OLIGOCHAETA OF THE SIJU CAVE, GARO HILLS, ASSAM.

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(Plate VI.)

The small collection of worms from the Siju Cave comprises only five identifiable species. These are, however, of considerable interest, since four out of the five are new; none of the few worms previously recorded from the Garo Hills (2) were found in the cave.

It cannot be said that the distinctive characters of the several species are in any way related to their peculiar habitat. This is of course scarcely to be expected, since earthworms live in general in conditions which resemble in a great degree those of a cave. All the species were pale in colour, unpigmented, with no difference between the dorsal and ventral surfaces.

Family ENCHYTRAEIDAE.

Genus **Enchytraeus.**

Enchytraeus cavicola, sp. nov.

(Plate VI, figs. 1—4.)

Siju Cave, Garo Hills, Assam; 500 feet from entrance. S. Kemp and B. Chopra, February, 1922. A number of specimens, found in damp bat-guano, of which a fair proportion are mature.

External Characters.—Length of the sexual animals 7–9 mm.; diameter 0·3 mm. Segments 36 in each of two specimens examined. Colour white, without pigmentation; the clitellum more opaque.

Prostomium rounded, hemispherical.

No dorsal pores or head pore.

Setae two per bundle in both dorsal and ventral bundles throughout the body. The setae are of the Enchytraeine type, the shaft being straight (there may be a suspicion of a slight distal curvature in some cases), and the tip bluntly pointed; those in the posterior part of the body are longer and stouter than those of the anterior bundles; thus while the setae in one of the anterior bundles measured 38μ in length and 4μ in thickness, those near the hinder end were 70μ long and 7μ thick.

The clitellum extends over segms. xii–$\frac{1}{2}$xiii (=$1\frac{1}{2}$).

Internal Anatomy.—What I have called postpharyngeal bulbs (4) are present as a pair of rounded knob-like masses of cells behind the pharynx on the dorsal side, with a solid stalk connecting them with the pharyngeal epithelium (figs. 2, 4).

Salivary glands are also present, and in a rather curious form. These structures usually have the form of twisting tubules, the lumen of which discharges into the hinder part of the pharynx. In the present species the tubules (*sal.*, figs. 1, 4) are 20μ in thickness, and twist and curl in segm. iv; a lumen may or may not be visible; these enter in front a median chamber of irregular shape, 36–64μ in height and up to 76μ

in transverse diameter, with walls of varying and sometimes irregular thickness (*ch.*, figs. 1, 2) ; this chamber, situated immediately dorsal to the beginning of the oesophagus, is connected by a solid tract of tissue with an upwardly and backwardly directed recess (*r*) in the hinder part of the dorsal pharyngeal wall.

The septal glands (*s. gl.*, figs. 1, 4) are three pairs, in segms. iv, v and vi ; they are not very bulky.

Some of the coelomic corpuscles (*corp.*, fig. 1) are broadly elliptical, others fusiform in shape. In length they are 24–27μ ; the body is granular, and there is a small dot-like nucleus. They are numerous in the anterior segments as far back as segm. viii, and sometimes are closely packed together in the hindmost segments of the body.

The dorsal vessel arises in segm. xiii.

The nephridia have a relatively large anteseptal portion in which the tube undergoes a few turnings ; the organ is somewhat constricted at the septum, and the postseptal portion is ovoid in shape ; the duct is short and relatively thin, and leaves the end of the postseptal portion at a right angle. The appearance of the nephridia differs, however, even in the same specimen, according to the plane of the section, and perhaps according to the degree of contraction of the particular part of the animal.

The cerebral ganglion in a well extended specimen is shown in fig. 3 ; it is about one and a half times as long as broad, is somewhat indented in front and behind, and its sides are almost parallel.

The testes were no longer visible in the specimens sectioned ; there were sperm morulae and spermatozoa floating freely in segm. xi. The funnels are small and thin,—only 40μ in diameter,—relatively much smaller than in many other Enchytraeids ; they take up a comparatively small part of segment xi, and are 5–6 times as long as broad.

The vas deferens is long, thin (7 μ), and thrown into numerous coils in segm. xii. There is a small compact spherical penial bulb, with definite outline, 50μ in diameter, from the neighbourhood of which muscular fibres radiate upwards to the body-wall.

The ovaries have the usual situation. Ova may be seen extending back to the level of segm. xvi.

