XXII ON A COLLECTION OF OLIGOCHAETA FROM VARIOUS PARTS OF INDIA AND FURTHER INDIA

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(Plates XVI—XVIII.)

CONTENTS.

INTRODUCTION.

The greater part of the present communication deals with a number of specimens of Oligochaeta, many of them of considerable interest, which have lately been added to the collection of the Indian Museum; my thanks are due to Dr. Annandale, Director of the Zoological Survey of India, for the opportunity of examining them. I have also added records, and sometimes notes or descriptions, of the worms which have come into my hands from elsewhere during the past year or so.

The chief localities which have yielded material of interest have been the following:—

(1). Murree, in the Himalayas of the N. Punjab. The list of the earthworms of the Punjab is still a short one, and the addition of even two species is an event of some local interest. One of these two species is *Drawida japonica*, a peregrine species which has been found in China, Japan, and the Bahamas, but which has not, curiously, hitherto been certainly identified from India. Also from Murree I have received a *Helodrilus* which to the best of my knowledge is new; though as the records of this genus are scattered, and in part inaccessible to me, I ought to express myself with caution; this perhaps represents one of the outposts of the Lumbricidae in their southward extension from Palaearctic regions, another being possibly *Helodrilus* (*Bimastus*) *indicus*, Mchlsn. (*cf.* Michaelsen, 13), from Calcutta.

(2). Rangamati, in the Chittagong Hill Tracts, Bengal,—near the head of the Bay of Bengal,—is quite a nest of species of *Drawida*. I need only point out that the occurrence of a number of endemic species in this region emphasizes what I wrote formerly, on the geographical aspect of the facts of distribution of the genus *Drawida*, after describing a number of new species of the genus from the Abor country (17).

(3). New species of *Perionyx* from the Eastern Himalayas are in accordance with what we should expect from the known geographical distribution of the genus.

(4). From Portuguese India and the neighbourhood Mr. Kemp has collected a number of interesting species; these include *Erythraeodrilus kinneari*, recently described by me (19), and no fewer than five species of a genus which I believe to be that of which Bourne's *Perichaeta stuarti* is the type, and which is now known as *Hoplochaetella*; we might indeed speak of a " nest " of these species in this region. As the discussion of this material is complicated, I propose to devote an introductory chapter to it, instead of interrupting the systematic portion of the paper by an excursus of such an extent,—one which, in addition, touches on points of somewhat wider interest.

THE GENUS *HOPLOCHAETELLA*.

In 1886 Bourne published, in a " Preliminary notice of Earthworms from the Nilgiris and Shevaroys " (7), a short description of a species which he called *Perichaeta stuarti*. Beddard in 1890 (1) established for this worm the genus *Hoplochaeta*; but, in 1895 (3) he thought that it might be referable to Benham's genus *Plagiochaeta*, and that the name *Hoplochaeta* had perhaps better be withdrawn, pending further investigations by the discoverer of the species; the worm does not find a place at all in his systematic account of species and genera. Michaelsen, however, in 1900 (10) retained the genus under the name *Hoplochaetella* (*Hoplochaeta* having been found to be preoccupied), and it has since figured in his lists of Indian Earthworms (13, 14). The worm has played a part in zoogeographical discussions, since Michaelsen (13) has referred to this genus several species described by Benham from the South Island of New Zealand as *Plagiochaeta* (4), and has thus illustrated the connection between the Oligochaete fauna of New Zealand and India.

All that we know of the anatomy of the Indian *Hoplochaetella*, however, is derived from Bourne's original account. Though Bourne subsequently expanded the descriptions of the Moniligastridae enumerated in his preliminary account, he did not do so for *Perichaeta stuarti* nor for most of the other Megascolecidae. I venture therefore,—since the ascription of five species obtained by Mr. Kemp to the genus of which *Perichaeta stuarti* is the type requires some justification,—to transcribe Bourne's words.

"*Perichaeta stuarti*, sp. n.

The clitellum extends over somites xiv, xv, and xvi; it is very well marked.

There are two pairs of male pores in somites xvii and xix respectively; these are all four placed upon a whitish, slightly depressed patch, which thus extends over the greater portion of

somite xvii, the whole of somite xviii, and the greater portion of somite xix. Connected with each of these pores is a large coiled prostatic gland, which extends backwards in each case through some 8 or 9 somites.

There is a single median oviducal pore in the anterior portion of somite xiv.

There are two pairs of spermathecae, situated in somites vii and viii respectively. They do not possess any appendages, but present a sort of frilled appearance around the base.

The gizzard is situated in somite x.

In somites xxiii-xxvi (?) there are four pairs of special diverticula on the dorso-lateral portions of the intestine.

I have not observed any nephridia.

There are about 52 setae in each somite, arranged with small dorsal and ventral gaps ; setae are present on the clitellum.

There are no special setae in somite xviii ; but in the anterior portion of somite viii (i.e., between the anterior and posterior pair of spermathecae) there are two groups of large modified setae. Where these project on the surface, there is a papilla which in some specimens becomes very well marked.

Length 148 mm., circumference 15 mm. ; number of somites 111.

Hab. Yercaud, at an elevation of about 5,000 ft.[1], and also down the ghaut as low as Salem (1,000 ft.). I have specimens from Salem.

This is an exceedingly common worm in this region. It occurs in dry ground, and often under large stones."

The only other remark Bourne makes about the worm is a reference to the two pairs of male pores as establishing a difference between it and other species of *Perichaeta*.

It will be seen at once that there are striking similarities between *Perichaeta stuarti* and the group of species described in the body of the present paper under the genus *Hoplochaetella*. Besides such general features as size, setal numbers and distribution, situation of prostatic and female apertures, the two pairs of long coiled prostates, etc., there are the special setae in segment viii, dis placed out of the line and seated on papillae ; and the frill of diverticula at the base of the spermathecae, which is exactly paralleled in several species here described.

The differences are however not negligible. Thus the gizzard is said to be in segment x ; this is anomalous,—I do not recall any single Megascolecid in which it occurs in this position, *i.e.* in a

[1] With regard to the locality, Bourne in a subsquent publication says, "I have stated that *Perichaeta stuarti* is to be found at an elevation of 5000 ft., and also at one of 1000 ft., but this has proved to be a mistake which arose from my collector having mixed specimens from the two localities. I cannot find *P. stuarti* at any great distance down the ghaut." (On certain Earthworms from the Western Himalayas and Dehra Dun, *P. As. Soc. Bengal*, vol. lvii, 1889). Michaelsen has overlooked this correction.

testis segment, and certainly not in any of the subfam. Octochaetinae. Michaelsen does not seem quite clear what to make of it; in the generic characters which he attributes to *Hoplochaetella* (10) he has "1 Muskelmagen vor den Hoden-Segm."; while in the specific diagnosis of *H. stuarti* he says "Muskelmagen im 10 Segm." I think we may fairly suspect an error in Bourne's statement.

The four pairs of dorso-lateral intestinal caeca may or may not be more than the usual segmental bulgings of the intestinal walls, commonly best marked in the dorso-lateral region, carried to an unusual degree.

These are the only differences between *Perichaeta stuarti* and the group of species described below that could possibly be of generic importance;—I mean, the only differences that unequivocally follow from the description. Michaelsen in his generic and specific diagnoses in the "*Tierreich*" gives other points, which rest on inference.

The first of these is the (doubtful, for he queries it) position of the male pore (*i.e* the ending of the vas deferens, as distinct from the prostatic pores) on segment xviii. Bourne does not mention this; in so far as we can infer anything, I think we must infer the absence of pores on xviii.; since in his introduction he brings forward the presence of two male pores, on segments xvii and xix, as a distinction between *P. stuarti* and ordinary species of *Perichaeta*, which have "a pair of laterally-placed male pores in somite xviii."

The second is the position of the spermathecal apertures in furrows 7/8 and 8/9. Bourne makes no reference of any kind to the apertures, saying only that the spermathecae are in segments vii and viii. The apertures often are in the furrows just mentioned in the Octochaetinae, but not always; in *Erythraeodrilus*, and in some species of *Octochaetus*, they are on the segments, not between them.

The third and most important is the condition of the nephridial system. All that Bourne says is, "I have not observed any nephridia." Michaelsen naturally takes this to mean that the system is micronephric throughout. I hope I shall not be going too far if I suggest that *Perichaeta stuarti* may have possessed both mega- and micronephridia, and that the meganephridia as well as the micronephridia may have been overlooked by Bourne. It is to be remembered that (1) in the group of species which I describe in the body of the paper the meganephridia only begin in segment xx; if a similar condition existed in *P. stuarti* it *might* not have attracted attention in a dissection of the anterior part of the worm (though I admit that Bourne must have dissected one or more specimens back to at least the level of the hinder ends of the long prostates). (2) Bourne's observations on the nephridia of other species described in the same paper are extraordinarily various; thus "I have found no nephridia," (*Perichaeta lawsoni*); "there are two pairs of groups of small nephridia opening on the posterior edges of somites vii. and viii," (*P. gracilis*,—nothing about nephri-

dia elsewhere) ; " I am at present unable to say anything about the nephridia " (*P. burliarensis*); " no nephridia were observed " (*P. hulikalensis*) ; " nephridia seem to be present in certain anterior segments only" (*P. mirabilis*); " the nephridia occur in, at any rate, most of the somites; they are very large and present rosettes of tubules in certain anterior somites" (*P. salettensis*). We can only conclude that Bourne's observations on the nephridia of his various species are inadequate in respect of present-day requirements, and are not of much help in identifying his forms; one can hardly accept his statements, for example, with regard to the nephridial distribution in *P. gracilis* and *P. mirabilis*. (3) The ease or difficulty of determining the nephridial condition depends largely on the condition of the specimen; it is easiest in a well-preserved spirit specimen, as the nephridia are then opaque, but in badly preserved material it may be impossible. Even much later than Bourne's day the most experienced investigators have at times been under the necessity of revising their accounts of the nephridial conditions; so Benham (4, 6,—*Plagiochaeta ricardi* and *montana* at first supposed micronephridial, later recognized as meganephric) ; Michaelsen (11, 14,—*Eudichogaster ashworthi* at first supposed micronephridial, later recognized as having both mega- and micronephridia).

Thus I do not think it is unfair to leave aside the nephridia of *Perichaeta stuarti* altogether. When Bourne says "I have not observed any nephridia," it may simply have been for want of sufficiently close observation, or the specimen may have been badly preserved ; in any case we are dealing with the early days of Oligochaete research, with a preliminary communication which was only meant to be a first survey of the field, and written at a time it was not known even what characters were of generic value. We must admit that we know nothing about the nephridia, even by inference.

I have, I think, shown that there is pretty certainly a mistake in Bourne's statement concerning the position of the gizzard; that there is no ground at all for supposing a separate male pore in segment xviii, or that the spermathecal apertures are necessarily in furrows 7/8 and 8/9 (though this last point is relatively unimportant) ; the intestinal caeca, whether they were accidental inflations of the gut-wall or not, would not be of generic importance; and, finally, we are in the dark as regards the nephridia. In all other respects the worms in the present collection resemble *Perichaeta stuarti* ; and I have therefore, after much hesitation, decided to unite them in the same genus, the diagnosis of which now runs as follows :—

Genus *Hoplochaetella*, Mchlsn. emend. Stephenson.

Setae in rings. Calcareous glands four pairs, in x-xiii. Micro nephridia throughout the body ; meganephridia in addition from xx onwards, one pair per segment. Two pairs testes, free in x and xi. Two pairs long coiled prostates, opening on the posterior part of xvii and the anterior part of xviii, or in grooves 17/18 and 18/19. Vasa

deferentia open in common with the ducts of the anterior pair of prostates. One unpaired female pore. Two pairs spermathecae with apertures on viii; accessory glands in the neighbourhood. No penial setae; displaced and modified setae on one or more of segments vii, viii, ix.

ON OTHER SUPPOSED SPECIES OF THE GENUS *HOPLOCHAETELLA*.

In 1909 Michaelsen (13) united with the genus *Hoplochaetella* as defined by him (Acanthodriline arrangement of posterior male organs, setae in rings, micronephridia) three species of worms originally described by Benham from New Zealand,—*Plagiochaeta rossii*, *P. ricardi*, and *P. montana* (the last two however with an element of doubt, owing to the fact that Benham had revised his earlier statement concerning the nephridial system).

Plagiochaeta is a genus of the subfamily Acanthodrilinae of which the type was described by Benham in 1892; the originally paired setae have undergone the perichaetine increase, the posterior male organs have the original Acanthodriline arrangement, the testes and funnels are enclosed in testis-sacs; the type of the genus is meganephric, with nephridiopores alternating in position in successive segments; there are penial setae, and the gizzard is rudimentary. Benham (4) subsequently described four new species; three of these were micronephric, but he did not at the time consider this peculiarity sufficient to warrant a generic separation. It was these three species which Michaelsen, with different views on the value of the nephridial condition, united with *Hoplochaetella*.

Benham, however, had already found that two of the three species were in reality meganephric (5); but this Michaelsen had not been willing to accept at its full value; he did so afterwards for *P. ricardi*, and Benham has since shown that his statement regarding the presence of meganephridia was correct also for *P. montana*. This leaves only *P. rossii* to be added to the genus *Hoplochaetella* (Benham and Cameron, 6).

Now the type of the genus *Hoplochaetella* is *Perichaeta stuarti*, and if my former arguments are correct, *Plagiochaeta rossii* differs from *Hoplochaetella* in two of the three points of cardinal importance,—setae, nephridial condition, and arrangement of posterior male organs. It cannot then go into, or even very near, *Hoplochaetella*, and it is necessary to separate it under another name as a new genus. I may add that while the general facies of *Perichaeta stuarti* agrees, so far as can be judged, with that of the species which I describe below as *Hoplochaetella*, there is nothing in the original description of *Plagiochaeta rossii* to remind us of *Perichaeta stuarti*; in *Plagiochaeta rossii* the prostates are confined to their proper segments, in which they are coiled into a ball, the spermathecal ducts have groups of botryoidal diverticula, and there are prominent porophores with spermatic ridges leading from the anterior to the posterior prostatic pore of each side.

THE SYSTEMATIC POSITION AND RELATIONSHIPS OF THE GENUS *HOPLOCHAETELLA*.

That *Hoplochaetella*, as here defined, is the direct ancestor of *Erythraeodrilus* seems certain. It happens that *Erythraeodrilus* (both batches,—the original specimens collected in 1913, as well as the example in the present collection) and the five species of *Hoplochaetella* here described (though not the type species, *Perichaeta stuarti*), come from within a few miles of each other. The general facies is similar; and the two genera agree in such peculiarities as the point where the meganephridia begin, the position and relative sizes of the calcareous glands, the length and disposition of the prostatic ducts, the presence of accessory spermathecal glands, and the vascular commissure of segment xiv; some of these are so special (*e.g.* the accessory spermathecal glands, the vascular commissure in xiv) that they cannot be regarded as other than marks of close affinity.

The differences are :—the fusion of the septa in the region of the testes in the one, and the presence of testis-sacs of the usual type in the other; the three pairs of seminal vesicles and the absence of displaced setae in the spermathecal region of *Erythraeodrilus*; the (sometimes, apparently) common opening of the spermathecae of the same side in *Erythraeodrilus*; and especially,—the essential point,—the total disappearance of the posterior pair of prostates in the latter genus. What we have, in fact, in these two genera, is two successive stages in the reduction of the original Acanthodriline male apparatus.

This may be illustrated by the figures on page 360. Text-fig. 1 gives a diagrammatic representation of the primitive condition, as found in *Notiodrilus* (I use the name in the sense in which it was used, for example, by Michaelsen in his "Geographische Verbreitung der Oligochäten"); the testes are free in segments x and xi, the vasa deferentia open on xviii, the two prostates independently on xvii and xix, the spermathecae in grooves 7/8 and 8/9. In the Megascolecinae the reduction takes place by the union of prostatic and proper male apertures in segment xviii,—in the situation of the opening of the vas deferens (text-fig. 2). In the Octochaetinae, however, a different process is at work, which ends in *Eutyphoeus* in the amalgamation of the opening of the vas deferens with the anterior prostatic pore in xvii, and disappearance of the posterior prostates; at the same time the two pairs of spermathecae are reduced to one, and similarly the two pairs of testes (text-fig. 5). The concomitant reduction of the prostatic and spermathecal apertures is related to the fact that the prostatic apertures of one worm are apposed in copulation to the spermathecal apertures of another.

In *Hoplochaetella* we have the condition shown in text-fig. 3. The opening of the vas deferens has fused with that of the anterior prostate; the prostatic apertures themselves seem previously to have approached closer together, since they are found, not on the middle of segments xvii and xix, but in or almost in the grooves 17/18 and 18/19,—almost as if the first impulse was to follow the Megascolecine mode of reduction. But (if I may continue to use

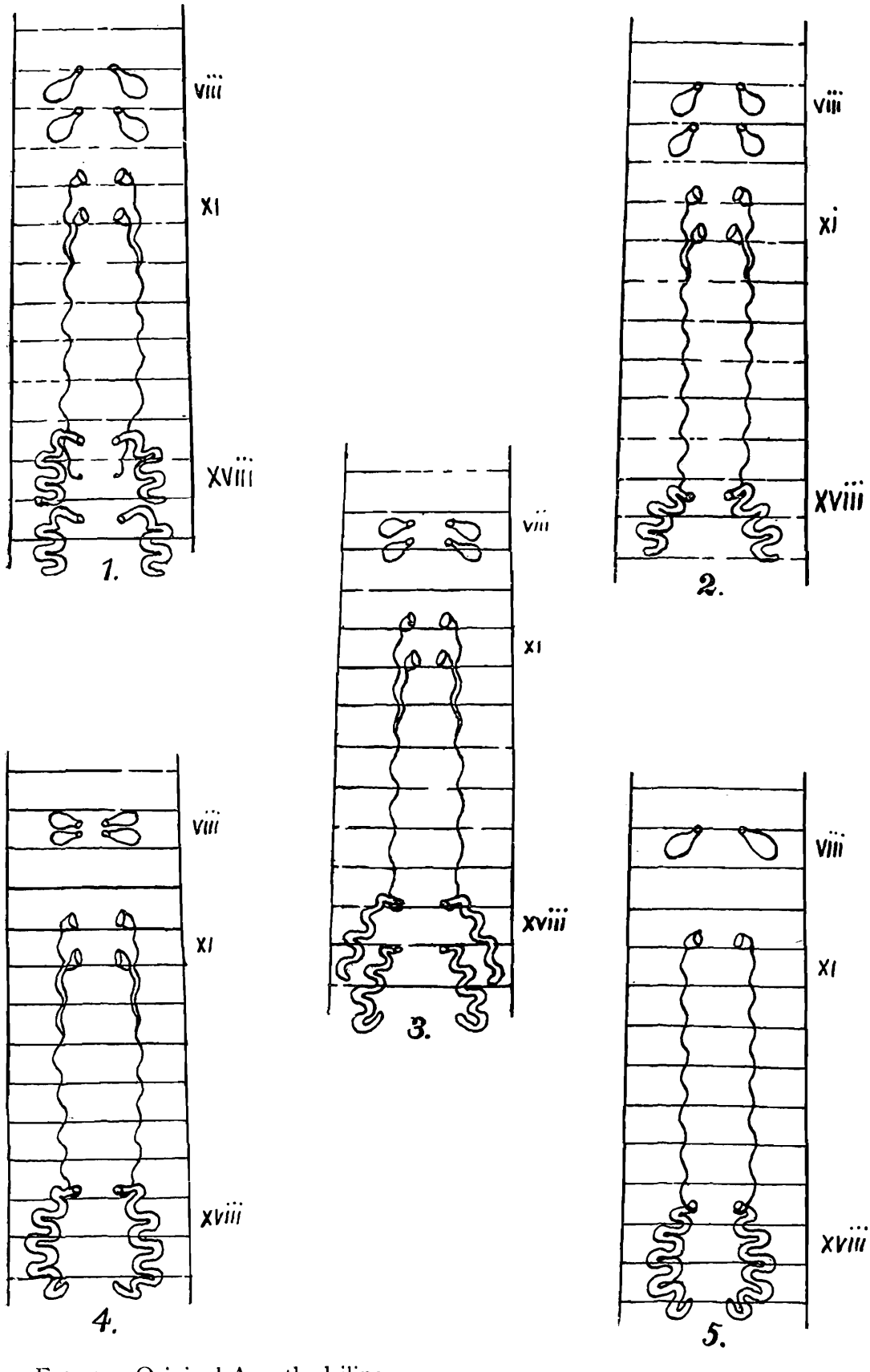

FIG. 1.—Original Acanthodriline.
,, 2.—Megascolecine. (The number of spermathecae is variable in the Megascolecinae).
,, 3.—*Hoplochaetella.*
,, 4.—*Erythraeodrilus.*
,, 5.—*Eutyphoeus.*

such expressions) when the prostatic pores reached this position, the ending of the vas deferens was able to jump the interval, and united itself with the prostatic pore in furrow 17/18.

