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NOTES ON EARTHWORMS FROM VARIOUS PLACES IN THE PROVINCE OF BURMA, WITH DESCRIPTIONS OF TWO NEW SPECIES.

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The present paper embodies the results of a study of earthworm collections made by the writer in the last three years at various places in a region extending from Tavoy in the south to Namkham on the Chinese border in the north, and from Thayetmyo and Sagaing on the west bank of the Irrawaddy river to the Shan country east of Taungyi. Almost all of the collections were made during the October, Christmas, and hot season vacations; the only time available for extended collecting trips to those in the educational service. These vacation periods are, however, more or less unpropitious for the collecting of earthworms as they all fall in the dry season. After the month of August the average daily rainfall and the number of rainy days per month decreases. The rainy intervals are followed by constantly longer periods without rainfall, during which the soil begins to dry out, so that by the middle of October, the soil is becoming hard and caked, a condition of course unfavourable to the existence of worms. It has been shown in a previous article (Gates 1926b), that in Rangoon, as the soil dries out, numbers of species gradually disappear, not to be found again until the rainy weather of the following spring. Among the number which disappear in this way are some of the characteristic forms such as the *Octochætin* species (all but one) and the endemic *Pheretima*. A larger group which contains all the species of *Drawida* (all endemic), most of the peregrine forms, and one endemic *Octochætin* form, is able to maintain itself in greatly lessened numbers during the dry weather in Rangoon. It was not therefore to be expected that collections, especially those made during the latter part of the dry season, would contain much more than endemic species of *Drawida* and peregrine forms of genera already known to occur in Burma. Such has been the case and only those places visited in August, September, and October, have yielded endemic species of genera other than *Drawida*. Again, on the basis of the Rangoon work, it is to be anticipated that when collections are made in the rainy season, new and characteristic species will be obtained, at least of the genera already known to be characteristic of Burma, especially from places such as Bhamo, Namkham, Tavoy, and Sagaing, for places which are much nearer to Rangoon than any of these are known to have forms not found in the latter town.

The large number of species to be found in Rangoon (14 out of 22) during the dry season is probably unusually large, due to the numerous areas which remain moist during the whole year. The ground around the numerous wells, hydrants, standpipes, lakes, canals, ditches, and drain.

pipes from houses, remains saturated even in the driest weather. In other towns visited, the number of year-round moist areas is much smaller and such areas are more limited in size. Hence, in spite of careful search, the number of species secured from the outlying towns is much smaller than in Rangoon. The largest numbers of species were secured in the month of October, but as has been pointed out the conditions in this month are becoming unfavourable, and it is probable that continued search even in such places, will reveal further forms in the months of greater rainfall. Although careful studies, extending over several days, were made in every town, in no place was the number of species secured as large as from Rangoon.

The new species described in this paper belong to the genera *Drawida* and *Eutyphæus*. No new species of *Pheretima* was obtained in any of the collections, although immature forms of a rather large species of *Pheretima* found in Taungyi, may prove to be new, when mature specimens are studied. This tends to confirm the opinion expressed in previous articles that the Burmese Oligochæte fauna is more closely related to the fauna of the Octochætin and Moniligastrin areas of the north-eastern part of India, than to the fauna of the more properly restricted *Pheretima* area to the south. Perhaps even more significant is the finding of immature specimens of what seems to be a species of *Notoscolex*. The nearest region in which endemic species of this genus is found is the territory to the north-west of Burma just mentioned.

The finding of certain worms which are rare in Rangoon, and hitherto known only from very limited numbers permits the recording of certain details previously lacking in regard to these species. In this connection it is interesting to note the wide variability of the genital markings in certain species of the genus *Drawida*:—variation not only in size and position, but also in shape.

The ability of *M. mauritii* to maintain itself in the midst of what may be considered unfavourable conditions is of especial note. This worm is about the only species to be found in any numbers in the so-called "dry-belt" of Burma, towards the end of the hot season. In this dry belt the annual amount of rainfall varies from 20-40 inches, and practically all of this amount falls in a comparatively few heavy showers in a few days in the wet season. In Pakkoku with an average yearly precipitation of 23.91 inches, Pagan with 23.32, Myingyan with 26.45, and Meiktila with 33 inches, large numbers of specimens of this species were obtained in April and in the early part of May before the first rains, around wells, in poorly irrigated gardens, and in ditches. Only very rarely were any other worms found in such places (*P. posthuma* and immature specimens of a species of *Drawida*).

So far as endemic species are concerned, Burma seems to be the meeting place of three groups, (1) Moniligastrin, and (2) certain Octochætin forms, and (3) *Pheretima*. Information as to the limits of distribution of the species of these groups is a matter of some interest. Almost none at all has been available in the past, and while the records published herewith are significant, they are only in the nature of a preliminary contribution.

Family MONILIGASTRIDAE.

Genus *Drawida* Mich.*Drawida caerulea*, sp. nov.*Description of type specimen.*

External characteristics.—Length 79 mm. Diameter 4 mm. Number of segments 178. Prostomium prolobous. Colour greyish ventrally, deep greyish-blue dorsally. Clitellum x-xiii, reddish grey. Dorsal pores absent.

The setæ begin on ii, and are closely paired; *ab* is equal to *cd.*, *aa* is less than *bc* throughout the whole length of the animal, *dd* is greater than one half of the circumference.

The spermathecal pores are in 7/8 in line with *cd.* The female pores are in 11/12 very slightly external to *b.* The male pores are in line with the intersegmental furrow 10/11 in *bc*, but nearer *b* than *c*, at the tip of columnar porophores.

The male papillæ are longitudinally oval swellings extending across parts of segments x and xi on each side, from just anterior to the setæ of x to just posterior to the setæ of xi, but not including either seta *a* or *b.* The swellings are marked off from the remainder of the segments by a deep furrow in the form of three quarters of a circle, on the anterior, posterior, and interior borders of the swelling. The exterior border is not marked off in this manner, the intersegmental furrow 10/11 ending abruptly against the outer side of the swelling. From the centre of the swollen area rises a conspicuous columnar projection which bears at its free end a small pore with a rather rough, jagged edge. There are no other genital markings, either on this or any of the other specimens of this species.

Internal anatomy.—Septa 5/6, 6/7, 7/8, and 8/9 are present and thickened, 9/10 is thin. Both 10/11 and 11/12 are present and attached normally to the ventral parietes, but dorsally they are fused so as to form a closed ovarian chamber. This is shut off internally from the oesophagus and from the ventral parietes in the region of the nerve cord.

The gizzards are four, in segments xiv, xv, xvi, and xvii.

The last hearts are in segment ix.

The testis-sacs in this specimen are asymmetrical. The left sac is ovoid in shape and confined to segment x. The right sac is constricted about in the middle, with half in each of segments ix and x. The vas deferens passes from the testis-sacs down the anterior face of 9/10 where it is arranged into a closely coiled mass. It then passes into segment x, posteriorly along the ventral parietes, and into the ventral body wall just anterior to the central part of the glandular-like area.

There are no organs resembling the prostates usually found in the species of this genus. Corresponding in position to the region of the oval swellings across segments x and xi is a glandular-like thickening of the ventral body wall, which projects only very slightly into the body cavity.

The paired moniliform ovisacs project into segment xvii.

The spermathecal ampulla is rather large, ovoid in shape, on the posterior face of 7/8. The duct is loosely coiled on the posterior face of the septum and just as it passes into the body wall is enlarged into a

small cone-shaped chamber, the greater part of which is embedded in the body wall. There is no atrial projection into segment vii.

Distribution.—Nyaunglebin, Thonze.

Occurrence.—August and September.¹

Remarks.—The length of other specimens varies from 55-75 mm., and the diameter from 3-4 mm. In many of the specimens, the setal intervals *aa* and *bc* are equal posteriorly, although anteriorly they are the same as in the type specimen. In several specimens which are regenerating the posterior segments, setæ *ab* on the regenerating piece are in line with setæ *ab* on the head piece, but the setæ *cd* are internal in position to *cd* on the old piece, so that *aa* and *bc* are equal on the regenerating piece although not equal on the most posterior segments of the head piece. The female pores are usually in line with *b*. The spermathecal pores are usually in line with *cd* but may extend internal to *c* or external to *d*.

The appearance of the male porophores and the supporting oval swellings does not vary in any of the specimens except that the porophores are sometimes bent towards each other, and occasionally the male pore is located at the end of a teat-like projection from the tip of the porophore.

The gizzards are three or four in the region of segments xiv-xviii.

The testis-sacs may be either ovoid and confined to segment x or constricted and equally in both ix and x. In either case these organs lie in a sort of posterior outpocketing of the septum 9/10 which, in appropriately treated specimens, can be dissected off from the testis-sac. The vas deferens always passes down to form the coiled mass on the anterior face of 9/10 and can be traced in dissections straight through the glandular-like thickening of the body wall into the projecting porophore. The extreme end of the columnar porophore is hollow and the vas deferens opens into this hollow.

***Drawida gracilis* Gates.**

Drawida gracilis, Gates, *Ann. Mag. Nat. Hist.* (9) XVI, p. 660 (1925).

Distribution and Occurrence.—Rangoon (November, December and January). Very rare. Only partially mature and immature specimens have been obtained since finding the original specimens. The species is easily distinguished, even including the immature forms, from all other Rangoon *Drawida* by its unusual length and the conspicuously enlarged ventral setæ on the segments anterior to the clitellum.

***Drawida longatria* Gates.**

Drawida longatria, Gates, *Ann. Mag. Nat. Hist.* (9) XVI, p. 50 (1925).

The genital markings of this species vary considerably, both in size and numbers present. Worms of this species obtained in Rangoon in the dry season, especially in the latter months just before the beginning of the rainy season, usually have no definite markings, aside from poorly defined male porophores on 10/11. The ventral surface of such worms

¹ In view of the apparent significance of the seasonal occurrence of the earthworms of Burma, the month in which the specimens were obtained, is indicated, either under title *Occurrence*, or in parentheses after name of place where specimens were obtained.

may be slightly swollen or wrinkled in regions which usually bear papillæ. The most invariable marking of these worms is the male porophore on 10/11. The porophore consists of a more or less conical projection of the body wall at the top of which is a smaller projection shaped like an egg, with the larger, round end attached to the top of the conical swelling and with the smaller, more pointed end bearing the male pore at its tip and projecting posteriorly over segment xi. The conical swelling of the body wall may have a series of furrows which cause a terraced appearance or the swelling may be entirely lacking. In some of the largest specimens, which have been found in October and November, the swelling conical is entirely lacking and in its place is a larger, longitudinally elongate, slightly raised, oval area. On this area there may be simply the eggshaped projection bearing the male pore, or there may be in addition to this a curious crinkling or ridging of the surface of the area. The male pores can be seen in only a few of the specimens, in the region *bc* but nearer *b* than *c*. The female pores are in 11/12 half-way between *b* and *c*.

Round papillæ of various sizes with a greyish circular spot at the centre may occur in the region *aa* on the middle part of any or all of segments viii, ix, and x, the posterior part of xi, and the anterior part of xii and xiii, or in the region *bc* on the anterior part of xii, or the anterior or posterior part of vii, viii, and ix. In this worm, unlike *D. rara* and *D. rangoonensis*, there appear to be some rather definite groupings of the genital papillæ, although less than one quarter of the worms studied have a complete set of papillæ of any of the arrangements described herewith. Another quarter lack one or two papillæ of a set. In the rest it is not possible to recognize even traces of any definite groupings.

One such arrangement is four large round papillæ on segment ix, each papilla extending from an intersegmental furrow nearly to the setæ *ab*, and transversely from slightly internal to *a* to slightly external to *b*; one pair on the anterior and the other on the posterior part of the segment. A second grouping is six or nine of the large round papillæ in rows of three on the anterior regions of segments xi and xii, or xi, xii, and xiii; the middle papilla of each row in the region *aa*. A third grouping is as follows: a single papilla in *aa* on the posterior part of xi, two on the anterior part of xii, each slightly external to the one on xi, and another papilla on 12/13 in the region *aa*. Another grouping less commonly found is eleven papillæ arranged as follows: one in the region *ab* on each side anteriorly on segments x, xii, and xiii, one each in 10/11, 11/12, 12/13 in the region *aa* and one in *bc* anteriorly on each side of segment ix. These groupings may occur together with papillæ in various positions on segments vii and viii or without them.

The Mongnai specimens have three round papillæ, in a line, located in the region *aa* in the middle part of segments viii, ix, and x. This arrangement has not been observed in worms obtained elsewhere. The Mongnai specimens also have a deep red pigment in the body wall of segments x-xiv. The male porophores in these specimens are simply irregular columnar projections on 10/11 in the usual position.

The external variation does not seem to be correlated with an internal variation except in the position of the gizzards, which although

usually four in number (rarely three only) may be found in any four successive segments of the region xv-xxii.

Distribution and Occurrence.—Bassein (Oct.), Moulmein (Oct.), Yaungwhe (April), Taungyi (April), Mongnai (April), Thayetmyo (Aug. and Sept.), Nyaunglebin (Sept.), Thonze (Aug. and Sept.), Prome (Aug. and Sept.).

***Drawida peguana* Gates.**

Drawida peguana, Gates, *Ann. Mag. Nat. Hist.* (9) XV, p. 316 (1925).

The text-figure of the atrium herewith was omitted from the original description (Fig. 1).

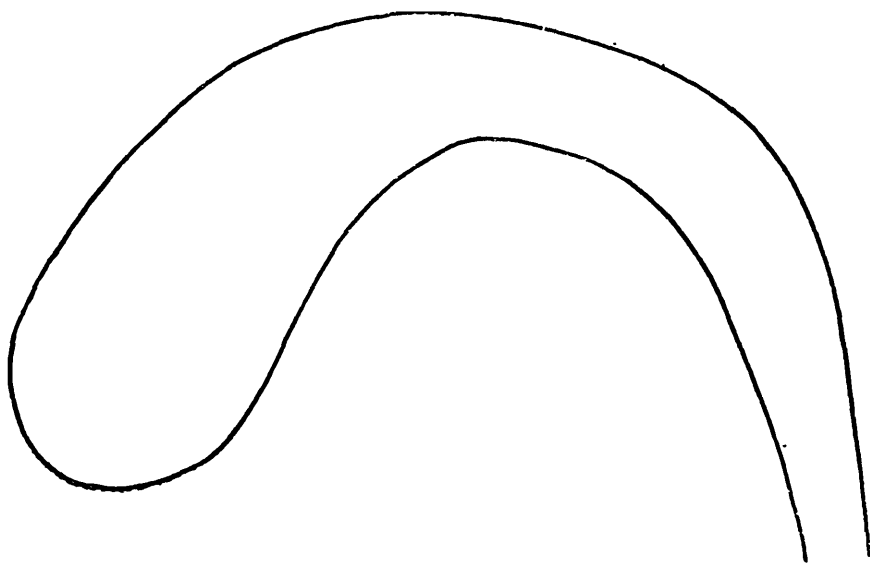


FIG. 1.—*Drawida peguana* Gates. Atrium, $\times$ ca. 90.

Distribution.—Moulmein (Oct., Nov., Dec. and Jan.).

***Drawida rangoonensis* Gates.**

Drawida rangoonensis, Gates, *Ann. Mag. Nat. Hist.* (9) XV, p. 320 (1925).

The clitellum is on segments x-xiii, occasionally extending on to the posterior portion of ix, and the anterior portion of xiv. Very rarely all of xiv may be included. The colour when present varies from a deep

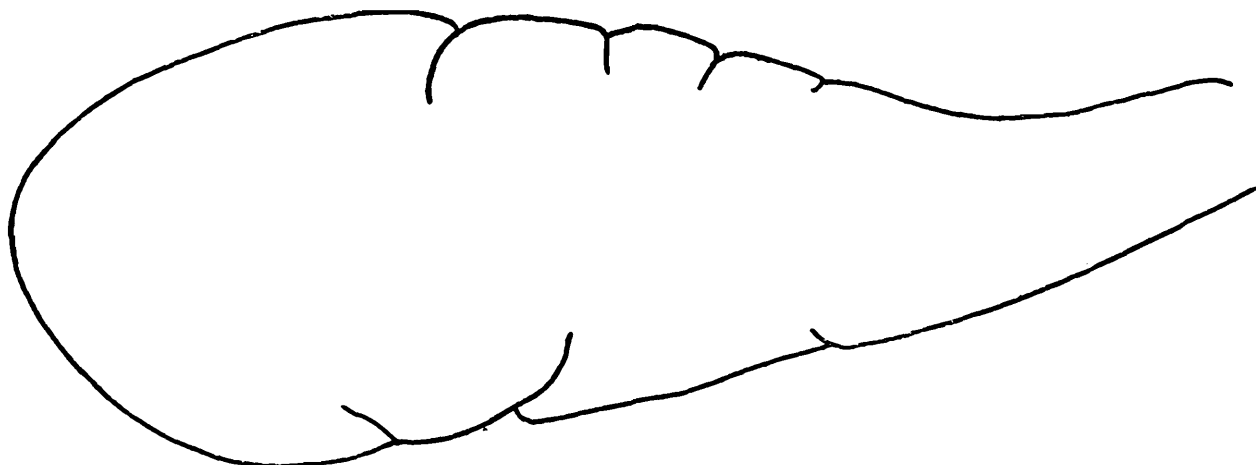


FIG. 2.—*Drawida rangoonensis* Gates. Atrium, $\times$ ca. 40.

red to a light orange and at least when red is due to the presence of pigment in the parietes, but the colour is often entirely lacking.

The male pores when visible are rather conspicuous apertures at the tops of papillæ in the region *bc* but nearer *b* than *c*. The spermathecal apertures occasionally lie slightly internal to *c* instead of in line with *c*. The female pores are in 11/12 in line with *b*. The male papillæ or porophores are either conical or transversely oval, flattish areas, and may be on the posterior part of *x* protruding slightly over *xi*, or the conical papillæ may be located in the intersegmental groove entirely surrounded by a furrow so that it is impossible to say that the papillæ belong more to one segment than the other. The genital markings may be round or transversely oval. The round papillæ occur in the region *aa* on the anterior part of *vii*, the median part of *viii*, the anterior part of *xi*, and the median part of *xii*; and in the region *bc* on the posterior part of *viii*, the anterior part of *ix*, the anterior part of *x*, and the posterior part of *xi*. The transversely oval markings are found only in the region *aa* on the posterior part of *ix*, the posterior part of *xii*, and the posterior part of *xiii*. Various groupings of the round and oval markings alone, as well as combinations of the two kinds, are found. The depression on segment *x* and the ridge extending over segments *x-xii* on each side of the type specimen, are not characteristic and do not occur in the majority of the present specimens. The region around the spermathecal pores may be swollen and bear minute round papillæ.

The gizzards are, with very rare exceptions, three in number in the region of segments *xiii-xvii*. The vas deferens passes into the prostate just below the ental end. The prostate is club-shaped, pear-shaped, or columnar.

The red colour of the clitellar segments, and the conspicuous male pores, when present, distinguish this species from *D. rara*. When these two characteristics are not visible dissection is necessary for identification. A drawing of the spermathecal atrium, omitted from the original description is given herewith (Fig. 2).

Distribution and Occurrence.—Bassein (Oct.).

***Drawida rara* Gates.**

Drawida rara, Gates, *Ann. Mag. Nat. Hist.* (9) XV, p. 321 (1925).

The length varies up to 80 mm. and the diameter to 3 mm. Segments *x-xiii* may be orange-coloured rarely, but are never deep red. The characteristic external structure of the species is the male papilla (?) on each side of 10/11, the inner edge of which is about in line with setæ *b* and extending externally to about half way between *b* and *c*. The papilla appears to belong to both *x* and *xi*, but more perhaps to *xi* than to *x*; it is not sharply conical and is often nearly flat. Almost always standing out from the centre is a minute teat-like projection which presumably bears the male pore, although no pore is visible here or elsewhere on the present specimens. This projection is bent slightly forward. The male papilla may be sharply marked off by a circumferential groove around its base, into which the intersegmental furrow runs on each side, or this groove may be lacking, in which case the intersegmental furrow ends abruptly on each side at the base of the papilla. When the circumferential groove is lacking there is a short, crescent-shaped furrow

at the anterior base of the papilla on segment x and another at the posterior base on segment xi.

The genital markings are of two kinds. The one most commonly found is an unusually elongate, transversely oval, swollen area which may be located in the following regions: *aa* on the posterior part of viii, or the anterior part of xi, in *bb* on the anterior part of ix, or the anterior part of x, or extending from midway between *b* and *c* on one side to the same place on the other side on the posterior part of xi, or in the region *bc* on each side of the anterior part of viii. More rarely, round papillæ may be found singly or paired in region *bc* on the anterior or posterior part of x, or the middle part of xi.

The gizzards are three or four, in the region of segments xiv-xviii. The prostates are flattened, circular masses sessile on the parietes. The vas deferens is small. The ovisacs frequently extend into xiii.

The original description stated that there were no atria, there is however a very small hollow enlargement of the spermathecal duct, located inside the septum 7/8 and within the parietes in all of the present specimens. This is visible as a small bulging of the septum close to the ventral parietes in the region of the spermathecal pore.

Distribution and Occurrence.—Bassein (Oct.), Moulmein (Oct., Nov., Dec., Jan.), Thayetmyo (Aug. and Sept.), Thonze (Sept.), Prome (Aug. and Sept.).

***Drawida tecta*, sp. nov.**

Description of the type specimen.

External characteristics.—Length 116 mm. Diameter 5 mm. Number of segments 188. Colour, a uniform light grey both dorsally and ventrally except on the clitellar segments which are deep brick red. The clitellum extends over segments x-xiii (4). There are no secondary annulations. The prostomium is prolobous.

The setæ begin on ii; they are closely paired, *ab* being equal to *cd*, *aa* is very slightly less than *bc*, and *dd* is greater than one half of the circumference.

The spermathecal pores are in 7/8 in line with seta *c*. The male pores are in 10/11 between *b* and *c*. The female pores are in 11/12 in line with seta *b*.

The genital markings consist of a pair of conical, ventrally flattened papillæ which are swellings of the very anterior border of segment xi, projecting forward onto x, in the region *bc*. These papillæ lack the characteristic red pigment of the clitellar segments, and because of their striking whiteness are rather conspicuous for the small size. The male pores are not located on these flap-like papillæ but underneath them, and the papillæ must be pushed back before the pores are visible. In the intersegmental furrow just under the papilla is, what at first sight appears to be an unusually large, round male pore. This, however, is not a pore but merely an unusually deep well-like depression. Projecting from the mouth of the depression or lying inside is a small tubular body which bears at its free ventral end the real male pore. There are no other genital markings.

Internal anatomy.—Septa 5/6, 6/7, 7/8 and 8/9 are present and thickened, 9/10 is thin, 10/11 and 11/12 are both attached to the dorsal and

ventral parietes but close together. Internally in segment xi, that part of the segment which contains the ova is shut off from the rest of the segment in such a way as to form a chamber in the shape of a U with the arms of the U inverted over the digestive system, forming also a small medianventral chamber containing the nerve cord.

The gizzards are three in segments xvi, xvii, and xviii.

The last hearts are in segment ix.

The testis-sacs are constricted by 9/10. The portions of the sacs which lie in ix, are only slightly enlarged anterior to the constriction and are bent upwards. At the posterior end of each sac is a similar constriction, the posterior "tail" passing between the ovarian chamber and the alimentary canal into segment xii on the left side and on the right side into segment xiv where it is bent upwards onto the dorsal surface of the digestive system. The vas deferens is easily traced; it consists of a few small coils entirely in x, and passes into the prostate near the inner free end. The prostates are U-shaped bodies lying on the floor of the segment with the opening directed posteriorly and the attached limb externally; they have a coarsely granular surface and a short, smooth surfaced duct or stalk.

The ovisacs pass into xv.

The spermathecal ampulla is rather large, and ovoid in shape. The duct is loosely coiled and is slightly enlarged just before it passes into the body wall posterior to 7/8.

Distribution.—Yaungwhe and Taungyi, F. S. S.

Occurrence.—April.

Remarks.—The length varies from 55 to 120 mm., the diameter from 3 to 5 mm. In practically all of the specimens from 3/4 on, except in the furrows between the clitellar segments, there are minute dark spots resembling dorsal pores, in the mid-dorsal line. These are never functional anterior to the clitellum and only rarely in the posterior part of the worm. The greatest extent of the clitellum is from just behind the setæ of segment ix to 14/15.

