sexes, being a third longer in the male, with the first segment longest and much enlarged; second segment nearly as long and but little shorter than the last two together; fourth and fifth about equal, while the third is a little longer than either of these two; each segment with several short hairs. In the female the second segment is much the longest and the last is longer than either of the two preceding. In both sexes the second, third and fourth joints are more darkly coloured. Antennal bands small, consisting of a small black blotch at the forward edge of each of the prominent eyes; eye with a short hair. Temples somewhat narrowly rounded, not expanded, with sides somewhat flattened; the dark, narrow, marginal bands interrupted on the rounded posterior angle, leaving a small clear space from which arises a long hair; some distance behind this is a minute prickle. In figure 2 the temples appear a little too much rounded, though there appears to be some variation in this respect, especially between the two sexes (fig. 2b). Occiput but slightly concave, bare, pale in colour. Ocular bands but partially visible, not meeting the occiput; space between bands clear, with signature visible, though indefinite.

Thorax much shorter than head. Dark lateral bands on both segments, turning in along their posterior margins, those of the metathorax not meeting on the meson and much heavier than those of the prothorax. Prothorax ordinary, with a long hair in each posterior lateral angle; metathorax longer than prothorax with straight, diverging sides; posterior margin obtusely angled on the abdomen, with a series of about fourteen submarginal hairs. Legs well developed with long, narrow tibiae and blackish markings.

Abdomen elliptical, widest at the third and fourth segments, each segment except the last with a dark blotch on each side, much darker toward the lateral margins with clear spaces for the spiracles on segments one to seven; in some specimens these

blotches meet at the centre and in others a median clear space is left. The ventral median blotches are visible from the dorsal surface. The last segment is rounded, protruding, bearing numerous long hairs. Each of the other segments with a transverse series of hairs arising along the posterior margin of the lateral blotches; there are also several long hairs in the posterior lateral angles. Genitalia appearing as a quadrangular plate with thickened margins and short penis and external appendages.

Female longer, more linear than male. Antennae as described above; last segment of abdomen bilobed, with two small blotches (fig. 2a); penultimate segment entirely coloured. In the specimens at hand the space between the blotches is not so clear as in the male, making the blotches appear less definite.

Measurements:

	♂, Leng. 1·62 mm.	Width.	♀, Leng., 1·92 mm.	Width.
Head	·47	·42	·50	·47
Prothorax	·12	·25	·10	·24
Metathorax	.14	·37	·12	·34
Abdomen	·98	·54	1·22	·52

Nirmus olivaceus, Nitzsch.

Many specimens from *Corvus splendens* (Nepal Valley, Trivandrum and Calcutta, India), *Corvus macrohynchus* (Nepal Valley, Ponsee, 3300 ft., Yunnan), *Pica rustica* (Upper Burma), and *Platysmurus leucopterus* (Perak, Federated Malay States).

Nirmus marginalis, Nitzsch.

Many specimens from *Dendrocitta rufa* (Calcutta, India; Cachar and Gowhatty, Assam; Burma), *Dendrocitta himalayensis* (Nepal Valley), and *Urocissa occipitalis* (Maundi, N.W India; Upper Burma).

Nirmus varius, Nitzsch.

Many specimens from *Corvus monedula* (Yarkand and Gilgit), *Corvus frugilegus* (Gilgit and Herat), *Corvus corax* (Ladak), and *Pica rustica* (Gilgit and Ladak).

Nirmus nigrosignatus, Piaget.

Males and females from *Garrulus leucotes* (Upper Burma).

Nirmus uncinosus, Nitzsch.

Males and females from *Corvus cornix* (Gilgit).

Nirmus punctatus, Nitzsch.

A single female of this characteristic gull- and tern-infesting *Nirmus* is included in the collection as taken from *Dendrocitta rufa*

(Calcutta, India). This is a clear case of straggling, the bird skin from which the parasite was taken having probably been temporarily near the skin or body of some gull or tern.

Nirmus clypeatus, n. sp.

(Plate xiv, figs. 3, 3a and 3b.)

A single male specimen from *Corvus cornix* (Kashgar, E. Turkestan). This species is Lipeuroid in general aspect of head and Nirmoid as to hind body.

Description of male: Head truncate conical, with transparent, expanded clypeus, the latter being the only part of the body without some colour. Portion of head in front of antennae considerably longer than that behind. A hair on the dorsal surface in the rounded anterior lateral angle of the clear portion of the clypeus; a marginal hair at the beginning of this clear portion and two more submarginal ones, one dorsal and one ventral, just behind; another hair on the margin at the distinct suture and a long one on the ventral surface directly mesad; also a hair on the margin some distance above the antennae and a ventral submarginal one midway between it and the suture. Clypeal signature broad, sides nearly parallel, obtusely pointed behind and somewhat paler than the general colour of the head. A light space before the mandibles, enclosed laterally by incurving internal bands. Antennal bands darkest where they turn inward before the antennae, extending forward a little past the origin of the clear portion of the clypeus and interrupted at the suture. Trabeculae acute, slightly shorter than the basal segment of the antennae. Antennae long, filiform, with first joint short, about the same length as the fourth; second segment longest, about as long as the two following together, and the last second in length. Eyes inconspicuous with a long hair. Temples flattened, slightly convex with rounded posterior angles; two hairs and a short prickle before these angles and narrow, black marginal bands extending from the posterior hair forward to the eye. Occiput slightly concave with anterior margin of prothorax showing through. Occipital bands pale, not reaching the occiput; space between bands a little lighter in colour than the temples with occipital signature visible.

Thorax about one-third shorter than head. Prothorax quadrilateral with sides slightly convex. Marginal bands present, turning in before they reach the posterior margin, not meeting on the meson; coxal bands distinct; a short hair in the posterior lateral angles. Metathorax with diverging sides and posterior margin obtusely angled on the abdomen. Three hairs arising from a clear pustule in the posterior lateral angle and two more near them with another small one, as shown in fig. 3b. Legs stout with few hairs.

Abdomen, excluding the first segment, elliptical, elongate, widest at the fourth segment; first segment appearing as a constriction, with sides slightly converging, narrower than metathorax

and much shorter than following segment; four hairs near the meson on the first segment, two near the anterior and two near the posterior margin, the latter being the longer. Second segment the longest, second last the shortest. Each segment with a transverse series of hairs, varying from two to four in number, the external one of each series on segments three to six being very long; there are also several hairs in the posterior lateral angles, increasing in length posteriorly. Each segment with a transverse band extending the full length of segments one to six inclusive, and partially divided on the meson, the division being most complete forward and diminishing in extent posteriorly; in the seventh and eighth segments the bands are narrowed and completely divided. Last segment rounded, entire, with numerous marginal, dorsal and ventral hairs and blotch covering segment. Genitalia with long, stout external appendages, equal in length to the anterior portion.

Measurements:

	♂, Length 1·88 mm.	Width.
Head	·50	·29
Prothorax	·11	·21
Metathorax	·16	·29
Abdomen	1·11	·47

Nirmus rufus, Nitzsch.

A single male from *Corvus sharpi* (Yarkand, Chinese Turkestan).

This specimen shows such differences from the description of the type of the species that it should probably be given a varietal name.

Colpocephalum semicinctum, Rudow.

Males and females from *Corvus splendens* (Trivandrum and Calcutta, India), *Corvus insolens* (Mergui, Burma), and *Corvus scapulatus* (Abyssinia).

Menopon insolitum, n. sp.

(Text-fig. 4.)

One male and one female from *Corvus insolens* (Mergui, Burma) This species belongs with Piaget's crow-infesting group, among which are several species with curiously deformed abdominal segments, and with two prominent groups of three or four short spines on the lower side of the first or second abdominal segments. Several of these species are: *M trinoton*, Piaget, *M anathorax*, Nitzsch, and *M mesoleucum*, Nitzsch. The present species differs from these in the form of the metathorax, the posterior margin of which is strongly convex, as well as in the shape of the abdominal

segments. This unusual condition of thorax and abdomen is found only in the female.

Description of female: Colour of body yellowish brown with lighter legs and head; thorax and abdomen with numerous short marginal spines. Head much wider than long, pale, almost transparent except for the curved ocular bands, mandibles and marginal occipital band. Front slightly angled on the meson and at the sides, with apparently several short hairs which have been broken off in our specimen, and longer ones before the ocular emarginations; ocular fringe prominent. Temples expanded, widest in front, with three pustules from which the hairs have been

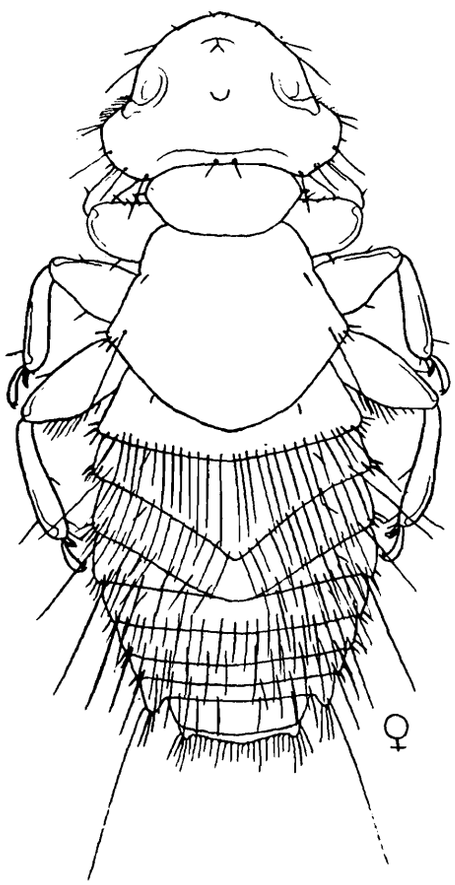


FIG. 4.—*Menopon insolitum*, Kellogg and Paine; Female.

broken, also two short hairs on each side; occiput concave with two short hairs.

Thorax just as wide as the head and as long as the first eight abdominal segments. Prothorax with median lateral angles bearing a short spine; posterior margin obscured, though probably convex. Metathorax, including mesothorax (which is indicated by a slight lateral marginal emargination), large, with posterior margin highly convex on the abdomen; sides almost straight, the posterior lateral angles armed with several short spines and a long submarginal hair. Colour of thorax darker than either head or abdomen, showing several internal bands.

Legs paler, front femora broad, last femora with a group of many short hairs along the posterior margin.

Abdomen shorter than head and thorax together, with sides evenly rounded, widest about midway; last segment truncate, bearing a fringe of fine hairs. Second and third segments strongly angled behind, the second being acute and the third more rounded; sixth and seventh segments short; segments five to eight with backward projecting postero-lateral angles, those of the eighth being quite prominent and each bearing a very long hair; these angles on all segments before the eighth bearing several short spines. Each segment bears a series of hairs across the posterior margin.

The male specimen at hand is very much smaller than the female, is probably not mature, though the genitalia appear well developed. The head is large in proportion to the rest of the body, with ocular bands and marginal occipital band darker than in the female specimen; a prominent, black ocular fleck is also present. The metathorax does not extend back over the abdomen as in the female, and the abdominal segments are ordinary. The abdomen is small, elliptical, with last segment entire, convex. The genitalia bear two well separated processes.

Measurements:

(probably juv.), ♂	Leng. 1·30 mm.	Width.	♀, Leng. 1·59 mm	Width.
Head	·34	·47	·36	·53
Prothorax	·13	·29	·13	·34
Metathorax	·28	·37	·43	·52
Abdomen	·60	·47	·80	·64

Menopon monochromateum, n. sp.

(Text-fig. 5.)

One female from *Garrulus lanceolatus* (Simla, W. Himalayas) and another from *Graculus graculus* (Khambajong, Tibet). A small, almost unicoloured species with unusually distinct black eye flecks and evenly parabolic anterior margin of the head.

Description of female: Ground colour of body yellowish brown, with golden brown markings and pale legs and marginal regions of head. Head much wider than long, semilunar, front with but faint indication of a median angle. Clypeus with two fine hairs, one on each side near the meson and five more, one of which is long, on the sides before the region of the ocular emargination. Ocular emargination almost completely filled by the eye, the latter with a large, distinct, black fleck. Temples narrow, rounded, bearing four long hairs, three of about half the length and several short spines. Occiput concave, apparently bare, with two small, dark, marginal blotches. Colour pale yellowish brown marginally, and darker, more golden near the centre; ocular bands dark, curving inward and forward; mandibles weak.

Thorax narrow, darker than rest of body, with distinct internal bands. Prothorax lenticular, the sides and posterior margin being continuous and rounded and bearing twelve hairs. Metathorax slightly wider, of about equal length, appearing as the first abdominal segment and bearing a submarginal series of about sixteen hairs. Legs pale, with broad femora and narrow tibiae well furnished with hairs.

Abdomen yellowish brown, long, widest near the middle; each segment with a darker, indefinite, transverse band and

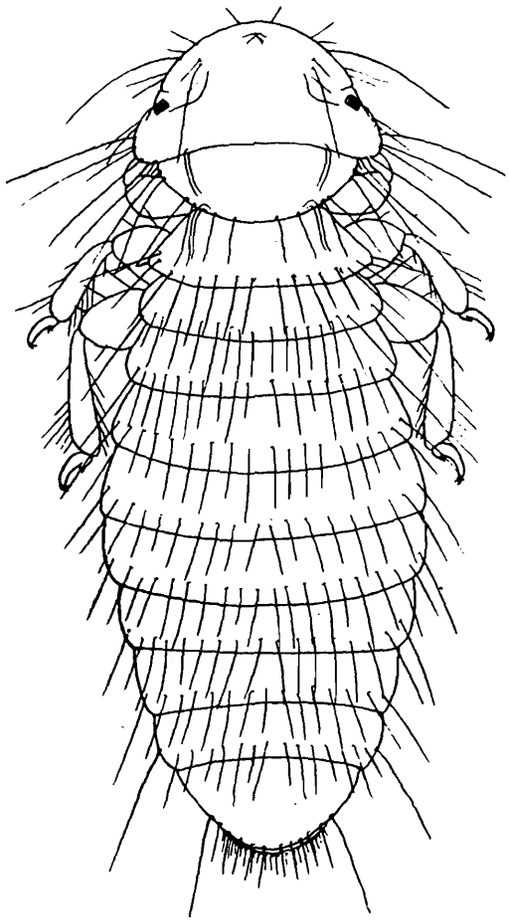


FIG. 5.—*Menopon monochromateum*, Kellogg and Paine; Female.

indefinite, interrupted marginal band. All segments, except the last, of about equal length, the last longer and rounded behind, bearing a fringe of hairs. Each segment with a transverse, submarginal series of hairs, the lateral ones the longest.

