AN ACCOUNT OF THE OLIGOCHAETA OF TRAVANCORE.

By K. S. PADMANABHA AIYER, *M.A.*

(Plates I-V).

CONTENTS.

	Page
Introduction	14
Family Aeolosomatidae.	
Genus *Aeolosoma.*	
Aeolosoma travancorense Aiyer	16
Family Naididae.	
Genus *Nais.*	
Nais pectinata Steph.	19
Nais pectinata var. *inequalis* Steph.	21
Nais communis var. *punjabensis* Steph.	21
Genus *Naidium.*	
Naidium menoni, sp. nov.	21
Naidium breviseta Bourne	23
Genus *Pristina.*	
Pristina longiseta Ehrb. f. *typica*	24
Pristina aequiseta A. G. Bourne	25
Pristina proboscidea var. *paraguayensis* Mich.	26
Genus *Stephensonia*, gen. nov.	
Stephensonia trivandrana, nom. nov.	27
Genus *Branchiodrilus.*	
Branchiodrilus menoni Steph.	29
Genus *Slavina.*	
Slavina appendiculata (Udek.)	30
Genus *Dero.*	
Dero zeylanica Steph.	30
Dero limosa Leidy	33
Dero austrina Steph.	34
Dero pectinata, sp. nov.	36
Dero palmata, sp. nov.	39
Dero niveum, sp. nov.	40
Genus *Aulophorus.*	
Aulophorus furcatus (Oken)	43
Aulophorus michaelseni Steph.	43
Family Tubificidae.	
Genus *Aulodrilus.*	
Aulodrilus trivandranus Aiyer	43
Family Enchytraeidae.	
Genus *Enchytraeus.*	
Enchytraeus barkudensis Steph.	44
Family Moniligastridae.	
Genus *Moniligaster.*	
Moniligaster deshayesi E. Perr.	44

	Page.
Genus *Drawida.*	
Drawida barwelli var. *impertusa* Steph.	47
Drawida ghatensis Mich.	48
Drawida pellucida (Bourne) f. *typica*	48
Drawida travancorensis Mich.	49
Drawida circumpapillatus, sp. nov.	50
Family Megascolecidae.	
Genus *Plutellus.*	
Plutellus variabilis, sp. nov.	51
Genus *Pontodrilus.*	
Pontodrilus bermudensis Bedd.	53
Genus *Woodwardiella.*	
Woodwardiella kayankulamensis, sp. nov.	53
Genus *Megascolides.*	
Megascolides chengannures, sp. nov.	54
Genus *Notoscolex.*	
Notoscolex tenmalai var. *ghatensis*, nov.	56
Notoscolex tenmalai var. *karakulamensis* Steph.	57
Notoscolex peermadensis, sp. nov.	58
Notoscolex travancorensis, sp. nov.	59
Notoscolex minimus, sp. nov.	60
Genus *Megascolex.*	
Megascolex travancorensis var. *proboscidea*, nov.	62
Megascolex auriculata, sp. nov.	64
Megascolex avicula, sp. nov.	66
Megascolex ratus Cogn.	68
Megascolex trivandranus Steph.	68
Megascolex peermadensis, sp. nov.	68
Megascolex kumiliensis, sp. nov.	70
Megascolex polytheca var. *uniquus*, nov. (?)	71
Genus *Pheretima.*	
Pheretima taprobanae Bedd.	72
Sub-family Ocnerodrilinae.	
Genus *Ocnerodrilus.*	
Ocnerodrilus occidentalis Eisen	72
Genus *Malabaria.*	
Malabaria biprostata, sp. nov.	73
References to Literature	75

Introduction.

The present paper[1] is the result of my investigation of the material collected by me from several parts of Travancore mainly during 1926-27. The most favourable time of the year for making collections of earthworms in this part of the country is immediately after the South-West and the North-East monsoons, *i.e.*, during July-August and November-December respectively. Consequently it was not possible to visit more localities than the few that I did. Nevertheless, judging from the new forms encountered, the results are encouraging and indicate forcibly the fact that, though a large number of forms have already been recorded

[1] Thesis accepted for the degree of Doctor of Science of the University of Madras.

from this part of India, our knowledge of the Oligochaete fauna of this interesting region is still far from complete.

The first account of Oligochaetes from Travancore is by Miss S. M. Fedarb in 1897 (7). Practically very little was known till the publication of the valuable papers by Dr. Michaelsen in 1910 and 1913 (9, 10). Dr. Stephenson has since described several forms from this region from material sent to him by the authorities of the Indian Museum at Calcutta, and by the Zoological Survey of India, and a complete account of forms up to 1923 was published in that author's volume on Oligochaeta in the "Fauna of British India" (20).

Among the points of interest in the aquatic oligochaetes dealt with in the present paper may be mentioned the discovery of a new genus of Naididae and the discovery of diffuse production of sexual cells in *Aeolosoma travancorense* Aiyer.

Our present knowledge of the terrestrial oligochaetes of Travancore extends to 49 species as follows :—

(Species marked by asterisks have been recorded by the writer.)

Fam. Moniligastridae.
Moniligaster deshayesi E. Perr.
,, *perrieri* Mich.
Drawida barwelli Bedd.
* ,, ,, var. *impertusa* Steph.
,, *ghatensis* Mich.
,, *pellucida* var. *pallida* Mich.
* ,, ,, f. *typica* Bourne.
,, *travancorensis* Mich.
,, *schunkari* Mich.
* ,, *circumpapillatus*, sp. nov.
Fam. Megascolecidae.
Plutellus timidus Cogn.
* ,, *variabilis*, sp. nov.
* *Pontodrilus bermudensis* Bedd.
* *Woodwardiella kayankulamensis*, sp. nov.
* *Megascolides chengannures*, sp. nov.
Notoscolex ponmudianus Mich.
,, *tenmalai* Mich.
* ,, ,, var. *ghatensis*, nov.
* ,, *peermadensis*, sp. nov.
* ,, *travancorensis*, sp. nov.
* ,, *minimus*, sp. nov.
Megascolex eunephros Cogn.
,, *insignis* Mich.
,, *konkanensis* Fedarb.
,, *pumilio* Steph.
Megascolex ratus Cogn.
,, *travancorensis* Mich.
* ,, ,, var. *proboscidea*, nov.
,, *trivandranus* Steph.
* ,, *auriculata*, sp. nov.
* ,, *avicula*, sp. nov.
* ,, *peermadensis*, sp. nov.
* ,, *kumiliensis*, sp. nov.
* ,, *polytheca* var. *uniquus*, nov.
Pheretima bicincta (E. Perr.)
,, *travancorensis* (Fedarb).
,, *trivandranus* Steph.
* ,, *taprobane* Bedd.
Octochaetus aitkeni (Fedarb).
,, *pittnyi* Mich.
Dichogaster affinis Mich.
,, *bolaui* Mich.
,, *malayana* Horst.
,, *travancorensis* Fedarb.
Ocnerodrilus occidentalis Eisen.
* *Malabaria biprostata*, sp. nov.
Eudrilus eugeniae Kinb.
Gordiodrilus travancorensis Mich.
Fam. Lumbricidae
Glyphidrilus annandalei Mich.
Helodrilus foetidus Steph.

As a result of the present investigation the genera *Woodwardiella*, *Megascolides*, and the recently discovered Ocnerodrilid genus *Malabaria* are now known to be represented in this region each by a new species. Three new species and a new variety of *Notoscolex* were found, while of *Megascolex*, which is already well represented, 4 new species and 2 new varieties are described. *Plutellus* and *Drawida* each gain a new species. It is also interesting to note that *Pheretima taprobane*, widely known from other parts of the world including Ceylon, is now recorded from India for the first time.

Among the structural peculiarities noted in the specimens of the present collection special mention may be made of the retractile proboscis

in a variety of *Megascolex travancorensis* and the glands in connection with the vas deferens in *Moniligaster deshayesi.*

I wish to take this opportunity to express my deep gratitude to Dr. J. Stephenson of the University of Edinburgh for the very kind and most helpful suggestions he has so generously given me from time to time during the progress of this work. I have also to thank Dr. W Michaelsen of Hamburg and Dr. E. Piguet of Geneva for their kindness in sending me some of their valuable monographs.

Family AEOLOSOMATIDAE.

Genus **Aeolosoma** Ehrbg.

Aeolosoma travancorense Aiyer.

(Plate I, fig. 1.)

This minute worm described by me in 1926 (2) from specimens obtained from a tank in Trivandrum has since been found to occur in tanks at Chirayinkil and Nagercoil. The specimens from the two latter localities were found living in minute tubes curved like the arc of a circle. The tube is made of a thin layer of mucus to which the worm's excreta and debris are attached.

In most of the present specimens, there are, scattered on the body, especially towards the hinder part, a small number of colourless oil globules.