The setal intervals vary. In the majority of the specimens *aa* posterior to the clitellum is evidently less than *bc*. In a few specimens as in the type, *aa* is only very slightly less or practically equal to *bc*. Frequently the interval *bc* dwindles posteriorly until it is less than *aa*. Posteriorly the setæ project conspicuously and are nearly twice as long as the anterior setæ but of the same diameter. A seta from segment xxi measures .25 mm. in length, while the same seta from a segment ten millimetres from the posterior end is .48 mm. long.

The spermathecal pores are in line with, or slightly internal to. The female pores are in *b* or slightly external to *b*. The papillæ described for the genital region are characteristic and differ, in over eighty specimens obtained, only in size. In several specimens there is a small slightly swollen area on the posterior border of x, just external to the papilla of xi, which lacks pigment but there is no definite papilla present.

The gizzards are three or four in the region of segments xv-xix.

In the majority of specimens dissected the constriction due to 9/10 divides the testis-sacs into about equal parts. Usually there are addi-

tional constrictions dividing the most anterior portion into a "beak" which is variously curved or bent, or the most posterior portion into a "tail" which is also bent or twisted.

The prostate varies in shape considerably ; it may be erect and columnar, or bent (crescent-shaped or U-shaped). The coarse granulations on the surface are easily rubbed off by a needle, leaving the remainder of the organ with a diameter only very slightly greater than that of the stalk. The vas deferens can be traced along the surface after the granulations have been removed, but it passes inside before reaching the free end.

The enlargement at the end of the spermathecal duct as it passes from the septum down onto the parietes is larger in most of the specimens than in the type and more readily visible.

Stephenson (1924) has described from the vicinity of Yaungwhe two worms *D. barwelli hehoensis*, and *D. fluviatilis*. *D. tecta* differs from the first in the character of the prostomium, genital papillæ, prostate, and ovarian chamber ; from *D. barwelli typica* in the character of the prostate atrium, and ovarian chamber ; and from *D. fluviatilis* in prostate, atrium, posterior setæ and male pores.

Family MEGASCOLECIDAE.

Genus **Pontodrilus** E. Perr.

Pontodrilus bermudensis Bedd.

Pontodrilus bermudensis, Beddard, *Ann. Mag. Nat. Hist.* (6) VII, p. 96 (1891).

The local specimens appear to be much larger than those found in India (Stephenson 1923), the Burma forms being 100-120 mm. long and 3-3½ mm. in diameter in comparison with a length of 32-65 mm. and a diameter of 2-2½ mm. for the Indian forms. The number of segments varies from 100 to 120. The spermathecal pores are in 7/8 and 8/9 in line with seta *b*, at the centre of nearly conical papillæ located in the intersegmental grooves. The female pores are paired on xiv, each is anterior and slightly internal to seta *a*. The pores are located on a slightly raised, oval area extending from 13/14 to the setæ of xiv. Genital markings in addition are transverse oval papillæ with a central depression, on 12/13 and 19/20. The oesophagus is much larger in xiv and xv than in the preceding segments, dark red in colour, and internally longitudinally corrugated. The intestine begins in xvi. The prostatic duct is about 2 mm. long and lies in xvii and xviii. It is curved into a crescent shape, and is about the same thickness throughout except at the extreme ends. The ornamentation of the setæ is exceedingly difficult to observe. Under the immersion lens it appears to consist of a few scattered ridges, each consisting of three to seven teeth. In all other respects the worm agrees with the description in Stephenson's *Fauna* volume.

Distribution and Occurrence.—The worms were found in rather sandy soil under logs some distance from the shore near Kadonkani in January. Not previously reported from Burma.

Genus **Notoscolex** Fletcher.**Notoscolex** sp.?

Immature specimens of a species probably of *Notoscolex* were obtained from Maymyo in the month of October. The genus has not hitherto been found in Burma. The nearest *Notoscolex* region is the Abor country, in the north-eastern frontier region of India which is on the north-western frontier of Burma. None of the species of this genus hitherto described from the Indian empire are peregrine and Stephenson (1923) lists all as of zoogeographical importance. It therefore appears probable that the form from the Shan States, so far from the Abor country, will also prove to be endemic.

The worms are 300-350 mm. long and 5-7 mm. in diameter. The clitellum and genital apertures are not visible.

Genus **Megascolex** Templeton.**Megascolex mauritii** (Kinb.).

Lampito mauritii, Kingberg, *Öfv. Ak. Förh.* XXIII, p. 103 (1867).

Distribution and Occurrence.—Thazi, Meiktila, Myingyan, Pagan, Pakkoku (all May and June), Mandalay (March and Oct.), Bhamo (April), Sagaing (March), Thayetmyo (Aug. and Sept.).

Genus **Pheretima** Kinb.**Pheretima anomala** Mich.

Pheretima anomala, Michaelsen, *Mt. Mus. Hamburg* XXIV, p. 167, text-fig. 14 (1907).

The seminal vesicles.—Michaelsen (1907) in his original description of this species says of these organs, "Samensäcke scheinen zu fehlen." Gates (1925) states, "There are no seminal vesicles," but mentions at the end of the paper the finding "of what may be regarded possibly as incipient seminal vesicles. These are small stalked bodies on the posterior face of septum 11/12. The stalks are attached to the septum just behind the testes of the preceding segment, pass upwards on the septum, and are very slightly enlarged at the free end. The whole thing is too small to dissect and has not been studied further. The worm was, with this single exception, true to the *anomala* type." As one of the anomalous features of this worm is the absence of the seminal vesicles, and as the single specimen mentioned previously, indicated the possibility of the occurrence of seminal vesicles perhaps in limited seasons of the year, all specimens of this species brought into the laboratory during the past year have been dissected. The species is rather rare in Rangoon city and the immediate vicinity, and nothing of interest was found until the middle of July. From this time until about the end of August more than one half of the specimens dissected either had seminal vesicles or what may be regarded as incipient or rudimentary stages of these organs. After the end of August (except in Maymyo worms) rudimentary or incipient stages were found only rarely and the fully developed vesicles not at all. This seems to suggest a seasonal development, functioning, and retrogression of these organs, but as there is not sufficient information as to the localities from which the various collections were obtained this can not be definitely stated at present. *P. posthuma*, for instance, seems to produce

much larger percentage of abnormal specimens in certain limited localities in the city area, and it may be possible that in similar limited areas *P. anomala* develops seminal vesicles but not elsewhere.

The seminal vesicles have been found in both segments xi and xii, in xii alone but not in xi alone, except in one abnormal specimen, and more commonly in xii alone than in both xi and xii. These organs when present have been paired with but a single exception. If present in a single segment, they may be in an incipient or rudimentary condition consisting of a short stalk with a very slight spherical enlargement at the free end, or the enlargement may be two to four times the diameter of the stalk. The base of the stalk is attached to the posterior face of the septum just behind the male funnel of the preceding segment and not behind the testis as previously stated. The base of the stalk and the upper end of the large funnel coincide in position on the septum. When two pairs of vesicles are found they have in every case been large and stalkless, either, with a single lobe, or two to five lobules. The size varies from that of the small leaf-like organs hidden under the septum to large enough to fill the space in the segment around the alimentary canal and to meet dorsally over the dorsal blood vessel.

One specimen has a single pair of vesicles in xi, a very large pair of ovaries in xii, a pair of funnels on the anterior face of 12/13 which in size and shape resemble the male funnels more than the oviduct funnels. There is a very small pair of ovaries in xiii in the usual position, but no oviduct funnels are visible in this segment. There is only one female pore visible externally and that is in the usual position on xiv.

Specimens from Maymyo are unusually large: 160-180 mm. long. All have well developed seminal vesicles in xi and xii. These worms were obtained in October.

Distribution and Occurrence.—Bassein (Oct.), Maymyo (Oct.), Lashio (Oct.), Moulmein (Oct.), Kawkareik (Oct.), Thonze (Aug. and Sept.), Prome (Aug. and Sept.).

***Pheretima birmanica* (Rosa).**

Perichaeta birmanica, Rosa Ann. Mus. Genova (2) VI, p. 164, pl. iii, figs. 7-9 (1888).

This species was erected by Rosa in 1888 for poorly preserved specimens obtained by Fea in Bhamo, Upper Burma. The species has not been reported since that time. The present specimens permit the addition of the following information.

Length 100-160 mm. Diameter 4-7 mm. Colour, dorsally a uniform brownish or bluish grey, from one end of the worm to the other, ventrally a dirty whitish. The clitellum is of approximately the same colour as the dorsal surface. Secondary annulations are lacking. The prostomium is epilobous but without the posterior cross furrow at the end of the tongue. The clitellum is ring-shaped, on segment xiv-xvi (3); intersegmental furrows and dorsal pores are lacking.

The spermathecal pores are three pairs in 5/6, 6/7, 7/8, just ventral to the lateral edge of the darker coloured dorsal surface. Each pore is indicated by a minute round papilla on the anterior border of the segment within the groove formed by the intersegmental furrow. There are 27-30 setæ between the lines of the pores.

The apertures of the copulatory chambers are very narrow, transverse, slit-like depressions in the setal circle, separated by 15-18 setæ. The region around the pore is usually slightly swollen, the swelling extending antero-posteriorly to the intersegmental furrows.

Septum 4/5 is present and thin, 5/6, 6/7, 7/8, are slightly thickened, 8/9 and 9/10 are absent or represented only by ventral rudiments. The gizzard is elongate, extending from 7/8 to 9/10.

There are three pairs of commissures in the "combined" segment. The anterior pair is small and passes to the gizzard (viii), the middle pair (ix) is the largest, the vessel on one side usually vestigial and not passing to the ventral vessel. The last pair (x) is slightly smaller than the larger commissure of ix, and is concealed under 10/11. The commissures of x and xi pass into the ventral vessel in this species, as in *P. lignicola*, *P. anomala*, and *P. insolita*, instead of into the lateral-oesophageals as in *P. posthuma*.

The seminal vesicles are small, flattened, leaf-like bodies on the posterior faces of 10/11 and 11/12 just above the testis-sacs of the preceding segment. They are not lobed in the majority of the specimens. The testis-sacs are small in x and xi.

The ovaries and oviduct funnels are in the usual position, large.

The prostates lie in xvii-xx, much lobulated, with ductules visible on the intestinal surface of the gland. The duct is bent into a characteristic U-shape with the limbs of the U pressed closely together. The open end of the U may be directed externally with the prostate limb posteriorly, or the open end may be anterior or posterior with the prostate limb outermost. The parietal end of the parietal limb passes under the other limb of the U and into the outer side of the roof of the dome-shaped copulatory chamber. This chamber can be cut off from the parietes, slit open on one side, and turned inside out. The wall of the chamber is smooth and shiny, with a single columnar projection just under the prostate duct, hanging down in the interior. This bears at its free ventral end a depression, either slit-shaped or concave, at the centre of which is the minute male pore.

The spermathecal duct is much shorter than the ampulla and not definitely marked off. Its base is surrounded by a mass of soft tissue through which the diverticulum passes to open into the duct. The diverticulum arises close to the base of the duct and passes along the duct and onto the ampulla as a nearly-straight, glistening tube, the remainder coiled into a heart-shaped mass (not in a zigzag line as in *P. houlleti tortuosa*) with the slightly enlarged end of the diverticulum at the tip of the coiled mass. The connective tissue between the loops is easily cut so that the diverticulum can be straightened out. It is $1\frac{1}{4}$ - $1\frac{1}{2}$ times the total length of the duct and ampulla.

Distribution and Occurrence.—Maymyo (Oct.), Lashio (Oct.).

***Pheretima elongata* (E. Perr.).**

Perichaeta elongata, E. Perrier, *Nouv. Arch. Mus. Paris* VIII, p. 124, pl. iv, fig. 70 (1872).

Distribution and Occurrence.—Mandalay (March, April, Oct.), Moulmein (Oct.), Mongnai (April).

Pheretima feae (Rosa).

Perichaeta feae, Rosa, *Ann. Mus. Genova* (2) VI, p. 161, pl. iii, figs. 1-6 (1888).

This worm was described by Rosa in 1888 from specimens collected by Fea. Stephenson (1916) had a single specimen collected by or for the Zoological Survey of India in 1911. The worm is common in Kawkareik in October, being frequently found crawling around on the ground in the early morning before the dew has evaporated. The live worm has such a snake-like appearance that Indian coolies cannot be persuaded to pick it up.

The present specimens are 230-250 mm. long, and about 12 mm. in diameter. Dorsally the worm is a very deep bluish black. The pigmented region is sharply demarcated laterally from the creamy-white ventral surface. The clitellum begins behind the setae of xiii, and extends nearly to the setae of xvii. There are 20-22 setae between the male pores, and 20-30 setae between the lines of the spermathecal pores, which are ventrally situated.

The male genital areas are round swellings extending from 17/18 to 18/19 and slightly concave at the top. At the bottom of the concavity is a flat circular area separated from the rest of the swelling by a slight but very evident circumferential furrow. At the centre of this flat area is the minute male pore.

Septa 10/11 and 11/12 are much thickened. The seminal vesicles of xi are large and in contact dorsally over the dorsal blood vessel. The vesicles of xii are two to three times as large as those of xi, and appear to extend into segments xvi-xvii, but are actually contained in xii, lying in posterior outpocketings of 12/13 which also push the other septa concerned out of their normal position in this region. The testis-sacs of x are round, those of xi larger and more elongate. The sperm ducts of a side unite on the posterior face of 11/12, the duct is large but more or less covered with loose connective tissue. The prostate ducts are 20-25 mm. long. The oviduct funnels are unusually elongate.

The commissures of segments viii and ix are small, those of viii passing to the gizzard, one of the pair belonging to ix vestigial, the other commissure passing to the ventral blood vessel. The commissures of x and xi also pass to the ventral vessel instead of to the lateral oesophageals.

Distribution and Occurrence.:—Kawkareik (Oct. and Nov.).

Pheretima hawayana (Rosa).

Perichaeta hawayana, Rosa, *Ann. Hofmus. Wien* VI, p. 396, pl. xiv, figs. 7, 9 (1891).

lineata, var. nov.

Length 60-90 mm. Diameter 3-4 mm. Number of segments 91-95. Colour of formaldehyde preserved specimens is a nearly uniform grey, only very slightly darker on the dorsal than on the ventral side. The clitellum is greyish red. The prostomium is epilobous but without the cross furrow at the posterior end of the tongue. The first dorsal pore is in 10/11.

The setae begin on ii, the circles are usually complete, without appreciable dorsal or ventral break, although there is rarely a slight dorsal

break. The specimens are soft so that it has not been possible to count accurately the setae.

The clitellum extends over segments xiv-xvi (3) in a few cases, but in most of the worms it begins slightly behind the intersegmental furrow 13/14; dorsal pores and intersegmental furrows are lacking, and setae have not been observed.

The male pores are minute and at the top of conical swellings in the circle of setae on segment xviii. The base of the swelling usually extends to the intersegmental furrows, anteriorly and posteriorly. There are fourteen to sixteen setae between the male pores. The female pore is minute, midventral in position on xiv. There are only two pairs of spermathecal pores situated on all specimens in 5/6 and 6/7 about one half of the circumference apart with 24-28 setae between the lines of the pores.

The genital papillae both anterior and posterior to the clitellum are similar in appearance and consist of a conical swelling bearing at its top a round, slightly concave depression which is greyish in colour. This depression is surrounded by a more or less sharply marked off rim of whitish tissue. The whole papilla is small and only very slightly raised above the general surface. The papillae posterior to the clitellum are a trifle smaller than those on the anterior segments.

The post-clitellar papillae are most often four in number, one pair on each side just internal to the male pore, on the inner side of the conical elevation, with one of the pair just anterior to and the other just posterior to the setae of the segment. The next most common arrangement consists of six papillae, a longitudinal row of three on each side, the first two of the three in the same positions as in the preceding arrangement, with the third on the anterior border of segment xix, close to but not touching furrow 18/19. More rarely still, eight papillae are present in two longitudinal rows of four. Curiously, when eight papillae are present, all are on segment xviii, the middle two in the same positions as in the first arrangement, the first one on the anterior and the last one on the posterior region of the segment, close to the intersegmental furrows. In several cases three papillae are present on each side, two as usual, the third external or internal to the other two and in the line of the setal circle.

The preclitellar papillae are median in position, on the anterior part of the segment but slightly nearer to the setal circle than to the anterior intersegmental furrow, on segments v, vi, vii, viii. Twenty specimens have four papillae on the segments named, 37 have papillae on vi, vii and viii, 12 have papillae on vii and viii, and four specimens papillae only on v and vi. A few other specimens have a single papilla on one of the four segments.

Internally the structure of the worms is much the same as described by Stephenson in the *Fauna* volume. There are no ovisacs. The duct of the prostate is curved like an arc of a circle with a slight crook at each end as the duct passes into the gland or the parietes. The concave side of the duct faces posteriorly. The prostate is large, in segments xviii-xxiii. The vas deferens in xviii, passes up onto the convex side of the prostatic duct along which it runs till it passes into the duct at the edge

of the prostate. The vas deferens is unusually conspicuous in these worms and is probably slightly enlarged in xviii.

The spermathecal ampulla is heart-shaped, or ovoid, slightly longer than the duct. The diverticulum is a simple tube attached to the ectal end of the duct, not coiled, slightly enlarged and spherical or pear shaped at the free end, the whole as long or slightly longer than the total length of the ampulla and duct.

Remarks.—The genital markings differ in position and in the case of the preclitellar papillæ, in the segments bearing them, from the worms of this species previously described from India. The constancy of the characteristic “longitudinally” linear arrangement of the papillæ seems to necessitate the establishment of a new variety, but as very little of the literature on this species is available, this can only be tentatively suggested at present.

Distribution and Occurrence.—Taungyi (height 4,763) and Htamsang (4,300) on the Taungyi-Kengtung military road, F. S. S. This worm is by far the commonest in both these places in the month of April. Lashio (Oct.). The species has not been found at all in lower Burma.

***Pheretima heterochaeta* (Mich.).**

Perichaeta heterochaeta, Michaelsen, *Abh. Ver. Hamburg* XIV, 2, p. 6 (1891).

The Lashio specimens of this species differs slightly from the description by Stephenson in the *Fauna* volume. The first dorsal pore is in 12/13 instead of anteriorly, and in the region of the male pore there are papillæ exactly similar in appearance to those on the anterior segments. The papillæ in the male region are single or paired. The single papilla may be median or lateral in position. The paired papillæ may be close together in the midventral region, or widely separated, each papilla just internal to the line of the male pores. Except for these papillæ and the position of the first dorsal pore the worms are similar to the typical variety. Michaelsen (1897) named a variety which differed chiefly from the typical variety in possession of a pair of papillæ close to and on the inner side of the male pores. This variety has disappeared from recent lists of Indian Oligochaetes. Possibly the present form is the same variety.

Distribution and Occurrence.—Bhamo (March), Namkhai, on the Namkham Bhamo road (March), Namkham (April), Maymyo (Oct.), Lashio (Oct.), Taungyi (April), Htamsang (April).

***Pheretima houlleti* (E. Perr.).**

Perichaeta houlleti, E. Perrier, *Nouv. Arch. Mus. Paris* VIII, p. 99, pl. ii, figs. 31-44, pl. iii (1872).

In a recent paper the writer pointed out that three Rangoon worms have bifid clitellar setæ said to be characteristic of this species. The smallest of the three worms, differing least from the original description was retained at the typical variety and the other two were described under names of *tortuosa* and *rugosa*, and retained tentatively as varieties. Since that time several papers containing further information have become available. Horst (1892) described worms (from various places in the Malay Archipelago) as *P. houlleti*. “The longest example measures

200 mm. in length," "between the male generative pores, 12 setae are to be seen," "the first dorsal pore lies in the intersegmental groove XI/XII", "a tubular diverticulum coiled in a zigzag line, nearly half as long as the pouch." "the first pair of spermathecae possesses only one globular body, but the other pairs have a greater number of them, viz., 3, 4, or 5." In regard to all these characters just mentioned; length, position of the first dorsal pore, number of setae between the male openings, the appearance of the spermathecal diverticulum, and the arrangement of the accessory glands, the worm agrees rather with *tortuosa*, than *typica*. The only important point of difference between Horst's worms and the Rangoon *tortuosa*, is the possession of the penial setae which Horst may possibly have overlooked. Ude (1905), on the other hand, described a worm from the Fiji Islands which is clearly *typica*. Rosa (1890b) described a worm from Palon, Burma under the name *P. campanulata* which Michaelsen later included with *P. houlleti*. This worm also agrees more in detail with *tortuosa* than with *typica*. But Rosa also makes no mention of penial setae. It is evident then that in the past at least two well defined varieties, if not actually species, of worms have been included within *P. houlleti*, and that these two varieties are rather widely distributed in the south-eastern Asiatic regions.

***Pheretima houlleti typica* (E. Perr).**

Distribution and Occurrence.—Bassein (Oct.), Bhamo (March), Sagaing (March), Namkham (April), Maymyo (Oct.), Lashio (Oct.), Moulmein (Oct.), Kawkareik (Oct.), Thayetmyo (Aug. and Sept.), Nyaunglebin (Sept.), Thonze (Aug. and Sept.), Prome (Aug. and Sept.).

***Pheretima houlleti tortuosa* Gates.**

P. houlleti tortuosa Gates, *Ann. Mag. Nat. Hist.* (9) XVII, p. 454, figs. 6-8 (1926).

Distribution and Occurrence.—Maymyo (Oct.), Lashio (Oct.), Moulmein (Oct.), Nyaunglebin (Sept.), Kawkareik (Oct.).

***Pheretima houlleti rugosa* Gates.**

P. houlleti rugosa, Gates, *Ann. Mag. Nat. Hist.* (9) XVII, p. 459, figs. 9-10 (1926).

Important differences of this from the typical variety are the absence of the spermathecae, the rudimentary condition of the seminal vesicles, and absence or vestigial condition of the prostates. The rudimentary condition of the seminal vesicles, the frequent absence of the prostates, the wrinkled appearance of the clitellar setae, and the absence of spermathecae suggest that the worms for which this variety was founded may in reality be abnormal specimens. In order to obtain further information on the matter a number of collections of the three types of this species were made in various parts of the city of Rangoon. All three types are found commonly in most parts of the city. *Rugosa*, although not quite as common as the other two is still one of the common worms of the Rangoon area. This seems to rule out the possibility of abnormality, as it certainly would be unusual to have a constant abnormal condition practically as common as the normal. Several hundred worms of this

type in these collections were examined to obtain further information as to the spermathecæ which might give some indication as to the rela-

tionship. In these collections only two worms were found with external indications of the presence of spermathecæ. On the first worm, in furrow 6/7 on the left side just below the edge of the pigmented area and about in line with seta *f* is a spermathecal pore. There are no other pores visible externally. Internally a single rudimentary spermatheca is visible. This (Fig. 3*a*) consists of a rather long duct with a nearly spherical enlargement at the free end. There is no sign of diverticulum or accessory glands, such as occur in *typica*. In the second worm there is a spermathecal pore in 8/9 on

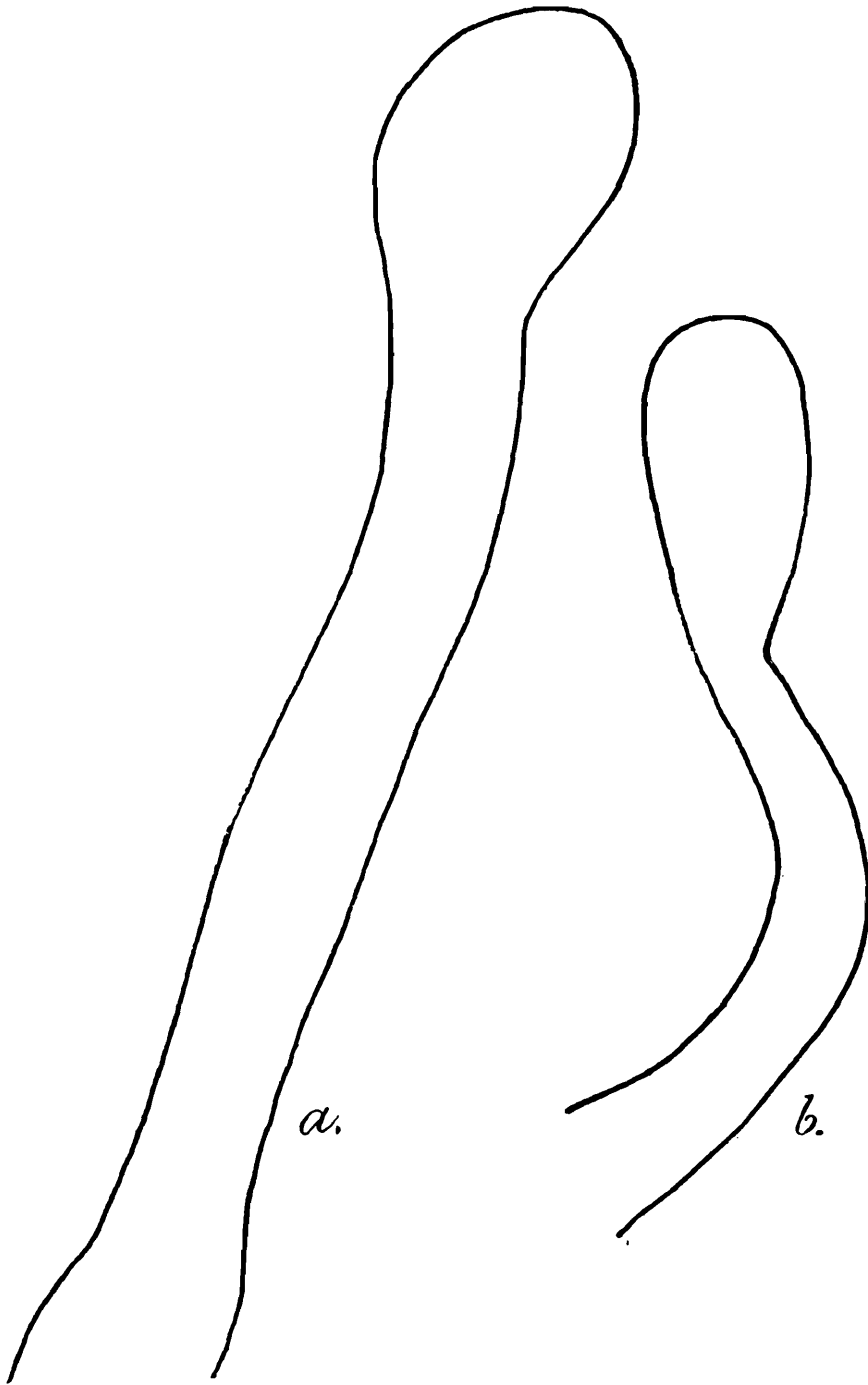


FIG. 3.—*Pheretima houletti rugosa* Gates.
a. Spermatheca, $\times$ ca. 70.
b. Spermatheca, $\times$ ca. 40.

the right side. In the furrow, internal to the pore, are two minute papillæ such as usually mark the external opening of the accessory glands of *typica* and *tortuosa*. Just in front of the spermathecal pore on the posterior part of viii is another pore, and on the anterior part of ix in line with the other is a fourth pore of the same size. Internally no spermatheca is visible. A minute hollow knob over the pore in 8/9 probably represents a vestige of a spermathecal duct. There are however four stalked glands exactly similar in appearance and size to the talked accessory glands of *typica* and *tortuosa*. The stalks of the inner

two of these glands pass into the hollow knob just mentioned. The stalks of the other two pass into the parietes to the pores on viii and ix. There are no indications internally of glands corresponding to the papillæ in 8/9 internal to the spermathecal pore. A third worm has no spermathecal pores visible externally but on the left side in the gizzard segment a rudimentary spermatheca is present. The duct (Fig. 3*b*) is long and curved and has at the free end an ovoid enlargement. There are no accessory glands present. Numbers of worms picked at random from the collection were dissected but no further specimens with spermathecæ were found.

