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 1926*b*), 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 *Eutyphœus*. 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 losely 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 occassionally 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 halfway 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).

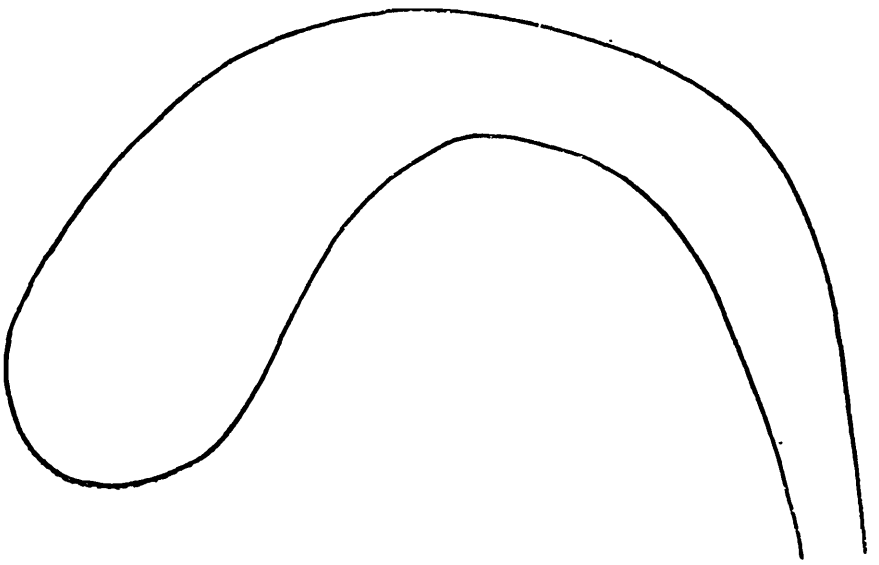

FIG. 1.—*Drawida peguana* Gates. Atrium, × *ca.* 90.

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

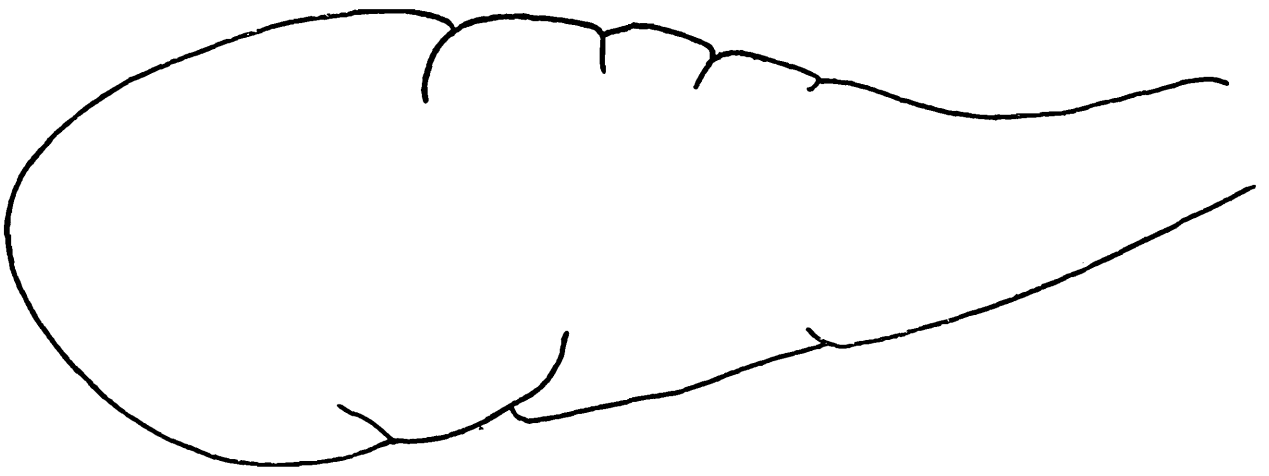

FIG. 2.—*Drawida rangoonensis* Gates. Atrium, × *ca.* 40.

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.

Fomily 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, Michælsen, *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 papillæ 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 papillæ 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 setæ of the segment. The next most common arrangement consists of six papillæ, 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 papillæ are present in two longitudinal rows of four. Curiously, when eight papillæ 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 papillæ 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 papillæ 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 papillæ on the segments named, 37 have papillæ on vi, vii and viii, 12 have papillæ on vii and viii, and four specimens papillæ 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 males 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 spermathecæ 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 setæ 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 setæ which Horst may possibly have overlooked. Ude (1905), on the other hand, described a worm from the Fiji Islands which is clearly *typica*. Rosa (1890*b*) 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 setæ. 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 spermathecæ, 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 setæ, and the absence of spermathecæ 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 relationship. 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 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

