THE OLIGOCHAETA OF THE INDAWGYI LAKE (UPPER BURMA).

By J. STEPHENSON, *M.B., D.Sc., Lieut.-Col. I.M.S. (ret.), Lecturer in Zoology, Edinburgh University.*

CONTENTS.

INTRODUCTION.

The following paper contains an account of the Oligochaeta collected by Dr. B. Chopra in and near the Indawgyi Lake in Upper Burma during his exploration of this area in 1926.

Not much need be said by way of introduction concerning the collection. Prof. Gates's papers published during the last few years have made the Burmese fauna well known to us, and the number of new forms here described is not large.

A species of *Limnodrilus* is pretty certainly new, but the single sexual specimen did not allow a complete description, and I have therefore not given it a name. *Branchiura sowerbyi* is now coming to be recognized as a regular inhabitant of the lakes and other collections of fresh water of the Indian region and the Far East.

Notoscolex choprai, here first described, is a member of an interesting and rather narrowly localized group of species within the genus, characterized by an abnormal shifting forwards of the organs of the anterior part of the body by one segment, and the presence of calciferous glands in front of the ovarian segment.

The relations between *Pheretima anomala*, "*P. insolita*," and the forma *centralis* here described, which is practically Gates's "Type F." (Gates, '25*a*), have interested me; and I have interpreted *P. anomala* and "*P. insolita*" as having diverged, the one in the direction of a

male, the other in that of a female form, from a forma *centralis*, the fully hermaphrodite original.

My thanks are due to Dr. Chopra for the care he took in the preservation of the worms. They were all in excellent condition, and the present is certainly the best preserved collection that it has been my fortune to receive.

Family TUBIFICIDAE.

Genus **Branchiura** Bedd.

Branchiura sowerbyi Bedd.

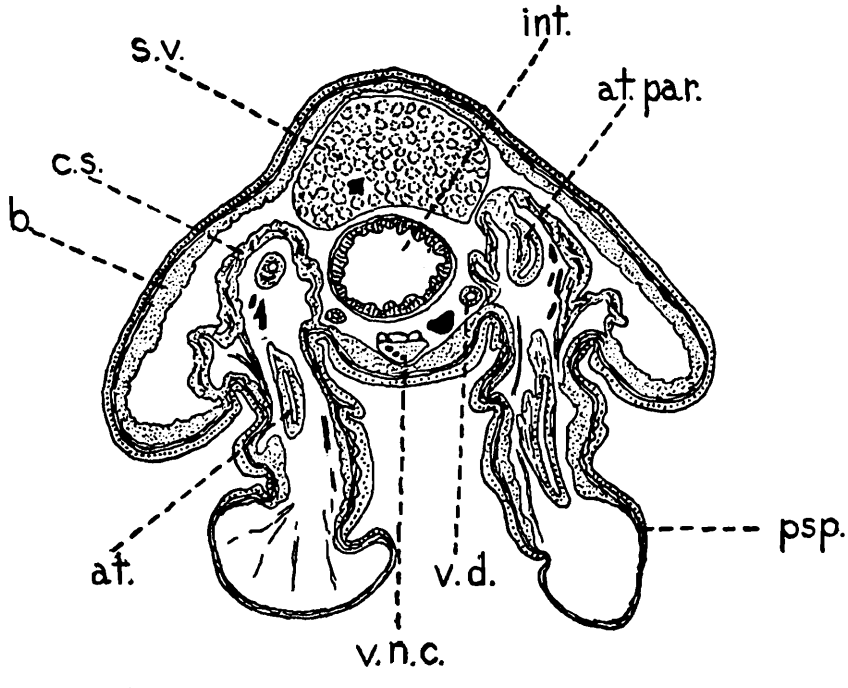
Indawgyi Station 7 ; dredging in the Indawgyi Lake along its western shore near Loimon, Myitkyina Dist., Upper Burma. B. Chopra. 4-5. xi. 26. Numerous fragments, the worm or worms apparently having undergone autotomy.

Indawgyi Station 3 ; dredging in the Indawgyi Lake at its south end and along its eastern shore near Lonton, Myitkyina Dist., Upper Burma. B. Chopra. 18-31. x. 26. Several fragments.

The same. A large number of fragments, those of the anterior end mostly sexual.

Indawgyi Station 10 ; dredging at the north end of the Indawgyi Lake, Myitkina Dist., Upper Burma. B. Chopra. 7-10. xi. 26. Three small fragments.

In the majority of the fragments which contained sexual organs (second tube from Indawgyi Station 3) the " pseudopenes " were seen projecting.



Text-fig. 1.—*Branchiura sowerbyi ;* transverse section through segm. xi, to show everted pseudopenes ; × 34 (Abbe's drawing apparatus). *At.*, atrium within coelomic sac ; *at. par.*, atrium and paratrium together, before union, just after entering coelomic sac ; *b.*, body-wall, with the three layers, epithelium, circular and longitudinal muscular coats ; *c.s.*, muscular wall of coelomic sac, which by its contraction causes extrusion of pseudopenis ; *int.*, intestine ; *psp.*, pseudopenis, the everted ectal portion of atrium ; *s.v.*, seminal vesicle (sperm sac) containing sperm morulae ; *v.d.*, vas deferens ; *v.n.c.*, ventral nerve cord.