Measurements:

	♀, Length 2·03 mm.	Width.
Head	·37	·67
Prothorax	·19	·50
Metathorax	·19	·56
Abdomen	1·40	·83

Menopon nigrum, Kellogg & Paine.

Many specimens from *Corvus splendens* (Nepal Valley, Guna, Trivandrum and Calcutta, India), and *Corvus macrorhynchus* (Foochow, China).

Menopon mesoleucum, Nitzsch.

Males and females from *Corvus cornix* (Kashgar and Gilgit), *Corvus corone* (Yarkand).

Menopon albiceps, Piaget.

One female from *Garrulus sinensis* (Foochow, China).

Menopon meniscus, Piaget.

One female from *Pica rustica* (Shiraz, Persia).

Menopon picae, Denny.

One male from *Graculus graculus* (Khambajong, Tibet).

III. MALLOPHAGA FROM MISCELLANEOUS BIRDS.

Lipeurus secretarius, Giebel.

Numerous males and females from *Vultur monachus* (Dhappa, nr. Calcutta, India).

Lipeurus baculus, Nitzsch.

Many specimens from domestic pigeons (Calcutta, India).

Colpocephalum maculatum, Piaget.

Males and females from *Vultur monachus* (Dhappa).

Menopon breviceps, Piaget.

Four females from a domestic duck (Berhampur, Murshidabad dist., Bengal).

Nitzschia minor, n sp.

(Plate xv, fig. 10).

Males and females from *Cypselus affinis* (Calcutta). This species differs from other *Nitzschias* in having the temples rounded and not expanded nor angulated. It is of small size with no strong markings and does not have a flat clypeal front as in Carriker's *N latifrons*.

Description of female: Colour pale yellowish brown, head lighter than thorax and abdomen, with no dark markings except ocular flecks and mandibles which are blackish.

Head shape of triangle with corners cut off, broader than long; front very obtusely but distinctly angled, with six or seven long hairs and several shorter ones; the concavity of the margin at point where palpi would project is all but imperceptible and the ocular emarginations are shallow with a conspicuous ocular fringe. Temples rounded, not angulated nor expanded, with five long hairs on each side and two short ones, also two short spines. Occipital margin concave, almost straight in the middle with four long hairs. Ground colour pale tawny with small, black, ocular flecks, blackish mandibles, brownish blotches on each side of the clypeus, and very small, weakly coloured ocular blotches.

Thorax just as long as the head. Prothorax trapezoidal with shortest side behind; sides converging, almost straight, and posterior margin slightly rounded; a long hair and two spines in the anterior angles, a hair on the rounded posterior angles and four on the posterior margin. Line of fusion between the meso- and metathorax plainly visible, marked by lateral emarginations and by a suture; metathorax appearing as the first abdominal segment, with four short spines along the mesothoracic suture, two stout spines in the posterior lateral angles and a row of hairs across the posterior margin. Legs rather long, concolorous with the thorax, the first pair with broad, short femora and the last pair with a patch of many short hairs, invisible from above, on the under side of the femora.

Abdomen elongate, widening to the fourth segment, then rounding evenly to the last which is truncate and bears a fringe of fine hairs; several short spines on the posterior margin of the first three segments near the lateral angles and each segment with a row of hairs across the posterior margin; posterior lateral angles with the usual long hairs. Colour an even yellowish brown with no blotches visible; narrow, transparent, lateral bands are present. Beneath, the sutures are laterally distinct and here is borne on each side a row of from five to eight short spines. In the male the last segment is narrower, more rounded and slightly protruding, not truncate.

Measurements:

	♀, Length 1·92 mm.	Width.	♂, Length 1·75 mm.	Width.
Head	·47	·59	·39	·52
Prothorax	·23	·36	·22	·32
Metathorax	·32	·58	·27	·48
Abdomen	·90	·71	·87	·71

EXPLANATION OF PLATE XIV.

FIG. 1.—*Docophorus thryptocephalus*, K. & P., ♀.

,, 1*a*. Antenna enlarged

,, 2.—*Nirmus biguttatus*, K. & P., ♂

,, 2*a*. Last segments of female.

,, 2*b*. Antenna of female.

,, 3.—*Nirmus clypeatus*, K. & P., ♂

,, 3*a*. Antenna enlarged.

,, 3*b*. Arrangement of metathoracic hairs.

,, 4.—*Goniocotes indicus*, K. & P., ♂

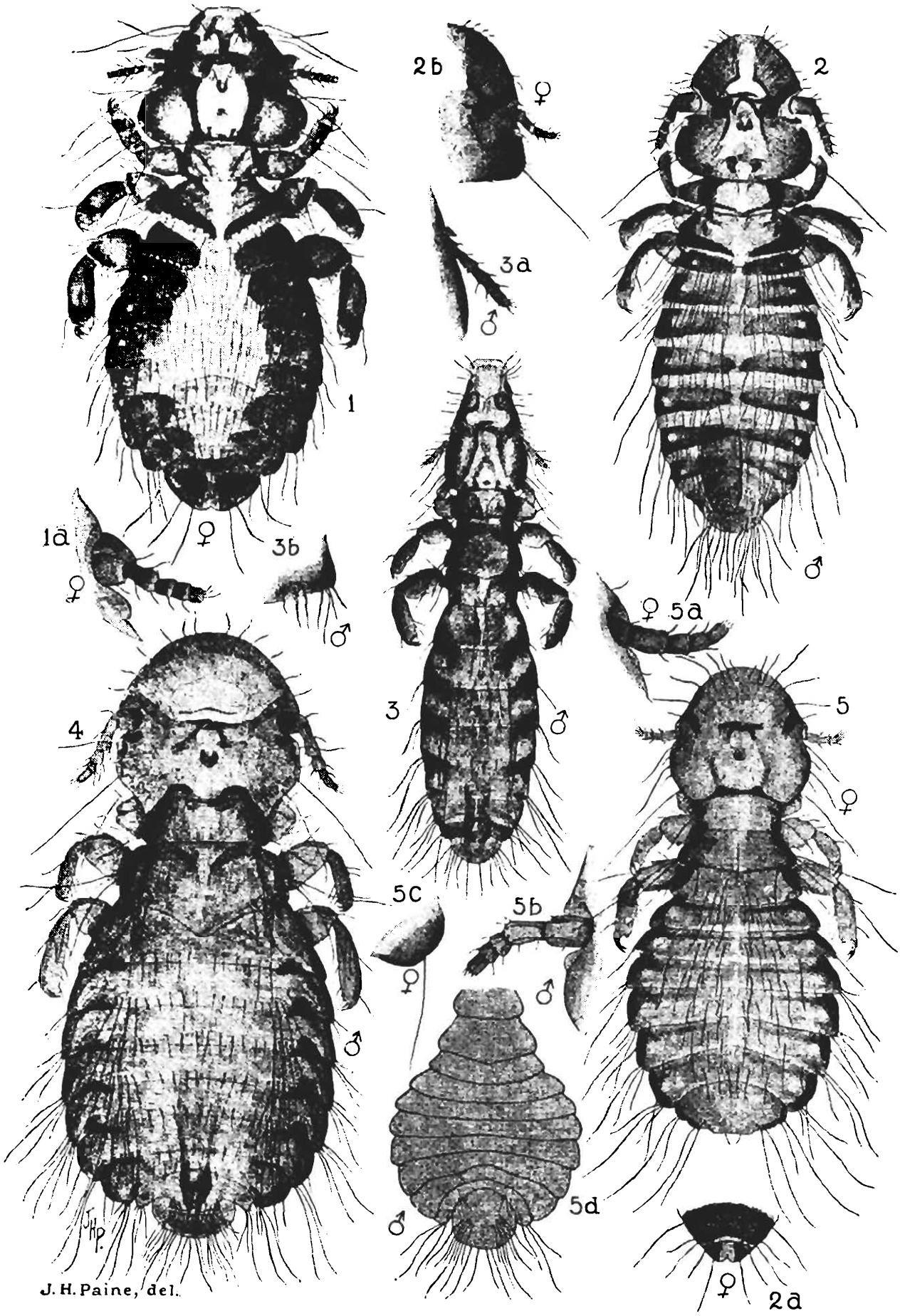
,, 5.—*Goniocotes nirmoides*, K. & P., ♀

,, 5*a*. Antenna of female enlarged.

,, 5*b*. Antenna of male on same scale as fig 5a.

,, 5*c*. Showing emargination and hair on temple.

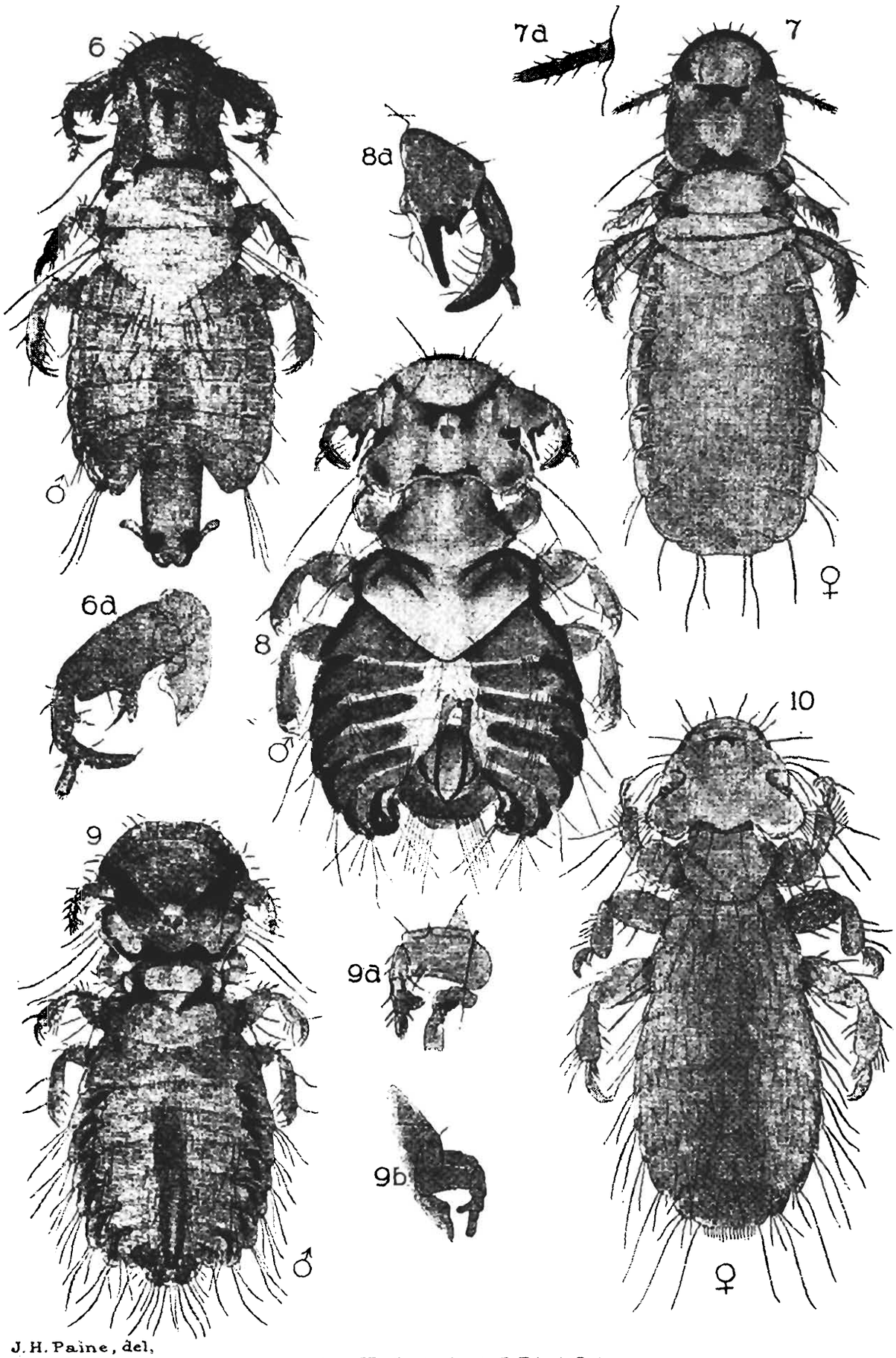
,, 5*d*. Thorax and abdomen of male.



ASIATIC MALLOPHAGA.

EXPLANATION OF PLATE XV.

FIG. 6.—*Goniodes neumannia*, K. & P., ♂.
,, 6*a*. Antenna enlarged.
,, 7.—*Goniodes neumannia*, K. & P., ♀.
,, 7*a*. Antenna enlarged.
,, 8.—*Goniodes megaceros*, K. & P., ♂.
,, 8*a*. Antenna enlarged.
,, 9.—*Goniodes processus*, K. & P., ♂.
,, 9*a*. Antenna enlarged.
,, 9*b*. From below, showing process on head.
,, 10. *Nitzschia minor*, K. & P., ♀.



J. H. Paine, del.

ASIATIC MALLOPHAGA.

XIII REPORT ON A COLLECTION OF FREE-LIVING NEMATODES FROM THE CHILKA LAKE ON THE EAST COAST OF INDIA

By F. H. STEWART, D.Sc.

[The collection on which this paper is based was made in connection with a zoological survey of the Chilka Lake now being undertaken by zoologists attached to the Indian Museum. The lake is a large lagoon connected with the sea by a narrow mouth and containing water that varies greatly in salinity at different places and at different seasons. Full particulars on this and other points will be given in a later paper—N. ANNANDALE.]

Distribution of the genera to which the species described in the following report belong.

(1) GEOGRAPHICAL. The four genera *Oncholaimus*, *Dorylaimus*, *Monhystera*, and *Leptosomatum* are cosmopolitan. Species of *Oncholaimus*, *Monhystera*, and *Leptosomatum* have been recorded from localities ranging from Scandinavia to the Antarctic, while *Dorylaimus* also occurs in the five continents and the Pacific islands.

(2) HABITAT. *Oncholaimus* is almost exclusively a marine genus. The exceptions to this rule recorded up to the present are—*O. rivalis*, Leydig, a doubtful *Oncholaimus* (Lit. 1); *O. thalassophygas*, de Man, which occurs in fresh water and the soil in Holland (Lit. 7); *O. indicus* v. Linstow, in the brackish water of the Ganges delta.