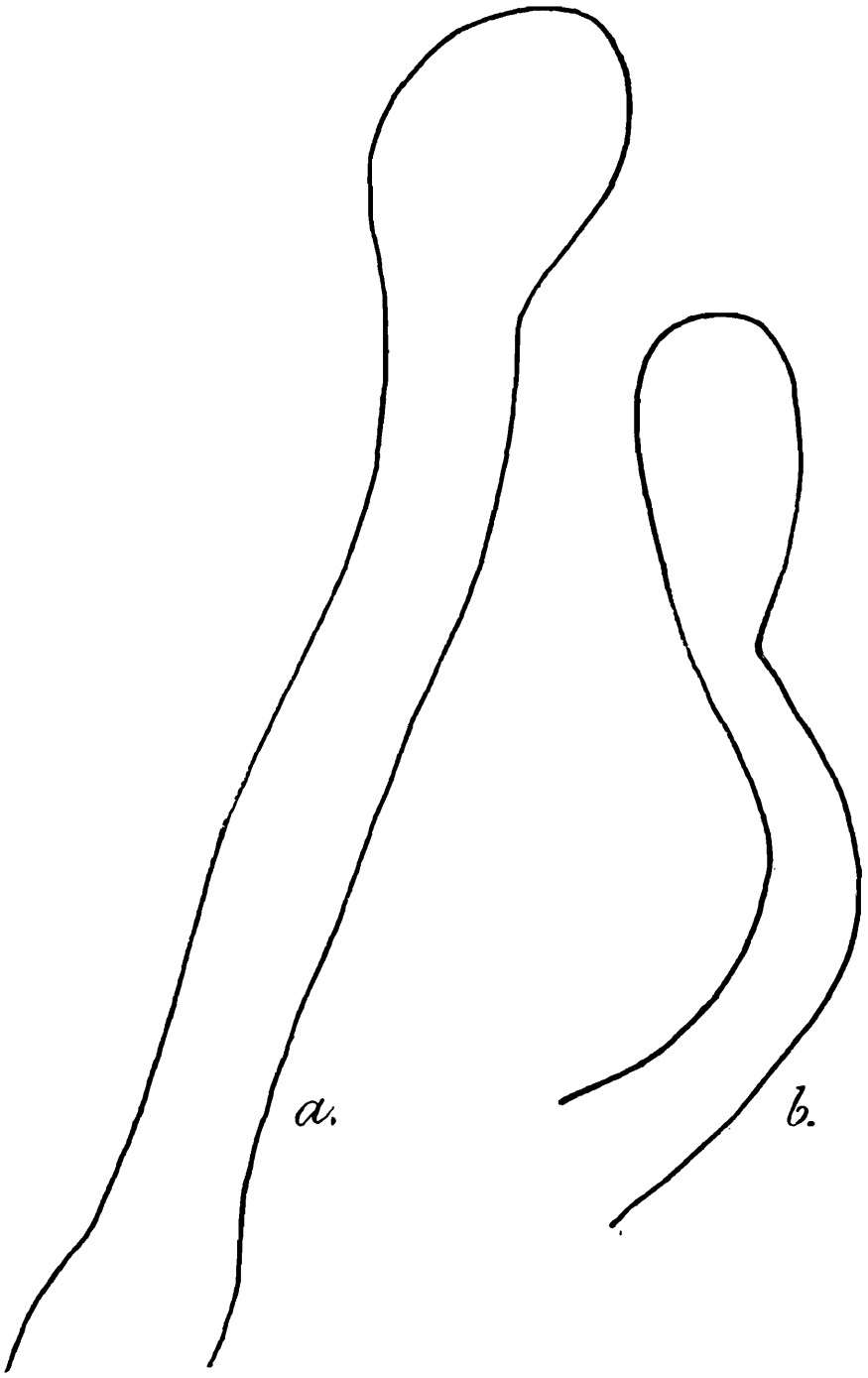

FIG. 3.—*Pheretima houlleti rugosa* Gates.
a. Spermatheca, × *ca*. 70.
b. Spermatheca, × *ca*. 40.

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 lef prostates are in xxii-xxiv, with duct in xxiv, and xxv-xxviii with duct in xxvi. The spermathecæ 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 spermathecæ. 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.

Octochætus (*Octochætoides*) *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 innner 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).

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

Rosa (1890*a*) in the original description of the species characterized the penial setæ as follows : " numerose, fortemente ricurve, nonpresentano alcun rigonfiamento e terminano in una semplice punta conica. In alcune sinota che le porzione terminale e 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.

Eutyphœus 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. 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.