Sexual reproduction.—A number of sexual specimens were obtained from the sample of mud from Nagercoil in May, 1927. These were subjected to careful examination under the microscope. No specimen was sectioned since even the fully mature worms were transparent enough to allow the internal organs to be studied. Before dealing with the reproduction in this species I shall quote below from Beddard's monograph what is already known about the genital organs of this genus :—

" D'Udekkum, Maggi and Stolc appear to have investigated the same species, *viz.*, *A. hemprichi* and *A. quaternarium.* The testis is median and unpaired and lies in the fifth segment ; the ovary occupies a corresponding position in the sixth segment. There are no sperm ducts ; the nephridia, particularly those of the sixth segment, which is slightly different in structure from the rest, serving as conduits of the sperm. The ova, which are few and large and apparently undergo amoeboid movements, escape by a large pore on the ventral surface of the sixth segment. The spermathecae are small oval sacs, one to three pairs occupying segments III-V. At the epoch of sexual maturity a clitellum is formed, which is figured by Stolc as limited to segments V-VII ; it is only developed on the ventral side of the body."

Clitellum.—The first point that is worthy of note in connection with sexual reproduction in the present species is he entire absence of a clitellum.

Male cells.—In mature individuals large numbers of sperm morulae and clusters of ripe spermatozoa are present throughout the body cavity and float about freely in it. In specimens less advanced in sexual maturity sperm morulae occur mostly in the intestinal region, though a few are seen floating about in the oesophageal region. In maturing individuals undergoing fission at the same time (several of the sexual specimens examined were also dividing asexually) morulae are seen mostly in the posterior individual.

Careful examination of a number of specimens convinced me of the absence of a testis. The presence of morulae in large numbers in the intestinal region of maturing individuals led me to look for male cells in the coelomic epithelium of this region. Several days were spent in the search for specimens showing the production of male cells. Four such individuals were at last found from which the following facts were made out. Three of the specimens were single individuals and one was just preparing to divide by fission.

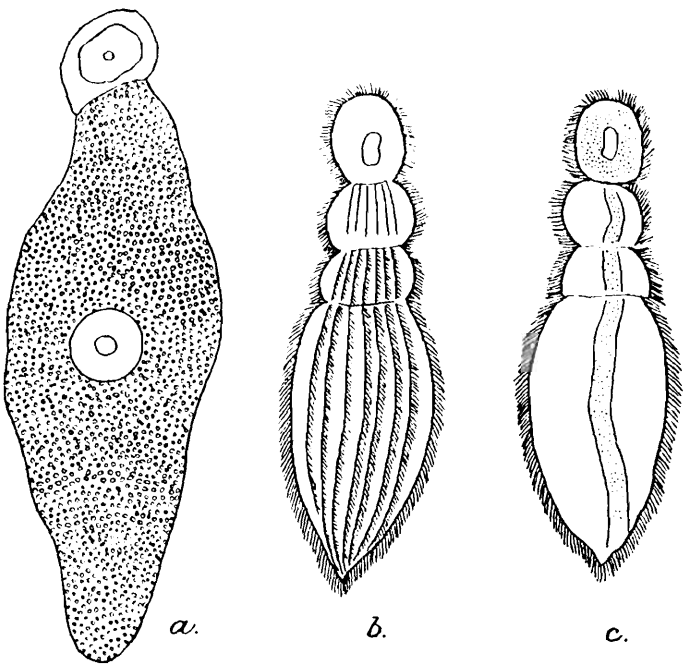
The contractile dorsal blood vessel, which in the oesophageal region is only as wide as the oesophagus, is in the intestinal region wider than the gut. Under pressure of the cover slip and especially during the contraction of the body the vessel looks very much wider than the intestine. The wall of this vessel is composed of long, extremely thin, fusiform cells which appear as little thickenings here and there in the otherwise uniformly thin wall. In the four specimens referred to above the wall of the dorsal blood vessel had produced in the intestinal region behind the stomach a number of conspicuous oval or rounded finely granulated uninucleated cells (Plate I, fig. 1). Such cells were also present but much less abundantly in the wall of the dorsal vessel in the oesophageal region. These are the spermatogonia or male cells. While a few male cells were seen floating in the body cavity, a large number of them, together with the early morula stage, were attached to the wall of the blood-vessel. It appears, therefore, that the spermatagonia become multinucleate prior to detachment from the wall of the vessel and that the few male cells found in the body cavity are the ones torn forcibly from it by the pressure of the cover slip as water is drained off from beneath it. A few free morulae were present in the body cavity in these specimens but very few or no fully-developed spermatozoa. The production of male cells was not observed in any other part of the body.

A sperm sac is absent. This is in correlation with the absence of septa and the diffuse production of male cells.

There are no special ducts for the passage of the sperms to the outside. The spermatozoa probably escape by means of the nephridia but I did not notice any actually passing through them.

Ovary and ova.—I did not notice an ovary in any of the numerous specimens examined. In fully mature individuals there is a single large ovum (text-fig. 1*a*) filled with spherical yolk granules on the ventral side of the stomach in segment V The ovum extends from the setal level of segment V, to the setal zone of segment VI and in one specimen measured 180μ long and 54μ wide. There is a clear circular yolk-free space in the centre which is occupied by the large rounded nucleus with a distinct nucleolus. Attached to the anterior end of the large ovum is a cell much

smaller in size and free from yolk granules. In half mature individuals two translucent (groundglass-like) cells are seen one behind the other on the ventral side of the stomach in segment V. Each of these is about



Text-Fig. 1.—*Acolosoma travancorense : a.*, ovum with accessory cell ; *b.*, Ciliate parasite × *ca.* 350 ; *c.*, the same showing meganucleus, × *ca.* 350.

the same size as the anterior cell referred to above. These two cells can be nothing else than oöcytes. In all probability only two oöcytes are produced, the hinder one developing into the ovum and the anterior one remaining as an " accessory," " nutritive " or " nurse " cell.

Oviducts are not present and the escape of the large ovum to the outside must be by the rupture of the body wall. No pores were noticed on the ventral side of segment V or VI.

Spermathecae are not present.

The points observed may be summarised as follows :—

1. A clitellum is not developed.
2. There is no testis. Male cells are produced from the wall of the dorsal blood vessel. There is no sperm sac. The morulae develop in the body cavity. There are no special genital ducts for the escape of the spermatozoa.
3. Ova are produced from the ventral body wall in segment V There are no oviducts.
4. Spermathecae are absent.

This species presents important differences from the two species *A. hemprichi* and *A. quaternarium* whose reproductive organs have so far been investigated. The absence of a clitellum and localised male gonads and the absence of spermathecae are undoubtedly important differences in the species of a genus and perhaps of sufficient importance as to justify its splitting into subgenera, but nothing definite can be said on this point till the sexual organs of the other Indian species of the genus have been worked out. *A. kashyapi* and *A. bengalense* are both

common in Travancore and when sexual specimens of these become available they will be studied and described.

Stephenson (19) has previously described a similar kind of diffuse production of male cells in *Chaetogaster orientalis*. At the end of his paper Stephenson remarks, "that this condition, which is not unlike that of the Polychaeta, represents a regression, and not the persistence of a primitive state, may be taken as certain." This may be true of the genus *Chaetogaster* whose ectoparasitic and commensal habits have brought on numerous modifications in its body structure. On the other hand in *Aeolosoma* the condition can be regarded only as the persistence of a primitive state.

Parasites.—An astomatous ciliate parasite (text-fig. 1*b*, *c*) allied to *Anoplophrya* was present in the stomach of several individuals, as many as seven occurring in the stomach of a single specimen. The parasite is ovoid in shape and 200-225μ in length. The cilia are arranged in longitudinal rows. The long meganucleus extends from one end of the body to the other. Reproduction is by multiple fission, the posterior part of the body dividing transversely into 3, 4 or sometimes 5 oval individuals, all of which remain attached to the parent for some time in a chain. Micronuclei and contractile vacuoles are apparently absent.

Family Naididae.

Genus **Nais** Müll. em. Vejd.

Nais pectinata Steph.

Kottayam, 20th April 1927. Numerous specimens.

The species was first described in 1910 by Stephenson (16) from specimens obtained from *Spongilla carteri* taken at Bheemanagar, Travancore. The present specimens were attached to *Hydrilla* and other aquatic plants.

External characters.—The worm is of a pale whitish colour and is 4-6 mm. in length during life. The number of segments varies within wide limits. In the longest specimen examined 65 segments were counted, while the smallest specimen had 24 segments.

