# DESCRIPTIONS OF INDIAN OLIGOCHAETA.

## II.

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### Introduction.

The greater part of the present paper consists of a description of a collection of Oligochaete worms from Burma, sent to me by Prof. Gates of Rangoon. I had previously received a number of worms from him, of which, along with others from various parts of the world, an account

is given in a recent paper (Stephenson, '31) ; had I known that the present collection was to follow so soon, I should have described all these Burmese worms together.

The present worms, like those previously received, are all of small size,—only one to two mm. in diameter ; nevertheless, the principal mode of investigation must be by dissection, not by sectioning ; naturally, worms gathered under such circumstances as these have not had the gut cleaned, and the contained earth, more often than not, both tears the sections to pieces when they are being cut, and ruins the knife. Moreover, the identification in a number of genera depends largely on the characters of the penial setae, which are entirely broken up and unrecognizable in sections. I did, however, get passable sections of *Ramiella cultrifera*, which were a useful supplement to the dissection of this diminutive worm. The Enchytraeid is of course in a different category,—its anatomy is described almost wholly from sections.

Only five species of Enchytraeids have hitherto been made known from the Indian region (I exclude Beddard's "*Henlea*" *lefroyi*, and, with Michaelsen, unite my *Fridericia carmichaeli* with *F bulbosa*). This is a striking contrast to the north temperate and arctic regions, where Enchytraeids are so extraordinarily numerous. *Enchytraeus rangoonensis* forms an addition to this small company.

The representative of the genus *Plutellus* is the first to be recorded from Burma. The distribution of the genus appears not very unlike that of *Drawida*, consisting of one area in S. India (including one species in Ceylon), and another round the head of the Bay of Bengal (Darjeeling District, the Abor country in Assam, and now Burma—the new locality being about 350 miles south of the Abor country).

Endemic species of *Perionyx* are already known from several places in Burma (Akyab, Inle Lake, Pyapon Dist.). *P. ditheca* from Thandaung, about 160 miles north of Rangoon, on the Shan Plateau but not in the Shan States, therefore does not extend the known range of the genus.

The genus *Ramiella* has a very scattered distribution ; the four species which were first known occupy stations on a slightly curved line which extends from north to south, Saharanpur to Coorg, through the western part of India. Two Burmese species are now known ; the one which is described in the present paper comes from two localities 500 miles apart.

The genus *Eudichogaster* appears not to have hitherto been recorded from within the political limits of Burma. Of the two species recorded below, *E. chittagongensis*, previously known from Rangamati, now appears as a peregrine form which has spread widely in Burma,—in the Chindwin Valley, in the Moulmein District, Rangoon, and Shwegyin (nearly 100 miles north of Rangoon) ; while *E. yeicus*, described for the first time, is, so far as is yet known, confined to the Moulmein District. Here again, therefore, the known limits of the genus are extended.

Small peregrine species of *Dichogaster* appear to be common throughout Burma :—*D. bolaui ; D. curgensis* (previously described from Coorg by Michaelsen, '21, and now found to be represented by a variety at Kutkai and Lashio in the Shan States) ; *D. modiglianii* ; *D. saliens ; D. sinuosus*, in a minor degree peregrine, being found in several places in the Shan

States, or at any rate on the Shan plateau (Thandaung, though not in the Shan States, being on the plateau). The last-mentioned worm is related to *D. floresiana* and *D. affinis*, both (especially *D. affinis*) widely spread.

In a recent letter Prof. Gates, who had previously ('30) expressed the opinion that my *Pheretima lignicola* might be identical with Beddard's *Amyntas alexandri*, suggested to me that if Beddard's type was in the British Museum I should examine it and so settle the point. The unique example of *P. alexandri* is in fact in the museum, and I have carried out Prof. Gates's suggestion. Since Beddard's account is incomplete in certain respects I give below a full description, from which it will be seen that there is no doubt whatever of the identity of the two worms. The name *Pheretima lignicola* Steph. is therefore to be replaced by *P. alexandri* (Bedd.).

Prof. Gates also thinks that Beddard's original specimen of *Perionyx m'intoshi* (from Akyab in Burma ; Beddard, '83) cannot safely be identified with the worms from India which he (Beddard) later ('92) called by the same name, since the Akyab specimen was immature and moreover differed from them in certain features. Beddard's account of these later worms is particularly brief and unsatisfying, and it is difficult to understand, being mixed up with descriptions of several other species and proceeding largely by means of a comparison with *P. intermedius* ; even the locality is not certain, for while, in the paper itself (Beddard, '92) they appear to be from Seebpore (Sibpur), in his Monograph (Beddard, '95) Beddard speaks of them as being from either Seebpore or Darjeeling, the uncertainty being due to his having mislaid his notes.

In the descriptions of the Akyab and Seebpore (?) worms, however, there seems to me to be nothing *against* the identification of the two (except, naturally, the incompleteness of the accounts). The differences concern :—

(i) The male area,—sucker-like and sunk below the general level in the Seebpore specimens, not depressed in the worm from Akyab. The depression is probably due to retraction by muscular bands, and would be less or absent in a worm which was not (as the Akyab specimen) fully mature.

(ii) For " testes " in the account of the first worm (Akyab) written in 1883, we must now read " seminal vesicles " ; these are said to be in xi and xii, each united to its fellow (across the middle line). The " sperm-sacs " (seminal vesicles) of the second batch (Seebpore) are said to be in x-xii, but this is a mistake (see my examination of one of these specimens *post.*), —they are here also in xi and xii (though not conjoined in the middle line).

(iii) The prostates in the first worm are large, the " atria " of the second are limited to a single segment. This is scarcely a contradiction ; in the specimen of the second batch which I have examined the prostates are at least of moderate size, and though limited to segm. xviii cause the septa in front of and behind it to bulge away from each other.

(iv) The Akyab specimen is longer (15 inches, or 370 mm.) than the others (249 and 320 mm.), but this degree of difference might easily fall within the limits of individual variability.

Unfortunately the first specimen, that from Akyab, to which the name *Perionyx m'intoshi* was first given, does not seem to have been preserved,—at least it is not in the British Museum. The second batch, from Seebpore (or Darjeeling ?), consisted, as far as can be inferred (*cf.* the footnote in Beddard, '92, p. 689) of two specimens, of which one only is in the Museum, and this has been mutilated in the male genital area (xviii and neighbouring segments). Seeing that Beddard's description is very incomplete, I give in the body of the paper an account of the anatomy of this example, as far as it can now be determined.

As to the question of nomenclature, Gates suggests to me that *Perionyx m'intoshi* should be regarded as an invalid species, and a new name given to the (Seebpore or Darjeeling) worms which differ from them. Beddard, however, who had had both worms under examination, thought they were the same, though he certainly admitted the contrary possibility ; and as said above I cannot find any definite point of difference. Indeed the shape of the spermathecal duct (no diverticulum, but a bulging on one side of the duct, (compare Beddard, '83, pl. viii, fig. 8 with fig. 6 in the present paper), and the description of the prostates, which consist in the Akyab worm of a number of small lobules, while in the specimen described below they are cut up on the surface into small lobules so as to preset almost a shaggy appearance, give some positive ground for supposing that they are really identical.

Specimens of all, and the types of the new species here described, are in the British Museum (Natural History), to the authorities of which my best thanks are due for the facilities kindly accorded me.

The following notes may be of use regarding the locality of some of the smaller places referred to :—

In the Chindwin Valley, above Monywa and below Homalin (not very far from the Assam border),

Paungbyin or Poungbyin (highest up the valley).
Kalewa.
Kindat.
Masein.
Mawlaik.

In the Northern Shan States, along the Mandalay-Lashio railway line or to the north of it,

Lashio.
Maymyo.
Kyaukme.
Kutkai.
Namkham.

In the Moulmein District (the word " District " is used in its technical sense as an administrative area),

Chaungson.
Kya-In.
Ye.

In the Mergui District,

Mergui.
Labaw.

In the Sandoway District,

Sandoway.

In the Toungoo District,

Thandaung, on the Shan plateau but not in the Shan States, about 160 miles N. of Rangoon.

Lastly Shwegyin and Nyaunglebin are not far from each other, about 100 miles north-east of Rangoon.

## SYSTEMATIC.

### Family ENCHYTRAEIDAE.

### Genus **Enchytraeus** Henle em. Mich.

### **Enchytraeus rangoonensis,** sp. n.

Rangoon; in tube along with *Dichogaster bolaui*, *Eudichogaster chittagongensis*, and *Ramiella cultrifera*. Five specimens, three with signs of sexual maturity.

The worms are very small ; length 5 mm. ; diameter 0·3 mm. Segments 35, 34, 31, 24+ (injured), 24.

The prostomium is blunt and rounded. There is a large head-pore on the prostomium, but dorsal pores are absent.

The setae are enchytraeine in form, regularly two per bundle throughout the body, larger at the hind than at the front end.

The clitellum embraces segment xii and nearly half of xiii ; it stops just in front of the setal zone of xiii (confirmed also in sections).

Sections show segmentally arranged bands of gland cells in the epidermis at the level of the setal bundles ; in tangential sections, which remove only a thin superficial slice of the body-wall, the whole of the nuclei of the surface epithelium are seen to be much elongated transversely, and arranged in a succession of transverse rings.