The spermathecae are perhaps the most interesting part of the anatomy. These organs are in the Enchytraeidae in general contained in segm. v, and their ducts reach the surface in the intersegmental groove 4/5. In the present species the spermathecal ampullae are situated either in segm. vi or vii, or in vi on one side and vii on the other, and the duct is a long thin tube which passes forwards to reach the surface in the usual position.

The ampulla (*amp.*, fig. 4) is a rather small sac, variable in size, 70–110μ long by 40–78μ in diameter ; its lumen contains, but is not filled by, a round ball of spermatozoa (*spz.*) cemented together by a considerable quantity of colourless and non-staining material ; the wall is thin, the epithelium low and flat, scarcely distinguishable as a separate layer, with nuclei here and there which cause slight projections ; there are a number of much flattened peritoneal nuclei in the outer part of the wall. The ampulla does not communicate with the oesophagus.

The duct (*duct*) is long, thin, cylindrical, 20μ in diameter; it runs forwards, sometimes with an irregular or undulating course, passing close by the side of the oesophagus, through segms. vi and v, and reaches the surface at furrow 4/5. There are no gland cells round the end of the duct.

All the ducts show a dilatation (*dil.*) on their course in segm. vi; each dilatation is about 36μ in diameter, and contains a wisp of spermatozoa. The epithelium of this dilatation is very irregular in height, and the lumen in section is thus somewhat star-shaped. Where the duct leaves the dilatation it is slightly invaginated backwards into the cavity of the dilatation; possibly all the organ ental to and including the dilatation should be considered as ampulla.

Remarks.—The peculiar form of the spermathecae, taken in conjunction with the small and slender male funnels, and the numbers of the setae (two per bundle throughout the body) form a distinctive group of features which will serve to characterize the species.

Family MONILIGASTRIDAE.

Genus **Drawida.**

Drawida troglodytes, sp. nov.

Siju Cave, Garo Hills, Assam; 2,000 feet from entrance. S. Kemp and B. Chopra, February, 1922. Two fragments, apparently belonging to a single animal which had undergone autotomy.

External Characters.—Length 70+25 mm.; diameter 4 mm. Segments 81+54. Colour a dirty grey, with no difference between the dorsal and ventral surfaces; the genital region (segms. ix to xiii or thereabouts) yellow, the genital organs showing through the body-wall. Secondary annulation begins from segm. xiv; the segments for some distance behind this are 4-annular, and then 3-annular as far as into the posterior fragment.

A prostomium is absent, but is simulated by a bulging forwards of the buccal cavity.

There are no dorsal pores.

The nephridiopores are in line with the setae *cd*.

The setae are small and closely paired; the interval *aa* is equal to *bc*, and *dd* is a little less than half the circumference.

The clitellum extends over segms. x-xiii or, at any rate ventrally, x–$\frac{1}{3}$ xiv; but it is not very marked, and its anterior limit is indistinct.

The male pores are situated in groove 10/11 on transversely oval papillae which take up a space equal to the setal interval *bc*, and are bounded in front and behind by well-marked grooves. The pores are to the inner side of the centres of the papillae, and hence are nearer the line *b* than *c*.

The female pores are in groove 11/12, in line with *b*.

The spermathecal pores are in groove 7/8, a little below the line of setae *c*.

There are no other genital markings.

Internal Anatomy.—Septa 5/6–8/9 are thickened, the first three considerably, the last a little less.

There are two well developed gizzards, in segms. xiv and xv ; there is perhaps in addition some strengthening of the muscular coat of the gut in segms. xiii and xvi.

The last heart is in segm. ix.

The excretory system is meganephric.

The testis sacs are contained entirely in segm. x ; they are of moderate size, and somewhat irregularly quadratic in shape. The vas deferens consists of a number of closely apposed loops on the outer side of and below the testis sac, entirely in segm. x ; the ectal portion of the vas runs upwards along the elongated prostate, which it enters at its dorsal (ental) end.

The prostate is of a light brown colour, and of an elongated cylindrical shape ; it is slightly curved round the gut, and joins the body-wall not far from the line of the ventral setae. Its surface is not shaggy or papillose, but still less is it smooth and shining,—it is " glandular " rather than muscular.

A complete ovarian chamber is present. The ovisacs are stoutly cylindrical, and extend backwards through segms. xii and xiii (right), or xii–xiv (by bulging back septum 13/14 on the left side).

The spermathecal ampulla is circular in shape (empty in the single specimen) ; the duct is somewhat, but not very markedly, sinuous, thin and rather difficult to follow towards its end ; it keeps on the posterior side of the septum ; there is no trace of an atrium, and the duct enters the body-wall just below the line of setae *c*.