I described the " pseudopenes " in a previous paper ('18), and gave a diagrammatic figure to illustrate the mechanism of protrusion (by eversion of the terminal portion of the atrium). My sections of the present specimens give a particularly clear view of the relations of the parts in protrusion, and I reproduce here (fig. 1) one of the transverse

series in illustration. It seems quite evident that whatever may be the function of the pseudopenes, they are far too voluminous to be used as intromittent organs.

Genus **Limnodrilus** Clap.

Limnodrilus sp.

Indawgyi Station 7 ; dredging in the Indawgyi Lake along its western shore near Loimon, Myitkyina Dist., Upper Burma. B. Chopra. 4-5. xi. 26. Numerous specimens, none sexual.

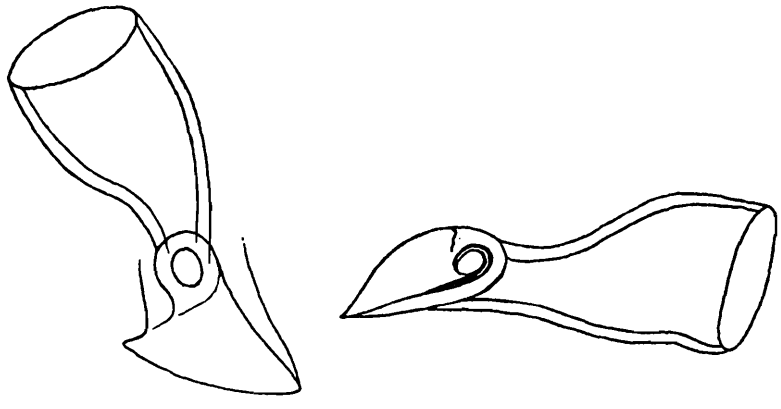
Indawgyi Station 3 ; dredging in the Indawgyi Lake at its south end and along its eastern shore near Lonton, Myitkyina Dist., Upper Burma. B. Chopra., 18-31. x. 26. A number of specimens, one with sexual organs.

Indawgyi Station 10 ; dredging at the north end of the Indawgyi Lake, Myitkyina Dist., Upper Burma. B. Chopra. 7-10. xi. 26. One complete worm and the anterior end of another, neither sexual.

The worms are filiform, very long in proportion to their thickness, the hinder part in particular being extremely thin and thread-like. The length is 80, 90, 100, or 120 mm., while the maximum diameter (towards the anterior end) is only about 0·5 mm., or at most 0·75 mm.

The prostomium is roughly triangular, with a blunt rounded anterior end.

The setae in both dorsal and ventral bundles are double-pronged crotchets, as usual in the genus. In the anterior part of the body (up to segm. viii in the sexual specimen, or up to xi in the others) there are two or occasionally three setae per bundle, but in the middle and hind regions each bundle consists of only a single seta. The proportions of the prongs vary ; the distal may be twice as long and twice as thick at the base as the proximal, but further back in the same specimen the two were more nearly equal. The nodulus is frankly distal (distal : proximal : : nearly or quite 1 : 2).



TEXT-FIG. 2.—*Limnodrilus* sp. ; chitinous penis sheaths, one drawn from one side, the other from the other side of the body.

In the anterior segments (i-vii, and again in ix and x) there are complicated parietal vascular loops ; possibly there are hearts in viii, but I cannot say that they were clearly distinguished. Parietal vessels, if present, were not visible in the hinder region of the body.

The spermathecal apertures are on segm. x, and the male pores on xi. The shape of the chitinous penis sheath could be seen in the only sexual specimen, which was examined in cedar oil, and is represented in fig. 2 ;

it is short,—only about twice as long as broad at its widest part,— and twice as wide above as below ; there is a one-sided lateral expansion at its lower end.

Remarks.—The only *Limnodrilus* known from the Indian region is *L. socialis* Steph., which is widely spread, occurring from the north to the south of India, in Burma, and in Japan. From that the present species differs widely in the number of setae per segment and in the shape of the chitinous penis sheath. The single sexual specimen unfortunately did not cut well, and I am unable to add anything to the short account written from the examination of the specimen in cedar oil ; I think, however, that the two peculiarities I have just mentioned will allow of the present form being recognised when it is met with again.

It is remarkable that this worm should have been found, on each of the three occasions, in the same localities as *Branchiura sowerbyi ;* and in this connection it may be recalled that I found *Branchiura sowerbyi* associated with another *Limnodrilus* (*L. socialis*) both at Lahore and in a consignment of worms brought by Annandale from Kyoto, Japan (Stephenson, '12, '17).

Family MONILIGASTRIDAE.

Genus **Drawida** Mich.