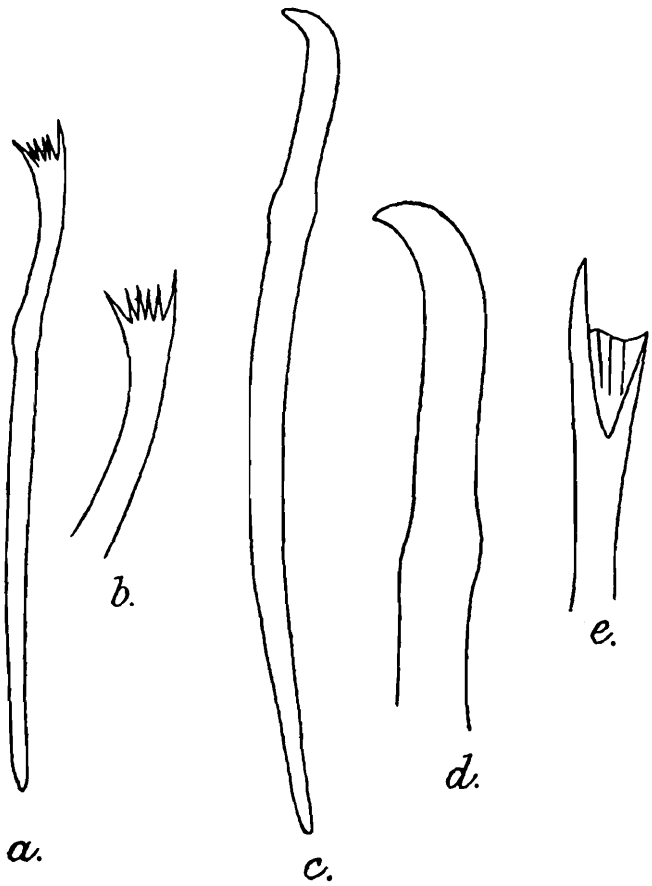
The number of ventral setae in a bundle varies from 3 to 7, 5 being regularly the number in segments II to V; Stephenson gives 3 as the number in his examples.

The dorsal bundles usually consist of one hair and one needle, but bundles composed of one hair and two needles and rarely two hairs and two needles also occur. The distal fourth of the needle seta (text-fig. 2 *a*) is slightly sickle-shaped and an indistinct nodulus is present at the end of the straight portion of the shaft. Four intermediate prongs are present between the two outer prongs (text-fig. 2 *b*).

The lengths of the setae in a few segments are given in the following table. (The measurements noted are in microns.)

No. of segments	II	III	IV	V	VI	VIII	XIII	XXIII
Needles	..	..	..	..	57	54	62	58
Hair setae	..	..	..	..	180	180	220	200
Ventral crotchets	65	62	62	60	58	58	52	58

Internal anatomy.—There is no stomach dilatation. Coelomic corpuscles are numerous and are 10μ in diameter. The first nephridium is in segment VII.



TEXT-FIG. 2.—*Nais pectinata* : *a.*, dorsal needle, × *ca.* 1790 ; *b* , distal end of dorsal needle, more magnified ; *c.*, penial seta, × *ca.* 1860 ; *d.*, distal end of penial seta, more magnified ; *e.*, tip of dorsal needle of *Nais pectinata* var. *inequalis*, × *ca.* 3000.

The dorsal vessel is attached to the alimentary canal along its left side as far as segment VI in which it crosses over to the dorsal side of the oesophagus. It then runs straight forwards and gives off four pairs of transverse commissures in segments V-II. The commissures in segment II are the stoutest and are given off immediately behind the brain. In front of the brain the dorsal vessel divides into two branches, a right and a left, which run backwards along the sides of the pharynx and unite below it in segment II, at the level of the ventral setae, to form the ventral vessel. A short vessel on each side connects each of the first pair of transverse commissures in segment II with the corresponding branch of the dorsal vessel in front.

The brain is deeply indented both in front and behind.

Sexual reproduction. Sexual individuals were obtained in fairly large numbers. The clitellum extends over ½V-½VII-VII-½VIII (=2-3 segments). The spermathecae are long cylindrical sacs in segment V and the single sperm sac extends backwards to segment XII.

As the worm becomes sexually mature the dorsal setae of segments VI and VII are lost. The penial setae are the modified ventral setae of segment VI, 4-5 per bundle. Each penial seta (text-fig. 2 *c*, *d*) is 68μ long (never longer) with a blunt, slightly curved, tip. The tip is not

usually bifid, but sometimes a very minute indistinct prong, representing the outer prong, is present.

In fully mature individuals the alimentary canal degenerates into a narrow cord in front of segment XIV

Nais pectinata var. **inequalis** Steph.

Specimens of this worm were fairly abundant in a tank in Trivandrum in July, 1926.

The only point on which I wish to add a note is the dorsal needle. The needle seta is 72μ long and has a very faint nodulus, distal to the middle of the shaft, beyond which is a slight sickle-shaped curve. The prong on the convex side of the curve is only half as long, and less than half as thick, as the inner prong. These two prongs could only be made out with the high power objective. On using the oil immersion lens it was seen that a webbing (text-fig. 2 *e*) connects the two outer prongs and is itself supported by two or three intermediate teeth which are of the same length as the prong on the convex side of the curve. The webbing is easily overlooked, as it is not visible when the outer prongs are focussed.

Nais communis Piguet var. **punjabensis** Steph.

A tank at Nagercoil, 1st June 1927. Numerous specimens.

Genus **Naidium** O. Schm.

Naidium menoni,[1] sp. nov.

Specimens of this worm were obtained from a tank at Chirayinkil in October, 1926 and later from a tank in Trivandrum in June, 1927 along with *Naidium breviseta*.

The worm is smaller in size than *N. breviseta;* single individuals measuring 5 mm. in length when living and chains of two individuals about 7 mm. The movement of the worm resembles that of *N. breviseta*. The number of segments in single individuals or chains may vary between 32 and 50.

The prostomium is slightly longer than broad and has a more or less rounded anterior margin. Sensory hairs are absent.

The ventral setae begin in segment II and consist of ordinary bifid crotchets. The setae of segment II and sometimes of II and III are shorter than those of succeeding segments. In the setae of the anterior segments (text-fig. 3 *a*) the outer prong is slightly longer than the inner but the prongs are equal from segment X backwards (text-fig. 3 *b*). As is clear from the table of measurements below the nodulus is at the middle of the shaft in the setae of segment II, slightly distal to

[1] Named after my old teacher, Professor K. R. Menon of the Presidency College, Madras.

the middle of the shaft in segment III, and distinctly distal from segment IV backwards.

No. of segments.	Distal : proximal.
II	20 : 20
III	20 : 25
IV	20 : 30
VII	20 : 30
XXVIII	18 30

The number per bundle is usually 5 in the anterior segments and 4-2 in the posterior segments. A single specimen was found with the following unusual numbers :—

Seven per bundle in segment II, 6 in III, 5 in IV-V, 6 in VI-VIII, 5 in IX-XIV and 4-3 in the posterior segments.

The dorsal setae, which begin in segment II, consist of one needle and one hair seta per bundle, rarely two needles and two hairs or one needle and two hairs. The distal half of the needle seta (text-fig. 3 *c*) has a bayonet-shaped or sigmoid curve and the tip is single pointed. There is no nodulus. The hair is almost straight and without any ornamentation. The needles and hairs of segments II and III are, like the ventral setae of these segments, shorter than those of the succeeding segments. The lengths (in microns) of the setae in three individuals are shown below :—

Specimen 1. (Chirayinkil)—

No. of segments	II	III	IV	V	VI	IX	XXI
Dorsal needles	45	54	64·8	72	79	75	72
Hair setae	126	170	180·0	198	198	162	130
Ventral crotchets	45	50	54	54	54	54	52

Specimen 2. (Chirayinkil)—

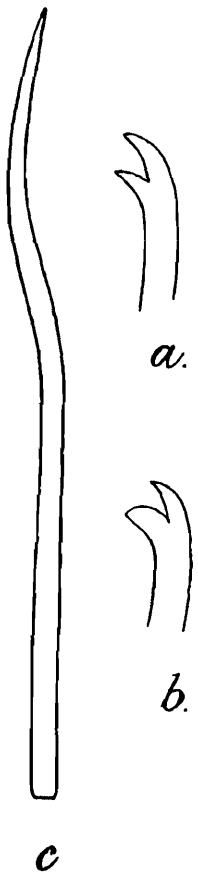
No. of segments	II	III	IV	V	VI	IX	XXI
Dorsal needles	39	52	74	75	72	60	58
Hair setae	92	130	144	162	162	144	126
Ventral crotchets	39	45	54	54	52	46	46

Specimen 3. (Trivandrum)—

No. of segments	II	III	IV	V	VI	IX
Dorsal needles	50	63	75	72	72	75
Hair setae	126	162	198	180	225	200
Ventral crotchets	50	54	54	61	61	61

Internal anatomy.—The pharynx is strongly ciliated and occupies segments II and III. The wall of the pharynx is attached to the body wall by means of muscle strands. The oesophagus extends through

segments IV-VI and dilates into the stomach which occupies segments VII and VIII. The stomachal dilatation is usually not so wide as the intestine behind and is, therefore, easily overlooked. The stomach is richly vascular and is covered with a thick layer of chloragogen cells. The inner lining of the stomach consists of a layer of finely granular gland cells, through which run narrow branching ducts. A short narrow ciliated portion connects the stomach with the wide intestine.