The next stage is *Erythraeodrilus* (text-fig. 4). Union between the end of the vas deferens and the anterior prostatic pores having been accomplished, the posterior prostates suddenly disappear. Two pairs of spermathecal openings are now superfluous, and the ducts of the spermathecae of the same side approach each other; various stages of this are met with in the several specimens of *Erythraeodrilus kinneari* that have been studied (*v. post.*); in one, the two ducts of the same side appear to open practically at the same spot, on the middle of segment viii. We may suppose that the course of evolution is leading, first to the union of the spermathecal apertures, then to the disappearance of one spermatheca on each side; then (if we may take a clue from *Eutyphoeus*) the remaining prostatic apertures will advance again to their original position on the middle of segment xvii, and the now single spermathecal apertures to their original position on furrow 7/8.

I need scarcely guard myself from misconstruction by saying that *Hoplochaetella* and *Erythraeodrilus* are not, of course, in the ancestral line of *Eutyphoeus* at all, since *Eutyphoeus* retains the primitive paired setae. But the same change which has led to *Eutyphoeus* appears to be going on in a parallel line of forms with the perichaetine setal arrangement.

Erythraeodrilus being thus the descendant, can we particularize regarding the immediate ancestors of *Hoplochaetella*? In a previous paper (19) I supposed *Erythraeodrilus* to be a descendant of *Howascolex* (which has lumbricine setae, acanthodriline male organs and mixed mega- and micronephridia) by a process of microscolecine reduction of the male organs and perichaetine increase of setae. *Hoplochaetella* would thus show us the stage in which increase of setae has taken place, but not as yet the microscolecine reduction; this is however being prepared for, since the male ducts already open in common with the anterior prostates; thus *Hoplochaetella* would be intermediate between *Howascolex* and *Erythraeodrilus*. There is perhaps some little difficulty with regard to the nephridial system. It is true it is of a mixed nature,—meganephridia and micronephridia co-existing,—in both. But while in *Hoplochaetella* and *Erythraeodrilus* micronephridia exist throughout the body, and meganephridia only from segment xx onwards, in *Howascolex* meganephridia exist throughout, and micronephridia only make their appearance behind the anterior region, in the middle portion of the body. I do not, however, think that we yet know enough of the exact way in which the change from mega- to micronephridia has taken place (it has quite possibly taken place in more than one way) to enable us to say that this difference prevents our deriving the one from the other; the condition in *Howascolex* is at any rate apparently less modified than that in *Hoplochaetella* and *Erythraeodrilus*.

There is another possibility as regards the derivation of *Hoplo-*

chaetella. It might be derived from *Plagiochaeta*,—or rather from *Perieodrilus*, a genus under which Michaelsen has placed those species, originally grouped as *Plagiochaeta* by Benham, which have the nephridiopores in the same line on each side (the type of the genus *Plagiochaeta* has them in two rows, alternating in successive segments). *Perieodrilus* has the acanthodriline arrangement of the posterior male organs and is meganephric, but has the perichaetine arrangement of the setae; it is in fact removed from *Notiodrilus* only by the development of the setae in rings instead of in pairs. From such a form *Hoplochaetella* differs in the partial breaking up of the nephridial system and the amalgamation of the openings of the vas deferens and anterior prostate.

If we take the first hypothesis, as I did for *Erythraeodrilus* previously, we find that we are in the presence of an element of our fauna which has relations with Madagascar [1] (the home of *Howascolex*). To some extent this is confirmed by the localities where *Hoplochaetella* and *Erythraeodrilus* have been found,—on the west coast of India. Bourne's *Perichaeta stuarti* was found, certainly, about 160 miles from the Malabar coast,—indeed nearer to the east than the west coast of the peninsula; but some of the present species were discovered actually on the shore, and seem to be euryhaline,—able to withstand the action of salt water,—and hence, probably, to endure a journey by sea (*cf.* the discussion by Michaelsen of the possible spread of *Microscolex* by the West-wind drift in the Southern Ocean, 12, 15, 16); the South-west monsoon blows steadily in the required direction for several months of every year. There is of course also the possibility that the introduction is of comparatively ancient date, by means of the land connection during the earlier Tertiary period.

On the second hypothesis *Hoplochaetella* will have had an Australasian origin. This is the present view; hitherto *Hoplochaetella* and *Octochaetus* have been the two genera common to India and New Zealand,—the indications of a communication between the two lands which probably at one period did not include Australia. The position is not very different if we suppose *Hoplochaetella* to be non-existent in New Zealand but to be derived from the New Zealand genus *Perieodrilus*.

Merely from the point of view of practical convenience, the first arrangement of the phylogenetic tree is preferable. As I have previously pointed out (19), the *Erythraeodrilus* branch can thus without difficulty be included in the Octochaetinae, by making the

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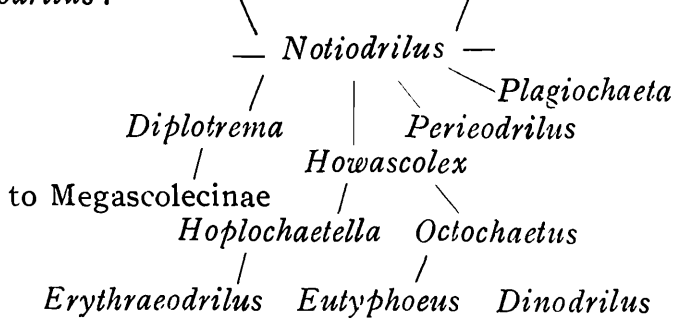
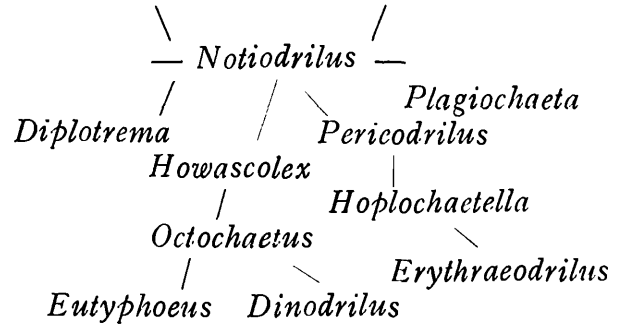
[1] Though Wallace, as is well known, gave up the theory of the existence of a former "Lemuria,"—a large tract of land including Madagascar, India, and Malaya,—and came to believe in the comparative fixity of the great land-masses of the globe (compare the view in his "Malay Peninsula" and "Island Life") later authors are not so conservative. Thus Gadow (9) supposes a permanent connection between Madagascar and India from Primary times up to the Oligocene, breaking up in late Oligocene; Depéret (8) supposes the connection between India and Madagascar to have been broken towards the end of the Cretaceous, but re-established during the Tertiary period; for the geological argument see, for example, Suess (21, vol. i, p. 417).

Octochaetinae begin with *Howascolex*; they then retain the character of a monophyletic and compact subdivision of the family. If however we derive *Hoplochaetella* from *Perieodrilus*, we have either to include *Hoplochaetella* and *Erythraeodrilus* in the Acanthodrilinae, or to make a separate subfamily for them. As Michaelsen has pointed out (13) " the family Megascolecidae is a much-branched tree, which took its origin from the acanthodriline primordial form, that is to say, from *Notiodrilus* (*Eodrilus*). The greater branches of this tree, the different subfamilies, are well defined in their distal parts." The original form, with the small branches clustering round the base of the tree, constitute the group Acanthodrilinae; on the present supposition one of these small branches, scarcely large enough to form a separate subfamily, consists of *Perieodrilus—Hoplochaetella—Erythraeodrilus*.

The finding of additional intermediate forms between the various genera will establish the lines of filiation more certainly. The Megascolecidae are an especially favourable group for the working out of phylogenetic relations, because we still possess what we might paradoxically call a living Palaeontology. We can, for example, trace the main line of descent of the Megascolecinae, from the original Acanthodriline to *Pheretima*, with hardly a break, by means of actually existing genera; it is as if *Phenacodus* and the subsequent stages in the phylogeny of the Horse were all alive today. In giving rise to descendants, the older genera have themselves lived on, scarcely modified; and what we have to hope for is the discovery of the still missing intermediate forms. Some of them, at least, we may reasonably expect to find, still alive and accessible to a complete investigation.

The two following schemes represent the alternative possibilities regarding the position and descent of *Hoplochaetella* and *Erythraeodrilus* :—





SYSTEMATIC ACCOUNT.

Fam. ENCHYTRAEIDAE.

Gen. **Fridericia.**

W. 88/1. Kierpur, Purneah Dist., Bihar. Sept. 1915. C. Paiva. A single specimen, not fully mature (or over-mature ?).

The specimen, diagnosed by the arrangement of the setae as belonging to this genus, but indeterminable as regards species, is mentioned here because the family is rarely met with in India.

Fam. MONILIGASTRIDAE.

Gen. **Drawida.**

Drawida kanarensis, sp. nov.

W. 132/1. Talewadi, near Castle Rock, N. Kanara Dist., Bombay Pres., October 1916. S. Kemp. Three specimens.
W. 133/1. Castle Rock, N. Kanara Dist., October 1916. S. Kemp. Three specimens.

External characters :—Length 60-70 mm.; maximum diameter 3½ mm. Colour pale grey, anterior end rather lighter. Segments 150-173, all very short behind the clitellum.

A prostomium is difficult to see in some cases; in one specimen it might be called zygolobous, though very small; in another it is perhaps prolobous.

Dorsal pores absent.

The setae are small and closely paired; *aa* is slightly less than, or in some regions appears about equal to, *cd*; *dd* is approximately equal to four-sevenths of the circumference.

The limits of the clitellum are rather indefinite, as the alteration in the body-wall is not great; it is saddle-shaped, and extends over x-xiii, and perhaps partly on to xiv (=4 or more).

The male apertures are in furrow 10/11, external to the line of setae *b*, but considerably nearer to *b* than to *c*; the lips of the groove are swollen here, and in one specimen papillae project from the groove at the site of the apertures.

The female apertures are in 11/12, in the line *b*.

The spermathecal apertures are in groove 7/8, just below *c*.

On segment xi are a pair of slightly raised and thickened patches, oval in shape, and one and a half times as broad as long; they take up nearly the whole length of the segment, and are better marked in front, where they are continuous with the swollen lip bounding the male aperture; their surface is rather ridged, and they are each limited by a slight groove. They approach fairly near each other towards the middle line, so that the setae *ab* are on the inner portion of the patch; the outer border is some distance below *c*. These patches were not found in the second batch of specimens.

Internal anatomy.—Septa 5/6 to 8/9 are thickened, especially the first three; the rest are thin.

There are three large, hard, subspherical gizzards in segments xv, xvi, and xvii respectively; the softer zones between them are little marked, a gizzard taking up a whole segment. In xiv is a much smaller gizzard, softer than the others, and narrower from side to side,—in other words the alimentary canal is not as broad here as it becomes in the next segment. In a specimen of the second batch which was dissected, there were four gizzards, in xiii-xvi, the first rather smaller.

The testis-sacs are attached to septum 9/10 in such a way that the larger part of the sac depends into segment x. A considerable portion however projects forwards into ix on the right side, though only a very small part does so on the left. The septum causes no constriction of the sac. The testis appears to be a diffuse proliferation of the inner wall of the sac. The vas deferens is a fine, much coiled tube on septum 9/10; the terminal portion is rather broader, and joins the prostate at its anterior and inner side.

The prostate is of moderate size, sessile on the body-wall, hemiovoidal in shape, with its transverse diameter greater than the antero-posterior; its surface is soft and yellowish, not smooth and shining.

There is no ovarian chamber, or in other words segment xi is opened into on opening the worm in the ordinary dissection, and masses of eggs fall out. The ovary is bushy, on septum 10/11. The funnel is a groove between two lips or ridges which curl upwards and inwards from below on septum 11/12. The ovisacs, large and ovoid, are contained in segment xiv, but a neck passes forwards to connect them with septum 11/12.

The spermathecal ampullae are large, and meet in the middle line, thus covering the rest of the contents of the segment; in shape they are irregular, and in the dissected specimen were filled with a shining white opaque mass, doubtless spermatozoa. The duct is considerably coiled, and passes down on the posterior face of septum 7/8; its first part is narrower than the rest; it joins the atrium without piercing the septum. The atrium is a cushion-like swelling, several times as thick as the end of the duct, which joins it in the centre of its upper surface; it is partly embedded in the body-wall, and projects slightly into segment viii; the septum can be separated forwards from over it, so that no part of the atrium is in segment vii, the septum being attached to the parietes in front of it. When opened, the atrium is found to be a hollow chamber.

Remarks.—This species is perhaps related to *D. barwelli*; but the latter has dorsal pores, no eggsacs (?), no distinct spermathecal atrium, and pear-shaped prostates From the *pellucidus* group the present form is distinguished by the character of the surface of the prostate.

Special genital marks are not common in the Moniligastridae; the "glandular" areas on segment xi are therefore of value for identification.

Drawida japonica (Mchlsn.) f. typica.

(Pl. xvi, fig. 1).

Murree, N. Punjab; alt. 7000 ft., 19-iv-1916. S. Gobind Singh. Numerous specimens.

External characters.—Length of a good average specimen 60 mm.; breadth 2 mm., or in the genital region may be 2·7 mm. Colour a greenish-grey, slightly darker dorsally. Segments 142.

Setae closely paired; *aa* is slightly less than *bc* behind the genital region, about equal to it in front; *dd* is equal to half the circumference. The setae are very small on segment ii, if indeed all of them are present; they are large on the genital region.

The nephridiopores may be present in three situations,—in line with setae *cd*, or at the level of the ventral pair of setae, or lastly not far from the middorsal line; but there is no rule, and no regular alternation. They are in all cases immediately behind the intersegmental groove.

The genital papillae,—a characteristic of the species,—are variable in their situation, but seem to be always present in the sexual animal. Each is an oval area slightly raised above the general surface, with its long axis transverse, and with a circular groove in its centre; the middle of each area is thus marked off from the peripheral portion, and is perhaps a little, but not much, raised above the level of the oval area in general. Fig. 1 will give an idea of the appearance of the areas; they are never in the same position in two specimens; in number they may be two, three or four; and they occur on segments vii, viii, ix, and xii. They may be situated on either the anterior or the posterior part of the segment, or more rarely at the middle of its length; they may be either to the right or the left of the middle line, or seldom midventral.

With regard to the *internal anatomy*, it need only be stated that there are two gizzards, in segments xii and xiii; they are annular thickenings of the gut-wall, separated by a thin-walled section of the tube.

Remarks.—This species is the most markedly peregrine member of the genus; it has been found in Japan, China (f. *siemsseni*), and the Bahamas (f. *bahamensis*, = *Moniligaster bahamensis*, Beddard). The immature *Drawida* from Simla, said by Michaelsen "probably, or rather doubtless" to belong to *M willsi* (13), may with at least equal likelihood be referred to the present species.

Drawida hodgarti, sp. nov.

(Pl. xvi, fig. 2).

W. 70/1. Rangamati, Chittagong Hill Tracts, Bengal. 11-vii-1915. R. Hodgart. Four specimens.

External characters.—Length 113 mm.; maximum diameter 3·75 mm. Colour a uniform grey, nonpigmented. Segments 164; no secondary annulation. The rings of possibly sensory papillae found

in some species are only very faintly indicated, and only in the anterior segments.

Prostomium prolobous.

Dorsal pores absent.

The setae are small and closely paired ; *aa* is less than *bc*, and *d* is below the lateral line of the body.

The nephridiopores appear to be in line with the setae *c*.

No clitellum was visible on any of the specimens.

The male pores are slits with swollen anterior lip, in the intersegmental groove 10/11, with their centre just outside the line *b*.

The female apertures are doubtfully in *ab* or *b*.

The spermathecal apertures, with slightly swollen lips, are in 7/8 in or just internal to *c*.

There are no other genital markings.

Internal anatomy.—Septa 5/6, 6/7, 7/8, and 8/9 are considerably thickened, the rest all thin.

The gizzards are four in number, in segments xv to xviii ; the alimentary tube is also slightly strengthened in segment xiv. There are softer annuli behind each gizzard in each of the four segments.

The last heart is in segment ix.

The testis-sacs are kidney-shaped, in segment x, the anterior end projecting slightly into ix on the left side in the specimen dissected but not on the right.

The prostates are small and tubular, with a smooth and shining surface (hence probably muscular) ; each is slightly coiled, and the free end, which points inwards, is somewhat dilated (fig. 2).

The closely convoluted vas deferens forms a soft mass below the testis-sac on the anterior face of septum 9/10 ; below it joins the anterior face of the prostate not far from its free ental end (fig. 2).

In the dissection segment xi appears open above,—not closed dorsally by the apposition of septa 10/11 and 11/12 to form an ovarian chamber ; the floor of this space, above and at the sides of the alimentary canal, is formed by a membranous sheet which passes from the anterior to the posterior septum, so that the alimentary canal is excluded from the space which contains the ovaries and funnels.

Each ovary appears as a fringe on the posterior surface of septum 10/11, crescentic in form, tapering upwards nearly as far as the dorsal vessel. The ovisacs are small and finger-shaped, and (in the specimen dissected, at least) are confined to segment xii.

