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ON A COLLECTION OF OLIGOCHÆTA, MAINLY FROM CEYLON.

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(With two Plates.)

INTRODUCTION.

IN November of last year (1911) I received from Dr. Annandale of the Indian Museum, Calcutta, an interesting collection of Oligochæta made by him in Ceylon during the preceding month, with one tube, containing the single specimen of *Drawida annandalei*, from Tanjore in South India. The species belong to both of the large subdivisions of the Order, the Microdrili and Megadrili; a peculiarity about the habitat of the specimens is that they were all taken either in water or in rotten wood; none of them, therefore, are "earth-worms" in the literal sense of the word.

In 1909 Michaelsen (8) wrote, at the beginning of a communication describing a new *Megascolex* from Ceylon: "As the earthworm fauna of Ceylon belongs to the best known of the tropics, I was surprised at seeing that these worms represented a new species. This circumstance gives a new indication of the richness of the Oligochæt fauna of Ceylon, and of our being far from a complete knowledge of the latter."

The same facts are more forcibly exemplified by the results of the examination of the present collection. Fourteen species were represented (excluding one specimen which was unidentifiable) in the six tubes; of the fourteen, nine are new, while another is sufficiently distinct to rank as a new variety. One tube was a miniature museum in itself; besides an example of *Pheretima hawayana*, it contained, represented mostly by single specimens, six species of *Megascolex*, all new. A partial explanation of the extremely large proportion of new species is perhaps to be found in the peculiar habitat from which they were drawn.

Of the four species which are already known, we are acquainted with one (*Aulophorus palustris*) only through a short diagnosis previously published by Michaelsen. Another (*Limnodrilus socialis*), first described a short time ago by myself, is interesting as being one of the very few Tubificids known to occur in the Indian region. The remaining two (*Pheretima hawayana* and *Dichogaster affinis*) have been known for some time.

The type specimens of the new species are to be kept in the Indian Museum, duplicates being sent to Colombo where possible.

I wish here to express my thanks to the authorities of the Natural History Museum, South Kensington, for very kindly affording me all possible facilities in the use of their library during the writing of this Paper.

Dero zeylanica, sp. nov.

(Plate I., Figs. 1–4.)

Four specimens, one incomplete ; in the same tube as *Limnodrilus socialis* and *Aulophorus palustris*. Hill country, Kandy, Ceylon, 1,600 feet.

The *length* of a complete single animal was 7·5 mm. ; none of the specimens were preparing for asexual division ; when this occurs the length of the chains would probably be greater. *Breadth*, maximum ·35 mm. *Segments* 43–60. *Prostomium* short, rounded. There are no *eyes*.

The *posterior end* of the animal is expanded, and in the preserved specimens this expansion may either have the form of an approximately circular sucker-like disc, facing upwards, with a definite margin, or of a deep and narrow cup, opening dorsally, and compressed from side to side ; the latter was the case in the specimen chosen for sectioning (figs. 1–3). A number of ridges can be indistinctly seen on the inside of the cup, or on the face of the disc ; some of these are more distinct than others, and in the case where the posterior end of the animal is flattened they radiate towards the periphery of the disc.

A series of transverse sections is necessary in order fully to elucidate the structure of this region ; the following description begins anteriorly, from a point in front of the opening out of the intestine into the branchial fossa or branchial funnel, and proceeds posteriorly to the hinder end of the animal.

In the specimen taken for sectioning, the whole posterior end of the animal appears to have been laterally compressed. The first peculiarity to be mentioned is the occurrence, dorsal to the end of the intestine, of a pocket, or forward diverticulum from the branchial fossa ; at the anterior blind end of this pocket a pair of gills originate, which further back lie free within the cavity of the diverticulum (fig. 1).

Proceeding backward, the diverticulum and gut shortly unite, and we may now speak of the cavity as the branchial fossa. The first

pair of gills, already mentioned, here fuse along one of their sides with the dorsal wall of the fossa, and thus constitute longitudinal ridges of the wall. Here also another gill arises, ventral to the first pair, from the lateral wall of the funnel; its fellow however springs (in this particular specimen at least) from the right gill of the first pair. These two, constituting the second pair, lie at first free in the cavity of the fossa; but on proceeding backwards they soon fuse with its walls, and appear, like the first pair, as ridges (fig. 2).

The third pair of gills now appear; in these, unlike the first two pairs, the anterior ends, which are first encountered, are free. The branchial chamber now opens out dorsally; the first pair of gills appear in a transverse section as projections just within the margin; the second pair are similar, and more ventrally situated; the third pair are free in the cavity at a still lower level.

The first pair of gills now flatten out and disappear; the third pair fuse with the wall of the funnel; and a fourth pair appear ventrally, at first free within the cavity (fig. 3), but soon fusing with the wall of the funnel. A section of the funnel therefore now shows three projections of the wall on each side, corresponding to three ridges.

The second pair of gills now flatten out and disappear; the third does the same; and lastly the fourth also. All have disappeared some little distance in front of the posterior end of the funnel.

The free gills and gill ridges are ciliated; they are covered in part by a characteristic pyriform epithelium (fig. 3); the diameter of the gills, or of the ridges, is from 50 to 70 μ.

The relative lengths of the several portions of the branchial fossa may be estimated from the number of sections which go to each. The sections being of a thickness of 8 μ, it is found that the anteriorly pointing diverticulum dorsal to the end of the gut is 40 μ in length; from the mouth of the diverticulum (which coincides with the end of the gut) to where the branchial fossa opens out dorsally is 96 μ; and from this point to the posterior end of the animal is 272 μ. The whole length of the fossa is therefore less than half a millimetre.

The *dorsal setæ* begin in segment VI., and are of two kinds, capillary and needle setæ. In the anterior segments there are three capillary and three needle setæ per bundle, arranged in pairs of one of each kind; further back the bundles consist of two capillary and two needle setæ; and behind this again of a single pair only. The capillary setæ vary in length from 240 to 320 μ; thus they do not exceed the diameter of the body. The needle setæ (fig. 4) are nearly straight, with however a slight sickle-shaped curve; the point is bifid, but the forking is so fine as to be only just visible with the ordinary high power of the microscope. Their length varies considerably, from 82 to 102 μ. The very slight nodulus is distal to the middle of the shaft.

The *ventral setæ* of segments II.–V., differ somewhat from the rest. The shaft is only very slightly curved in the usual S-shape ; the distal prong of the forked end is nearly twice as long as the proximal ; the prongs are about equal in thickness at their base, or the proximal is perhaps a little thinner ; the angle between the prongs is narrower than in the setæ of the posterior bundles. The nodulus is either exactly at or slightly proximal to the middle of the shaft. In length they are from 123 to 128 μ. The number per bundle is four or five.

In the segments from the sixth onwards, the distal prong is slightly longer than the proximal, and only one-half or two-thirds as thick at its base ; the nodulus is either slightly or very markedly distal to the middle of the shaft (distal : proximal : : 41 : 46 or 41 : 57). In length they are from 87 to 98 μ. Towards the anterior end of the animal there are four, or occasionally five, setæ per bundle ; further back the number sinks to three, and then to two.

The alimentary canal shows but little differentiation throughout its extent. The *pharynx* is ciliated ; its floor is lined by long columnar cells, while the cells which form its roof are shorter ; sections show a pair of small recesses dorsolaterally in this region. There are no definite *septal glands ;* but a few large deeply staining gland cells occur in connection with the alimentary tract in segments III., IV., and V. *Chloragogen cells* begin in segment VI. There is no *stomach.*

The *dorsal vessel*, covered with chloragogen cells, courses along the ventral side of the intestine, a little to the right of the middle line. The ventral vessel is situated in a corresponding position on the left.

The *cerebral ganglion* is widely indented in front, but is not indented behind.

Sexual organs were not present, nor was *asexual reproduction* in progress in any of the specimens.

The present form would seem to be one of the best marked species of the genus, and the characters of the posterior end appear to be quite distinctive. It is of course true, as has been pointed out by Michaelsen (6), that the gill-bearing hinder end of species of *Dero* (including *Aulophorus*) is liable to vary considerably according to whether it has or has not been completely developed after the process of fission ; and Bousfield (4) had previously drawn attention to the great differences which exist between the conditions of contraction and full expansion.

In the present case however the distinctive features of the hinder end are due to a characteristic difference of type ; and it is impossible to refer the peculiarities of the species to difference in degree of development or to differences of contraction or expansion. The chief peculiarities are, that for the greater part of their extent the gills are long ridges only ; and that while in the case of the posterior gills the ridges dissociate themselves from the wall of the fossa so as

to end freely within the latter, these freely ending processes are anterior, and directed forwards within the fossa, instead of pointing backwards as in other species.

Aulophorus palustris, Mchlsn.

(Plate I., Fig. 5.)

Several specimens, in the same tube as *Limnodrilus socialis* and *Dero zeylanica*. Hill country, Kandy, Ceylon, 1,600 feet.

The *length* varied from 3 to 4·5 mm.; but these were all single animals, no chains of two or more being met with; it appeared however that chains of two animals had existed in the material, but had broken asunder at the budding zone. *Breadth*, maximum ·3 mm. *Segments*, maximum 52; several of 35 segments; the anterior of two zooids which had broken apart at the budding zone showed 22 segments.

The *prostomium* is short and rounded; the anterior end of the animal is gently swollen, and is thickest at the level of segment IV.; the thinnest part of the animal is at segments VI.–VII., so that this region has somewhat the appearance of a neck. There are no *eyes*.

The hinder end of the animal bears the gills and palps. The *palps* are a pair of long slender projections from the posterior lip of the branchial funnel; in length they appear to be about equal to the longest gills; in breadth they taper gently from a diameter of 60 μ at their base to 16 μ at their tip; the tip is not expanded; their cavity is not, as is that of the gills, crossed by strands or stellate cells. The *gills* are inserted within the margin of the funnel, which has a complete dorsal lip. There are four pairs of gills, each gill being a sausage- or finger-shaped process, of the same diameter throughout. In breadth they are about 60 μ; the length varies, the longest being about ·4 mm.; the most dorsally placed are the shortest, about ·08 mm., and arise furthest forward, within the dorsal (anterior) lip of the branchial funnel. The cavity of each gill is crossed by numerous very regularly arranged strands or partitions, which give it a segmented appearance, as if it were made up of a series of separate chambers; a nucleus is easily visible in the middle of each strand. The same appearance is seen in sections of a gill cut longitudinally; in transverse sections however the partition appears as a large single stellate cell.

The *dorsal setæ* begin on segment V.; each bundle consists regularly of one capillary and one needle seta. The capillary seta does not exceed the diameter of the body in length; the needle seta is about 51–55 μ long, sickle-shaped, forked at the free extremity, with a slight nodulus at the junction of the curved with the straight portion of the shaft (fig. 5*a*).