The coelomic corpuscles are apparently in part metamorphosed into a coagulum, which is present in some amount in the body-cavity. Individual corpuscles can however be recognized of an average length of about 24μ, and oval or fusiform in shape ; no normal, scarcely any distinctly recognizable, nuclei are to be seen within the corpuscles, but what appear to be traces of degenerate nuclei are visible both within the corpuscles and in the coagulum.

Septal glands occupy segments iv, v and vi. Salivary glands are present as small, quite short, twisted tubes, immediately behind the pharynx, occupying only a part—not the whole length —of segment iv ; they present a number of dilatations, and so are of very irregular diameter ; they are branched, and their walls show few nuclei.

There are no oesophageal pouches. There is a moderate and fairly sudden dilatation of the oesophagus to form the intestine in segment x ; this division of the two portions of the alimentary tract is quite distinct

in most of the specimens ; in one of the sectioned worms, however, it is less so. There are no " chyle cells " (cells with intracellular canaliculi) in the intestine.

The dorsal vessel begins in the clitellar region, in segment xiii.

The preseptal portion of the nephridia, as seen in sections of the anterior region of the body, is of some size, two-thirds or three-quarters as long as the postseptal, but not so high (dorso-ventrally, in sagittal sections) ; the lumen undergoes a number of windings in this portion of the organ. A very narrow neck passes through the septum. The postseptal portion gives off the duct from its lower surface some little distance in front of the hinder end ; the duct goes at first rather backwards, sometimes markedly so, then bends downwards and sometimes slightly forwards.

Sperm morulae and ripening spermatozoa are present in segment xi. The male funnels (fig. 1) are small, 60μ in diameter at their widest

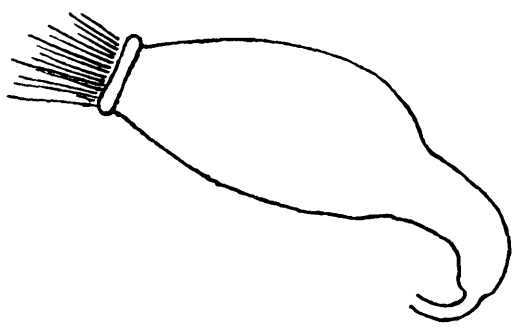

FIG. 1. *Enchytraeus rangoonensis ;* male funnel, semi-diagrammatic.

part, and three times as long as wide. The anterior end, 33μ in diameter, is formed by a thickned rim or collar ; the main portion of the funnel consists of two layers ; the inner layer, which lines the central lumen, consisting of low quadratic cells, the external of much elongated gland cells, of a more spongy texture, with nuclei near their outer ends. The posterior third of the funnel is much narrower than the rest, only 25μ in diameter, and consists of only one kind of cells, the gland cells.

The narrow vas deferens, only 7μ in diameter, forms a small close coil in the anterior part of segment xii. Its ectal end is thickened and surrounded by a few gland cells, some of which form a special defined aggregate on its inner side. There are no other masses of gland cells round the male aperture, and no penial body.

The ova may get forwards into segments xi, x and ix, and backwards into xv. The opening of the oviduct on the surface is well seen in sections, sagittal and tangential, though how the huge ova get out through such a small aperature is not evident ; the oviduct, too, appears as merely a short and narrow cord of connective tissue and cells, with no visible lumen.

The spermathecae are remarkable. The ampullae (?) are small rounded sacs in segment v, 44 by 52μ in diameter, the longer diameter being (? always) transverse, the shorter antero-posterior ; their epithelium is low and irregular ; there is no patent communication with the alimentary canal, but these chambers lie close against the oesophagus and there may be a continuity of tissue between them ; occasionally there may be spermatozoa in this portion of the apparatus and its ental

extension (*v. inf.*). The duct, 20μ in diameter, is a very regular narrow cylindrical tube, which with one or two bends in its course leads forwards, becoming rather narrower towards the body-wall and ending on the surface in furrow 4/5 ; it has a cubical epithelium, muscular coat, and peritoneal covering ; there are no gland cells round its termination.

The ental extension of the spermathecal apparatus, alluded to above, is tubular in form, of some length, and passes from the dilatation (called the ampulla above) backwards into segment vi or forwards into iv. Its course is irregular, and its diameter also (20-30μ) ; it does not branch, and ends internally in a dilated portion, which however is elongated, irregular and indefinite in form, not a simple ovoid chamber. These structures gave me considerable trouble before I understood them ; they are scarcely visible in specimens mounted whole, and it is difficult at first to follow out narrow tubular structures, such as these, which wind irregularly, in serial sections ; for a long time I confused them with the salivary glands. The ental extension may perhaps represent a diverticulum ; or possibly the whole of the apparatus except the duct,—the ental extension as well as what I have called the ampulla, should be considered as the ampulla.

No copulatory glands (Bauchmarkdrüsen) were seen.

## Family MONILIGASTRIDAE.

### Subfamily *MONILIGASTRINAE.*

#### Genus **Drawida** Mich.

#### **Drawida vulgaris** Gates.

Prof. Gates kindly sent me four sexually mature specimens of his recently described *Drawida vulgaris* (Gates, '30), from Kalewa, Burma. I will only note that, while Prof. Gates considers the male pore to be at the tip of the flap which projects on each side from the posterior margin of segment x, I (examining the specimens before I had received his description) supposed the pores to be in furrow 10/11, bounded in front by a much swollen and " glandular " anterior lip (*i.e.*, the " flap ") and behind by an inconspicuous posterior lip.

There is a slight slip in Gates's description of the testis sacs ; these are, as usual, suspended by septum 9/10, not 10/11, and project into segments ix and x.

## Family MEGASCOLECIDAE.

### Subfamily *MEGASCOLECINAE.*

#### Genus **Plutellus** E. Perrier.

#### **Plutellus inflexus,** sp. n.

Kalewa. A number of specimens.

*External Characters.*—The preserved specimens show in general a rather characteristic hooking of the anterior end, the middle of the bend being in the clitellum, so that this region cannot be straightened out.

Length 40-55 mm. ; diameter usually about 1·5 mm., with perhaps a maximum of 2 mm. Colour a rather pale pinkish grey, flesh-coloured ; the anterior end may be a darker grey, the clitellum a fairly light brown to deep purple. Segments (of the longest specimen) 150.

The prostomium is slightly epilobous, coming to a blunt angle behind, whence a faint longitudinal groove is continued back half-way through segment i ; this segment is of some length, longer than segment ii, from which it is well marked off.

Dorsal pores begin in furrow 7/8.

The setae are paired, the lateral less closely than the ventral ; in the middle of the body $aa=4ab=1\frac{1}{4}bc$, while *cd* is nearly twice *ab* ; behind the clitellum $aa=1\frac{1}{3}bc$, while *cd* is quite twice *ab* ; these latter ratios hold also in front of the clitellum ; *dd* is equal to half the circumference throughout the body.

The clitellum is saddle-shaped, coming down on each side to just above the line of setae *b*, and extends over segments xiii-xix (=7) ; it varies in colour as described above.

The male pores are on xviii, on small indefinite papillae, the middle of the papilla being in line with seta *a*.

The female pores are on xiv, on a slightly elevated transverse area which takes up the whole length of the segment and extends across the mid-ventral interval unoccupied by the clitellum ; the apertures are minute, just in front of setae *a*.

The spermathecal apertures were not seen externally ; from internal dissection they are four pairs, opening in furrows 5/6—8/9 in line with the ventral setae.

Genital markings are present as median papillae, transversely oval in shape, in furrows 11/12 and 12/13, extending over the intersetal interval *aa* ; that in 11/12, or both, may be wanting.

*Internal Anatomy.*—Septum 5/6 is somewhat thickened, 6/7, 7/8 and 8/9 considerably and 9/10 moderately so, 10/11 is somewhat strengthened, 11/12 slightly so, 12/13 scarcely at all.

There is a square, moderately firm gizzard in segment v. The oesophagus is very vascular, with transverse blood-channels in its wall, in

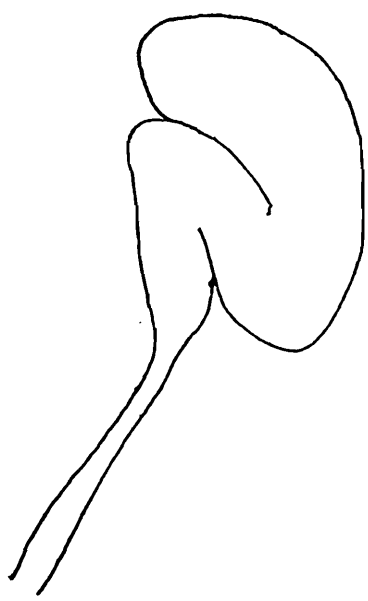

FIG. 2. *Plutellus inflexus* ; prostate.

segments ix-xii (most markedly so in xi-xii), but there are no set-off calciferous glands. The intestine swells out in xiv.

The last hearts are in segment xii.

The excretory system is meganephridial.

The testes and funnels are free in segments x and xi. Seminal vesicles are present in xi and xii as small lobed masses.

The prostates (fig. 2) are compact-looking structures, but are really tubular, the glandular part being folded on itself so that the apposed loops appear at first to be a compact mass. The duct is quite straight, runs inwards and slightly forwards, is shiny and of moderate length, with the ectal portion broader than the ental.

The relatively large ovaries and their funnels are in xiii. Ovisacs are present in xiv.