Remarks.—The worm presents no very remarkable features ; it bears a general resemblance to *D. pellucida* and its varieties. *D. pellucida* is a peregrine species, and it and its varieties have been found in Southern India, Ceylon, and the Abor country. The distinctive characters of the present form are the small number of gizzards and the elongated prostates.

The dissection of the worm is here sufficient to demonstrate, what I have elsewhere shown by microscopical sections (3),—that the prostate is not an independent appendage of the male duct, but is simply the ectal portion of the duct itself, thickened by the growth of muscular and glandular elements.

Family MEGASCOLECIDAE.

Subfamily *MEGASCOLECINAE.*

Genus **Megascolides.**

Megascolides antrophyes, sp. nov.

(Plate VI, figs. 5, 6)

Siju Cave, Garo Hills, Assam ; 2,000 feet from entrance. S. Kemp and B. Chopra, February, 1922. A single specimen.

The specimen was so small that dissection seemed likely to prove a difficult matter, and I had to consider whether it would not be better to section it. However the certainty that penial setae, if present, would be destroyed by sectioning, and the possibility that earth in the alimen-

tary canal might ruin the series, decided me to do my best with dissection.

External Characters.—Length 35 mm. ; diameter 1 mm. Segms. 112 mostly triannular. Colour pale, unpigmented, dorsal and ventral surfaces the same.

Dorsal pores begin in groove 10/11.

The setae are extremely small and difficult to see ; they are largest at the hinder end of the body, where $ab = \frac{2}{5}aa = \frac{1}{2}bc = \frac{4}{5}cd$; at this end of the body *dd* is small, only a quarter of the circumference.

The clitellum extends over $\frac{2}{3}$ xiii—xvii ($= 4\frac{2}{3}$) ; it is smooth, and without indication of the limits of the segment.

The male area (fig. 5) is cup-like, circular in shape with a strongly marked rim, the inner and outer sides of the rim being vertical. The area takes up the whole breadth of the ventral surface of segms. xviii and xix ; anteriorly it is bounded by the hinder margin of the clitellum, and here the rim is wanting ; within, on the floor, are two low transversely oval papillae filling up nearly the whole of the area.

The male pores (♂) appear to be on the anterior part of segm. xviii, near the margin of the clitellum. There is also an appearance of a pair of pores (*p.*) on xix, slightly further apart than the former, with which they seem to be connected by a pair of faintly marked grooves (*g*), somewhat convex towards the middle line. These appearances of pores and grooves must be considered doubtful ; I should have liked to confirm them by sections, but, as I have said, it was scarcely justifiable to section a unique specimen.

The female pore (♀) was indicated by a small faint whitish papilla midventrally situated on the anterior part of segm. xiv.

The spermathecal apertures were indistinct, but appeared to be not far from the middle line in grooves 7/8 and 8/9.

There were no other genital markings.

Internal Anatomy.—The septa from 6/7 to 11/12 are somewhat thickened.

The gizzard, in segm. vi, is relatively large, elongated, cylindrical, with parallel sides. There are two pairs of calciferous glands in segms. xii and xiii ; both are small, with slightly lobulated margins ; those in xiii are stalked, those in xii have a broader base. The intestine begins in xiv.

The last hearts are in segm. xiii.

The excretory system is micronephridial. The organs are small coiled tubes, and are not very numerous ; there are small masses of tubes on each side of the anterior end of the gizzard ; between this and the clitellum there are a few coils, and in some of the clittellar segments there are a few nephridia on each side in a transverse line ; behind the clitellum only one nephridium can be distinguished on each side in each segment,—a small twisted tube in line with the setae *c* ; in the last dozen segments the organs are rather larger, but they are still one pair per segment.

Male funnels were identified as glistening masses in segms. x and xi ; there are no testis sacs. Seminal vesicles appear to be altogether absent.

The prostates are tubular, of relatively great length, extending with a wavy course back to xxix or xxx ; the duct leaves the anterior end of the gland and passes obliquely forwards and inwards through segm. xix to end near the side of the ventral nerve cord in xviii ; the duct is thin, but slightly wider and more shiny near its ectal end.

In the segment behind that in which the prostatic ducts end are a pair of round flat white cushions, close to the middle line and close behind the ends of the prostatic ducts ; these cushions are slightly darker in their centres. They apparently correspond to the posterior of the two flat papillae within the male area, and the darker centres are represented on the surface by the pore-like dots previously described ; but whether there really are any apertures is, I think, doubtful. The vasa deferentia I think I can trace backwards to join the prostates at their ends in segm. xviii.