The *ventral setæ* of segments II.–IV. (fig. 5*b*) differ somewhat from those behind; they are four or five per bundle, 76–84 μ in length, with the usual double curve and forked extremity; the

distal prong of the fork is twice as long as the proximal, but only two-thirds as broad at its base ; the nodulus is markedly proximal to the middle of the length of the shaft (proximal : distal : : 34 : 50 or 34 : 42). Behind segment V. the ventral setæ (fig. 5*c*) are four per bundle, except posteriorly, where bundles of three and then of two setæ occur ; the prongs of the fork are equal in length, the distal prong however is only half as thick as the proximal ; the nodulus is markedly distal to the middle of the shaft (proximal : distal : : 40 : 28 or 42 : 26). In length they are shorter than the setæ of the most anterior segments (68 μ) ; the proximal curve of the shaft is ample, and better marked than in the anterior setæ ; but I could not discover any considerable difference in thickness between the two groups.

The *buccal cavity* is tubular, and extends through segments I. and II. ; the *pharynx*, in segments III.–IV., is lined by elongated columnar ciliated epithelium, the cells being specially long in the dorsal wall ; the musculature of the pharynx is weak, and there is nothing to suggest that the pharynx is protrusible, or that it can act as a sucker, as in *A. tonkinensis* (9, 10). *Septal glands* are present in segments IV. and V., situated laterally and dorsolaterally on the alimentary canal ; they are attached to the front faces of septa 4/5 and 5/6, and consist of aggregates of large ovoid or pyriform cells ; a few such cells are also seen in segment VI. The *œsophagus* extends through segments V.–VIII., when the tube dilates to become the *intestine ;* there is thus no stomach. *Chloragogen cells* begin in segment VI.

The *dorsal vessel* has a ventro-lateral position to the left of the middle line throughout the greater part of its extent. It becomes lateral in segment VII., and dorsal in VI., according to the evidence of sections. The lateral commissures could not be made out.

In *asexual reproduction* $n = 22$ (three instances). None of the specimens showed any trace of sexual organs.

In 1905 Michaelsen (7) published the following provisional diagnosis of a species of *Aulophorus* collected by Stuhlmann in 1888 in Zanzibar, reserving all description of the animal till later : " Länge etwa 9 mm., Dicke max. ·3 mm., Segmentzahl etwa 50. Dorsale Borstenbündel am 5 Segment beginnend, mit Haarborsten und gabelspitzigen Hakenborsten. Kiemennapf mit 4 (5 ?) Paar fingerförmigen Kiemen. Palpen schlank, am Hinter- (Unter-) Rande entspringend."

No further account has however appeared ; and it must therefore remain somewhat doubtful whether my identification of the present species with it is correct. The agreement is fairly close ; I do not regard the difference in length as of great importance. I might add that I saw no reason, from an examination of the limited number of specimens at my disposal, to suppose that more than four pairs of gills were ever present ; and that I am in some doubt as to how far

the term " Hakenborsten," which Michaelsen applies to the shorter dorsal setæ of *A. palustris*, can be used for those of the present form. The definition of a " Hakenborste " is " eine verhältnismässig kurze .....S-förmig gebogene Borste.....," (Michaelsen, 5) ; and it is evident that the dorsal setæ of the present form are not, as are the ventral setæ (to which the term" Hakenborsten " is properly applied), curved like the letter S. The dorsal setæ of the form here described are more properly termed needle-setæ, since " eine Nadelborste entsteht aus der Hakenborste, wenn diese ihre S-förmige Krümmung aufgiebt " (ib. id.). The point is of some importance, as owing to the degree of variability in the development and possibly in the number of the gills in this and the allied genus *Dero*, the setæ may probably be found to afford a more reliable means of discrimination of the several species (*cf.* Michaelsen, 6).

Hesperodrilus zeylanicus, sp. nov.

(Plate I., Fig. 6.)

A single specimen, found crawling on the under surface of a stone aken from a streamlet running down the bank of the lake in very marshy ground, Nuwara Eliya, Ceylon, 6,000 feet.

The specimen was curled up, and damaged (nearly severed) at one place near the posterior end ; many of the dorsal setæ had also been broken off. The *length* was estimated at 8 mm. ; *breadth*, maximum ·6 mm. ; *segments* 34 with a small undifferentiated region posteriorly. *Prostomium* short, bluntly conical ; the length from tip of prostomium to mouth is about equal to the length of a body-segment. *Clittellum* 1/5 XII.–XIII. = 1 1/5.

The *dorsal setæ* begin in segment III., and are all capillary ; they vary in thickness, some being much stouter than others ; this difference exists in many cases between the setæ of the same bundle. The largest number in a bundle was five ; four were counted not infrequently. In length, the longest (·58 mm.) are about equal to the diameter of the body.

The *ventral setæ* are as a rule two per bundle ; of the two, one is a simple hook, while the other is forked at its free end (fig. 6) ; both have the usual double curve. The forked setæ are 118–123 μ long ; the prong on the outside of the curve is much the smaller, being only about half as long, and one-third as thick at its base, as the other ; the nodulus is slight, and is markedly distal to the middle of the shaft (distal : proximal : : 45 : 73 or 47 : 76) ; the shaft is stout—6·3 μ broad—considerably stouter than that of the singly pointed setæ.

The singly pointed setæ are about the same length as the forked setæ ; the curves of the shaft are slightly less pronounced ; there is no nodulus ; and the shaft, though varying in thickness in different bundles, is considerably thinner (*e.g.*, 3·4 μ) than that of the doubly pointed setæ.

As stated, the rule is that a ventral bundle is constituted by one seta of each kind ; in segment VII., however, and again in XIV., there were two such pairs on each side. In segment XII., on which are situated the openings of the male ducts, there are no ventral setæ.

With regard to the *alimentary canal*, the following features may be briefly noted. The epithelium of the buccal cavity is flat, as is also that of the floor of the pharynx ; the roof of the pharynx is lined by columnar, richly ciliated cells. The pharynx passes into the œsophagus without any sharp line of demarcation, and this latter becomes the intestine in segment VIII. There is no stomach. A number of large, deeply staining cells are attached to both sides of septa 4/5, 5/6, 6/7, and there are a few also on 7/8.

The *cerebral ganglion* is very intimately attached to the roof of the pharynx. The *ventral nerve cord* is closely united with the ventral body-wall, which in transverse sections shows a median ventral groove externally, corresponding to the line of the nerve cord ; there are three giant fibres dorsally in the cord, the middle one being the largest.

The *testes* are in segment XI. ; sperm morulæ were found in segments X. and XI., dorsal to the alimentary canal, and not enclosed in sperm-sacs. The *sperm funnels* are situated on the anterior face of septum 11/12 ; the *vas deferens* is seen ventral to the intestine in XII. ; as is explained below, I did not follow it throughout its course ; it appears however finally as a thin tube, 12–15 μ in diameter, running forwards from the level of septum 13/14 and arching dorsally to join the proximal (upper) end of the *atrium*. This latter is a conspicuous glandular-looking mass, vertically elongated, situated in the anterior part of segment XIII. ; it narrows towards its lower end and is prolonged obliquely forwards to the male aperture on segment XII.

The *spermathecæ* are ovoid sacs, 80 × 70 μ and 120 × 95 μ respectively, situated dorsally, one in segment XIV., the other in XVI. The first, in XIV., was provided with a long narrow duct, 20 μ in diameter, leading directly ventralwards. The second, in XVI. (slightly the larger of the two), possessed a duct which, wider at first than in the previous case, narrowed gradually and led first downwards, and then forwards ventral to the intestine in segment XV., to open externally behind the ventral setæ of XIV., in or near the intersegmental furrow 14/15.

I very much regret that owing to an unfortunate accident my series of sections of this unique specimen was so damaged as to be of little use in working out its anatomy. Fortunately the worm was of small size, and consequently was transparent enough to allow of a more or less complete account of its anatomy being written from observations made while it was in cedar oil, before embedding. The chief points of interest which have escaped me are the nephridia,

the female organs, and a portion of the course of the vas deferens. The location of the various organs was definitely determined in the entire specimen, and I was able to confirm this in the sections ; the characters of the spermathecæ and their ducts, and the fact of the entry of the vas deferens into the proximal end of the atrium, were also made out by both methods.

Of the four species of *Hesperodrilus* recorded by Beddard (1, 2) from South America (where alone, so far, the genus has been found), two (*H. albus* and *H. pellucidus*) showed the same form of " cephalization " which occurs commonly among the Naididæ, that is, the dorsal setæ began at a level posterior to the beginning of the ventral setæ. The present species shows the same peculiarity, the dorsal setæ beginning in the third, the ventral as usual in the second segment. It is immediately distinguished, however, from both *H. albus* and *H. pellucidus* by the much shorter prostomium and the ventral position of the spermathecal apertures.

The present species displays, in addition, a number of other peculiarities, which, though striking, have possibly not the same morphological value. Thus the atrium is in segment XIII. instead of XII., and the spermathecal apertures in the posterior part of XIV. instead of in XIII. ; in other words, while in the genus *Hesperodrilus* as a whole the genital organs are displaced one segment backwards as compared with most Tubificidæ, in the present specimen the posterior half of the genital organs show a backward displacement of *two* segments.

Among the specimens of *H. albus* examined by Beddard was one which showed the genital organs in the usual Tubificid position, *i.e.*, displaced one segment *forwards* as compared with the rest of the genus. Since therefore the position of the genital organs is variable in at least one species of *Hesperodrilus*, it may be so in the present case also, and it is possible that the peculiar disposition here recorded is merely an individual variation.

My failure to detect the female apparatus may have been due to the fact that the specimen was only in an early stage of sexual development ; and the absence of sperm-sacs may perhaps also be due to the same cause. It is however unlikely that the entry of the vas deferens into the proximal portion (instead of the distal, as in other species of *Hesperodrilus*) of the atrium can be similarly explained.

The following diagnosis, I believe, omits all doubtful points, of both the kinds exemplified above :—

Hesperodrilus zeylanicus, sp. nov. Length 8 mm., breadth ·6 mm., segments 34 ; prostomium about the length of an ordinary body-segment ; clitellum 1/5 XII.–XIII. = 1 1/5. Dorsal setæ begin in III., up to 5 per bundle, capilliform, longest equal to diameter of body. Ventral setæ in pairs of one forked and one singly pointed seta ; one, or occasionally two, such pairs on each

side in each segment (except I. and XII.); the singly pointed seta thinner than the forked one, and without nodulus; the outer prong of the forked seta much smaller than the inner, the nodulus markedly distal. Vas deferens enters atrium at the proximal end of the latter. Spermathecæ ovoid, with long narrow ducts; spermathecal apertures ventral

Ceylon (Nuwara Eliya).