Text-fig. 3.—*Naidium menoni* : *a.*, distal end of ventral seta of anterior region ; *b.*, distal end of ventral seta of posterior segment ; *c.*, dorsal needle of segment V, × *ca.* 1520.

Chloragogen cells begin in segment V There are three pairs of septal glands consisting of masses of clear glassy cells, in segments III, IV and V

Coelomic corpuscles are numerous. As in *N. breviseta,* these bodies appear black when seen by transmitted light and whitish when seen by reflected light. An average sized corpuscle measures 15μ in diameter.

The first nephridium is in segment IX.

The dorsal vessel runs in close connection with the alimentary canal, lying on its ventral side a little to the left of the middle line. It passes round the gut and comes to lie dorsally in segment VIII. There are three pairs of contractile vascular loops in segments V, VI and VII. The dorsal vessel also gives off transverse commissures in segments IV, III and II, the last pair (that in II) arising immediately behind the brain. The vessel then runs forwards below the brain and emerging on its anterior side divides into two branches (a right and a left), which pass ventrally and run backwards internal to the lines of the ventral bundles of setae and unite in the middle line, at the level of the ventral setae of segment V, to form the ventral vessel. The vascular loops in segment V join the ventral vessel immediately behind its formation, while each of the transverse commissures in front joins the anterior ventral vessel of the same side. The ventral vessel is non-contractile and is not attached to the alimentary canal.

The brain is widely indented both in front and behind.

Asexual reproduction was noted in several individuals and η was found to vary between 22 and 24. In one specimen η was 28. Seven segments are always intercalated in the budding zone at the anterior end of the posterior individual.

Naidium breviseta Bourne.

The following notes may be added to supplement my account (1) of this species :—

In the specimens obtained from Trivandrum in 1925 the prostomium is longer than broad with a blunt apex and is not drawn out into a

proboscis. The specimens collected later from Trivandrum, Kovilam and Chirayinkil possess a distinct mobile probescis as in the various species of the genus *Pristina*.

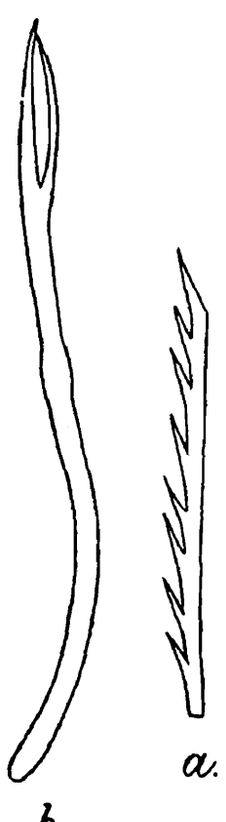
I stated in my previous account that there is no stomach in this species. On examining the recently obtained specimens and comparing these with the new species described in this paper, I find that this species also possesses a stomachal dilatation in segments VII and VIII.

The dorsal vessel which occupies the same position as in *N. menoni* comes to lie dorsally in segment VII. There are three pairs of contractile vascular loops in segments V-VII, and non-contractile (or slightly contractile) transverse commissures in segments IV-II. The ventral vessel is formed at the level of the ventral setae of segment VI. The vascular loops in segment VI join the ventral vessel immediately behind its formation while each of the commissures in front joins the anterior ventral vessel of the corresponding side.

Genus **Pristina** Ehrbg.

Pristina longiseta Ehrb. f. **typica.**

Trivandrum. August, 1924 and August, 1926. Numerous specimens.



TEXT-FIG. 4.—*Pristina longiseta* : *a.*, portion of hair seta showing serrations, × *ca.* 3040 ; *b.*, penial seta, × *ca.* 1520.

The serration of the hair setae (text-fig. 4 *a*) in the present specimens cannot be said to be slight.

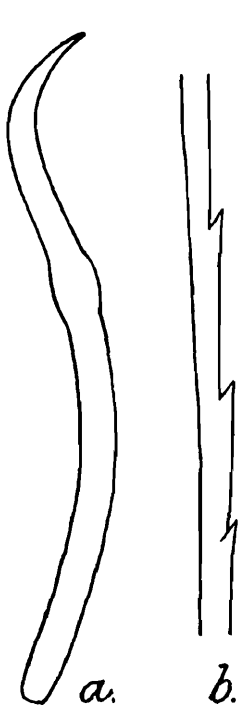
The penial setae (text-fig. 4 *b*) call for a brief notice. The ventral bundles of segment VI are modified as penial setae, 2 per bundle. Each seta is 72μ in length with the proximal half more strongly curved than the distal. There is a faint nodulus a little distal to the middle of the shaft and the distal fourth of the seta is divided into two enormous prongs as in *Naidium breviseta* (*vide* Stephenson, 25). The prongs, which appear to be connected together by a thin membrane, diverge slightly and meet again at the tip. The resemblance of these setae to the penial setae of *Naidium breviseta* is so striking that it affords one more proof of the affinity between the two genera. Stephenson's figure (20) of the penial seta of this species is different. I, therefore, forwarded my slide to him, and he kindly wrote to me confirming my determination of the species, and added that he must have overlooked the second prong when he examined the seta many years ago. As the seta lies on its side it is not easy to see the inner prong which is situated somewhat below the outer prong.

Pristina aequiseta A. G. Bourne.

Vellayani lake. August, 1926. Numerous specimens.
Trivandrum. September, 1926. Numerous specimens.

Length of specimens 2–2·5 mm.

In the present specimens the ventral setae of segment V are the "giant setae" and not those of segment IV Suspecting that this form might be a variety of *P. aequiseta*, I referred the point to Dr. Stephenson who kindly informed me that "Michaelsen in 1913 had worms from S. America which presented the enlarged ventral setae only in segment V, not in IV; so also Hempelmann in Germany in 1923."



TEXT-FIG. 5.—*a.*, giant seta of *Pristina aequiseta*, × *ca.* 1520; *b.*, portion of hair seta of *Pristina proboscidea* showing serrations, × *ca.* 3040.

The giant seta (text-fig. 5 *a*) is 63μ long, very much stouter than the ordinary crotchets and has a strong double curve. The nodulus is distal to the middle of the shaft (distal : proximal : : 15 : 20). The proximal prong which is stated by Bourne, Piguet, and others to be rudimentary has in the present specimens completely disappeared, and the seta ends in a simple point, the distal portion beyond the nodulus presenting an appearance not unlike that of the blade of a pruning knife. The number per bundle is usually one. The following exceptional cases have been observed :—

1. In one individual there were three setae in each bundle, one of which was modified as the giant seta, the other two being ordinary crotchets. In the giant seta of one side a minute rudimentary proximal prong was present.
2. In one specimen there were two giant setae in one bundle and one in the other.
3. In two specimens there were two giant setae in each bundle.

The lengths of the setae in the present specimens are shown in the table below for comparison with those of the European specimens described by Piguet (11).

No. of segments	II	III	IV	V	VI	IX
Dorsal needles			32·5-35			
Hair setae	91	104	117	130	130	135
Ventral crotchets	45	32·5	35	63	39	39

Piguet's specimens :—

No. of segments	II	III	IV	V	VI	VIII
Dorsal needles	33	43	49	50	50	54
Hair setae	121	184	180	197	230	246
Ventral crotchets	62	46	62	56	54	56

The alimentary canal has a covering of chloragogen cells which begin in segment VI. Coelomic corpuscles are present; each consisting of a round cell with granular protoplasm and a few oil-drop-like bodies in it. An average sized corpuscle is 9μ in diameter.

There are two pairs of contractile vascular loops in segments VI and VII, those in VII being stouter. In addition to these there are transverse commissures in segments II-IV

The brain is indented both in front and behind.

The value of η was 13 in five specimens, 14 in one and 15 in three.

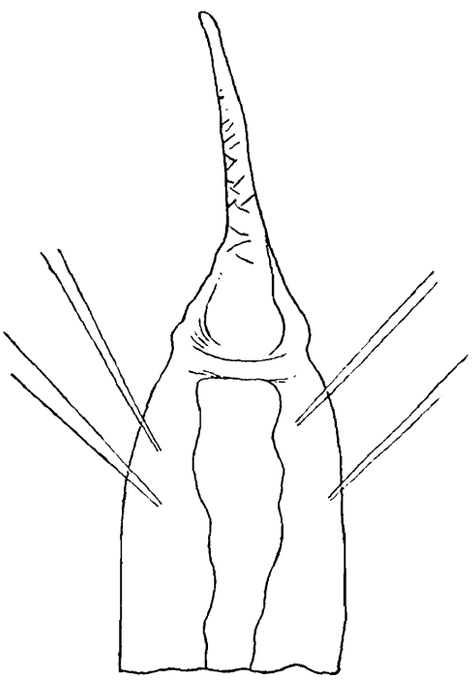
Pristina proboscidea var. **paraguayensis** Mich.