Distribution and Occurrence.—Rangoon (June to Dec.), Moulmein (Oct.).

Abnormal specimens.

Var. typica.

1. Anterior end (tail apparently cut off by the cooly in digging) 45 mm. long. Immature, clitellum not yet visible. Anterior to segment xvii, the worm is normal. The intersegmental furrows are distinct and can be determined without difficulty. The segmentation, hence the intersegmental furrows and setæ are normal on the right side behind xvii, but on the left side of the mid-dorsal line, the setal circles frequently divide into two lines of setæ which diverge, passing around onto the ventral side, where one of the diverging lines ends abruptly in or near the midventral line, the other line being continuous with the setæ of the right side. In two places the extra line of setæ has no relation with the setal circle, ending dorsally and ventrally without connection with the row of setæ of the segment. That part of the segment having the extra row of setæ is separated from the rest of the segment of the left side by a furrow which begins and ends blindly near the region of the mid-dorsal and midventral lines. This intercalation of half setal circles occurs on segments xix, xxi, xxii, xxiv, xxx, xxiii, xlviii, 1, liii, (numbering from segment one on the right side).

The apertures of the copulatory chambers in xviii are separated by nine setæ. There is an additional aperture on the left side in the setal circle of segment xxi (right side) or, if the areas containing setæ are considered also as segments, in xxiii (left side).

The worm was dissected from the dorsal side and, of course, in so doing the dorsal parts of the septa were destroyed, but the determination of the attachment of the septa laterally and ventrally is easy as the preservation of the worm is good. The extra lines of setæ indicated on the left side belong to half segments which have no equivalent on the right side. The septum marking off the half segment passes underneath the alimentary canal and then turns backward and is fused to the face of the septum next behind on the right side. Thus, for instance, 18/19 on the right side is continuous with 19/20 on the left side while 1⁸/19 on the left side is fused medio-ventrally at least to the anterior face of 18/19 on the right side. It is to be presumed that the same fusion exists dorsally. The septa marking off other half segments on the left side are similarly attached.

The prostates of the left side are in xvii-xx and xxii-xxv, with ducts in xviii and xxiii. The prostate of the right side lies in xvii-xx, with duct in xviii. The intestinal caecum of the left side is lacking.

Var. *tortuosa*.

2. Length 156 mm. The first dorsal pore is in 13/14 instead of 10/11. Setæ are lacking on segment vii on the right side, and on segment viii on the left side, but the intersegmental furrow 7/8 is well marked and continuous around the worm. The setal circle of xiii is broken, ventrally the setæ begin abruptly in the region of the midventral line, but anterior to the middle of the segment, extend up around the dorsal side and then end abruptly also in the midventral line but in the posterior part of the segment. Intersegmental furrows 12/13 and 13/14 are distinct, complete, and normal. The clitellum extends from 13/14 to 19/20 on the left side, and from 13/14 to the setæ of xvii, on the right side: intersegmental furrows and dorsal pores are not visible, but setal circles are faintly indicated. The spermathecal pores are in 7/8, 8/9 and 9/10 on the right side, and in 9/10 and 10/11 on the left side. There are apertures of copulatory chambers in the setal circles of xxi on the right side, and xxiv and xxvi on the left side. Segment xx is a half segment, wedge-shaped, present on the left side only. There are no female pores visible.

Septa 4/5-8/9 are present, 9/10 is present on the left side only, 10/11, 12/13 are absent, 13/14 is present on the right side only, 20/21 is present on the left side only. Other septa normal.

The gizzard is in segment ix. There is a large intestinal caecum in xxx on the right side, another in xxxix on the left side. There is a small intestinal caecum in xxxviii on the left side.

There are paired masses of acinous blood glands in segments v, vi, and vii. There are paired commissures or "hearts" in segments iii-ix, four pairs in the combined segments without septa (x-xiii), one pair of commissures in xiv, two hearts on the left side and one on the right side of xv (all three unusually large), paired commissures in xvi, and a large heart in xvii on the right side. The supra-oesophageal vessel is visible first at about the region of the commissures of xi, it is large and gorged with blood.

There is a single testis-sac on the right side of segment xiii, and a pair of testis-sacs in xiv. There is a large seminal vesicle on the right side of xiv, another on the right side of xv, and a rudiment on the left side of the same segment. There is a funnel about three times as large as usual in xv, on the anterior face of 15/16 on the left side. The duct is also large and readily visible and can be traced through segment xvi, and into xvii, where it passes into the body wall. In segment xvi, on the right side there is an ovary, but on the left side there is a small, stalked, ovoid body on the posterior face of 15/16 slightly dorsal to the position of an ovary. There are paired oviduct funnels in the usual positions in segment xvi. There is an ovary and an oviduct funnel on the right side of xvii, and an ovoid body without stalk on the posterior face of 16/17 on the left side.

The right prostate is in xx-xxiv with the duct in xxi. The left prostates are in xxii-xxiv, with duct in xxiv, and xxv-xxviii with duct in xxvi. The spermathecae are in the segments indicated by the pores.

***Pheretima insolita* Gates.**

Pheretima insolita, Gates, *Ann. Mag. Nat. Hist.* (9) XVI, p. 568 (1925).

The specimens of this species from Maymyo are unusually large, 150-180 mm. long and are characterized by a saddle-shaped appearance of the clitellum. About one mm. from the midventral line on each side the clitellum appears to end abruptly, with the edge of the clitellar area marked off side, by a longitudinal furrow from 13/14 to 16/17 on each. The furrow may be straight or it may be curved slightly upwards at the anterior and posterior ends. In the region between the two furrows the intersegmental furrows and setal circles are present, although not indicated beyond the furrows. The female pore is at the centre of a round swelling which has a smooth glandular appearance similar to that of the clitellum dorsally. Sections show that the clitellar thickening of the epidermis is present all around the animal, but ventrally, except around the female pore, it is only about one quarter or less as thick as elsewhere. No indications of such a modification have been observed in worms of this species obtained from other places.

In some of the Maymyo specimens the vas deferens is clearly visible on the ventral parietes, instead of buried in more or less loose connective tissue. In a few of these specimens the vas deferens has been traced into the region of segments xxvi-xxx before it becomes too thin to be traced further.

Distribution and Occurrence.—Type A. Bassein (Oct.), Maymyo (Oct.), Lashio (Oct.), Moulmein (Oct.), Thonze, (Aug. and Sept.), Prome (Aug. and Sept.). Type F. Thonze (Aug. and Sept.). This type is much more common in Thonze than elsewhere and nearly as common there as Type A.

***Pheretima lignicola* Steph.**

Pheretima lignicola, Stephenson, *Rec. Ind. Mus.* VIII, p. 399, pl. XXVII, fig. 17 (1914).

Specimens of this species obtained from Kawkareik are unusually large; 180-200 mm. long, and 7-8 mm. thick.

Distribution and Occurrence.—Maymyo (Oct.), Lashio (Oct.), Moulmein (Oct.), Kawkareik (Oct.), Thayetmyo (Aug. and Sept.), Nyaunglebin (Sept.), Thonze (Aug. and Sept.), Prome (Aug. and Sept.).

***Pheretima peguana* (Rosa).**

Perichæta peguana, Rosa, *Ann. Mus. Genova* (2) X, p. 113, pl. i, figs. 6-8 (1890).

Distribution and Occurrence.—Bassein (Oct.), Bhamo (March—one specimen only), Moulmein (Oct.), Kawkareik (Oct.), Thayetmyo (Aug. and Sept.), Thonze (Aug. and Sept.), Prome (Aug. and Sept.).

Pheretima planata Gates.

Pheretima planata Gates, *Ann. Mag. Nat. Hist.* (9) XVII, p. 411, fig. 1-2 (1926).

Distribution and Occurrence.—Bhamo (March), Moulmein (Oct.), Nyaunglebin (Sept.), Tavoy (April).

Pheretima posthuma (L. Vaill.).

Perichæta posthuma, Vaillant, *Ann. Sci. Nat.* (5) X, p. 228 (1868).

Distribution and Occurrence.—Bassein (Oct.), Meiktila (May), Mandalay (Oct.-Mar.), Sagaing (March), Moulmein (Oct.-Jan.), Kawkareik (Oct.), Taungyi (Apr.), Thayetmyo (Aug. and Sept.), Tavoy (April), Thonze (Aug. and Sept.), Prome (Aug. and Sept.).

Pheretima sp.?

While digging for worms on the outskirts of Taungyi, fragments of four specimens of a large *Pheretima* were secured. No complete worms were obtained, and the three anterior pieces all belonged to immature worms. The clitellum, spermathecal and female pores are not visible. The male pores are visible with difficulty as minute openings in the setal circle of xviii. The species must be a large one as these immature specimens are 8-10 mm. in diameter. The genital organs are not sufficiently developed to repay description. There are four pairs of spermathecae. The worms were found in well-rotted leaves which had accumulated in a small depression, and were three to four feet from the surface.

Genus **Perionyx** E. Perr.**Perionyx excavatus** E. Perr.

Perionyx excavatus, E. Perrier, *Nouv. Arch. Mus. Paris* VIII, p. 126, pl. iv, figs. 73, 74 (1872).

Distribution and Occurrence.—Bassein (Oct.), Bhamo (Mar.), Maymyo (Oct.), Moulmein (Oct.), Kawkareik (Oct.), Taungyi (April), Kalaw (Mar.-May), Nyaunglebin (Sept.), Yaungwhe (April), Inle Lake, on the floating islands, (April), Tavoy (April), Thonze (Aug. and Sept.), Prome (Aug. and Sept.).

OCTOCHAETINAE.

Genus **Octochaetus** Bedd.**Octochaetus birmanicus** Gates.

Octochaetus (Octochaetoides) birmanicus, Gates, *Ann. Mag. Nat. Hist.* (9) XVI, p. 55 (1925).

The genital papillæ of this species are never very distinctly outlined and are easily overlooked, as they are almost always included in the pos-

terior ridge or lip of the characteristic shield-like marking of the male region. There may be one, two, or three successive pairs of transversely oval papillæ in the region *aa* of this posterior lip or ridge, on either the anterior or posterior parts of segments xviii-xxi. The papillæ of a pair are usually in contact in the middle of the region *aa*, or more rarely there is a single unusually long papilla in the same region. Frequently the papillæ are altogether lacking.

Only one worm has been found with papillæ entirely outside the marking on the male area. In this specimen there are two pairs of the usual oval papillæ on the posterior lip or ridge of the male area, on the anterior and on the posterior part of segment xix. On segment xxi there is an elongate, transversely oval, raised area, extending from 20/21-21/22 and from seta *b* of one side to *b* of the other side, and containing seta *a* of each side. Projecting from the flat surface of this area in the region *aa* are two smaller papillæ, oval in outline, with the inner borders in contact in the middle of *aa* and with a slight but evident furrow running around both papillæ and marking them off from the rest of the raised area.

Distribution and Occurrence.—Bassein (Oct.), Moulmein (Oct.), Thonze (Aug. and Sept.).

Eutyphoeus foveatus (Rosa).

Typhæus foveatus, Rosa, *Ann. Mus. Genova* (2) IX, p. 389 (1890).

Rosa (1890a) in the original description of the species characterized the penial setæ as follows: "numerosa, fortemente ricurve, non presentano alcun rigonfiamento e terminano in una semplice punta conica. In alcune sinota che le porzione terminale è rivestita di piccole punte disposte senza ordine." In the course of work on *E. spinulosus* it became necessary to use the oil immersion lens, which had not been previously employed, on the setæ of that species as well as *foveatus*, for purpose of more adequate comparison. As a result a few details can be added as to setæ of the latter. The penial setæ are always curved in a fashion which may be called spiral. Even the smallest of the reserve setæ show this coiling of the free tip. Under the immersion lens the surface of a seta shows a delicate surface striation. The striæ are fine, very close together and run in the direction of the coiling of the shaft. The ornamentation in certain cases consists of scattered "points," but more often the "points" are aggregated into more or less irregular rows. The rows are rather short and do not appear to continue as complete circles around the shaft. The teeth of which the rows are composed are spine-like, the length of the tooth greater than its width at the base.

Distribution and Occurrence.—Moulmein (Oct.), Thonze (Aug. and Sept.). Prome (Aug. and Sept.).

Eutyphoeus peguanus Gates.

Eutyphæus peguanus, Gates, *Ann. Mag. Nat. Hist.* (9) XV, p. 323 (1925).

Distribution and Occurrence.—Bassein (Oct.), Thonze (Aug. and Sept.), Moulmein (Oct.).

Eutyphoeus rarus Gates.

Eutyphoeus rarus Gates, *Ann. Mag. Nat. Hist.* (9) XVI, p. 59 (1925).

The wrinkling and bending of the free end of the penial setæ which characterized all of the original specimens is lacking in the present forms.

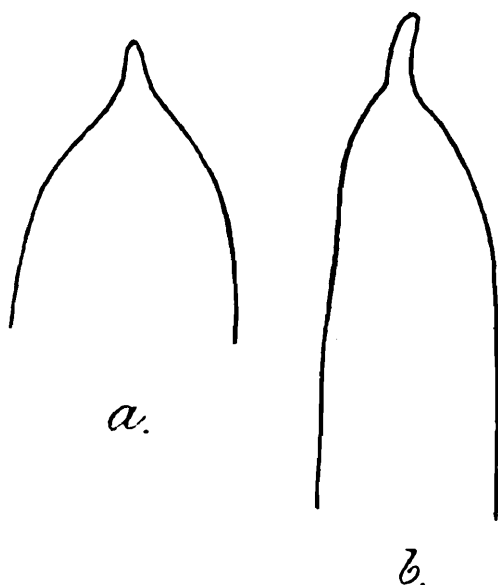


FIG. 4.—*Eutyphoeus rarus* Gates.

a. Penial seta, $\times$ ca. 820.

b. Tip of penial seta to show spine, $\times$ ca. 820.

The ornamentation consists of closely crowded, very irregular, frequently broken rows or ridges. The character of the ridges is exceedingly difficult to make out, even under the oil immersion lens, and appears to consist of rows of closely crowded, very fine, short spines. The ornamentation begins close to the tip and extends unusually far back. The free tip of the seta rounds off rather bluntly but from its centre projects a single rather long spine. This is most easily seen in the younger setæ of the bundle; in the older setæ it is often broken or worn off. The spine and the ornamentation are characteristic so far as the Burmese species of this genus are concerned.

Distribution and Occurrence.—Bassein (Oct.), Thonze (Aug. and Sept.), Prome (Aug. and Sept.).

Eutyphoeus spinulosus, sp. nov.*Description of the type specimen.*

External characteristics.—Length 131 mm. (This is only an anterior piece, the posterior end is lacking), diameter 7 mm. just anterior to the clitellum tapering to 4 mm. posteriorly. Colour, deep rich brown.

The prostomium is large and prolobous.

On segments iv and v there is a single deep secondary furrow posterior to the setæ of the segment. On vi and vii there are two deep secondary furrows, one anterior to and the other posterior to the setæ, and the most posterior annulus thus formed is sub-divided by a slighter tertiary furrow. Segment viii has two deep secondary furrows and a slighter tertiary furrow on each of the most anterior and posterior annuli thus formed. On ix there are five slight furrows, on x there are four, on xi, xii and xiii there are two deep and two slight furrows. Segment xiv has two slight furrows.

The first dorsal pore is in 11/12. The pores in 11/12 and 12/13 are much smaller than the pore in 13/14 and following.

The setæ begin on ii, there are eight per segment, paired but not closely; *aa* is greater than *bc* which is greater than *cd*, *cd* is equal to *ab*; *dd* is greater than one-half of the circumference.

The clitellum is not clearly marked off but probably begins just behind the setæ of xiii and extends to 17/18. It is interrupted ven-

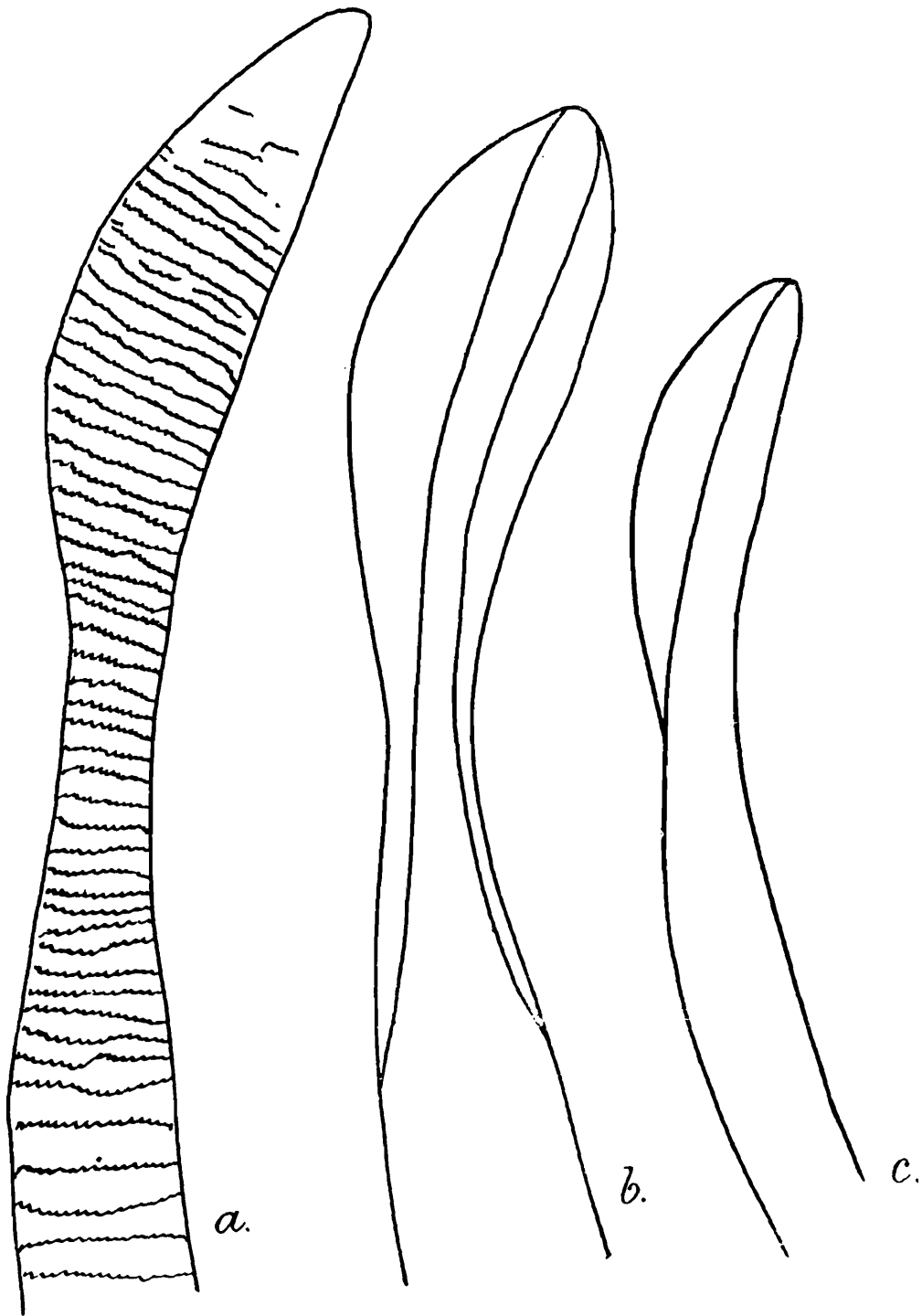


FIG. 5.—*Eutyphoeus spinulosus*, sp. nov.

a. Tip of penial seta, $\times$ ca. 650.

b. Penial seta, $\times$ ca. 650.

c. Tip of penial seta, $\times$ ca. 400.

trally by the glandular areas and the male area. Setæ are present in their usual positions with the exception of *a* and *b* on xvii. Intersegmental furrows are visible but the dorsal pores are lacking behind 13/14.

The male apertures as well as those of the prostatic ducts are not visible externally, but in this region is a single, large, transversely oval

aperture $2\frac{1}{2}$ by $1\frac{1}{4}$ mm., with the ends bluntly rounded. This aperture is surrounded by a lip in the shape of a ring of hard white tissue which lacks the characteristic brown pigment. This aperture and the surrounding lip lie between the setæ of xvi and the setæ of xviii, and extend outwards to half way between seta *b* and *c*. The aperture opens into a wider cavern in the ventral wall of the worm from the floor of which, close to the outer wall on each side, rises a thin-walled, columnar tube, usually at a slight angle so that the tube leans slightly towards the centre of the cavern. At the end of the tube is a pore through which penial setæ project. The floor (roof as viewed from the dorsal dissection) is thin but tough.

The female aperture is single, on the left side only, at the bottom of a slight concavity in the centre of an oval uncoloured area, in front of and very slightly internal to *a*. The oval area lies between 13/14 and the setæ of xiv, and from just inside *b* to nearly half of *aa*.

The spermathecal pores are one pair in 7/8 in line with seta *b*.

The genital markings in the clitellar region are not distinctly outlined, possibly due to imperfect preservation. They appear to be two transverse oval areas on segments xiv, xv and xvi. the posterior of which is larger and lies between the setæ of xv and the setæ of xvi. The smaller one lies between the setæ of xiv, and the setæ of xv. The anterior area lies in the intersetal space *aa* and is in contact with the posterior area in this region. The posterior area extends to slightly beyond *b* on each side. Setæ *a* and *b* of each side lie in a little notch between these two areas. The markings are greyish white.