Limnodrilus socialis, Stephenson.

This worm occurs twice in the present collection, both batches of specimens having been taken at Kandy (hill country, 1,600 feet). In one case Dr. Annandale notes that "these worms were very numerous in the mud at the bottom of a pool of very dirty water in a disused tunnel frequented by bats." The other tube contained also the specimens of *Dero zeylanica* and *Aulophorus palustris* (v. ant.); these "were taken in the mud left in a small depression in the bed of a bathing-pool formed by the overflow of the Kandy lake. The pool had just been emptied in order that it might be cleaned, and the worms must originally have been in 5 or 6 feet of water."

The rarity of Tubificidæ throughout the whole of the Indian region (only three species having been so far recorded), and the striking similarity in behaviour, has caused me to suspect that this species may be that referred to by Willey in his recent book on "Convergence in Evolution" (13). Writing of the similarity in appearance and habits between the larvæ of *Chironomus* and the Tubificidæ, he says of the latter (with special reference to an unnamed species of *Limnodrilus* from Ceylon):—"They keep the head and fore-body buried in the mud, whilst the hinder portion of the body, through which respiration is effected, is kept constantly waving as near the surface of the shallow water as possible. When alarmed, an entire colony will instantly withdraw out of sight into the mud as with one consent ..... *Limnodrilus*, as observed by me in Ceylon, forms dense aggregates of individuals surrounded by mud, but does not form definite tubes which can be isolated from the clumps."

The above has such a striking resemblance to my original description of the habits of the worm as observed at Lahore (11), that, with these specimens, also from Ceylon, before one, it is difficult to believe that the species are not the same.

This worm is apparently widely distributed in the East; I have received specimens from Calcutta also. When in Kashmir last summer I saw, in a pool at Baramula, a colony of what I believe to have been this species; though, as I had of set purpose omitted to take any apparatus with me, this remains for the present a conjecture only.

Drawida annandalei, sp. nov.

(Plate I., Fig. 7.)

A single specimen.

Tanjore, South India; from the river Caveri, in the mud below the water; October, 1911.

External Characters.—*Length* 35 mm.; *width*, max. 1·75 mm.; *Colour* olive. *Segments* 137.

Prostomium prolobous.

Clitellum 2/3 X.–2/3 XIII. = approximately 3 1/3, but not well marked.

Male and *female pores*, and *spermathecal apertures*, not seen externally.

A *genital area* is present on segments X. and XI. This is a slightly darker oval patch, with its longer diameter transverse, along the line of furrow 10/11; the patch lies between the ventral setæ of X. and those of XI.; within it, a smaller oval area is marked out by a slight ridge, as shown in the figure (fig. 7).

The *setæ* are closely paired. The interval *aa* is less than *bc*; and *dd* is equal to about half the circumference.

Internal Anatomy.—*Septa* 5/6–8/9 are much thickened.

The *pharynx* exhibits a dorsal pouch, which, according to the evidence of sections, opens into the pharynx by a narrow longitudinal slit, while expanding laterally in the pharyngeal wall above this. Three *gizzards* are present in segments XII., XIII., and XIV.

Hearts are present in segments VI.–IX.

Male Organs.—The large *testicular vesicles* are suspended by septum 9/10, and project forwards into IX. and backwards into X. The *funnel* is a part of the wall of the sac, the mouth of the funnel being but little dilated, and situated at about the level of the septum (9/10). From this the *vas deferens* proceeds; this is a coiled tube, situated in segments IX. and X., penetrating the prostatic cells to open into the inner (proximal) end of the atrium. The *atrium* of the one side is a tube, vertically placed in segment X., lined with high columnar epithelium, outside which is a muscular layer; outside the muscular layer again is a thick covering of *prostatic gland cells;* the whole organ (atrium + prostatic investment) is somewhat longer in the vertical direction than it is thick; it occupies the segment from the dorsal body-wall above to the ventral below; ventrally the lumen penetrates the body-wall to open at the *male aperture* in furrow 10/11, in the line of the ventral setæ. There is no *copulatory pouch*.

On the other side of the body the atrium with its glandular investment is pressed down, in the sections, against the ventral body-wall, in such a way that the vas deferens enters it anteriorly.

Female Organs.—The *ovary* is in segment XI., as is also the *funnel;* the *female aperture* is in furrow 11/12. The large *ovisacs*

extend backwards through several segments from septum 11/12, as far as segment XVI. ; they are dilated in their posterior portions.

The *spermathecæ* are in segment VIII. ; they are comparatively small spherical sacs, with a much-coiled duct in the same segment. This duct comes forwards into VII., where it joins the posterior face of the muscular spermathecal atrium near its base. This muscular sac is of moderate size ; narrowing at its base, it becomes a tube which runs for a short distance in a lateral direction to open externally in furrow 7/8.

Remarks.—This species is on the whole not unlike *D. ramnadana*, Mchlsn. (9), from which however it is distinguished by two important features : (1) the presence of a characteristic copulatory area ; (2) the fact that the vas deferens enters the prostatic mass at the proximal (inner) end of the latter, not at its basal front, in the thickness of the body-wall.

LAMPITO MAURITII, Kinb., var. ZEYLANICA, var. nov.

Two specimens, one not fully mature.

In rotten wood, in the hotel compound, Anuradhapura (low country), Ceylon. October, 1911. In a tube along with a specimen of *Dichogaster affinis*.

EXTERNAL CHARACTERS.—*Length* 4 inches ; *breadth* 3 1/2 mm. *Colour* gray. *Segments* 147.

Prostomium prolobous.

First *dorsal pore* in intersegmental furrow 12/13.

The *clitellum* extends over segments XIV.–XVII. = 4 ; it does not obliterate the limits of the segments ; setæ are present on the clitellar segments.

The *male apertures* are situated in large round sucker-like depressions, with raised and swollen margins, on segment XVIII. The interval between the apertures is equal to 1/4 of the circumference ; there are no setæ in this interval.

The *female aperture* is not very conspicuous, median, on the anterior part of segment XIV.

I failed to see the *spermathecal apertures ;* and there are no other genital marks of any kind.

The *setæ* are in a chain, which is interrupted both ventrally and dorsally. Ventrally $aa = 3\,1/2\,ab$ (in front of the clitellum $= 3\,ab$) ; and dorsally $zz = 2\text{–}2\,1/2\,yz$. There is no regular difference between the setal intervals in different parts of the chain ; no setæ are specially enlarged. The numbers of setæ are as follows :—36/VI., *ca.* 45/IX., 33/XIX., 33/XXV., and 34 in the middle of the body.

INTERNAL ANATOMY.—Septa 6/7 and 7/8 are somewhat thickened, 8/9–12/13 much thickened, and 13/14 again somewhat thickened.

The *gizzard* is in segment VI. There are yellow bulgings of *the œsophagus* in XI. and XII., but no calciferous glands. The

intestine begins in XV., and there are no diverticula (as far back as segment XXXIV. at least).

The last *heart* is in segment XIII.

There is one pair of *meganephridia* per segment behind the male apertures, as well as *micronephridia*.

Male Organs.—The *testes* and *seminal funnels*, the latter white and glancing, are free in segments X. and XI. The *vesiculæ seminales* are paired, and much cut up into small lobules, in segments IX. and XII. The *prostates* are comparatively small, the prostatic duct thick and S-shaped. Separate from the prostate, and close to the terminal portion of its duct, is a small gland attached by a short stalk to the inner surface of the body-wall; it is of the same opaque whiteness and the same texture as the prostate; on the one side this accessory gland was situated some little distance anterior, on the other side posterior, to the end of the prostatic duct. The *penial setæ* are ·83 mm. in length, 22–27 μ in breadth, curved, and then very slightly recurved again, distally; the free end appears bifid, the two limbs resembling the limbs of a horseshoe; above the free end are a number of prominent spines, arranged in irregular circles round the distal portion of the shaft, with which they make an acute angle.

Female Organs.—The *ovaries* and *ovarian funnels* are in XIII. The *spermathecæ* open in the furrows 6/7, 7/8, and 8/9; there are thus three pairs. The ampulla of each is bent on itself; when straightened it is fusiform, narrowing distally to the external aperture, without separate duct. From its base arise one or two minute club-shaped diverticula, from 1/8 to 1/4 as long as the ampulla; on the left side, only the posterior of the three spermathecæ had two diverticula; on the right side, the two hinder spermathecæ had two diverticula, the anterior only one.

Remarks.—The features wherein the present form appears to differ from the typical form, as described, for example, in Michaelsen's "Oligochæta" in the Tierreich, are the following:—The head is prolobous; the chain of setæ is very distinctly interrupted, both dorsally and ventrally ($aa = 3\ 1/2\ ab$); no setæ are noticeably enlarged; the setal intervals *ab*, *bc*, *cd*, &c., do not undergo a regular diminution dorsalwards; the first dorsal pore is in 12/13. Less important, perhaps, are the small size of the prostates, the smaller penial setæ, the variability of the spermathecal diverticula; the large round papillæ, on which, in the typical form, the male pores are situated, are here represented by sucker-like areas with a prominent circular rim.

Megascolex annandalei, sp. nov.

One sexually mature specimen.

Pattipola, Ceylon, hill country, 6,000 feet. In rotten wood of dead tree stumps and logs in jungle.

External Characters.—*Length* 2 1/2 inches; *breadth*, maximum 3 mm.; *segments* 120. *Colour* pale olive.

Prostomium small, prolobous. First *dorsal pore* in furrow 9/10; dorsal pores extremely distinct in some regions.

Clitellum not distinct, apparently XIV.–XVI. = 3.

Male pores on XVIII., on papillæ, in a common slightly elevated transversely extended glandular area; the pores in line of setæ *b*, separated by an interval equal to 1/5 circumference.

Copulatory areas as single ventral oval patches on segments XI., XII., and XV.; the one on XV. encroaching slightly on XIV.; the outlines of the other two flattened where they touch, along the furrow 11/12. The area on XI. was not precisely in the middle of the ventral surface, being displaced a little to the right.

Setæ in each segment numerous. A definitely limited mid-ventral tract is without setæ, as also a more indefinite mid-dorsal tract. The lines of setæ *a* and *b* are distinct and regular on each side; but the rest of the setæ are much less regularly arranged. The lines of the ventralmost setæ (*a* and *b*) converge inwards a little about the region of the male aperture, which is in line *b*. The setæ are small and difficult to count; the number per segment varies considerably, but is roughly 24–32 in the anterior part of the body. In the anterior part of the body *ab* = 2/7 *aa*, more posteriorly = 1/3 *aa*.

Internal Anatomy.—The *gizzard* is in VI.; in XV. the *œsophagus* appears as a rounded white mass; in XIX. the *intestine* begins.