Dorylaimus has been recorded only from fresh water and the soil.

Monhystera is chiefly a freshwater genus. Bastian (Lit. 1) describes two species (*M disjuncta* and *ambigua*) from the sea, with a doubt, however, as to whether they should truly be classed in the genus. G. Schneider (Lit. 11) describes two species (*M. trabeculosa* and *bipunctata*) from the Baltic. Several species such as *M. microphthalma*, *macrura*, and *agilis*, deMan, inhabit brackish water.

Leptosomatum is entirely marine.

Oncholaimus chilkensis, sp. nov.

(Pl. xxx, figs. 1—4; Pl. xxxi, figs. 15, 17, 18.)

Two tubes; (1) *Indian Museum No. ZEV* 6237/7. Among filamentous algae at edge of lake: Chilka Lake, Gantasila, Ganjam district, Madras. 19-4-14. Two adult female specimens, mounted

in glycerine-jelly-formalin. (2) *Indian Museum No. ZEV* 6195/7: from *Spongilla* sp., Pigeon Island, Chilka Lake, Orissa. 25-1-14. Two immature specimens, mounted in glycerine-jelly-formalin.

The measurements will be found in Table I

The head is marked off from the body by a slight but abrupt increase in breadth at the level of the posterior end of the buccal capsule. The maximum breadth is situated at the middle of the body and decreases very slightly and gradually to the anterior end; in the posterior third there is also a slight but gradual decrease to the anus; tail conical from the anus to the commencement of the caudal appendage. Vulva very slightly prominent, close to the middle of the body.

The head bears six lips, mobile as in *O. indicus*. In the four specimens under consideration at present the lips are closed in over the mouth. The lips are situated—two laterally, two subdorsally and two subventrally. Each lip bears a minute papilla on the outer surface. Bristles do not occur on the head. Lateral organs, oval in shape, lying transversely, distant 0·019 mm. from the anterior extremity, length 0·005 mm., breadth 0·0085 mm., anterior border of the oval slightly flattened. Buccal capsule cylindrical with a large right subventral tooth, and two smaller teeth, one dorsal, one left lateral as in *O. indicus*, v. Linst.

No rings on the cuticle. Hairs occur irregularly in the oesophageal region, one marked row in each lateral line in this region. No bristles at the vulva or anus.

Tail simply conical from the anus to the commencement of the caudal appendage, differing therefore from *O. fuscus*, Bast. and *O. indicus*, v. Linst. (*vide* Pls. xxxi, xxxii, figs. 18, 19, 20). The caudal appendage is uniform in diameter and curves ventrally. A very slight annular constriction at the junction of tail and caudal appendage. A single caudal gland tube in front of the caudal appendage.

Oesophagus simple club-shaped, coarsely muscular. Intestine with many black globules.

Nerve ring not observed. Many cells enclosing the oesophagus. No ocelli.

Female gonads of the usual double type, a shell gland interposes between ovarian caecum and uterus as in *O. vulgaris*, Bast.

Contrasting	(1) *O. fuscus*, Bast.	(2) *O. indicus*, v.L.	(3) *O. chilkensis.*
Total length ...	7 mm. ...	2·2 mm. ...	2·2 mm.
Head and body	Separated by a very faint increase of breadth at end of mouth capsule.	Not separated. Fig. 16. ...	Separated by marked increase of breadth. Fig. 17.
Shape of tail ...	Fig. 20. ...	Fig. 19. ...	Fig. 18.
Colour ...	Brown. ...	Grey. ...	Brown.

Cobb's Formula, ♀ , $\frac{1{\cdot}37 - \times - 2{\cdot}59 - 2{\cdot}74 - 1{\cdot}63.}{1{\cdot}37 - \times - 11{\cdot}9 - 45{\cdot}9 - 95.}$

Dorylaimus, sp.[1]

(Pl. xxx, figs. 5—7.)

(1) One tube unnumbered: from *Suberites aquae-dulcioris*, Annandale, Gantasila, February 1914, and (2) *Indian Museum No. ZEV* 6194/7: from *Spongilla* sp., Pigeon Island, Chilka Lake. 25-1-14.

Measurements—Table I.

Head rounded. Body cylindrical (Pl. xxx, fig. 5). Tail short, obtusely rounded. Head region narrower than the rest of the body including the tail.

Head (Pl. xxx, fig. 7), no lips or papillae or bristles; no lateral organs, but a pair of tubular organs in the dorsal and ventral lines distant 0·008 mm. from the head; opening of tubule slightly prominent; tubule runs inward and backward. Buccal capsule not present; quill 0·024 mm. long.

No rings or marks on the cuticle.

Tail short and blunt; in the male one short bristle in front of the anus, and the oblique muscular striation usual in the genus.

Oesophagus divided into anterior and posterior portions of subequal length by a diaphragm. At the junction of the two sections, the anterior section measures 0·022 mm. in diameter, the posterior section 0·026 mm., the radial muscular striation of the second section is more distinct and coarse than that of the first section. The posterior part of the second section is glandular in structure, and measures 0·03 mm. in diameter.

Nerve ring at junction of the two sections of the oesophagus.

Ventral duct or gland not observed.

Male gonads consist of two opposed testes and the vas deferens. Spicules two, very broadly sabre-shaped. No preanal papillae.

Female gonads of usual type. Uterine egg elongated subcylindrical.

Most closely allied to *Dorylaimus intermedius*, de Man: head without lips; tail blunt, very short.

Monhystera uria, sp. nov.

(Pls. xxx and xxxi, figs. 8—10.)

Indian Museum No. ZEV 6196/7.

From the gelatinous spawn of a Eunicid worm, Rambha, Chilka Lake, Ganjam, edge of the lake. 24-1-14. Six specimens examined, mounted in glycerine-jelly-formalin. Three males, two females, one immature.

Head rounded. Anterior extremity slightly tapered. Greatest diameter near the middle of the body; body attenuated

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[1] Owing to the absence of zoological consulting libraries in the smaller stations of India the present writer is unable to assure himself that this species has not already been described. It has consequently not been named, but the writer hopes to be in a position to supply the omission at an early date.

gradually in the posterior quarter to form a filiform tail. (Pl. xxx, figs. 8 and 9.)

The head bears a low collar of delicate mobile membrane around the mouth. No papillae or bristles. Lateral organs distinct, circular, 0·0038 mm. in diameter; distance of the organs from the head equal to the breadth of the cephalic cone (0·0053 mm.). Oral cavity oval, enclosed between the collar and the anterior end of the oesophagus.

The cuticle bears no rings, marks, or hairs, with the exception of one flagellum on the extremity of the tail.

Lateral lines not distinguishable from muscle fields in preparations of the entire animal.

The tail decreases gradually in diameter from the level of the anus; conical in shape. No bristles, glands, or papillae, with the exception of the single terminal flagellum.

Oesophagus simply club-shaped. No bulbs, division, or definite colouration; no appendix. Intestine as in the genus; no sign of cellular division; charged with black granules superficially. Rectum short.

Nerve ring not observed. No ocelli.

No ventral gland.

Testis commences 0·017 mm. behind the end of the oesophagus and lies on the right side of the intestine. A prostate-like mass present at the junction of the testis and vas deferens. Vas deferens opens immediately in front of the anus through a small almond-shaped body. Two spicules in the wall of the rectum, long, thin, simply curved. Ovary in anterior extremity 0·102 mm. distant from head; ovary and uterus single. Uterus short, sausage-shaped, 0·064 mm. in length, contains spermatozoa only.

The immature specimen (Pl. xxxi, fig. 10) measures 0·357 mm. in length, possesses a distinct tubular buccal cavity with fine chitinous walls and a pointed anterior extremity, which is perforated for the mouth. Oesophagus clothed with a cellular coat. An oval hyaline mass situated posterior to the oesophagus represents the gonads. The intestine is composed of loose fibrillar tissue with some black granules.

The species is most closely allied to *Monhystera dispar*, Bast., in that it bears no ocelli, possesses a gut with black granules; a smooth unringed cuticle; lateral organs not spiral; distance of lateral organ from head equal to breadth of head; distance of vulva to anus greater than anus to tail. It differs from *M. dispar* in the following points:—Total length in *M dispar* 0·72—1·1 mm.; in *M. uria* 0·54 mm.; $\frac{\text{oesophagus}}{\text{total length}}$:—in *M. dispar* $\frac{1}{4·5—5·5}$ in *M. uria* $\frac{1}{5·8}$; $\frac{\text{tail}}{\text{total length}}$:—in *M dispar* $\frac{1}{6—7}$ in *M uria* $\frac{1}{5·25}$ Six oral hairs in *M. dispar*, none in *M uria*. Short filiform caudal appendage in *M uria*, none in *M. dispar*. Males more frequent in *M. uria*, unknown in *M dispar*.

Cobb's Formula— ♂ $\frac{1{\cdot}03 - \times - 2{\cdot}32 - 2{\cdot}83 - 2{\cdot}32}{{\cdot}51 - \times - 13{\cdot}9 - 50{\cdot} - 85{\cdot}8}$

♀ $\frac{\times - \times - 3{\cdot}1 - 3{\cdot}8 - 2{\cdot}5}{\times - \times - 17 - 58 - 83{\cdot}}$

Leptosomatum indicum, sp nov.

(Pl. xxxi, figs. 11—14.)

Indian Museum, No. ZEV 6142/7.

Manikpatna, outer channel of Chilka Lake, on the 16th of September 1903, from algae an an oyster shell. A single male specimen, mounted in glycerine jelly-formalin.

Head rounded. Diameter of the body increases in the first 0·34 mm. of the length to 0·0703 mm., thereafter increases very gradually to 0·088 mm. at a distance of 0·185 mm. from the tail. The tail is curved ventrally

Lips none. Papillae none. The mouth is surrounded by a membranous ring. A cap of yellow cuticular substance lies under the cuticle of the head, the base of the cap reaching to a distance of 0·022 mm. from the anterior extremity. The cap when seen in optical section presents the appearance of distinct skeletal pieces. A circle of very scant (4) short and stout hairs surrounds the head. Lateral organs are present—spherical capsules opening by an oval pore to the exterior; breadth of the capsule 0·0074 mm. (The lateral organs are described by Bastian as the apertures of the excretory glands.) Buccal cavity not present.

No rings or markings of the cuticle. No hairs except around the mouth.

Tail rounded obtuse. Anus slightly prominent. A papilla situated in the midline 0·071 mm. before the anus. No caudal bristles. Oblique muscles in front of the anus as in *Dorylaimus* Three tubular caudal glands opening at the posterior extremity. The duct of the caudal glands, while traversing the substance of the cuticle, is dilated to form a peculiar biscuit-shaped ampulla.

Alimentary System.—The oesophagus is of uniform breadth throughout the greater portion of its length. It measures 0·022 mm. until within 0·29 mm. from the posterior extremity of the organ. At this level it commences to expand slightly and reaches a maximum of 0·033 mm.

The oesophagus is not divided into sections nor dilated to form bulbs: colour of a dull yellow; not markedly muscular. A nipple-like appendage of the oesophagus projects into the commencement of the lumen of the intestine.

Intestine of the usual form; it does not exhibit tesselation on the outer surface, which is rough and irregular in appearance. Rectum not observed.

Nervous System.—Nerve ring 0·02 mm. in breadth, distant 0·289 mm. from the head. Cellular collar commences 0·05 mm.

from the head and clothes the remainder of the oesophagus: is exceptionally developed. Ocelli two in number, diameter of the ocellus 0·009 mm; distance of ocelli from the head 0·56 mm. They lie on the outer surface of the oesophagus immediately dorsal to the lateral lines; colour, black with a tinge of red. Two lines of fine red-black granules extend backward for a short distance from the ocelli.

Lateral organs as described above.

The Excretory System.—Excretory glands not distinguishable, but may exist in the mass of collar cells. No opening of the ventral gland distinguished unless a slight mark in the ventral line opposite the nerve ring represents the pore.

Male Reproductive Organs.—The fundus of the anterior testis lies 1·7 mm. distant from the head. Testes double; remainder of tract single. Spicules two, of the form indicated in fig. 13 of Pl. xxxi, hollow. A single accessory piece.

Cobb's Formula— ♂ $\frac{0—1·32—1·32—1·55—1·7}{0—5·78—15·78—50·0—98·4}$

Monhystera megalaima, sp. nov.

(Pl. xxxii, figs. 21—27.)

Indian Museum No. ZEV 6237-7. Among filamentous algae at edge of lake, Chilka Lake, Gantasila. 19-4-14. One male, one female, mounted in glycerine-jelly-formalin.

Measurements, see Table I.

Female.—A delicate organism. Body tapering only very slightly to the head, the posterior extremity tapers gradually from a short distance in front of the vulva; tail pointed but not filiform, with a permanent ventral curvature.

Head marked off from the body by a slight annular constriction; anterior surface flatly rounded (Pl. xxxii, figs. 22, 23); a circle of stout bristles, six in number, surrounds the head; length of bristles 0·0136 mm.; internal to this ring is a second ring of very short spines. No lips or papillae. Lateral organs large, circular, 0·0088 mm. in diameter; their anterior margin 0·0187 mm. from the head, a distance approximately equal to the breadth of the head. Mouth capsule oval, transverse, walls delicate; no teeth or cuticular thickenings.

Cuticle marked with very fine transverse rings from head to tail; the rings extend throughout the thickness of the cuticle. Hairs scanty, scattered irregularly, of remarkable length (0·02 mm., i.e. more than half the breadth of the body) and tenuity, sometimes spirally curled. No papillae.

Lateral lines and muscle fields not distinguishable.

Tail, see Pl. xxxii, fig. 24; a circle of short bristles close to the tip, no bristles at the anus or vulva. No glands or papillae.

Oesophagus simple, club-shaped, no bulb or division; a transverse diaphragm in the muscular substance at a level immediately

in front of the lateral organs. Intestine with brown granules and without tesselation.

Neither nerve ring nor cellular collar visible.

No ventral gland.

Fundus of ovary 0·205 mm. from head. Gonad tube single as in the genus. Uterus contains large unsegmented ova.

Male.—General outline resembles the female but the tail is more blunt. (Pl. xxxii, fig. 25).

The specimen is coiled on itself, and owing to its delicate character could not be straightened. The head is therefore seen obliquely and foreshortened. Indications of a buccal cavity are however visible, together with the cephalic ring of setae as in the female (Pl. xxxii, fig. 26). Lateral organ faintly distinguishable.