The spermathecal ampulla is small, roundly ovoid ; from it is given off the somewhat wavy or coiled duct, which wanders down on the posterior face of septum 7/8, reaching the body-wall before becoming connected with the atrium. The atrium does not appear in segment viii at all ; it is a finger-like process altogether in front of septum 7/8. It shows no dilatation at its base, *i.e.* there is no atrial chamber apart from the process itself. The spermathecal duct joins the atrium at its ectal end, within the body-wall.

Remarks.—The finger-like upwardly projecting atrium relates the present form to *D. travancorensis* and *D. jalpaigurensis* ; the

similarity to the former is increased by the absence of any other widening at the termination of the spermathecal duct, and to the latter by the coiled form of the prostate. It differs from both in the number or in the position of the gizzards, as well as from *D. jalpaigurensis* in the absence of genital markings.

Drawida affinis, sp. nov.

W. 131/1. Rangamati, Chittagong Hill Tracts, Bengal, 11-vii-1915. R. Hodgart. A single specimen.

External characters.—Length 37 mm.; maximum diameter 3 mm. Colour a uniform medium gray. Segments 107, with, in addition, a small zone of regeneration consisting of eight very small segments; all the segments are very narrow from front to back.

The prostomium was small and could not be accurately examined, owing to its being withdrawn within the first segment.

Dorsal pores are absent.

The setae are closely paired; there is a relatively narrow interval between the ventral bundles, so that *aa* : *bc* : : 3 : 5, or 4 : 7. The lateral bundles of setae are at the level of the lateral line of the body (*dd* = half the circumference).

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

No clitellum was visible, nor are there any genital markings.

The male apertures are in groove 10/11, with their centres in *b*; they are inconspicuous and slit-like.

The female pores were not visible.

There was possibly a slight indication of the spermathecal apertures in grooves 7/8 slightly ventral to *c*.

Internal anatomy.—Septa 5/6 to 8/9 are moderately thickened.

The gizzards are three in number, in segments xiii-xv, with softer annuli intervening.

The last hearts are in segment ix; they run freely, not being connected to the septa by mesentery, as is usually the case.

The testis-sacs are attached to septum 9/10, and are ovoid in shape and contained wholly in segment x. The vas deferens is narrow, and constitutes a coiled mass in x, on the posterior face of septum 9/10. The prostate is tubular, and consists of several closely applied coils or loops (more than in the last species); it is rather shiny in appearance, and becomes progressively narrower towards its ectal end; the vas deferens joins it at a point above (ental to) the middle of its length.

The ovarian chamber,—segment xi,—is constituted as in the last species; the alimentary canal is excluded by means of a membranous connection between septa 10/11 and 11/12 which arches over the gut, but the septa are not united together dorsally near their junction with the parietes. No ovaries or ovisacs were visible.

The spermathecae were small, empty and transparent; they were flattened against septum 7/8, and approximately circular in shape. A narrow coiled duct leads downwards. The atrium has

the same shape and relations as in the last species; there is no swelling at its base.

Remarks.—This species is also one of the group which comprises *D. travancorensis*, *D. jalpaigurensis*, and the last described form (as well as several which follow), characterized by the elongated prostate and much elongated spermathecal atrium. The prostate has the simplest form in *D. travancorensis*, where it is simply pear-shaped; but others of the group are apparently less modified as regards the ovarian chamber.

The relatively narrow interval between the ventral setal bundles is rather characteristic of the present species.

Drawida rangamatiana, sp. nov.

(Pl. xvi, fig. 3).

W. 82/1. Rangamati, Chittagong Hill Tracts, Bengal. 17-vii-1915. R. Hodgart. A single specimen.

External characters.—Length 137 mm.; maximum breadth 7·5 mm. Nonpigmented, light grey in colour. Segments 237; in the posterior third of the body the segments are very short.

There is apparently no prostomium.

Dorsal pores are absent.

The setae are closely paired. In the anterior segments *aa* is equal to *bc*, behind the genital region *aa* is two-thirds of *bc*, but in the middle of the body and towards the hinder end it is distinctly less than half *bc*; *d* is in the lateral line of the body, so that *dd* is half the circumference. All the setae are relatively very small, considering the large size of the worm.

The nephridiopores are in the line of the lateral setal bundles.

No clitellum was distinguishable.

The male apertures are in groove 10/11, with their centres between *b* and *c*, but nearer to *c*; the borders of these segments are much swollen where they are in relation with the apertures.

The female apertures are in 11/12, between *b* and *c*, but nearer *b*; the position is marked on one side by a thickening and whitening of the posterior lip of the groove.

The spermathecal pores are in 7/8, their centres just below *c*; the lips of the groove are swollen here, the swelling of the anterior lip extending upwards beyond *d*.

Internal anatomy.—Septa 5/6, 6/7, 7/8, and 8/9 are very stout and strong, especially the first two; 8/9 is the thinnest of the four; the rest are thin.

The oesophagus, thin-walled and filled with reddish powder, was in the single specimen available bulged alternately on the two sides in successive segments. The gizzards are four in number, in segments xvi to xix, and are separated by softer annuli.

The last hearts are in segment viii; there are two commissures on each side in this segment.

The testis-sacs are rather similar to those of *D. ghatensis*; though to be looked on as derived from septum 9/10, they occupy

a much more posterior position than usual; on the one side the sac was situated in segment xii, bulging back septum 12/13; on the other it extended back into xiii. The forward connection of the sac with its place of origin is by means of a neck, as in *D. ghatensis*; but I could not isolate the neck cleanly from the surrounding structures, for example from the septa through which it passes; there was certainly a continuity of structure between it and septum 11/12. One testis-sac was opened and an attempt was made to turn out its contents and to identify the testis and funnel, but it was not successful; the contents were very firm, and not separable from the inner surface of the wall of the sac.

The vas deferens leads forwards from the testis-sac, and forms a very fine and tightly coiled tube, which joins the prostate rather lower down than its middle, *i.e.* rather nearer its ectal than its ental end. The prostate is a softish white, not shiny, closely curled cylindrical structure, of about the same diameter throughout, of moderate size and without any differentiated duct; it is contained in segment x.

The ovarian chamber does not reach the dorsal body-wall. The ovisacs are small and finger-shaped; they extend back into segment xiii.

The spermathecal ampulla is small and globular; the duct, thin and much coiled at first, and afterwards with a wavy course, runs downwards on the posterior face of septum 7/8. Where it pierces the body-wall there arises a long stalked appendage, the most conspicuous part of the whole apparatus; it stands erect in segment vii, free from and in front of the septum; its ental portion is dilated in the form of an elongated cone with rounded tip; the stalk which connects this with the body-wall is fairly stout, somewhat curved, smooth and slightly shiny, and longer than the dilated ental portion. Fig. 3 represents the appearance of this atrial appendage under the low power of the microscope; the lumen of the dilated portion was empty.

Remarks.—The relationships of this form are with the former group. The coiling of the prostate is as marked as in *D. affinis*, and the atrial appendage of the spermathecal apparatus is more marked and of a more characteristic shape. The resemblance of the testis-sac to that of *D. ghatensis* (14) has been mentioned. It is curious that the last heart is in segment viii (not ix, as usual), and that viii should contain two pairs of hearts.

Drawida papillifer, sp. nov.

W. 83/1. Rangamati, Chittagong Hill Tracts, Bengal. 11-vii-1915. R. Hodgart. A single specimen.

External characters.—Length 70 mm.; thickness 3·75 mm. Colour light grey, nonpigmented. Segments 148.

Prostomium damaged, perhaps prolobous.

Dorsal pores absent.

Setae closely paired; *aa* is rather less than *bc*, *dd* is equal to half the circumference.

Nephridiopores apparently in line with setae *d*.

The male apertures are indistinct, in groove 10/11, between *b* and *c* their centre rather nearer to *c*; they are slit-like, and their lips are not swollen.

I could not distinguish the female apertures.

The spermathecal apertures are in groove 7/8, their centre just below the line of setae *c*.

The clitellum takes up segments x-xiii=4; its hinder end is ndistinct.

There are a few very slightly marked darkish papillae on the genital region, distributed as follows:—On segment vii a pair, dorsal to *d* and just behind the level of the setal bundles; on x a pair, below *c* and just in front of the level of the setae; on xi a single papilla, just behind groove 10/11 and between the lines *b* and *c* but nearer to *c*.

Internal anatomy.—Septa 5/6 and 6/7 are much strengthened; 7/8 and 8/9 much less so,—only moderately stout; 8/9 is bulged forward by the testis-sacs. Septum 9/10 is thin, and is attached to the body-wall at the middle of segment x (according to the external grooves).

The gizzards are three in number, in segments xv, xvi, and xvii; they are separated from each other by soft annuli.

The last heart is in segment ix; on one side in this segment, deeply situated on the intestine, there was an additional commissure.

The testis-sacs are irregular in shape, and asymmetrical, the right being rather anterior to the other, and extending across the middle line in front, while the left extends considerably further back; they are suspended by septum 9/10, but the greater part of the right sac is in ix, and of the left in x,—indeed the hinder end of the left sac is on a level with groove 11/12. On opening one of the sacs the flocculent matter was found to be very adherent to the inner surface of the wall; it would seem that the inner surface proliferates over the greater part of its extent, the testis being diffuse. A folded mass on the wall, at the place where the vas deferens leaves the sac, probably represents the funnel along with compacted spermatozoa.

The vas deferens is narrow and much convoluted; it leads down from the testis-sac to the prostate, which it joins at about the middle of its length. The prostate is soft and glandular-looking; it is elongated, and bent with the angle directed forwards; the ental end is wider than the ectal, so that if it were straight it would be described as club-shaped.

Septa 10/11 and 11/12 are separate from each other at the periphery by the ordinary length of a segment; hence on opening the worm the ovarian chamber is opened up, and numerous small ova fall out; the chamber is closed below (around the alimentary canal),

so that a needle can be passed from segment xii forwards into x along the side of the gut underneath the floor of the chamber.

The ovary is fringe-like, curving round the alimentary tube on the anterior wall of the ovarian chamber. The funnel on the posterior wall is an elongated groove with white lips, and with a similar curve. The ovisacs are large; the right extends back to septum 15/16; the left is curved ventrally so as to pass underneath the intestine, and is confined to segment xii, bulging back septum 12/13.

The spermathecal ampulla is an ovoid sac in the usual situation; the duct is long and convoluted, and leaves the ampulla rather below the middle of its greatest length, passing down to pierce the septum and join the base of the atrium. The atrium is of relatively large size; its upper part is constituted by an elongated ovoid sac, thin-walled, of regular shape, with a smooth surface and in size longer than, but not so broad as, the spermathecal ampulla; the lower part is a duct, half as wide and slightly more than half as long as the upper sac-like portion. The atrium is either erect in segment vii or lies forwards on the ventral body-wall.

Remarks :—This species again belongs to the same group as the former; but while the atrium of the spermatheca has developed still further, the elongation and coiling of the prostate is less than in the two forms immediately preceding. It is unfortunate that the species is represented by only one example, and that hence the value of the genital papillae as a distinguishing character is not easy to appraise.

Drawida nepalensis, Mchlsn.

(Pl. xvi, fig. 4).

W. 72/1. Rangamati, Chittagong Hill Tracts, Bengal. 13-vii-1915. R. Hodgart. Four specimens, one larger than the rest, and sexually mature.

W. 80/1. Kierpur, Purneah Dist., Bihar; under iron tub in open field. 10-ix-1915. C. Paiva. Nine specimens, the majority mature.

External characters.—Length 123 mm. (70 mm. Kierpur); diameter 5 mm. Colour light grey, almost white, nonpigmented. Segments 149.

Prostomium prolobous.

Dorsal pores absent; but the longitudinal muscular coat shows an interval middorsally behind each furrow, easily visible through the superficial layers; these gaps are well seen from the inner side of the body-wall, where they quite give the impression of dorsal pores (Michaelsen, " dorsal pores apparently absent "). The gaps are probably to be looked on as the remnants of pores. In a specimen of the second batch, on stripping off the cuticle and pressing on the body-wall, the spirit inside the body cavity welled out, in several regions, through these pores, as seen by the diffraction lines in the water in which the animal was lying; probably in addition to the longitudinal muscular coat being absent, the other

layers of the parietes were thinned and easily gave way on slight manipulation. The series could be followed forwards to furrow 4/5.

The setae are small and closely paired ; in front of the clitellum *aa=bc*, while in the rest of the body *aa* is rather less than *bc*. In the anterior half of the body *dd* is greater than half the circumference but rather less than two-thirds ; behind the middle it is equal to half the circumference. The relations were almost the same in the Kierpur specimens.

The nephridiopores are in line with the lateral setal bundles.

In the Kierpur specimens a slightly marked clitellum was present on segments x-xiii (possibly xiv should be included).

The male apertures are in groove 10/11, on very prominent papillae which have their centres rather nearer to the line *b* than to *c* ; the papillae are bluntly conical on a circular or transversely elongated oval base ; the height of the papilla is about equal to the diameter of the base ; each is encircled by a groove, and the lips of furrow 10/11 are swollen in front of and behind the papilla for an extent equal about to the interval *bc*.

The female apertures are small, on groove 11/12, in line with *b*.

The spermathecal apertures, difficult to recognise, are in furrow 7/8 just below the line of seta *c*.

Internal anatomy.—Septa 5/6 to 8/9 are much strengthened ; 9/10 is excessively tenuous, and apparently attached well behind the corresponding groove ; all behind are very thin.

There are three gizzards in the dissected specimen of the first batch, in segments xv, xvi, and xvii, separated by softer annuli ; the oesophagus is bulged in ix (or ix and x), but not markedly, and there are no lamellae internally. The specimen of the second batch which was examined had four gizzards, in segments xiv-xvii.

The last heart belongs to segment ix, but is displaced backwards with septum 9/10 so as to lie at the level of the hinder end of the prostate.

The testis-sac of the left side is large and conspicuous, and lies entirely behind septum 9/10, in the space between this and the conjoined septa 10/11 and 11/12 ; it is bent with its convexity inwards, and extends across the middle line. The testis-sac of the right side is much further back ; its hinder end is at the level of septum 15/16, septa 12/13, 13/14 and 14/15 all being bulged backwards and constituting an investment for the sac ; perhaps 11/12 is so also, but this cannot be disentangled from the sac in the same way as the others ; the sac is connected with 9/10 (from which it must be supposed to originate) by a membranous expansion above the alimentary tube and heart. In the Kierpur specimen the sacs were also asymmetrical, that on the right side passing back beneath the ovarian chamber.

On opening the testis-sac the greater part of the flocculent mass which fills it can be dislodged from its walls, leaving only the thin transparent membrane. At one part of the wall is the much folded

funnel with iridescent spermatozoa adhering, from which the vas deferens originates; anterior to the funnel, on the inner wall of the sac, the flocculent mass cannot be cleanly dislodged,—this patch represents the testis, a proliferation of the sac-wall

The vas deferens is a fine and excessively coiled tube, the scores of convolutions forming a large mass which lies against the testis-sac on its outer side. The first portion of the vas, which lies internal to the rest, is excessively fine,—much finer than the main mass; the general direction of the tube is forwards and downwards, and it terminates by joining the ental end of the prostate.

The prostate is a white cylindrical organ, bent in a loop on the left side with its convexity backwards and the ental end upwards, forming an **S** with the ental end of the **S** backwards on the right side; the ental end of the organ is slightly wider than the rest.

The ovarian chamber, enclosed above by the fusion of septa 10-11 and 11/12, is not opened into on opening the animal; there is apparently a free passage underneath the chamber by the side of the alimentary canal. The ovisacs arise from the posterior wall of the chamber; they are subcylindrical, with crenulated margins, and lie on the intestine one on each side of the middle line

The spermathecal ampulla, in the usual situation, is globular in form; a thin duct leads down in several loose coils on the septum, and after piercing the septum joins the base of the atrium in segment vii. The atrium (fig. 4) is very large, and, in the dissected specimen of the first batch, somewhat triangular in shape; in the natural condition the atria encircle the gut so that their straight dorsal edges almost meet in the middle line. In this specimen the organs are empty and laterally compressed, and a deep depression exists in its dorsal border; by manipulation this pit can be seen to be an invagination of the sac-wall which, when its lips are separated, appears funnel-shaped; if the pit were evaginated the atria would overlap the middorsal line. The lower end of the atrium narrows gradually to form a somewhat twisted duct. On opening the sac the inner surface is seen to be elevated into a number of transverse ridges, irregularly disposed and not distinctly annular; but there is no external annulation or grooving such as Michaelsen notes for his specimens. In the specimen from Kierpur, however, transverse ridges and folds were visible on the atrium, though not regularly disposed; and its margins were crenulated irregularly; the upper end was not invaginated.

Remarks.—I was kindly allowed to inspect the types of the species belonging to the Indian Museum; but unfortunately they arrived in such a damaged condition that I was unable to make any use of them.

I have given a complete description of the mature example from Rangamati, with notes on one of those from Kierpur, since they differ in details from Michaelsen's specimens. The two distinct parts of the vas deferens (which I think Michaelsen would have mentioned), the differences in the spermathecal atria, and details concerning the testis and funnel, are of minor importance; but I

am inclined to attribute more value to the position of the testis-sacs (Michaelsen, "on septum 9/10, depending from it, forwards and backwards, into the 9th and 10th segments"), and perhaps also to the absence of copulatory organs (though these were not present in all of Michaelsen's specimens).

The asymmetry of the testis-sacs in the specimens described above is remarkable; on one side there is an approach to the condition of *D. ghatensis* and *D. rangamatiana*. The indications of dorsal pores are also interesting.

I do not myself think that there is sufficient ground for suspecting an identity between *D. nepalensis* and Bourne's *D. uniqua*. Michaelsen (13) says at the beginning of his description that the two may perhaps prove to be identical; and at the end, that "this species comes near to *D. uniqua* (Bourne), if it is not identical with it." But after mentioning the large and peculiar spermathecal atrium he adds: "I do not believe that Bourne could have overlooked the above-described very characteristic structure or that he would have abstained from mentioning it had it been present in his species." I fully agree that Bourne would certainly have given an unmistakable description of this peculiar structure, had it been present; moreover, the prostates in the present species are far too long, and too twisted or bent, to be conceivably described as "teat-like" (as Bourne does for his form); nor are the ovaries free in the present species, as Bourne says for *D. uniqua*, but enclosed in a typical ovarian chamber (Michaelsen, "apparently enclosed"). At the time that Michaelsen wrote, it was doubtful whether any (endemic) species of the genus existed elsewhere than in South India, and it was reasonable to look with suspicion on species which contradicted conclusions otherwise apparently well established.

Fam. MEGASCOLECIDAE.

Subfam. *MEGASCOLECINAE.*

Gen. **Pontodrilus.**

Pontodrilus bermudensis, Bedd. f. **ephippiger** (Rosa).

W. 66/1. Near Chiquilim Point, Mormugao Bay, Portuguese India; under stones at edge of brackish water. 29-ix-1916. S. Kemp. A number of specimens.

W. 126/1. Mormugao Bay, in small bay between Goa and Vasco, shore collecting, under stones. Sept. 1916. S. Kemp. Several specimens.