The *nephridial system* is micronephridial. There is a large tuft of nephridial tubes on each side of the alimentary canal at the anterior end of the gizzard, a smaller one behind this on septum 6/7, and another on 7/8.

The first definite *septum* is 6/7, which is very thin; septum 7/8 is somewhat thickened.

The *male funnels* are one pair in X. and one pair in XI.; the *seminal vesicles* are in XI. and XII., and the lobular *prostates*, of moderate size, in XVIII.

The *spermathecæ* are one pair only, lying in segment IX. and opening at the level of furrow 8/9. The spermathecal sac is of an elongated ovoid shape, the duct being very short. A long tubular diverticulum springs from the base of the spermatheca; it is between three and four times as long as the spermathecal sac itself; this diverticulum may be somewhat coiled, and may extend for some distance across the middle line.

The *genital setæ* have a length of 4/5 mm., and a breadth of 24 μ. They are gently curved, the terminal portion being armed with small triangular teeth, distributed all round the circumference and not arranged in rows; the distal end tapers somewhat, and the extreme point is recurved and flattened.

MEGASCOLEX PATTIPOLENSIS, sp. nov.

(Plate II., Fig. 8.)

A single specimen. From the same locality as the last.

EXTERNAL CHARACTERS.—*Length* 2 inches ; *breadth* 2 1/2 mm. ; *segments* 129.

Prostomium prolobous, with in addition a pair of small grooves, leading backwards from the hinder limit of the prostomium through 1/3 of segment (combination of pro- and epilobous characters).

First *dorsal pore* in intersegmental furrow 5/6.

Clitellum absent (or not yet developed).

Male apertures on papillæ, in segment XVIII., in line of setæ *b*; interval between male apertures = 1/3 circumference ; the papillæ of the two sides connected by a narrow transverse ridge (fig. 8). *Female aperture* not observed.

Spermathecal apertures not very conspicuous, in furrow 8/9, in line of setæ *b*.

Genital papillæ (fig. 8) on segment XIX., transversely oval, their centre in line of setæ *b*; while abutting on furrow 18/19 they do not occupy the whole length of the segment antero-posteriorly ; in a transverse direction they extend from about the line of setæ *a* to an equal distance on the other side of *b*. Another pair of small, transversely elongated papillæ is situated in furrow 17/18, in front of and bordering on the anterior edge of the papilla of the male aperture on each side.

The *setæ* are sometimes difficult to see. Ventrally the setal ring is broken in each segment ; *aa* = 2 *ab* (segment XVII.) or 2 1/2 *ab* (XX. and further back) ; *ab* = *bc*, *bc* is slightly greater than *cd* ; *cd* = *de* approximately ; but though *a* and *b* are in regular longitudinal lines throughout the body, *c*, *d*, and *e* are placed somewhat irregularly posteriorly.

Dorsally to *e* are a few (*e.g.*, in the middle of the body, 4) more setæ, irregularly placed. Anteriorly *zz* = about 3 *yz* on the average ; in segment XIII. *zz* = 2 *yz*., at the junction of middle and posterior thirds of the body = 1 1/2 *yz*., and at the posterior end *zz* = *yz*. Thus the line *z* is irregular.

Number of setæ : 20/XIII. ; in middle of body 20 ; at junction of middle and posterior thirds 24 (12 on each side) or 25 (12 and 13 on each side respectively).

INTERNAL ANATOMY.—*Septum* 6/7 is (?) slightly thickened : septa 7/8 and 8/9 are moderately, 9/10 and 10/11 considerably strengthened.

There is a large *gizzard* in segment VI. *Calciferous glands* are present in XV. and XVI., appearing as lateral swellings on the œsophagus, which narrows again in XVII., and dilates to form the intestine in XVIII. There are no intestinal diverticula (at least as far back as XL.) A *typhlosole* is present.

The last *heart* is in segment XIII.

Numbers of small separate *micronephridia* are present.

The male *funnels* are free, in segments X. and XI. The *vesiculæ seminales*, in XI. and XII., are lobulated masses surrounding the alimentary canal. The *prostates* are of moderate size, simple rounded masses, not lobulated, with stout white ducts ; the whole resembling a mushroom. No *penial setæ* observed.

The *spermathecæ* are one pair, opening between VIII. and IX. ; spindle-shaped, with a short thick duct, and a finger-shaped diverticulum as long as the ampulla, attached to the duct at the base of the ampulla.

Megascolex bifoveatus, sp. nov.

(Plate II., Fig. 9.)

Two specimens. From the same locality as the last.

External Characters.—The specimen examined was incomplete at its hinder end ; in *length* it measured 1 2/3 inch ; *breadth*, max. 3 mm., but narrower in front of the clitellum ; the anterior end (first few segments) tapering. *Colour* light gray, with a pinkish tinge on dorsal surface anteriorly. *Segments* > 85 (after dissecting the incomplete specimen I unfortunately, on subsequently meeting with a complete specimen, omitted to count the segments of the latter).

Prostomium epilobous 3/5–3/4.

First *dorsal pore* in intersegmental furrow 5/6.

Clitellum embracing segments XIV.–XVI. = 3 ; setæ present as regular rings on clitellar segments.

Male apertures on segment XVIII. as small pits, surrounded by small oval areas which however are not elevated. The apertures are 1/7 of the circumference apart, approximately in the line of seta *d* ; but no setæ are present in the interval between the apertures.

Female aperture indistinct, apparently mid-ventral on segment XIV.

Spermathecal apertures in furrows 7/8 and 8/9.

Genital marks are present as a pair of conspicuous oval pits, with the long axis transversely placed in furrow 19/20, the centre of each situated slightly internal to the line of the male apertures.

The *setæ* form a ring in each segment, which is almost closed both dorsally and ventrally. Dorsally the interval is irregular ; $zz = 2\,yz$ approximately. Ventrally $aa = 2\,ab$ regularly. The setæ on the ventral side are placed somewhat closer together, in the anterior part of the body at least, than on the dorsal side. Number of setæ 39/V., 40/IX., *ca.* 41/XIX., 42/XXVIII.

Internal Anatomy.—The first distinguishable *septum* is 5/6 ; 6/7–8/9 are somewhat thickened, 9/10–13/14 considerably so, 14/15 and 15/16 moderately.

The *gizzard*, situated in segment VII., is not large nor very hard. There are no *calciferous glands*. The *intestine* begins in XV.

The last *heart* is in segment XIII.

Very numerous small *micronephridia* are present in each segment.

Male Organs.—Testes were not distinguished. The male *funnels* are free in segments X. and XI. *Vesiculæ seminales* are situated in XI. and XII., paired, of large size, much lobulated, the lobules forming grape-like masses. The *prostates* are of moderate size, occupying segments XVIII., XIX., and XX.; they are also much lobulated; the duct is straight and stout, arising from the gland in XVIII.

The *ovaries*, in segment XIII., are comparatively large, and fan-shaped, folded longitudinally. The female *funnels* are small.

The *spermathecæ* are two pairs, opening in furrows 7/8 and 8/9; the ampulla of each is circular, flattened between the gizzard and the body-wall; the duct is short and fairly thick; a small diverticulum, of an elongated ovoid shape, and one-quarter as long as the ampulla, arises from the duct.

On opening the ampulla, the upper end of the duct is seen to be invaginated into the cavity of the ampulla.

The *genital setæ* (fig. 9) are ·72–·75 mm. long, and 14–16 μ thick. They are almost straight, except at the distal end, which is curved to form the quadrant of a circle. The distal end (except the extreme point) is ornamented with finely sculptured dots, which are arranged in four circles one above the other.

Megascolex curtus, sp. nov

(Plate II., Fig. 10.)

A single specimen, incomplete at its posterior end. From the same locality as the preceding.

External Characters.—*Length* of the fragment 1 1/2 inch; *breadth* 3 mm.; *colour* light gray; *segments* present 90.

Prostomium epilobous 1/3.

First *dorsal pore* in intersegmental furrow 13/14.

The *clitellum* embraces segments XIV.–XVII., = 4; it extends all round the circumference, but is less well marked ventrally in XVII. Setæ are present on the clitellar segments.

The *male apertures* are on small papillæ on segment XVIII., in the line of setæ *b*, 1/7 of the circumference apart. The surrounding and intervening parts of the body-wall are thickened, wrinkled, with irregular depressions just anterior and internal to the male apertures, and an elevation in the mid-ventral line.

The *female aperture* was not distinguishable.

The *spermathecal apertures* are one pair, in furrow 8/9, apparently between the lines of setæ *b* and *c*; but these apertures were very inconspicuous.

Genital papillæ are present as two median ventral large flat oval elevations. Of these, one is situated on segment XX., occupying the whole length of the segment and encroaching forwards on XIX. as far as the middle of this segment; transversely it extends from the line of setæ *a* on one side to the same line on the other side

(the lines of the setæ converge inwards somewhat at this region). The other papilla is slightly larger than the first; it is situated on segment XII., encroaching however on the neighbouring segments (for about half the length of XIII. and one-third the length of XI.); it has a very faint circular elevation at its centre; transversely it extends from a point between the setal lines *a* and *b* on one side to a corresponding point on the other side.

The *setal rings* are broken both dorsally and ventrally. Dorsally $zz = 2\ yz$ in the anterior, $= 4\ yz$ in the posterior part of the body; ventrally $aa = 3\ ab$ in front of clitellum, $= 4\ ab$ nearly behind clitellum. In front of the clitellum all the setæ are arranged in regular longitudinal lines, in 6 pairs on each side, or 24 setæ per segment; $ab < bc$; $cd = ab$. In the hinder part of the specimen the setæ were frequently difficult of observation; while *a* and *b*, *y* and *z*, were throughout arranged in definite longitudinal lines, the more laterally placed setæ appeared to be more irregularly distributed; the number of setæ per segment was, at least approximately, the same (24). The setæ of segments II.–VII. were moderately enlarged.

Internal Anatomy. *Septa* 8/9–10/11 are moderately thickened.

The *gizzard* is in segment VI. There are no *intestinal cæca* (as far back as segment XL).

The *nephridial system* consists of micronephridia.

The *male funnels* are free, in segments X. and XI.

The *vesiculæ seminales*, in XI. and XII., are much lobulated, and extend unbroken across the middle line dorsally. The *prostates* are small and compact, the duct thin and straight.

The *spermathecæ* lie in segment IX., with their apertures in furrow 8/9. The ampulla has an inverted pyriform shape; the duct is moderately thick, and nearly as long as the ampulla. The diverticulum is very long, and extends inwards as far as the middle line; it is bent on itself at the junction of its inner and middle thirds, the inner third thus lying alongside the rest; the diverticulum is of equal thickness throughout, being about as wide as the duct; its length, when straightened, is about three times that of ampulla and duct together (fig. 10).