Drawida longatria Gates.

Kamaing, Myitkyina Dist., Upper Burma. B. Chopra. Nov.-Dec., 1926. Three specimens, sexually mature.

This species was originally described by Gates ('25), and is again referred to in later papers (Gates, '26, '26*a*). The present specimens show a number of not altogether negligible variations.

The worms are smaller than those originally described by Gates ; in length they measured 77, 95, and 105 mm., in diameter 3·5 mm. The longest had 168 segments, but was perhaps incomplete posteriorly ; the next longest had 183.

The specimens (unlike former examples) showed indications of dorsal pores (cf. *D. barwelli, D. nepalensis* and *D. rosea*). These began behind the clitellum as dark spots, and in some of these spots I think there was a patent passage through the body-wall ; the dried surface became moist on putting the contents of the body-cavity under pressure by bending the worm,—though possibly this might have been due to an oozing through the parietes.

The ventral setal bundles of the original examples seem to have been closer together than in the present specimens. Here, in the hinder and middle part of the body, *aa* is slightly less than (almost equal to) *bc*, and *dd* is equal to four-sevenths of the circumference ; in the anterior region *aa=bc*.

In furrow 10/11 are a pair of large blunt rounded papillae each of which forms part of a more extensive elevation, longer than broad, which takes up the greater part of the length of segms. x and xi. The papillae are situated between the lines of setae *b* and *c*, the centre of the papilla

being nearer to *b* than to *c*, and the transverse extent of the papilla equal to about the inner two-thirds of the interval *bc*. The surface of the papilla is occupied by a slightly convex oval area, the long axis of the oval being longitudinal; this area is sharply delimited at its margin by a well marked narrow groove. These papillae appear to be the porophores, though the exact situation on them of the male pores is not obvious.

The spermathecal apertures, in furrow 7/8, are conspicuous, bounded by prominent lips, the middle of the slit-like apertures being in line with seta *c*.

There are in these specimens no papillae on segm. viii, as in the original examples. In one of my three specimens there are, on segm. xi and rather on its anterior portion, a pair of fairly conspicuous indefinite whitish swellings of moderate size, situated mainly external to the line of the ventral setae but extending inwards so as to include this line.

The number of gizzards in the specimen I dissected is five,—one more than in the original description.

The greater part of the vas deferens is so disposed as to form a large mass of small lamellae,—in places perhaps best described as cauliflower-like,—larger than the kidney-shaped testis sac, to the hilus of which it is attached. I found the prostate smooth and shining, not (as Gates) finely granular. The parts of the ovisacs in segm. xii were much swollen and full of ova.

Drawida nepalensis Mich.

Rocky stream about half a mile from Namma rest house, Myitkyina Dist, Upper Burma. B. Chopra. 15. x. 26. Four specimens, one very small and immature.

Nyaungbin, a village at the north end of the Indawgyi Lake, Myitkyina Dist., Upper Burma. B. Chopra. 7-10. xi. 26. Four specimens, all sexual.

The habitat of the first batch,—in a rocky stream,—is interesting as an example of the predilection of the genus for water (cf. on this subject Stephenson, '23, p. 34). These were very small specimens, the largest 43 and 48 mm.; while those of the second batch are 90-100 mm.

The indications of dorsal pores begin in both batches behind the clitellum. The pores are represented by dark spots, and there may be a slight pitting, but no fluid comes through on pressure.

In two specimens of the second batch the clitellum is immediately obvious, being coloured a rather pretty rose tint. In this batch a pair of small transverse depressions, each bounded by a raised lip, is situated a little behind furrow 7/8, each depression being in line with the spermathecal pore in front of it. The depressions are not of much greater extent than the slit-like apertures; that of the right side is absent in one of the two clitellate specimens, and both are wanting in one of the others.

The gizzards, in the dissected specimen of the first batch, are three in number, in segms. xiv-xvi, while in the dissected specimen of the other batch there are only two (as in Michaelsen's specimens from Java; Michaelsen, '24).

The spermathecal duct is (first batch) disposed in irregular windings, which are loosely attached to the septum.

Family MEGASCOLECIDAE.

Subfamily *MEGASCOLECINAE.*

Genus **Notoscolex** Fletcher.

Notoscolex choprai, sp. nov.

Nyaungbin, a village at the north end of the Indawgyi Lake, Myitkyina Dist., Upper Burma. B. Chopra. 7-10. xi. 26. Two specimens, mature.
Lonton, a small village on the western shore of the Indawgyi Lake, Myitkyina Dist., Upper Burma. B. Chopra. 18-31. x. 26. Four specimens, mature.

External Characters.

The two specimens of the first batch are 190 and 220 mm. long; those of the second are respectively 430, 290, 212, and 180 mm.,—one being thus very considerably longer than any of the others. The maximum diameter is 5 to 6·5 mm. Segments (of a specimen of average length) 304. Colour a fairly uniform grey, hinder end lighter; clitellum purple.