Internal anatomy.—Septa 4/5 and 5/6 are very thick, especially 5/6, and displaced slightly backwards; 6/7 and 7/8 are missing; 8/9, 9/10, and 10/11 are thickened and displaced backwards, 9/10 and 8/9 close together; 11/12 is missing so that when the worm is opened from the dorsal side a large segment apparently containing two pairs of commissures is revealed. Segment xi is represented by a median chamber under the alimentary canal, which contains the male funnels, testes, commissures of xi, ventral blood vessel and the nerve cord. The wall bounding this segment is thin transparent tissue except for the anterior wall which is part of septum 10/11. The remaining septa are thin and attached normally.

The gizzard has an equatorial thickening in the form of a wide prominent ridge. There are calciferous glands in xii, similar to those of the other Burmese species of the genus. The intestine begins in xv. There are no intestinal caeca.

There are large tufted masses of nephridia in iii adherent to the parietes.

Posterior to the gizzard are seven pairs of commissures. Under 8/9 are two pairs with the anterior pair of which the dorsal blood vessel ends. These two pairs belong to segments vii and viii. The last pair is in segment xiii.

The testes and male funnels are enclosed in the median chamber under the oesophagus. A pair of large lobed seminal vesicles in contact dorsally over the dorsal blood vessel, fill the space between 10/11 and 12/13. The tubular prostates are large and extend through segments

xvi-xix. The duct is confined to xvii. The ectal portion is thick, narrowing slowly, and is looped two or three times. The ental half of the duct is fine and closely coiled. Each portion of the duct is about 7 mm. long. The sperm duct is difficult to trace as it is covered over with a tufted tissue which can only be dissected off with difficulty. The duct is spirally coiled in segments xiii-xvi. In segment xvii it bends outward to pass around the prostatic duct in the region where the latter passes into the body wall. Posteriorly and slightly internal to the ectal end of the prostatic duct the sperm duct is enlarged into an egg-shaped body which is nearly buried in the parietes.

The ovaries are large, leaf-like bodies flattened against the posterior face of 12/13. The oviduct funnels are large and in the usual positions. The wall of the spermathecal ampulla is thin and transparent and as it is empty is pressed against the ventral parietes by the gizzard. The duct is short and stout, with a very thick wall which has longitudinal corrugations on its inner side. A single diverticulum containing six seminal chambers forms a low horizontal ridge on the outer side in the region where the duct expands into the ampulla.

No glands are visible on the ventral parietes in xiv, xv, or xvi.

The penial setæ are 3-3.75 mm. long, 50-55 micra thick at the base, 20-40 micra thick in the middle of the seta. The shaft is straight except at the extreme ends which are slightly bent in opposite directions, the tip slightly more than the base. Close to the tip the shaft narrows to a diameter of about 20 micra. Beyond this narrow region the seta becomes much wider again, because of the presence on each side of the shaft, from the narrow region to the tip, of sheet-like or fin-like lateral extensions. The ornamentation consists of irregular transverse rows of very



FIG. 6.—*Eutyphoeus spinulosus*, sp. nov.
Ornamentation from penial seta.
Magnification unknown. (Oil Immersion).

fine teeth placed so close together as to form a continuous circle or ridge around the shaft. The rows of teeth are also placed closely together. The ornamented region of the seta is unusually long.

Distribution.—Bassein.

Occurrence.—October.

Remarks.—This species so closely resembles *E. foveatus* both externally and internally that these worms were mistaken for the Rangoon species in the preliminary examination. Only a few specimens which were incomplete posteriorly and hence short were preserved for detailed comparison with *foveatus*. As it will be impossible to obtain further worms for some time, it has been necessary to describe the species from the present incomplete forms.

The following differences or variations from conditions described in the type specimen should be noted. Interval *cd* in some worms is slightly greater than *ab*, either on the preclitellar segments or on seg-

ments x-xxx. In two specimens it is greater than *ab* throughout the whole length of the worm, in this case *cd* and *bc* are equal.

In four specimens two female pores are visible on segment xiv. In only one is the pore on the right side as conspicuous as that on the left, in the other three the second pore can be seen only on careful scrutiny. In all other specimens the female pore is single and on the left side only.

The aperture on xvii varies widely in shape and may be circular hexagonal, rectagonal, or oval according to the contraction in killing.

Septum 8/9 is displaced backwards to the level of the setæ on ix, 9/10 to the level of the setæ on x, and 10/11 to slightly posterior to the intersegmental furrow 10/11. Septum 10/11 is pushed forwards into x by the contents of the testicular chamber so that a small rounded knob-like projection lies over the nerve cord. In segment xi two cords of strong tissue pass into the parietes one on each side of the nerve cord from the posterior face of 10/11 just above the projection into x.

A longitudinal sheet of tissue attached laterally to the alimentary canal is present forming a suboesophageal chamber in segments ix-xiii.

The typhlosole is large, nearly filling the lumen of the intestine just behind the clitellum, but diminishing in size posteriorly and ending abruptly against the intestinal glands about 170-180 mm. from the anterior end of the worm. These glands are paired and occupy five succeeding segments but are not well enough preserved to warrant further description.

The prostates are 30-40 mm. long. The duct is 10-18 mm. long, the last 6-9 mm. very thin and closely coiled. The prostate duct passes into the parietes just above the porophore with which it seems to be continuous. The sperm duct can be traced in only a few of the worms. The enlargement at the posterior end varies in size occasionally being so small as to be entirely concealed within the parietes, or entirely lacking. It is only rarely as large as in *E. foveatus*.

The spermathecæ of several specimens lack diverticula, in all others the diverticulum is a transverse ridge on the outer side of the duct close to the place where the thin wall of the ampulla joins the thick wall of the duct. The diverticulum contains 3-10 seminal chambers.

As has already been suggested this worm very closely resembles *E. foveatus*. It differs from the latter in the following respects:—(1) The genital markings are two instead of one (The two markings of the present species cover, however, about the same area as the single one of *E. foveatus*. The single marking of the latter worm could have arisen from the two markings of this worm by the coalescence of the margins in *aa* on xv. Or the double marked condition might have arisen from the single by a failure of two primitive glandular areas to coalesce. In view of the rather poor preservation of the specimens this character alone is not of great value). (2) The duct of the prostate is longer in the present species than in *E. foveatus*. (3) The Bassein form has only one diverticulum instead of two as in the Rangoon form. (4) The penial setæ are not spirally twisted as in *foveatus*, the ornamentation is more extensive, the ridges are not broken so often, the teeth which make up the ridges are shorter and less spine-like, and lateral extensions of the seta are present in the form of wings or fins,

Stephenson (1923, p. 428) has pointed out that the species of this genus very closely resemble each other and that the discrimination of the metanodic forms "depends almost wholly on external markings and the characters of the penial setæ and spermathecal diverticula." The differences in the spermathecal diverticulum and the external markings are not enough perhaps to warrant separating these two worms but these characteristics with the important differences between the penial setæ of the two forms necessitate the founding of a separate species for the Bassein form. The two species must, however, be very closely related.

Family LUMBRICIDÆ.

Genus *Pontoscolex* Schmarda.

Pontoscolex corethrurus (Fr. Müll).

Lumbricus corethrurus, Müller *Arch. Naturg.* XXIII, p. 113 (1890).

Distribution and Occurrence.—Bassein, Moulmein, Kawkareik, in October; Bhamo (March); Tavoy (April); Nyaunglebin (Sept.); Thonze, Prome, and Thayetmyo (Aug. and Sept.).

Genus *Glyphidrilus* Horst.

Glyphidrilus papillatus (Rosa).

Bilimba papillata, Rosa, *Ann. Mus. Genova* (2^a) IX, p. 386, pl. xii, fig. 1 (1890).

Distribution and Occurrence.—Bhamo, Sagaing, Woreabone, (Bhamo-Namkham road) March.

Glyphidrilus sp.?

Immature specimens of a species of *Glyphidrilus* were secured in the following places:—Moulmein and Kawkareik (Oct.); Nyaunglebin (Sept.); Thonze and Prome (Aug. and Sept.).

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A NOTE ON INDIAN WATER-MITES.

By KARL VIETS, *Bremen.*

The earliest record of Indian water-mites seems to be a paper by E. von Daday, who described some species from Ceylon¹. Descriptions of new species of Hydracarina from India will shortly be published in the *Zoologische Jahrbücher, Abt. Systematik*, and in this note only a list of the species is given.

I wish to express my thanks to Dr. B. N. Chopra, who kindly submitted for examination and identification some collections from the Zoological Survey of India, Indian Museum, Calcutta.

The localities where the mites were found are Bengal, Burma, United Provinces, Siam and the Andamans. In all 15 species have been identified, and of these 8 are either new species or new varieties. The specimens in the two genera *Hydrachna* and *Arrhenurus*, having been obtained only in immature stages, have had to be left without specific identification. The remaining 5 species are :—

Diplodontus despiciens (O. F. M.), known as common from Europe, Asia, America and Africa.

Hygrobatas falcipalpis Koen., known from Java.²

Encentridophorus chelatus Walter ?, known from Aru-Isles.³

Arrhenurus pseudoaffinis Piers., known from Sumatra.⁴

Arrhenurus congener Daday, known from Ceylon.¹

Besides these I found, among the collections of the Indian Museum, larval stages of Hydracarina attached to several aquatic insects.

The distribution of the 15 species is as follows :—

I. Bengal :—

Eulais degenerata asiatica Viets.

Hydrachna trilobata Viets.

Hydrachna sp.

Diplodontus despiciens (O. F. M.).

Hygrobatas falcipalpis Koenike.

Unionicola diversipes Viets.

Unionicola scutigera Viets.

Arrhenurus pseudoaffinis Piersig.

¹ E. v. Daday. Mikroskopische Süßwasserthiere aus Ceylon. *Természeti Füzetek* XXI, Anhangsheft (1898).

² F. Koenike. Hydrachniden aus Java. 2. *Beiheft Jahrb. Hamburg Wissensch. Anstalten* XXIII (1906).

³ Ch. Walter. Hydracarina von den Aru-Inseln. *Abh. Senckenberg. Nat. Ges.* XXXIV (1911).

⁴ R. Piersig. Ueber Süßwasser-Acarinen von Hinterindien, Sumatra, Java und den Sandwich-Inseln. *Zoolog. Jahrb., Abt. Syst.* XXIII (1906).

[The author seems to have overlooked a paper by E. von Daday, published in *Rec. Ind. Mus.* II, pp. 339, 340 (1908), in which a new species is described under the name of *Eulais tibetana*. Ed.]

II. Burma :—

Unionicola diversipes Viets.*Arrhenurus hamiger* Viets.

III. United Provinces :—

Eylais degenerata asiatica Viets.*Eylais rimosoides* Viets.*Limnesia gentilis indica* Viets.*Neumania volzi indica* Viets.*Encentridophorus chelatus* Walter ?*Arrhenurus congener* Daday.

IV. Siam :—

Hygrobates falcipalpis Koenike.*Arrhenurus* sp.

V. Andamans :—

Arrhenurus pseudoaffinis Piersig.

The species dealt with in this note are preserved in the collections of the Zoological Survey of India and are registered under numbers 2905/19 : 8611/42 to 8634/42.

ZOOLOGICAL RESULTS OF A TOUR IN THE FAR EAST¹

THE TANAIIDACEA AND ISOPODA OF TALÉ SAP.

By CHAS. CHILTON, M.A., D.Sc., F.L.S., etc., Rector and Professor of
Biology, Canterbury College, New Zealand.

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INTRODUCTION.

Of the Tanaidacea there is only one species represented in the collection, viz.:—*Apseudes sapensis* sp. nov., closely related to *A. chilkaensis* Chilton from Chilka Lake but showing certain differences and some puzzling unexplained variations. In all the specimens the eyes appear to be imperfect and in some they are completely absent.

Of the Isopoda there are only six species of which one, *Rocinela simplex* is, with some hesitation, described as new. Three, or perhaps four, of the species also occur at Chilka Lake and the others are known from places not far distant in Indo-Malayan Seas. The similarities in physical conditions between Chilka Lake and Talé Sap are clearly emphasized by the correspondence of the Isopodan faunas of the two districts.

One of the species, *Sphaeroma terebrans* Bate is of economic importance owing to its habit of boring into piles and other wooden structures in harbour works but the other species do not call for special notice here.

The illustrations which form so important a part of this paper have been prepared for me by one of my students, Miss Beryl I. Parlane, B.A.

¹ Previous papers in this series appeared in the *Memoirs of the Asiatic Society of Bengal*, Vol. VI (1916–1925).

LIST OF SPECIES WITH DISTRIBUTION.

TANAIDACEA.

Apseudes sapensis sp. nov. Talé Sap, various localities.

ISOPODA.

Cirolana pleonastica Stebbing : Talé Sap, Chilka Lake, New Britain.

Cirolana parva Hansen : Talé Sap, Chilka Lake, Ceylon, Gulf of Mexico, etc.

Rocinela simplex sp. nov. Talé Sap. ? Chilka Lake.

Nerocila phaeopleura Schiödt and Meinert : Talé Sap, Java Sea, Sumatra, etc.

Sphaeroma terebrans Bate : Talé Sap, Ceylon, East Coasts of Australia, etc.

Ligia exotica Roux : widely distributed on warmer shores of the Indian, Pacific and Atlantic Oceans.

LIST OF STATIONS WITH NAMES OF THE SPECIES FOUND THEREAT.

STATION 5.— $\frac{1}{2}$ mi. E. N. E. of mouth of Patalung R., Talé Sap, Siam.
Depth 2 metres : bottom soft brownish mud with some weed : water quite fresh.

Apseudes sapensis.

„ 6.— $\frac{1}{2}$ mi. E. of Patalung R., Talé Sap, Siam.
Open lake : bottom bare with much decayed vegetation and a few broken shells—water quite fresh.

Apseudes sapensis.

Rocinela simplex.

„ 8.— $\frac{1}{2}$ mi. off shore a little south of mouth of Patalung, R.,
Water quite fresh.

Apseudes sapensis.

Rocinela simplex.

„ 9.—Middle of inner lake, Talé Sap, Siam. 2 metres.
Bottom hard mud, water fresh.

Apseudes sapensis.

Rocinela simplex.

„ 11.—Koh Si Hah, Talé Sap, Siam.
Shore collecting : under bark of sodden logs and in burrows of *Martesia*. Water fresh.

Apseudes sapensis.

Sphaeroma terebrans.

Cirolana parva.

16.—From fishing nets at Singgora, inside mouth of outer lake, Talé Sap, Siam.

Nerocila phaeopleura.

„ 21.—Across channel from Singgora, Talé Sap, Siam, $4\frac{1}{2}$ metres.
Bottom mud with many dead shells.

Apseudes sapensis.

STATION 23.—Eastern channel between Koh Yaw and Mainland. Talé Sap, Siam. Bottom soft mud.

Apseudes sapensis.

Cirolana pleonastica.

Sphaeroma terebrans.

Rocinela simplex.

„ 25.—Ban Lein Chak on connecting channel, $6\frac{1}{2}$ metres, Talé Sap, Siam. Bottom hard mud.

Rocinela simplex.

„ 31 —Pak Payun at inner end of connecting channel $3\frac{1}{2}$ — $5\frac{1}{2}$ metres, Talé Sap, Siam. Bottom soft mud overlying coarse sand.

Apseudes sapensis.

Cirolana parva.

Rocinela simplex.

„ 35.—Fishing-stake at inner end of Singgora channel 2 metres in dense mud, Talé Sap, Siam. Amphipods and Isopods in dead *Balanus* shells.

Cirolana pleonastica.

„ 37.—Inner end of Singgora Channel, Talé Sap, Siam.

Apseudes sapensis.

„ ?—Kaw Keoh, near Singgora, Talé Sap, Siam. 27-1-16.

Ligia exotica.

TANAIDACEA.

Apseudes sapensis, sp. nov.

(Fig. 1 a to 1 r.)

Localities.—Station 5.—Several specimens.

„ 6.—One.

„ 8.—Many.

„ 9.—Five.

„ 11.—One.

„ 21.—Five.

„ 23.—Several.

„ 31 —Five.

„ 37 —Several.

Male.—Similar to *A. chilensis* Chilton in general shape of body, the antennæ, thoracic legs and uropods but differing in the following points :—rostrum narrower and acutely pointed anteriorly, eyes usually present but imperfect, chelipeds in male having basal joint much more swollen and produced into a rounded lobe beyond the attachment of the ischium, the propod and fixed finger also of slightly different shape ; second trunk legs stouter, fringed with long hairs and with the spinules usually stouter and more distinct.

Female.—Chelipeds very slender, the carpus greatly elongated and much longer than the propod, second trunk legs short and stout, spinules usually distinct.

Length about 8 mm. Colour—whitish.

Remarks—This species appears to be abundant at numerous localities in Talé Sap just as *A. chilensis* is in Chilka Lake. The two species are evidently closely allied and have probably only recently differentiated from the same stock. In *A. chilensis* I could find no sign of eyes, in *A. sapensis* they are usually represented by irregular patches of pigment but these vary in amount, sometimes being absent altogether and the eye is manifestly imperfect. Annandale says *A. chilensis* "is very abundant in Chilka Lake on a bottom of bare mud, in which it probably buries itself." *A. sapensis* probably has the same habit but in both species the numerous long hairs on the second trunk legs and other appendages appear to indicate that they are good swimmers, and most of the specimens collected are clean and free from particles of mud.

The general resemblance of the Talé Sap specimens to *A. chilensis* is so great that I at first thought they belonged to the same species

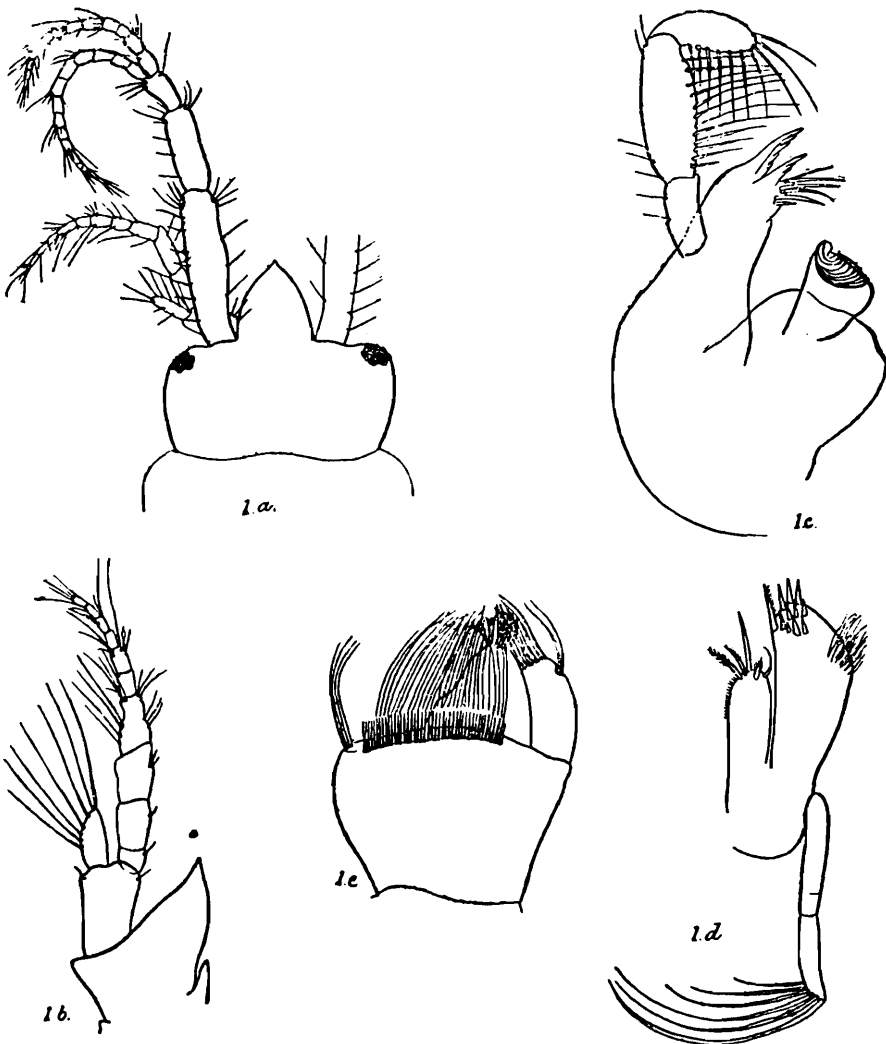


FIG. 1a.—*Apsydes sapensis*, sp. nov. Head of male specimen, showing rostrum and antennæ.

FIG. 1b.—*Apsydes sapensis*, sp. nov. Second antenna.

FIG. 1c.—*Apsydes sapensis*, sp. nov. Mandible.

FIG. 1d.—*Apsydes sapensis* sp. nov. First maxilla.

FIG. 1e.—*Apsydes sapensis*, sp. nov. Second maxilla.

until dissection of the appendages revealed the differences mentioned above; the differences in the appendages are best marked in fully

matured males. In these the basal joint of the chelipeds is very narrow at the attachment to the body but rapidly expands into an ovoid shape about half as broad as long and projects as a rounded lobe fringed with a few hairs beyond the attachment of the slender ischium; the carpus is considerably longer than the propod, it is more than twice as long as

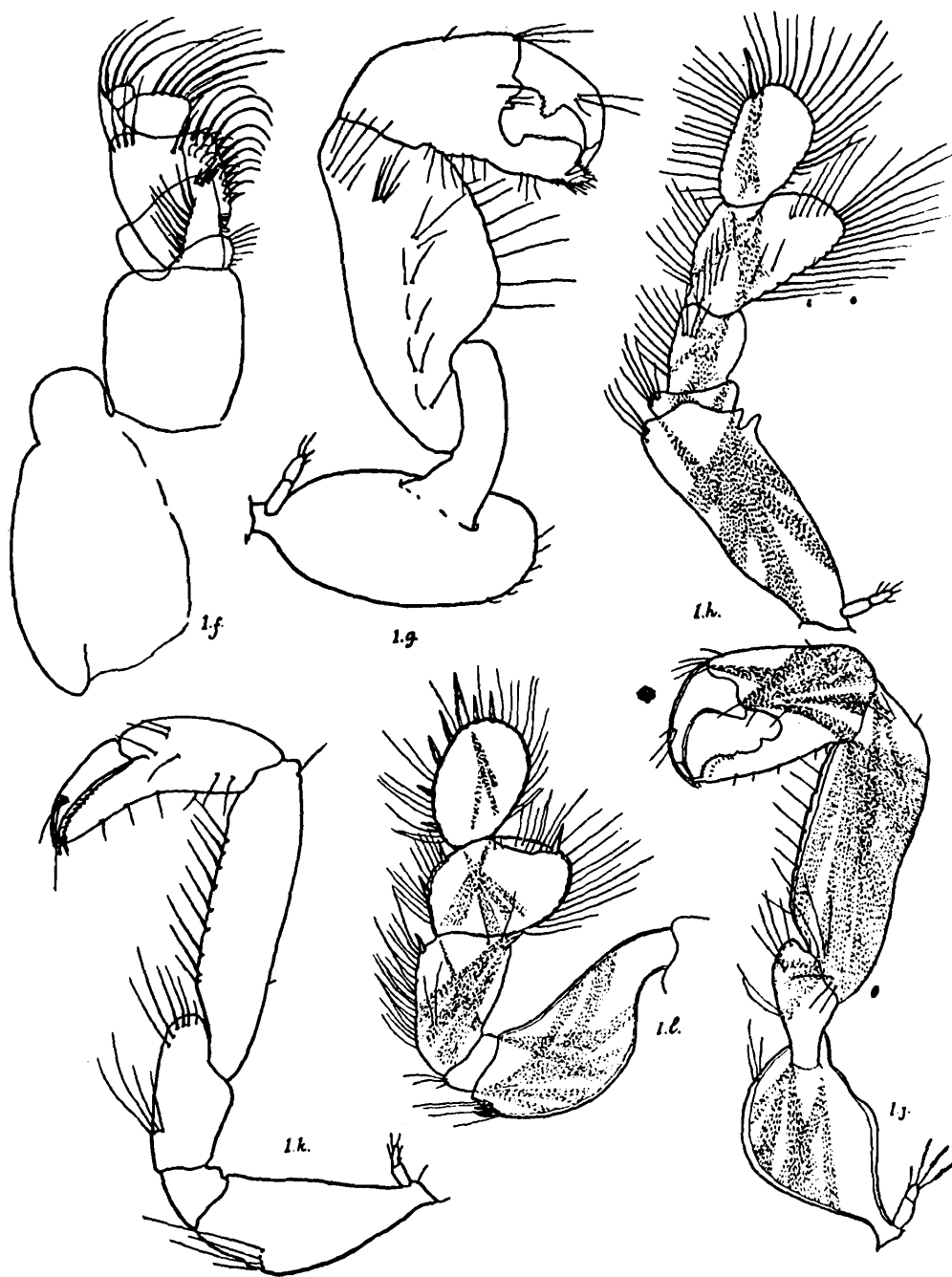


FIG. 1f.—*Aapseudes sapensis*, sp. nov. Maxilliped.