Cuticle as in the female. No bristles observed on the body.

Tail narrows abruptly near the termination. No glands, papillae, or bristles.

The testis commences immediately behind the oesophagus and lies on the left side of the intestine. Vas deferens situated ventrally to the intestine. Spicules (Pl. xxxii, fig. 27) with knob-like proximal extremities, twisted shafts, and glans-like distal extremities, hollow.

This species resembles *M. dubia*, Bütschli, and *M. agilis* de Man, in possessing a transversely striated cuticle; contrasted with the former, however, it is of more slender form, and the lateral organs are not spiral; contrasted with the latter, the vulva is situated more posteriorly, and the distance from vulva to anus is equal to, not twice as great as, the distance from anus to tail.

Cobb's Formula,— ♀ $\frac{\times - \times - 2{\cdot}69 - 2{\cdot}84 - 2}{0{\cdot}69 - \times - 16{\cdot}1 - 78{\cdot}1 - 88{\cdot}3}$

LIST OF SOME IMPORTANT PAPERS DEALING WITH FREE-LIVING NEMATODES.

(1) Bastian, Charlton — Monograph of the Anguillulidae.—*Trans. Linn. Soc.*, vol. 25, 1866.

(2) Bütschli, O. — Beiträge zur kenntniss der freilebenden nematoden.—*Nov. Act. Kais. Leop. Carol. Akad.*

(3) Bütschli, O. — Zur Kenntniss der freileb. Nemat.—*Senckenbg Natforsch. Ges. Abhand.* 1873.

(4) Daday, v. — Freshwater nematodes of South America.—*Zoologica*, 1905, p. 51.

(5) Daday, v. — Freshwater nematodes of German Africa.—*Zoologica*, 1910, vol. 23.

(6) Daday, v. — Die freilebende Süsswasser-Nematoden Ungarns. —*Zoologisch. Jahrb.*, Syst., Bd. 10.

(7) Man, de — *Nematoden der Niederländisch. Fauna*, Leiden, 1884.

(8) Man, de *Mém. Soc. Zool. de France*, vol. 1.
(9) Man, de *Mém. Soc. Zool. de France*, vol. 2.
(10) Man, de *Zool. Jahrb.*, Suppl. 15, vol. 1, 1912.
(11) Schneider, G. *Zool. Anz.* 29, p. 626.

LETTERING OF PLATES.

Reference letters—acc. p=accessory piece, *amp.*=ampulla, *an.* =anus, *b.c.*=buccal cavity, *ceph. cap*=cephalic cap, *d. ej* = ductus ejaculatorius, *d.h.*=dorsal hair, *d. t.*=dorsal tooth, *d. tu.*= dorsal tubule, *go.*=gonads, *h.*=hair, *in.*=incisura, *int.*=intestine, *lat. h.*=lateral hair *l. l.*=lateral line, *l. lat. lip pap.*=papilla of lateral lip, *l. m* =longitudinal muscle, *L. lat. o.*=left lateral organ, *l.o.* and *lat. o.*=lateral organ, *l. oc.*=left ocellus, *L. sp.*=left spicule, *n. r.*=nerve ring, *obl. m*=oblique muscle, *oc.*=ocellus, *oe. pig. gran.*=oesophageal pigment-granules, *oes.*=oesophagus, *oes. l.*=oesophageal lumen, *ov.*=ovary, *pap.*=papilla, Pap. R. *lat. lip.*=papilla of right lateral lip, *q.*=quill, *rect.*=rectum, *R. lat. o.*=right lateral organ, *r.s.v.p.*=right sub-ventral papilla, *R.s.v.t.*=right sub-ventral tooth, *s.d.t.*=right subdorsal tooth, *sp.*=spicule, *t. g.*=tail gland, *ut.*=uterus, *v.*=vulva, *vag.*=vagina, *v.h.*=ventral hair, *v t.*=ventral tooth, *v.tu.*=ventral tubule.

Table I.	*Oncholaimus chilkensis.*			*Dorylaimus*, sp.			*Monhystera uria.*			*Monhystera macrolaima.*		*Leptosomatum unumcinctum.*
	♀6237A	6195	♀6237B	♂ from *Suberites.*	♂6194	♀6194	♂6196	♂6196	♀6196	♀6237	♂6237	♂6142
					2	2	1*a*	1*b*	3			
Total length	2·210	1·540	2·700	2·000	1·870	1·938	...	·660	·536	1·300	·765	5·000
Maximum breadth ...	·060	·057	·074	·041	·044	·052	...	·019	·024	·044	·025	·088
Head to maximum br. ...	·022	...	...	...	...	...	...	...	...	...	...	4·815
Mx. br.	1	1	1	1		1		1	1	1	1	1
Total l.	36·8	28·7	36·	50	...	37	...	37	23	29·5	30·6	56·8
Head br.	·022	...	·026	·015	...	·012	..	...	...	·0185	...	·033
Buccal capsule l. ...	·039	·032	·037	...	...	...	...	·003	...	·009	...	...
Br. of body at end bucc. cap.	·037	·027	·037	...	...	...	...	·007	...	...	...	...
Oesophag. l.	·323	·269	·323	·377	·425	·400	...	·092	·093	·210	·0935	·799
Oesophag. l.		1		1	1	1		1	1	1	1	1
Total l.	...	5·7	...	5·3	5	4·4	...	7·1	5·8	6·2	8·07	6·38
Br. of body at end oes. ...	·055	·056	·070	·037	...	·040	·015	·015	·017	·035	·020	·066
Ant. end oes. to nerve ring...	...	·104	...	·200	...	·200	...	...	...	...	...	·289
Nerve ring to post. end oes.	...	·155	...	·177	...	·200	...	...	...	...	...	·510
Ant. end oes. to n. r.		1										1
N. r. to post. end oes. ...	...	1·49	...	...	...	...	...	...	..	...	...	1·7
Br. of body at n. r. ...	...	...	...	...	...	·035	...	...	...	...	...	·066
Oes. ant. mx. br. ...	·022	·017	·026	·026	...	·019	...	...	...	...	...	...
Oes. ant. min. br. ...	...	...	...	·022	...	·014	...	..	...	...	...	...
Oes. post. mx. br. ...	·033	·029	·042	·030	...	·032	...	...	...	...	...	·033
Oes. post. min br. ...	...	...	...	...	...	...	...	...	...	...	...	...
Head to vulva	1·280	...	1·240	...	...	·850	...	...	·314	1·016	...	...
Vulva to tail	1·140	...	1·450	...	...	1·090	...	...	·222	·284	...	...
Head to vulva	1		1			1			1	1		
Vulva to tail	0·89	...	1·17	...	...	1·28	...	...	0·7	0·28	...	...

Table I.	*Oncholaimus chilkensis.*			*Dorylaimus*, sp.			*Monhystera uria.*			*Monhystera macrolaima.*		*Leptosomatum indicum.*
Br. of body { at middle	...	...	...	...	...	...	...	...	...	·044	·025	...
Br. of body { at vulva	·060	...	·074	·040	...	·055	...	·019	·020	·037	...	·078
Head to anus ...	2·060	...	2·564	1·978	...	1·920	...	...	·434	1·148	·680	4·922
Anus to tail ...	·150	...	·136	·022		·018	·093	·0935	·102	·152	·085	·078
Post-anal length	1	...	1	1	...	1	...	1	1	1	1	1
Total length	14·7		19·8	91		107·7		7·1	5·25	8·5	9	64·3
Br. of body at anus	·037	...	·044	·030	...	·029	...	·015	·014	·026	...	...
Caudal appendage l.	...	...	·075	...	...	...	·015	·202	...	...	...	·085
Caudal appendage br.	...	...	·007	...	...	...	·002	·002	·003	...	...	...
Spine or quill l. ...	...	...	...	·023	...	...	...	...	...	...	...	...
Lat. organ diameter	·005 × ·0085	...	·005	...	...	...	...	·004	...	...	...	·007
Lat. line mx. br.	...	...	...	...	...	...	...	·0017	...	...	...	·013
Head to ventral pore	...	...	...	...	...	...	...	...	...	...	...	...
Male spicule l. ...	...	...	...	·037	...	...	·027	·030	...	...	...	·088
Uterine ovum l.	...	...	...	...	...	...	...	...	...	...	...	...
Uterine ovum br.	...	...	...	...	...	...	...	...	...	...	...	...

EXPLANATION OF PLATE XXX.

FIG. 1.—*Oncholaimus chilkensis*, sp. n., immature, ×150.

,, 2.—*Oncholaimus chilkensis*, sp. n., immature, ×1000, head from right side.

,, 3.—*Oncholaimus chilkensis*, sp. n., immature, ×1000, head from ventral aspect.

,, 4.—*Oncholaimus chilkensis*, sp. n., immature, ×750, tail.

,, 5.—*Dorylaimus* sp., male, ×325, outline.

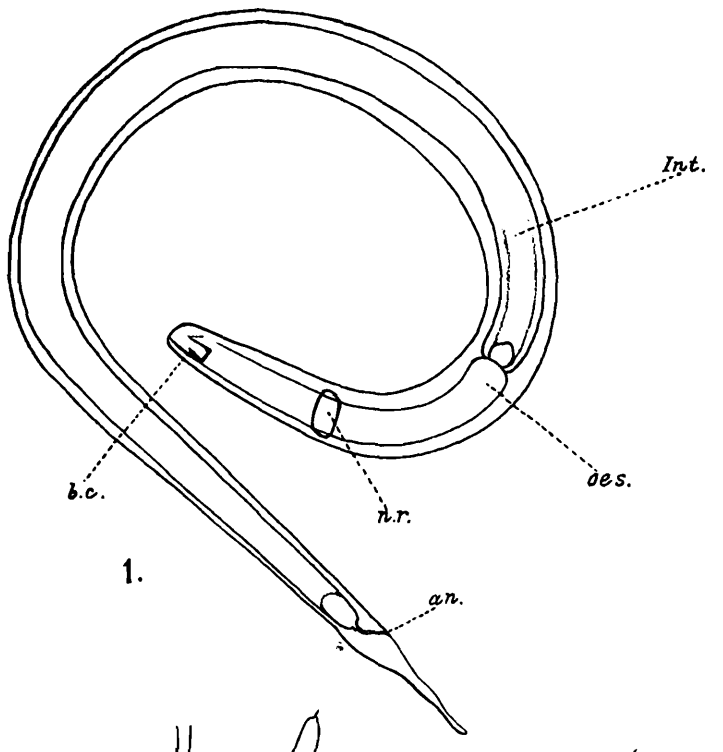
,, 6.—*Dorylaimus* sp., male, ×750, tail from the left side.

,, 7.—*Dorylaimus* sp., male, ×1000, head from left side.

,, 8.—*Monhystera uria*, sp. n., female, ×283.

,, 9.—*Monhystera uria*, sp. n., male, ×750, tail from right side.

Rec. Ind. Mus., Vol. X, 1914.



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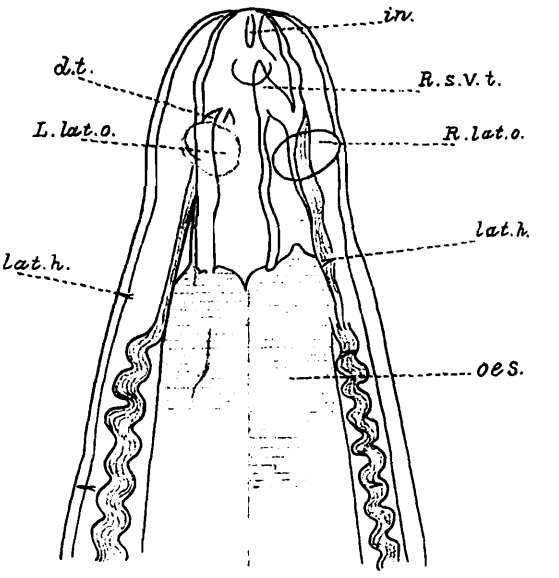

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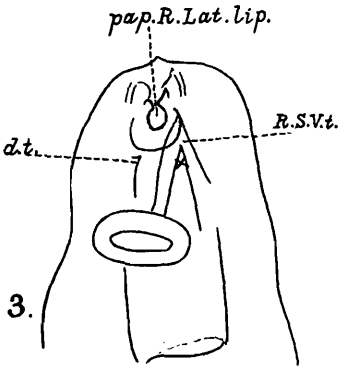

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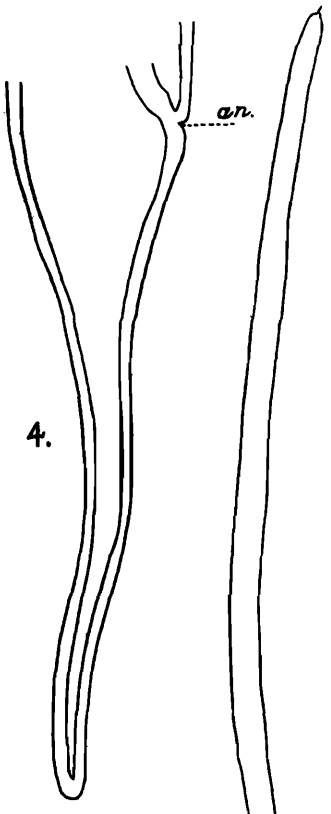

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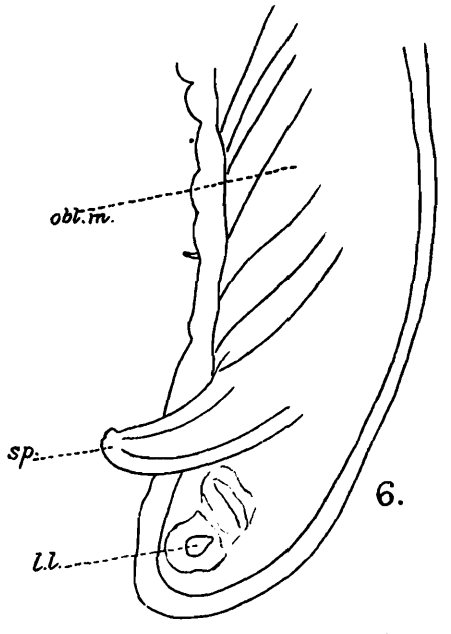