The spermathecae (fig. 3) are four pairs, in segments vi-ix ; the ampulla is an ovoid sac of regular shape ; a duct can scarcely be described,

FIG. 3. *Plutellus inflexus ;* spermatheca.

since the sac merely narrows somewhat towards its attachment to the body-wall. A single short diverticulum, one-third as long as the ampulla, rather club-shaped, is attached near the junction of the sac with the body-wall.

The penial setae (fig. 4) are 0·4—0·45 mm. in length, nearly 4μ thick at the middle of the shaft, and 5μ near the proximal end. The greater

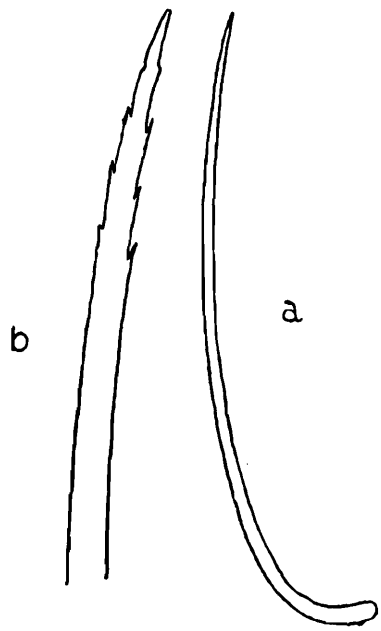


FIG. 4. *Plutellus inflexus ;* penial seta ; *a.* whole seta, ×160 ; *b.* distal end, ×1000.

portion of the shaft, including the distal end, is only slightly bowed, but the proximal end is considerably curved. The distal end tapers gently, and the tip is pointed ; just above the tip there are a few—about half a dozen—fairly conspicuous spines.

## Genus **Pheretima** Kinb.

### **Pheretima alexandri** (Bedd.).

British Museum Collection. A single specimen (type) ; locality given as " India."

*External Characters.*—For the reasons that have led me to describe this specimen see the Introduction.

Length 148 mm. ; diameter 5 mm. Colour pale, ochraceous ; no apparent difference between dorsal and ventral surfaces. Segments 130 ; setal zones in some of the preclitellar segments elevated, but no definite secondary annulation.

Mouth large, terminal, buccal mucous membrane protruding ; no prostomium distinguishable, but a number of longitudinal grooves radiate from the margin of the mouth almost as far as the hinder border of segment i ; the prostomium may be the area enclosed between the dorsal-most couple of these grooves, but there is no anteriorly projecting lobe overhanging the mouth.

Dorsal pores from furrow 12/13.

The setae are in rings ; the dorsal break is very slight (*zz*=ca. $1\frac{1}{4}$ *yz*), and the ventral break in front of the clitellum is somewhat irregular but always small,—largest in the most anterior segments ; behind the clitellum the ventral break is either very small and irregular or altogether indistinguishable. The setae are largest at the two ends of the body, especially at the anterior ; they are not markedly closer set dorsally or ventrally. The following numbers were counted :—33/v, 44/ix, 50/xii, 62/xix, and 60 in the middle of the body.

The clitellum extends over segments xiv-xvi (=3) ; it is smooth, but the position of the dorsal pores is indicated, though they are not pervious ; there is a faint indication of the position of the setae ventrally on xiv.

The male apertures, on xviii, are small but easily visible, in the centre of large circular papillae, which extend on to xvii and xix—almost to the setal zone of xix, but not quite so far on xvii ; each papilla is slightly depressed in the centre, and is crossed transversely by a couple of grooves, one in front of and one behind the male pore ; of these the posterior groove on each side is much the better marked,—both longer and deeper than the anterior. The anterior border of the papilla is more sharply delimited than the rest of its extent. The pores are about two-sevenths of the circumference apart ; twelve setae intervene.

The female pore is single, on xiv, in a small sub-circular area in the setal zone.

The spermathecal apertures are not visible externally.

There are no other genital markings.

*Internal Anatomy.*—Septum 4/5 is somewhat strengthened, 5/6 considerably so, 6/7 is much thickened and 7/8 most of all ; 8/9 and 9/10 are absent, 10/11 is somewhat thickened, 11/12 and one or two more slightly and diminishingly so.

The gizzard, behind septum 7/8, is large, firm, shortly cylindrical, narrowing slightly at its anterior end. Just behind the gizzard is a collar surrounding the alimentary tube, doubtless, as in the specimens which I called *P. lignicola* (Stephenson, '16), composed of blood-glands (in the paper just referred to " behind the pharynx " (on p. 335) should read " behind the gizzard "). The intestinal caeca, originating in xxvii and extending forward to xxii, are slender and smooth.

The last hearts are in xiii.

The micronephridia are extremely numerous and small.

The anterior pair of testis sacs are sessile on the interior surface of septum 10/11 ; the posterior pair are large, taking up the whole length of segment xi, enclosing the seminal vesicles and hearts of the segment, and uniting in the middle line dorsally beneath the dorsal vessel. The posterior seminal vesicles, in xii, are rather small, smooth and only very slightly lobed.

The prostates are large, extending through segments xvii-xx, and much cut up into lobes. The duct, at first relatively thin and soft, becomes firmer, thicker, and shining ; it has an irregular twisted course, but its main part forms a considerable loop, directed forwards ; the ectal limb of the loop is uniformaly thick, more than twice as thick as the initial part of the duct.

The ovaries and funnels are in xiii ; there are no ovisacs.

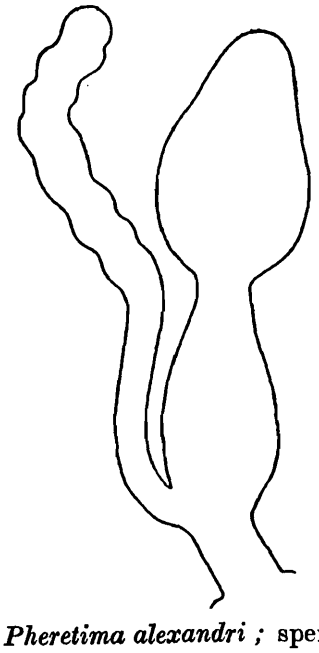

FIG. 5. *Pheretima alexandri ;* spermatheca.

The spermathecae (fig. 5) are four pairs, discharging in furrows 5/6-8/9. The ampulla is of a flattened oval or inverted pear shape. The duct, rather longer than the ampulla, narrower entally, widening below, is muscular and shining ; the terminal portion, where it is about to enter the body-wall, is when fully displayed in dissection a little softer and less shining than the rest, rather narrower again, and set at a small angle to the rest of the duct. The widest part of the duct is two-thirds as broad as the ampulla or more,—it may be fully as broad ; the ratio depends on the width of the ampulla, which is variable. The diverticulum is single,

elongated, tubular, extending as far as or even some distance beyond the end of the ampulla ; it is given off near the junction of the duct with the body-wall, at the slight bend in the course of the duct ; its ectal portion is smooth and shining, the ental portion being rather wider, and somewhat moniliform.

*Remarks.*—The specimen is said by Beddard ('00) to have been sent to him from Kew Gardens (near London), having been imported from the neighbourhood of Calcutta. Beddard did not count the setae (except on segment ii), since he was unwilling, as he says, to injure his only specimen ; counting the setae should hardly, I think, be a very dangerous process. The only septum stated by Beddard to be absent is 8/9 ; 9/10, however, is also wanting. I had considered the presence of 9/10 in *P. alexandri* and its absence in my *P. lignicola* as one of the distinctions between them. Moreover, in saying that " the sperm sacs (*i.e.*, the seminal vesicles) in xi and xii are not in any way remarkable," Beddard overlooks the fact that the vesicles of xi are contained within the testis sacs of that segment. My statement (in the " Fauna of British India " volume, Stephenson, '23) that the prostatic duct forms a simple loop and is of equal diameter throughout, was an inference from Beddard's figure ; it is not borne out by my examination of the specimen.

## Genus **Perionyx** E. Perrier.

### **Perionyx m'intoshi** Bedd.

British Museum Collection. A single specimen, labelled " *Perionyx macintoshii*—India." From the measurements it is evidently the specimen referred to in the footnote in Beddard's paper, '92, p. 689. The whole worm is softened ; the ventral body-wall has been removed over segments xvii-xx, *i.e.*, the male field and its immediate neighbourhood (cut out, presumably for microscopic examination) ; the hinder end has been opened for the last 15 mm., and the corresponding part of the intestine removed. Beddard had left the organs of the right side comparatively undisturbed, and I also have interfered with them as little as possible.

*External Characters.*—Length 325 mm. ; diameter *ca.* 8 mm. Colour rusty, a light reddish-brown. Segments *ca.* 240 ; no secondary annulation apparent.

Prostomium very slightly and very faintly epilobous, almost prolobous ; the transverse groove in front of the very short tongue, behind the projecting lobe of the prostomium, is shallow and ill-marked.

Dorsal pores from furrow 5/6.

The setae are very small relatively to the size of the worm, and are very difficult to count,—*ca.* 78/v, *ca.* 87/ix, *ca.* 83/xii (this number is very doubtful), *ca.* 86/xxii, and 90-95 in the middle of the body. The ventral break is indistinguishable ; the dorsal break is small in the posterior region (on the average *ca.* 2*yz*, but irregular), while anteriorly it is very small or absent. The setae are closer set ventrally than dorsally.