Trivandrum. September, 1926. A few specimens.

Length of single individuals 5 mm.

Number of segments 23-46.

The length of the proboscis (text-fig. 6) varies to some extent. The shortest proboscis was ·27 mm. in length and the longest measured ·46 mm., three times as long as the prostomium.



TEXT-FIG. 6.—*Pristina proboscidea*, anterior end of body.

The ventral setae are bifid crotchets, 4-9 per bundle in the anterior segments. The setae of segment II are longer and stouter than the rest and have the nodulus exactly at the middle of the shaft. The number per bundle in the anterior segments of two specimens is shown below :—

1. 5/II, 6/III, 5/IV, 6/V-VI, 8/VII-XIII.
2. 4/II, 7/III, 8/IV, 7/V-VIII, 8/IX-XI, 9/XII.

The dorsal setae consist of two hairs and two or three simple pointed needles per bundle.

Lengths of setae in the anterior segments :—

No. of segments	II	III	IV	V	XII
Hair setae	450	180	360	380	450
Ventral crotchets	90-108	72-81	72	72	72

Hair setae measuring 620μ have been observed about the middle of the body. The serrations of the hair setae (text-fig. 5 *b*) are visible under the high power of the microscope. They are 6·5-9μ apart in the middle of the seta and vanish proximally but get closer and more distinct distally.

There is a stomach in segment VIII. Chloragogen cells begin about the sixth segment. There are two pairs of contractile vascular loops in VI and VII, those in VII being stouter. Transverse commissural vessels are present in segments II-V The dorsal blood vessel is sometimes covered with a layer of chloragogen cells as far as segment VII.

Asexual reproduction was noted in a few individuals and η was found to vary between 19 and 24.

Genus **Stephensonia,** gen. nov.

Diagnosis.—Prostomium almost rounded. Ventral bundles of setae begin in II, consisting of bifid crotchets. Dorsal bundles begin in II, consisting of hair setae and simple pointed needles. Four segments only are intercalated in the budding zone at the anterior end of the posterior animal. Clitellum includes IV$\frac{1}{2}$-VI$\frac{3}{4}$ (=2$\frac{1}{4}$). Testes in IV (?). Ovaries in V (?). Male funnel on anterior face of septum 4/5, vas deferens leading to a pear-shaped atrium in V Male pores in V Sperm sac single, formed from septum 4/5 extending into VI. Ovisac single, formed from septum 5/6 extending into VII. Spermathecae in IV Penial setae internal to the male aperture, 4-5 per bundle.

Stephensonia trivandrana, nom. nov.

(Plate I, figs. 2, 3 and 4.)

The species was described by me under the name *Naidium* (?) *trivandranum* in the *Ann. Mag. Nat. Hist.*, Ser. 9, Vol. XVIII, p. 139 (1926).

Sexual reproduction.—Mud containing specimens of this worm was brought to the laboratory in November, 1925, and though it was being examined from time to time, sexual specimens were obtained from this culture only after a lapse of eight months, in June, 1926. It is also worthy of note that only eight specimens were obtained in all, although the mud in the basin had a very large number of asexually dividing individuals. Four of the sexual specimens were examined entire under the microscope and three were sectioned.

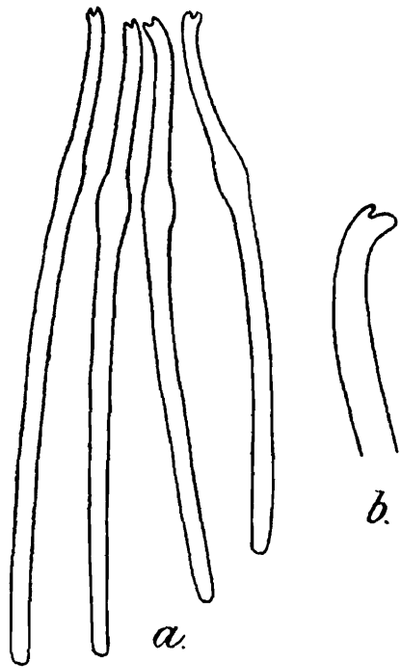
The clitellum is conspicuous during life by its thickness and whitish colour. It extends from the level of the setae of segment IV to the level of the setae of segment VI or gets slightly beyond it (=2$\frac{1}{4}$). The clitellum is covered by large transversely elongated cells filled with colourless oil-like droplets. These cells get easily separated from the body wall by the pressure of the cover slip and assume a rounded shape.

The testes were not noticed either in the entire specimens or in the sections. They should presumably have been in segment IV in which the male funnels are seen.

The sperm sac (Plate I, fig. 2) is single and occupies segment V, sometimes extending into segment VI. It is a backward pouch of septum 4/5 and contains morulae and other stages of developing sperms, besides sheaves of ripe spermatozoa.

The male funnels (Plate I, fig. 2) are on the anterior face of septum 4/5 and are distinctly funnel-shaped and ciliated. They are 27μ long and 18μ wide at the mouth. Masses of ripe spermatozoa are seen at the entrance to the funnel. The vas deferens is 9μ wide at its beginning behind septum 4/5. It passes downwards towards the body wall but in none of my serial sections could I trace the entrance of the vas deferens into the atrium ; it may possibly be at its upper pole.

The atrium (Plate I, figs. 2 and 4) is an ovoid or pear-shaped sac in segment V, about 54μ long, 36μ wide at its broad ental end, and 27μ at its narrow ectal end. Its lumen is narrow and its wall consists of a single layer of finely granulated columnar cells with basal nucleus. The ectal end of the atrium appears to open directly to the outside without the intermediation of an ejaculatory duct. The male apertures (Plate I, fig. 3) are situated a little external to the ventral bundles of setae on a slight invagination of the body wall. The upper two-thirds of the atrium are covered by a mass of prostatic cells (Plate I, fig. 4). The prostatic cells are pear-shaped with their broad ends turned towards the body cavity and their narrow ends turned towards or attached to the atrium. The protoplasm is finely granulated and the rounded nuclei are situated in the broad portion distally to the centre.



TEXT-FIG. 7.—*Stephensonia trivandrana : a.*, penial setae, × *ca.* 1250 ; *b.*, distal end of penial seta more magnified.

The penial setae (text-fig. 7*a*, *b*) are the modified ventral setae of segment V. There are four or five setae per bundle. Each seta is 81μ

long with the nodulus distinctly distal. The shaft beyond the nodulus has a slight sickle-shaped curve and the tip of the seta is divided into two blunt prongs. In living specimens the setae of a bundle are seen to converge distally so that the bundle presents an appearance not unlike a hollow cone.

The ovaries have disappeared in all the specimens. They are doubtless situated in segment V In one of the specimens examined entire under the microscope I noticed on one side in segment V a small cluster of granulated round cells attached to the posterior face of septum 4/5. I suppose that this was the ovary of that side.

The ovisac is single and extends through segment VI into segment VII. It is a backward pouch of septum 5/6. The sac contains one large ovum only, composed of a large mass of small eosin-staining spherical yolk granules, or one such large ovum together with a few small ova at its hinder end. The yolk mass in one specimen was 315μ in length and 112μ in width.

The female efferent apparatus was not observed.

The spermathecae are in segment IV. The ampulla is oval or spherical in shape with the short duct distinctly marked off from it by a constriction. The ampulla is 72μ long if oval, or 65μ in diameter if spherical. The duct is 27μ in height and 21μ in width.

Remarks.—The sexual organs are situated in segments IV and V, a fact which makes the position of this worm rather unique among the Naididae. It is now clear that this is not a species of *Naidium* under which it was provisionally placed by me in my original account (2). It differs markedly from *Naidium*, the reproductive organs of which have been recently described by Stephenson (25). A new genus has, therefore, to be erected for the reception of this species and I propose to name this genus *Stephensonia*.

Stephenson (20) has stated that in Naididae " there seems to be some connection between the position of the genital organs and the extent of the budding zone. The testis and spermathecae are formed in the last segment which is derived from the budding zone." In most genera of this family, the testes and spermathecae are situated in the *fifth* segment, and *five* segments are produced in the budding zone. In *Pristina seven* segments are produced in the budding zone, and the testes are in the *seventh* segment. *Naidium*, whose sexual organs were not known at the time the Fauna volume was written, is now seen to confirm the relation referred to. The present genus, in which the sexual organs have " jumped forward " one segment, establishes beyond doubt the relation between the budding zone and the position of the sexual organs. As I have already stated in my previous account (2) of this worm, *four* segments only are produced in the budding zone and testes and spermathecae are situated in the last segment derived from it.