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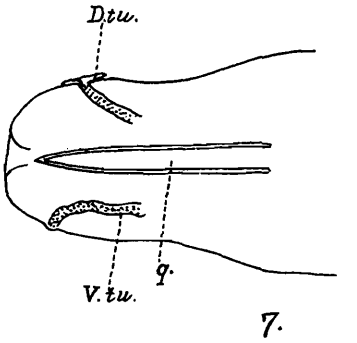

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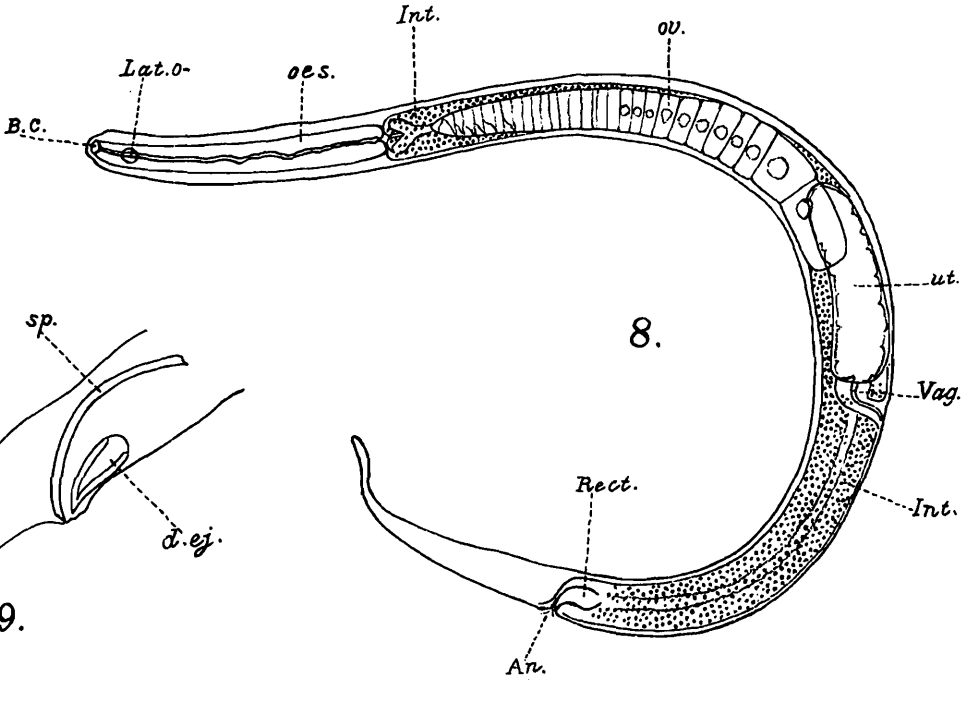

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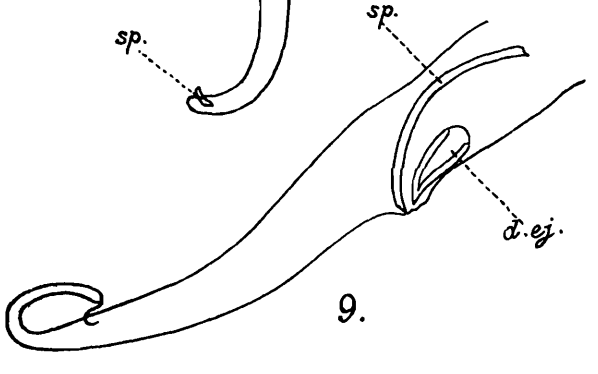

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F.H.Stewart, del.

A.Chowdhary, lith.

NEMATODES FROM CHILKA LAKE

EXPLANATION OF PLATE XXXI.

FIG. 10.—*Monhystera uria*, sp. n., immature, ×650.

,, 11.—*Leptosomatum indicum*, sp. n., × 686, head from right side.

,, 12.—*Leptosomatum indicum*, sp. n., × 686, head from right side.

,, 13.—*Leptosomatum indicum*, sp. n., ×333, male, tail from right side.

,, 14.—*Leptosomatum indicum*, sp. n., male, ×30, outline.

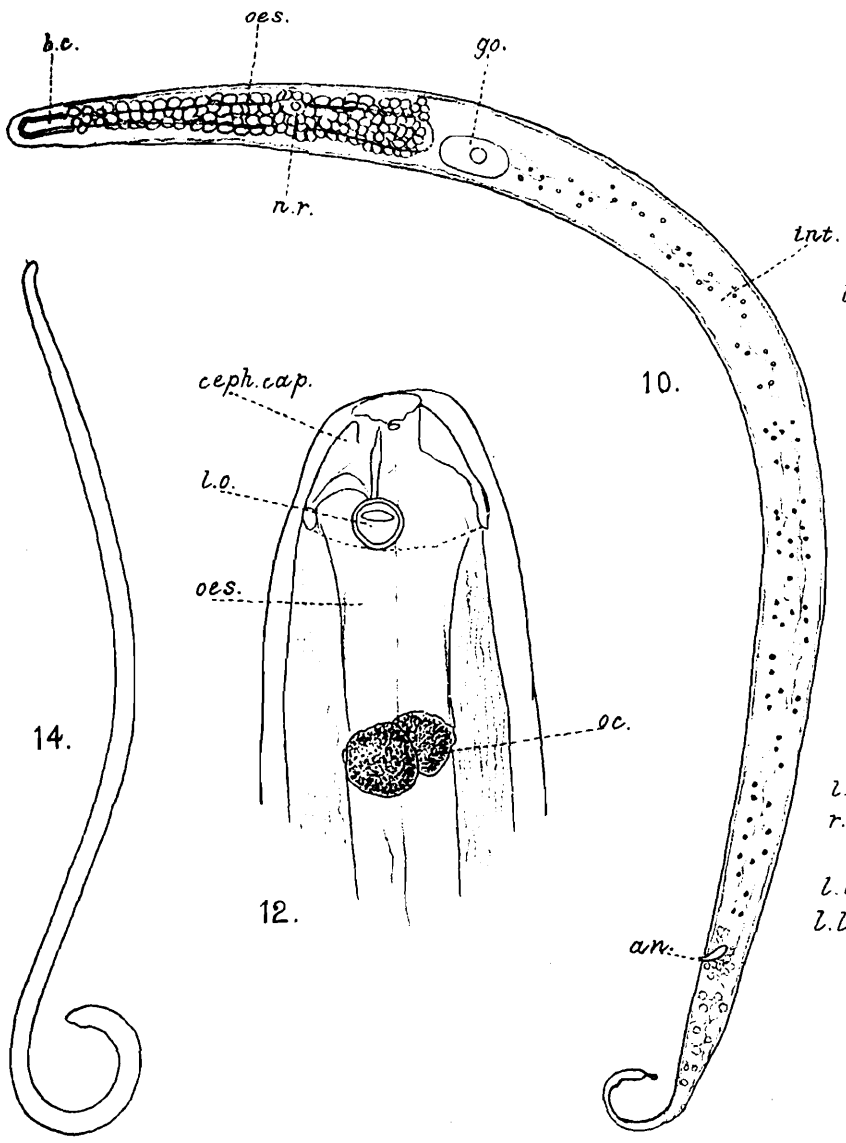
,, 15.—*Oncholaimus chilkensis*, sp. n., female, ×1000, head from left. No. 6237a.

,, 16.—*Oncholaimus indicus*, v. Linst. Outline of head, ×433, for comparison with fig. 17.

,, 17.—*Oncholaimus chilkensis*, sp. n. Outline of head for comparison with fig. 16. × 433.

,, 18.—*Oncholaimus chilkensis*, sp. n., female, × 433, tail (No. 6237b).

,, 19.—*Oncholaimus indicus*, v. Linst. female, × 433, tail for comparison with fig. 18 (No. 5576/2).



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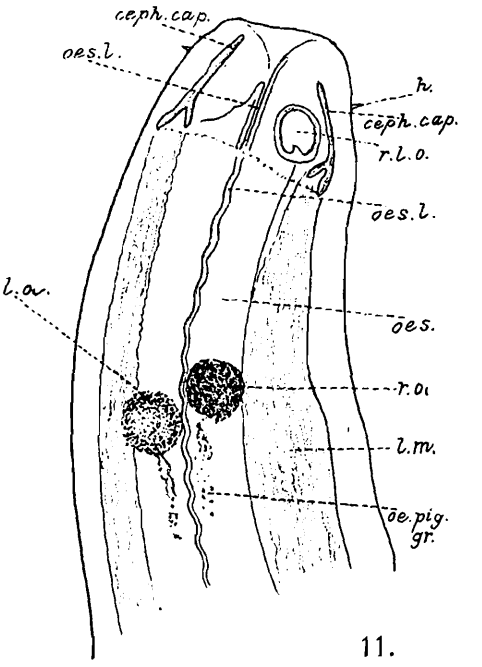

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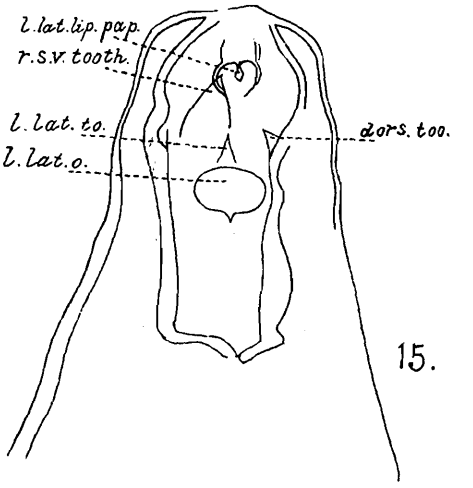

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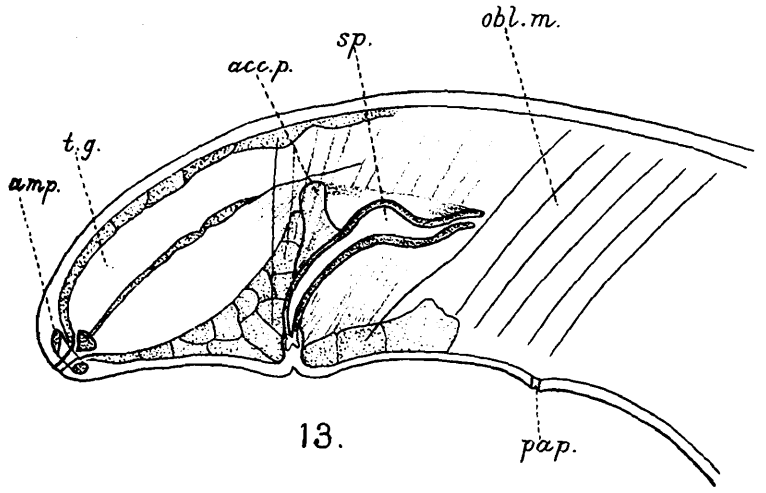

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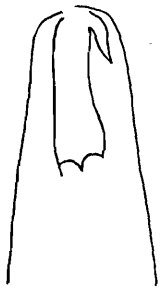

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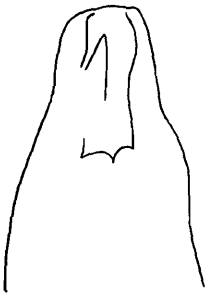

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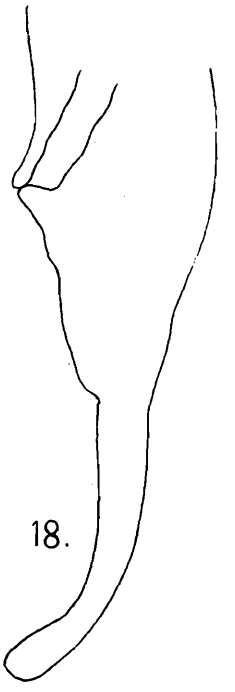

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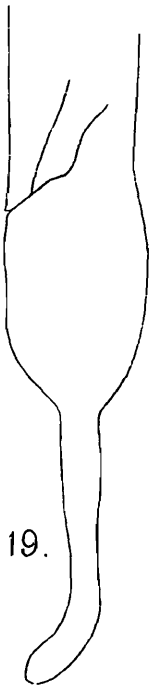


19.

F. H. Stewart, del.

A. Chowdhary, lith.

NEMATODES FROM CHILKA LAKE.

EXPLANATION OF PLATE XXXII.

FIG. 20.—*Oncholaimus fuscus*, Bast., male, tail (copied from Bastian) for comparison with fig. 18.

,, 21.—*Monhystera megalaima*, sp. n., female, × 118.

,, 22.—*Monhystera megalaima*. sp. n., female, anterior extremity × 379.

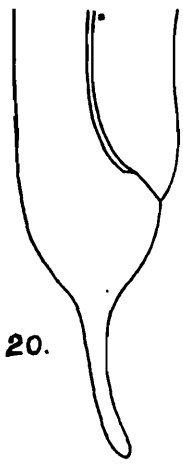
,, 23.—*Monhystera megalaima*, sp. n., female, head, × 1110.

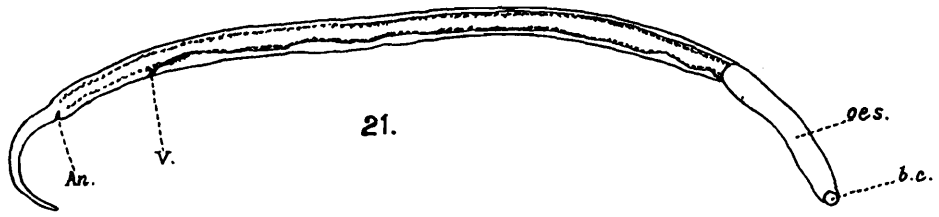
,, 24.—*Monhystera megalaima*, sp. n., female, tail, × 382.

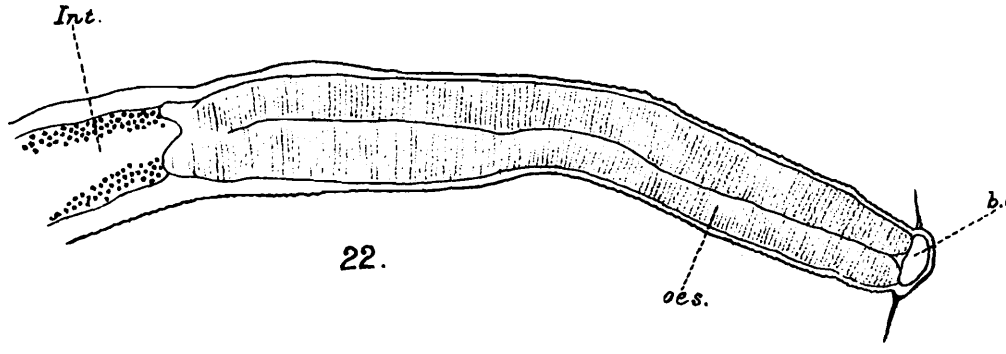
,, 25.—*Monhystera megalaima*, sp. n., male, × 150.