Genital setæ are present, in length 7·25 mm., in breadth ·022 mm. The distal extremity is slightly broadened and flattened, and tapers to a blunt point. The last ·6–·7 mm. of its length is ornamented with small triangular teeth, irregularly distributed all round the circumference of the shaft.

Megascolex quintus, sp. nov.

(Plate II., Figs. 11 and 12.)

A single specimen. From the same locality as the last.

External Characters.—*Length* 2 1/2 inches; *breadth* 2 1/2 mm. *colour* light gray; *segments* 139. The specimen was contracted at the clitellar region.

Prostomium epilobous 1/2.

First *dorsal pore* in intersegmental furrow 6/7.

Clitellum not developed.

Male apertures on segment XVIII., in line of setæ *b*, 1/6 of the circumference apart, on very small inconspicuous whitish papillæ. The male apertures are included in a slightly raised *genital field* (fig. 11), of somewhat oval shape, which embraces the ventral portions of segment XVIII., half of XVII., and two-thirds of XIX. Also situated in the genital field are a pair of flat circular areas, each with a dark dot in the middle, occupying the anterior part of XVIII. and encroaching on XVII.; these areas are thus situated between and in front of the male apertures. The intersegmental furrow 17/18 is obliterated ventrally.

The *spermathecal apertures* are very inconspicuous, one pair, in furrow 8/9, just external to the line of setæ *b*.

The *setæ* form a ring, interrupted both dorsally and ventrally. Ventrally, $aa = 3\ ab$ nearly; dorsally, *zz* is quite an irregular interval. The more ventrally situated setæ (*ab*, *cd*, *ef*) form a series of regular longitudinal lines. Behind the clitellum, $\left.\begin{matrix} ab = bc = cd \\ = de = ef \end{matrix}\right\}$, but the differences are slight only. Seta *e* is about at the lateral line of the body; dorsal to *f* are two or occasionally three more setæ on each side, irregularly placed; thus there are usually 16 setæ per segment. In front of the clitellum the setæ are fewer, 6 only on each side. The setæ of segments II.–VI. are enlarged, especially *a* and *b*. Numbers of setæ: 12/V., 12/IX., 12/XIII., and 16 behind the clitellum.

Internal Anatomy.—*Septum* 7/8 is moderately thickened, septa 8/9–13/14 considerably, 14/15–17/18 again moderately.

The *gizzard* is in segment VI. *Calciferous glands* are present in XV. and XVI. as considerable dilatations of the œsophagus, very vascular, with a lamellated structure internally. The *intestine* begins in XVIII. No intestinal diverticula were seen.

The last *heart* is in segment XIII.

The excretory system consists of *micronephridia*.

Testes and *male funnels* are free in segments X. and XI. The *vesiculæ seminales*, paired, in XI. and XII. are racemose in form. The *prostates* are small, confined to segment XVIII.; the duct is thick, and straight except for a bend at its inner (proximal) end.

No *penial setæ* were discovered.

Ovaries were present in segment XIII., but the ovarian funnels were not seen.

The *spermathecæ* lie in segment IX., and open in furrow 8/9. The ampulla is elongated, and somewhat dilated proximally; there is no distinctly marked-off duct. The diverticulum is finger like, and joins the base of the ampulla. On the left side (fig. 12)

the ampulla was bent on itself, and the diverticulum was about 2/5 as long as the ampulla ; on the right side the ampulla was smaller and straight, and the diverticulum was almost as long as the ampulla.

Megascolex sextus, sp. nov.

(Plate II., Figs. 13 and 14.)

A single specimen. From the same locality as the last.

External Characters.—*Length* 4 inches ; *breadth* 2 mm. ; *colour* brown dorsally, with transverse segmentally repeated whitish markings along the lines of the setæ, light gray ventrally, the anterior end darker. *Segments* 114.

Prostomium epilobous 2/3 limited posteriorly however by a faint transverse marking between the hinder ends of the longitudinal grooves. The *first segment* is cleft in the middle line ventrally.

The first *dorsal pore* is situated in segment V., near the intersegmental furrow 5/6 ; and all the dorsal pores in the anterior part of the body are in front of the furrows.

The *clitellum* extends from 1/2 XIV.–XVI. = 2 1/2 ; the body is slightly swollen here, but otherwise there is no notable change in the character of the skin ; the setæ are quite obvious on all the clitellar segments.

The *male apertures* are on papillæ on segment XVIII., 1/4 of the circumference apart from each other ; no setæ occur in the interval between the apertures.

The *spermathecal apertures* are in the furrows 6/7 and 7/8, and are nearly half the circumference apart.

There are two pairs of *genital papillæ*. One pair, in furrow 17/18, are small whitish elevations, slightly internal to the line of the male apertures. The others, in furrow 9/10, are a pair of conspicuous oval papillæ, their long axis transversely placed, with eye-like markings in the centre ; they are situated internal to the line of the spermathecal apertures, a little more than 1/5 of the circumference apart.

The *setæ* are disposed in rings, which dorsally are almost closed ; ventrally *aa* = 2 *ab* posteriorly, or in front of the clitellum often = 2 1/2 *ab*. The setæ are at approximately the same distance apart at all parts of the chain. Number of setæ : *ca.* 36/V., *ca.* 40/IX., 36/XV., 50/XIX., and posteriorly 50.

Internal Anatomy.—*Septa* 9/10–13/14 are slightly thickened.

The *gizzard* is in segment VII. The *intestine* begins in XIV. The last *heart* is in XIII. The excretory system consists of *micronephridia*.

The *testes* and *seminal funnels* are in segments X. and XI., enclosed in testicular sacs which are connected dorsally over the œsophagus in each segment. The funnels are large, brilliantly glancing, and iridescent.

The *vesiculæ seminales* are paired, in segments XI. and XII., comparatively small in size, not lobulated. The *prostates* are lobulated, and occupy four segments, XVIII.–XXI.; the duct is stout, originates in XIX., and runs obliquely forwards to open in XVIII.

The *ovaries* are large, and are situated, with the *ovarian funnels*, in segment XIII.

The *spermathecæ* (fig. 13) are two pairs, in segments VII. and VIII., opening in the furrows 6/7 and 7/8. The ampulla is somewhat flattened, irregularly circular and sac-like; the duct is very broad, and nearly as long as the ampulla, from which it is not sharply marked off. The diverticulum is very small, club-shaped, and arises from the junction of ampulla and duct.

The *genital setæ* (fig. 14) are in length ·94 mm., in breadth 16–18 μ. The distal end is curved through about the quadrant of a circle, is tapering and pointed, and is ornamented by a single circle of minute sculpturings at the commencement of the terminal curve.

Pheretima hawayana, (Rosa).

For reasons to be subsequently assigned, I give an account of some of the anatomical features of the single specimen of this species in the present collection. It was found, along with the six species of *Megascolex*, in the rotten wood of dead tree stumps and logs in the jungle, at Pattipola (hill country), Ceylon, 6,000 feet.

External Characters.—*Length* 2 inches; *breadth* 2 1/2 mm. *Colour* yellowish brown. *Segments* 91.

Prostomium epilobous 1/2.

First *dorsal pore* in intersegmental furrow 10/11.

The *clitellum* comprises segments XIV.–XVI. = 3; it is annular in form, and has a few small setæ ventrally on segment XVI. only.

The *male apertures* are on segment XVIII., widely separated, and not elevated. There are twelve setæ intervening between the apertures; these setæ however do not approach very near to the inner margins of the apertures themselves.

The *female aperture* is presumably situated in a small, mid-ventral, somewhat transversely extended depression on segment XIV.

The *spermathecal apertures* were invisible from the exterior.

Genital markings were present in the form of a number of spots to the inner side of the male apertures. These were of a dark colour, and were, I think, somewhat depressed, certainly not elevated. There were four such spots on the left, and two on the right side, in a transverse line slightly behind the level of the male apertures, and therefore behind the level of the setæ. A minute darkish spot was also visible ventrolaterally on the left side of segment VIII., just in front of furrow 8/9.

The *setæ* form a ring in each segment, which behind the clitellum is almost closed dorsally ($zz = 2\ yz$ or less); in the first few segments of the body, zz is a wide interval, and yz is also much wider than posteriorly. Ventrally the ring is quite, or almost, closed; if not quite closed, the line of setæ a, and the interval aa, is irregular. As far back as segment IX., the setæ on the ventral surface are arranged at very irregular, and in some segments very wide, intervals. The ventral setæ of segments III.–IX. are enlarged; those of X. are quite small.

Internal Anatomy.—The lower margin of the *intestinal diverticula* has a crenated appearance.

The *prostates* are large, occupying six segments; the duct forms a single loop. On the right side there were four *accessory glands;* and on the left side two only, somewhat larger than those of the right; there is thus no direct relation to the number of dark spots seen externally, the numbers for each side, four and two, being reversed.

The *spermathecæ* open between segments 5/6, 6/7, and 7/8; there are thus three pairs. The ampulla is circular in shape, and flattened; the duct is narrow, and nearly as long as the ampulla; the diverticulum, in most cases directed inwards towards the middle line, is narrow, nearly as long as ampulla and duct together, and dilated at its inner extremity.

Remarks.—In a recent Paper on some earthworms from Yunnan and the Shan States (12), I have described some specimens of *P. hawayana* which very much resemble the above. The interest lies in the fact that they are in some respects intermediate between the typical form of *P. hawayana* and the sub-species *barbadensis*.

These two forms were previously described as separate species, and are so considered by Michaelsen in the Tierreich (5). Beddard however (3, p. 645) considered that they should be united; and this Michaelsen (9, p. 187) accepts, with however the following proviso: "I am not yet quite convinced that this view is correct. Till now I have not seen a specimen—and I have examined many—which aroused any doubt as to whether it should be placed in the typical form or in the sub-species."

We may take as a basis of comparison (i.) the diagnosis of *P. hawayana* and *P. barbadensis* in the Tierreich, and (ii.) the following passage from Michaelsen's Paper just referred to:—"In the generally more robust typical form with stronger setæ in the anterior part of the body the papillæ near the male pores are always united at each side, occupying an oblong oval area medial from the male pores and mostly somewhat oblique. In the sub-species *barbadensis*, the papillæ near the male pores are scattered, partly very near the male pores, partly near the median ventral line."

In the present specimen we find no papillæ, but darkish spots (= " Fleckchen " of *P. hawayana*, in Tierreich) ; which however were not confluent but separate (= *barbadensis*), and near and on the inner side of the male aperture (= *hawayana*). The setæ of the anterior segments were strengthened (= *hawayana*) ; the setal chains were not quite closed (= *hawayana*), but on the other hand the dorsal interval was the more marked (the contrary is characteristic of *P. hawayana, cf.* Tierreich). The clitellum occupied the whole of three segments (= *barbadensis*) ; the intestinal cæca showed a series of secondary diverticula, and the prostatic duct was curved (= *hawayana*).