Gen. **Perionyx.**

Specimens belonging to this genus, unidentifiable because of immaturity, were found at Kalimpong and Pashok, in the Darjiling District, E. Himalayas.

Perionyx excavatus, E. Perrier.

W. 69/1. Rangamati, Chittagong Hill Tracts, Bengal. 11-vii-1915. R. Hodgart. Six specimens of moderate size and one very small one.

W. 81/1. Phagu, near Simla, alt. 9000 ft.; in very wet earth at edge of spring. 11-v-1916. N. Annandale and S. W. Kemp. Four specimens.

The specimens from Phagu are noted as having been, when captured, deep purple above with strong green iridescence, and much paler below.

There was really no gizzard; in segment vi the oesophagus was rather swollen, but the walls when cut into were not thickened. There was no widening of the oesophagus in segment xiii.

There were no diverticula on the spermathecae (examined microscopically also); this was not apparently due to the specimens being in an early stage of sexual maturity, since all the other parts of the genital system are well developed; the ovaries are large, and the seminal vesicles of segment xii reach backwards as far as septum 13/14. I have previously found the diverticula absent in a specimen from Dibrugarh, N. E. Assam (17).

Specimens which were immature, but referable with more or less of probability to this species, were obtained from the following localities:—

Kasauli, W. Himalayas. Baini Prashad. 31-vii-1916.
Talewadi, near Castle Rock, N. Kanara District, Bombay Pres. Oct. 1916. S. W. Kemp.

Perionyx pallidus, sp. nov.

(Pl. xvi, figs. 5, 6).

W. 89/1. Kalimpong, Darjiling Dist., E. Himalayas; alt. 600-4500 ft. 24-iv to 10-v-1915. F. H. Gravely. Several specimens, one mature.

External characters.—Length 80 mm.; thickness 3·25 mm. Colour pale, with purplish tinge dorsally at anterior end, and purple median stripe throughout the body. Body slightly depressed in the anterior portion. The mature specimen was regenerating the hinder end; another of the same size showed 118 segments.

Prostomium epilobous $\frac{1}{2}$; the sides of the tongue parallel.

Dorsal pores from furrow 4/5.

The setae are in rings which are quite closed ventrally, and almost closed dorsally. The middorsal interval varies slightly; in the anterior part of the body *zz* averages $1\frac{1}{2}$ *yz*, further back about $1\frac{1}{4}yz$. The setae are set closer together ventrally than laterally or dorsally; there is no difference in the size of the setae in different segments. The following numbers were counted:—53/v, 72/ix, 52/xi, 64/xii, 52/xix, and in the middle of the body 70.

The clitellum extends over segments xiii-xvi = 4; the body is slightly swollen here, and buff in colour; setae are present as elsewhere.

In segment xviii the midventral region is slightly depressed, and running across it in the position of the setal line is a groove, sharply cut and narrow, though rather wider and deeper at the position of the male pores; these are small cracks, one-tenth of the circumference apart, or with an interval of about seven intersetal

spaces. A few black spots in the bottom of the groove represent the slightly modified penial setae; the other setae begin some little distance outside the groove.

The female aperture seems not to have developed.

The spermathecal apertures are in the furrows 6/7 and 7/8; they are small and slit-like, separated by a space equal to about seven intersetal intervals, or about the same as in the case of the male pores.

Internal anatomy.—Septa 5/6 and 6/7 are thin, 7/8, 8/9 and 9/10 are slightly thickened, and the rest thin.

There is a rudimentary gizzard in segment vi, slightly firmer and paler, through the presence of muscle fibres, than the rest of the oesophagus. The tube is swollen in segments xiii and xiv, and on opening it longitudinal lamellae were found in this region, but they were of no great height and might rather be called foldings than lamellae. The intestine begins in xvii; there is no typhlosole (in the anterior part).

The last heart is in segment xiii.

The excretory system is meganephric; I saw no difference between the nephridia of different segments, and the ducts terminate at the same level.

Testes and funnels are free in segments x and xi. The seminal vesicles are of moderate size, in xi and xii; they are fused in each segment dorsally over the alimentary canal; their contour is smooth, not cut up into lobes.

The prostates, of the *Pheretima*-type, are very small, and confined to segment xviii; the duct runs straight inwards.

The spermathecae are two pairs, in segments vii and viii, opening forwards into furrows 6/7 and 7/8. They are small, with a sac-like ampulla which is rather constricted at its middle, the upper portion being the wider. The duct is scarcely separately distinguishable, and is hardly more than the narrower end of the sac; it is short and half as wide as the ampulla. There is a fairly well-marked bulging on one side of the lower part of the sac in one of the organs which was mounted for microscopic examination (fig. 5); this may represent the beginning of a seminal chamber. A connective tissue strand passes upwards from the summit of the ampulla.

The penial setae (fig. 6) are scarcely modified, and represent a very early stage in their evolution (*cf. P. nainiana*, Michaelsen, 13). They have the ordinary form; in length they measure ·175 mm., in thickness 17μ; with the high power a few fine sculpturings are seen on the distal half of the shaft.

Remarks.—Of the species of this genus which have the spermathecal apertures in furrows 6/7 and 7/8, perhaps *P. aborensis* resembles the present form most closely; but the colour, the intervals between the male and spermathecal apertures respectively, the position of the last heart, and the fusion of the seminal vesicles of each of the two segments, seem sufficient to distinguish them. Differences in the male field separate the present species from *P.*

kempi, *pincerna*, *inornatus*, and *sikkimensis*; the last mentioned has also thickened septa and characteristic penial setae.

Perionyx gravelyi, sp. nov.

(Pl. xvi, figs. 7, 8).

W. 79/1. Pashok, Darjiling Dist., E. Himalayas; alt. 5500 ft. 26-v to 14-vi-1916. F. H. Gravely. A single specimen.

External characters:—Length 48 mm.; maximum breadth 2 mm. Colour dorsally a light purple, more marked at the anterior end, with a darker middorsal stripe, pale ventrally. Segments 89.

Prostomium epilobous $\frac{2}{3}$, tongue broad, cut off behind.

Dorsal pores begin at furrow 6/7.

The setae are in rings, which are almost closed dorsally and ventrally; the middorsal and midventral intervals are perhaps equal to $1\frac{1}{4}yz$ and $1\frac{1}{4}ab$ respectively in front of the genital region, and to $1\frac{1}{2}zy$ and $1\frac{1}{2}ab$ behind it. There are no noteworthy differences between the intersetal intervals. The following numbers were counted: 34/v, 40/ix, 40/xii, 32/xix, and 32 in the middle of the body.

The clitellum is very indistinct; it includes perhaps xiii or $\frac{1}{2}$xiii-xvi = $3\frac{1}{2}$ or 4; setae and dorsal pores are present.

The male apertures are on segment xviii, in the form of slit-like transverse cracks just behind the level of the setae and between setae *a* and *b* on each side (fig. 7). Seta *a* is particularly black; *b* is slightly further out than the *b* of other segments, and *c* of segment xviii corresponds to *d* of other segments in position. The apertures and setae *a* and *b* are situated on papillae which meet and fuse in the middle line; there is a transverse groove in front of and behind the conjoined papillae, so that a strip of segment xviii is left unmodified at the anterior and posterior borders of the segment.

The female aperture was not visible.

The spermathecal apertures are in furrows 6/7 and 7/8, between the lines of setae *a* and *b*. They are thus, like the male pores, very near the midventral line.

Internal anatomy.—Septa 7/8, 8/9, and 9/10 are slightly strengthened; there is perhaps some slight thickening of the septa as far back as the prostatic region.

The gizzard is small, cylindrical, and moderately firm, in segment v. The oesophagus is somewhat swollen in xiv and xv,—in the latter segment transverse vascular channels are visible on the dorsal wall. The intestine begins by a gradual widening in segments xvii to xix; there is no typhlosole in the anterior portion.

The last heart is in segment xii.

Testes and funnels are free in segment x; funnels were seen in xi but testes were not identified. The vesicula seminalis of segment xi is large and single, extending across the middle line and down on each side of the oesophagus, taking up the whole length and breadth

of the segment. In segment xii the vesicles may be described as a pair, but fused in the middle line behind septum 11/12, and thence depending back on each side so as to bulge septum 12/13 back nearly to the level of 13/14. All the vesicles are of simple outline and not lobed.

The prostates occupy segments xvii to xix, and are cut up into three lobes, corresponding to the three segments; they are however relatively small structures. The duct originates at the middle of the gland, and passes at first backwards to the level of septum 18/19, then obliquely forwards and inwards; the angle is perhaps characteristic; each duct is rather thin, soft, and broader towards its ectal end.

The spermathecae are situated in segments vii and viii, and their ducts are directed forwards. The ampulla is sac-like and irregular in shape; the duct is half as thick and nearly as long as the ampulla, from which it is not sharply marked off; there is no diverticulum.

The penial setae,—those on each side of the male apertures, *a* and *b* of segment xviii,—are but little modified. They are ·4 mm. in length, and 21μ broad at the middle; there is a slight curve in the proximal part of the shaft, and the tip is slightly bent; the tip is pointed, and near it there are a few fine dot-like sculpturings arranged more or less in transverse rows (fig. 8).

Remarks.—The present form belongs to the same group of species as the last; the characters of the male field and the penial setae are probably sufficient to distinguish it, though its characters are on the whole negative rather than positive.

Perionyx aborensis, Stephenson var. **heterochaetus**, nov.

(Pl. xvi, fig. 9).

W. 138/1. Pashok, Darjiling Dist., E. Himalayas; alt. 5000 ft. 26-v to 14-vi-1916. F. H. Gravely. A single specimen.

External characters.—Length 60 mm.; breadth 2·5 mm. Colour on dorsal surface dark purple anteriorly, brownish with darker median stripe behind; pale ventrally. The body is depressed, the ventro-lateral angles being fairly pronounced and the ventral surface slightly concave. Segments 100.

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

Dorsal pores from furrow 5/6.

The setae, in rings, have a rather peculiar arrangement. In the first thirty-four segments the setae on the dorsal surface are much larger, and set more widely apart, than behind; the change is sudden, and coincides with a change in pigmentation, which is darker and purpler in front, lighter and browner behind. In the anterior part of the body *zz* is a little greater than *yz*,—about $1\frac{1}{4}$ *yz*; behind there is hardly any difference. The ventral setae are comparatively small and close together throughout, and the ring is closed (*aa* = *ab*). The following numbers were counted :—30/v

31/viii, 30/ix, 31/xii, 33/xix, and about 50 in the middle of the body.

The clitellum appeared to extend over segments xiii-xvii = 5, but was most marked in xiv-xvi; it is light in colour, and the setae and dorsal pores are retained.

The male area, on xviii, is a whitish patch which takes up the whole length of the segment; the lateral margins are rather swollen, and its centre is rather more concave than the rest of the ventral surface The apertures are transverse grooves in line with the setae; the centre of each is about opposite to the setal interval *de*, the interval between the centres of the grooves being thus equal to $\frac{2}{15}$ of the circumference; the interval between the inner ends of the grooves is equal to the length of one of the grooves. Slight depressions, also transverse in direction, are present in front of and behind the grooves, which thus are bounded by slightly marked anterior and posterior lips. The setae begin on the outer margin of the male area.

The female aperture is on segment xiv,—a small transverse slit in the midventral line, surrounded by a whitish oval patch, the whole of which is included between the line of setae and the anterior border of the segment.

The spermathecal pores are situated in furrows 6/7 and 7/8, one-sixth of the circumference apart and about in line with seta *e*.

Internal anatomy.—Septa 6/7, 7/8, and 8/9 are slightly thickened.

There is a rudimentary gizzard in segment v, the oesophagus being somewhat swollen and its walls thickened. The oesophagus is also swollen in segments xi, xii, and xiii, where transverse vascular channels are to be seen in its wall; the interior here is rugose merely. The intestine begins in xix, behind the prostate; there is no typhlosole in its anterior part.

The last heart is in segment xii.

Testes and funnels, the latter included in large masses of iridescent spermatozoa, are present in segments x and xi; a mass of coagulum fills up segment x[1], very much resembling the seminal vesicles in the two succeeding segments, and differing only in being more easily detachable.

The seminal vesicles, in segments xi and xii, are large, and fill out their respective segments; they are flocculent masses, with simple outline, which meet in the middle line dorsally but do not fuse there with their fellow of the other side (doubtfully so in the case of the posterior pair).

The prostates are squarish blocks, confined to segment xviii. The duct is not very stout, and only slightly muscular apparently; it lies in a hilus of the gland for the most part, where it is curled

[1] I have little doubt that the seminal vesicles which I stated to be present in segment x in *P. depressus*, and said to be more intimately attached to septum 9/10 than to 10/11 (17) are really only masses of coagulum. These masses are mainly composed of spermatozoa, making their way, presumably, from the seminal vesicles, where they have been ripening, to the mouths of the funnels.

and twisted; if straightened out it would be of moderate length. Its ectal portion is rather stouter than the rest; it joins the body-wall at the outer margin of a slightly raised whitish cushion. No penial setal sacs were seen.

Ovaries and funnels were well developed, in segment xiii.

The spermathecae are situated in segments vii and viii, opening forwards into grooves 6/7 and 7/8. The ampulla is irregular in shape, and about as broad as long; the duct is very broad,—two-thirds as wide and two-thirds as long as the ampulla, so that the whole organ has a stumpy appearance. There is a single diverticulum, sessile on the inner side of the upper part of the duct; a few indistinct seminal chambers are visible on its surface (fig. 9).

Remarks.—The present form presents some similarities to *P. depressus*, in the depressed form, the general character of the male field, the prostatic duct, and the relations of spermathecal ampulla and duct. It appears to be even more closely related to *P. aborensis*; the differences are the numbers of setae (about 30 per segment in the anterior part of the body as against more than 60 in *P. aborensis*), the setal distribution (the peculiar arrangement in the present form is not, apparently, found in *P. aborensis*, where it is noted that the setae of segments viii and its neighbours are the largest), and the absence of spermathecal diverticulum in *P. aborensis*; the apertures are rather closer together in the present form.

As in so many cases, it is difficult to know quite what to do with a single specimen; had there been a number of specimens for examination its position could probably have been settled with some degree of certainty. The erection of a variety offers a temporary refuge; the varietal may be advanced to a specific name or may be dropped altogether, as subsequent specimens come under examination.

Perionyx nanus, sp. nov.

(Pl. xvi, fig. 10).

W. 78/1. Pashok, Darjiling Dist., E. Himalayas; 5000 ft. alt. 26-v to 14-vi-1916. F. H. Gravely. Two specimens, one mature.

External characters.—Length 53 mm.; diameter 1·5 mm. Colour brownish-purple dorsally, pale ventrally. Ventral surface flattened. Segments 100.

Prostomium epilobous ½, tongue not closed behind.

Dorsal pores begin from furrow 5/6.

The setal ring is almost closed dorsally; and entirely closed ventrally in the anterior part of the body, but behind the anterior third a slight break can be distinguished. The following numbers occurred: *ca.* 36/ix; about the same, but too small to count accurately in xii; 35/xix, and in the middle of the body 34.

The clitellum extends over xiv-xvii = 4; it is well marked, and rather lighter in colour than the rest of the surface, smooth, the setae quite distinct but the intersegmental grooves less well marked than elsewhere.

The male apertures are on segment xviii, in line with *g* or the interval *gh*; they are wide apart, this interval representing a distance equal about to a quarter of the circumference; the pores are slightly behind the line of the setae, and are prolonged inwards towards the middle line by slight grooves. Surrounding each aperture is a whitish oval opaque thickened patch, which is itself surrounded by a more translucent lip; the aperture is situated excentrically in the oval patch, between the centre and the outer margin. The whole takes up the entire ventral surface of segment xviii, the lip on each side forming a prominence at the lateral margin of the ventral surface of the animal (fig. 10). There are no setae between the male apertures.

The female aperture was not actually visible, but was indicated by a very slightly paler transversely oval patch taking up the space between furrow 13/14 and the setal ring of xiv.

The spermathecal apertures are large and patent, widely apart (not quite one-third of the circumference) and near the lateral margin of the ventral surface, in furrows 6/7 and 7/8; they are bounded by distinct lips, and a gelatinous matter was protruding from them.

Internal anatomy.—No septa are notably thickened; 8/9 and 9/10 seemed slightly strengthened, and perhaps 7/8 and 10/11 very slightly so.

A rudimentary gizzard is situated in segment v, the outline of the thickening of the oesophageal wall being somewhat Y-shaped, the posterior portion is narrower, and the wall between the limbs of the Y is soft. The oesophagus is bulged in segment ix, with marked transverse striations (vascular channels). The intestine begins in xix.

The last heart is in segment xii.

Testes and funnels are free in segments x and xi (testes not certainly identified in xi; the funnels are conspicuous through the adherent iridescent spermatozoa). Segment x is filled with coagulum, as in the last species. The vesiculae seminales, large loose flocculent masses with only slightly indented margins, take up the whole length of segments xi and xii; those on xi fuse dorsally over the gut, while those in xii meet but are apparently still separable.

The prostates take up part of segment xvii and all of xviii and xix, and are indented by the septa. The duct is thin, soft, not muscular, of the same diameter throughout, and bent once on itself, the convexity of the loop being forwards; there is no modification of the body-wall where the duct joins it. No penial setal sacs were seen.

Ovaries and funnels were present in segment xiii.

The spermathecae are two pairs, in segments vii and viii; they are very simple in form,—roughly pear-shaped with a thick stalk. The ampulla is of some size, and fills out the whole length of the segment; each was, in the present specimen, full of a coagulated yellow gelatinous material. The duct is broad and short, —half as broad and a quarter as long as the ampulla, from which

it is not sharply marked off. There is a single diverticulum, sessile and wart-like,—in one case hardly noticeable,—on the inner side at the junction of ampulla and duct; it contains glistening spermatozoa, but is not, apparently, chambered.

Remarks.—This species also belongs to the group of *P. aborensis* (spermathecal apertures in 6/7 and 7/8, simple form of spermathecae, and absence of penial setae); but its special characters,—small size, lateral position of the male and spermathecal apertures, characters of the spermathecal diverticulum and male field,—render it perhaps the most distinct of the group.

Perionyx m'intoshi, Bedd.

W. 87/1. Nepal Valley, alt. 4500—6500 ft. 26-vi-1916. Col. J. Manners-Smith. Two specimens, the larger softened.

Little is known about this interesting species, though it was one of the earliest of the genus to be described. The first worm to be described by Beddard under this name was represented by a single immature specimen from Akyab in Burma; this was later considered of doubtful validity by the author himself (3), as also by Michaelsen (10, 13). Our only other source of information is a second short account by Beddard (2); Vaillant, in his *Hist. nat. des Annelés* (1889), which I have not been able to consult, refers to the species, but apparently only from the point of view of classification and without having had any fresh material. It is therefore worth while to give an account of the specimens which have now come to hand.

External characters.—Length 230 mm.; diameter average 10, maximum 12·5 mm. (the softer specimen measured 280 mm. in length, and was of a maximum diameter of 17 mm., but in the condition of the worm these figures are not reliable). The colour is a lighter or darker purple dorsally (the two specimens differ), with the clitellum of a buff tint and the ventral surface pale. The segments of the longer worm were 225 in number; there was no secondary annulation.