The clitellum is not very well marked, and its limits are not sharply defined ; it embraces segments xiii-xx (=8) ; though Beddard gives its extent as xiii-xix, there can scarcely be any doubt that in this specimen

an additional segment is included. Intersegmental furrows are present and even well marked in the anterior part of the region, though there is some smoothing out, especially over segments xvi-xx.

The body-wall has been removed in the male area, so that the characters of the male field cannot be given. The female pore is conspicuous, mid-ventrally situated on xiv, between the setal zone and the anterior margin of the segment. The spermathecal pores are inconspicuous, in furrows 7/8 and 8/9, very close to the middle line.

*Internal Anatomy.*—Septum 4/5 is present, thin ; 5/6 is thin, 6/7 slightly and 7/8 moderately thickened ; succeeding septa are somewhat thickened, the thickening decreasing but slightly perceptible even as far back as segment xx.

The gizzard is in vi, of moderate size but soft.

The last hearts are in segment xiii.

The testes, which are bushy, and funnels are free in segments x and xi. The seminal vesicles (called " testes " by Beddard, '83), situated in xi and xii (none in x), are of moderate size, lobed, and then further divided up on the surface into minute lobules, so that they have a granular appearance.

The prostates are of moderate size, lobed and lobulated, so that the appearance is almost shaggy ; they are confined to segment xviii, causing the septa which limit the segment to bulge apart. The duct leaves the middle of the inner surface of the gland, but most of it on one side, and all on the other, has been cut away with the ventral body-wall ; the small portion which is left on one side is soft and narrow ; it appears to have been directed straight inwards. The terminal portion of the vas deferens is almost as thick as the prostatic duct.

The ovaries are in xiii ; the funnels were not distinguishable. There are no ovisacs.

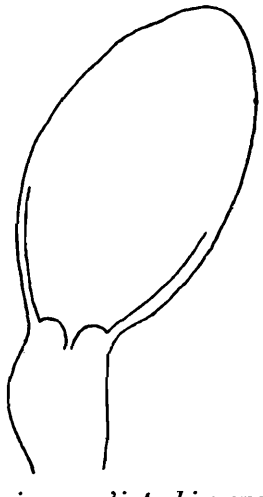

FIG. 6. *Perionyx m'intoshi ;* spermatheca.

The spermathecal ampulla (fig. 6) is a simple sac. The duct is rather broad, soft, bulging considerably on its inner side, this bulging portion shining, almost iridescent, as if spermatozoa were contained within ; it is one-third as long, and where thickest half as wide, as the ampulla ; and it projects into the ampulla somewhat like the os uteri into the vagina.

**Perionyx ditheca,** sp. n.

Thandaung. Four specimens.

*External Characters.*—Length 55-70 mm. ; maximum diameter 1½-2 mm. Segments of the longest specimen 106. Colour a slightly pinkish grey.

Prostomium epilobous *ca.* ½ or less ; tongue broad, not cut off behind, the lateral limiting grooves not very distinct. The general annulation of the body is very pronounced in all the specimens.

Dorsal pores begin in furrow 5/6.

The setae are arranged in rings, and are small, especially in the anterior part of the body. There is no ventral break ; in most segments there is a very slight dorsal interruption (*zz*=*ca.* 1¼ *yz*). The setae are set rather wider dorsally than ventrally. The following numbers were counted with difficulty ; all the numbers are approximate only :— 38/v, 38/ix, 42/xii, 38/xix, and 32 in the middle of the body.

The clitellum extends over segments xiii-xviii (=6) ; it is ring-shaped, swollen, and reddish in colour ; setae and dorsal pores are visible.

The male area, on segment xviii, appears as a mid-ventral depression in which are situated a pair of small rounded papillae, contiguous or nearly so in the middle line, turned somewhat towards each other and looking therefore not directly downwards but inwards as well ; the antero-posterior extent of the papillae is less than the length of the segment, and they are bounded by two transverse grooves, one in front of and one behind the pair of papillae. The male pores are one in the centre of each papilla.

The female aperture is apparently situated in a conspicuous and moderately deep mid-ventral depression close to the anterior margin of segment xiv, which has the form of a transverse groove deepest in the middle, or a star-shaped pit with about four radiating furrows.

The spermathecal apertures are a single pair, near the middle line in furrow 7/8. One or more of the neighbouring furrows, 6/7 and 8/9, may, though indistinctly, appear to contain pores, and sometimes (*v. inf.*) actually do so.

There are no other genital markings.

*Internal Anatomy.*—No septa are much thickened, though perhaps 6/7—9/10 are slightly so. In the first specimen dissected there was no appreciable gizzard ; the somewhat quadratic segment of the alimentary canal in v seemed to be neither broader nor firmer than the neighbouring parts of the tube ; in a second example, however, this part seemed to be slightly firmer, and one might speak of a very vestigial gizzard in segment v. The alimentary canal swells out either behind the prostatic region, or in segment xvii, to form the intestine.

The last hearts are in segment xii.

The excretory system is meganephridial ; there is no alternation in the position of the nephridiopores.

Testes and funnels are free in segments x and xi. In one specimen seminal vesicles were present in xi and xii as small lobulated masses, each a transverse row of rounded lobules ; in a second, the vesicles were small in xi, of moderate size and racemose in xii, and there was a third pair, small and lobulated, in xiii.

The prostates are small and compact, confined to segment xviii, and not causing the septa to bulge apart. The duct is narrow, slightly shining, generally transverse in direction but somewhat twisted.

There are no penial setae.

The ovaries are relatively large, in xiii, which also contains the funnels. Small ovisacs are present in xiv.

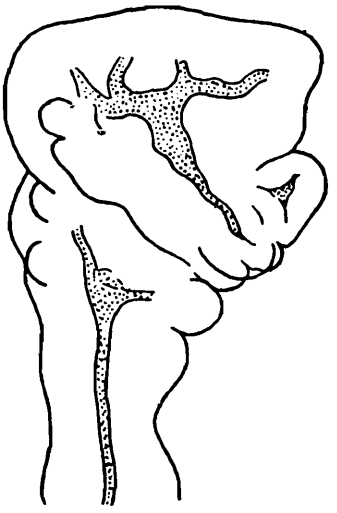

FIG. 7. *Perionyx ditheca ;* spermatheca.

The spermathecae (fig. 7) in the first specimen dissected are a single pair, in segment viii, discharging in furrow 7/8 ; the ampulla is on the whole roundish in form, though very irregularly so owing to the presence of small bulgings, almost lobulations. The diverticula, if any are present, are difficult to distinguish in dissection from these lobulations or sacculations ; possibly there are two, conjoined, at the base of the ampulla. The duct is short, of moderate thickness,—as long as and half as wide as the ampulla. When examined under the microscope the diverticula are still not definitely to be distinguished from the sacculations of the ampulla, and the whole appears as a mass of rounded chambers of various sizes.

In the second specimen spermathecae were present in segment viii on both sides, and in vii only on the left side. The shape was as just described, the lobulation of the ampulla perhaps not quite so marked. In the organs of segment viii none of the lobules could be specially singled out as representing a diverticulum ; but in the single organ in segment vii it might possibly be allowable so to distinguish one small sacculation at the ental end of the duct.

## Subfamily *OCTOCHAETINAE.*

### Genus **Ramiella** Steph.

### **Remiella cultrifera,** sp. n.

Rangoon. July 1930. A number of specimens, many mature.
Rangoon. No date. A single specimen.
Kalewa. Three small specimens, one not fully mature.

The specimens of the first batch from Rangoon may be considered as typical, and will be first described.

*External Characters.*—The longest specimens measure 20 mm. ; maximum diameter 1 mm. Colour pale grey, anterior end lighter, unpigmented. Segments 84, 82.

Prostomium epilobous about $\frac{1}{3}$, with square-cut hinder border.

Dorsal pores from furrow 8/9.

Setae paired ; in the middle of the body *ab* is somewhat less than *cd*, and *aa* and *bc* are about equal, though in some places *bc* is rather the larger ; $ab=\frac{2}{5}aa=\frac{2}{5}bc$, and *dd* is slightly less than half the circumference. In front of the clitellum the setae are too small to be properly seen.

The clitellum is saddle-shaped, a narrow ventral region being free from thickening ; it includes the segments from xiii backwards to nearly the hinder limit of xvii (=nearly 5).

The prostatic pores are on xvii (at the hinder end of the segment) and xix, in line with setae *ab*, and are connected by almost straight (slightly convex inwards, or very faintly irregular) seminal grooves, which are limited on each side by slightly swollen white walls.

The spermathecal apertures are in furrows 7/8 and 8/9, in line with seta *b* or just below this (internal to this).

*Internal Anatomy.*—As the specimens were so small, they were examined by longitudinal sections (two specimens) as well as by dissection.

Septa 5/6—8/9 are somewhat thickened, 9/10—11/12 slightly so.

In the dissected specimen the gizzard, round and shining but rather soft, was in segment vi ; in one of the sectioned specimens it was in vi, in the other in vii. Calciferous glands are absent. The intestine begins in segment xiv.

The last hearts are in xii.

The number of nephridia is small,—apparently two only on each side in each segment.

Testes and funnels are free in segments x and xi. There is a single pair of seminal vesicles, relatively large, rounded and transversely oval in shape, in xii, nearly touching each other in the middle line.

The prostates are two pairs, tubular in form ; the glandular portion is rather flocculent-looking and very friable, bent twice or more in one plane as it lies on the body-wall, the loops one behind the other. The duct is narrow, straight, of some length, and runs transversely in the segment ; the penial setal sacs are prominent.