FIG. 1g.—*Aapseudes sapensis*, sp. nov. Cheliped of male.

FIG. 1h.—*Aapseudes sapensis*, sp. nov. Second trunk leg of same specimen (fig. 1g)

FIG. 1i.—*Aapseudes sapensis*, sp. nov. Cheliped of another male specimen.

FIG. 1k.—*Aapseudes sapensis*, sp. nov. Cheliped of ovigerous female.

FIG. 1l.—*Aapseudes sapensis*, sp. nov. Second trunk leg of same female (fig. 1k).

broad and has the expanded inner margin sparsely fringed with long setæ; the fixed finger is thickened except at the narrowed base and

near the tip, the movable finger much curved, very acute and with a triangular projection on its inner side near its base (fig. 1 *g*). The shape of the various joints of the cheliped varies greatly according to the stage of development and in younger specimens is much more like that of *A. chilkenensis*. The second trunk leg of the same male is shown in fig. 1 *h*, and is very stout, all the joints being much broadened and fringed with long hairs; in this specimen the terminal joint has the whole margin thickly fringed with long hairs and only the distal member of the stout setules is prominent, the others being small and almost indistinguishable among the long hairs.

In the female the cheliped is very slender and has quite a different appearance; a very slender one is shown in fig. 1 *m*, which was taken from a specimen presumably female though not actually bearing eggs. Fig. 1 *n*, from an ovigerous female is not quite so slender. The second trunk leg of this ovigerous female is shown in fig. 1 *l*, in which it will be noticed the usual stout setæ are very prominent and the long hairs scanty. The relative development of the setules and the long hairs appear to vary considerably in different specimens; apparently the hairs are more numerous and the setules smaller in the males while in the females the setules are more numerous and larger and the hairs more scanty. This may perhaps be associated with more active swimming habits of the male and more sluggish habit of the female especially when bearing eggs, the second trunk legs being then more fossorial in function. But observation of the living animals would be necessary to confirm this supposition and some of the specimens show exceptions to the general statements made above.

As in other species of *Apseudes* the remaining trunk limbs show a great variety of pattern in the arrangement of the setæ on the different joints. These will be better shown by figs. 1 *n*, *o*, *p*, *q*, than by a detailed description.

The head with rostrum and antennæ is shown in fig. 1 *a*, taken from a male specimen in which the eyes were fairly prominent, the second antenna is shown more clearly in fig. 1 *b*, from which it is seen that the basal joint is very broad and is produced at the inner distal angle to a very acute point.

The mouth parts are small in comparison with the size of the animal and not easy to dissect out satisfactorily but they appear to be of the normal structure more or less closely resembling those of *Apseudes spinosus* as described by Sars. In the mandible, (fig. 1 *c*) the cutting edges are narrow and sharp, the palp arises near the distal extremity and has the second joint much longer than the first or third, its inner margin and that of the third are fringed with long setæ; in the figure 1 *d*, the molar tubercle and basal portion of the mandible are not shown in their normal position but as displaced in mounting the specimen.

In the first maxilla (fig. 1 *d*) the outer lobe is much longer and broader than the inner but otherwise this appendage is not very different from that of *Apseudes spinosus*. The second maxilla (fig. 1 *e*) has the basal portion broad and long, its distal margin fringed with setæ which almost conceal the two small lobes,

The maxilliped (fig. 1 *f*) has the joints of the palp broader than in *A. spinosus* but similarly fringed with long setæ.

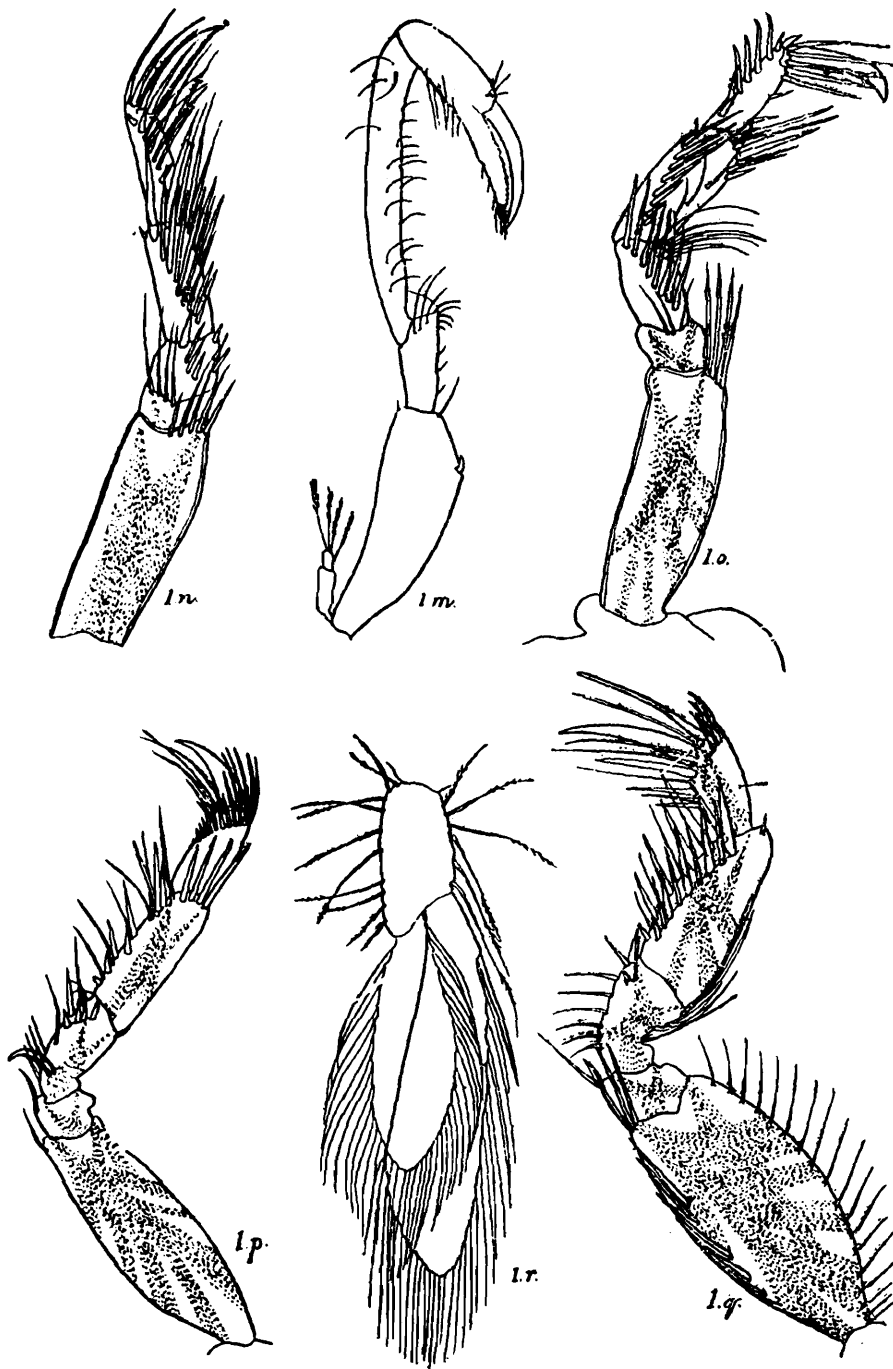


FIG. 1 *m*.—*Apseudes sapensis*, sp. nov. Cheliped of another female.

FIG. 1 *n*, *o*, *p*, *q*.—*Apseudes sapensis*, sp. nov. Third, fourth, fifth and seventh trunk legs of a female specimen, to show arrangement of setæ. The sixth leg is similar to the seventh but without the fringe of setæ on the basal joint.

FIG. 1 *r*.—Uropod.

In the pleopods (fig. 1 *r*) the inner lobe is much longer than the outer, both are fringed with long hairs while the inner one has in addition a long stout seta on its inner side near the base.

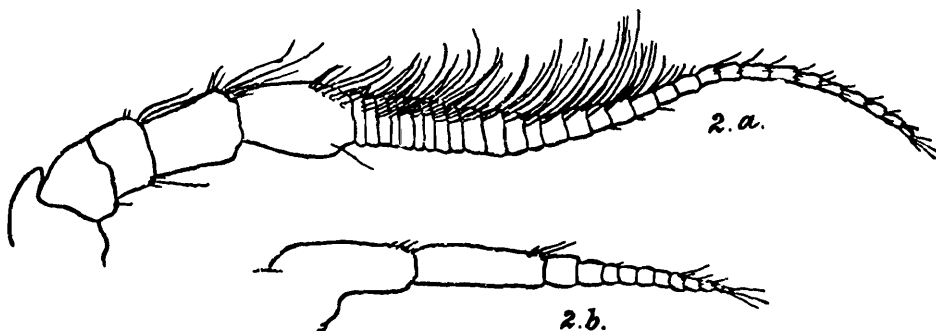
Both branches of the uropod are very slender, the outer being almost one-fourth the length of the inner.

ISOPODA.

Cirolana pleonastica Stebbing.(Fig. 2 *a* and *b*.)*Cirolana pleonastica*, Chilton, 1924, p. 883, figs. 4, *a*—*c*.*Localities* —Station 23.—Several.

,, 36.—Several.

Among the specimens are several males which can be distinguished from the females by the greater abundance of fine hairs on the second antennæ the uropoda. I give figures of the antennæ (fig. 2 *a* and *b*) of a male specimen showing the abundance of hairs on the second antenna

FIG. 2*a*.—*Cirolana pleonastica* Stebbing. First antenna of male.FIG. 2*b*.—*Cirolana pleonastica* Stebbing. Second antenna of male.

a character which was not so well developed in the male specimen from Chilka Lake that I examined.

Distribution.—Talé Sap ; Chilka Lake ; New Britain.

Cirolana parva Hansen.*Cirolana parva*, Chilton, 1924, p. 883.*Localities*.—Station 11.—Several.

,, 31.—One. Length about 9 mm.

These appear to belong to this somewhat ill-defined species.

Colour greyish. Sometimes with a darker median band in which is a longitudinal row of lighter patches and on each side a similar row of light patches more indistinctly defined.

This species is widely distributed in the warmer seas of Asia and America.

Nerocila phaeopleura Schiödte and Meinert.(Fig. 3 *a* and *b*.)*Nerocila phaeopleura*, Schiödte and Meinert, 1881, p. 13, pl. 1, figs. 6 and 7.*Nerocila phaeopleura*, Nierstrasz, 1915, p. 75, pl. 13, fig. 1, 2.*Nerocila phaeopleura*, Nierstrasz, 1918, p. 113, pl. 9, figs. 6, 7.*Locality*.—Station 16. One ovigerous female, two immature females.

The ovigerous female is somewhat narrower than the forms figured by Schiödte and Meinert and by Nierstrasz and perhaps not fully deve-

loped but agrees on the whole well with the descriptions given by them. The species seems to be well characterized by the horizontal expansions of the lower angles of the first two segments of the pleon, the narrow rami of the uropods and the lateral bands of pigmented dots on the posterior part of the body.

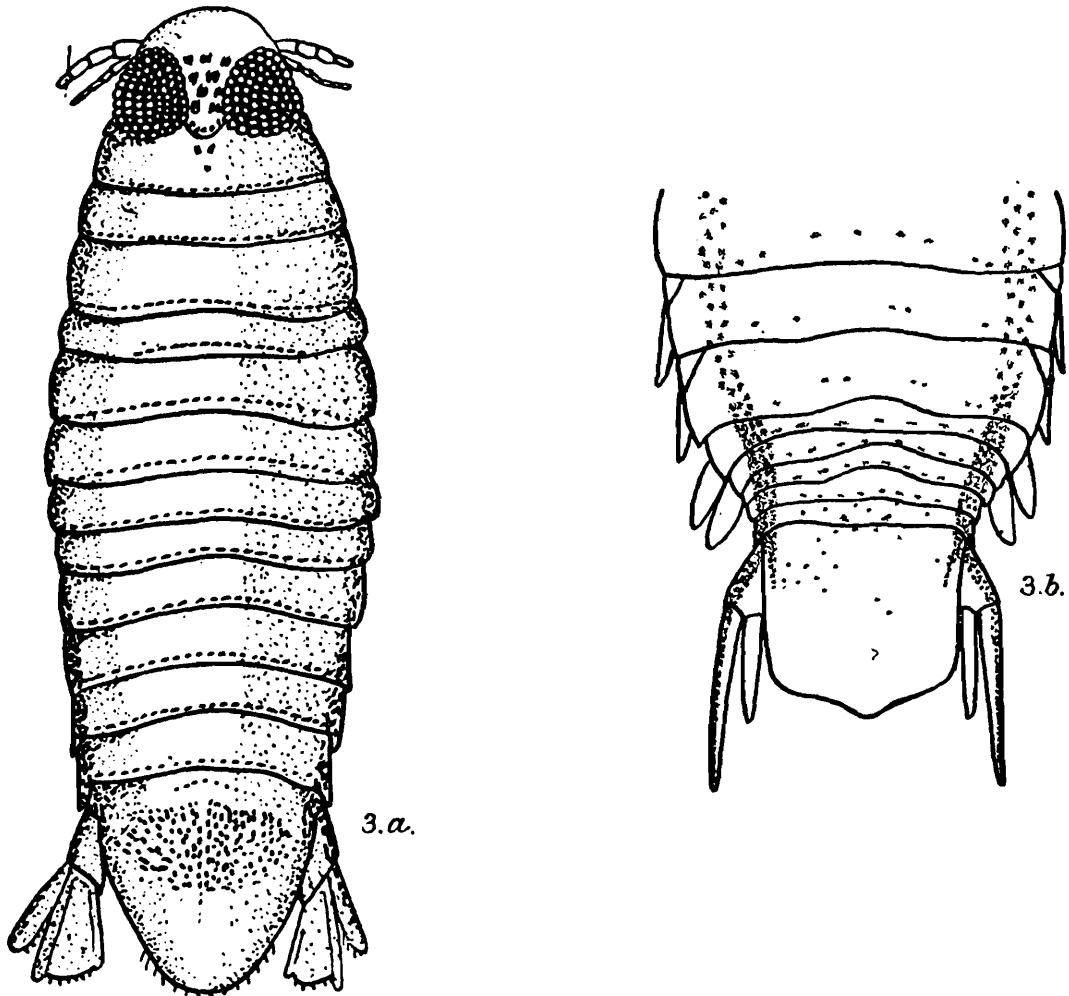


FIG. 3a.—*Nerocila phaeopleura* Schiödte and Meinert. Immature form.

FIG. 3b.—*Nerocila phaeopleura* Schiödte and Meinert. Posterior segments of thorax pleon and pleotelson of adult female

For the purpose of comparison I give the following measurements of the *Talé Sap* specimens

Ovigerous female—Length 16 mm. (*i. e.*, head 2 mm. thorax 9, pleon 5); breadth 6 mm.

Immature females.—Length 16 mm. [*viz.*, Head 2, thorax 7, pleon (segments 1—5) 4, pleotelson 3]; greatest breadth 6 mm.

Distribution.—East Indian Archipelago. Specimens named by Meinert and Schiödte are in the Royal Museum of Natural History, Leiden.

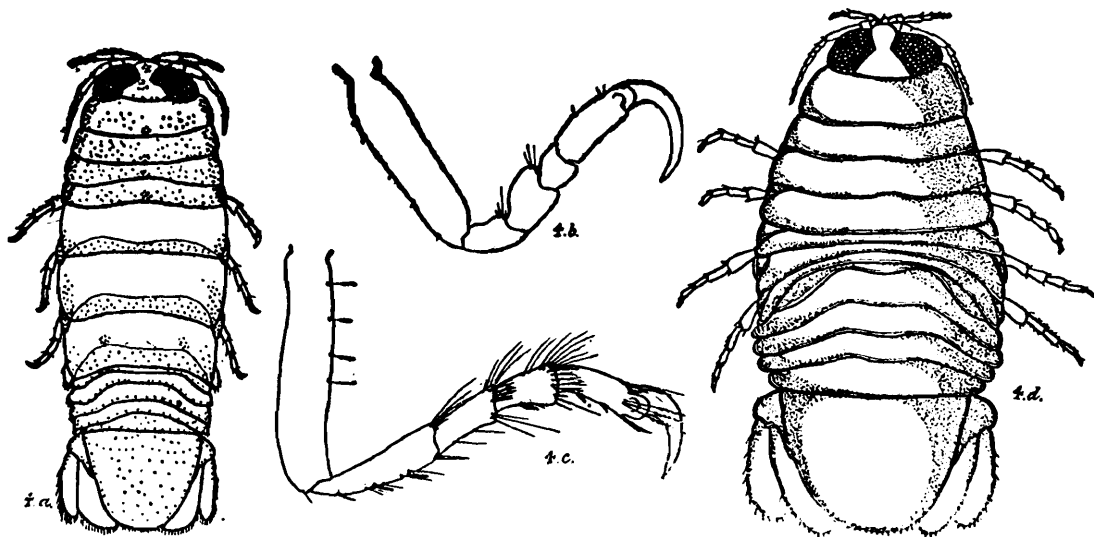
Nierstrasz has recorded this species from the Java Sea and from the West Coast of Sumatra and has drawn attention to certain details in which his specimens differ from those described by Schiödte and Meinert.

Rocinela simplex sp. nov.(Fig. 4 *a* to *m*.)? *Rocinela orientalis*, Chilton, 1924, p. 886 (not of Schiödte and Meinert).

- Localities*.—Station 23.—One female 16 mm. long, one male, 13 mm. and several immature.
 „ 6.—One female 14 mm long.
 „ 8.—One immature.
 „ 31.—Several, all immature, the smallest 5 mm. long, the largest 11 mm.
 „ 25.—Three, immature.
 „ 9.—One, immature, 4.5 mm. long, 2 mm. broad.

These specimens present a good series of immature forms. As I am unable to identify them with any known species I establish this as a new species but provisionally only as none of the specimens examined is fully mature. It appears to belong to Schiödte and Meinert's section II in which the flagellum of the second pair of antennæ contains about 11 joints; the eyes are very distinct and well separated and the propod of the first pair of legs is unarmed. It seems to be close to *R. signata* Sch. and M. with a specimen of which from the Bahamas I have been able to compare it. The Talé Sap forms differ from this specimen, however, in having the body longer and more slender, though the pleotelson is broader; the epimera especially the seventh, are less acute and there is no sign of the pair of pigmented semilunar bands, separated by a longitudinal stripe on the pleotelson which is characteristic of *R. signata*.

The following notes on the different specimens, with the figures, will perhaps be sufficient for identification:—From Station 23, young

FIG. 4a.—*Rocinela simplex*, sp. nov. Female, dorsal view.FIG. 4b.—*Rocinela simplex*, sp. nov. First peraeopod of the sam.FIG. 4c.—*Rocinela simplex*, sp. nov. Seventh peraeopod.FIG. 4d.—*Rocinela simplex*, sp. nov. Immature form, male, dorsal view.

female, length 16 mm., *i.e.*, Head 1, Thorax 10 ($1\frac{1}{2}$, $\frac{1}{2}$, $\frac{1}{2}$, $2\frac{1}{2}$, 3, 2), Abdomen $2\frac{1}{2}$, Pleotelson $2\frac{1}{2}$; greatest breadth 6 mm. (fig. 4 *a*). Station

6, young female, length 14 mm., i.e., Head 1, Thorax 8 ($1, \frac{1}{2}, \frac{1}{2}, \frac{1}{2}, 2, 2\frac{1}{2}, \frac{1}{2}$), Abdomen $2\frac{1}{2}$, Pleotelson $2\frac{1}{2}$; greatest breadth 6 mm.

These two females have the body distended below, presumably by the enlarged ovaries, but the brood plates are not formed and apparently the final moult has not been completed. In the first specimen the 5th, 6th, and 7th segments of thorax are elongated as shown by the figures given the others being short as in the immature forms; in the second specimen only the 5th and 6th segments are elongated. The second specimen is greyish, the whole dorsal surface being covered with small pigmented markings; in the first the colour is lighter, the elon-

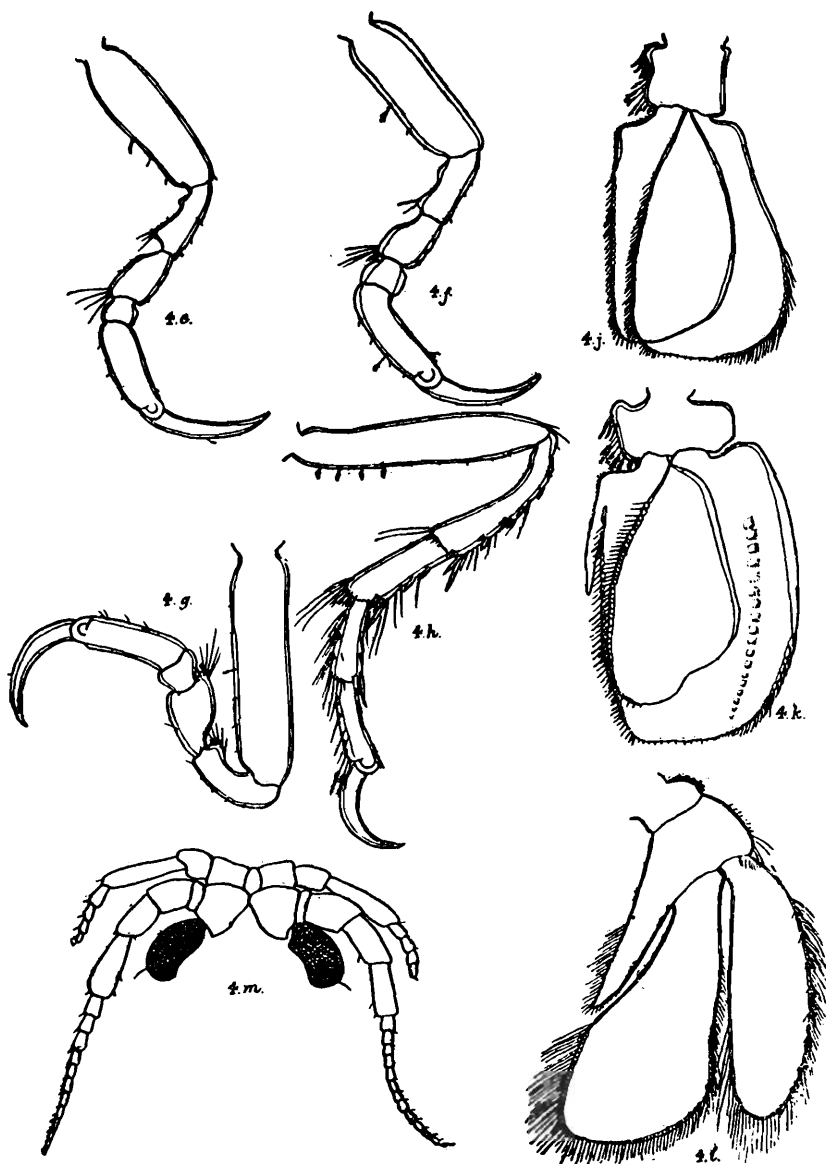


FIG. 4e, f, g, h.—*Rocinela simplex*, sp. nov. First, second, third and seventh pereopods of same specimen (fig. 4d).

FIG. 4j, k.—*Rocinela simplex*, sp. nov. First and second pleopoda of same (fig. 4d).

FIG. 4l.—*Rocinela simplex*, sp. nov. Uropod of same (fig. 4d).

FIG. 4m.—*Rocinela simplex*, sp. nov. Antennæ, etc. of immature specimen, 4.5 mm. long.

gated segments having a transverse band of pigmentation on the posterior portion only.

The pleotelson is broadly rounded posteriorly and, like the uropoda, fringed with hairs.

In the first pair of legs the propod are cylindrical and unarmed as shown in fig. 4 *b*; the seventh pair are much longer, more slender and provided with numerous long hairs on some of the joints (fig. 4 *c*).

The immature forms examined vary in length from 4.5 mm. up to 13 mm. They are all evidently free swimming forms and are much flatter and broader than the females described above. In the smallest the seventh segment of thorax was small and without appendages; various stages in the development of the seventh peraeopod were shown in the other specimens.