The prostomium is epilobous ½; the tongue being open behind.

Dorsal pores are present from furrow 5/6.

The relatively small setae are in rings which are, often at any rate, closed both dorsally and ventrally; there are numerous gaps in various places on the dorsal surface, but since complete rings can be found the gaps may be accidental. The setae are closer together on the ventral than on the dorsal surface; the intersetal spaces are often very irregular. The following numbers were counted: 78/v, 72/ix 76/xii (but there were long gaps in each of these three series), *ca.* 90/xxiii, and 112 in the middle of the body.

The clitellum is not sharply delimited; it extends over ½xiii-xx=7½; the furrows are still well marked, and setae are present.

The male area is a midventral depression on segment xix, which in the more mature of the two specimens is rather longer than broad; it takes up the whole of the length of the segment,

and encroaches in front and behind on the adjacent segments; the depression is rectangular in shape, and has a well marked border, —rather less well marked however at the sides, near the male pores. These are round pits with distinct lips, situated very close together slightly behind the middle of the segment, the line of the setae bends forwards in front of the apertures.

The female aperture is single, and appears as a small transversely elongated pit, on segment xiv, midway between the line of the setae and the anterior limiting furrow.

The spermathecal pores are situated in furrows 7/8 and 8/9, fairly close together, but not, apparently, as close as the male pores.

There are no other genital marks.

Internal anatomy.—Septum 4/5 is thin, 5/6 slightly and 6/7-11/12 somewhat or moderately thickened; a number of those that follow, as far perhaps as 18/19, are slightly thickened. A large number of Nematode parasites were found in some of the anterior segments, in x and especially in xi.

The gizzard, in segment vi, is of fair size even relatively to the large size of the animal; it is moderately firm though not hard; the anterior end is the broader, and there is a constriction not far behind the anterior end, where a transverse sheet of muscle (not a septum) is inserted round the organ. There are no calcareous glands. The intestine begins in segment xviii.

The meganephridia are disposed in the same longitudinal line throughout the body.

The last heart is in segment xiii.

Free funnels were found in segments x and xi, and testes in the former segment; testes were not identified with certainty in xi but the condition of the specimens left something to be desired, and this segment was packed with the Nematode parasites mentioned above. Vesiculae seminales are present in xi and xii; they are large, soft, and somewhat cut up into lobes at their surfaces; those in xii are large enough to bulge back the septum; in one specimen those of the same segment had fused together over the intestinal canal, in the other those of the two sides were separate. There appears to be, in addition to the above, a small empty rudimentary seminal vesicle in segment xiii, attached to the posterior face of septum 12/13.

The prostate, of the *Pheretima*-type, is confined to segment xix; it is cut up by indentations into lobes, and the short and stout though soft duct runs from the hilus transversely inwards to its exit.

Ovaries were present in segment xiii, attached to the posterior face of septum 12/13; the funnels were not seen. In both specimens rudimentary ovisacs were seen in xiv.

The spermathecae have the simplest possible form,—almost spherical sacs, prolonged into a short thin duct. There are no diverticula, though the ampullae themselves show a warty prominence or two

There are no penial setae.

Remarks.—A curious feature of both the specimens is the shifting backwards of the male apertures one segment, to xix ; this is accompanied by an extension of the clitellum also (Beddard describes the clitellum as including segments xiii-xix). There is some doubt as to the locality from which Beddard's (second and well characterized) specimens were obtained ; in his paper he says Seebpore, but subsequently (3) states that he had mislaid his notes and that it might be from Darjiling ; the locality of the present specimens renders this second supposition perhaps the more likely of the two.

Genus **Lampito.**

Lampito mauritii, Kinberg.

W. 136/1. Vareeg Islet, S. side of Mormugao Bay, Portuguese India ; shore collecting, under stones. August, 1916. S. W. Kemp. A single specimen.

Genus **Pheretima.**

Pheretima posthuma (L. Vaill.).

It is scarcely necessary any longer to particularize concerning the distribution of this almost ubiquitous worm, at any rate in those provinces where it has already been found. I have lately received, in the present collection belonging to the Indian Museum and otherwise, specimens from Ludhiana (Punjab), Allahabad, Agra, Lucknow (United Provinces), Rangamati (Bengal), Kierpur (Bihar), as well as from Ajmere in Rajputana, a part of the country of whose Oligochaete fauna we are still in ignorance.

A specimen from Kierpur, Purneah Dist., Bihar, showed a peculiarity which is worth passing mention. This was the accessory papilla on segment xvii on the right side. The accessory papillae are as a rule present on segments xvii and xix, almost in line with and somewhat resembling the papillae which bear the male pores on segment xviii ; this particular papilla however seemed so exactly like the true porophores that I opened the worm, and found that it represented the opening of an accessory prostate, instead of as usual a small bunch of cutaneous glands. This prostate was small, and attached by a strand of tissue to the septum in front ; but it had a well-developed duct, coiled and almost as thick as the one in segment xviii.

Pheretima houlleti (E. Perrier).

Allahabad, United Provinces. L. Karam Narain Bahl.

Pheretima heterochaeta (Mchlsn).

W. 139/1. Rangamati, Chittagong Hill Tracts, Bengal. 11-vii-1915. R. Hodgart. A single specimen.

Pheretima hawayana (Rosa).

W. 74/1. Nepal Valley, E. Himalayas; 4500-6500 ft. Col. Manners-Smith. A single specimen.

Pheretima annandalei, sp. nov.

(Pl. xvi, fig. 11).

W. 8/1. Casuarina woods at Singgora, Tale Sap, Siam. 20-1-1916. N. Annandale. A single specimen, the first four segments damaged.

External characters.—Length 58 mm.; thickness 4 mm. Colour varied, rather blotchy, generally pale, with a greenish tinge behind the clitellum; anteriorly buff, with a brownish pigmentation dorsally in the first few segments; clitellum drab-grey. Segments 63.

Prostomium ?

Dorsal pores not distinguishable in front of the clitellum; there may be one at the anterior border of the clitellum, in furrow 13/14.

The setae are in rings; the dorsal interval is small and rather irregular (*zz* = 1½*yz* in front of the clitellum, less behind); the ring is almost or quite closed ventrally. The setae in front of segment x are rather larger than the average size, and those situated dorsally on segments x and xi are markedly small. There is in general no marked difference in the setal intervals in different parts of the ring, though they are closer ventrally in some of the anterior segments, *e.g.*, viii and ix. The following numbers were counted: 43/v, 59/ix, 55/xii, 51/xix, and 53 in the middle of the body.

The clitellum extends over segments xiv-xvi = 3; it is smooth and rather swollen, without setae or dorsal pores.

The male apertures are situated ventro-laterally, widely apart on segment xviii, the interval between them being about equal to one-third of the circumference; twelve setae intervene. The apertures are transverse slits, not much raised, with much puckered lips, in the line of the setae.

The female pore or pores may be represented by a small slightly raised white patch on segment xiv, near the anterior border of the clitellum.

The spermathecal apertures are small, with slightly tumid lips, in furrows 5/6, 6/7, 7/8 and 8/9; they are situated rather above the lateral line of the body, the interval between those of a pair, measured across the dorsum, being five twelfths of the circumference.

Genital markings are present as small papillae in the male and spermathecal regions. The posterior cluster, about a dozen in number, is situated midventrally on segments xviii and xix. The anterior, seven in number, is midventral on viii, in front of and behind the line of the setae.

Internal anatomy.—Septum 4/5 is thin; 5/6 and 6/7 are somewhat thickened, and have a dense fur of micronephridia on their

anterior faces; 7/8 is thin. No more septa are to be distinctly recognized till 11/12, which is thin, as are all the rest. Septum 10/11 is probably represented by a thin membrane which covers the anterior seminal vesicle; this can be stripped forwards off the vesicle, by which it is much bulged forwards, and seen to get an attachment to the body-wall.

The alimentary tube is much bent on itself in segment v; in vi it is thin-walled and dilated. The gizzard is situated behind septum 7/8, and is large, firm, and squarish. The intestine begins in segment xv. A pair of simple conical diverticula arise in segment xxvii (probably, but the septa are very indistinct). The typhlosole begins at the level of the caeca; it consists of a vertical lamina, the sides of which are folded into a series of vertical ridges. Paired lymph-glands are situated on the intestine.

The last heart is in segment xiii.

The excretory system is micronephridial.

Testis-sacs contain the testes and funnels; the sacs are two pairs, those of a pair being quite separate, but those of the same side appear to communicate; the anterior is also connected with the anterior, the posterior with the posterior seminal vesicle. Both pairs of vesicles are very conspicuous, large and white; the anterior, which probably belongs to segment x, extends forwards to impinge on the hinder end of the gizzard; the posterior, in segment xii, extends backwards carrying before it septa 12/13, 13/14, and also to some extent 14/15. The posterior is of simple form, while the front margin of the anterior is slightly lobed.

The prostates take up segments xvii to xx; they are deeply indented into lobes, and in the normal position almost meet dorsally over the intestine. The shining and muscular duct is coiled circularly; it is of moderate stoutness, except at its ectal end, where it narrows, and then joins a copulatory pouch; the whole,—duct and pouch,—are contained in a membranous (probably muscular) sac, through which the duct can be seen, but which has to be torn through before it can be properly displayed. Duct, pouch, and sac form a large flat elevation on the body-wall, which impinges upon and rather bulges forwards and backwards the septa limiting segment xviii in front and behind.

The ovaries have the usual situation.

The spermathecae (fig. 11) are four pairs. The ampulla is irregular or of an elongated triangular shape; the stout duct, long and bent on itself, is nearly twice the length and half the thickness of the ampulla. The single diverticulum is a small ovoid iridescent sac attached by a thin wavy stalk to the duct at its extreme upper end, just below its junction with the ampulla. The loop formed by the duct is bound together by connective tissue, which has to be torn through before the various parts of the apparatus can be nicely laid bare.

Corresponding to the external papillae there is seen on the inner surface of the body-wall, on both sides of the ventral nerve cord, and between and behind the copulatory sacs, a group of

small stalked glands, sometimes rather mushroom-like; a similar group exists in the spermathecal region.

Subfam. *OCTOCHAETINAE.*

Gen. **Hoplochaetella.**

Hoplochaetella suctoria, sp. nov.

(Pl. xvi, fig. 12; pl. xvii, figs. 13, 14).

W. 67/1. Sanvordem, Portuguese India; under stones near river subject to tidal influences. 11-ix-1916. S. Kemp. Five specimens.

External characters.—Length 140 mm.; thickness 6 mm. Colour a light brown dorsally, with rather darker median stripe; pale ventrally; setal rings on whitish lines. Segments 145.

Prostomium epilobous $\frac{2}{3}$, tongue not closed behind.

Dorsal pores from furrow 4/5.

The setae are disposed in rings; the middorsal interval is small,—about *2yz*, but it varies somewhat, and may be less than *2yz* in the anterior part of the body; the midventral interval is similar to the middorsal. The setae of some of the anterior segments are enlarged, more especially those of segments iii-viii; in general, the ventral setae are set more closely than those on the lateral and dorsal aspects; this is especially noticeable in the posterior part of the body. The following numbers were counted:—66/v, 66/ix, 63/xii, 60/xxi, and 58 behind the middle of the body.

The clitellum was not distinguishable.

The external genital markings vary somewhat; it will perhaps be most convenient to describe the first specimen in some detail, and then briefly to allude to the differences in the others.

In the first specimen examined (fig. 12) the male field embraced segments xvii-xix, the most striking feature being the presence of three circular or obliquely oval clean-cut depressions with flat bottoms, which from their sucker-like appearance suggested the specific name; of these a pair were situated on segment xvii, their length antero posteriorly being equal to the length of the segment, and the distance between the inner margins of the depressions being about equal to twice their longest diameter, the outer and anterior wall of each depression is steeper than the rest of the circumference. A similar depression is present on segment xix, but this is single, and to the right of the middle line, which it almost reaches by its inner margin; in this one it is the outer and posterior part of the circumference which is the best defined. The whole area which includes these three depressions, as well as the prostatic apertures to be mentioned immediately, is sunk below the general surface; the sunken region is triangular in shape, in accordance with the disposition of the sucker-like depressions, but the triangle is not symmetrical about the middle line.

The prostatic apertures are represented by two pairs of small transversely elongated, almost linear, pits in furrows 17/18 and 18/19 respectively; the anterior pair is situated rather internal to

the depressions on xvii, which they almost touch by their outer ends; the right aperture of the posterior pair has its centre in line with that of the hinder sucker-like depression, and is situated tangentially to it (fig. 12).

The female aperture is situated midventrally on segment xiv, in front of the line of the setae.

The spermathecal apertures are two pairs, situated on segment viii, the anterior in the line of the setae, the posterior just in front of furrow 8/9. Each aperture appears as a small transverse slit with slightly raised whitish lip; the inner ends are not far from the middle line. In none of the specimens could I make out any actual pore within the transverse grooves; and this was commonly the case in other species of the genus also, so that the communication of the spermatheca with the exterior apparently takes place only for a limited interval.

A series of genital marks in the neighbourhood of the spermathecal apertures is visible on close examination of this region. These consist of a number of minute papillae, whitish, each with a black central dot. These dots are displaced setae: on delicate manipulation they can be felt to grate against a needle; I isolated some of them, and describe them below. The disposition of the displaced setae in this particular specimen is shown in fig. 13; briefly, there were three on segment vii, arranged more or less transversely near the midventral line behind the middle of the segment; a transverse row of six on the anterior half of segment viii; and five on the anterior half of ix, three to the right and two to the left of the middle line. An examination of the figure will show that the displaced setae correspond in position to gaps in the regular setal line, and further that the number in each group corresponds to the number of setae missing from the regular line; this is the case in the other species of the genus also.

There is considerable variation in these external genital characters. The sucker-like depressions may be more or less distinct; the single posterior depression may be accurately in the middle line; or it may be rather further back than in the specimen described above, over furrow 19/20; or finally the triangle may be reversed,—there may be one anterior and two posterior depressions. In the spermathecal region the anterior pair of spermathecal apertures (or the grooves which are to contain them) may be just in front of, rather than in the line of, the setae; and displaced setae may be absent on segment vii.

Internal anatomy.—The disposition of the septa in the anterior part of the body was not at first clear to me; the difficulty arises from the extreme tenuity of some of the septa, and the fact that others are fused together in the manner to be described. Dissection of more than one specimen was necessary; the result given below was found to hold, in general terms, for the other species of the genus also.

Septum 4/5, behind the pharyngeal mass, is thin, but shows the presence of a few muscular strands, and so is rather stronger

than those which follow. Septa 5/6, 6/7 and 7/8 are very thin indeed,—the extreme of delicacy and transparency; 6/7 is really behind the gizzard, since it can by gentle manipulation be peeled backwards from off its wall as far as its hinder end. Septum 8/9 is scarcely thickened; ix is a wide segment containing the anterior seminal vesicles and posterior spermathecae; 9/10 is slightly thickened, and is united peripherally with the following septum 10/11, and the next after, 11/12, in such a way that at first the three together appear as if they constituted one enormously thickened septum; after separating them 10/11 and 11/12 are seen to be in reality not much thickened. Segments x and xi, enclosed between these fused septa, are narrow segments which contain the testes and funnels, as well as two pairs of hearts and calcareous glands. Septum 12/13 is somewhat thickened, and 13/14 and 14/15 perhaps slightly.

The gizzard, in segment vi, is large and subspherical; the immediately preceding part of the alimentary tube is also fairly firm. Calcareous glands are present in segments x, xi, xii and xiii; they lie within the arch of the heart, are kidney-shaped, well set off from the oesophagus, and compressed antero-posteriorly; the two posterior pairs are larger than the two anterior. The typhlosole is a strongly marked vertical ridge. There are lymph-glands similar to those of *Pheretima* on the septa middorsally over the dorsal vessel; these become more or less distinctly paired towards the hinder end of the animal.

The last heart is in segment xiii; but there is a pair of commissural vessels, smaller than the hearts, though quite obvious, in xiv. The dorsal vessel is single.

The excretory system is mixed mega- and micronephridial. Meganephridia exist as far forward as segment xii, but are quite small in front of xx,—indeed are hardly recognizable in xviii and xix. From segment xx backwards the meganephridium, in the form of a thin tube, is disposed in a large loop which reaches outwards on the body-wall to not very far from the middorsal line; the micronephridia are numerous, arranged in a transverse row along the middle of each segment. The condition is the same towards the hinder end of the body,—a long fine loop behind the septum stretching to near the middorsal line, its ventral end about two-ninths of the half-circumference from the ventral nerve cord, and the micronephridia in a transverse row behind the meganephridium. In the anterior part of the body the micronephridia lose their transverse arrangement, and become scattered on the body-wall (from about segment xvii forwards) and very numerous; there are the usual large tufts at the hinder end of the pharynx, and other similar but smaller tufts on each side in the most anterior segments of all.

Testes and funnels are free, in segments x and xi (the testes were rather doubtfully identified in xi); these segments are enclosed between the fused septa, as previously explained, and contain much coagulum,—probably masses of sperm-morulae and

developing spermatozoa. There are two pairs of seminal vesicles, both of moderate size and both slightly lobed in outline; the anterior are in segment ix, attached to septum 9/10, the posterior in xii attached to 11/12.

The prostates are two pairs, together extending from segment xvii to xxv. Each is a long and convoluted tube thrown into a number of loops in each segment through which it passes. The posterior, after occupving segments xxv-xxii, suddenly in segment xxi, becomes thin,—a quarter of its former diameter; and so continuing through xx, becomes in xix a fusiform shining muscular tube, which turns obliquely inwards to end near the middle line at the anterior border of the segment; the thickest part of the duct (the fusiform swelling near its termination) is about as wide as the main portion of the gland. The anterior prostate begins on each side in segment xxi, thus overlapping the thin anterior portion of the posterior gland; it maintains its initial thickness through xx and xix, becomes thin in xviii, and the fusiform duct, of the same character as that of the posterior gland, curves inwards in xvii to open near the middle line at the hinder border of the segment.

The vas deferens comes down on each side to join the end of the ducts of the anterior pair of prostates on their outer sides. No such arrangement can be seen in connection with the posterior prostates.

Underneath the prostatic ducts in segments xvii and on the right side in xix, and therefore corresponding to the sucker-like depressions seen externally, are circular white cushions or elevations of the body-wall. This region (segments xvii, xviii and xix in their ventral portions) is characterized by dense clusters of micronephridia, which however are absent from the circular cushions just mentioned.

The ovaries are in segment xiii.

The spermathecae are two pairs; the ampulla is sac-like, broadly ovoid with pointed tip; the duct is broad and short, and not set off from the ampulla, of which it is merely a narrower continuation. There are numerous diverticula, about fifteen to a score, arranged as a complete circle round the lower part of the ampulla; each is a small rounded protuberance, broadly sessile (fig. 14). The ducts of the anterior pair of spermathecae run backwards under the peritoneal and connective tissue layers of the body-wall, becoming narrower as they do so, and ultimately pierce the parietes not far from the middle line at about the middle of the length of segment viii; this corresponds with the surface-marking previously described.