The ovaries are present in segment xiii. No ovisacs were seen.

The spermathecae (fig. 8, *a* and *b*) are situated in segments viii and ix. The ampulla is sac-like or slightly irregular in shape ; the duct is fully as long as the ampulla, bent irregularly to a greater or less degree, moderately stout—about a quarter as wide as the ampulla—the ental end being slightly thicker than the ectal. The diverticulum is an ovoid chamber of some size, almost sessile and marked off by only a slight constriction from the upper end of the duct just below the ampulla ; its size varies,—it may be about two-fifths as long and half as wide as the ampulla, or it may be somewhat smaller than this, or occasionally it may be altogether

absent. The ampulla is usually bent over on to the duct as in fig. 8 *a*, but duct and ampulla may be in the same line as in fig. 8 *b*.

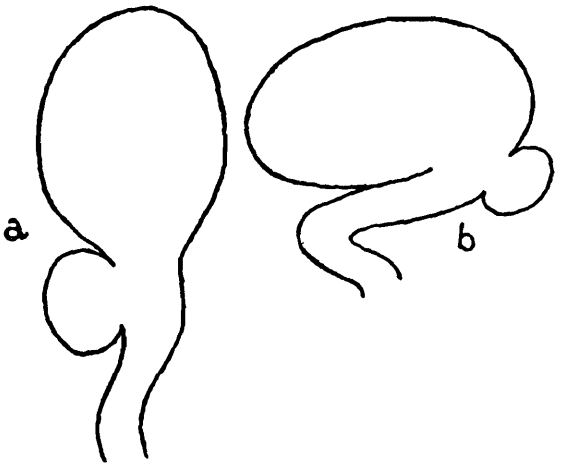


FIG. 8. *Ramiella cultrifera ; a* and *b*, two examples of spermathecae.

The penial setae are of two kinds, one of each kind being present in each bundle. (*a*) The first form (fig. 9) is 0·54-0·57 mm. long measured

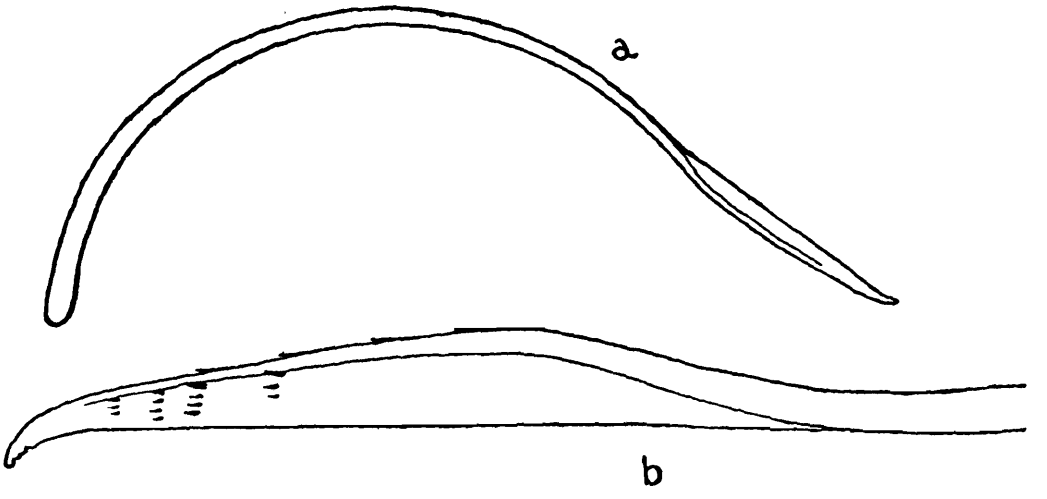


FIG. 9. *Ramiella cultrifera ;* penial seta, first form ; *a*. whole seta, ×160; *b*. distal end, ×550.

across the curve, 12μ in diameter at the middle of its length, and rather swollen towards the base ; the shaft is curved in an arc of about a third of a circle, the distal end, one-fourth or a little more of the total length, is not curved but continues the direction of the shaft tangentially ; the tip is bluntly pointed, and evidently soft, being somewhat bent and crinkled ; the distal (straight) portion of the seta forms a blade-like expansion, 18-19μ in width, one border, the edge, being turned outwards, the other border, which constitutes a thickened rib, the continuation of the shaft of the seta, being towards the inside of the curve of the shaft. A few spines are seen on this thickened border, and a few fine markings, in short irregular transverse rows, are present on the distal part of the flattened blade.

(*b*) The second form of penial seta (fig. 10) has the same length, thickness, soft tip, and curve as the former,—except that the distal end

FIG. 10. *Ramiella cultrifera ;* penial seta, second form ; distal end, ×375.

may be bent slightly outwards. There is no blade-like expansion, but the distal fourth of the seta is ornamented by about ten sparse and irregular circles of small spines, sometimes scarcely standing off at all from the shaft and difficult to see ; the number of spines in a circle is few—perhaps four,—or sometimes scarcely more than two lateral rows of spines along the borders of the seta may be seen.

The specimens from Kalewa differ somewhat from the above description, and may perhaps constitute a separate variety.

Length 25 mm. ; diameter 1 mm. Colour pinkish-grey. Segments 85.

Prostomium nearly tanylobous, tongue not closed behind ; but the grooves bounding the prostomium are very faint, and one specimen would ordinarily be described as zygolobous.

Dorsal pores from furrow 6/7.

The setal intervals in the middle of the body have the ratios $ab=\frac{1}{4}aa=\frac{1}{3}bc=\frac{2}{3}cd$, while $dd$=half the circumference ; thus $aa$ is greater than $bc$, and $cd$ is greater than $ab$. In front of the clitellum $aa$ and $bc$ are more nearly equal, and are equivalent to $3ab$.

Clitellum xiii-xvii (=5), brown in colour, smooth, dorsal pores visible, ring-shaped (? completely) except on xvii. The seminal grooves can scarcely be said to be limited by walls, but the margins of the grooves are slightly puckered and possibly a little swollen. The female pores, not seen in the former specimens, are in front of and internal to setae *a*.

Septum 5/6 is thin, 6/7, 7/8 and 8/9 are much strengthened, 9/10 moderately and the following three septa slightly thickened. The gizzard, in vi, is barrel-shaped, firm, and of moderate size. In front of septum

5/6 the oesophagus is iridescent, with shining longitudinal muscle fibres, and slightly swollen ; this portion has not a well defined anterior limit, and is much narrower and shorter, as well as softer, than the gizzard in vi ; it is thus a strengthened part of the oesophagus, not a second gizzard.

The two nephridia on each side of a segment (behind the clitellum) are one dorsal to seta *d*, and one in the interval *cd*.

There are ovisacs of moderate size in segment xiv.

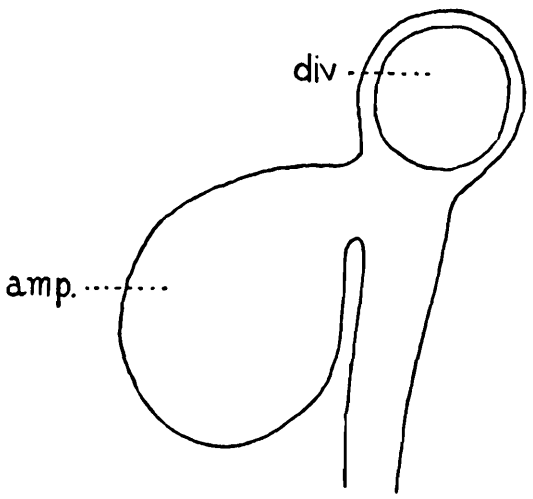


FIG. 11. *Ramiella cultrifera* ? var. ; spermatheca ; *amp.*, ampulla ; *div.*, diverticulum.

The spermathecae are shown in fig. 11 ; the main axis of the organ appears to be constituted by the straight duct and the diverticulum, the latter a subspherical chamber tensely full of a glittering mass of spermatozoa, slightly contracted at its base where it is continued into the duct. The ampulla appears as a lateral appendage, a sac, constricted at its base of attachment to the duct just below the diverticulum.

The two varieties of penial setae are not unlike those described above ; in the first variety (fig. 12), the flattened portion has a thickened border

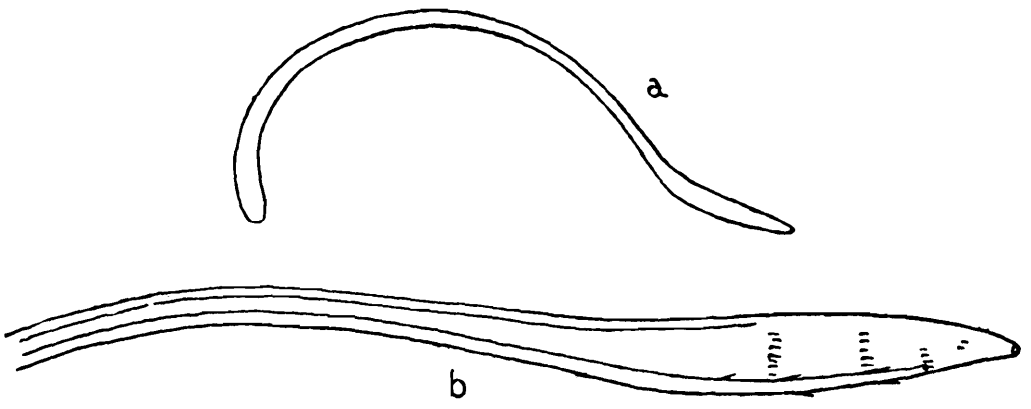


FIG. 12. *Ramiella cultrifera* ? var. ; penial seta, first form ; *a.* whole seta, ×100 ; *b.* distal end, ×425.

along part or the whole of what is there a sharp edge, and the neighbouring portion of the shaft appears to be grooved, but I am not quite certain

as to the interpretation. The tip of the second variety (fig. 13) has an angular appearance, and the spines are fewer and smaller than in the

FIG. 13. *Ramiella cultrifera* ? var. ; penial seta, second form ; distal end, ×425.