One from Station 23, a male as shown by the appendage on the endopod of pleopod 2, is about half as broad as long (13 mm. by 6.5 mm.) and is shown in fig. 4 *d*, from which the proportions of the segments may be seen. The whole body is very flat and depressed, the seventh peraeopods were well developed (see fig. 4 *h*). Other peraeopods and the uropoda are figured and do require detailed description. Fig. 4 *m* shows the antennæ of an immature form only 4.5 mm. long as seen from below.

The immature form from Chilka Lake probably belongs to this species rather than to *Rocinela orientalis* to which I doubtfully referred it (1924, p. 886).

***Sphaeroma terebrans* Bate.**

Sphaeroma terebrans, Stebbing, 1904, p. 16, pl. 4.

Sphaeroma terebrans, Chilton, 1919, p. 12, footnote.

Localities.—Station 11.—6 specimens, some imperfect. Length about 7 mm.

„ 23.—One.

These specimens are smaller than some in my collection from the east coast of Australia but I think undoubtedly belong to this species which is a destructive boring Isopod widely distributed in the warmer seas of India, Australia, etc. It is closely allied to or perhaps the same as *S. destructor* Richardson which has done much damage in Florida, U. S. A. I have specimens from Brisbane River, Queensland, and other localities on the east coast of Australia, some of them being much smaller than the others and having the tubercles, etc., on the dorsal surface of the pleon less distinct.

Mr. E. Jacobson of Fort de Kock, Sumatra, has sent me specimens from Simalur Islands, Sumatra. These are white (in spirit) and only 3 mm. long but I think belong to this species, though owing to their small size the tubercles on the posterior segments of the body are very indistinct. They were found living in holes and crevices in submerged stems and roots of *Rhizophora* and with them was the commensal, *Iais pubescens* (Dana) var. *longistylis* Chilton, which is associated also with *S. quoyana* M. Edw., an Australian and New Zealand species which burrows into soft rock as well as into wood.

Sphaeroma felix Lanchester, locality unknown, is insufficiently described for identification and the size is not given but it is probably the same as *S. terebrans*,

S. terebrans, like *S. quoyana*, is capable of thriving in brackish or even in fresh water.

***Ligia exotica* Roux.**

Ligia exotica, Chilton, 1916, p. 462, figs. 1—22.

Ligia exotica, Chilton, 1924, p. 894.

Locality.—Station 20.

Three specimens, imperfect. One specimen is very small. Another is a male not fully mature and not showing the characteristic process on the propod of the first pair of legs.

This species is to be found on the sea-shore in all the warmer seas of the world. I have some particularly large specimens from Japan. A full account of its external anatomy is given in the first paper quoted above. The late Dr. N. Annandale has added some notes on the habit of the species to this and also to the paper published in 1924.

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NOTES ON LIZARDS IN THE INDIAN MUSEUM.

I. ON THE UNNAMED COLLECTION OF LIZARDS OF THE FAMILY GECKONIDAE.

By SUNDER LAL HORA, *D.Sc., Officiating Superintendent, Zoological Survey of India.*

During the last decade or so a large collection of unnamed lizards from India and other parts of Asia has accumulated in the Indian Museum and while identifying this fresh material, I have come across several interesting points regarding certain species. In the present series of notes only those species are discussed whose existing descriptions require amplification in view of the fresh material examined. For any further details Boulenger's comprehensive works and Annandale's notes on the Oriental Herpetology may be consulted. It may, however, be pointed out that through the efforts of the late Dr. Annandale our named collection of lizards is very representative of the Indian fauna and is in a very good condition.

I have here followed the order in which families, genera and species are described in Boulenger's volume on Reptilia and Batrachia in the Fauna of British India series for convenience of reference.

Genus **Gymnodactylus** Spix.

Since Annandale's monograph¹ of the Indian species of this genus two new species have been described from within the limits of the Indian Empire, one from the Western Himalayas² and the other from Waziristan.³ Annandale⁴ recorded the occurrence of *G. lawdranus* in the Kumaon Hills and definitely assigned it a position somewhat near *G. stoliczkae*. Loveridge⁵ has quite recently contributed a short paper on the mite pockets in certain Indian species of *Gymnodactylus* and has recorded the presence of five specimens of *G. lawdranus* in the collection of the Museum of Comparative Zoology, Cambridge, Mass, U. S. A., from Ambala and the Kulu valley.

In order to throw further light on the observations made by Loveridge I have very carefully examined our entire collection of *Gymnodactylus* for mites and have found them in the arm-pits of *G. fasciolatus* and *G. triedrus*. The number of mites has been very small not exceeding five in each arm-pit and the pits are not well developed. In *G. lawdranus* and *G. kachensis* the pits are well marked, but in *G. scaber*, *G. khasiensis* and *G. consobrinus* they are only slightly developed. In all other species examined (see Annandale's paper for list of species) no

¹ Annandale, *Rec. Ind. Mus.* IX, pp. 310-326, pls. xvi, xvii (1913).

² Ingoldby, *Journ. Bombay Nat. Hist. Soc.* XXVIII, p. 1051 (1923).

³ Miss Procter, *Journ. Bombay Nat. Hist. Soc.* XXIX, p. 121 (1924).

⁴ Annandale, *Rec. Ind. Mus.* X, p. 319 (1914).

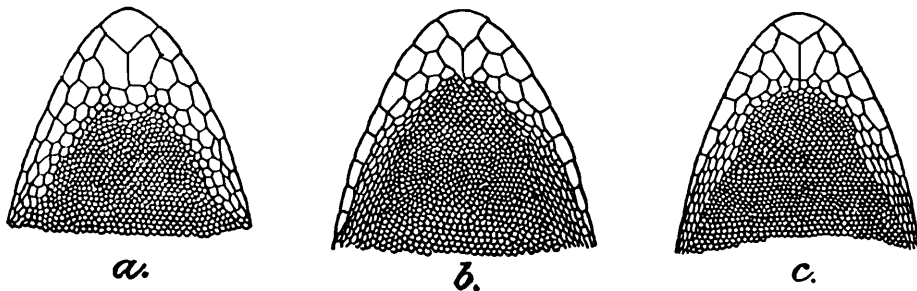
⁵ Loveridge, *Proc. Zool. Soc. London*, pt. IV, p. 1431 (1925).

arm-pits of any nature have been found. It is rather difficult, as Mr. Loveridge has already pointed out, to attach any great importance to this character because it is extremely liable to variation both on the excellence or otherwise of the preservation of the specimens, and on the nature of the preservative used.

***Gymnodactylus albofasciatus* Boulenger.**

1913. *Gymnodactylus albofasciatus*, Annandale, *op. cit.*, p. 322.

This species exhibits striking similarities in build and colouration to *Gymnodactylus deccanensis* but Boulenger¹ separated it from the latter on the following characters, "The dorsal pholidosis is not composed of uniform large tubercles, but of intermixed smaller and larger tubercles, the latter being mostly feebly keeled; the small scales on the limbs and upper part of the tail intermixed with larger keeled tubercles. The ventral scales are larger, tubercular and feebly keeled. No chin-shields behind the median pair. The tubercular plates under the basal phalanx of all the digits much more developed. The ground colour of the upper parts is darker than in our specimens of *G. deccanensis*, chestnut-brown." When Annandale wrote his monograph on *Gymnodactylus*, there was in our collection a single specimen of *G. albofasciatus*, probably a co-type, and two examples of *G. deccanensis*, one of which was obtained in exchange from the British Museum. The diagnostic characteristics mentioned by Boulenger for the two species are quite apparent in these three specimens, but since 1913 we have received six examples from N. Canara which are referable to *G. albofasciatus* but differ from it in several points, the most important being the presence of chin-shields behind the median



TEXT FIG. 1.—Chin shields of *Gymnodactylus deccanensis* and *G. albofasciatus*.

a. *G. deccanensis* $\times 2$; b. *G. albofasciatus* (B. M. specimen) $\times 2$; c. *G. albofasciatus* (Castle Rock specimen) $\times 2$.

pair. The larger tubercles on the dorsal surface in almost all the fresh specimens are relatively much smaller than those found in the three specimens mentioned above, and the scales on the ventral surface correspond to those of *G. deccanensis*. The tubercular plates under the basal phalanx of all the digits are, however, better developed. Out of the fresh material the four specimens from Castle Rock possess a very dark ground colour on the upper surface, while the other two from Karmal, a place situated only $6\frac{1}{2}$ miles from Castle Rock, are much lighter in colour.

¹ Boulenger, *Brit. Mus. Cat. Lizards* I, p. 37 (1885).

From an examination of the fresh material, it seems quite probable that when large series of individuals of the species are examined, the differences noted by Boulenger and those characterizing the fresh material will vanish altogether. It may then be possible to distinguish local races of *G. deccanensis* but at present I have not enough material to combine the two species. From the material before me they can be distinguished by the nature of their colour bands. In *G. deccanensis* the white bands are relatively much broader and possess well-defined, fairly broad black margins.

Measurements in millimetres of two specimens from Castle Rock.

Total length	134.7	96.5
Length of tail	61.2	47.0
Length of body	51.5	34.9
Length of head	22.0	14.6
Width of head	15.5	10.6
Length of snout	8.3	6.0
Diameter of eye	5.2	4.0
Distance between eye and ear opening	7.4	4.7
Fore limb	29.0	17.3
Hind limb	35.0	21.5

***Gymnodactylus khasiensis* (Jerdon).**

(Plate VII, figs. 4—6.)

1913. *Gymnodactylus khasiensis*, Annandale, *op. cit.*, p. 319.

I hesitatingly refer to this species a female specimen in our collection from Gopaldhara in the Darjeeling District. Its general form and build is very similar to *Gymnodactylus khasiensis* but its colouration is well marked and very characteristic. For convenience of reference I give below a short description of its colouration and measurements together with figures.

There are six rows of greatly elongated spots forming more or less continuous longitudinal stripes on the dorsal and dorso-lateral surfaces of the animal. The four of these stripes on the dorsal surface begin near the tip of the snout and are continued backwards on to the tail, which has been partially regenerated. The central stripe on each side passes through the eye. The outermost stripe on each side is short and is restricted to the region between the shoulder and the hip joint, it consists of short and irregular spots. There are short cross bars at irregular intervals, joining these stripes together. A series of similar spots is present on the upper surface of the limbs forming an irregular pattern. The under surface is dull white. Most of the dorsal tubercles possess black tipped keels.

Measurements in millimetres.

Length of body	48.5
Length of head	18.0
Width of head	12.3
Length of snout	7.1
Diameter of eye	4.0
Distance between eye and ear opening	5.5
Length of fore limb	25.0
Length of hind limb	30.0

Gymnodactylus khasiensis is found in North-eastern Burma, Assam and in the Eastern Himalayas (Darjeeling District).

Gymnodactylus sp.

(Plate VII, figs. 1—3.)

While examining the named collection of *Agamura* in the Indian Museum I have found confused with it several specimens of *Alsophyllax tuberculatus* and one completely dessicated and badly damaged specimen of *Gymnodactylus*, which I am unable to refer to any known species. These specimens do not bear any locality numbers, but it seems quite probable that they formed a part of Blandford's Persian collection.

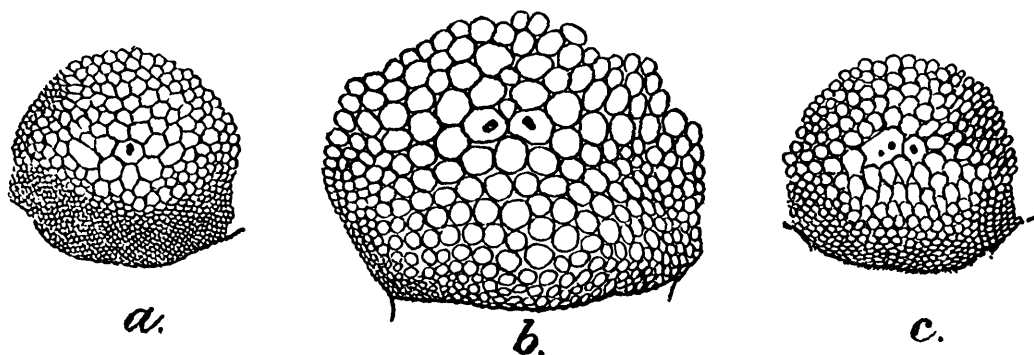
The sharply keeled, trihedral tubercles on the back are arranged in 12 series in the middle of the body. The tail appears to be divided into distinct rings and each ring bears four well-marked, sharply-pointed, large and keeled tubercles on each side near the commencement of the tail while there are only 3 rows of spines on each side later on. There are no tubercles on the mid-dorsal surface of the tail. The sub-caudal plates are rectangular and well-developed. They are grooved and keeled in various ways and in this respect are very characteristic. The limbs are also covered with sharp, keeled tubercles. The scales on the under surface are small, more or less circular and slightly imbricate.

There are three preanal pores and no femoral pores.

There are about eight transverse black bands across the dorsal surface of the body and several similar bands on the portion of the tail present. The limbs and the head are also spotted.

Genus **Agamura** Blandford.

Only two species have hitherto been described under this generic denomination and both of these exhibit striking similarities in general form, habits and colouration. *Agamura cruralis* and *A. persica* have



TEXT FIG. 2. —The preanal pores in *Agamura persica*.

a. Specimen No. 1189 showing one pore $\times 3\frac{1}{2}$; b, Specimen No. 3501 showing normal condition $\times 3\frac{1}{2}$; Specimen No. 15243 showing three pores $\times 4\frac{3}{4}$.

been separated from each other both by Blandford¹ and Boulenger² on a number of apparently important characters. But later on Boulenger³

¹ Blandford, *Eastern Persia* II (Zoology and Geology), pp. 355-359, pl. xxiii, figs. 3, 3a, 4a, 4b (1876).

² Boulenger, *Brit. Mus. Cat. Lizards* I, pp. 50, 51 (1885).

³ Boulenger, *Trans. Linn. Soc. (2) Zoology* V, p. 95 (1889).

in his report on the Reptiles and Batrachians of the Afghan Delimitation Commission has pointed out that the differences hitherto believed to exist between the two species are less important. The examination of the material in our collection has convinced me that the two species are identical and as regards tubercles on the snout, the form and extent of the rostral and mental shields and the presence or absence of enlarged convex tubercles on the upper parts of thigh and tarsus the individuals show considerable variation.

The specimens before me can, however, be separated in to two groups, firstly those with long limbs and preanal pores and secondly those with short limbs and without preanal pore. The former in my opinion represent the males of *A. persica* while an examination of all the eight specimens of the latter form shows that they are females.

The number of preanal pores varies from one to three, the usual number being two. There is one specimen in our collection with 3 pores piercing two enlarged scales. The scale bearing two pores is much larger and is of a peculiar shape. In two specimens there is only one pore.

In the following table I give the localities from where the male and female specimens of *Agamura persica* are represented in our collection.

Agamura persica ♂.

3487	Mand, Baluchistan	Persian collection (W. T. Blanford).
3486, } 6812 }	Zamran, Nibing River	Do.
3501	Mand, Baluchistan	Museum collector.
6811	Askan nr. Bampusht	Persian collection (W. T. Blanford).
19656	Near Shiban Pass (4000 ft.)	F. P. Maynard and Capt. MacMohan.
17081	Las Bela, Baluchistan	Zugmayer.
15243	Kohak, Perso-Baluch Frontier	Seistan Commission.

Agamura persica ♀.

13938, } 13940, } 13948 }	Baluchistan	.	F. P. Maynard.
13109	Hamoon Khusa	.	Afghan Boundary Commission.
3460	S. Persia	.	Persian collection (W. T. Blanford).
3461	Rayin, S. E. Persia	.	Do.
19655	Lab-i-Baring, Seistan	.	N. Annandale.
19648		.	?

Genus **Gonatodes** Fitzing.

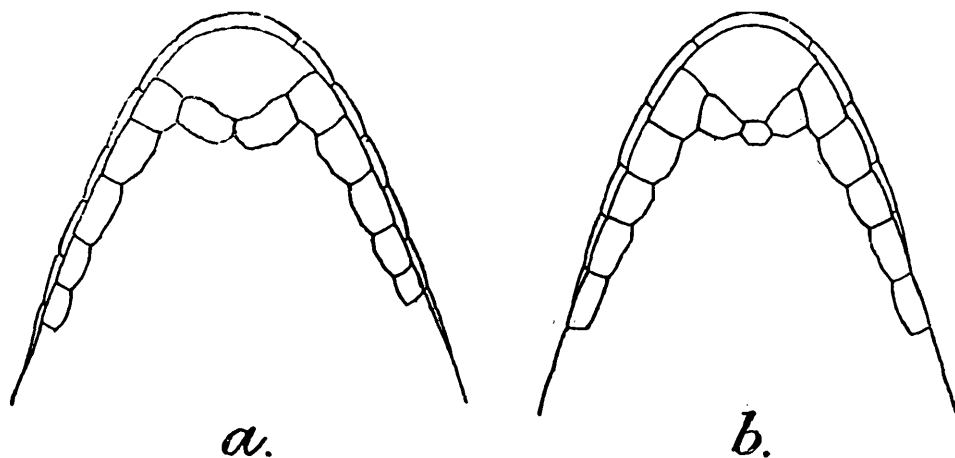
(Plate VII, fig. 7.)

In our unnamed collection there have been in all nine specimens of this genus from S. India. Of these two belong to *Gonatodes wynadensis* and were collected by Dr. Annandale and Major Sewell near Law's Falls, below Conoor, while the remaining examples are referable to *G. gracilis*. Four specimens of the latter species are from the neigh-

bourhood of Nierolay and Mettupalaiyam and are typical in every respect, but the others from Tèrkumalai, Courtallum are much darker in colouration. The whole of the upper surface is banded with black and white bars and the same pattern is present on the limbs. The under surface is dull white except in the region of the head where there are longitudinal stripes on the sides.

The specimens of the three Indian species with small spine-like tubercles on the flanks have been greatly confused in our collection. I give below the localities whence specimens of the three species are represented in our Museum.

Gonatodes jerdonii characterized by the absence of any tubercles on the tail is represented by the type-specimen in our collection; it is hopelessly broken into bits and is no longer capable of being handled. Of the other two species, *G. gracilis* and *G. kandianus*, there are several specimens. *G. kandianus* is distinguished by Boulenger¹ in his key by the presence of keeled scales on the under surface in the neck region, but in the specimens that I have examined this character varies considerably. In some the keeled scales extend over a considerable portion of the belly, while in others they are totally absent. In distinguishing these two species I have mainly relied on the character of the chin shields. *G. kandianus* possesses a relatively longer and more pointed snout and



TEXT FIG. 3.—Chin shields of *Gonatodes gracilis* and *G. kandianus*.
a. *G. gracilis* $\times 7\frac{1}{2}$; b. *G. kandianus* $\times 7\frac{1}{2}$.

3 chin shields behind the mental instead of two large ones as in *G. gracilis*. In *G. jerdonii* there is “a pair of small triangular chin plates” just separated by a large “lower rostral.”²

G. gracilis.

15079-80	Sevagherry Hills	Brit. Mus. Exchange.
19636	Between Nierolay and Mettupalaiyam, base of Nilgiris	N. Annandale.
19633-5	Nierolay, base of Nilgiris	Do.
19676-8	Terkumalai, Courtallum	H. S. Rao.

¹ Boulenger, *Fauna Brit. Ind. Reptiles*, p. 74 (1890).

² Theobald, *Cat. Rept. As. Soc. Mus.*, p. 31 (1868).

G. kandianus.

15114	Ceylon	Basil Museum.
5971	Kandy, Ceylon	H. Ferguson.
16708-09	Peradeniya, Ceylon	F. H. Gravely.
17114	Nr. Umbari	Do.
17864-67	Trichur, Cochin State	Do.
16599	Marikuppam, S. India	Museum Collector.
16600-01	Bangalore, S. India	N. Annandale.
16143	Tenmalai, S. India	Do.

Genus **Hemidactylus** Gray.

(Plate VII, fig. 8.)

As is to be expected a major portion of our unnamed collection of geckos belonged to this genus. Representatives of as many as six species, viz., *Hemidactylus brookii*, *H. bowringii*, *H. flaviviridis*, *H. frenatus*, *H. garnoti* and *H. platyurus*, have been found in it. All of these are fairly common and widely distributed species and there is very little to be said about them except that in a specimen of *H. brookii* from Digboi in the Lakhimpur District of Assam the tail is very abnormal and that *H. frenatus* has been found as far north as Kierpur in the Purneah District of Bihar. I also refer here to the presence of a single, dessicated specimen of *H. frenatus* from Maradu Island, Addu Atoll (Maldives).

In a normal specimen of *Hemidactylus brookii* the tail is "rounded, tapering, depressed; above with small smooth scales and 6 or 8 longitudinal series of large, pointed, strongly keeled tubercles; below with a median series of transversely dilated plates." In the abnormal specimen from Assam the tail slightly behind its origin is regenerated into a triradiate structure with two rounded, short arms on the sides and a similar but slightly longer structure in the middle. There are no tubercles on the upper surface and the scales, though slightly enlarged on the under surface, do not form definite plates.

EXPLANATION OF PLATE VII.

(Figures 1—6 and 8 are drawn by Babu A. C. Chowdhary, while figure 7 is drawn by Babu S. C. Mondul.)

Gymnodactylus sp.

1. The animal as seen from above $\times 1\frac{1}{2}$.
2. A portion of skin from dorsal surface showing arrangement of trihedral tubercles $\times 4$.
3. Anterior portion of the tail as seen from below $\times 3$.

Gymnodactylus khasiensis (Jerdon).

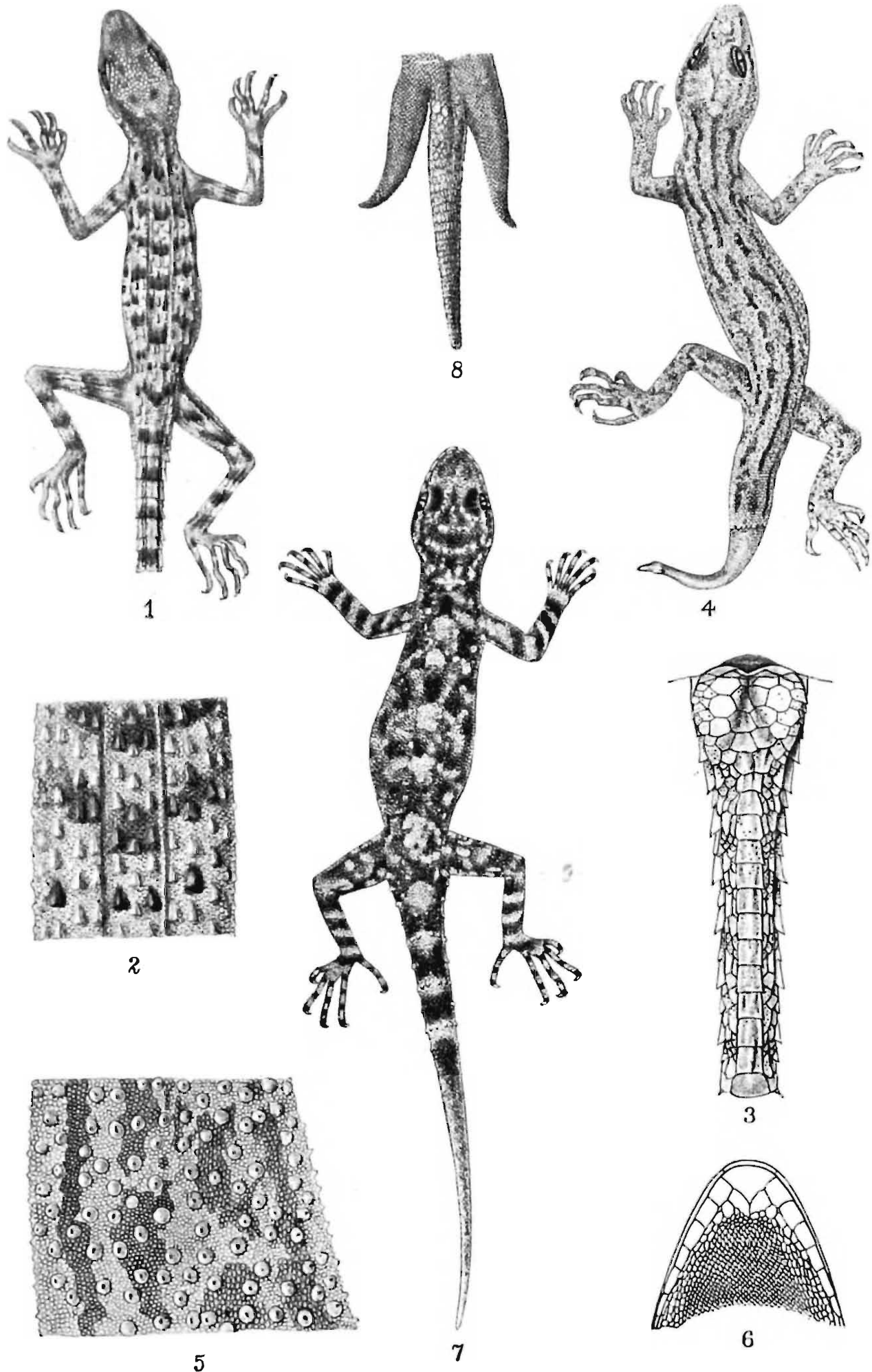
4. The Gopaldhara specimen as seen from above.
5. A portion of skin from dorsal surface of same showing arrangement of larger tubercles $\times 5$.
6. Chin shields of same $\times 3$.