There is a very distinct secondary annulation of the anterior segments, which is particularly confusing, since the setae are here very small and seen only with difficulty. I have however succeeded in making out the complete series of setal bundles in more than one specimen, and find that segms. i, ii and iii consist of a single annulus each, segm. iv of two, v of two or three, vi of three or four, vii-xi of four, and xii of three or (counting two slighter furrows) five.

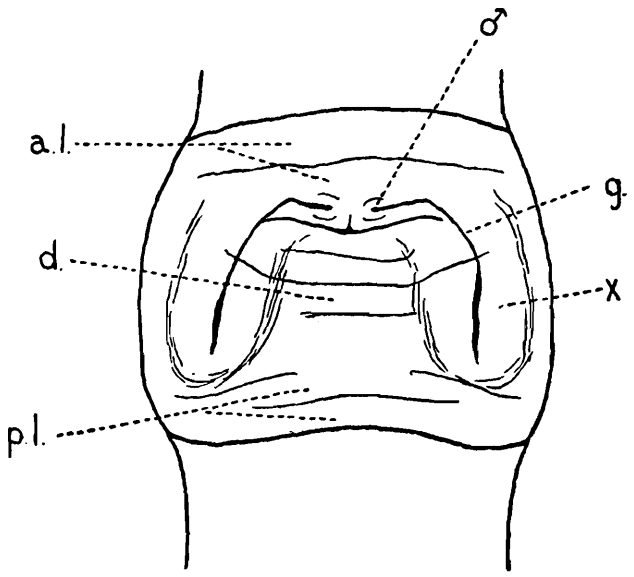
The prostomium is small and prolobous; segm. i is marked by a number of short longitudinal grooves all round its anterior margin. Dorsal pores begin from furrow 9/10.

The setae are small and paired; *ab* is equal to one-third of *aa*, but varies somewhat in different parts of the body, perhaps owing to irregular contraction; it is equal to a half to two-fifths of *bc*, and is almost equal to *cd*; *dd* is about two-thirds of the circumference; *aa* is relatively smaller in front of the clitellum.

The clitellum extends over segms. xiii-$\frac{2}{3}$xvi ($=3\frac{2}{3}$); thus it (and the genital apertures) are one segment further forward than is usual in the genus. It is purple in colour and well defined,—limited behind by a constriction which excludes a sharply defined annulus of segm. xvi from the clitellar region. Dorsal pores are visible on the clitellum.

The male area (fig. 3) includes the whole ventral surface of segms. xvii and xviii, with the posterior third of segm. xvi. In shape the area is almost quadrangular, the anterior end being narrower and the anterior angles rounded off; the whole area is about one-fourth wider than long. The periphery of the area is raised, forming a very broad and tumid border surrounding a central depression, of the same shape as the whole area. The bottom of the area is somewhat furrowed transversely; there is also a transverse furrow on the anterior lip of the area, a second, bent somewhat backwards in its middle part, delimiting the anterior lip from the central depression, and sometimes a third on the posterior lip. The lateral lips are particularly broad; each has a well

defined clean longitudinal cleft or furrow, of some length, along its middle, best marked in its posterior portion ; this cleft is continued



TEXT-FIG. 3.—*Notoscolex choprai ;* the male area. *A.l.*, anterior lip, with transverse groove ; *d.*, central depression ; *g.*, groove leading to male pore, ♂ ; *p.l.*, posterior lip, also with transverse groove ; *x*, lateral lip around posterior end of groove (forming almost an independent papilla).

forwards and bends inwards towards the middle line, ending in a pore—the male pore—not far from its fellow of the other side, in front of the short transverse groove between anterior lip and central depression. The male pores are thus on segm. xvii, on the posterior aspect of the anterior lip of the male area ; but this region may overhang the central depression, so that in a strictly ventral view the pores are concealed.

The female apertures are near each other in a whitish transversely oval area on the anterior portion of segm. xiii.

The spermathecal pores are inconspicuous, deeply situated in furrows 6/7 and 7/8 near the middle line, slightly internal to the line of seta *a*.

Internal Anatomy.

Septum 4/5 is thin, 5/6 slightly thickened, 6/7, 7/8, 8/9 and 9/10 very thick and muscular, 10/11 somewhat and 11/12 slightly thickened ; one or two still further back are perhaps slightly thickened also.

The gizzard is large, elongated, cylindrical or slightly barrel-shaped, in segm. vi. Calciferous glands are present in segms. x, xi and xii, the first pair flattened antero-posteriorly, and all somewhat kidney-shaped. The intestine begins in xiv.

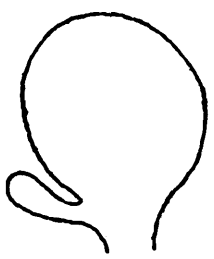
The last hearts are situated in segm. xii.

There are numerous small micronephridia. In the anterior segments tufted nephridia are present ; and at the hinder end there is, in addition to numerous micronephridia, a pair of larger loops per segment ; but I almost missed these, in consequence of their being closely applied to the intestine (not lying on the body-wall in the dissection), and hence inconspicuous.