A number of accessory glands are associated with the spermathecae. These project into the coelom near the spermathecal apertures, are club-shaped in general form, and about a millimetre or a little more in length; they are not hollow diverticula from the base of the spermathecae, but solid masses of cells. A large nephridial tube is closely associated with each spermatheca; and in addition there are copious micronephridia all round them.

The displaced setae of the spermathecal region are not visible from inside, since their sacs are wholly imbedded in the body-wall. The only way to obtain them for examination is therefore to cut out a piece of the body-wall containing some of them, and to tease it out with needles on a slide. The ordinary setae of this region are ·44 mm. in length and 25μ in thickness below the nodulus; they have the usual curve, the tip is blunt, the nodulus is distal to the middle of the shaft; there are a few extremely fine sculpturings, —short transverse rows of dots,—scattered near the tip. The displaced setae are rather longer and slenderer,—·49 mm. in length and 24μ in thickness; the tip is sharper, the distal portion tapers gradually, there is no distinct nodulus, and the proximal end of the shaft is bent in the opposite way from that of the normal seta, *i.e.* the curve is in the same direction as the distal curve, not in the opposite as usual; transverse sculpturings, well marked and extending for some distance along the shaft, ornament the distal end, but these transverse markings are not arranged in regular rings.

Hoplochaetella kempi, sp. nov.

(Pl. xvii, figs. 15, 16).

W. 68/1. Talewadi, near Castle Rock, N. Kanara Dist., Bombay Pres., October 1916. S. Kemp. Nine specimens.

External characters.—The largest specimen was 103 mm. long and 4·5 mm. in thickness. Colour a rich brown above with darker middorsal stripe; pale ventrally, the setae on whitish rings. Segments 106.

Prostomium very variable, epilobous $\frac{2}{5}$ to $\frac{4}{5}$; broad and triangular, or narrow and with parallel sides.

Dorsal pores commence from furrow 6/7.

The setae in rings; ventrally *aa* = 2½*ab* behind the clitellum, and about 2*ab* in front,—but *ab* itself is somewhat variable; dorsally *zz* = 2 to 3*yz*, but here again the middorsal interval and intersetal spaces are irregular, and this is the case laterally too. The intersetal spaces are greater, on the average, dorsally than ventrally throughout the body. The following numbers were counted:—52/v 56/x. 45/xx, and 44 in the middle of the body.

The clitellum extends over segments ½xiii–xvi = 3½; it is darker in colour than the general surface, and is smooth, but setae and dorsal pores are present.

The ventral surface is concave over segments xvii–xix. The prostatic pores are two pairs of well-defined pits, in furrows 17/18 and 18/19; these are fairly deep, transversely oval in shape, and in length from side to side about equal to two intersetal intervals; the midventral interval between the pits of the same pair is greater than the long diameter of the pits, but less than twice the diameter; the actual apertures are probably at the bottom of the pits,—this was seen to be the case in the posterior pair.

Conspicuous on the male field, in the specimen first examined, are two large broadly oval papillae, each surrounded by a deep

clear-cut groove, the flat surface of the papilla being about on a level with the general surface. Of these the anterior is midventral, in furrow 16/17 ; the posterior has its centre on the anterior part of segment xx, but its size is such that it encroaches forwards on to segment xix, and so partially obliterates groove 19/20 (fig. 15) ; it is to the left of the middle line, and takes up in transverse extent a space equal to the distance between seta *a* and *f*. The antero-posterior length of each papilla is almost equal to the length of a segment. Setae are absent from xvii and xix midventrally, and from xx in the region of the papilla. The whole area of the male pores and papillae is whitish and thickened.

The female aperture is situated midventrally on segment xiv, in the centre of a small circular area in front of the line of the setae.

The spermathecal apertures are represented by two pairs of small elevations on segment viii ; of these the anterior are situated between the row of setae and the anterior margin, the posterior just in front of furrow 8/9 ; all are pretty close to the middle line. There appear to be a few displaced setae on each of the anterior pair of papillae ; but the curious thing is that there is no actual pore, no definite opening, either on the papillae or elsewhere ; I looked for apertures carefully in the grooves, but there are certainly none there. This peculiarity seems to characterize all the species of the genus ; and one is driven to suppose that the spermathecal apertures form only when actually required, at the time of copulation and oviposition ; at any rate the openings are only virtual or potential at other times.

In this region there are other small elevations which bear setae ; a pair on segment ix, just in front of the setal line, and a pair on vii actually in the line of the setae (in this latter case the special setae are therefore not " displaced ").

In this species also the appearances on the genital region vary somewhat in different specimens. Thus it is commoner to find the anterior of the two papillae of the male area on the right side, balancing the posterior, as it were, which is on the left ; or both anterior and posterior papillae may be midventral or almost so ; or there may be only one papilla, posterior and on the right side. In the spermathecal region the special setae on their papillae are usually in line with the ordinary setae of segments vii and ix.

Internal anatomy.—The disposition of the septa is so similar to what has been described for the last species that nothing further need be said.

The gizzard, squarish in form and of moderately large size, is in segment vi. Calcareous glands, of large size, stalked and set off from the oesophagus, are present in segments xii and xiii ; they are over-arched by the hearts, and in xii overlaid by the seminal vesicles ; similar glands are also present in x and xi, but smaller and more deeply placed in the segment. The intestine begins in xvi ; the typhlosole is a simple longitudinal vertical lamina, of

relatively large size. Lymph-glands are again present on the intestine from its beginning, appearing as a row of minute lobules lying transversely across the dorsal vessel and attached to the posterior septum of each segment.

The first transverse vascular commissure is in segment viii, the dorsal vessel, though continued forwards over the gizzard, not giving off any regular series of branches in front (*cf. Erythraeodrilus*). The last vessel that can properly be called a heart is in segment xiii; but, as in the last species, there is a pair of very obvious commissures in xiv. The "hearts" are light in colour,—*i.e.* muscular and contractile; they are narrowed at their entry into the dorsal vessel, and in segments xii and xiii appear to have a connection with the supraintestinal also. The commissures of segment xiv are about half the diameter of the hearts, and do not sweep out so far in the segment; they are dark in colour, and are not contracted at their entry into the dorsal vessel.

The meganephridia are first plainly visible in segment xx; as in the last species they are long thin loops stretching outwards on the body-wall to near the middorsal line; each lies along the middle of the segment, and appears to be quite free from the septum in front. The micronephridia are numerous, arranged in a transverse band in each segment, though not in a single series; they form a dense fur all over the inner surface of the body-wall in the clitellar segments; and in front of this also they are densely set and without regular arrangement; there are considerable tufts at the hinder angles of the pharynx in segment v, as well as in the most anterior segments in front of this.

In segments x and xi, ventrally situated and (in xi at least) continuous across the middle line, there were seen fairly large iridescent lobed masses, not enclosed in a membrane, and representing clumps of spermatozoa round the funnels. The testes were not distinguished, and may have atrophied. The vesiculae seminales are two pairs, of moderate size, slightly lobed, in segments ix and xii.

The prostates are tubular; the two pairs have the same general arrangement as before. The anterior pair reaches back to segment xx or xxi, the posterior to xxiv. The ental end of the anterior gland is somewhat narrower than the main mass of the gland; in segment xix the main mass becomes a narrow shining duct, which crosses segment xviii, twisting about as it does so; the duct ends, widening rather rapidly, by getting into xvii and piercing the body-wall at the posterior border of the segment. In the posterior pair there is not much difference in the thickness of the glandular part throughout its extent; each becomes a narrow shining duct at the anterior border of segment xxi; this duct is convoluted as it crosses xx, widens as it enters xix, and, as seen from inside, pierces the body-wall at about the middle of the length of the segment. In both the anterior and posterior glands the terminal portion of the duct is directed inwards towards the middle line.

The vas deferens was identified on the outer side of the termination of the anterior duct; it ends by entering the body-wall just behind and external to the prostatic duct.

Firm white cushions are seen on the inside of the body-wall, in situations corresponding to the large flat papillae seen externally. Except where occupied by the cushions the midventral region on the inner side of the body-wall in segments xvi–xxi is densely covered by rather large micronephridia.

Ovaries are present in segment xiii.

The spermathecal ampulla (fig. 16) is sac-like and ovoid in shape; the duct is only slightly set off from the ampulla, is somewhat less in length than the ampulla broad, especially at its upper end, but narrows considerably towards its termination. On the duct, at about the middle of its length, are two to four diverticula, small rounded knobs filled with white shining matter. In addition, the accessory glands are here numerous and conspicuous; each is an elongated cylindrical structure, solid, soft, and white, with a short narrow stalk (fig. 16); on one side there were seven,—three in front of the anterior spermatheca, three between the two, and one near the posterior spermatheca; on the other side there were six, one in front of the anterior, three between the two, and one behind the posterior spermatheca.

Hoplochaetella inornata, sp. nov.

(Pl. xvii, fig. 17).

W. 130/1. Talewadi, near Castle Rock, N. Kanara Dist., Bombay Pres., October 1916. S. Kemp. A single specimen.

External characters.—Length 101 mm.; maximum thickness 6 mm. Colour light brown dorsally, pale ventrally; the white circles on which the setae are implanted are a conspicuous feature. The anus is a vertical slit. Segments 79.

The prostomium is epilobous; the tongue, with parallel sides, is bounded by grooves of which that on the right side goes back only through half of the first segment, while that on the left is continued on to segment ii.

Dorsal pores begin from furrow 6/7.

The setae are on rings which are closed dorsally, and almost closed ventrally ($aa = 2ab$ or less); there is no regular variation in the intersetal intervals between the dorsal and ventral surfaces, or between one region of the body and another. The setae of segments viii–xii are very small. The following numbers were counted :— 84/v, 80/ix, *ca.* 84/xii, 85/xx, and 91 in the middle of the body.

The clitellum extends over segments $\frac{1}{2}$xiii–xvi $= 3\frac{1}{2}$; it is smooth, brown, and markedly constricted; setae are visible and the intersegmental furrows are indicated, but there are no dorsal pores.

The prostatic apertures are two pairs, on segments xvii and xix, at the hinder and anterior borders of these segments respec

tively. They are in the form of small pits, fairly close together, the anterior rather closer than the posterior; each pit has a distinct lip, the outline of the whole being not quite circular, but broadly oval in a transverse direction; the lip in each case extends over the adjacent intersegmental furrow, obliterating it for a short distance, but the pits are just within the boundaries of their respective segments.

The female aperture is represented by a small pit in a small white circular area, midventrally situated on segment xiv in front of the line of the setae.

The spermathecal apertures are represented by two pairs of small papillae on segment viii, the anterior pair midway between the setal line and the anterior furrow, the posterior midway between the setae and the posterior furrow; the papillae are transversely oval in form, and not far from the middle line, the posterior pair being closer together than the anterior; a slight darkening of the centre is all that represents the end of the spermathecal duct. It is interesting to notice how exactly the position of the prostatic apertures corresponds to that of the spermathecal papillae; segment xviii, which intervenes between the pairs of prostatic pores, is a much shorter segment than viii; and the smaller interval between the posterior pair of spermathecal apertures answers to the smaller interval between the anterior prostatic pores when the worms are facing in opposite directions in copulation.

The setae of segment viii are absent ventrally; they begin external to the line of the outer margins of the spermathecal papillae. There are a few dark dots in the posterior spermathecal papillae which may be displaced setae.

Internal anatomy.—The arrangement of the septa is exactly as before.

The pharyngeal mass is in front of septum 4/5; in segment v the oesophagus becomes broader and fairly firm; the gizzard is in vi, barrel-shaped and limited in front and behind by a firm annular ridge. Calcareous glands, kidney-shaped and attached by the hilus, are present in segments x–xiii, small in the two anterior, larger in the two posterior segments. The intestine begins in xvi; lymph-glands lie across the dorsal vessel. In segment xv a large yellowish kidney-shaped mass lies dorsally on the oesophagus and dorsal vessels, its convexity backwards; it is firm, with a slightly rough surface, takes up the whole length of the segment, and is considerably wider than the alimentary tube at this point; it is probably a lymphoid mass. The typhlosole is as before.

The last heart is in segment xiii, and the first in viii; the dorsal vessel is continued forwards over the gizzard as in the foregoing species, and there is the same distinction between the heart in xiii and the stout vascular commissure in xiv as was noted there.

The meganephridia are first visible in segment xx; the nephridia have throughout the same arrangement as in the last species.

Testes and much folded iridescent masses representing the funnels covered with ripe spermatozoa are free in segments x and xi. The anterior seminal vesicles, in segment ix, are large, yellowish and very conspicuous masses, very slightly lobed ; the posterior pair in segment xii are not so large and are more cut up into lobes, though still not deeply.

The anterior prostate on each side extends back to segment xxiii ; the glandular part becomes in segment xx a thin coiled duct which passes forwards through xix, swells gradually in xviii, becoming broad, firm and muscular, and curving inwards towards the middle line ends in segment xvii. The posterior gland, beginning behind in segment xxviii, passes forwards to xxiv, where similarly it becomes a thin coiled duct ; this becomes gradually thicker in xxi and xx, and ends in xix, the final portion of its course being almost straight.

The two vasa deferentia of the right side were identified in their course backwards underneath the peritoneum ; they pass the duct of the anterior prostate on its outer side, and end curving rather inwards behind it.

Ovaries and funnels are present in segment xiii. A minute lobulated appendage of septum 13/14 on its posterior face is probably a small ovisac.

The spermathecal ampulla (fig. 17) is an irregular sac, narrower below, and continued into the duct without any sharp demarcation. At about the place where the one passes into the other is a ring of small white shining sessile diverticula, about a score in all ; but these do not form a single circle all round,—they are arranged two deep on each side of the duct, where they are more closely set than in front or behind. Beyond the diverticula the duct is stout, shining, and narrows slightly towards its ectal end ; in length the portion below the diverticula is about half that of the ampulla.

Between the openings of the spermathecae of the same side, and so about the middle of segment viii, is a group of five rather twisted accessory glands, implanted quite near each other ; they are similar to those previously described, each with a narrow cylindrical duct which is much shorter than the elongated glandular portion.

A character of this specimen which was not noted in the previous species is the presence of accessory glands in the region of the prostatic apertures also. There are three pairs, in segments xvii, xviii and xix respectively. Those in xviii are the largest ; they are massive and solid-looking, rather rectangular in shape, take up the whole length of the segment, and nearly touch each other in the middle line. Those in xvii and xix are only about half the size of those in xviii ; they are on the inner side of, and rather conceal the end of, the prostatic ducts. All have short stout stalks ; the stalks of the glands in xvii and xix appear to become continuous with that of the gland in xviii by passing through the septa where these are attached to the parietes.

Hoplochaetella bifoveata, sp. nov.

(Pl. xvii, fig. 18).

W. 129/1. Talewadi, near Castle Rock, N. Kanara Dist., Bombay Pres., October 1916. S. Kemp. A single specimen.

External characters.—Length 82 mm. ; diameter at the clitellum, which is bulged, $5\frac{1}{2}$ mm., behind this 4 mm. Colour light brown above, with a darker middorsal stripe; pale below; setae on slightly whiter transverse rings. Segments 62; possibly the specimen has been damaged, since the last segment is of full size, and is not followed by any zone in which differentiation of new segments is going on.

Prostomium epilobous $\frac{1}{2}$, very broad,—perhaps somewhat distorted, as the buccal cavity is everted.

Dorsal pores commence from furrow 5/6.

The middorsal setal interval is irregular in front of the clitellum, perhaps because a number of setae have dropped out here and there; normally *zz* may be equal to *2yz*; a short distance behind the clitellum the setae become very small and difficult to see on the dorsal surface, but the interval is perhaps about the same. Ventrally they can be better distinguished against the paler background; *aa* = *2ab* throughout the greater part of the body, = $2\frac{1}{2}$*ab* for some distance behind the clitellum, and is irregular or = *2ab* in front of the clitellum. On the whole the setae are more closely set ventrally than laterally or dorsally; this is best seen behind the middle of the body. The following numbers were counted: 49/v, 62/x, 60/xii, *ca.* 50/xxii.

The clitellum extends over segments $\frac{1}{2}$xiii-xvi = $3\frac{1}{2}$; segments xvii and part of xviii are also somewhat modified. The clitellar region is smooth, brownish in colour both dorsally and ventrally, and much swollen; setae are visible, but no dorsal pores.

The conspicuous features in the male area (fig. 18) are two large depressed areas, shallow and saucer-like, with only slightly raised rim. These are situated midventrally in the position of grooves 16/17 and 19/20, but in each case the depression extends further onto the posterior of the two segments (as far as the setal line) than on the anterior. From side to side each takes up approximately a space equal to the interval between the prostatic pores of the same pair; and in each case the anterior margin of the depression is the better defined, and is rather straighter.

The prostatic apertures are two pairs of small transversely oval shallow depressions with raised lips, in furrows 17/18 and 18/19, not very far from the middle line; the actual openings of the ducts are however invisible, or are perhaps represented by dark dots near the inner and anterior margin of the depressions. It might be more accurate to say that the posterior pair of pits are on the most anterior part of segment xix rather than in groove 18/19; grooves do not really exist here, and the pits are rather nearer to the setal line of xix than to that of xviii.

The female aperture seems to be situated just in front of the line of the setae midventrally on segment xiv, on a small white transversely oval papilla.

The spermathecal papillae are two pairs, on segment viii, the anterior pair midway between the setal ring and the anterior intersegmental furrow, the posterior just in front of the posterior furrow. Setae are absent from the midventral region of segment viii, but displaced setae are found on all the spermathecal papillae. A pair of small papillae are also present in segment ix, in or slightly in front of the setal ring and in line with the spermathecal papillae ; on these too displaced setae are seen.

Internal anatomy.—The specimen was in poor condition internally ; it is however remarkably similar to the last species. The septa, circulatory system, and nephridia require no comment. The barrel-shaped gizzard is in segment vi ; of the four pairs of calcareous glands those in segments xii and xiii are smaller than in the preceding species.

The testes and funnels are as before ; the two pairs of vesiculae seminales are yellowish, of fair size and slightly lobed. Each of the prostatic ducts is extremely thin in its course from the end of the glandular portion to its terminal swelling. The vasa deferentia pass by the outer side of the termination of the anterior duct while still separate, then turn behind it, unite, and end. There are small accessory glands in the neighbourhood of the prostatic apertures, in front of and behind the termination of each of the ducts. In addition, two large white cushions occupy the middle line in positions corresponding to the external depressions.

The ampulla of the spermatheca is of a longer or shorter ovoid form, narrowing below where its outline is more irregular. On this lower narrower part are situated two, three or four seminal chambers, of moderate size, sessile, white and shining. Below this the sac is continued into the duct, narrow and almost wholly within the body-wall. There are a number of accessory glands, of the former type, in the neighbourhood of the spermathecae. The whole is very like the organs in *H. kempi* (fig. 16).

Hoplochaetella affinis, sp. nov.

(Pl. xvii, figs. 19, 20).