Rangoon specimens ; the part which is bent outwards is shorter than in the setae with flattened ends.

In the single specimen of the second batch from Rangoon the prostomium was epilobous ½, the rather broad tongue being open behind. Dorsal pores began in furrow 7/8. As to the setae, *aa* is greater than *bc*, and *ab* is rather less than *cd* ; *dd* is a little more than half the circumference. The clitellum, extending over xiii in front and two-thirds of xvii behind, is ring-shaped, though the mid-ventral region is lighter and thinner, so that it might almost be described as saddle-shaped. The penial setae are of the type of those of the other Rangoon specimens.

## Genus **Octochaetus** Bedd.

### **Octochaetus (Octochaetoides) fermori** Mich.

Sandoway. Two specimens.

The species occurs in India from north to south, from east to west; I have recently found it in a consignment of worms from the Malay Peninsula. It is therefore markedly peregrine.

## Genus **Eudichogaster** Mich.

### **Eudichogaster chittagongensis** Steph.

Rangoon. July 1930. A single specimen.
Rangoon. No date. Several specimens.
Moulmein. Aug. 1930. A number of specimens.
Ye. Aug. 1930. Four specimens.
Kya-In. Aug. 1930. Three specimens.
Kalewa. A number of specimens.
Poungbyin. Two specimens.
Kindat, Masein, Mawlaik. Ten specimens.
Shwegyin. Sept. 1930. Several specimens.

The following notes will help to complete our knowledge of this species.

The dorsal pore in furrow 11/12 may be quite large, or it may be small and rudimentary, or it may be altogether absent.

The clitellum is ring-shaped, and ordinarily embraces segments xiii-xvii ; but part of xvii may be excluded.

In most specimens the male field takes up the length of segment xvii, and consists of a rather narrow transverse groove extending across the segment between the lines of setae *b* ; the anterior and posterior lips meet and fuse outside the line of *b*, and after fusing are continued a little further out. In a number of specimens from Rangoon, which I did not recognize

on external examination, owing to the different and more marked characters of the male field, a considerable depression, or shallow pit, included the hinder end of xvii and a small portion of the anterior end of xviii ; it was bounded in front by the hinder end of the clitellum and laterally by the male papillae, while the more shelving posterior wall of the fossa stopped short of the setal zone of xviii.

The male papillae bear each a short, rather oblique groove ; the prostatic pore is presumably at the anterior end of the groove, on xvii, and the opening of the vas deferens at its hinder end, apparently about the level of furrow 17/18. On internal dissection the vas deferens is difficult to see, but it does, pretty certainly, pass external to the end of the prostatic duct and pierces the parietes a little behind the level of the entry of the prostatic duct into the body-wall.

I found no sign of testis sacs in segment x in three specimens from different localities which I dissected ; x was either apparently quite empty of genital organs, or contained a small mass of iridescent spermatozoa on the floor of the segment, with or without small funnels in addition. In one of the specimens from Rangoon, however, I found an explanation of my original statement (Stephenson, '17) concerning the presence of conjoined testis sacs and seminal vesicles in x ; a well defined mass of male cells occupied the segment, attached deeply on each side, probably to the testis. On freeing this and examining it in glycerin it was found to be a solid mass of sperm morulae and spermatozoa, with a definite outline but no enclosing membrane ; it is just possible, however, that such an enclosing membrane may have existed earlier (as for example in some species of *Enchytraeus*, where it breaks down later), and so may have been present in my original specimens.

In previous examples an ornamentation of the penial setae has gone unnoticed (Stephenson, '17), or (Stephenson, '31) has consisted only of slight irregularities of outline. In one of the specimens from Kya-In in which these setae were examined they might almost be described as serrated.

A knob-like excrescence low down on the tubular spermathecae probably represents the diverticulum (*cf.* also the figure of spermatheca (fig. 32b) in Stephenson, '17).

### **Eudichogaster yeicus,** sp. n.

Ye. Aug. 1930. Four specimens.
Chaungson. Aug. 1930. Five specimens.
Kya-In. Aug. 1930. Four specimens.
(All localities in Moulmein District).

*External Characters.*—Length 45 mm. or less ; maximum diameter (at clitellum) 2 mm. Colour a medium grey ; clitellum a little darker. Segments *ca.* 150.

Prostomium pro-epilobous or slightly epilobous, with rounded posterior border ; no distinct groove continued back from hinder angle of prostomium dorsally on segm. i, at most a very slight triangular depression. Segment i indistinctly separated from ii.

Dorsal pores begin in furrow 11/12.

The setae, larger in the hinder part of the body, are paired, but not closely. In the middle of the body $ab = \frac{1}{2}aa$ (sometimes more, or less)=

$\frac{3}{4}bc$, while *bc* is very little greater than *cd* ; *dd*=half the circumference. Behind the clitellum $ab=\frac{1}{2}aa$ or less,$=\frac{1}{2}-\frac{3}{5}bc$,$=\frac{2}{3}-\frac{3}{4}cd$ ; in front of the clitellum $ab=\frac{1}{2}aa=ca$. $\frac{2}{3}bc=\frac{2}{3}-\frac{3}{4}cd$.

The clitellum extends over segments xiii-xvii (=5), is ring-shaped, and sharply defined.

The male area is a transversely extended rectangle, narrow in its antero-posterior extent, surrounded on all sides by a low lip, the whole taking up the hinder part of xvii, xviii, and all xix, and extending on each side to a little outside the line of setae b. The prostatic pores, on xvii and xix, in line with the setae *b*, are small transverse slits bounded by slight anterior and posterior lips. The seminal grooves join the outer ends of the slits, and have a slightly irregular course or are convex inwards, the pores and grooves of the two sides presenting somewhat the appearance of a pair of square brackets [ ]. The prostatic pores of each segment are joined by a transverse furrow, and there is also a slight furrow across the middle of segment xviii. The endings of the vasa deferentia were not distinguished.

The female pores were, when visible, situated in front of and internal to setae *a* of segment xiv, on a slight common transverse elevation.

The spermathecal pores are very indistinct, but appear to be in furrows 7/8 and 8/9, in or just below the line of setae *b*.

*Internal Anatomy.*—Septa 4/5 and 5/6 are very thin, 6/7 is represented only by a few strands or a very tenuous membrane behind the second gizzard ; from 7/8 or 8/9 the septa as far as 12/13 are slightly thickened as compared with the rest, though they are still thin.

There are two gizzards, in v and vi, firm, of relatively considerable size, narrowing posteriorly. The calciferous glands, in x, xi and xii, are ovoid in shape, broadly attached to the oesophagus, and all of about the same size. The intestine begins in xv.

The last hearts are in segment xii.

The micronephridia are small twisted tubes, three on each side per segment ; one occupies the interval *bc* on the body-wall, one is situated in or just above the line of setae *d*, and one is placed more dorsally. Occasionally there are four on a side, the ventralmost of the three being divided into two.

In the first specimen to be dissected (from Ye), testis sacs were present in segment x, transversely elongated in shape, and containing the male funnels and testes (or at least, though the testes were not definitely recognized, some opalescent sperm masses) ; in segment xi the funnels were free (testes not recognized). Seminal vesicles were present in ix only, small, of a rounded oval in shape. In a second dissected specimen (from Chaungson), though the external marks of sexual maturity were present, and the ovaries and ovisacs were fully developed, the anterior male organs were not to be made out,—neither testes, funnels, nor seminal vesicles ; probably their period of functioning was over. The male organs seem, in some of these Eudichogasters, to be very temporary in their duration (*cf. E. chittagongensis*).

The prostates are two pairs, small tubular organs, short and twisted, each confined to its own segment ; the duct is short, straight, and soft, and runs transversely inwards.

Ovaries are present in xiii, and ovisacs in xiv.

The spermathecae (fig. 14) are two pairs, in form not very unlike those of *E. chittagongensis*. They are long and tubular, and may be consider-

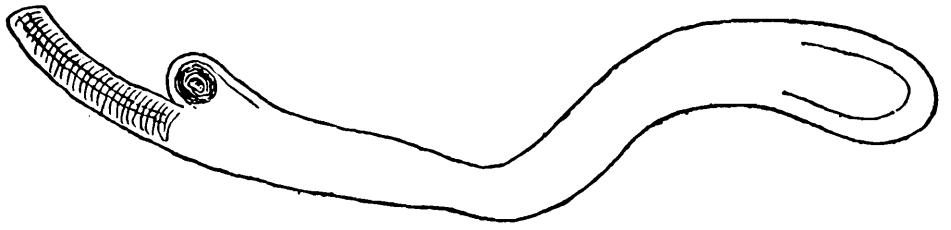

FIG. 14. *Eudichogaster yeicus ;* spermatheca.

ably bent in their course ; there is no distinct division into ampulla and duct, but the rather narrower part, about one-sixth of the whole, below the attachment of the diverticulum is probably to be considered as the duct ; the ental end is slightly and ovoidally dilated. The diverticulum is a small entirely sessile rounded chamber near the base of the organ, containing spermatozoa.