The male funnels are free, in segms. ix and x ; testes were not identified. The seminal vesicles are two pairs, in x and xi, of moderate size, meeting in the mid-dorsal line, smooth and not cut up into lobes.

The prostates are compact glands situated in segments xvi-xx, but may push the anterior and posterior septa respectively of these segments somewhat forwards and backwards ; in the dissected specimen the two glands were not quite at the same level. The outer margin of the posterior part of the gland appears lobed because of constrictions due to the septa. The duct is given off from the anterior portion of the gland ; it is short and bent, the loop having its blind end directed forwards on one side, backwards on the other ; it is soft, not muscular, and ends under cover of a strong sheet of oblique muscle bands situated on the body-wall within the circular muscle layer. There are no penial setae.

The ovaries are in segm. xii.



TEXT-FIG. 4.—*Notoscolex choprai ;* spermatheca.

The spermathecae (fig. 4), situated in segms. vi and vii, or both in vi (the greater part, at least, of the posterior spermatheca of the left side was in vi in the dissected specimen), open quite near the middle line. The ampulla is a simple sac ; the duct is short and moderately stout ; there is a single diverticulum, shortly club-shaped, given off from the anterior side of the upper end of the duct.

Remarks.—The shifting forwards of the organs of the anterior part of the body by one segment, and the position of the calciferous glands in front of the ovarian segment, place this species in the *stewarti* group (*N. stewarti, striatus, oneili, birmanicus*). From *N. stewarti*, to which it has the greatest resemblance, it is distinguished by its larger size, by the extent of the clitellum, the characters of the male field and the relative proportions of the spermathecal ampulla and diverticulum.

The whole *stewarti* group is, so far as known at present, confined to the Abor region and Upper Burma.

Genus **Pheretima** Kinb.

Pheretima andersoni Mich. var. **choprai**, n. var.

Nyaungbin, a village at the north end of the Indawgyi Lake, Myitkyina Dist., Upper Burma. B. Chopra. 7-10. xi. 26. Two specimens, sexually mature.

External Characters.

Length 132-138 mm. ; maximum diameter 5 mm. Colour brownish purple dorsally, rather paler behind ; pale ventrally ; clitellum rather

more distinctly purple. Segments 118 and 119; some slight irregular secondary annulation in some of the preclitellar segments.

Prostomium large, broad, epilobous $\frac{1}{3}$; the tongue not delimited behind.

Dorsal pores begin in furrow 12/13.

The setae are very small, very numerous, arranged without dorsal or ventral break, and equally closely set dorsally and ventrally; I counted them as follows:—69/ix, 72/xii, 81/xix, and 90 in the middle of the body, while towards the hinder end they were particularly numerous and close-set, 100 or more per segment.

The clitellum, extending over segms. xiv-xvi (=3), is purple in colour, smooth, and without dorsal pores or setae.

The male pores are about two-sevenths or nearly one-third of the circumference apart, with 14-16 setae intervening; they are situated on large round porophores, which take up the whole length of the segment.

The female aperture is midventrally situated, in one specimen in a short transverse furrow, in the other appearing as a mere oval depression.

The spermathecal pores are four pairs, in furrows 5/6-8/9, more than one-third of the circumference apart and nearly in the lateral line.

Over furrow 21/22, in the specimen first examined, are a pair of large flat circular papillae, extending lengthwise from the setae of xxi to those of xxii, and indeed causing the setal rows to bulge apart slightly; the outer borders of the papillae are about in line with the centres of the male porophores; the borders are very slightly elevated and whiter in colour than the centres of the papillae. In furrows 22/23, 23/24 and 24/25 is a series of unpaired papillae, midventrally situated, similar to but slightly smaller than the paired papillae, very slightly broader than long, nearly touching their neighbours in front and behind,—*i.e.*, each nearly equal to a segment in length.

In the second specimen the paired papillae are similarly placed; the unpaired papillae are six in number,—one very small one in furrow 18/19; the three over 22/23, 23/24 and 24/25 as large as those in furrow 21/22 and distinctly oval in shape, their transverse extent being almost equal to the transverse interval between the paired papillae; and two, over furrows 25/26 and 26/27, considerably smaller, especially the last, which is a little to the left of the middle line.

Internal Anatomy.

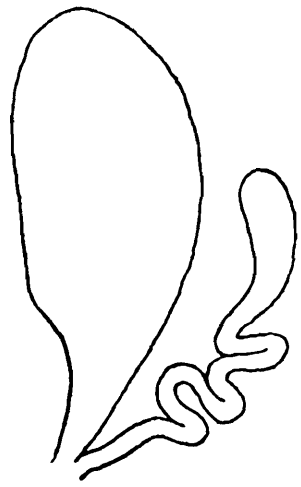
The differences from the type form of the species are as follows:—Septa 3/4, 4/5, and 5/6 are thin (5/6 appearing thickened because covered on its anterior face by a layer of nephridial tubules), 6/7 is similar to 5/6, 7/8 slightly thickened; the next is 10/11, which along with 11/12 is somewhat thickened.