W. 128/1. Mormugao Bay, Portuguese India (Donna Paula Bay and vicinity) ; shore collecting. August, 1916. S. Kemp. Six specimens.
W. 125/1. Mormugao Bay, Portuguese India (Vareeg Islet, S. side of Mormugao Bay) ; shore collecting, under stones. August, 1916. S. Kemp. Two specimens, one damaged.
W. 127/1. Mormugao Bay, Portuguese India (small bay on S. W. side of Mormugao Head) ; shore collecting. September, 1916. S. Kemp. Two specimens, in rather poor condition internally.

The description is based on the first batch of specimens, which are to be considered as the types. The other batches differ slightly from the first, and are referred to subsequently.

External characters.—Length 140 mm.; maximum diameter 7 mm. Colour brown dorsally, with a darker middorsal stripe; pale ventrally; setae on white circular ridges. Segments 130.

Prostomium comparatively small, epilobous ¾.

Dorsal pores begin from furrow 5/6.

The setal rings show an irregular dorsal break; in the anterior part of the body $zz = 2—3yz$, for some distance behind the clitellum $= 4—5yz$, and more posteriorly $2—3yz$. The ventral break is smaller and more regular; in front of the clitellum $aa = 1\frac{1}{2}ab$, and behind $2ab$ The intersetal distances are also more regular on the ventral side than on the dorsal; in some regions the setae on the dorsal side are arranged distinctly as couples, with a fair interval between the couples,—equal to twice the space between the individuals of a couple. The numbers counted were :— 72/v, 80/ix (including 8 displaced), 74/xii, 65/xix, and 60 in the middle of the body.

The clitellum is very indistinct; it is marked by a slight reddish tinge on the dorsal surface, and extends over ½xiii—½xvi, or perhaps xiii-xvi,—three or four segments.

The male area (fig. 19) saucer-like and depressed, with a thickened lip; in one case the inner margin of the lip, instead of sloping into the central depression, is much sharper, and actually overhangs. The shape of the area is oval, with its long axis antero-posterior; it covers (without the thickened lip) segments xvii-xix, and its breadth is two-thirds of its length.

In this depression are situated the prostatic apertures,—small darkish transversely oval spots, with perhaps a rather whiter border, on segments xvii and xix respectively, near the posterior and anterior borders; those of a pair are roughly distant from each other about one-third of the width of the ventral surface as seen on looking down on it. In addition, contained within the depressed area, are two transversely oval dark-coloured slightly sunken patches, midventrally (or very slightly asymmetrically) situated on segments xvii and xix; they are rather on the posterior portions of their respective segments, and do not reach the anterior border of these, but on the other hand they may transgress the hinder limit of the segment and encroach on the one behind. The anterior of these sunken patches is between the anterior pair of prostatic pores, and the posterior rather behind the posterior pores; the transverse extent of each is about equal to the interval between the prostatic pores of a pair. In an earlier stage these markings are narrower antero-posteriorly; the one seems to originate in groove 17/18, in line with the anterior prostatic apertures, and the other in the line of the setae of xix, and so behind the posterior pair of pores. The whole area is not at first delimited by a raised lip.

The female aperture is a small depression midventrally situated between the setal ring and the anterior margin of segment xiv.

The spermathecal pores are represented by two pairs of small papillae on segment viii, one pair near the posterior border of the

segment and the other in front of the setal ring, slightly nearer to the ring than to the anterior margin of the segment. The distance between the papillae of a pair appears to be rather less than that between the prostatic apertures of the same pair; longitudinally, the interval between successive spermathecal apertures is equal to that between successive prostatic apertures. There are no actual pores on these spermathecal papillae, but their centres are slightly darker.

The displaced setae of the spermathecal region had in one of the specimens the following disposition: in segment ix the setae *abcd* on each side were displaced forwards so as to lie in a line near the furrow 8/9; on segment viii *ab* on each side are similarly displaced, and *cd* appear to be in close association with the spermathecal papillae; on segment vii three setae near the mid-ventral line are displaced backwards towards the intersegmental groove.

Internal anatomy —The septa, alimentary tract, circulatory and nephridial systems are as in the last two species

Testes and funnels are free in segments x and xi. The anterior seminal vesicles, in segment ix, are of very large size and irregular shape, wedged in between the other organs, and indented in front by the posterior spermathecae; the hinder pair of vesicles, in segment xii, are of moderate size, with a lobulated margin; they extend inward dorsally towards the middle line.

The anterior prostates extend backwards to segment xx or xxi; the glandular part of the posterior occupies segments xxii to xxiii or xxiv. Succeeding to the glandular part in each is a fine much-coiled narrow duct of some length, which widens into a fusiform shining dilatation at its termination; this end portion may have a longitudinal direction, or may bend inwards with a gentle convexity towards the front. Two rather indefinite soft white cushions occupy on the inside of the body-wall the position of the dark sunken area on the male genital field.

The ovaries are in segment xiii; there were no ovisacs in xiv.

The spermathecal ampulla (fig. 20) is somewhat conical in form, with rounded apex and rather constricted at its base: below this constriction are a number of diverticula or seminal chambers, oval in shape with their long axis in the same direction as that of the ampulla, glistening, sessile, and arranged in an incomplete circle; the gap in the circle is on the outer side; in number there were 9 on each anterior spermatheca, and 10 and 12 on the two posterior. The duct, which may be considered as beginning at the constriction mentioned above, has the form of an inverted cone, its base upwards, narrowing very considerably towards the body-wall; it is rather shorter than the ampulla. Accessory glands are present in the neighbourhood, the largest being situated between the posterior pair of spermathecae

The third batch of specimens differs from the first markedly in colour; they are pale, and for the most part nonpigmented, though there is a slight brown colouration dorsally over the ante-

rior end, and a pale brown middorsal stripe throughout the whole length. The dorsal pores begin one segment earlier, in groove 4/5.

The setae appeared to me to be much smaller than those of the specimens first examined; but this might be due to the different state of preservation,—they might seem smaller in a softer specimen, and might appear to project more in a harder and more contracted one. The dorsal interval is equal to *2yz* or less in front of the clitellum, and is on the average $2\frac{1}{2}yz$ behind this. The ventral interval is equal to $2\frac{1}{2}ab$ in the anterior part of the body (irregular however in the preclitellar segments), and to *2ab* in the posterior half. The setae are rather wider apart dorsally than ventrally, but I did not notice any pairing of the setae. The largest setae are those on the ventral surface in the preclitellar region.

The sunken pigmented patches on the male genital field are here sunken flat papillae, dark in colour but with a whitish margin, and surrounded by a groove; they are situated on furrows 16/17 and 19/20 respectively,—the anterior further forwards and the posterior further back, than in the type specimens. In one of the two worms in this batch the anterior papilla was double, one on each side over the position of groove 16/17, the centre of each in a line with the outer edge of the anterior prostatic pit; thus the whole male area, being widened anteriorly, becomes triangular instead of oval.

There were no distinct diverticula on the spermathecae, probably because there was no glistening mass of spermatozoa contained within.

I should perhaps have separated the specimens described above from the type as a distinct variety characterized by the different colour, the different position of the genital markings and first dorsal pore, and perhaps the setal characters. The second batch of specimens enumerated at the head of the account of this species (Vareeg Islet) however decided me against this; here the brown colouration was well marked, as in the type specimens, but the dorsal pores began from groove 4/5 as in the examples just commented on; the setae, too, appeared to be similar in size to those of the latter, while the position of the anterior genital "papilla" was intermediate,—on the anterior part of xvii, neither so far forward as in the one nor so far back as in the other of the previous batches. It seems best therefore to regard the species as a variable one, but not to attempt to divide it.

Genus **Erythraeodrilus.**

Erythraeodrilus kinneari, Stephenson.

(Pl. xvii, fig. 21).

W. 65/1. Castle Rock, N. Kanara Dist., Bombay Pres. Oct. 1916. S. W. Kemp. A single specimen, mutilated posteriorly.

Before giving a few notes on the specimen in the present collection I may add some remarks on the type specimens of the

species, which were kindly sent for re-examination and comparison with the example now obtained, by the Director of the Zoological Survey. This is the more necessary as owing to a regrettable accident in the post, the tube containing the specimens was broken on the return journey, and the types are now practically valueless.

The specimen which I previously (19) took as the basis of my description, with the well-marked papillae on segment xviii, has spermathecae and spermathecal diverticula as shown in the figure (19, fig. 8); the diverticula are numerous and in two groups, the individual chambers being very fairly independent of each other. The " accessory spermathecae ", as I called them in my previous account, are not hollow sacs, but stalked glands similar to those in the various species of *Hoplochaetella* described in the present paper. The manner of opening of the spermathecae is correctly described; externally there appears a slight whitening in the setal line of segment viii at two places, one on each side of the middle line, the interval between them being about equal to that between the male apertures. The prostates are in the form of a series of loops. There is, as stated, no heart in segment xiii; but in xiv there is a vascular commissure similar to that described in *Hoplochaetella* (*cf.* p. 390 *ant.*).

In the other dissected specimen there is only one accessory spermathecal gland on each side (as against two and three in the type). The anterior pair of spermathecae cannot be followed so far back as in the former specimen, and the duct really seems to pierce the body-wall in front of the groove 7/8; the posterior pair as before pierce the body-wall at the level of the setal ring in viii. The ampulla of the spermatheca is irregular in shape; the duct is about as long as the ampulla, broad at its origin, still further swollen at the level of origin of the diverticula, and contracting considerably towards the external aperture. The diverticula are about ten in number, arranged more or less distinctly in two groups of about five each; though distinct enough, the separate diverticula are not stalked (they might almost be called stalked in the previous specimen), and rather resemble the chambers which so commonly surround, more or less completely, the base of the ampulla in species of the genus *Eutyphoeus*. The ectal portion of the duct is distinctly muscular. The gizzard is barrel-shaped. There is no heart in segment xiii, but the commissural vessel is present in xiv, as in the previous example. Externally, the male apertures are further apart than in the type specimen,—about a quarter of the circumference instead of one-seventh. In the spermathecal region there are slight papillae which seem to correspond to the apertures; these are (i) in the setal ring of segment viii, about at the situation of setae *e* on each side and (ii) just in front of groove 7/8, in line with the same setae; these correspond to the sites at which the ducts of the spermathecae seem to pierce the parietes as seen from the inside. There is a fifth papilla in this region, also in the setal ring of segment viii, at the site of seta *b* on the left side.

In the third, undissected, specimen of the original batch, the male papillae are not more than one-seventh or one-eighth of the circumference apart. There is one pair of slightly marked spermathecal papillae,—slight whitenings of the surface rather than definite papillae,—in the line of the setae of segment viii, the interval between them corresponding to that between the male pores; no second pair is indicated. This specimen was probably not as fully mature as the others.

I may now briefly describe the specimen in the present collection

External characters.—Length 40 mm.; diameter 2 mm. Colour grey (original colour ?). Segments 64.

Prostomium ? (buccal cavity everted).

Dorsal pores from furrow 3/4.

Setae in rings; middorsal interval small, = 2*yz* or less; midventral also small, = about 1½*ab*. There appear to be about 34-36 setae per segment both in front of and behind the clitellum, and 28 towards the end of the fragment.

Clitellum smooth, brown in colour, extending over ½xiii-½xvi = 3; setae indicated.

The male apertures, on segment xvii, are not very close together,—about a quarter of the circumference apart; they are situated on whitish papillae which take up the whole of the space between the line of the setae and the furrow which limits the segment posteriorly.

The female aperture is single and conspicuous, on segment xiv, in a whitish circular patch situated between the line of the setae and the anterior border of the segment.

The only signs of apertures in the spermathecal region are a pair of small pale papillae, not very easily distinguishable, in the line of the setae, about in the situation of seta *d*.

There are no other genital marks

Internal anatomy.—The septa are all thin.

The gizzard is large and barrel-shaped. Calcareous glands are present in segments x, xi, and xii; there is no marked difference in size throughout the series.

The last heart is embedded in septum 13/14, which is bulged backwards, so the heart at first appears to be in segment xiv; it really however belongs to xiii.

The meganephridia begin from segment xx.

Testes and funnels are present in segments x and xi; in xi they are contained within testis-sacs,—large soft structures, much resembling seminal vesicles; in segment x they are also probably in sacs, though this was not so clearly demonstrated. The vesiculae seminales are in segments ix, x and xii; they are large, soft, and not much cut up into lobes; those in xii meet over the alimentary canal.

The tubular prostates are one pair; each is a series of simple loops which begins behind about segment xx, passes forwards to xvi, and then bends back again; succeeding the glandular part is a

thin tube, short and twisted, which becomes stout and shiny near its termination, just before it pierces the body-wall

Ovaries and funnels are present in segment xiii.

The spermathecae (fig. 21) are two pairs; the ampulla is sac-like, and set off from the duct; the duct is about as long as the ampulla, fairly stout, shiny, and narrowing somewhat towards the ectal end; from its upper end are given off two diverticula, rounded in form, each containing more than one chamber (2-4). The anterior spermathecae seem to end between segments vii and viii; the posterior appear to be implanted in the body-wall, one just behind the setal ring, the other in the line of the setae. There is only one small accessory gland, just in front of the ending of the posterior spermatheca; it has a narrow stalk, and is about as long as the duct of the spermatheca.

Genus **Octochaetus.**

Octochaetus fermori, Mchlsn.

Kasauli, W. Himalayas, 6000 ft ; under stones. 20-vii-1916. Baini Prashad. A single specimen.
Hoshiarpur, Punjab. 14-vii-1916. Ibrahim.

Octochaetus barkudensis, Stephenson.

(Pl. xviii, figs. 25-27).

W. 13/1. Barkuda Island, Chilka Lake, Ganjam Dist., Madras Pres., 16 to 22-vii-1916. N. Annandale and F. H. Gravely. A number of specimens, some mature.

As this species is known from only one mature example (20), I may add here a description of the features of the present more ample batch of specimens.

External characters.—Length of the largest specimen 91 mm., and thickness 3 mm.; average length and thickness 60 mm. and 2 mm. respectively. Colour a medium grey, no difference between dorsal and ventral surfaces. Segments 136, triannulate from segment vii as far as the clitellum.

Prostomium epilobous $\frac{1}{2}$, tongue not cut off behind.

Dorsal pores from furrow 12/13.

From the anterior end to some distance behind the clitellum $aa = 3\frac{1}{2}ab = 1\frac{1}{4}bc$; $cd = 1\frac{1}{2}ab$ and so is slightly greater than $\frac{1}{2}bc$. Further back *aa* and *bc* become progressively narrower relatively to the intervals between the two setae of a bundle; so that *aa* is less than $3ab$, and $bc = 2ab$; *dd* is rather more than half the circumference.

The genital markings (fig. 25) present several points of difference as compared with the previous specimen. On segment viii, pretty constantly in sexual specimens, are a pair of transversely oval cushion-like elevations, which include the setae *ab* on each side; they do not take up quite the whole length of the segment, and do not quite meet in the middle line. On segment xvi also are

typically a pair of circular or roundly oval papillae, meeting or almost meeting in the middle line and extending outwards to beyond the line of seta *b*,—that is, to the outer border of the ventral surface; they are quite flat, and take up the whole length of the segment, encroaching also on to segment xv; they may be scarcely raised above the general surface; and, in one instance at least, could be distinguished into a central whitish portion surrounded by a darker groove with a whitish lip outside all. On segment xviii there may be a pair of similar, even larger papillae extending forwards on to xvii, and meeting in the middle line with only a narrow groove between them; these obviously correspond to the approximately rectangular cushions on this segment, which also are separated from each other in the middle line by a narrow groove, described in the original account. In one specimen there was present on segment xxii midventrally a large transversely oval papilla, taking up the whole length of the segment and extending to between setae *a* and *b* on each side

The female apertures are small, and placed near each other in a darker patch rather in front of the middle of the length of segment xiv. The spermathecal apertures seem not to be visible externally.

Internal anatomy.—The first septum may be 4/5, as stated in the previous account; but here its attachment seemed, in two specimens dissected, to be either at 5/6 or between 4/5 and 5/6.

The calcareous glands are large, but asymmetrical; on the left side the gland is mostly in segment xv, on the right in xvi,—the disposition being such that the anterior part of the left gland gets in front of the posterior part of the right, the dorsal vessel passing obliquely between them; the opening of the glands seems to be in xv on both sides; the glands are lobed, and septum 14/15 is markedly bulged forwards on the left side.

In the former account I stated that the testes and funnels were free; the statement has now to be modified, at any rate for the present specimens. Testis-sacs are present; that in segment xi is large, single, and extending dorsally covers over the hearts and alimentary tube; in one of the dissected specimens it was constituted by a fine membrane stretching between septa 10/11 and 11/12, while in the other it was free from both septa, with a slightly lobed border. The anterior sac in one case resembled the posterior in being constituted by a membrane stretching between the septa; in the other it was, like the posterior in that specimen, free from the septa, and indeed narrow from front to back.

The prostates are of moderate size, and are composed of a number of closely apposed coils; the duct is thin and twisted, of considerable length when extended, and without any thickening in its course.

The shape of the spermathecal ampulla varies very considerably. The diverticula may be absent, or there may be one, or two; again they may be sessile, or narrowed at the base, or even definitely stalked; three or four chambers may be indicated in the diverticulum, or the surface may be smooth without any lobula-

tion ; some of these variations are shown in the figures of spermathecae from the dissected specimens (fig. 26)

The penial and copulatory setae have the shapes previously described. In some of the copulatory setae of segment viii, towards the base what I previously described as a lateral flange cut up into teeth appears rather as a series of distinct spines curved like petals or scales, applied to the surface of the seta (fig. 27).

Octochaetus castellanus, sp. nov.

(Pl. xvii, fig. 22 ; pl. xviii, figs. 23, 24).

W. 134/1. Castle Rock, N. Kanara Dist., Bombay Pres. October 1916. S. W. Kemp. A single specimen, in poor condition.

External characters.—Length 48 mm. ; maximum diameter 2 mm. Colour ? Segments roughly 125 ; in some regions the separate segments are not distinguishable.

Prostomium ?

Dorsal pores perhaps from furrow 5/6.

The setae are widely paired , $aa = 1\frac{2}{3}\ ab = bc = 1\frac{1}{2}cd$; $dd =$ approximately half the circumference.

The prostatic pores, on segments xvii and xix, are small pits situated, in each segment, on a common elevation with a rounded margin; the pores themselves are medial from the line of setae *a*. The seminal grooves are bowed outwards, and run on rather broad curved ridges, so that there is a circular depression in the middle of the male area.

The female aperture is single and midventral, on segment xiv.

The spermathecal apertures are perhaps indicated at the site of setae *a* on segments viii and ix.

Internal anatomy.—Septa 9/10 and 10/11 are slightly thickened ; all are present after the first few.

There is a long, soft, and bulged portion of the oesophagus in front of the gizzard ; the gizzard is conspicuous, relatively large, barrel-shaped, situated in segment vii. There is one pair of calcareous glands in xiv, of moderate size and symmetrical.

The nephridia cannot be identified on the body-wall ; there are large tufts at the side of the oesophagus, in front of the gizzard and spermathecae.

The testes were not identified ; funnels were present, free, in segments x and xi, the largest seeming to be that in the hinder segment on the left side, but I would not lay any stress on this slight difference. Seminal vesicles are present in segment xii ; they are deeply lobed, and rather small.