I could discover no penial setae.

There are two pairs of spermathecae, which lie in segms. vii and viii. The ampulla is a relatively large ovoid sac ; the duct is half as long and at its upper part one-third as thick as the ampulla, but it diminishes in diameter towards its outlet ; a single diverticulum is given off from the upper part or from the middle of the duct,—a long, narrow, cylindrical tube, somewhat wavy, reaching when straightened out as far as the ental end of the ampulla (fig. 6).

Remarks.—The present species does not appear to be closely related to any other Indian form. The genus is not common in India, but it is widely spread ; geographically, the nearest record to the present is British Sikkim (E. Himalayas).

Subfamily *DIPLOCARDIINAE.*

Genus **Dichogaster.**

Dichogaster bolaui (Mich.)

Siju Cave, Garo Hills, Assam ; 450-500 feet from entrance. S. Kemp and B. Chopra, February, 1922. A number of specimens.

The same, 500 feet from entrance. Six specimens, four of them small and immature.

The same, 350 feet from entrance. Three specimens.

A number of mature and well preserved specimens gave me the opportunity of examining the anatomy of this species both by dissections and microscopic sections.

One batch (the first) consisted of worms of an average length of 50 mm. and of a diameter of $1\frac{1}{4}$—2 mm. They were thus considerably larger than the usual run of the species (Michaelsen in the Tierreich (1) gives the dimensions as 20–40 mm. in length and $1\frac{1}{3}$–$1\frac{1}{2}$ mm. in diameter).

In two dissections I placed the gizzards, once in segms. vi and vii, and once in segms. vii and viii. But two series of longitudinal sections showed that they are really in vi and vii ; certain of the septa—7/8, 8/9 and 9/10—are very close together, and very thin, and this, joined to the very small size of the worms, renders it impossible to be certain

of the disposition from dissection alone. Indeed the condition may not be immediately clear even from sections; septum 9/10 is inserted into the body-wall, over a considerable part of its periphery, along with 10/11, which is liable to cause confusion; again, in one series one of the septa was missing on the dorsal side, so that in a dissection it would have been possible—counting from behind, where (in the genital region) the numbering of the segments is easily determinable—to interpret the gizzards as being in vii and viii.

In one of the dissections the gizzards seemed scarcely separate, being demarcated neither by a softer intervening ring nor by a constriction; nor was there a septum between the two. In the sections, however, a thinner ring could be distinguished; and, while there was no complete septum 6/7, there appeared to be a few remnants of it attached to the interval between the two gizzards.

The seminal vesicles are very variable, but always small. In one specimen I found them on both sides in both xi and xii; while in another (sectioned) specimen they were quite rudimentary in x (attached to the anterior face of septum 10/11) and xii, and somewhat larger in xi (on the posterior face of 10/11); those in x and xii would certainly not have been visible in a dissection.

Family LUMBRICIDAE.

Subfamily *MICROCHAETINAE.*

Genus **Glyphidrilus.**

Glyphidrilus spelaeotes, sp. nov.

Siju Cave, Garo Hills, Assam; 2,000 feet from entrance. S. Kemp and B. Chopra, February, 1922. Seven complete or fairly complete specimens and a few fragments; only one specimen with signs of maturity.

The same; 3,000 feet from entrance. Two specimens, one mature, both incomplete posteriorly.

From the condition of the specimens the animals would appear to undergo autotomy on handling or preservation.

External Characters.—Length 175 mm.; diameter 2–3 mm.; they are thus long thin worms. Segments of a complete but non-sexual worm 310, the last score or two very short. Colour pale, or light brownish grey, the same on both dorsal and ventral surfaces. Secondary annulation in the preclitellar segments; there may be as many as six secondary annuli per segment, and even eight may be indicated. The body is four-sided behind the wings; the dorsal surface is grooved, the groove becoming more marked towards the hinder end of the body; the ventral or the lateral surfaces may also be grooved. The anus is dorsal, a pear-shaped opening with the narrow pointed end anterior and the hinder margin rounded.

The prostomium is prominent, zygolobous and bluntly triangular.

There are no dorsal pores.