Genus **Branchiodrilus** Mich.

Branchiodrilus menoni Steph.

Nagercoil. From soft mud in an old unused tank. April, 1927 Five specimens, two sexual.

Genus **Slavina** Vejd. em. Steph.

Slavina appendiculata (Udek.).

Nagercoil, from very soft mud in an old irrigation tank, 1927 A single specimen, not sexual.

This species has hitherto been recorded in India from Calcutta, Lahore and the Andaman Islands. Its occurrence in the southernmost corner of India may be taken as an indication of its general distribution throughout the Indian area.

Genus **Dero** Oken.

Dero zeylanica Steph.

Trivandrum. Collected on several occasions. Numerous specimens.
Nagercoil. April, 1927. Numerous specimens.
Chirayinkil. April, 1926. Numerous specimens.

This is the first time that this species is recorded from India. It was first described in 1913 by Stephenson (15) from specimens sent to him by Dr. Annandale from Ceylon. Of the six species of *Dero* that are known to occur in Travancore, I find this to be the commonest. Many of the tanks from which mud was examined for aquatic oligochaetes contain large numbers of this species.

The length of single individuals may reach up to 10 mm. and that of chains 14 mm. Number of segments 42-82, with always a few newly forming segments at the posterior end. The worm has a pale red colour with the branchial region at the posterior end rather whitish. When disturbed it swims like a *Nais* with an active serpentine movement. The worm does not generally live in tubes but specimens have often been found living within close fitting mucilaginous tubes to which sand particles and mud adhere.

The *dorsal setae* begin in segment VI and consist of double-pronged needles and hair setae. In the anterior segments there are three, rarely four, hair setae and as many needles per bundle. The hair setae and needles of a bundle alternate. The lengths of the setae in the specimens examined by me agree remarkably well with those noted by Stephenson in his specimens from Ceylon.

The *ventral setae* also agree closely with Stephenson's specimens. The number per bundle in segments II-V is four or five. The number in the anterior segments from the sixth segment onwards is four, five or sometimes six. The setae of segments II-V are less curved than those of the succeeding segments, vary in length from 114-123·5μ, and have the nodulus at the middle of the shaft. " The outer prong is nearly twice as long as the inner and the prongs are about equal in thickness at the base." The setae from segment VI onwards vary in length from 85-95μ and have the nodulus distal to the middle of the shaft (distal : proximal : : 19 : 26).

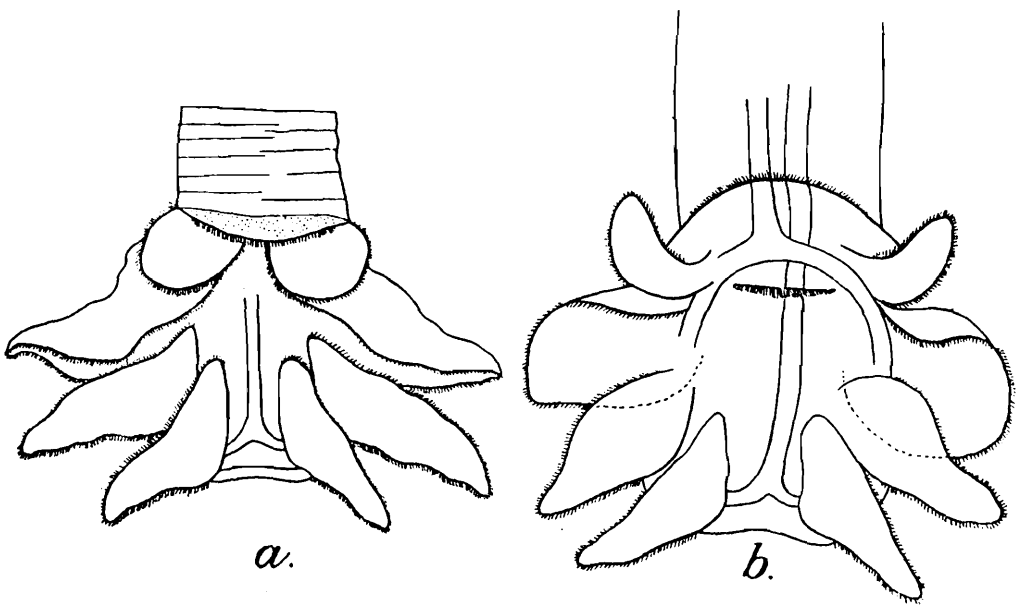
Branchiæ.—There is a distinct pocket-like forward extension of the branchial fossa on the dorsal side of the posterior end of the alimentary canal. This diverticulum is clearly seen when the gills are in a retracted condition.

The first pair of gills, the smallest, are oval or circular in outline when fully expanded, and spring from the anterior end of the pocket-like diverticulum into which they can be completely withdrawn when the fossa is closed.

The second pair, which originate from the anterior part of the lateral wall of the fossa, are the broadest. These, like the first pair, are almost circular in outline but the anterior one-third is usually folded backwards over the rest.

The third and fourth pairs of gills spring from the floor of the branchial fossa. Each of these is a thin plate, roughly triangular in shape, and is attached to the floor by the short base, the two long sides being free. These gills sometimes stand out almost vertically but usually slant to one side or the other. It is only when they lie almost flat on one side that their real dimensions can be made out. When the gills are fully expanded their free ends project beyond the margin of the fossa.

The dorsal anterior margin of the fossa is ciliated but is not broken up to form secondary gills.



TEXT-FIG. 8.—*Dero zeylanica : a.*, branchial region (diagrammatic); *b.*, the same, diverticulum thrown forwards.

Internal anatomy.—There are no septal glands. Attached to the gut in segments III, IV and V are aggregations of flattened, circular, granulated cells of varying sizes. An average sized cell is 11μ in diameter.

There is a stomach, which occupies segments IX and X, or X only, or rarely VIII and IX. The stomach is lined by gland cells arranged in transverse rows. The narrow intervals between the rows give the stomachal wall a wrinkled appearance.

Chloragogen cells begin in segment VI. The first nephridium is in segment VIII. The dorsal blood vessel lies on the ventral side of the alimentary canal, a little to the *left* (*cf.* Stephenson, 15) of the middle line, as far as segment VI, in which it crosses over to the dorsal side. The ventral vessel is formed in segment II at the level of the ventral setae. There are four contractile vascular loops in segments VI-IX and sometimes an additional pair in segment IX.

The brain is widely indented in front and narrowly so behind. The indentation behind appears as a deep narrow fissure as in *D. limosa* and *D. austrina.* Scattered over the surface of the brain are very minute glistening particles.

Asexual reproduction.—Fission was observed in a large number of specimens and in almost all cases η was found to be 32, though rarely it was 31 or 33.

Sexual reproduction.—Several specimens were obtained on three occasions from laboratory culture in January 1926, May 1926 and May 1927.

The clitellum extends from the level of the setae of segment V or the level of the spermathecal apertures or sometimes a little in front of them to the level of the setae of segment VIII (=3).

The testes have disappeared in all the specimens examined. The sperm sac, a backward pouching of septum 5/6, is large and single and extends through segments VI-XI or XII, taking up nearly the whole body cavity in these segments.

The male funnels, which lie on the anterior face of septum 5/6, are cup-shaped and slightly deeper than wide (54μ deep and 45μ wide at the mouth). The vas deferens entering segment VI runs backwards, then upwards close to the atrial sac, and enters it a little above its middle. The vas deferens has no investment of peritoneal cells.

The atrium is a large, thin-walled, almost globular sac, in segment VI, filled with bundles of ripe spermatozoa. A short ejaculatory duct starts from its lower pole and opens to the outside in an invagination of the body wall. The duct is surrounded by a thick mass of small peritoneal cells.

The ovaries were not noticed in any specimen. The single ovisac, which is a backward pouching of septum 6/7, extends up to segment XV or XVI. The anterior part of the ovisac is occupied by the massive sperm sac, while the posterior portion is taken up by one large ovum which occupies three or four segments. The ovum in one specimen is 540μ long and 180μ wide at the anterior end and 115μ at the posterior end. It is filled with spherical yolk granules except round the nuclear portion.

The spermathecae are in segment V The ampulla is long, club-shaped and thin-walled. In several specimens examined entire under the microscope and in two of the four specimens sectioned the spermathecae enter the sperm sac and may extend up to segment VIII. Both spermathecae may enter the sperm sac or only one. The duct is 54μ in height and 27μ wide at its ental end. It gradually narrows towards the ectal end and opens to the outside a little in front of the level of the ventral setae.

There are no penial setae. The ventral setae of segment VI are lost when the specimens become sexually mature.