Most of the characters of the present specimen were found also in the examples from the Shan States. The present specimen from Ceylon differs from them however in having a few clitellar setæ, in the fact that the setal rings are not quite closed, and in having circular rather than ovoid, spermathecal ampullæ.

Dichogaster affinis, (Mchlsn.).

A single specimen, in a tube along with the *Lampito* previously described. In rotten wood in the hotel compound, Anuradhapura (low country), Ceylon.

This species is already known from Ceylon ; I subjoin a few notes on the single specimen submitted to me, since it shows a few peculiarities, mostly however in all probability of an individual nature only.

Length 30 mm. ; *breadth*, max. 1·5 mm. ; *segments* 125. *Colour* brownish red (due to contents of gut), with white specks (nephridia) behind the clitellum. The chief of the peculiarities referred to above was in the segmentation ; the two pairs of *prostatic pores* were on segments XVI. and XVIII., instead of XVII. and XIX., and internally also the organs, from the pharynx backwards, were one segment in front of their normal position.

The *clitellum* was incomplete ventrally, and extended from XIII. to 1/2 XX. = 7 1/2. The *body-wall* was elsewhere very thin, and the red woody material could be plainly seen filling out the gut in its whole extent behind the clitellum.

The *nephridia* were very conspicuous externally, appearing as three white spots on each side in each segment behind the clitellum ; in some of the anterior segments there were four such spots. They were of an opaque flocculent appearance, each in linear series with the corresponding organ in preceding and succeeding segments, the whole of them thus being arranged for the most part in regular longitudinal lines along the body. They become much smaller towards the posterior end, and in the middle and posterior thirds of the body the dorsal row is somewhat widely separated from the other more ventrally situated rows.

The *prostatic pores*, as mentioned above, are on segments XVI. and XVIII.; those of the same side are connected by an almost straight longitudinal groove, and the two apertures and connecting groove of each side have raised margins. Since the ridges bordering the grooves on their inner side approach each other closely in the mid-ventral line, the appearance of the whole is that of a raised square with rounded corners.

The *genital "papillæ"* do not appear to be raised. Each is a small inconspicuous circular area, mid-ventrally situated in the course of furrows 7/8 and 8/9, with a smaller circular marking in its centre. There was a similar very small area between and behind the posterior prostatic apertures mid-ventrally in furrow 18/19.

The *setæ* had the normal relations for the species. The length of the ordinary setæ was 115–125, in shape they were of the "*Enchytræus* type," with a hooked proximal and almost straight, tapering, and pointed distal end.

The anterior portion of the animal was sectioned longitudinally; the woody material in the intestine and gizzards proved very damaging to these parts of the sections, so that unfortunately the spermathecæ, in the region of the gizzards, were almost unrecognizable. The following points may be briefly noted.

Septum 7/8 was moderately thickened, septa 8/9–10/11 considerably, 11/12 and 12/13 moderately; allowing for the difference in the numbering of the segments, this is practically the condition given in the diagnosis of the species by Michaelsen (5). There was a well-marked *typhlosole*. The first *dorsal pore* was in the furrow 4/5 (this would correspond to 5/6 in a normal specimen).

The *nephridia* presented a curious appearance in sections. They were mainly composed of circular aggregates, up to 22 μ in diameter, of small white spherical non-staining granules; and it is presumably to this material that the opaque white appearance of the nephridia in the entire animal was due. Nuclei and strands of tissue were present between the granular aggregations; substituting these white grains for oil, the appearance of a nephridium in section was not unlike that of a group of fat cells.

The *seminal funnels*, *vesiculæ seminales*, *male apertures*, *prostates*, *gizzards*, *spermathecal apertures*, and *calciferous glands* agreed in structure and position (making the necessary allowance) with what has been previously described for the species.

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Description of Figures.

Plate I.

Fig. 1.—*Dero zeylanica*; transverse section through posterior end, cutting both intestine and dorsal diverticulum of branchial fossa, the latter containing the first pair of gills; × 155, Abbe's drawing apparatus.

Fig. 2.—The same; transverse section at a more posterior level; intestine has opened into the branchial fossa, which is still closed dorsally; the first and second pairs of gills as ridges on the walls of the fossa; × 155, Abbe's drawing apparatus.

Fig. 3.—The same, more posteriorly still; the branchial fossa has opened out dorsally; the first pair of gills has disappeared; the second, third, and fourth pairs are seen; × 155, Abbe's drawing apparatus.

Br. f., branchial fossa; *d. d.*, dorsal diverticulum of fossa; g^1–g^4, first to fourth pairs of gills; *int.*, intestine; *marg.*, margin of fossa; *sp. c.*, nerve cord; *x.*, pear-shaped epithelial cells of gills.

Fig. 4.—Dorsal needle-seta of *Dero zeylanica*.

Fig. 5.—Setæ of *Aulophorus palustris*; *a*, dorsal needle; *b*, ventral seta of segments II.–IV.; *c*, ventral seta of segments behind IV. (*b* and *c* more highly magnified than *a*).

Fig. 6.—Ventral setæ of *Hesperodrilus zeylanicus ;* the distal end of the single-pointed seta is uppermost ; × 600.

Fig. 7.—Genital area of *Drawida annandalei.*

Plate II.

Fig. 8.—Genital area of *Megascolex pattipolensis.*

Fig. 9.—Distal end of genital seta of *Megascolex bifoveatus.*

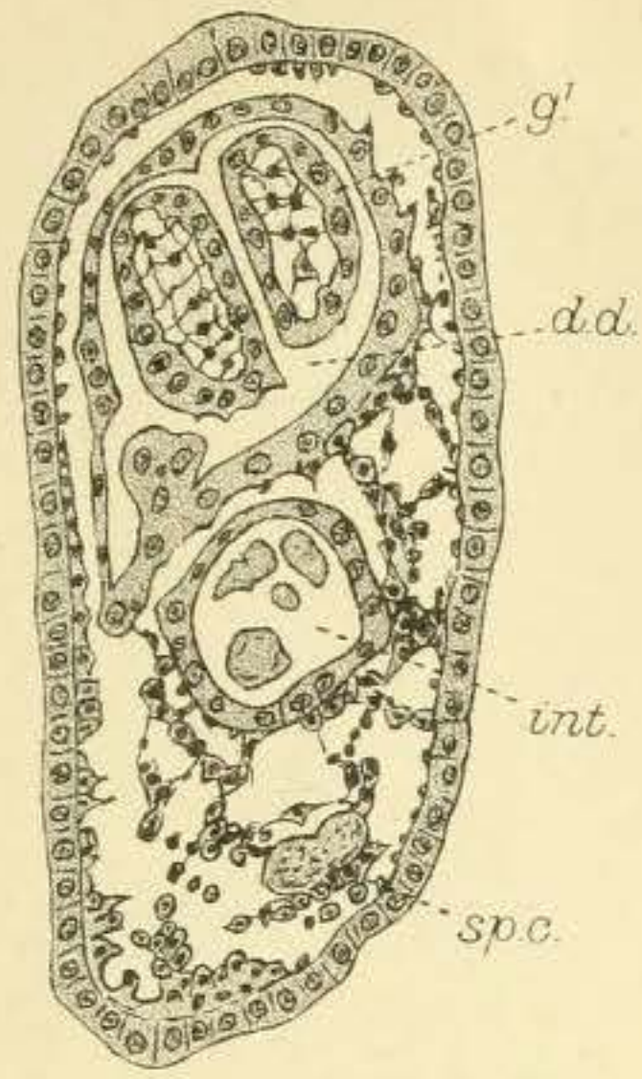
Fig. 10.—Distal end of genital seta of *Megascolex curtus.*

Fig. 11. —Genital area of *Megascolex quintus.*

Fig. 12.—Spermatheca of *Megascolex quintus.*

Fig. 13.—Spermatheca of *Megascolex sextus.*

Fig. 14.—Distal end of genital seta of *Megascolex sextus.*



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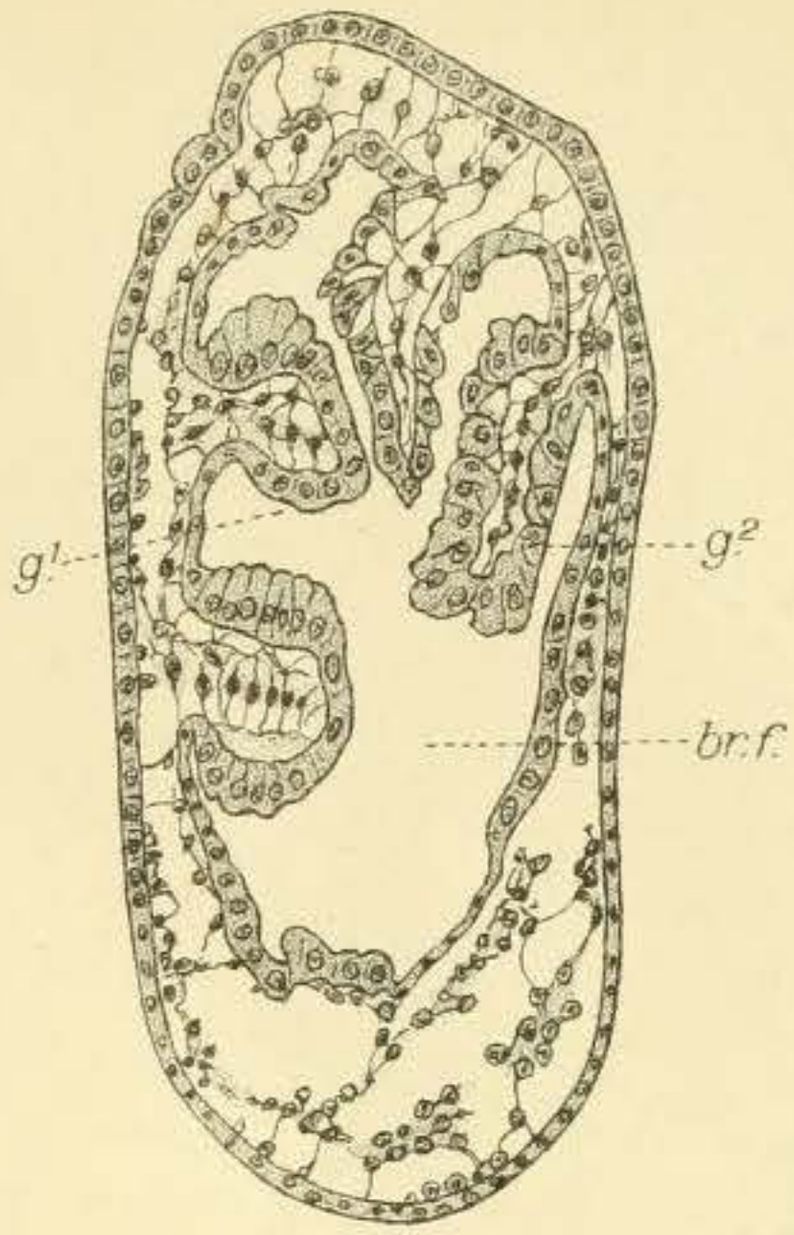