The caeca originate in segm. xxvii.

The last hearts are in segm. xiii (not xii).

The chief difference in the male organs is that there were, so far as I saw, no seminal vesicles in segm. x; those in xi and xii are not cut up into lobes.

The spermathecal ampulla (fig. 5) is an ovoid sac, not sharply delimited from the duct, which is quite short though easily recognizable, only a



TEXT-FIG. 5.—*Pheretima andersoni* var. *choprai* ; spermatheca.

fraction of the length of the ampulla, and narrowing to its termination. The diverticulum originates at the extreme ectal end of the duct ; it is tubular, dilated in a club-shaped manner at its ental end, and thrown into a few closely apposed loops or winding irregularly in its middle portion ; in length, if extended, it would nearly equal the ampulla and duct together.

Remarks.—The differences of the present variety from the type form of the species are the smaller size, the paired papillae on furrow 21/22 (instead of a single median papilla), and the more elongated spermathecal ampulla ; the much smaller degree of thickening of the septa, and the situation of the last heart in segment xiii may also be mentioned.

Pheretima anomala Mich.

Hopin, Myitkyina Dist., Upper Burma. B. Chopra. 12-13. x. 26. Two specimens, mature.

The genital papillae do not extend back behind segm. xxi ; in one specimen there is a pair of papillae on xvii,—one segment further forward than usual.

The distribution of the testes and male funnels was also abnormal ; they were present in segms. v, vi, vii, viii, one pair in the combined segments ix-x (there being apparently no septum 9/10), and one pair in xi ; but the last two pairs, instead of being, as usual, enclosed in testis sacs, were free, like those in front of them.

A large number of small round yellowish bodies seen through the thin body-wall in the hinder third or half of the worm were found, on opening the specimen, to be mostly adherent in a layer to the inner surface of the body-wall ; they were simply masses of Monocystis spores (pseudonavicellae) along with some granular matter.

Forma **centralis,** nov.

Nyaungbin, a village at the north end of Indawgyi Lake, Myitkyina Dist., Upper Burma. B. Chopra. 7-10. xi. 26. Three specimens, mature.

In the first specimen examined, there was a large and prominent papilla (male porophore) on the left side of segm. xx, while smaller

papillae were present on the left side of segms. xvii and xviii, and on the right side of segms. xviii and xx. On the left side of xix and on the right side of xvii and xix there were no definite papillae, but small transverse slit-like apertures were present, sometimes on slight elevations.

In the second, the male pores on segm. xx were not on porophores, but were distinguishable by being slightly internal to the other apertures, which were small and slit-like, faintly visible on both sides on segms. xvii-xix, on xxi and xxiii on the right side only.

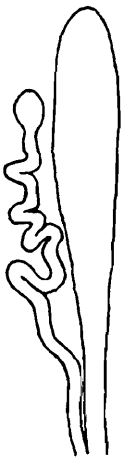
In the third, the male porophores were on xx, and small slits were present on both sides on xvii, xviii and xix.

Internally, I could not discover any trace of septa 8/9 and 9/10.

The testis sacs, two pairs, in segms. x and xi, are all separate from each other ; there are no supernumerary testes. The vesiculae seminales, in xi and xii, are of moderate size, with a few shallow lobulations. The prostates are of moderate size, extending from segm. xix to xxii, and are deeply cut up into lobes ; the duct forms a single loop, with its blind end pointing forwards, the ental limb narrow and not shining, the ectal limb shining and becoming much thicker. There is no copulatory pouch.

There are three pairs of accessory prostates (in the dissected specimen) in segms. xvii, xviii and xix respectively,—rounded and rather mush-room-like in shape, each with a very stout duct-like portion, soft yet shining and apparently muscular.

Ovaries and funnels are present in segm. xiii ; the ovaries are flattened and rather disc-like, and are attached by the middle of their anterior surface to the posterior face of septum 12/13.



TEXT-FIG. 6.—*Pheretima anomala* f. *centralis* ; spermatheca.

The spermathecae (fig. 6) are three pairs, opening in furrows 5/6, 6/7 and 7/8. The ampulla is a much elongated narrow sac ; the duct is not distinctly marked off, but may be said to be half or two-thirds as long as the ampulla. The diverticulum, tubular, sinuous, with knob-like ental end, enters the extreme ectal end of the duct, and if straightened out would extend beyond the end of the ampulla.

Remarks.—Miss G. E. Pickford recently drew my attention to the remarkable *Pheretima speiseri* Mich. from New Hebrides in which Michaelsen ('13) has described a form A without male pores or prostates (but possessing the anterior male organs), and a form B with male pores and prostates but with reduced spermathecae ; she remarked (*in litt.*) that this looked very like a case of secondary bisexuality,—the hermaphrodite form having differentiated in two directions, so that the form A was losing its male organs (becoming predominantly female), and the form B its female organs (becoming predominantly male). She has herself described ('29) a form C, which is fully hermaphrodite, and is, therefore, to be looked on as the central form from which the others are being separated off.