The setae are paired, but rather widely so, especially the lateral. In front of the wings $ab = \frac{1}{2}\,aa = \frac{2}{5}\,bc = \frac{4}{5}\,cd$, and $dda = 1\frac{1}{3}\,a$; a little

behind the wings $ab = \frac{2}{5}\ aa = \frac{1}{3}\ bc = \frac{4}{5}\ cd$, while *dd* is greater than *aa* and about equal to 3*cd*; towards the hinder end the ratios are the same except that *dd* is relatively greater and *aa* is equal to or even greater than *bc*, while there may be no perceptible difference between *ab* and *cd*. The setal couples behind the wings are situated along the angles of the body. The setae are prominent in the hinder part of the body,—indeed they are so everywhere except in the anterior 20 or 30 segments; examined microscopically they are seen to be ornamented with a few fine transverse lines near the tip.

The clitellum, in the only specimen in which it is distinguishable, extends over segms. xvi–xxx, and in addition xiv and xv are slightly altered; but the modification is nowhere very great, and is mainly evidenced by the loss of the secondary annulation.

The wings are attached between the line of the dorsal and that of the ventral setal couples, and extend from xviii or xix to xxiv or $\frac{1}{2}$ xxv; they are bent downwards and inwards, and on segm. xviii they are, if present, less prominent than in the rest of their extent. This portion,—*i.e.*, that on xviii,—is discontinuous from the rest, being cut off by an incision.

There are several series of circular papillae, each with a central depression from which rises a small round mamillary projection. The papillae are placed on the hinder part of the segments on which they occur; their diameter is equal to two-thirds of the length of the segment, so that the anterior quarter or third of the segment is not encroached on by the papillae. In the only two specimens that show them, their distribution varies so much that it is necessary to describe them separately in each.

In the first of the two specimens there are (*a*) a midventral papilla on segm. xi; (*b*) a submedian series, with their centres internal to the line of setae *a*, paired and touching in the middle line in segms. xix and xxvii, single and on the right side only on xxviii; (*c*) a pair with their centres immediately outside the line of setae *b*, on segm. xxv; (*d*) a dorso-lateral series, between the lines of *c* and *d*, paired on xiv and xvi, single, small and on the left side on xv.

In the second specimen there were (*a*) midventral papillae on segms. xvii and xviii; (*b*) a pair a little above the line of setae *b* on segm. xxv; (*c*) a pair midway between the lines of *b* and *c* on segm. xvii.

In addition there was, in the first specimen, a median dorsal series of a different kind; these were circular, slightly raised, without depression or mamillary projection in the centre, situated over the middle of the segment (not over its hinder part), and taking up nearly the whole length of the segment; these occur on segms. xviii to xxviii and perhaps slightly on xxix. They are not to be seen in the second specimen.

I could not discover the genital apertures.

Internal Anatomy.—No septa are notably thickened; mostly they are very tenuous, and indeed are scarcely perceptible behind 12/13; 8/9 is perhaps the most thickened, and all from 5/6 to 12/13 seem a little stronger than those behind,—they are at any rate visible without difficulty.

The gizzard occupies segm. viii and the hinder part of vii ; it is rather soft, in shape square in front, cylindrical but narrowing a little at the hinder end. The intestine begins suddenly in segm. xv.

There are four pairs of hearts, in viii–xi.

The excretory system is meganephric. No nephridia are distinguishable in the first eleven segments, and they are very small in xii and small in xiii ; thenceforward they appear as considerable twisted tubes as far as segm. xxx, after which they become larger and form flattish opaque lobed masses which cover nearly all the body-wall except a middorsal streak and the midventral region between the lines of the setae *a* ; *i.e.*, they cover the inside of the body-wall from the line *a* to above *d*.

The male funnels are free in segms. x and xi. There are four pairs of seminal vesicles, in segms. ix–xii, of moderate size, those in xii being the largest ; they are all slightly lobed, those in xii most so.

The ovaries are in segms. xiii. There are perhaps ovisacs in xiv.

The spermathecae are small ovoid sacs disposed with their long axes longitudinal, without distinguishable duct and therefore sessile on the body-wall. They are arranged in three transverse rows on each side, with five (once four) in each row, over grooves 13/14, 14/15 and 15/16 ; in each row the organs are placed in line with the setae *a*, *b*, *c*, and *d*, and one of the five is between the lines *b* and *c*.

No prostates were seen.

Remarks.—The present species is related, as shown by the extent of the clitellum and of the wings, to the species already known from Burma and from Bengal and Orissa (*G. papillatus* and *tuberosus*) ; in *G. annandalei* from S. India both clitellum and wings extend considerably further back.

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