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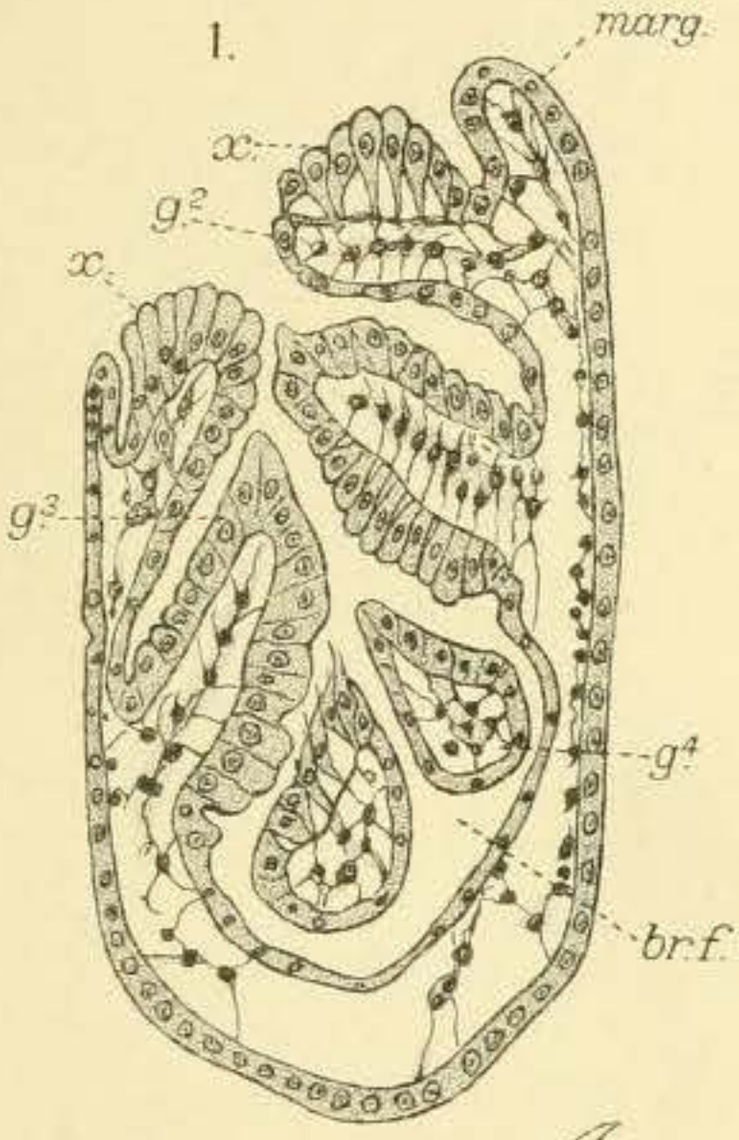

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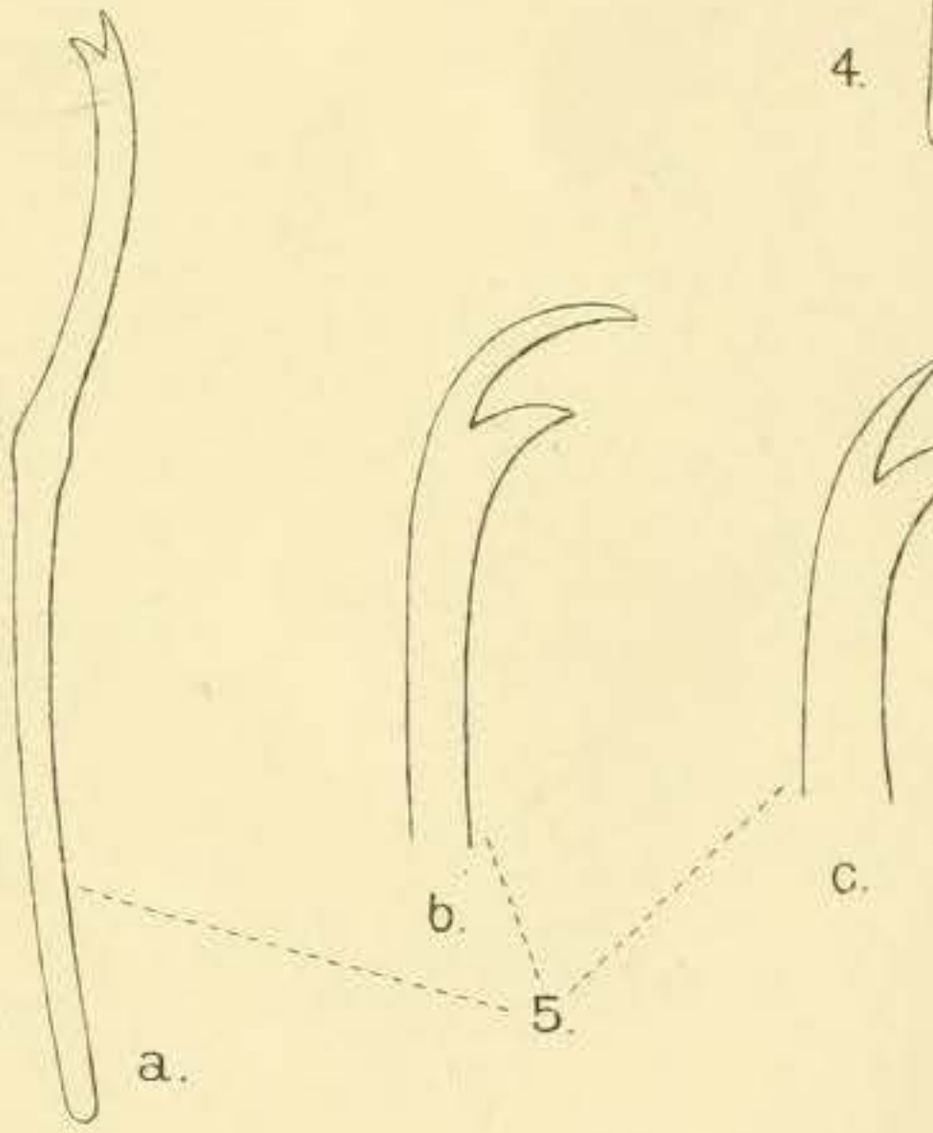