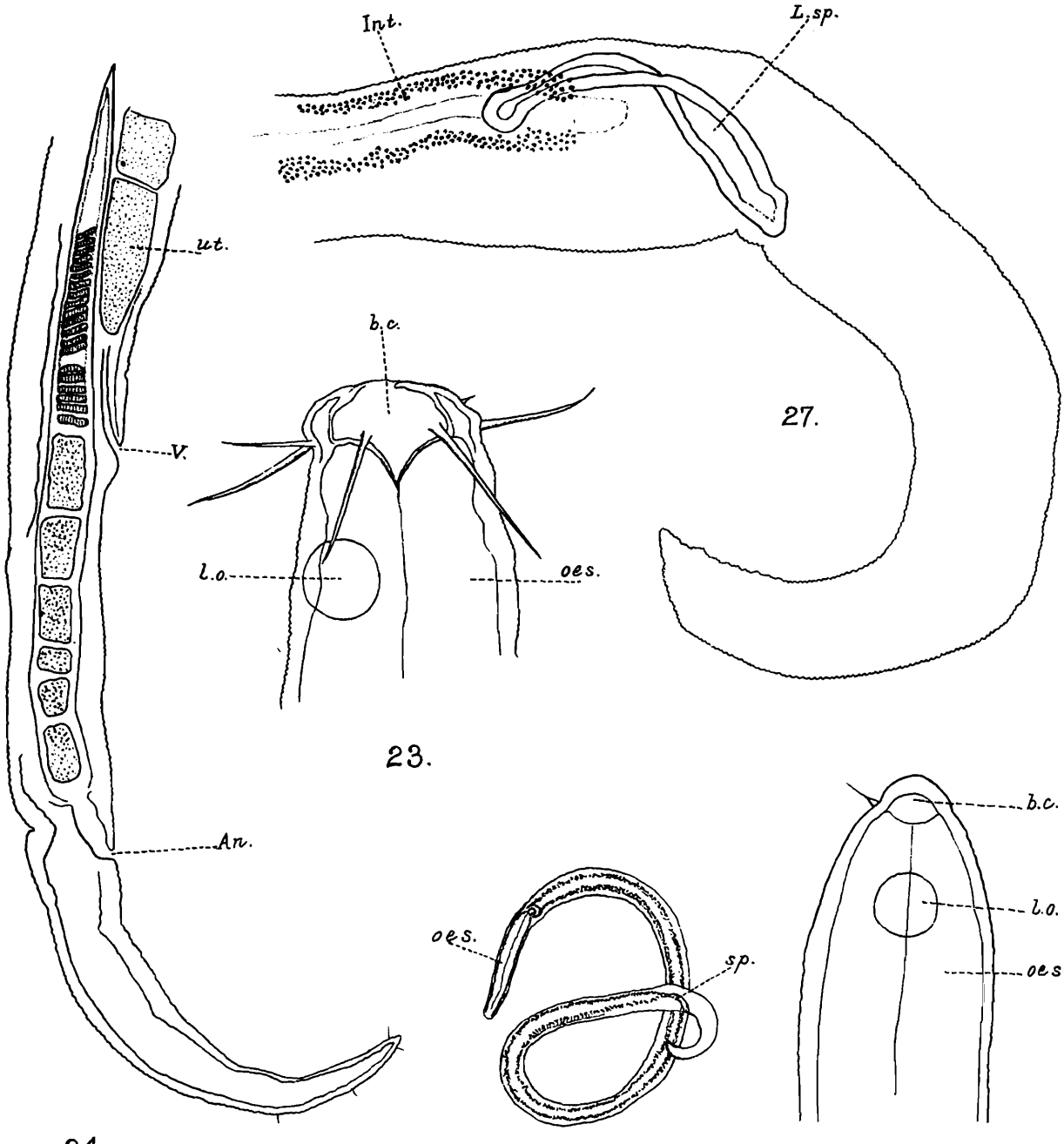
,, 26.—*Monhystera megalaima*, sp. n., male, head, × 1500.

,, 27.—*Monhystera megalaima*, sp. n., male, tail, × 1100.









F.H. Stewart, del. A. Chowdhary, lith.

NEMATODES FROM CHILKA LAKE

XIV LITTORAL OLIGOCHAETA FROM THE CHILKA LAKE ON THE EAST COAST OF INDIA.

By J STEPHENSON, *D.Sc., Major, I.M.S., Prof. of Biology, Government College, Lahore.*

On the occasion of a recent visit to Calcutta, Dr. Annandale handed over to me for examination three specimens of a worm, which had recently been taken at the Chilka Lake during a preliminary survey of that area. I subsequently received in Lahore four more captures of Oligochaete worms, taken during the more detailed investigation of the lake. Three of these were specifically identical with the specimens I had examined in Calcutta, and represent a species of *Pontodrilus* which I identify with *P. ephippiger*, Rosa. Since, however, the specimens show a considerable amount of variation among themselves, as well as some minor differences from the form with which I identify them, I give a fairly complete description below

The remaining batch of specimens, which I identify with *Criodrilus lacuum*, Hoffmstr., consisted of a very large number of individuals; but unfortunately I failed to find any which showed the least external mark of sexual maturity. However I dissected two of the best-grown specimens, and fortunately found the genital organs in an early stage of development. But as under these conditions there must be at least a slight element of doubt in the specific, if not generic, diagnosis, I have given here also a number of descriptive details, in order that the result may be amenable to criticism if necessary.

General Remarks.

The occurrence of *Criodrilus tacuum* is interesting, since the family (Glossoscolecidae) to which it belongs is represented in India, so far as hitherto known, by only two or three species. The nearest locality to India from which this species has previously been reported is, I think, the Lake of Tiberias in Palestine (Stephenson, 10 from specimens collected by Annandale); and along with this may be mentioned several places in Syria (Rosa, 8). This is of interest in view of Annandale's recent remarks (1) concerning the relationship between the faunas of India and of the Jordan Valley. *Criodrilus lacuum*, as its name implies, has a limnic habitat; I am not aware whether it has previously been recorded from any locality which could be described as 'littoral,' though the Lake of Tiberias of course contains a high percentage of salt. For the rest, it occurs principally in Central Europe.

The genus *Pontodrilus* has been recorded twice previously from the Indian region. The references are to *P. bermudensis*,

Bedd., from Ceylon (cf. Michaelsen, 7), the distribution of which is circummundane in the tropics; and to Beddard's species *laccadivensis*, which occurs in both the Laccadive and Maldive Islands (3).

Criodrilus lacuum, Hoffmstr.

Shore at Satpara, Puri district, Orissa, from fisherman; 14-iii-1914. Very numerous specimens, none showing external marks of maturity.

Length average 80, maximum 100 mm.; breadth 2 mm. Colour an equable grey. Segments *ca.* 240. Prostomium zygolobous. No dorsal pores.

The body from about segment ix onwards is somewhat four-cornered; in the posterior fourth of the body, the dorsal surface is concave, thus presenting a shallow longitudinal groove. The posterior end is sharply pointed. The anus is dorsal, and forms a longitudinal slit with whitish margins, the posterior end of which does not reach the pointed posterior end of the body. The number of segments over which the anus extends is difficult to count, as they are small, and, at the end, not completely differentiated; but about 6 or 7 can be recognized and counted, as well as a small undifferentiated zone posteriorly. The segments after the first three are triannulate, soon becoming four- and five-ringed by the subdivision of one or more of the primary rings; posteriorly the segments are again three-ringed.

The setal intervals vary somewhat; the relations may roughly be expressed thus:—$aa = 2\text{–}2\frac{1}{4}ab = bc = 2\text{–}2\frac{1}{4}cd = \frac{2}{3}\text{–}\frac{3}{4}ad$. In the anterior part of the body $aa = 1\frac{2}{3}ab$. The setae are ornamented towards the tip, but much less markedly than is shown by Vejdovsky in his figure (11).

The first septum is $\frac{4}{5}$; thereafter the septa gradually increase in thickness, being moderately thick at $\frac{8}{9}$, and so continuing to $\frac{12}{13}$. Behind this the thickness rapidly decreases again, and $\frac{16}{17}$ and those behind are of the usual attenuated type.

A rudimentary gizzard was present in segments xiii–xiv in one specimen dissected; in the other it was questionable whether there was anything which could be called a gizzard.

The last heart is in segment xi. Nephridia begin in xii (xi one side of one specimen).

The testes are situated in x and xi; one funnel was seen in x. The four pairs of seminal vesicles depend, two anteriorly (i.e. forwards from the posterior wall of the segment) into ix and x, and two posteriorly into xi and xii. Ovaries and ovarian funnels were seen in xiii, and small ovisacs depending backwards into xiv.

Pontodrilus ephippiger, Rosa.

In damp mud under stones at edge of Chilka Lake at Gantasila, Ganjam district; 27-xii-1913; three specimens, two being fully mature.

Chilka	survey	28	Z.E.V	$\frac{6\,2\,2\,6}{7}$; a number of specimens.
,,	,,	75	Z.E.V.	$\frac{6\,2\,2\,7}{7}$; two specimens.
,,	,,	82	Z.E.V	$\frac{6\,2\,2\,8}{7}$; three specimens.

Length variable in the different captures, 32–65 mm.; diameter maximum 2–2½ mm. Colour in general light grey throughout; the first batch of specimens however were olive-green, the anteclitellar region paler, and clitellum with a reddish tinge.

Prostomium slightly epilobous. Segments 106–108. No dorsal pores.

The lateral setae are not paired. In front of the clitellum the setal intervals may be represented by the formula $ab = \frac{3}{5}aa = \frac{3}{5}bc = \frac{3}{5}cd$, *aa*, *bc* and *cd* being thus equal to each other; or *cd* may even be slightly greater than *bc*. Behind the clitellum the relations are $ab = \frac{1}{2}aa$, and *aa* = or slightly > *bc* = *cd*. Throughout the body $dd = 2cd$. No ornamentation can be seen on the setae even under the oil-immersion lens.

The clitellum is absent ventrally, the ventral surface in this region forming a broad groove. The clitellum extends from ½xiii–xvii = 4½ (once xiii–xvii = 5).

The male apertures are situated on small papillae in segment xviii in the line of setae *b*. At the margins of the ventral surface in xviii, and extending on to the adjacent parts of xvii and xix, are a pair of very prominent longitudinal ridges, white and rounded. Internal to the ridge of each side is a deep depression, also, like the ridge, narrow, longitudinal, and well-defined, i.e. an antero posterior groove of the same length as the ridge, which latter bounds the groove on its outer side. Between the grooves of the two sides the ventral surface may be slightly hollowed. The situation of the male apertures is on the inner, rather more gently sloping, wall of the longitudinal grooves above described.

The female apertures appear as two white points anteriorly in xiv, nearer the groove $\frac{1}{1}\frac{3}{4}$ than the line of the setae; they are one on each side of the nerve cord, which can be seen shining through, and internal to the line of setae *a*.

The spermathecal apertures are two pairs, on small white papillae, in furrows $\frac{7}{8}$ and $\frac{8}{9}$ in the line of setae *b*. In one specimen, while three of the four apertures were in the lines of *b*, one (left anterior) was exactly in line with the setae *a*.

The genital markings are variable. (i) Most constant is one in $\frac{1}{2}\frac{9}{0}$, of an oval shape with long axis transverse; its extent varies, between setae *a* and *a*, or between *b* and *b*; the form it takes also varies:—(*a*) It may be a depression, with a well-marked lip-like margin, and thus somewhat sucker-like; (*b*) or a broad white low papilla with a flat surface; (*c*) or a whitish well-defined area, but not raised above the general surface; or (*d*) it may be very inconspicuous, though never, so far as I observed, entirely absent.

The next commonest genital mark is (ii) a similar oval area in furrow $\frac{12}{13}$, of whitish colour, stretching from between lines *a* and *b* on one side to a corresponding point on the other. This has the form of a low flat papilla; it was present, though not always equally well-marked, in about half the specimens examined. (iii) In one case there was a slight whitish ill-defined elevation in the situation of groove $\frac{13}{14}$.

Septum $\frac{5}{6}$ is thin or only slightly thickened; the septa increase in thickness from $\frac{6}{7}$ to $\frac{9}{10}$, and then continue thick to $\frac{11}{12}$; $\frac{12}{13}$ is thinner again, and thence onwards all are thin.

There is no gizzard; the intestine begins to swell out in xv. The last heart is in xiii.

The nephridia are absent from the first twelve segments; they are present in segment xv, and onwards, but (in the specimens dissected) absent in xiv, though either one or a pair were found in xiii.

Small testes were seen in segment x; they were not identified in xi, but funnels were present in both segments (x and xi). Testes and funnels were free in the body-cavity.

The vesiculae seminales are two pairs, in xi and xii, each grapelike, being cut up deeply into small lobes.

The prostates are of moderate size, tubular and slightly coiled, especially at the free end, which is posterior; they run forwards and inwards, from the eighteenth to the seventeenth segment, and at their anterior end, where the duct commences, they lie alongside or under cover of the intestine (in the dissected animal). The duct runs backwards and outwards, roughly parallel to and on the inner side of the glandular portion; it is strong, stout and intensely glistening, only slightly curved, and of approximately the same diameter throughout (or perhaps slightly narrower at its outer end); it is rather shorter than the gland.

Ovaries and ovarian funnels were seen in xiii.

The spermathecae are two pairs, lying in segments viii and ix. The ampulla varies in shape from roughly spherical to elongated ovoid; the duct is of moderate or relatively considerable width, and is nearly as long as (subspherical ampulla), or more than half as long as (elongated ampulla), the ampulla itself. The diverticulum is tubular, not swollen or very slightly swollen at its internal end; its length also appears to vary,—it may either fall considerably short of or extend considerably beyond the end of the ampulla, according as this latter is or is not elongated in form. The name diverticulum is in strictness hardly applicable, as the structure to which it is applied is here implanted on the inner surface of the body-wall separately from though close to the end of the duct. No penial setae were discovered.