Degeneration of the anterior part of the alimentary canal observed in certain forms of Naididae occurs in this species also.

Remarks.—There appears to be no essential difference between the sexual organs in the two species *D. limosa* and *D. zeylanica.* In the present species the sperm sac extends backwards much more than in

D. limosa and the spermathecae, which are very long, enter the sperm sac.

Dero limosa Leidy.

Trivandrum. December, 1925; May, 1926; May, 1927. Numerous specimens.
Kottayam. May, 1927. Numerous specimens.

The worm is smaller, more slender and less active than *D. zeylanica* and can be easily recognised with a hand lens by the pinkish tinge on its body wall. The specimens from Kottayam were mostly living in tubes and the worm could be seen alternately putting out its posterior end and exposing the gills and then drawing it in and protruding the head after the fashion of *Aulophorus tonkinensis.*

Scattered in the epidermis are minute pigment granules of a pinkish colour but sometimes of an orange tint. There is an aggregation of these pigment particles along the dorso-anterior and lateral margins of the branchial fossa.

The lengths of the setae in the specimens from the two localities are shown in the table below :—

Trivandrum specimens—

No. of segments	II	III	V	VI	VIII
Needle setae			..	63	70
Hairs				175	200
Ventral crotchets	95–104	95–104	95–104	72	81

Kottayam specimens—

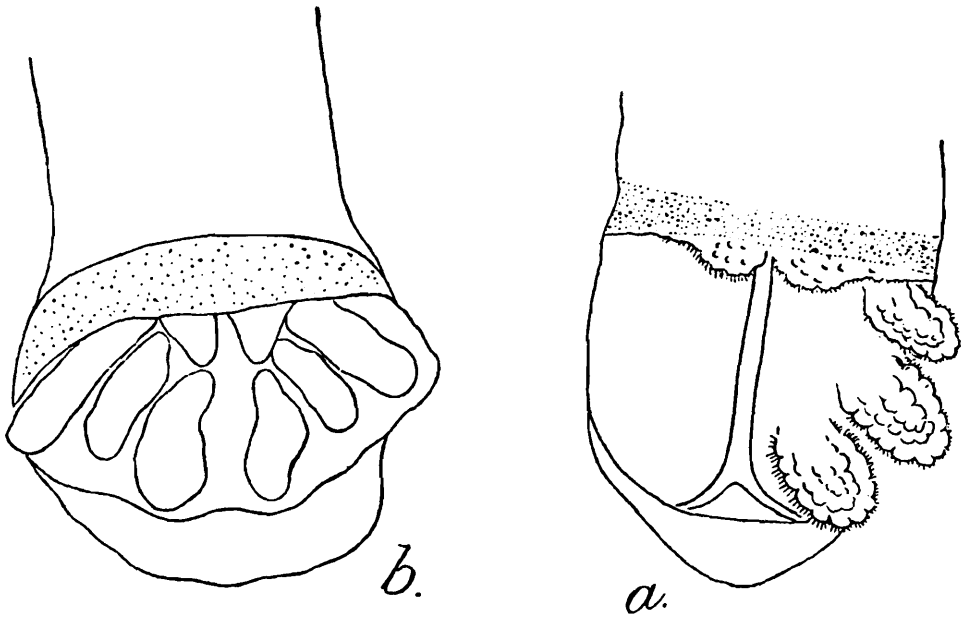
No. of segments	II	III	V	VI	VIII	XVII
Needle setae				72	72	70
Hairs				200	220	200
Ventral crotchets	108	108	108	90	90	90

Branchiae.—Taking the branchial arrangement, the present specimens may be classed into two groups.

In the first group, which includes the majority of my specimens (text-fig. 9*a*), there is a slight narrow pocket-like space between the dorso-anterior margin of the fossa and the terminal portion of the alimentary canal. The dorso-anterior border is cut up in the middle and gives rise to a pair of secondary gills (projections from the margin of the fossa). A second pair of gills, as long as the gills from the floor of the fossa, originate from the narrow pocket-like space near the lateral angle. These gills, not being " projections from the margin ", may be looked upon as ' true ' gills. The two remaining pairs spring from the floor of the fossa. Thus in the majority of the specimens, there are three pairs of " true " gills and one pair of " secondary " gills.

In the remaining few specimens (text-fig. 9*b*), which constitute the second group, there is a distinct forward extension of the branchial fossa as in *D. zeylanica.* In this group all the four pairs are true gills, the first pair springing from the diverticulum, the second pair from the anterior lateral angles of the fossa and the third and fourth pairs from the floor of the fossa.

Stephenson in the Fauna volume remarks that in his specimens from Lahore " the dorsal margin of the fossa was more cut up than usual,



TEXT-FIG. 9.—*Dero limosa* : Branchial region : *a.*, one pair of secondary and three pairs of true gills ; *b.*, four pairs of true gills (prevserved specimen).

apparently, and gave the appearance of two pairs of secondary gills." Stephenson's specimens appear to me to be intermediate between the type-form of the species (with one pair of secondary and two pairs of true gills) and the first group of my specimens (with one pair of secondary gills and three pairs of true gills).

The dorsal vessel occupies the same position as in *D. zeylanica*, *i.e.*, ventral, a little to the left of the middle line. There are four pairs of contractile vascular loops in segments VI-IX and not in VII-X as in Stephenson's specimens from North India.

Fission was noted in a number of individuals and η was found to vary from 19-24, 19 and 20 being more general than 21-24.

Dero austrina Steph.

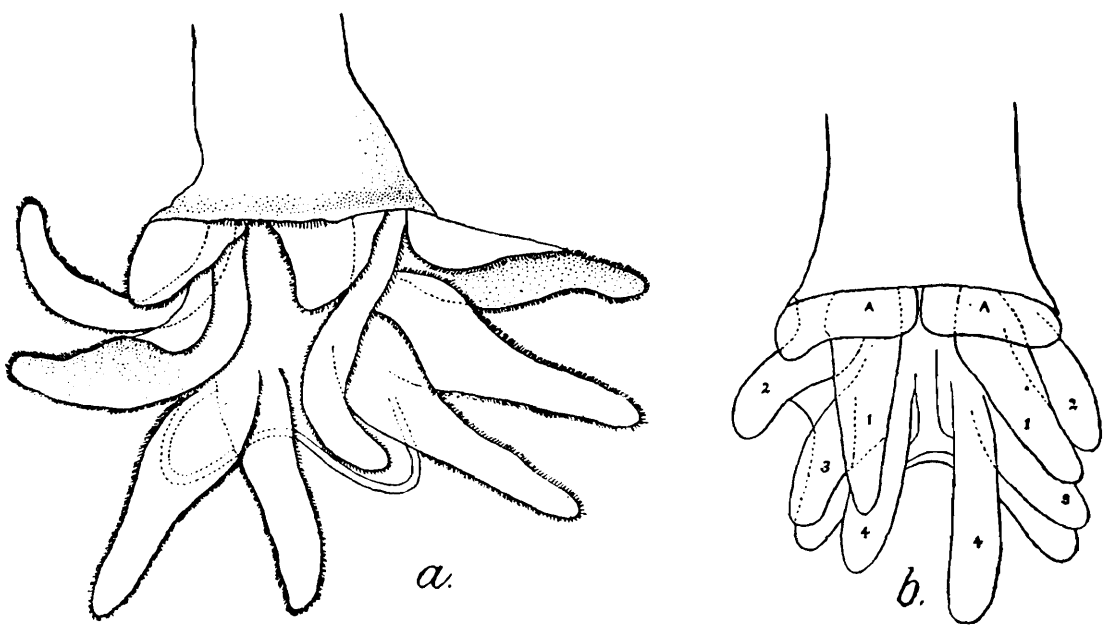
Trivandrum. May, 1926 ; June, 1927. Numerous specimens.

Length of specimens 10-18 mm. The largest number of segments counted is 106. A protective coat of hardened mucus is present in most individuals.

The setae agree closely with Stephenson's account of them. The ventral setae are only 4-5 per bundle in the anterior region up to segment IX, then the number diminishes to 3 or 4 and more posteriorly sinks to 2 or 3

Gills.—In all the specimens examined by me there are four pairs of true gills and one pair of secondary gills (text-fig. 10*a*, *b*). The secondary gills in this species correspond to the first pair of gills in *D. zeylanica*. In *D. zeylanica* they originate from the dorsal extension of the

branchial fossa but here on the other hand, though they can be retracted slightly beneath the anterior margin, they appear to be continuous with it, when the fossa is fully expanded. All the four pairs of true gills are of about the same length when fully extended and project far beyond the margin of the fossa. The first pair arise in front of the secondary gills near the lateral wall. The second pair spring from the lateral wall of the fossa. These have the anterior one-third of the basal half folded backwards. The third and the fourth pairs originate from the floor of the fossa.