Gonatodes gracilis (Beddome).

- 7 The Terkumalai, Courtallum specimen as seen from above $\times 2$.

Hemidactylus brookii (Gray).

8. Abnormal, triradiate tail of a specimen from Assam as seen from above $\times 2$.



A. C. Chowdhary & S. C. Mondul del

A REVISION OF THE GENUS *IDIONYX* SELYS.

By LT.-COL F. C. FRASER, *I.M.S., F.E.S.*

Twenty years ago only four species of this interesting and archaic genus were known. In 1912 Dr. Ris added two more species to this number and gave some details of what he thought to be a pair of *optata* from South China. These insects, however, turn out to be a distinct species, which I have named in this paper "*carinata*." Since that date seven species have been described by myself, one from Assam and six from South India. In addition to the new species *carinata* already mentioned, I now have three more new ones to describe, all from North India and Burma. As I have before me nearly one hundred specimens, representing fourteen species of the genus, which is by far the largest collection of specimens ever brought together, the moment seems opportune for a revision of the genus as a whole.

The large amount of material, and accompanying notes, have not afforded much help in establishing definite groups. A careful study of the venation and genitalia has proved both to be valueless for this purpose, the one because of its inconstancy, the other because of its homogeneity. Employing the list of characters given below, I have been able to establish only three fairly-defined groups, but quite a number fall outside these. The characters exhibited are shared in such a haphazard way, that one is forced to the conclusion that many of them have had an independent origin. In support of this, I may mention that none of the S. India species occurs in N.E. India and Burma, and *vice versâ*, but yet we find species in both areas possessing similar characters allotted differently. Thus a female from Burma will have saffronated wings and a specialized vesicle, whilst one from S. India will have the wings saffronated but the vesicle simple. Another from Assam will have the vesicle simple, saffronated wings and a humeral stripe, whilst one from Coorg presents a specialized vesicle, saffronated wings but no humeral stripe. Instances like this may be multiplied. The only explanation which can be offered to this riddle, is that the forces of natural selection responsible for moulding the species, have been similar in both areas, and have thus called forth parallel characters. A varying exposure to these forces would explain why the characters have been differently allotted. There is no doubt that similarity of environment calls forth similar characters in species, even when not nearly related, as the following note clearly proves. Mr. E. B. Williamson sent me two species of *Perilestes* from S. America and I was profoundly struck by their close similarity to *Protostictas* from S. India. Writing to him later, I sent him a description of the surroundings in which *Protosticta* was found, *viz.*, dark rocky haunts in the beds of mountain streams. In reply, he stated that my description might well have been written for that of *Perilestes*.

The habits of *Idionyx* are not very well known, and I have to rely almost entirely on my own observations in S. India. Mr. T. Bainbrigge

Fletcher has, however, given me a few notes relative to species from Shillong, Assam. Their flight is usually high, light and airy, some being gregarious in habit especially *saffronata* and *nadganiensis*, whilst others are solitary. *Saffronata* may be seen often in large numbers, 30 or more at a time, disporting themselves in the air like a swarm of gigantic midges. For this "nuptial dance," they choose small sunny glades in dense forest, or rather, in what I call a "jungle chimney," a small clearing in high forest where the sun only penetrates at its zenith. Their flight takes place only during sunlight, a cloud passing over being the signal for their immediate disappearance. On dull days they may be seen resting high up in trees, clinging to twigs. Other species ramble over a long course in their flight, *galeata* and *burliyaensis* especially having this habit. A riding through a forest is a favourite path for their wanderings. Mr. Fletcher has observed this habit in *optata*. Some species are subcrepuscular in habit, that is, they do not appear on the wing until late in the day. *Burliyaensis*, and more especially its subspecies *fulvia*, have this habit; numbers may be seen flying low over paths or dirty cattle standings at about four or five in the afternoon, and seemingly find an abundance of food in such localities. This species may also be seen ascending and descending ravines, following the course of mountain streams, and hugging the water closely, apparently searching for females. The latter oviposit in mud or wet sand, often penetrating deep undergrowth for this purpose. A favourite spot is at the foot of a steep bank, where springs have found their way to the surface, and a thin sheet of water covers the soil percolating slowly to the river below. *Nilgiriensis* will enter small natural caves in river banks and there deposit its eggs in the wet sand which floors such gloomy retreats. The saffronation of the female wings appears to be rather of a protective nature than decorative, for those so adorned are remarkably invisible during flight. Viewed from below they are of course, very conspicuous, but from above, and when skimming over the ground, they are most puzzling insects to capture on account of their invisibility.

I have employed the same characters for differentiating the species as I used in the survey of the Western India species. Of these features, I regard saffronation of the wings as least important, as with the exception of *stevensi* and *saffronata*, it is an unstable character and dependent on the age of specimens. The hindwing of the female is invariably broader than that of the male and the reticulation is decidedly closer. Thus the discoidal field is often made up of two rows of cells instead of one, the interval between the nervures *Cui* and *Cuii* in the hindwings is frequently filled with a double row of cells instead of one, and there are always 3 rows of cells between the base of the wing and the inner margin of the loop, although only 2 are found in the male.

As regards the genitalia on the second abdominal segment of the male, in the species which I have examined,—*optata*, *yolanda*, *dohrni*, *montana*, *intricata*, *saffronata*, *imbricata*, *galeata*, *unguiculata* and *stevensi*, the differences are so slight as to be worthless for purposes of practical differentiation. I have however figured some of these on Plate X in the hope that they may be of use to future students.

The following is a list of the species at present known, together with their localities. The numbers following each species correspond to those given below for individual characters, and serve to show how they are shared by each :—

1. *Idionyx optata* Selys (nec Ris). Assam. 1, 3, 5, 7, 10=11=13.
2. *Idionyx carinata* nom. nov. (*optata* Ris nec Selys). S. China. 1, 3, 5, 7, 10, 11, 13.
3. *Idionyx intricata* sp. nov. Assam. 1, 3, 5, 7, 9, 11, 13
4. *Idionyx yolanda* Selys. Penang. 8, 9, 11, 13.
5. *Idionyx nadganiensis* Fras. Nilgiris and Coorg. 8, 9, 11, 13.
6. *Idionyx stevensi* Fras. Assam. 1, 3, 5, 8, 9, 11, 13.
7. *Idionyx claudia* Ris. S. China. 2, 4, 5, 8, 9, 11, 14.
8. *Idionyx corona* Fras. Mysore and Malabar. 7, 10, 11, 14.
9. *Idionyx burliyaensis* Fras. Nilgiris and Coorg. 2, 4, 6, 7, 10, 11, 14.
10. *Idionyx galeata* Fras. Coorg and S. Kanara. 2, 4, 6, 7, 9, 10, 11, 14.
11. *Idionyx unguiculata* sp. nov. Burma. 2, 4, 6, 7, 10, 11, 14.
12. *Idionyx dokrni* Kruger. Sumatra and Malaysia. 2, 4, 6, 8, 10, 11, 14.
13. *Idionyx montana* Karsch. Java and Borneo. 2, 4, 6, 8, 10, 11, 14.
14. *Idionyx imbricata* sp. nov. Assam. 2, 4, 6, 8, 10, 11, 14.
15. *Idionyx philippa* Ris. Philippines. 8, 10, 11, 13.
16. *Idionyx saffronata* Fras. Nilgiris and Coorg. 2, 4, 6, 8, 9, 11, 14.
17. *Idionyx selysi* sp. nov. Burma. 2, 4, 5, 8, 10, 11, 13.
18. *Idionyx nilgiriensis* Fras. Nilgiris. 8, 10, 12, 13.

Of these, the female alone is known of *nilgiriensis*, *corona*, *nadganiensis*, *yolanda* and *philippa*, whilst both sexes of all the other thirteen species have been discovered.

The following are the principal characters by which species are differentiated :—

Male characters :—

- (1) Superior anal appendages shorter than inferior.
- (2) Superior anal appendages longer or of same length as inferior.
- (3) Superior anal appendages with a ventral spine.
- (4) Superior anal appendages without a ventral spine.
- (5) Tenth abdominal segment with a well-marked dorsal spine.
- (6) Tenth abdominal segment without any dorsal spine.

Female characters :—

- (7) Vesicle highly specialized.
- (8) Vesicle simple, rounded.
- (9) Base of wings as far out as outer side of trigone deeply saffronated.
- (10) Base of wings not or only poorly saffronated.
- (11) End of abdomen markedly compressed.
- (12) End of abdomen markedly depressed.

Bisexual characters :—

- (13) Antehumeral yellow stripe present.
- (14) Antehumeral stripe absent.

Group I. *optata*.

Female with abdomen markedly compressed, not dilated at the end, vesicle simple or specialized ; wings variably saffronated. Male (where known) with a well-defined dorsal spine on segment 10 ; superior anal appendages shorter than the inferior, and with a ventral spine ; both sexes with a humeral stripe—*optata*, *yolanda*, *carinata*, *intricata*, *stevensi*, and *nadganiensis*.

Group II. *corona*.

Female with abdomen markedly compressed ; not dilated at the end ; vesicle specialized ; wings not saffronated at the base, or if so, then only as far as the inner angle of trigone. Male (where known) with superior anal appendages longer than inferior, and without a ventral spine ; no dorsal spine on segment 10 ; antehumeral stripe absent in both sexes—*corona*, *burliyaensis*, *galeata* and *unguiculata*.

Group III. *dohrni*.

Characters similar to the last group save that the vesicle is simple—*dohrni*, *montana*, *imbricata* and *philippa*. (The female of *imbricata* has a short humeral stripe hidden entirely by the head.)

Group IV *saffronata*.

Female with abdomen markedly compressed, not dilated at the end ; vesicle simple ; wings saffronated as far out as outer side of trigone ; male with superior anal appendages longer than inferior, and without a ventral spine ; antehumeral stripe absent in both sexes—*saffronata*.

Group V *claudia*.

Female with abdomen markedly compressed, not dilated at the end ; vesicle simple ; wings saffronated as far out as outer side of trigone. Male with superior anal appendages of the same length as inferior, both very simple and Libelluline in character, with no ventral spine ; a robust spine on dorsum of segment 10—*claudia*.

Group VI. *nilgiriensis*.

Female with abdominal segments 7 to 9 markedly dilated and depressed as in *Phyllomacromia* ; vesicle simple ; antehumeral stripe present—*nilgiriensis*.

Group VII. *selysi*.

Female with abdomen markedly compressed, not dilated at the end ; vesicle simple ; wings not saffronated. Male with a long spine on dorsum of segment 10 ; superior anal appendages slightly longer than the inferior, and without a ventral spine ; both sexes with an antehumeral stripe, much better defined in the female—*selysi*.

Genus **Idionyx** Selys.

Hagen, *Zool. bot. Wien.* XVII, p. 58 (1867); Brauer, *Ib.* XVIII, p. 370, 742 (1868); Selys, *Ann. Soc. Ent. Belg.* (C. B.) p. 6, (1871); *Id. Add. Syn. Cord., Bull. Acad. Belg.* (ii), XXXVII (1874); *Id. ib. 2nd Add. Syn. Cord., (ii)* XLV (1878); Kirb., *Cat. Odon.* p. 56 (1890); Karsch, *Ens. Nachr.* XVII, p. 27 (1891); Mart., *Cat. Coll. Selys., Cordulines*, p. 57, 80, (1906); Ris, *Suppl. Ent. No. 1*, p. 79 (1912).

Dragon flies of medium size belonging to the subfamily *Corduliinae*. Head very large, as large as the thorax; eyes broadly contiguous; occiput small; frons and vesicle metallic, the latter tumid and rounded in the male, extremely variable in the female, rounded, conical, bifid, pointed or prolonged into a long intricate spine. Prothorax small, hinder lobe simple.

Thorax very small, metallic, coloured with bright citron yellow. Legs long and slim, hind femora extending a little beyond hinder end of thorax and armed with numerous minute closely-set, imbricated spines on the flexor surface, and two rows of fine hair-like spines on all three pairs. Tibial spines numerous, fine, long and closely-set; all tibiae keeled, the hind pair with a long keel, the middle and anterior pairs with a short distal keel; tibial claws bifid. Armature similar in the female but the tibial keels absent.

Wings hyaline, often saffronated at the extreme base, and very broadly so in several females; occasionally deeply enfumed in the female; nodal index rather high; reticulation moderately close; apices somewhat rounded, apices shallowly notched in the male, broadly and evenly rounded in the female; hindwing much broader than the fore, especially in the female. Usually 1 cubital nervure in the forewings, 2 in the hind; loop variable, rather long and blunt and without the Libelluline toe, of about 4 to 7 cells in the male, 8 to 10 in the female; hypertrigones traversed once or twice in the forewings, once in the hind; trigones and subtrigones entire, the former, in the forewing, equilateral and usually smaller than the subtrigones, its base far distad of level of arc; in the hind, the trigone with distal and costal sides longer than basal, the base slightly distad of level of arc; sectors of arc in all wings fused for a long distance; only a single row of discoidal cells in forewing nearly as far as border of wing, in the hind a single or double row for a distance of about 5 to 6 cells; 2 rows of postanal cells in forewing; a single row of cells between the bases of *Cui* and *Cuii* in the hindwing of male, 1 or 2 rows in the female; pterostigma very short, unbraced, acute and oblique at both ends, over about 2 cells; membrane short.

Abdomen cylindrical in the male, markedly compressed in the female, tumid at base and somewhat expanded at anal end, from segments 7 to 10; the 10th segment in the male usually carinated, and often bearing a robust dorsal spine, simple and much abbreviated in the female. (In *nilgiriensis* the terminal segments of abdomen are much expanded and depressed as in *Phyllomacromia*.) Anal appendages of male markedly variable and intricate, simple and aborted in the female. Genitalia of second segment of male homogeneous in the species; lamina depressed; anterior hamules fine stilette-shaped organs, the posterior tumid, with

broad, rounded, conical base and short robust hook, shaped like the beak of a parrot. Vulvar scale variable, usually short and inconspicuous.

Distribution.—North and West India, Burma, Indo-China, Java, Sumatra, Borneo and the Philippines. (Not so far recorded from Ceylon.)

Genotype,—*yolanda* Selys.

The nomenclature of the genus is rather obscure. Selys in his "*Cause-ries Odonatologique No. 4*," states that more than 30 years prior to the writing of the *Cause-rie*, he sent the descriptions of the genera *Idionyx* and *Zygonyx* to his friend and collaborator Dr. Hagen, being too fully occupied with his *Synopsis des Agrionines* to describe them himself. He cited as the genotype of *Idionyx*, *yolanda*, the only known species of the genus at that time, and which had never been described. Hagen in 1867, and Brauer in the following year, published a very short description of the genus. The former, at the time, had possession of Burmeister's type *Epophthalmia gracilis* (regarded at the present time, and probably correctly so, as a *Syncordulia*), and fell into the error of supposing that *gracilis* and *yolanda* were one and the same species, owing to the details sent by Selys being of so meagre a nature as to fit both species equally. Hagen cited both names in his description, but added a note to say that he regarded them as conspecific. Unfortunately *yolanda* was then a nomen nudum, whereas *gracilis* had been described—thus *gracilis*, masquerading as *yolanda*, appears as the genotype of *Idionyx*. It is a clear case of impersonation, and *yolanda* and not *gracilis* was intended as the genotype by Selys. When the latter finally described *Idionyx* and *yolanda* fully in the *Synopsis des Cordulines*, 1871, he gave the latter as the true genotype. Although, strictly speaking, *gracilis* is the genotype owing to an unfortunate error on the part of Hagen, I think that the only commonsense line to take under the circumstances, is to assume *yolanda* to be the real type, a course I follow in this paper. References to the literature concerned is given below.

I take this opportunity of thanking Mr. T. Bainbrigge Fletcher, Col. F. Wall and Dr. Laidlaw for their valuable help and contributions, without which, much of this paper could not have been written.

***Idionyx optata* Selys (nec Ris).**

(Plate VII. fig. 1, Plate X, fig. 2.)

Idionyx optata Selys, 2nd Add. *Syn. Cord. Bull. Acad. Belg.* (ii) XLV, p. 196 (1878); Mart., *Cat. Coll. Selys*, p. 80, (*Cordulines*) (1906); Fras. (*Idionyx ornata*), *Mem. Pusa*, Vol. VII, pp. 64, 65 (1922); Ris (*Idionyx optata*) *Suppl. Ent. No. 1* (1912); Selys, *Ann. Mus., Civ. Gen.* 30, p. 472 (1891).

In the Pusa Memoirs, l.c., I described an *Idionyx* as a new species under the name of *ornata*. Since that was published, Mr. T. Bainbrigge

Since the above was written, Mr. Nathan Banks of Washington, U. S., has kindly re-examined the type of *Epophthalmia gracilis* Burm., for me, and sends the following notes :—"The wings closely resemble those of *Syncordulia atrifrons* as given by Martin; all hypertrigones entire; sectors of arc separated at origin; trigone of hindwing just distad of line of arc; discoidal field of forewing parallel to termen; pterostigma longer than in *atrifrons*; 8 antenodal nervures in forewings, 5 in the hind; 6 postnodal nervures in the hindwings. The species is a true *Syncordulia*, and indeed is the type of the genus." Our thanks are due to Mr. Banks for finally settling the true place of this most interesting insect.

Fletcher has secured a male at Shillong, Khasia Hills, Assam, where the female was originally taken. An examination of this male proves it to be *optata* Selys, the female of which had not been described. The Selysian type comes from Cherrapunji, a distance of only twelve miles from Shillong.

Dr. Ris has described a species from South China as *optata*, and has figured the anal appendages, which I have reproduced on Plate VIII, fig. 1. A comparison of the respective appendages of the Shillong and South China specimens with the Selysian description, shows clearly that the former is the real *optata*. I have therefore shown Dr. Ris' species as new under the name of *carinata*.

The Shillong male does not differ in any way from the original Selysian description, but I am able to amplify the latter by the following particulars:—nodal index male $\frac{7-12}{8-8} \left| \frac{12-7}{8-8} \right.$, female $\frac{7-3}{10-8} \left| \frac{13-7}{9-1} \right.$; discoidal field in the male single-celled for a distance of 12 cells; anal loop male 9 cells, female 12 cells. Genitalia as shown on Plate X, fig. 3.

Distribution.—Khasia Hills, Assam, Shillong and Cherrapunji.

Distinguished from *carinata* by the smaller ventral spine on superior appendages and by the inferior appendage with an upper spine on each side and their much greater length. The females are easily distinguished by their respective vesicles. In *optata* this is conical, the apex divided into four small evenly-sized tubercles. In *carinata* the apex is trifid, the middle of the three small spines the longer.

***Idionyx yolanda* Selys.**

Idionyx yolanda Selys, *Ann. Soc. Ent. Belg.* (C. R.) p. vi (1870); Id., *2nd. Add. Syn. Cord. Bull. Acad. Belg.* (ii) XLV (1878); Id. ib. XXXI, p. 520 (1871).

The type, in the Selysian collection, is a female from Singapore, and from the original description, it is quite clear that it does not belong to the supposed allotype male from the Karen Hills, Burma. Our knowledge of the genus shows us that the individual species have a remarkably restricted range, so that it is hardly possible that a female from Singapore would be related to a male from Upper Burma. Convincing proof has, however, been obtained by the capture of both sexes of the Burmese form by Col. F. Wall. *Yolanda* has the lower part of the front of thorax, very much like what is found in *Macromias* of the *moorei* group, and there is no well-defined antehumeral stripe. The wing bases are also extensively saffronated.

The male of *yolanda* therefore still remains unknown, and the male from Upper Burma constitutes a new species which I have named after De Selys.

***Idionyx selysi* sp. nov.**

(Plate IX, fig. 6, Plate X, fig. 6.)

Selys (*Idionyx yolanda* pars) *2nd Add. Cord. Bull. Acad. Belg.* (ii) XLV (1878).

Male.—Abdomen 31 mm. Hindwing 30 mm.

Agrees entirely with the description given by Selys for the supposed male of *yolanda* from the Karen Hills, except that the dorsal spine on segment 10 is tipped with bright yellow. This however appears to be a

variable character, as in one specimen it is hardly noticeable, and in another, the whole spine is yellow as well as the carina running from its base to base of segment. The loop has 8 cells, the nodal index $\frac{5-13}{8-8} \bigg| \frac{12-6}{8-8}$.

Female.—Abdomen 27 mm. Hindwing 30 mm.

Head similarly coloured to the male. Vesicle simple, rounded. Thorax with the markings much broader than in the male, the antehumeral stripe better defined than in any other species, bright citron yellow, extending nearly up to the alar sinus, tapering from its middle to a fine point above, converging on its fellow and sharply defined throughout. The yellow on metepimeron not bordered with black behind or below.

Markings of legs and abdomen similar to the male. In one specimen, segments 7 and 8 have the dorsal carina marked with yellow.

Wings only slightly saffronated at the base and not much more so than in the male (*Yolanda* female has the bases of wings broadly saffronated). Nodal index $\frac{6-13}{8-9} \bigg| \frac{13-6}{8-7}$; 9 cells in the loop, only a single row of cells at the commencement of the discoidal field and also between the origins of *Cui* and *Cuii*.

Vulvar scale prominent, projecting, scoop-shaped, not bifid at apex.

Distribution.—The male in the Selysian collection from the Karen Hills, N. Burma. Two males and three females from Maymyo, N. Shan States, Upper Burma, collected by Col. F. Wall, I.M.S., 12-15. vi. 24 and 7 vii. 24.

The species is remarkable for the large extent of colouring, both on thorax and abdomen, especially in the female. The latter is again remarkable on account of its open reticulation, which exactly parallels the male, contrary to the usual rule of the genus.

***Idionyx intricata* sp. nov.**

(Plate VIII, fig. 5.)

Male.—Abdomen 28 mm. Hindwing 30 mm. (Female unknown.)

Head. Labium, labrum and a small medial spot on anteclypeus, yellow, the labrum darker and with a bronzed appearance along its borders, postclypeus dark bronzed metallic, frons dark green, and vesicle dark steely blue metallic; occiput black; eyes emerald green.

Prothorax black, pale yellow low down on sides.

Thorax dark bronzed green with a vestigial, very short, lower, dorsal stripe of palest yellow; laterally metallic green with a narrow medial pale yellow stripe and a similar coloured bordering to the hinder part of metepimeron.

Legs. Femora dark reddish brown, tibiae yellow except for the proximal ends which are dark red. Tibial keels:—three-fourths the length of hind tibia, one-fifth of the middle and rather more than one-third the length of anterior pairs.

Wings hyaline, slightly but distinctly enfumed along the costal and subcostal spaces; pterostigma blackish brown, over 2 cells; nodal index $\frac{6-13}{10-10} \bigg| \frac{13-7}{1-1}$; loop with 8 cells; hypertrigones $\frac{2-2}{1-1}$; discoidal field in hindwings with a single row of cells, only one row between *Cui* and *Cuii* in the same wings.

Abdomen black, the ventro-lateral borders of segments 1 and 2 broadly yellow, segment 2 has also a narrow mid-dorsal bilobed yellow stripe. The tenth segment with a long acute dorsal spine not quite as long as that of *optata*.

Anal appendages black (Plate VIII, Fig. 5). Superiors short and robust, a little dilated at base, then with parallel sides until near the apex where it expands into a flattened organ shaped like the human hand shorn of its fingers save the stumps, of which, four may be noted,—one a robust spine at the inner corner sloping inward and downward, a second adjacent to the last, directed almost straight back, the fourth a robust spine directed straight out from the outer corner, and lastly a third which is a mere knuckle lying between the two latter digitations. The inferior appendage considerably longer and very similar to that of *optata*, but the lateral spines with a greater spread and larger, and with their inner margins crenulate. The terminal portion curving steeply upward.

Female.—Abdomen 31 mm. Hindwing 35 mm. (Male unknown.)

Very similar to *stevensi* and *nadganiensis*, but differs from both by its highly specialized vesicle.