The present is a parallel case. In 1909 Michaelsen described *Pheretima anomala* from Sibpur near Calcutta, in which, while the testes are actually in larger number than normal, the female characters are disappearing, spermathecae being entirely absent. Though of course there are many earthworms which are normally without spermathecae, it is possible nevertheless that the forms described by Michaelsen function only as males.

In 1925 Gates ('25*a*) described from Rangoon, along with *P. anomala*, certain specimens to which at the time he did not give a specific name (later called *P. insolita*), in which on the contrary certain of the male organs were in a state of regression ; the prostates and accessory prostates (mushroom glands) were absent, there were no copulatory papillae nor visible male pores, and the vas deferens was much attenuated towards its end, dwindling to a very fine thread, exceedingly difficult or sometimes impossible to trace,—indeed it " cannot be traced with certainty to an external pore in any of the dissections." Such specimens can hardly act as males, in view of the absence of visible male pores, and of the fact that a viscid fluid requires a tube to be of a certain calibre if it is to pass along it. They are therefore functional females,—a view which is borne out by the fact that they were only found by Gates ('25*a*) in localities from which *P. anomala* was also obtained.

Gates also found a number of specimens with a single small prostate or a pair, with a single mushroom gland, or with a mushroom gland and a small prostate. Some specimens (type F) had a fully developed pair of prostates, and the normal number of mushroom glands, but lacked the characteristic copulatory papillae of *P. anomala*, possessing instead pores with puckered lips.

This latter condition is that of two out of three of my present specimens. My third specimen, however, had a certain number of copulatory papillae, and thus represents the original hermaphrodite form from which presumably both *insolita* and *anomala* have been derived, the one (*insolita*) by suppression of certain of the male characters, the other (*anomala*) by suppression of certain female characters.

I think it is necessary to unite all the forms here discussed under one species, *Pheretima anomala* Mich. ; the forms lacking spermathecae (possibly functional males), originally described by Michaelsen, will constitute the forma *typica ;* the functional females will be the f. *insolita*

(Gates) ; and the central form from which both the above have diverged, comprising Gates's type F and the specimens described above, may be called *P. anomala* f. *centralis*.

Pheretima elongata (E. Perr.)

Lonton, a small village on the western shore of the Indawgyi Lake, Myitkyina Dist., Upper Burma. B. Chopra. 18-31. x. 26. Seven specimens, mature.

Pheretima houlleti (E. Perr.)

Kamaing, Myitkyina Dist., Upper Burma. B. Chopra. Nov.-Dec., 1926. A number of specimens.

Lonton, a small village on the western shore of the Indawgyi Lake,Myitkyina Dist., Upper Burma. B. Chopra. 18-31. x. 26. Six specimens.

In 1900 Michaelsen united Rosa's *Perichaeta campanulata* with *Pheretima houlleti* under the latter name ; but Gates later ('27) showed that they ought to be kept separate. The present specimens belong rather to the species *houlleti* than to *campanulata ;* I give a few notes on certain features, including those which are diagnostic of the two species.

The longest specimen measures 142 mm. ; the maximum diameter is 3·5 mm. The dorsal and ventral setae of segms. ii-ix are not irregularly placed to any notable extent ; the setae are more closely set dorsally. The ventral setae of segms. ii-ix are larger than usual, and are modified in shape,—not always in the same way ; there is no definite nodulus, and in some there is a fine ornamentation of delicate transverse markings (? each a fine series of points) near the tip. The dorsal and ventral breaks are small and irregular, the average extent of these being $1\frac{1}{2}$ *ab* and $1\frac{1}{2}$ *yz ;* in general the setae are small ; the following numbers were counted :—31/v, 47/ix, 54/xii, 52/xix, and 52 in the middle of the body. The number of setae intervening between the male pores varies from 4 to 12, and the distance apart of the pores from one-fourth to one-third of the circumference.

No penial setae were discoverable.

The testis sacs of each segment, x or xi, are widely separate ; the sacs of xi reach anteriorly to and join septum 10/11, on the anterior side of which are situated the testis sacs of segm. x ; but whether or not there is a connection through the septum between the sacs of xi and x could only be ascertained from a series of sections.

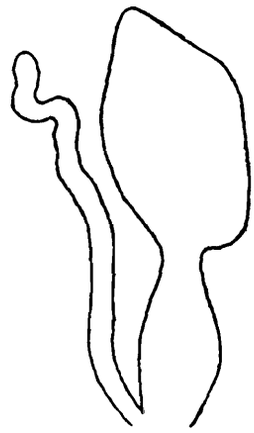
Small white glandular masses (" accessory prostates ") are attached to and open into the copulatory chamber.