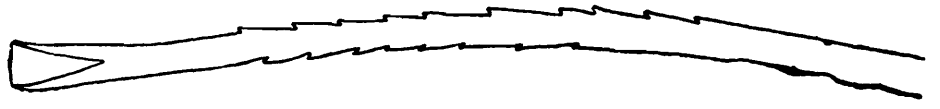

FIG. 15. *Eudichogaster yeicus ;* penial seta, distal end, ×1000.

The penial setae (fig. 15) are 0·4 mm. in length, and 4μ in diameter at the middle ; they are curved in a gentle bow either along their whole length, or only in their distal half or less. The distal end tapers slightly ; the tip, as seen sideways, is pointed, but seen on the flat is expanded and thin,—or rather is forked, and the interval between the prongs is occupied by a delicate web ; the webbed portion is 4μ broad, the shaft just above the web 2·5μ in diameter. The distal 120μ is ornamented with a number of small serrations, somewhat irregularly arranged, and those of the two sides not necessarily opposite.

No copulatory setae were discovered in the spermathecal region.

## Subfamily *DIPLOCARDIINAE.*

### Genus **Dichogaster** Bedd.

### **Dichogaster bolaui** (Mich.).

Namkham, Shan States. April 1930. Four specimens.
Rangoon. July 1930. A single specimen.
Rangoon. (No date). A number of specimens.
Mergui. Three specimens.
Maymyo. A number of specimens.

In the present collection there are a considerable number of tubes of small worms the correct determination of which has caused me much difficulty and hesitation. Among them are some which I labelled *Dichogaster bolaui*, and others which I called *D. malayana ;* and I may first note the points of distinction between these two worms as they may be

gathered from the original descriptions (Michaelsen, '91, *cf.* also Michaelsen, '97 ; Horst, '93). (I neglect small and unimportant differences).

According to Horst, who had specimens of *D. bolaui* from Michaelsen for comparison, this worm is slenderer than *D. malayana*, and the anterior segments are not longer than the rest (in *malayana* the first five segments are longer than succeeding ones). The clitellum is saddle-shaped in *bolaui*, ring-shaped in *malayana* (except that the space between the ventral setae of the posterior clitellar segments seems not to be glandular). The female pore is single on a circular papilla in *bolaui*, or as it is put by Horst, " surrounded by an oval wall, of which there is not any trace in our species " (*i.e.*, in *malayana*) ; there is no direct statement that the female pore is double in *malayana*, though apparently we are to infer it. The hooked form of penial seta has about 8 teeth in *bolaui*, 4 in *malayana*.

*D. bolaui* varies considerably in size, being 20-40 mm. in length (up to 60 mm. when living), and this, as well as the possibility of varying degrees of contraction, renders the slenderer habit of *D. bolaui* of very doubtful value as a distinction ; different degrees of contraction might perhaps also account for an apparent difference of length of the anterior aegments. We are left with the clitellum, the female pore, and the spines of the penial setae.

I may now give some account of the worms in the present collection, some of which I at first called *D. bolaui*, others *D. malayana* ; sometimes I was doubtful, sometimes I revised my first judgment.

In all, the first segment is not distinctly demarcated from the second.

The clitellum is always well defined, and includes segments xiii-xx, neither more nor less (*D. bolaui* xiii or xiv-xviii, xix or xx, " Tierreich ") ; in many it is certainly ring-shaped, not very thick, very smooth, rather lighter and apparently somewhat thinner below, with the furrows still present. In many I noted it as saddle-shaped, and these were referred to *D. bolaui ;* but re-examination in practically every case showed that there was undoubtedly some thickening mid-ventrally also, though the intersegmental furrows were still present there ; the clitellum in these specimens was thicker than in the others, and it seems now to me that this condition represents a more advanced stage ; with continued development the thickness increases, except ventrally, where it remains moderate in amount,—and hence the appearance of a saddle-shaped clitellum with a longitudinal mid-ventral groove between the swollen edges. In many the clitellum is apparently definitely absent on segment xx ventrally.

The female pore is single, on a papilla which is sometimes hardly raised at all, but which is delimited by a groove ; the groove is perhaps less definite laterally than in front and behind. The papilla takes up the whole length of segment xiv, and may include the ventral setae on each side.

There is very frequently a longitudinal groove in the middle line between the two seminal grooves on xvii–xix ; such a median groove is noted for *D. bolaui* by Michaelsen in the " Tierreich." (The statement in the " Tierreich " that the seminal grooves are convex towards the middle line in *D. malayana* is an inference from the figure ; in Horst's text they are described as " longitudinal oval.")

Dorsal pores are often visible on the clitellum in the situation of furrow 13/14 or 14/15.

Seminal vesicles may be present in xi and xii,—small and racemose in form, or vestigial. (In *D. bolaui* Michaelsen gives one pair of vesicles in xi, rudimentary.)

I examined a large number of penial setae of these specimens, some with the oil immersion lens, but could not separate the two species by this means ; on the contrary, these setae showed a remarkable uniformity. The number of spines on the hooked variety does, however, vary from four to six ; often two spines lie side by side. The two kinds of penial setae of *bolaui* are said to be of the same diameter (5μ) ; in all my slides, however, the hooked form is notably the thicker,—6·4μ as compared with 4·7μ (measured with the oil immersion) in diameter at the middle ; the length of the hooked setae is 0·35 mm., that of the scalpel-shaped 0·32 mm.

I cannot doubt that in spite of the differences in the clitellum all these specimens belong to the same species. If I am right in my explanation of the differences in the appearances of the clitellum, the form characteristic of *D. malayana* is merely an earlier stage than that which is described for *D. bolaui*. The number of teeth of the penial setae in my specimens is as a rule intermediate between those assigned to the two species by their authors. I cannot, however, explain the difference in the descriptions of the female pore or pores.

On the whole, I believe that the distinction between *D. bolaui* and *malayana* cannot be maintained ; *D. bolaui* is widely spread in the warmer regions of the globe,—is in fact circummundane. *D. malayana* was recorded by Horst from a number of places in the Malayan Archipelago, and thus, like *D. bolaui*, is peregrine. I have just recently received from the Philippine Islands some small Dichogasters, among them one which presents the characters of the above worms from Burma,—clitellum extending all round but thinner ventrally, etc.

### **Dichogaster curgensis** Mich. var. **unilocularis** Steph.

Kutkai. A number of specimens.
Lashio. Five specimens.

I have recently described this variety from Lashio (Stephenson, '31). The following notes mostly concern points of difference from the type of the species (Michaelsen, '21).

In length the specimens measured 21-30 mm. The colour is slightly purplish on the dorsum, with a median dark stripe. Dorsal pores begin in furrow 5/6 (once 4/5). The setal interval *dd* is equal to two-thirds of the circumference.

The clitellum extends over xii or xiii-xx, and is ring-shaped, but the ventral surface of xii and xx is not included in the thickening ; when the clitellum extends on to xii (as it does in most specimens) it is the lateral portions of the segment that are included. In some specimens the clitellum appears (possibly because development is not complete) saddle-shaped.

Seminal vesicles are present in all specimens dissected, small in xii, and small or absent in xi.

The spermathecae (fig. 16) differ a little from my former description. The ampulla is elongated, twice or three times as long as broad ; the duct

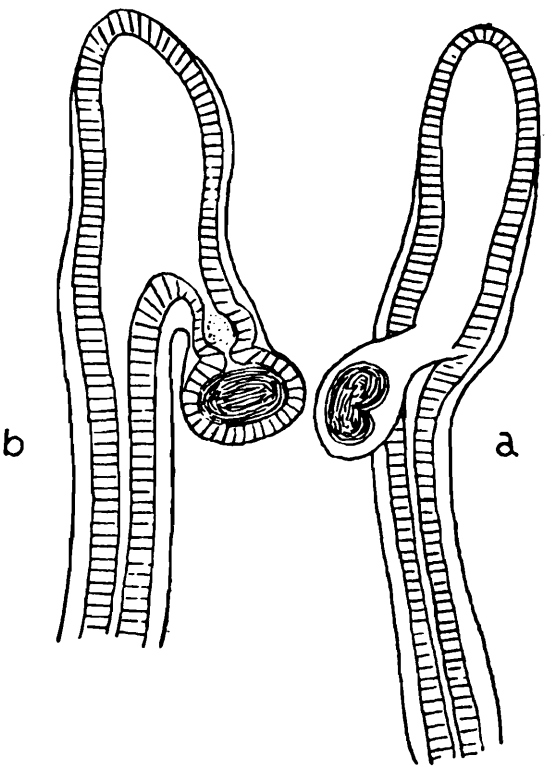


FIG. 16. *Dichogaster curgensis* var. *unilocularis* ; two spermathecae, diagrammatic.

is cylindrical, rather longer than the ampulla and three-fourths as broad, not sharply delimited. The diverticulum is as a rule single, stalked, hanging down, coming off from the base of the ampulla (not from the duct) ; the chamber is rounded and contains a mass of spermatozoa. In half the cases (six out of twelve) there is, as in the example shown in fig. 16a, a small second chamber, possibly occasionally even a third (so that the diverticulum is then not strictly ' unilocular '), above that containing the spermatozoa ; these accessory chambers are usually empty or at most contain only a little granular matter.