The present species has been described by Rosa (9) from Christmas Island; the chief differences between that author's specimens and mine are the absence of the genital papillae on $\frac{12}{13}$ and $\frac{13}{14}$, and the "deep slit-like" character of the marking on $\frac{19}{20}$

in Rosa's examples; though he and I describe the area surrounding the male pores in different ways, there appears to be an essential similarity between the two accounts.

I have also compared Beddard's account of *P. laccadivensis* (3). This latter is a larger worm, and the spermathecal apertures are situated, in some but not all individuals, near the extremities of long dumbbell-shaped cutaneous thickenings in $\frac{7}{8}$ and $\frac{8}{9}$; but the male area (illustrated not in the original paper, but in 4) resembles very much that of *P. ephippiger.* Since *P. ephippiger* is a variable species (compare the data as to size, papillae, first nephridia, characters and length of spermatheca and diverticulum given above, from a limited number of specimens), and *P. laccadivensis* is so also, at least in the matter of cutaneous thickenings or papillae, I believe that the two species should be united.

Michaelsen has recently united *P. insularis* (Rosa) with his own species *P. arenae* and Beddard's *P. bermudensis* (compare 5, and the lists of Indian species in 6 and 7). I can see no essential difference between the descriptions of *P. ephippiger* and *P. arenae*, except that the setae are ornamented in *P. arenae*, not in *P. ephippiger*; and when the revision of the genus is next undertaken it will be necessary, I believe, to consider whether this is sufficient to distinguish them; since Beddard, even when looking for it, at first failed to find the ornamentation (2). This would reduce *P. bermudensis, arenae, insularis, ephippiger,* and *laccadivensis* to a single species. Some consideration should also be given to *P. matsushimensis*, which possesses the same characteristic male genital area; though the absence of a distinct muscular prostatic duct is perhaps a sufficient ground for separation.

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XV DESCRIPTION OF A NEW SPECIES OF TERRESTRIAL ISOPODA FROM BORNEO

By WALTER E. COLLINGE, M.Sc., F.L.S., F.E.S.

(Plate xxxv, figs. 1–9.)

Amongst the collection of terrestrial Isopoda in the Indian Museum, which Dr. Annandale has kindly placed in my hands for examination and identification, is a tube containing a number of specimens of a new species of *Cubaris* collected near Sarawak, which is here described. I have much pleasure in associating with it the name of Dr. Annandale.

Cubaris annandalei, n. sp.

Body (fig. 1) oblong oval, dorsally convex with a series of ridges on the mesosomatic segments; metasome broad and partly hidden by the overlapping segments of the mesosome. Cephalon (fig. 2) small and flanked by the lateral plates of the 1st segment of the mesosome; epistome with small median triangular ridge; lateral lobes small and indefinite, median lobe absent. Eyes lateral and prominent. Antennulae small and 3-jointed. Antennae (fig. 3) slender, covered with small setae and one or two spines; last segment elongated, flagellum 2-jointed, the distal joint being the larger. Mandibles (fig. 4) short and stout with four blunt tooth-like surfaces and two tufts of setae. 1st maxillae (fig. 5): outer lobe with four large pointed spines, then five more slender ones, with their apices divided into two or more divisions, and one incurved pointed spine; inner lobe small and narrow with two setaceous spines distally (fig. 6). 2nd maxillae small and plate-like with slight indication of a division into two lobes. The segments of the mesosome are all ornamented with a series of irregular ridges; lateral plates well defined and separated from one another, the 1st and the 6th are broadest. Maxillipedes (fig 7) large, the outer lobe terminates in a curved spine divided at its point and two smaller pointed spines; the inner lobe is well-developed and provided with four small marginal spines. Thoracic appendages (fig. 8) comparatively short, covered with setae and well-developed spines on the inner borders of the three terminal segments. Uropoda (fig. 9) largely hidden by the telson and not extending beyond it; basal plate thick and somewhat triangular, exopodite small, articulating in a cavity on the inner margin and

dorsal surface of the basal plate, the endopodite is considerably larger, triangular in section and fringed with numerous spines, distally it terminates in three long whip-like setae. Its point of articulation is on the ventral side of the inner proximal extremity of the basal plate. Telson (fig. 10) constricted above the middle, with the free edge almost straight. Length 8 mm. Colour (in alcohol) greenish-grey with lighter coloured ridges.

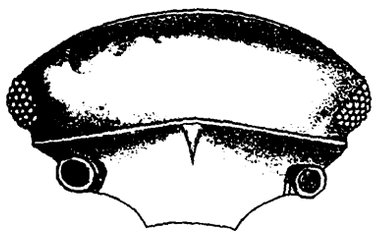
Habitat.—Ten miles south of Sarawak, Borneo, 26-vi-1910 (*C. W. Beebe*). Regd. No. 8601-10.

Type.—In the collection of the Indian Museum.

The form of the uropoda and telson at once separates this species from any hitherto described.

DESCRIPTION OF PLATE XXXV.

FIG. 1.—*Cubaris annandalei*, n. sp. Dorsal view: × 9.
,, 2.— Antero-dorsal view of head.
,, 3.— Antenna.
,, 4.— Left mandible, inner side.
,, 4a.— ,, ,, outer side.
,, 5.— 1st maxilla, inner lobe.
,, 6.— ,, ,, outer lobe.
,, 7.— Maxillipede.
,, 8.— Second thoracic appendage.
,, 9.— Uropod of right side, dorsal view.
,, 10.— Telson, dorsal view.



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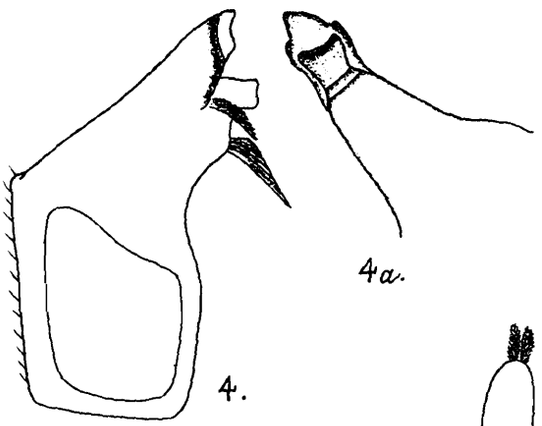

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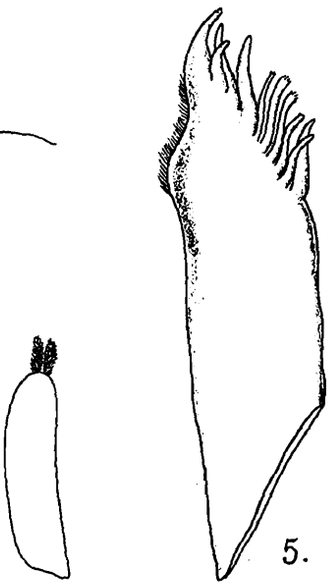

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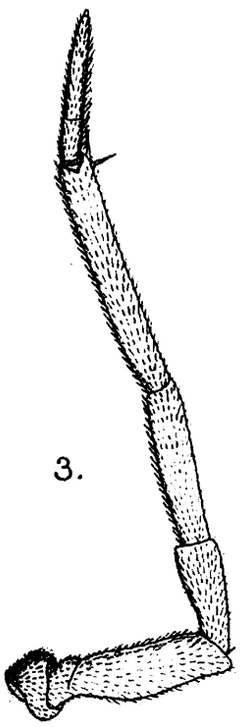

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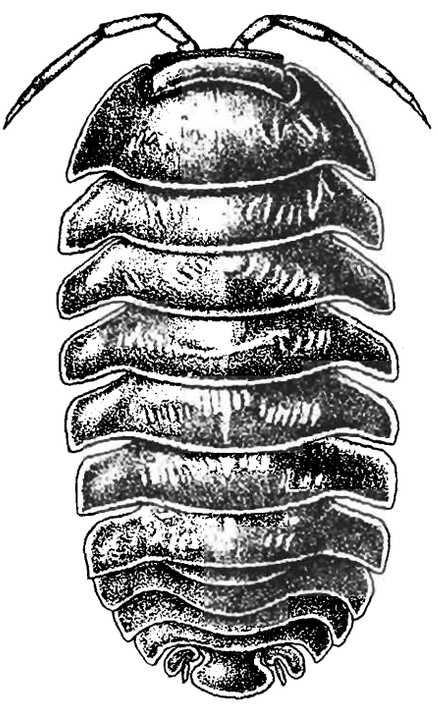

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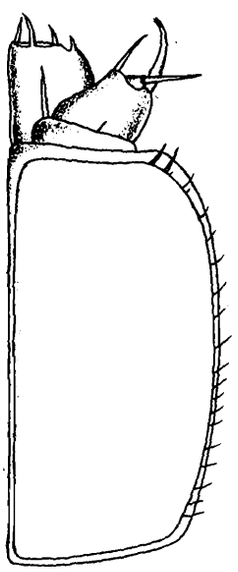

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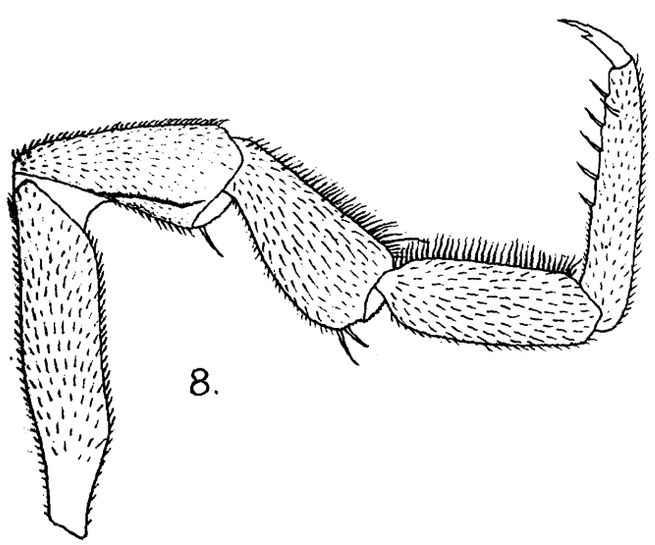

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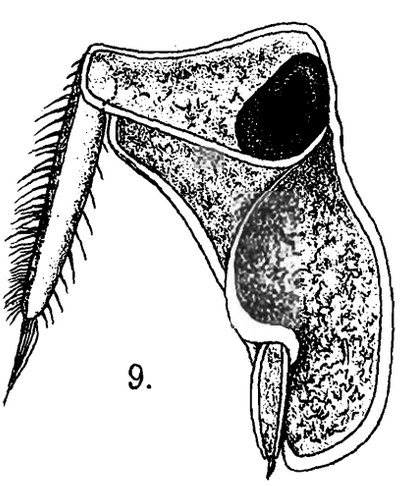


9.

A. Chowdhary, lith.

CUBARIS ANNANDALEI, n. sp.

MISCELLANEA

INSECTS.

NOTES ON CICADIDAE.—The following notes are upon a collection of Cicadidae made in the Eastern Himalayas between April, 1912, and May, 1913, by His Excellency Lord Carmichael, to whom I am greatly indebted for his kindness in sending them to me. My thanks are also due to Dr. N. Annandale, Superintendent of the Indian Museum, Calcutta, for his courtesy in inviting me to publish this contribution in this Journal. In all the collection contained 12 species, the most striking of which are the two beautiful species of *Tosena*, and several of the series are very large. The range in altitude is from 500 feet at Sukna to 7000 feet at Darjiling. Several of the species, notably *Huechys sanguinea* and *Scieroptera splendidula*, have an immense range over India and Malaysia, while others, such as *Platylomia saturata*, *Meimuna tripurasura*, and *Haphsa nicomache*, are typically and exclusively Indian.

Sub-family *CICADINAE*.

Division TACUARIA.

Gen. *Tosena*, Am. et Serv.

1. *T melanoptera*, White.
   Two males, taken at Singla, Darjiling District (1500 ft.), in June, 1912.
2. *T mearesiana*, Westw.
   A series of 11, males and females, from Ghumti (4000 ft.), taken in August, 1912, and one from Sevook, 1000 ft. (May, 1913). All perfectly typical.

Division DUNDUBIARIA.

Gen. *Platylomia*, Stål.

3. *P. saturata*, Walk.
   Six specimens from Government House grounds, Darjiling.

Gen. *Haphsa*, Dist.

4. *H. nicomache*, Walk.
   A large series, about 30, from Darjiling. In the whole series there is only one female. Taken in May, 1912.

Gen. *Meimuna*, Dist.

5. *M tripurasura*, Dist.
A still larger series of about 60 specimens, all males. Darjiling, May, 1912, and Singla.

Gen. *Pomponia*, Stål.

6. *P. thalia*, Walk.
A single specimen, male, very much mutilated. Taken at Sevook in April, 1912.

Subfam. *GAEANINAE.*

Division CICADATRARIA.

Gen. *Terpnosia*, Dist.

7. *T clio*, Walk.
One female from Sukna (April, 1913) and one male from Sevook (April, 1913).

Gen. *Gaeana*, Am. and Serv.

8. *G. festiva*, Walk.
One male from Singla, May, 1913. A typical specimen, resembling closely the figure in Distant's *Monograph of Oriental Cicadidae.*

Gen. *Balinta*. Dist.

9. *B. octonotata*, Westw.
A typical series from Singla, taken in May, 1912. All males.

Gen. *Mogannia*, Am. and Serv.

10. *M conica*, Germ.
One male from Singla, April, 1913. Rather more distinctly marked than usual, the central stripe being very well defined.

Subfam. *TIBICININAE.*

Division HUECHYSARIA.

Gen. *Huechys*, Am and Serv.

11. *H. sanguinea*, de Geer.
A fairly large series from Sukna, April, 1913. Most of them are females, and curiously enough, in other series of this species I have had from Tonkin and Japan the females have largely predominated. These Sukna specimens are very typical of the species,

with beautiful deep black tegmina and very rich red front to head, mesonotum, and abdomen.

Gen. *Scieroptera*, Stål.

12. *S. splendidula*, Fabr.

Four specimens from Singla. They are of the variety named as *cuprea*, with very distinct yellow costal membranes to the tegmina.

HOWARD ASHTON.

BATRACHIA.