The number of spermathecae is variable,—either two or three pairs, or two on one side and three on the other. The windings of the spermathecal diverticulum are somewhat irregular, and are not usually all in the same plane, though they may be so or nearly so. The stalked accessory gland in connection with each spermatheca may be absent,—in one of the two specimens dissected (which had only two pairs of spermathecae) none of the organs was accompanied by a stalked gland.

Pheretima lignicola Steph.

Hopin, Myitkyina Dist., Upper Burma. B. Chopra. 12-13. x. 26. Two specimens, sexual.

Nyaungbin, a village at the north end of the Indawgyi Lake, Myitkyina Dist., Upper Burma. B. Chopra. 7-10. xi. 26. Six specimens, sexual.



TEXT-FIG. 7.—*Pheretima lignicola* ; spermatheca.

The spermathecal diverticulum in the specimen dissected (from Hopin) (fig. 7) is longer and more simply tubular than originally described by me,—just about as long as ampulla and duct together.

Pheretima peguana (Rosa).

Lonton, a small village on the western shore of the Indawgyi Lake, Myitkyina Dist., Upper Burma. B. Chopra. 18-31. x. 26. Three specimens, sexual.

Pheretima planata Gates.

Kamaing, Myitkyina Dist., Upper Burma. B. Chopra. Nov.-Dec., 1926 Numerous specimens, mostly sexually mature.

Loinon, a small village on the western shore of the Indawgyi Lake, Myitkyina Dist., Upper Burma. B. Chopra. 2-5. xi. 26. Numerous specimens, none fully mature (at least none with clitellum).

Nyaungbin, a village at the north end of the Indawgyi Lake, Myitkyina Dist., Upper Burma. B. Chopra. 7-10. xi. 26. Two specimens, sexual.

Lonton, a small village on the western shore of the Indawgyi Lake, Myitkyina Dist., Upper Burma. B. Chopra. 18-31. x. 26. Numerous specimens, sexual.

Genus **Perionyx** E. Perr.

Perionyx excavatus E. Perr.

Nyaungbin, a village at the north end of the Indawgyi Lake, Myitkyina Dist., Upper Burma. B. Chopra. 7-10. xi. 26. Numerous specimens, mostly without or with only slight sexual marks, a few more advanced.

Lonton, a small village on the western shore of the Indawgyi Lake, Myitkyina Dist., Upper Burma. B. Chopra. 18-31. x. 26. Several specimens.

The specimens were of larger size than usual,—those from Nyaungbin up to 125 mm., and those from Lonton up to 175 mm. The limits previously recorded seem to be 23-120 mm.

A single immature specimen of a *Perionyx* was taken at Loinon, on the western shore of the lake, and may quite possibly have belonged to the same species. It was 133 mm. in length ; the male pores were barely indicated, on segm. xx, and the female pore was represented by a slight depression on xvi ; these positions are of course abnormal, but there are in fact large variations in the situation of the genital apertures in *P. excavatus*.

REFERENCES TO LITERATURE.

'25 Gates, G. E. Some new Earthworms from Rangoon, Burma. II. *Ann. Mag. Nat. Hist.*, (9), XVI.

'25*a* Gates, G. E. Some Notes on *Pheretima anomala* Mich., and a related species new to India and Burma. *Ann. Mag. Nat. Hist.*, (9), XV.

'26 Gates, G. E. The Earthworms of Rangoon. *Journ. Burma Research Soc.*, XV.

'26*a* Gates, G. E. Notes on Earthworms from various places in the Province of Burma, with description of two new species. *Rec. Ind. Mus.*, XXVIII.

'27 Gates, G. E. Note on *Perichaeta campanulata* Rosa and *Pheretima houlleti* (E. Perr.). *Ann. Mus. Civ. Stor. Nat. Genova*, LII.

'00 Michaelsen, W Oligochaeta, in Das Tierreich. Berlin.

'09 Michaelsen, W. The Oligochaeta of India, Nepal, Ceylon, Burma, and the Andaman Islands. *Mem. Ind. Mus.*, 1.

'13 Michaelsen, W Die Oligochäten von Neu Caledonien und den benachbarten Inselgruppen. In F. Sarasin and T. Roux, Nova Caledonia, A, Zool., Bd. 1, Heft iii. Wiesbaden.

'24 Michaelsen, W Oligochäten von Niederlandisch-indien. *Treubia*, V.

'29 Pickford, Grace E. On an interesting Earthworm from the New Hebrides. *Ann. Mag. Nat. Hist.*, (10), III.

'12 Stephenson, J. On *Branchiura sowerbyi* Beddard, and on a new species of *Limnodrilus* with distinctive characters. *Trans. Roy. Soc. Edinb.*, XLVIII.

'17 Stephenson, J. Aquatic Oligochaeta from Japan and China, in : Annandale, N. Zoological Results of a Tour in the Far East. *Mem. As. Soc. Bengal*, VI.

'18 Stephenson, J. Aquatic Oligochaeta of the Inle Lake. *Rec. Ind. Mus.*, XIV.

'23 Stephenson, J. Oligochaeta, in Fauna of British India series. London.