The penial setae, two per bundle, are, or may be, quite obviously of different sizes ; *e.g.*, one of the two may be 0·84 mm. in length and 5μ in diameter at the middle, the other 0·73 mm. long and 4μ in diameter at the middle ; their form is as previously described (Stephenson, '31). However this difference in size does not seem to be universal.

### **Dichogaster modiglianii** (Rosa).

Lashio. Two specimens.
Mergui. A number of specimens.
Rangoon. Several specimens.
Nyaunglebin, Pegu. K. John. Sept. A number of specimens.

The worms from all the above localities which I now identify as *D. modiglianii* (Rosa) are identical with my *D. doveri*, the description of which is now appearing in the *Journal of the Federated Malay States Museums*. The supposed differences between *D. modiglianii* and my *D. doveri* are as follows :—

*D. doveri* is a larger worm (up to 60 mm. long, with 115-118 segments, as against 22 mm. and 76 segments for *D. modiglianii*) ; it is non-pigmented (*modiglianii* is dark grey) ; segments i and ii are not, or only

faintly, demarcated (this is not noted for *modiglianii*) ; in *modiglianii* the anterior segments are especially elongated, which is not the case in *doveri*. The dorsal pores in *modiglianii* begin in 4/5, in *doveri* in 5/6 (occasionally, perhaps, in 4/5,—there may at any rate be a pit here in some specimens). A chief difference seems to be the clitellum,—ring-shaped in *doveri*, saddle-shaped (" incomplete ventrally ") in *modiglianii* except on xiii where it is complete. Transverse sulci are present on xvii and xix in *modiglianii* in front of the anterior and behind the posterior prostatic pores respectively. In the variety of penial setae with thicker tip the end is cut off squarely and perhaps very slightly broadened in *doveri*, while in *modiglianii* the end is described as knobbed, and shown in the figure as swollen and rounded.

The chief differences between the two descriptions concern the clitellum and the thicker kind of penial setae ; I think also that the very slight or non-existent delimitation of segment i from ii, which is a feature of *doveri*, would have been noted by Rosa in his worm if it had existed. I am not inclined to lay much stress on any other difference.

I have had great difficulty in coming to a conclusion regarding the identity or otherwise of the two species. What has finally caused me to unite them is (i) the fact that I a short time ago (Stephenson, '31) recorded *D. modiglianii* under that name from Mergui,—one of the localities from which I now receive these worms which are identical with my *D. doveri*. A re-examination of the penial setae of the earlier batch shows that in this respect the worms are identical with my *D. doveri*, though the clitellum is saddle-shaped (as stated for *modiglianii*), not ring-shaped (as in *doveri*).

(ii) Within the last few days I have received a number of worms from the Philippine Islands which have the penial setae of *D. doveri* and a clitellum which is ring-shaped over segments xiv-xvi at least, though lighter in colour and perhaps thinner below on xiii and xx (the male field comes in ventrally on xvii-xix). In one specimen however the clitellum might fairly be described as saddle-shaped.

These specimens seem to show that the clitellum may vary in appearance at different times, possibly (as perhaps in *D. bolaui, v. ant.*) owing to continued growth of the dorsal and lateral portions after the ventral region has reached a standstill, the apparently saddle-shaped clitellum being thus a later stage ; certainly in *D. bolaui* it is the less developed and thinner clitella (=" *D. malayana* ") that are obviously ring-shaped. What I have written, in the paper which is now appearing (in the *Journ. F. M. S. Mus.*), on *D. doveri* may be taken as completing our knowledge of *D. modiglianii*, the original description of which is, perhaps, according to present standards, somewhat brief.

### **Dichogaster saliens** (Bedd.).

Kutkai. Numerous specimens.
Namkham. April 1930. A number of specimens.
Maymyo. Aug. 1930. K. N. Sharma. Five specimens.
Maymyo. Numerous specimens.
Lashio. A number of specimens.
Thandaung. Numerous specimens.

In the Kutkai specimens the dorsal pores begin in 4/5 (small or rudimentary), or 5/6. The clitellum is saddle-shaped ; it is however always

wanting over more or less of segment xx ; in extent it falls short of furrow 20/21 oftener than not, including only two-thirds or three-fourths of the segment, though sometimes all of xx is included dorsally and laterally. There is a small transverse groove-like depression in 15/16,—sometimes only a slight deepening of the intersegmental furrow for a short distance, or a small transversely oval papilla surrounded by a slight moat.

Septum 4/5 is thin, but quite distinct. There are four longitudinal rows of nephridia on each side, but sometimes also a small fifth nephridium is to be seen ventrally in the segment. The spermatheca is illustrated in fig. 17 ; transverse muscle fibres begin on the duct immediately below the attachment of the diverticulum.

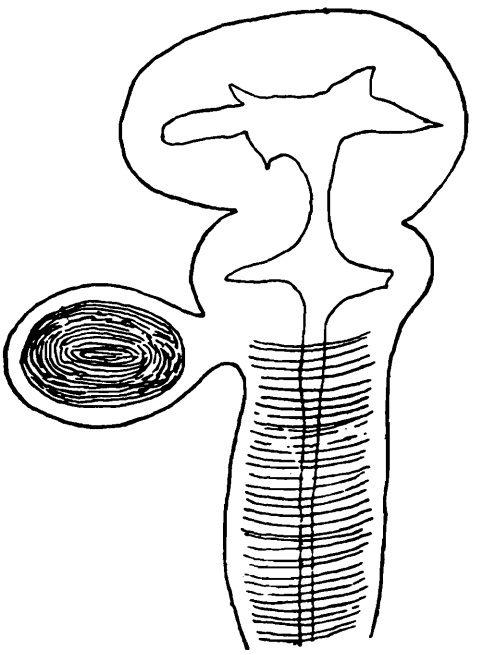

FIG. 17. *Dichogaster saliens* ; spermatheca.

The two penial setae of a bundle differ markedly. The longer is 0·71 mm. in length and 10μ thick at the middle of the shaft, the last 0·185 mm. being markedly undulating, with about three small jagged markings or teeth to each undulation. The smaller is 0·54 mm. long, 6μ thick at the middle of the shaft, the undulation extremely slight, hardly distinguishable, and no teeth or markings visible with the ordinary high power.

Specimens from Namkham were very similar.

The above notes have reference to the characters in which *D. saliens* was supposed to differ from *D. crawi* ; I have recently (Stephenson, '31) proposed to unite the two, and have discussed in some detail the supposed differences between them.

### **Dichogaster sinuosus** Steph.

Kyaukme. May 1930. Two specimens.
Namkham. April 1930. Five specimens.
Maymyo. Aug. 1930. Three specimens.
Lashio. Three specimens.
Labaw. Three specimens.

I described this worm recently (Stephenson, '31) mainly on the basis of specimens from Labaw. I add a few notes principally derived from a detailed examination of examples from Namkham.

The length may be as much as 60 mm., and the number of segments about 127. A groove, as before, extends back from the hinder end of the prostomium for a little distance. Segments i and ii are not marked off from one another.

In the middle of the body *aa=bc*, and *dd* is equal to two-thirds of the circumference. In front of the clitellum *aa* is less than *bc*, and *dd* is three-quarters of the circumference.

In these specimens (as in the former ones) it occasionally happens that a part of segment xxii is included in the clitellum.

The female pores are situated on a transversely oval papilla, and the setae of xx on a slightly raised area.

The copulatory papillae on 7/8, 8/9, and 9/10 vary in distinctness, and one or more are sometimes absent ; those on 7/8 and 8/9 may be very well marked, taking up the mid-ventral interval between the spermathecal apertures, the central portion or crest of each being enclosed within a groove.

The spermathecal ampulla, in the specimen from Namkham which I dissected, was in most of the organs broader transversely than long, and thus wider than the duct below it. The duct is very obviously divided into two parts by a constriction ; there is in fact one constriction below the ampulla and another between the two parts of the duct. There may be masses resembling spermatophores in the ampulla (as in previous examples).

The sinuosity and toothing of the smaller variety of penial setae are very slight ; the toothing is invisible with the ordinary high power.

The two species to which the present shows most affinity are *D. floresiana* (Horst) and *D. affinis* (Mich.). The penial setae of the present species and of *D. floresiana* seem to be practically identical (though in Michaelsen's key in the " Tierreich " *D. floresiana* is classified under forms which have only one kind of penial setae). The seminal grooves of the latter worm, however, are bracket-shaped { }, " a character by which this species can be easily distinguished from other congeners " (Horst), and there are no genital papillae ; other differences include the absence in *floresiana* of the groove on the dorsal surface of segment i which prolongs backwards the hinder angle of the prostomium ; the commencement of dorsal pores in 6/7 ; and the relatively greater extent of *aa* as compared with *bc*.

From *D. affinis*, which has similar copulatory papillae, the chief difference consists in the penial setae, which are in that species of one kind only, shorter, only about a quarter as thick as the larger penial setae of *D. sinuosus* (1·6μ against 6μ), and without teeth or thorns.

## Family LUMBRICIDAE.

### Genus **Bimastus** H. F. Moore.

### **Bimastus parvus** Eisen.

Maymyo. A single specimen.
Thandaung. A single specimen.

In the specimen from Thandaung I cannot find any dorsal pores in front of furrow 9/10, and even this one is small (normally the pores begin in 5/6).

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