The prostates are in segments xvii and xix ; they are relatively small, and thrown into several loops ; the duct, thin, semi-transparent, and apparently not muscular, is half as wide as the opaque glandular part, and runs straight inwards.

The spermathecae (fig. 22) are two pairs of rather small organs situated near the middle line. The ampulla is spherical, and the duct, with a rather curved course, is about as long as the

ampulla and one-third as thick; the diverticulum is single, club-shaped, and attached near the ental end of the duct on its inner side; the spermatic chamber is single. The length of the diverticulum is less than that of the ampulla. So far as can be made out internally, the external openings of the spermathecae would be between the setal line and the anterior border of segments viii and ix respectively.

The length of the penial setae (fig. 23, *a* and *b*) varies, ·87—1 mm.; the thickness at the middle is 14μ; they are thus of very considerable length relatively to their thickness. The main part of the shaft has only a slight curve; but the curve of the distal end varies somewhat, so that two types can be distinguished. In the first, the curve of the distal end merely continues the curve of the shaft, and the tip is tapering and bluntly pointed; a few teeth, of moderate size and fairly closely applied to the shaft, are present some little distance above the tip. In the second, the distal end is considerably bent, it may be to nearly a right angle; the tip is thinned and rather expanded, and in a few almost spatula-like, the end being also less clearly defined and slightly bifid; the teeth are more numerous. The shorter length given above represents the first type, the longer the second.

The copulatory setae (fig. 24) belonging to segments viii and ix are ·61 mm. long and 20μ in thickness at the middle of the shaft. The shaft is bowed, at the ends more so than in the middle. The distal portion of the shaft,—almost half,—is cut up along both its convex and concave borders into a series of rough notches, seven or eight on each side, and a thin web appears to span each notch. The tip is rather claw-shaped, and bluntly pointed.

Genus **Eutyphoeus**.

Eutyphoeus incommodus (Bedd.).

Rurki, United Provinces. August (about), 1916. Ibrahim. Not quite mature, hence identification not absolutely certain.
Agra, United Provinces. September, 1916. L. Haru Ram.

Eutyphoeus waltoni, Mchlsn.

Hoshiarpur, Punjab. 14-vii-1916. Ibrahim.
Lucknow, United Provinces. August (about), 1916. Ibrahim.
Agra, United Provinces. September, 1916. L. Haru Ram.

Eutyphoeus gigas, sp. nov.

(Pl. xviii, figs. 28-30).

W. 73/1. Rangamati, Chittagong Hill Tracts, Bengal. 11-vii-1915. R. Hodgart. A single specimen.

External characters.—Length 250 mm.; thickness behind clitellum 9 mm. Colour purplish-brown dorsally with darker median stripe; pale ventrally. Segments 212; segment iv is biannulate, v triannulate, vi also triannulate but the posterior

annulus is beginning to be divided; vii is quadriannulate, and viii has five annuli through the division of the anterior annulus; the same annulation is continued back to the clitellum, except that some segments may have even more numerous secondary annuli.

The prostomium is minute, prolobous, withdrawn under cover of segment i.

Dorsal pores are present from furrow 11/12.

The setae are paired; in front of the clitellum $ab = \frac{1}{3}$ to $\frac{2}{5}$ aa, $= \frac{2}{3} cd$; $aa = bc$, and dd is two-thirds of the circumference. Behind the clitellum $ab = \frac{1}{3} aa$ (rather less immediately behind the clitellum), $= \frac{2}{3}$ or $\frac{3}{4} cd$, while aa is greater than bc, about $1\frac{1}{4}$ or $1\frac{1}{3}$ bc; dd is three-fifths of the circumference. Behind the middle of the body $ab = \frac{2}{5} aa$, $= \frac{3}{4} cd$; $aa = 1\frac{1}{3} bc$; and dd is little more than half the circumference.

The clitellum begins just behind the setae of xiii; it includes the whole of xvii. It is smooth, and there are no dorsal pores, but setae are present, or the indications of them.

The male apertures (fig. 28) are situated in pits on segment xvii; these pits are large and circular, with their centres in line with seta *b*, and their inner borders internal to the line of *a*. The apertures are transverse slits which are borne on papillae at the bottom of the pits. The papilla being in the outer part of the pit, the centre of the aperture is slightly outside the line of seta *b*.

The female aperture was seen on the left side only, on segment xiv, as a transverse slit corresponding in extent to the interval *ab*, in front of which setae it is situated.

The spermathecal apertures are comparatively small, slit-like, the lips not swollen, in furrow 7/8 just outside the line of seta *b*.

In furrow 15/16 are a pair of transverse depressions, elongated and rather irregular in shape, pointed at their inner and outer ends and broadest in the middle of their extent; these extend inwards to near the middle line and almost meet each other there; and as their middle point is external to seta *b* they are fairly extensive. On the hinder part of segment xvi, behind the setae *ab* and extending equally for a short distance to the inner side of the line of *a* and to the outer side of the line of *b*, are a pair of small oval areas, surrounded by a narrow groove and somewhat depressed in the middle.

Internal anatomy.—Septum 4/5 is strong, 5/6 very strong; 6/7 and 7/8 are absent; 8/9 and 9/10 are somewhat thickened, 10/11 slightly thickened; the last three are very close together, so that segments ix and x are very short segments internally. Segment xi is absent as a separate cavity; septum 11/12 is a membrane-like sheet of tissue which binds the heart of segment xi to the alimentary canal, and also attaches the vesiculae seminales to the wall of the gut (see the description of the septa in *E. waltoni*, by Stephenson (18), with which the present species agrees). Septum 12/13 is thin, and bulged backwards by the seminal vesicle so as to lie against 13/14.

The gizzard is large, firm, and subspherical, in the posterior part of the very considerable free space between septa 5/6 and 8/9. Calcareous glands are present in segment xii; they are only visible on opening the gut, when the condition is seen to be that which I have described for *E. bishambari* (18); externally they are indicated only by the oesophagus being swollen, and rather dark in colour and hard. The intestine begins in segment xv; in xxviii are a pair of caeca, of an elongated conical form resembling those of *Pheretima*; they lie wholly in xxviii, that of the right side being directed transversely towards the middle line above the intestine, that of the left being doubled underneath the intestine.

The last heart is in segment xiii. The dorsal vessel ends anteriorly in front of septum 8/9, at the hinder end of the large free space, by giving origin to two transverse commissures on each side; these lie close together behind the gizzard; and since they belong to segments viii and vii the gizzard is morphologically in segment vii.

The micronephridia are arranged behind the clitellum in perfectly regular transverse rows, one row in each segment, and about a dozen nephridia on each side; they are irregular in the clitellar region and for some distance in front of it, absent in the "free space" between septa 5/6 and 8/9, and irregular again in front; there are the usual tufts on each side of the pharynx, and thick clusters round the base of the spermathecae.

Testis-sacs are present in segment xi, opaque white in colour, and communicating with the seminal vesicles in xii; the heart of segment xi, covered by a connective tissue membrane representing septum 11/12, passes down internal to the sac. As the specimen was single I did not carry out the dissection which would have been necessary to ascertain whether the sacs communicate with each other beneath the alimentary tube. The seminal vesicles, one pair, extend forwards as far as septum 10/11, and push septum 12/13 back to the level of 13/14; they are large and appear wrapped round the alimentary tube; their margins are somewhat lobate.

The prostates extend through segments xvii to xx, and consist of a number of closely applied coils; each narrows at its anterior end to form a firm, shining and muscular duct, one-third of the diameter of the glandular portion; maintaining the same thickness it takes an inward direction, with many coils and loops, to its ending.

Ovaries and funnels not identified.

There is one pair of spermathecae (fig. 29); each consists of an antero-posteriorly elongated sac, irregular in shape, attached to the parietes by a broad base, from which the sac projects both forwards and especially backwards; the region on its under surface where the sac is attached to the body-wall is the only thing that can be described as a duct. There are two diverticula, one on each side, opening at the base of the ampulla; each consists of a sac and duct, the sac compound, showing a dozen to twenty chambers

which cause a lobulation of the surface, and the duct stout, slightly curved, and about as long as the terminal sac.

The penial setae (fig. 30) are in length 5·3 mm., and in thickness near the base 50 μ ; near the tip the thickness is still 44 μ. The shaft is almost straight, slightly bowed towards the tip, where it tapers rather rapidly to a fine point The distal portion of the shaft, about ·85 mm., is ornamented (except the extreme tip) with very numerous and densely crowded transverse markings, each consisting of a few points set side by side.

Remarks.—Several species of *Eutyphoeus* run to a large size; thus *E. paivai* may be 195 mm. in length, and *E. waltoni* 230 mm., while *E. chittagongianus* is the same length as the present specimen.

A rather curious feature of the present species is the presence of intestinal caeca resembling those of *Pheretima.*

Subfam. *TRIGASTRINAE.*

Gen. **Eudichogaster.**

Eudichogaster chittagongensis, sp. nov.

(Pl. xviii, figs. 31-33).

W. 71/1. Rangamati, Chittagong Hill Tracts, Bengal. 11-vii-1915. R. Hodgart. Two specimens.

External characters.—Length 30 mm.; diameter 1·5 mm., the swollen preclitellar portion 2 mm., the constricted clitellar region just under 1 mm.; a curious appearance is given by the bulbous anterior end followed by the constricted clitellum. Colour an indefinite grey. Segments approximately 121.

Prostomium epilobous $\frac{1}{2}$ or a little more; it is triangular, the blunt apex being directed posteriorly; the apex may be continued backwards as a shallow groove as far as the furrow between the first and second segments.

The dorsal pores begin immediately behind the clitellum.

The setae are paired. Behind the clitellum $ab = \frac{1}{3}aa = \frac{2}{5}bc = \frac{2}{3}cd$, and d is below the lateral line of the body; towards the hinder end of the body the setae are less closely paired, and $ab = \frac{1}{2}aa$, $= \frac{2}{3}bc = \frac{2}{3}cd$, bc and cd being equal or very nearly so, while d is about the lateral line of the body.

The clitellum is smooth and constricted, and extends over segments $\frac{1}{2}$xiii-$\frac{1}{2}$xvii (over the whole of xiii on the ventral surface).

There is a depression behind the slightly excavated posterior border of the clitellum; this depression, elongated in the transverse direction, thus takes up the hinder part of segment xvii, but does not extend beyond it. On its sloping sides are the male apertures, short obliquely placed slits, their anterior ends nearer the middle line than the posterior; they are situated between the lines of setae a and b, which are absent from segment xvii (fig. 31).

The female apertures, on segment xiv, appear as transverse cracks one on each side just in front of seta a.

The spermathecal apertures are possibly represented by whitish patches on segment viii in the site of the ventral pair of setae (*ab*); a single seta, apparently *b*, is present in each patch.

There are no other genital markings.

Internal anatomy.—Septa 4/5 to 7/8 are thin; the rest of those in the anterior part of the body,—8/9 to 12/13,—are slightly strengthened.

The gizzards are large, in segments v and vi. Calcareous glands are present as small white swellings in segments x, xi, and xii. The typhlosole is a simple vertical lamina.

The last heart is in segment xii.

The excretory system is micronephridial; the arrangement varies a little in various parts of the body. Behind the prostatic region the nephridia are in three or four rows, of which the dorsal row consists of more elongated loops than the rest; the organs are not of the flat circular type met with in some species, but are thin tubes in the form of loops; if there are four rows, the two ventralmost are close together. Behind the middle of the body there are three rows, of the same relative size as further forwards. Near the hinder end the lowermost of the three nephridia increases relatively and absolutely in size, and is the most conspicuous of the three,—a twisted tube which has its inner end in the line of setae *a* and its outer end external to *b*; of the other two, one lies between *c* and *d*, and the other dorsal to *d*; these two are less easily seen.

In segment x are a pair of large opaque white shining masses with deeply lobulated margins; these are the most prominent things in the dissection; they are attached to septum 10/11, meet each other in the middorsal line above the other structures of the segment, and extend deeply down in the segment but without being attached to the ventral body-wall. These represent testis-sacs and seminal vesicles conjoined; on opening one, a funnel was found deeply placed, but the testis was not identified. There are no other anterior male organs.

The prostates, one on each side, are very small; they are situated in segment xvii, and are placed in a direction transverse to the long axis of the body. The duct is much narrower than the gland, of the same diameter throughout, and rather bent; if straightened out it would be almost as long as the glandular portion; the general direction of the duct is transversely inwards.

The ovaries are situated in segment xiii. There are a pair of well-marked and relatively large ovisacs in segment xiv.

The spermathecae lie in segment viii; each is a twisted tube, without distinction of ampulla and duct. On one side (fig. 32, *a*) the tube appeared of equal diameter throughout, except for a slight dilatation at its ental extremity; on the other side it was more irregular (fig. 32, *b*, which represents it under the low power of the microscope). The external opening is near the middle line and behind the anterior limit of the segment in which they lie,—possibly, as surmised from the external characters, in the situation of setae

a; but the worm is extremely small for dissection. The simple form of the spermathecae does not appear to be due to immaturity; the clitellum is remarkably well defined and thick, and all the other organs are present.

The penial setae (fig. 33) are 58 mm. in length, and approximately 3·5μ in thickness; they are rather whip-like,—slender, tapering gently, with pointed tip and rather wavy course; they are without ornamentation

Remarks.—The present form shows resemblances to *E. parva* (Fedarb), but differs in the absence of seminal vesicles in segment xi, in possessing penial setae, and in the shape of the prostates and narrowness of the prostatic ducts.

Gen. **Dichogaster.**

Dichogaster bolaui (Mchlsn.).

W. 84/1. Rangamati, Chittagong Hill Tracts, Bengal. 15-vii-1915 R. Hodgart. Three specimens, in a bad state of preservation.

Dichogaster affinis (Mchlsn.).

W. 137/1. Tale Sap, Siam. 20-i-1916. N. Annandale. A single specimen.

The identification is not absolutely certain, as the specimen was not fully mature.

Subfam. *OCNERODRILINAE.*

Gen. **Ocnerodrilus.**

Ocnerodrilus (Ocnerodrilus) occidentalis, Eisen.

W. 90/1. Botanic Gardens, Singapore; among dead leaves in tank, 24-xii-1915. N Annandale. About a dozen specimens, in poor condition, some fragmentary.

Fam. GEOSCOLECIDAE.

In addition to the following species, the collection contained a quite immature specimen of this family, obtained from a small isolated almost dry pool in sand, at Balighai (Chilka Survey, 8-iv-1915).

Gen. **Pontoscolex.**

Pontoscolex corethrurus (Fr. Mull.).

W. 91/1. Penang Hill, at edge of a small stream, alt. 1200 ft. 10-ii-1916. N. Annandale.

Fam. LUMBRICIDAE.

Gen. **Helodrilus.**

Helodrilus (Allolobophora) caliginosus (Sav.) subsp **trapezoides** (Ant. Dug.)

Simla, 7000 ft., W. Himalayas. Oct. 1916. S. L. Ghose. Several specimens.

Helodrilus (Bimastus) parvus (Eisen).

Kasauli, 6000 ft., W. Himalayas. 31-viii-1916. Baini Prashad. Several specimens.

Helodrilus (Eisenia) foetidus (Sav.).

W. 86/1. Sevok, Darjiling Dist., E. Himalayas. 10-v-1915. J. N. Masson. A single specimen.

Helodrilus (Helodrilus) mariensis, sp. nov.

Murree, W. Himalayas (N. Punjab); alt. 7000 ft. 15-iv-1916. Gobind Singh. Several specimens.

External characters.—Length about 100 mm. (the specimens were much curled up); maximum thickness 6 mm. Colour greenish grey, equable throughout, except that the clitellum has a buff tinge. Segments 151. The anterior end tapers rapidly; the posterior is cut off straight, so that the anus is situated in the middle of a flat posterior surface; four segments are to be seen on this flat face. The anterior end is round in transverse section, but the clitellar and post-clitellar regions are flattened ventrally; at the middle of the body the dorsal surface becomes flattened also,—indeed concave,—and a section would appear four-sided, the dorsal side being the longest; towards the hinder end all four surfaces are concave, and the ventral setal bundles are placed at the ventro-lateral angles, the dorsal bundles being however below the dorso-lateral angles (text-fig. 6).

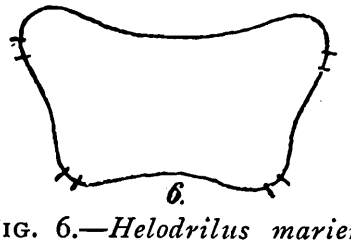


FIG. 6.—*Helodrilus mariensis*, transverse section behind middle, to show shape, and position of setae.

Prostomium epilobous $\frac{1}{3}$.

Dorsal pores from furrow 4/5.

The setae are closely paired throughout; $aa = 1\frac{1}{2}bc$, except towards the posterior end, where it is $1\frac{1}{3}bc$. In front of the clitellum the dorsal bundle is situated below the lateral line of the body; in the middle of the body they are about in the lateral line; while towards the hinder end they are above the lateral line, and, as said, below the dorso-lateral angle of a section of the body.

The clitellum extends over segments xxvii-xxxiv = 8. In fully mature specimens there are tubercles at the site of the ventral setae of all of these segments except the last, which almost form a "wall" on each side; the tubercles seem to be best marked on segments xxix or xxx to xxxiii. The ventral setal bundles of segments x and xi, or ix, x and xi, are also situated on glandular cushions or tubercles.

The male pores are situated on segment xv, on large round papillae which take up the whole of segment xv and parts of xiv and xvi. The apertures themselves are outside the line of setae *b*; the porophores about touch this line by their inner borders.

The female and spermathecal apertures were not visible.

Internal anatomy.—The first septum distinguishable by dissection is 5/6, which is somewhat thickened ; 6/7 is considerably thickened, 7/8, 8/9, and 9/10 are all very strong, 10/11 is about equal to 6/7, and 11/12 to 5/6. The next two septa, 12/13 and 13/14, are also slightly thickened.

The gizzard occupies segments xvii, xviii and a small part of xix; it is firm and cylindrical. The typhlosole is simple and rounded.

The oesophagus in segment x is swollen ; and, besides the general swelling of the tube, there are a pair of small yellowish projections on each side of the dorsal vessel and in front of the hearts; in segment xiii the tube is also distinctly bulged, in an evenly rounded manner, and is vascular ; in xiv it is quite narrow. On opening up the oesophagus, the inner surface of the wall is seen to be strongly ridged from its beginning in segment vi ; the small projections in segment x are distinct crypts, also ridged, and in open communication with the general lumen ; in xii the ridging is longitudinal, and more regular than in front ; in xiii the wall is very vascular, but the ridging has ceased.

The last heart is in segment xii.

The excretory system is meganephric.

Testes and funnels are free in segments x and xi. Vesiculae seminales, of moderate size, are present in segments xi and xii, attached to the anterior septum of the segment.

Ovaries, funnels, and ovisacs are present in the usual segments.

The spermathecae are two pairs, small, ovoid, sessile, and situated in segments x and xi at the anterior border of each ; they seem to open in grooves 9/10 and 10/11, in line with the dorsal setal bundles.

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