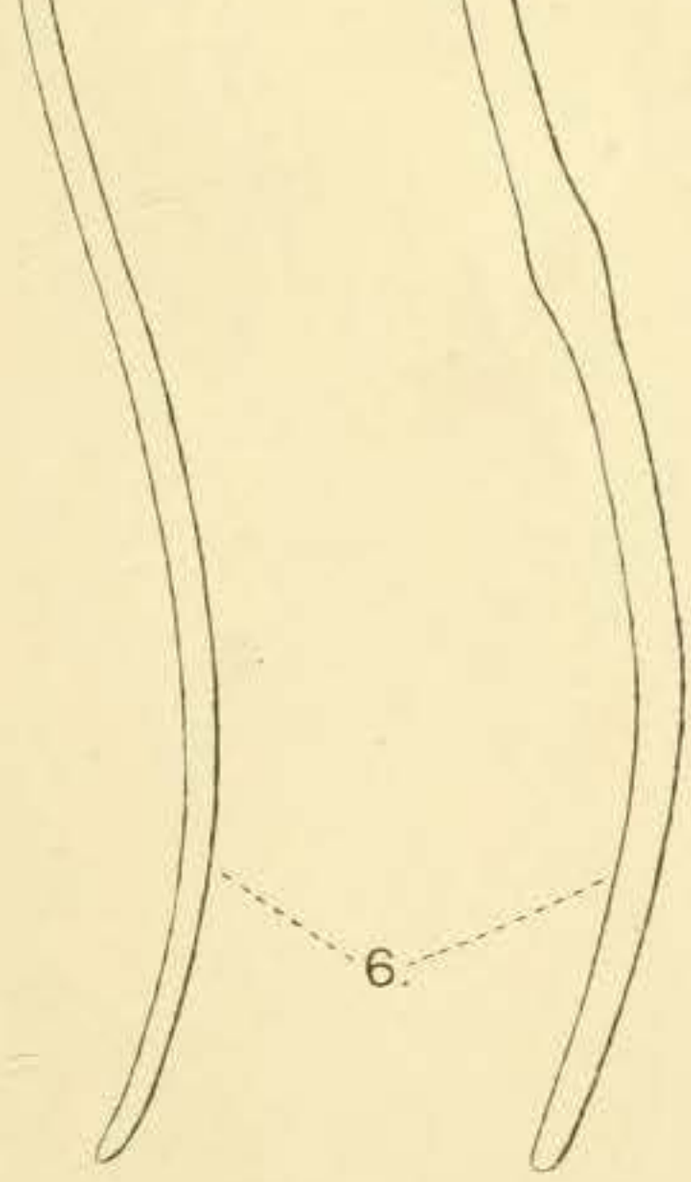

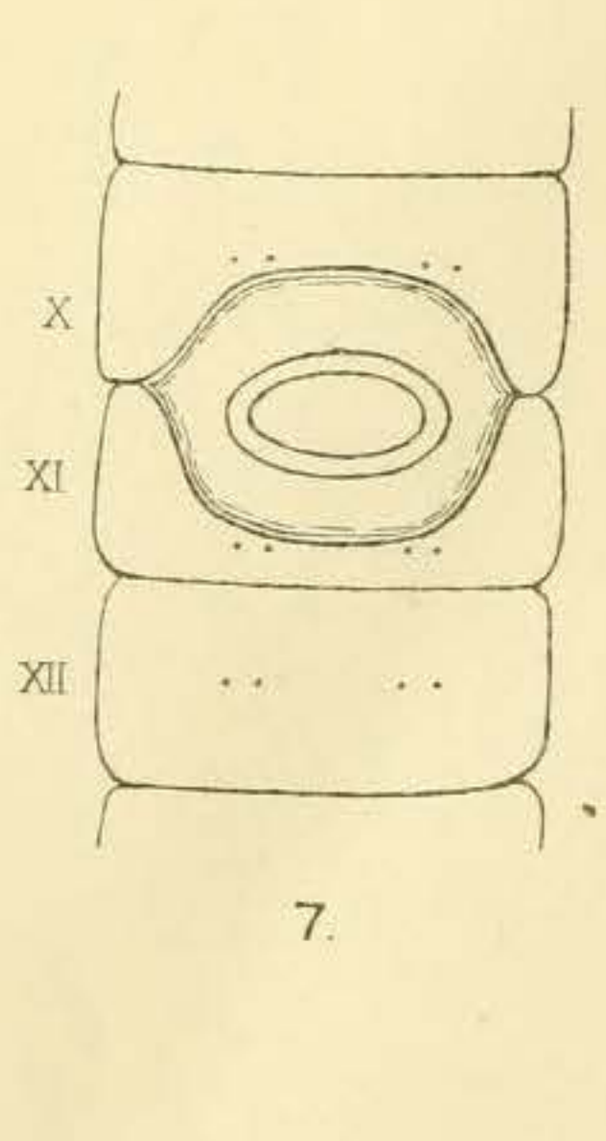

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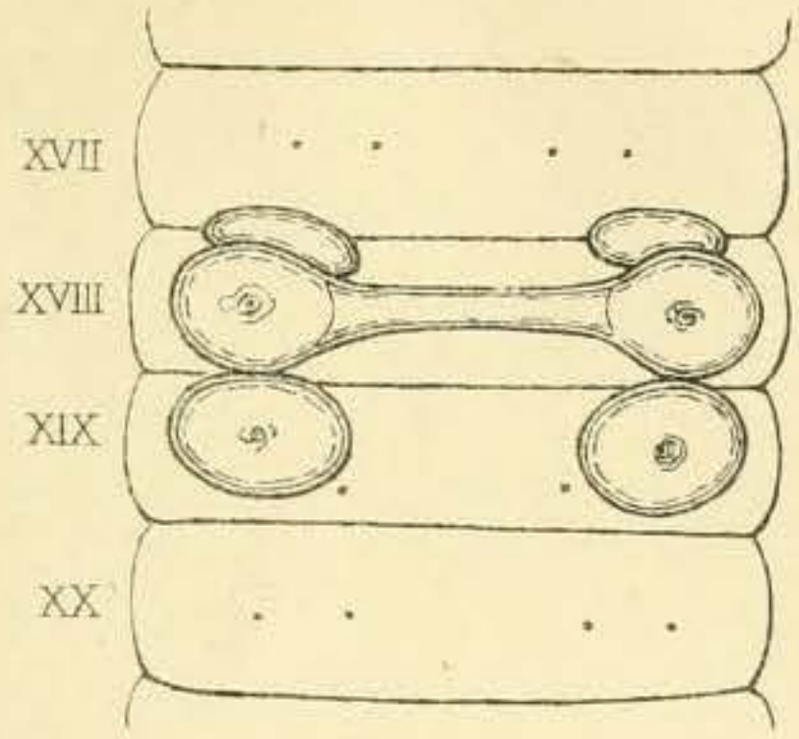
1–4. Dero zeylanica. 5. Aulophorus palustris.
6. Hesperodrilus zeylanicus. 7. Drawida annandalei.



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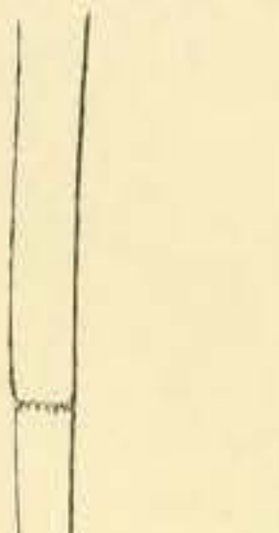

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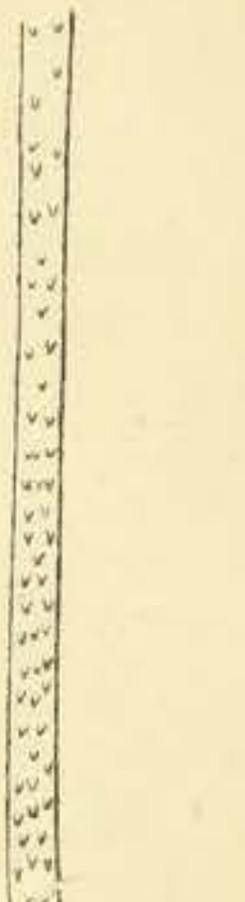

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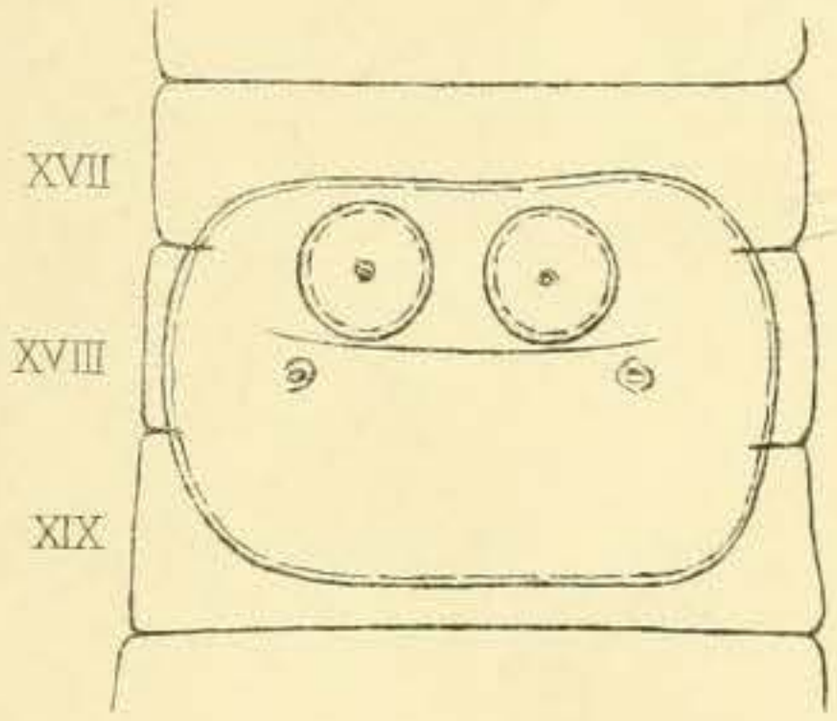

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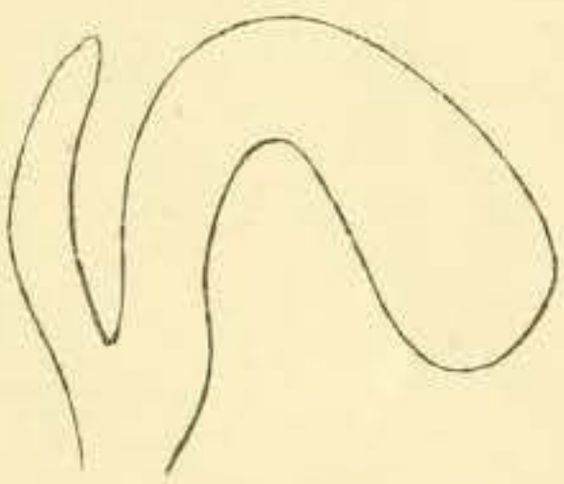

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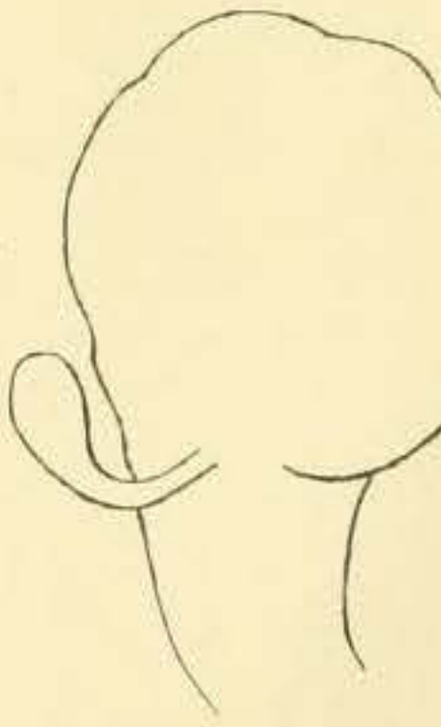

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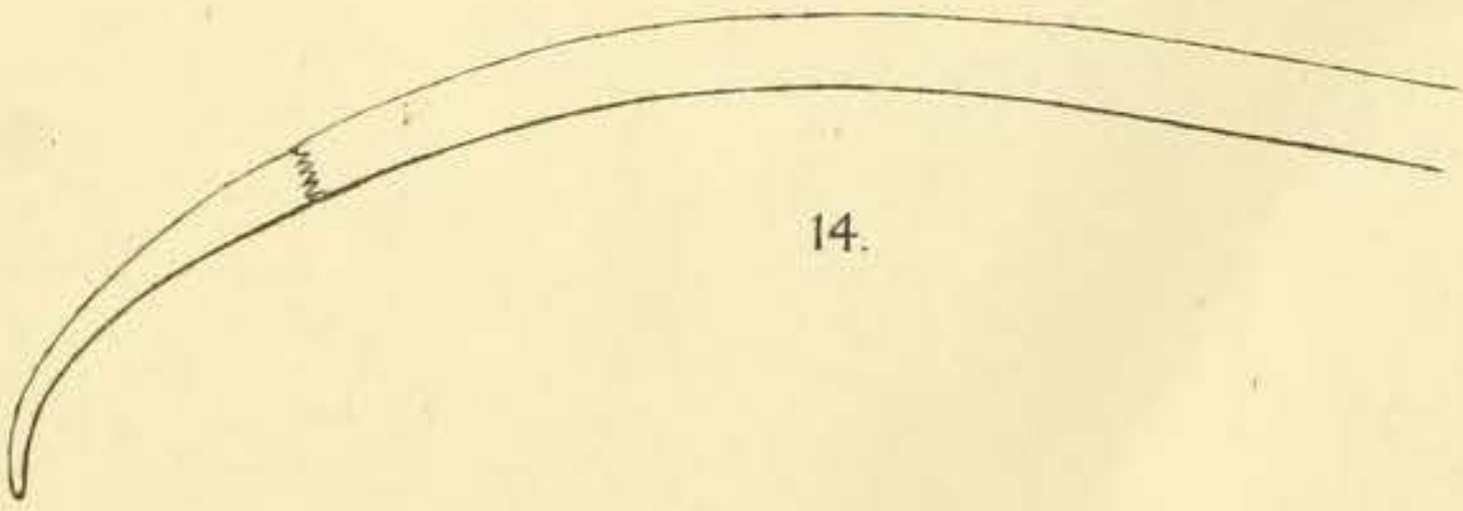

14.

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8. Megascolex pattipolensis. 9. Megascolex bifoveatus.
10. Megascolex curtus. 11 & 12. Megascolex quintus.
13 & 14. Megascolex sextus.