Head. Labium, labrum and mandibles bright citron yellow, the labrum more especially; clypeus bronzed black; frons and vesicle metallic blue or green, the latter standing very high, cone-shaped, its apex bifid, split into two small lateral points. Eyes green; occiput black.

Prothorax blackish brown, an anterior collar, the posterior lobe, and its sides low down pale yellow.

Thorax metallic green or bluish green, marked with a short antehumeral pale yellow stripe, extending not more than halfway up the dorsum and lying midway between the mid-dorsal carina and humeral suture. Laterally a narrow median pale yellow stripe and the hinder half of metepimeron the same colour.

Legs black, the anterior pair of femora reddish brown, the proximal parts yellowish, tibiae bright yellow, tarsi reddish brown.

Wings evenly and diffusely enfumed, their bases bright golden amber as far out as the outer ends of trigones; pterostigma black, over $2\frac{1}{2}$ to 3 cells; reticulation closer than usual, nodal index:— $\frac{8-14}{10-11} \left| \frac{14-8}{11-11} \right|$; hypertrigones $\frac{2-1}{1-1}$; loop 10-11 cells; 2 rows of cells between *Cui* and *Cuii* in hindwings, and 2 rows of discoidal cells in the same wings.

Abdomen black, markings similar to *intricata*:—the ventral border of segments 1 to 3 pale yellow, rather broadly so on segment 2, where is also found a bilobed narrow mid-dorsal stripe. Vulvar scale robust, prominent, produced back in a beak-like manner.

Distribution.—A single male from Cherrapunji, Khasia Hills, Assam, by Mr. T. Bainbrigge Fletcher, and a single female by the same collector from Tura, Garo Hills, Assam, 3,500-4,000 ft., between 15. vii and 30. viii. 23. Belongs to the *optata* group; the male easily identified by its anal appendages, and the female by its bifid vesicle. The basal saffronation in the latter is more extensive than in *optata*, and in this respect resembles *stevensi* and *nadganiensis*. I have paired this with *intricata* rather than with *imbricata* from the same district, as it more nearly resembles the former.

Idionyx unguiculata sp. nov.

(Plate VIII, fig. 3.)

Male.—Abdomen 32 mm. Hindwing 31 mm.

Head. Labium pale brownish yellow, labrum citron yellow framed in a narrow black border; a small spot of yellow at centre of anteclypeus, the latter and the postclypeus black with bronzy reflex; frons bluish green metallic as is also the vesicle; occiput black; eyes green.

Prothorax brown, the posterior lobe pale yellow.

Thorax metallic green, without a dorsal stripe. A narrow medial lateral stripe citron yellow, as is also the hinder and ventral border of metepimeron. Legs entirely black, tibial keels exactly similar to those of *intricata*.

Wings hyaline, only a faint saffronation at base of hindwings. Pterostigma black, over $1\frac{1}{2}$ to 2 cells; nodal index $\frac{7-13}{9-8} | \frac{14-7}{8-8}$; 9 to 10 cells in loop; single rows of cells in discoidal fields and between *Cui* and *Cuii* in hindwings. Membrane white, greyish externally.

Abdomen black, the ventral borders of segments 1 to 3 and a middorsal narrow stripe running from segment 1, over 2, to a little beyond the middle of segment 3, citron yellow. The basal joints of segments 3 to 7 narrowly ringed with yellow. Segment 7 has a small ventral tuft of golden hairs. Segment 10 strongly keeled, this almost amounting to the nature of a dorsal spine.

Anal appendages black (Plate VIII, fig. 3). Superiors as long as the combined length of segments 9 and 10, broad at base, tapering slightly to apex which has a spiral twist from within, down and out, the end of the spiral fringed with a tuft of bright golden hairs. On the outer side of appendage, a rough and distinct eminence which represents an atrophied ventral spine. Inferior appendage considerably longer and much more robust, rather more than its basal half thick and broad and directed horizontally back, the apical smaller portion curving rapidly and strongly upward, tapering to a fine point. Above deeply grooved and hollowed out, and presenting at about its middle, on the thin edge of the groove, on each side, a small delicate upright spine.

Genitalia similar to type.

Female.—Abdomen 31 mm. Hindwing 28 mm.

Very similar to the male but differing in the following respects:—The vesicle enormously produced into a long thin drawn-out spine very similar to that seen in *corona*, and as equally acute and long. (In one specimen the horn is perfect; in a second the tip has been fractured off by pressure of the paper packet, in which the broken part was found; in a third, the vesicle has been crumpled up and folded on itself by the same agency as the last, but its real shape is easy to distinguish.) There is a short vestigial dorsal yellow thoracic stripe, only seen with difficulty. In the teneral specimens the bases of all wings are deeply saffronated as far out as the 3rd antenodal nervure and the proximal border of trigone in forewing, and distal border of trigone in hindwing. In the adult specimen, the saffronation is restricted to two dark amber rays in the subcostal and cubital spaces and a pale intervening saffronation as far out as the 2nd antenodal nervure. The wings of the adult are evenly

and palely enfumed; nodal index $\frac{8-13}{9-8} | \frac{14-7}{8-9}$, $\frac{7-13}{8-8} | \frac{12-8}{7-10}$, $\frac{5-13}{8-8} | \frac{12-6}{7-9}$; loop 9 to 11 cells; discoidal field and space between *Cui* and *Cuii* in hindwings with 2 rows of cells at commencement.

Distribution.—Maymyo, N. Shan States, Upper Burma, collected by Col. F. Wall, I.M.S., 31. v to 10. vi. 25. A male and three females.

The males are easily distinguished from all other species by the unique spiral twist of the superior appendages. The females are as easily distinguished on account of the character of their long spine-shaped vesicle, copied only by *corona* and *burliyarensis*, both of which however come from South India and have no trace of a dorsal thoracic stripe. Only in the subspecies *fulvia* do we find extensive saffronation, but of a different brownish tint. The atrophied ventral vestigial spine of the superior appendages suggests a distant relationship to the *optata* group.

Idionyx imbricata sp. nov.

(Plate IX, fig. 4, Plate X, fig. 1.)

Male.—(Female unknown.)

Head. Labium bright yellow, lateral lobes slightly tinged with brown; labrum bright citron yellow finely margined with black; ante- and postclypeus black, the former with a small diffuse spot of yellow at its middle, which is confluent with the yellow of labrum; frons and sides of postclypeus greenish blue metallic, the former broad and rounded, coarsely pitted; vesicle metallic blue, rounded and depressed.

Eyes green; occiput black.

Prothorax black, its posterior lobe bright yellow.

Thorax metallic green or bluish green with a golden reflex, humeral stripe absent. Laterally a narrow median stripe, and the hinder half of the metepimeron bright citron yellow. Beneath, two oblique metallic blue stripes continuous with the same colour of the sides, and between and behind these, a large triangular spot of black.

Legs black, the two hinder pairs of tibiæ bright yellow, the anterior pair with an outward stripe of the same colour. The keel on the hinder tibiæ extending for four-fifths from distal end, for rather less than the distal half of the anterior pair. Femora and trochanters black, but the anterior coxæ and a spot on the anterior trochanters yellow. Claws bifid, yellow.

Wings hyaline, bases palely saffronated as far out as trigones; nodal index $\frac{6-12}{9-8} | \frac{12-7}{9-9}$; only a single row of cells between *Cui* and *Cuii* in hindwing; loop with 9 to 10 cells; pterostigma black, over 2 cells, moderately long, unbraced; discoidal field of forewing with a single row of cells as far as node.

Abdomen black, segments 1 and 2 with a broad bright yellow mid-dorsal stripe extending from base to apex of each segment, each also with a broad latero-ventral stripe of yellow, which is continued on to the adjacent basal portion of segment 3. The latter segment with the mid-dorsal carina finely yellow. The apical half of segment 7 and the whole length of segments 8 and 9 yellow ventro-laterally. Segment 10 with

a blunt keel not amounting to a definite spine. Segment 7 with a tuft of bright yellow hairs at the distal end of its ventral surface.

Female.—Abdomen 31 mm. Hindwing 33 mm.

Head. Labium and labrum yellow; anteclypeus brown, postclypeus yellowish, frons and vesicle metallic green, the latter simple, rounded; occiput black.

Prothorax light brown.

Thorax metallic bluish green marked with citron yellow as follows:—a lower vestigial humeral stripe extending upwards for not more than one-third the length of dorsum of thorax, a mediolateral oblique narrow stripe and the hinder border of the metepimeron. Legs blackish brown.

Wings hyaline, brightly saffronated at the extreme bases, as far out as the first antenodal nervure and slightly more so in the cubital space; nodal index $\frac{8-13}{10-9} \left| \frac{13-8}{9-10} \right|$; 1 cubital nervure in forewings, 2 in the hind; 10 cells in the loop; only a single row of cells between *Cui* and *Cuii* in the hindwings; all hypertrigones traversed once; pterostigma small, dark brown, over 2 to $2\frac{1}{2}$ cells.

Abdomen laterally compressed, black, the dorsal carina of segments 2 and 3 narrowly yellow, as also the joint between these segments. The ventral borders of segments 7 and 8 narrowly yellow.

Anal appendages short, conical, black. Vulvar scale very short, rounded, with an obtuse point in the middle.

Distribution.—Shillong, Assam, 6,000 ft., one male collected by Mr. T. Bainbrigge Fletcher, 8. vi. 24, the type, and now in the Brit. Mus. Two females from the same locality, 6. viii. 25, in the Morton collection.

***Idionyx carinata* sp. nov.**

(Plate VIII, fig. 1.)

Idionyx optata, Ris nec Selys, Suppl. Ent. No. 1, pp. 81-83 (1912).

One male, one female from Tsa-Yiu-San, 16-14. vii. 1910, Mus. Konigsberg.

Male.—Abdomen 35 mm. Hindwing 33 mm.

Closely similar to *optata* Selys, from which it is only distinguishable by the difference in shape of the anal appendages. There are however only 4 to 6 cells in the loop, instead of the 10 present in the male, and 12 in the female of *optata*. The tibiae are all bright yellow on the extensor surface, whereas in *optata* male only the hind pair are yellow, the middle pair brownish yellow, and the anterior pair dark brown. The anal appendages vary as follows,—the ventral spine of superiors is much more robust and nearly double the size of that found in *optata*; seen in profile, this appendage is much stouter; the inferior appendage in profile is also stouter and thicker at the apex, and the small spine surmounting the lateral lobe of *optata* is altogether absent. Seen from above, the inferior appendage is much longer in *optata*, and the superiors are more slim. The dorsal spine on segment 10 is considerably shorter and stouter than in *optata*.

Female.—Abdomen 33 mm. Hindwing 36 mm.

Also very similar to *optata*, but differs by the smaller loop (6 to 9 cells as against 12 in *optata*), and by the vesicle which is bluntly conical, crowned with three blunt spines, the middle one the longest (Conical with four blunt tubercles in *optata*).

Distribution.—A single pair from Tsa-Yiu-San, S. China. Type and allotype in the Konigsberg Museum.

EXPLANATION OF PLATES.

PLATE VIII.

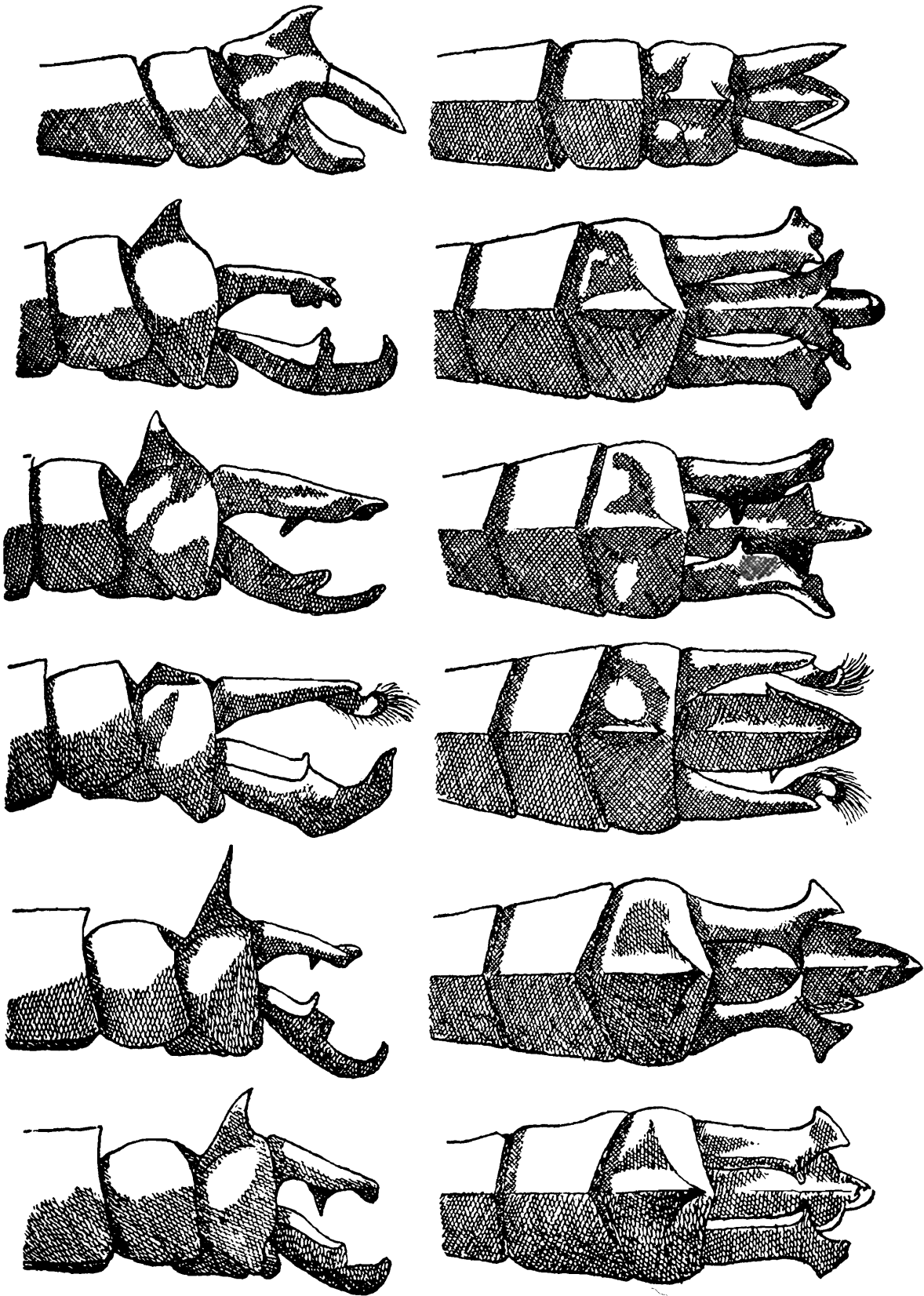
1. Lateral and dorsal views of anal appendages of *Idionyx carinata* sp. nov.
2. The same of *Idionyx optata* Selys.
3. The same of *Idionyx unguiculata* sp. nov.
4. The same of *Idionyx stevensi* Fras.
5. The same of *Idionyx intricata* sp. nov.
6. The same of *Idionyx claudia* Ris.

PLATE IX.

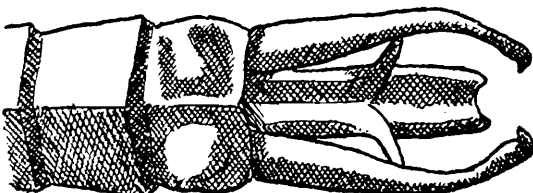
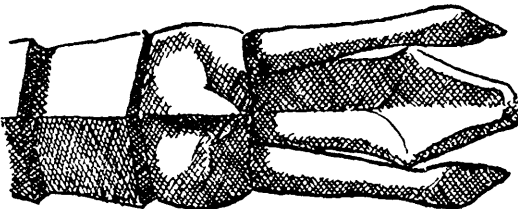
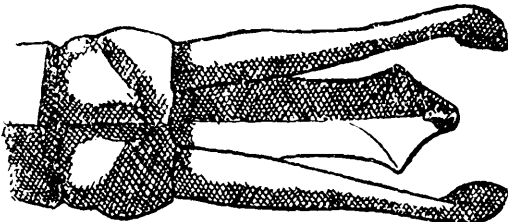
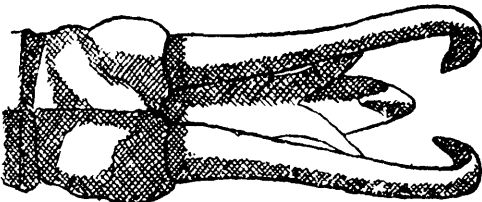
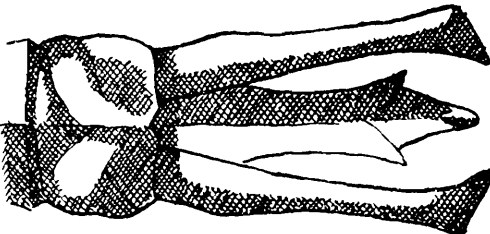
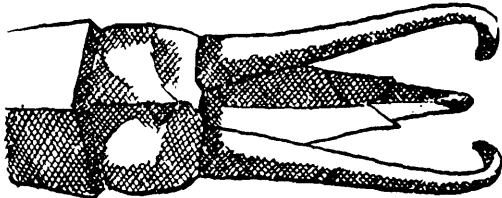
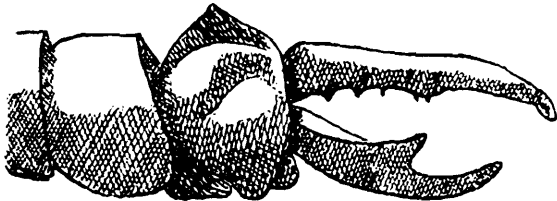
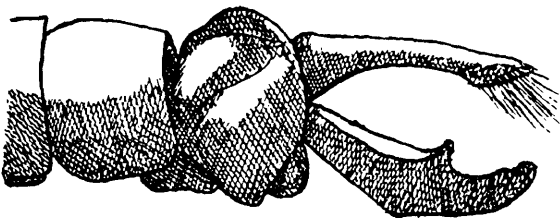
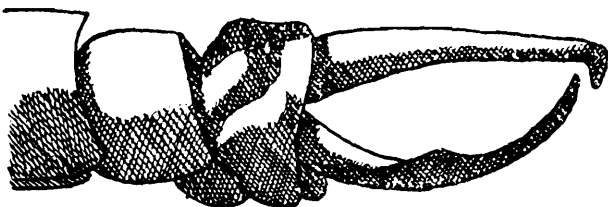
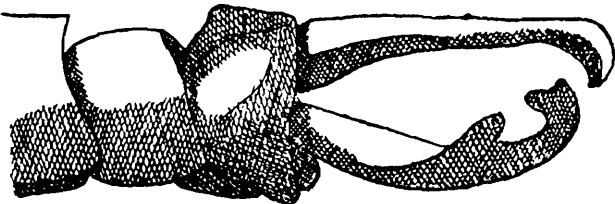
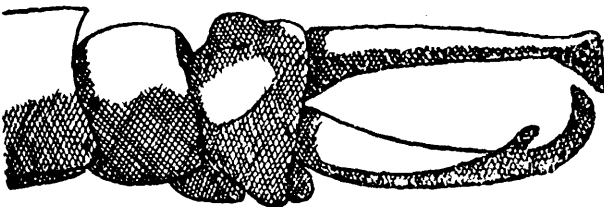
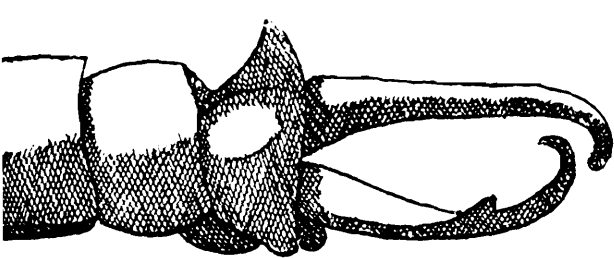
1. Lateral and dorsal views of anal appendages of *Idionyx saffronata* Fras.
2. The same of *Idionyx burliyaensis* Fras.
3. The same of *Idionyx montana* Karsch.
4. The same of *Idionyx imbricata* sp. nov.
5. The same of *Idionyx dohrni* Kruger.
6. The same of *Idionyx selysi* sp. nov.

PLATE X.

Genitalia of,—1. *Idionyx imbricata* sp. nov., 2. *Idionyx optata* Selys, 3. *Idionyx dohrni* Kruger, 4. *Idionyx montana* Karsch, 5. *Idionyx galeata* Fras., 6. *Idionyx selysi* sp. nov., 7. *Idionyx saffronata* Fras., 8. *Idionyx stevensi* Fras., 9a. Lateral and 9b. dorsal views of anal appendages of *Idionyx galeata* Fras.



ANAL APPENDAGES OF *Idionyx*



6

5

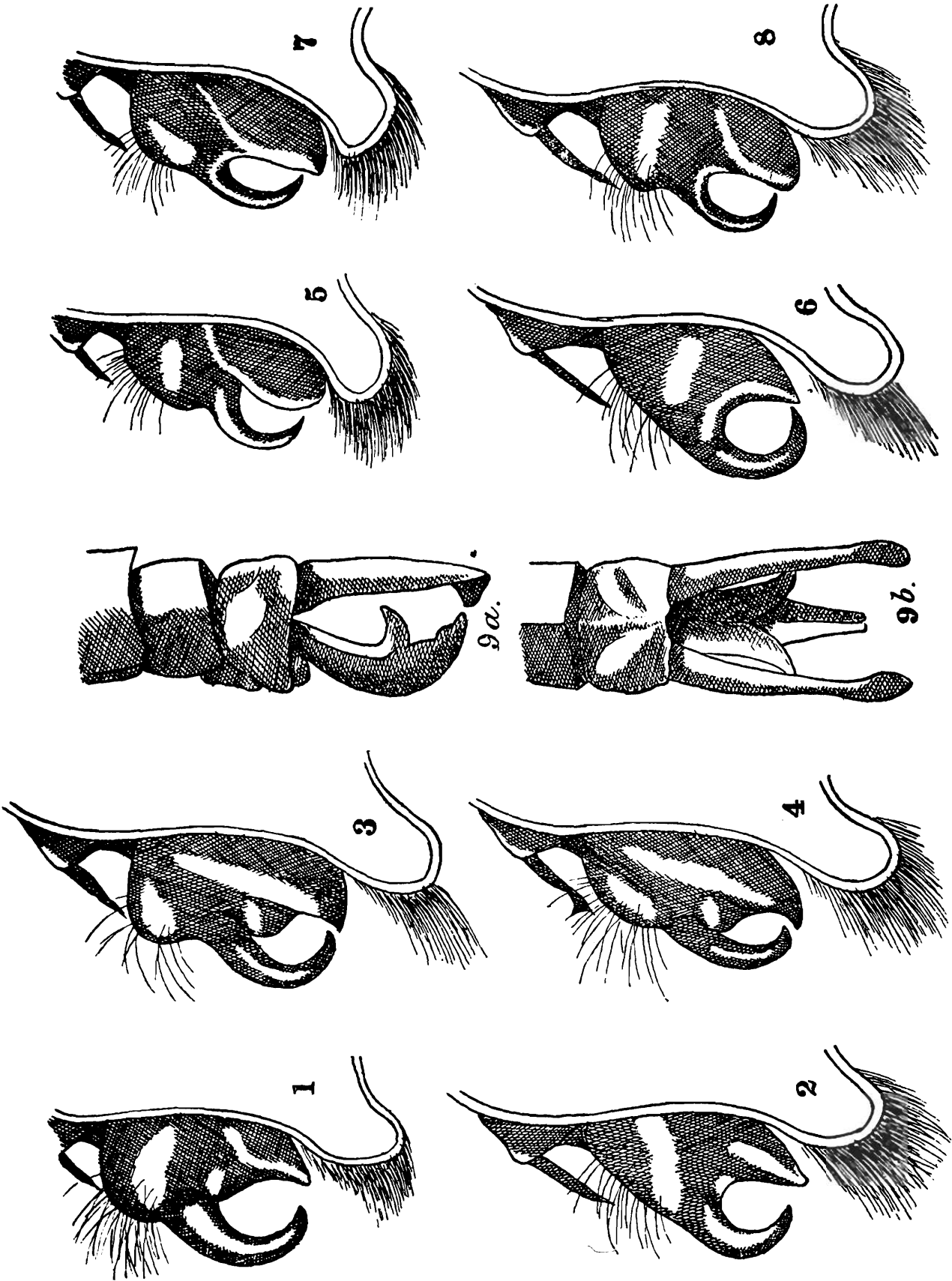
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ANAL APPENDAGES OF *Idionyx*



GENITALIA OF *Idionyx*