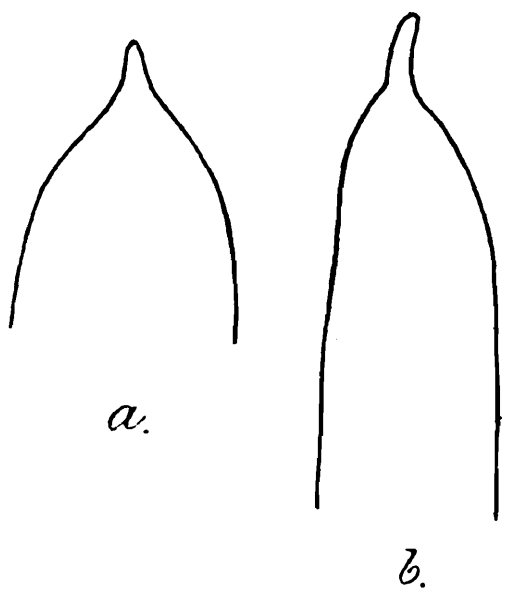

FIG. 4.—*Eutyphoeus rarus* Gates.
a. Penial seta, × *ca*. 820.
b. Tip of penial seta to show spine, × *ca*. 820.

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-

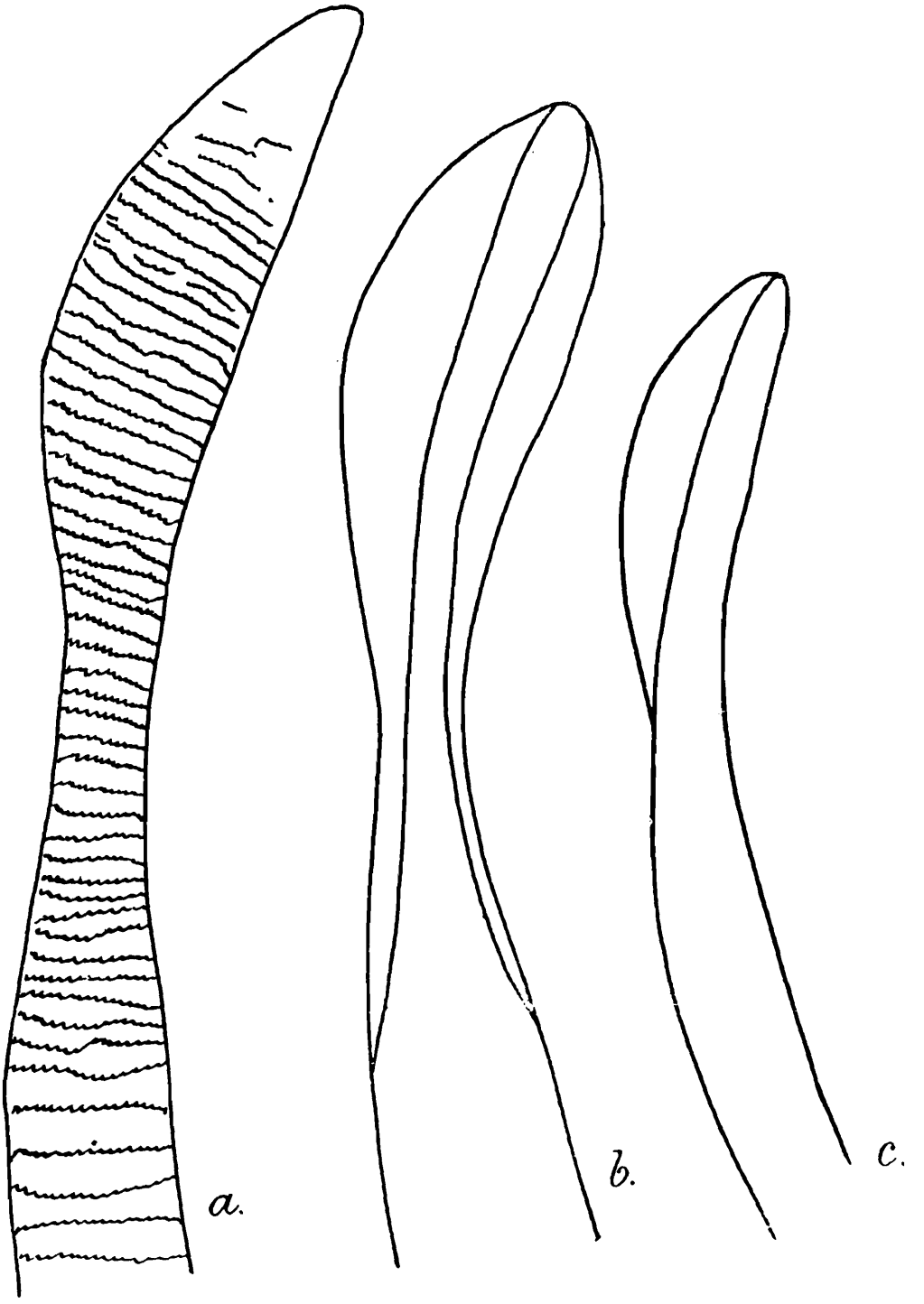

FIG. 5.—*Eutyphoeus spinulosus*, sp. nov.
a. Tip of penial seta, × *ca.* 650.
b. Penial seta, × *ca.* 650.
c. Tip of penial seta, × *ca.* 400.

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 2½ by 1¼ 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 metandric 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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