LARVA OF *Rana curtipes*, Boul. ("Fauna," p. 458).—According to Dr. Boulenger, *R. curtipes* is reported to occur in the West Coast of India, and all the specimens in my collection were taken in Coorg. It is not essentially aquatic, but is found concealed under stones and dry vegetation, coming out in the night for food. The species is often mistaken by natives for *Rhacophorus maculatus* (the chunam or tree frog) and, because of the superficial resemblance, is often called "kal therai." The frog enters the water during the breeding-season, which begins with the appearance of the S. W monsoon. The males which are smaller are very lively and their call notes may be denoted by the short syllables "Thrub, Thrub," quite characteristic of the species. Last May, specimens of larvae were secured illustrating practically the different stages in the metamorphosis.

Larva.—The tadpoles are plentiful in small jungle streams and occur in April, May and June. They may be described as follows:—

Head and Body.—The body is oval; the dorsal and ventral surfaces are flat. It is much longer than broad. Snout broadly rounded. Mouth ventral. Tip of tail moderately rounded. Skin quite smooth.

Nostril and Eye.—Interorbital space slightly more than twice the distance between the eye and nostril. Eyes moderate, dorsolateral. Pupil round, becoming horizontal as the forelegs develop. Nostril dorsal, nearer the eye than to snout. (In the adult, the nostril is nearer the snout, and the interorbital space less than $1\frac{1}{4}$ times the distance between the eye and nostril).

Mouth.—Ventral, fairly large, with the lower lip better developed. It is directed slightly backward. The upper margin of the upper lip devoid of papillae; but the sides of the upper lip and corners of the mouth fringed with two or three rows of big tubercles. Smaller ones fringe the lower lip. The dental formula may be expressed thus; 3 : 3—5 + 3—5 | 1 + 5 : 5—7, meaning that in the upper lip there are from three to five inner broken and three outer complete rows of short horny teeth, and in the lower lip there is one inner interrupted and from five to seven complete series. The beak consists of an upper and a lower horny provi-

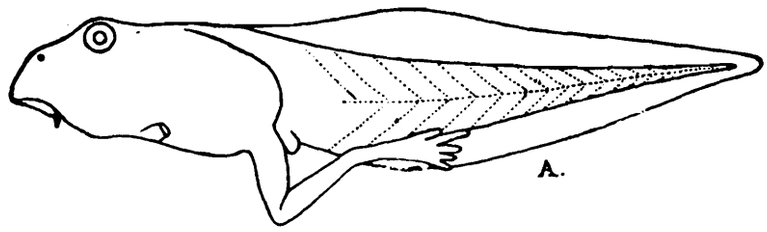
sional jaw; the latter is crescentic in form and both are finely serrated or granulate.

Glands.—No definite glands can be made out in any regular series, except a few pits on the head of some tadpoles and the parotoids, which, however, are by no means conspicuous. A row of fine white roundish glandular masses along the outer margins of the dorsal and ventral crests of the tail.

Spiracle tubular, sinistral, opening backwards and slightly upwards. Somewhat low on the side.

Anus situated in median line in front of the lower tail lobe.

Tail almost 1½ times the length of the body. The muscular portion is stout and tapers to a fine point. Tip moderately rounded. In the middle part of the tail the upper and lower lobes nearly equal in depth. Both are strongly arched. In individuals in which the hind limbs are not fully developed, the dorsal fin begins beyond the root of the tail.



Dimensions of an individual (A) in which the hind limbs are just sprouting and (B) in which they are fully developed:—

	(A)	(B)
Length from snout to tip of tail	55 mm.	68 mm.
,, of head and body	23 ,,	27 ,,
,, of tail	32 ,,	41 ,,
Maximum breadth of body	14 ,,	16 ,,
,, depth of body	10 ,,	12 ,,
,, ,, of tail	10 ,,	13 ,,

Colouration.—Dorsal part of the body uniformly dark with a few darker spots. Ventral dirty white. The muscular parts and the lobes are blotched.

Biological.—The tadpoles are active swimmers, but are easily caught. They are mainly found in shoals near the margins of the stream, browsing on weeds. They do not object to but greedily take animal food.

The tail persists in this species as a short stumpy process even when the frog has reached almost the maximum size.

CENTRAL COLLEGE, BANGALORE. C. R. NARAYAN RAO.

REPTILES.

NOTES ON AQUATIC CHELONIA OF THE INDUS SYSTEM.—In the volume on the Reptiles and Batrachia (1890) in the "Fauna of British India," Boulenger records six species of aquatic Chelonia (*Emyda granosa*, *Damonia hamiltonii*, *Hardella thurgii*, *Kachuga dhongoka*, *K. smithii*, *K. tectum*) from the Indus without comment, while he includes this river in the area of distribution of two others (*Trionyx gangeticus* and *Chitra indica*) with some doubt. *Trionyx gangeticus* has been definitely recorded from the Indus system by Dr. Siebenrock in his "Synopsis der Rezenten Schildkröten" (*Zool Jahrbucher*, Jena, 1909) and by Dr. Annandale in *Rec. Ind. Mus.*, Vol. vii (1912). I have also found it in rivers of the same system; in which I have recently taken specimens of *Chitra indica*. The following notes refer to these two species and others that I have recently obtained in the Punjab.

The following are the six Chelonia that I found in the Indus system:—

Trionychidae.	Testudinidae.
Trionyx gangeticus, Cuvier.	*Kachuga smithii* (Gray).
Chitra indica, Gray.	*Kachuga tectum* (Gray).
Emyda granosa (Schoepff).	*Damonia hamiltonii* (Gray).

I have to thank Dr. N. Annandale for the very great help he gave me in the preparation of this paper, and for the kindness, and the facilities given me while working in the Indian Museum for a few days.

Trionyx gangeticus (Cuvier).

Boulenger, *Fauna*, p. 12: Siebenrock, p. 596: Annandale, (2) p. 157.

The Indus, the Ganges and their tributaries, probably also the Brahmaputra system. The form from the Mahanaddi River has been separated as *Trionyx gangeticus mahanaddicus* by Dr. Annandale (*Rec. Ind. Mus.*, Vol. vii, Part iii, No. 25). Specimens of the typical form were obtained from the following places:—

Ferozepore (Rivers Sutlej and Beas united).
Makhu. ,, ,,
Lahore (Ravi and Chota Ravi stream).
Ludhiana (Budha stream).

Food:—On the whole it is carnivorous in habit.

A large specimen from the Chota Ravi on being dissected showed bones of some bird in its stomach, another from the

Sutlej (Ferozpore) had the complete femur of a large bird in its stomach, while yet another had the nearly complete pelvic girdle and the sacral and two other vertebrae of a frog. *T gangeticus* is attracted by kneaded flour, which is used by the fishermen for baiting their lines; hence very often they find on examining the line a number of these creatures hanging by the hooks. The fishermen usually bring these out of the river and breaking their necks throw them out of the river, owing to the very large amount of damage that they do to the line, also because the fish avoid the place where there are tortoises. Some specimens from Ferozpore were kept living in a tub of water for about two months. It was found that they preferred old rotten flesh to everything else, though they would not desist from eating any and everything when hungry.

Remarks:—In the Punjab tortoises are not much esteemed as an article of food except by the nomad tribes. The *Sahnsies* consume them in quite large numbers. They have a peculiar way of their own for catching them. They take the rotten and foul smelling flesh of some animal and put it into the river close to the shore. The tortoises are attracted in large numbers by the smell and begin to feed on the flesh. Then a large number of these people with a peculiar sort of harpoon of their own go into the river and surround the spot on all sides; and begin making a good deal of noise, uttering shrill cries and so on. The animals becoming terrified rush away, but are harpooned in large numbers by the *Sahnsies*. The harpoon pierces the carapace and in some cases when it was wielded by some very strong man, it was seen even to pierce the plastron of quite large individuals.

The flesh is eaten, while the fat is stored and used instead of oil or for making embrocations. The *Sickligars* also eat these animals, but in much smaller numbers.

Chitra indica (Gray).

Boulenger, *Fauna*, p. 16: Siebenrock, p. 608: Annandale (2), p. 169.

The range for this animal as given in the Fauna is "Ganges and Irawaddy; Indus?": by Dr. Siebenrock "Indien; Nepal, Allahabad; Ganges, Calcutta; Irawaddy": and by Dr. Annandale "The Ganges and Irawaddi river systems as far as the base of Himalayas in the former. The species is not uncommon in the Gangetic delta and large individuals can often be bought in the Calcutta market, in which, however, they are less abundant than *T hurum* and *T gangeticus*." A specimen was recently obtained from Makhu (Rivers Sutlej and Beas united), along with the other forms here mentioned. It was a young female. The carapace measured 16·8 × 18·4 cm. I have since obtained a larger specimen at Ludhiana.

Dr. Annandale has called my attention to the extremely small size of the young of this species, which is certainly the largest of the Indian Trionychidae when full grown.

The measurements of some in the collection of the Indian Museum are as follows :—

1.	Carapace	52·3 cm. × 59·7 cm.	Largest specimen from Calcutta.
2.	,,	5·9 cm. × 6·05 cm.	A specimen from Jalpaiguri, Northern Bengal.
3.	,,	4·8 cm. × 5·1 cm.	The smallest specimen from Jalpaiguri.
4.	,,	2·9 cm. × 3·3 cm.	A very small ♀ from Allahabad.

On comparing the young one with a young specimen of *Emyda granosa scutata* (Peters) which was taken at Moulmein just after hatching and the size of which is 4·1 cm. × 3·6 cm., it appears that the young ones of *C. indica* on hatching are actually smaller than those of *Emyda granosa scutata*, which is a much smaller form when adult.

In the young specimens of this form it appears that the upper jaw is not fully ossified as it breaks off when the skeleton is being prepared. This was the case with my specimen from Makhu and some of the skeletons in the Indian Museum.

On the inner margin of the hypoplastron there are five processes on that of the left side and four on the right side.[1]

The contents of the stomach of a specimen from Ludhiana included the bones of a fish and some small snail-shells.

Emyda granosa (Schoepff).

Boulenger, *Fauna*, p. 49 : Siebenrock, p. 59 : Annandale (2), p. 171.

Distribution :—"Valleys of the Indus and the Ganges, but it probably occurs in Assam and certainly does so on the coast of Arrakan." Specimens of the typical form were obtained at Phagwara in a small stream known as the *Baen*, in a small rivulet about four miles from Ferozpore, and also in the *Budha* stream at Ludhiana.

The colour of the plastron varied from perfect white to yellow.

The number of bony marginal plates varies from 14 to 20.

Kachuga smithii (Gray).

Boulenger, *Fauna*, p. 42 : Siebenrock, p. 453.

Distribution :—The species has been recorded from the upper Ganges and Indus with their tributaries. Dr. Annandale tells me that the young specimen he recorded (*Rec. Ind. Mus.*, vol. i, p. 171 ; 1907) from Rajshahi on the lower Ganges as *K. sylhetensis* really belongs to this species. I found it to be quite abundant at Ferozpore (Sutlej and Beas united), Lahore (Ravi), and at Kapurthala (in a small stream known as *Baen*).

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[1] Annandale in *Rec. Ind. Mus.*, VII, p. 170, says that there are three or four.

Boulenger's description in the "Fauna" quite corresponds with that of specimens from various localities, except in the appearance of the fourth vertebral shield, which varies very much in specimens from the same as well as from different localities. In some it tapers very much in front so that the suture between this shield and the third is quite narrow, while in others it is much broader

The colour also varies somewhat, from olive brown to pale brown dorsally. In the young of this species there is an orange-coloured band on the anterior part of the dorsal keel; two orange spots are also present just behind the nape, one on each side; these disappear in adults.

The animal chiefly feeds on rotten flesh. On enquiring from fishermen at Ferozpore it was found that the animal is never attracted by the flour bait which they use in fishing, but is often caught also by the small prawns which they sometimes use as bait. Specimens kept living in large tubs were seen to like flesh much better than anything else. Large amounts of vegetable matter found in the stomach of a specimen cut up in the Museum at Calcutta show, however, that it takes vegetables also. Thus it appears that the animal is omnivorous. A young specimen of this form was found buried in mud with the head projecting, on the side of the river Ravi at Lahore. The water had retracted from this place about three months before, yet the animal was found living. It appears, therefore, that this form can hibernate like *Emyda granosa*.[1]

Kachuga tectum (Gray).

Boulenger, *Fauna*, p. 43: Siebenrock, p 454: Annandale (3), p. 38.

The range for this animal as given in the "Fauna" is Ganges and Indus systems. Specimens were obtained at Makhu from the united water of the Sutlej and the Beas. None, however, could be got at Ferozpore and the fishermen there also stated that this form does not occur there. Specimens were also got at Ludhiana from the *Budha* stream, a tributary of the river Sutlej.

The colour of this form is variable with age. In the young the plastron is orange-coloured with very distinct black spots, while in the adult the orange is replaced by yellow and the black spots become less numerous. The carapace in the young is olive green with small black dots all over and the orange band on the first three vertebrals is very much more distinct than in the adult; moreover, the carapace in the adult becomes dark olive.

The animal is herbivorous; it desists from flesh but eats blades of grass and other vegetables very readily.

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[1] Annandale in *Rec. Ind. Mus.*, VII, p. 171.

It is a very active animal, moving at a very rapid rate on land though thoroughly aquatic, and swimming very quickly in water.

Damonia hamiltonii (Gray).

Boulenger, *Fauna*, p. 84 : Siebenrock, p. 476.

This form has been recorded from Bengal, Punjab, and Upper Sindh. A single specimen of this was obtained from Makhu. It is at present in the collection of the Indian Museum, Calcutta. One thing to be particularly noted about this form is the large number of round yellow spots on the cornea.

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BAINI PARSHAD, *B.Sc.*

RANGE OF *Acanthodactylus cantoris*, Günther.—The range of the genus *Acanthodactylus*, Weigmann, as given by Boulenger in the *Fauna of British India, Reptilia and Batrachia*, is as follows : "South of Spain and Portugal ; Africa, north of the equator ; South-Western Asia, eastwards to the Punjab ;" and that of the species *Acanthodactylus cantoris* is "North-Western India from Agra to Sind, Baluchistan, South-Western Persia" Thus it appears that Boulenger specially excludes the Punjab from the area in which this species is found. But I found it in the following places in the Punjab : Lahore, Abohar, Dharamkot and Nathana in the Ferozpore district, and in Jullundher.

The colouration of the specimens obtained from various localities did not differ very much and quite corresponds to the description given by Boulenger, except that in some specimens the white and black longitudinal lines alternating with each other become rather indistinct. In one of the specimens from Lahore there were two tails one above the other, these appeared to have grown

out in place of the tail which somehow had got broken. The specimen has been sent to the Indian Museum.

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