TEXT-FIG. 10.—*Dero australina*: Branchial region: *a.*, live specimen; *b.*, preserved specimen.

The ventro-posterior border of the branchial fossa is cleft in the form of a broad inverted V and produced on each side into a short palp-like projection. Each palp is 110μ long and as much wide in the middle and narrows a little towards the rounded tip. The palps are non-vascular and non-contractile. When the gills contract the distal half of each palp folds obliquely inwards over them.

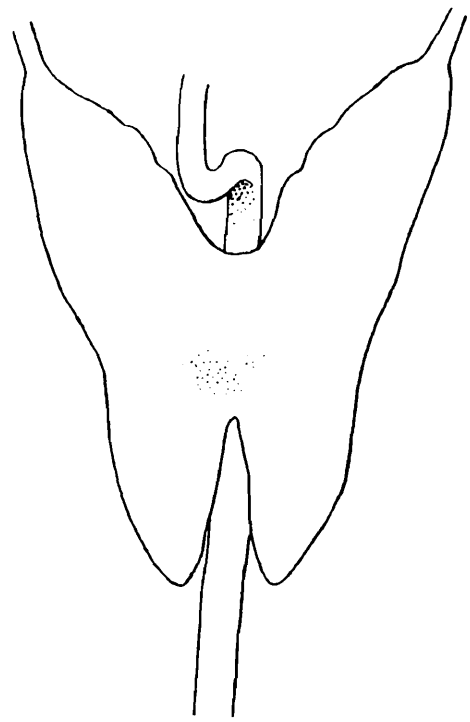
Septal glands are present in segments IV and V and appear to have the same structure as in *Aulophorus*. They are very vascular being supplied by branches of the dorsal vessel.

The stomach extends through 2 or 3 segments from segment X or XI and is slightly constricted by the septa. The stomach can be distinguished from the wide intestine that follows it by the lining of gland cells arranged in transverse rows as in the other species of *Dero*.

The brain is widely indented in front and narrowly cleft behind (text-fig. 11). The narrow posterior fissure extends forwards as far as the middle. A number of very minute glistening particles are seen aggregated together a little to the left side of the termination of the posterior fissure.

Asexual reproduction.—Though large numbers of specimens were examined asexual reproduction was observed in two individuals only. One of these had 106 segments and was dividing between the 53rd and 54th segments (exactly at the middle). The other had 77 segments

and was dividing between the 45th and 46th segments. Gills were developed at the posterior end of the anterior individual in each case but no new segments were formed at the anterior end of the posterior individual. The individuals were seen to separate in this condition



TEXT-FIG. 11.—*Dero austrina* : Brain.

and the new segments (five) at the anterior end of the posterior animal were produced after separation. Several individuals in which gills were present at the hinder end but in which the first four setigerous segments were in different stages of formation were obtained. This proves beyond doubt that while the regeneration of the hinder end of the anterior animal takes place *before* separation, the formation of the ' head ' segments of the posterior animal takes place only *after* separation.

Dero pectinata, sp. nov.

Trivandrum. 12-V-1927. Numerous specimens.

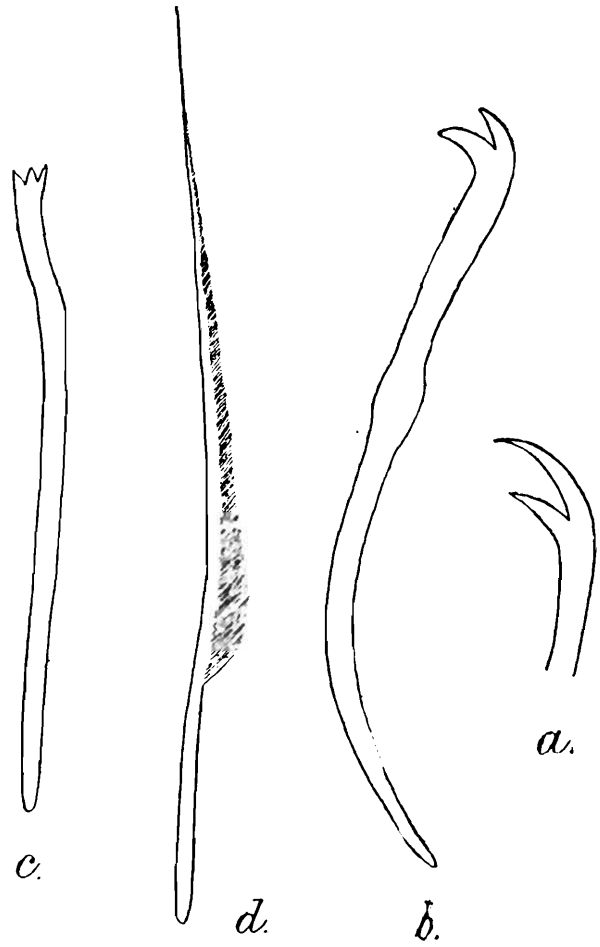
External characters.—This is a very minute and slender worm, single individuals measuring 2 mm. or less in length when living and chains of two very slightly longer. Number of segments 19-25. The *prostomium* is bluntly conical with a few hair-like protoplasmic processes along the margin.

The *ventral setae* begin in segment II and consist of bifid crotchets. The setae of segments II-V are much longer than those of the succeeding segments and are much less curved. The nodulus is distinctly proximal to the middle of the shaft (distal : proximal : : 36 : 22) and the outer prong (text-fig. 12*a*) is longer than, though of the same thickness as, the inner prong. The number of setae per bundle is 4.

The ventral setae from segment VI onwards have the nodulus distal to the middle of the shaft (dist. : prox. : : 10 : 20) and have the outer

prong (text-fig. 12*b*) slightly shorter and less thick than the inner. The number per bundle is four except in a few posterior segments in which the number diminishes to 3 and then to 2.

The dorsal setae begin in segment VI and each bundle consists of one hair seta and one needle. The needle seta (text-fig. 12*c*) has an indistinct nodulus distal to the middle of the shaft (dist. : prox. : : 5 : 23). The shaft is straight up to the nodulus, beyond which it is slightly curved like a bayonet. The tip of the needle is divided into three equal prongs. The prongs are distinct only under the oil immersion lens. The hair



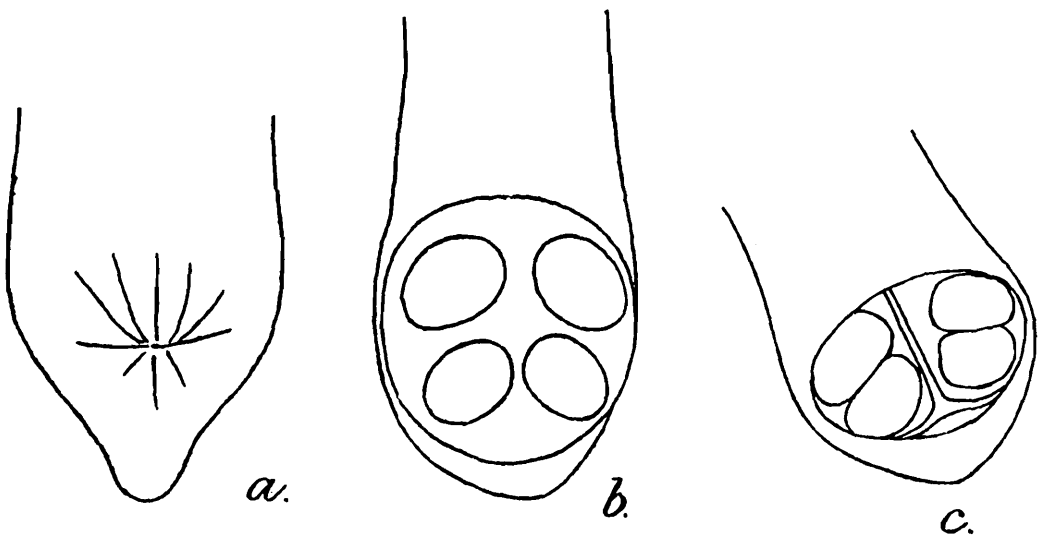
Text-fig. 12.—*Dero pectinata : a.*, distal end of ventral seta of segment III, × *ca.* 2820 ; *b.*, ventral seta of posterior segment, × *ca.* 2820 ; *c.*, dorsal needle, × 2480 ; *d.*, hair seta, × *ca.* 1700.

seta (text-fig. 12*d*) has a slight sickle-shaped curve and is ornamented on the convex border with a row of closely-set oblique barbs giving the seta the appearance of a feather. The barbs begin at the commencement of the curve and getting gradually shorter towards the tip cease a little distance behind it.

Lengths of the setae—			
No. of segments	I to V	VI	XII
Needles		37	37
Hairs	..	78	78
Ventral crotchets	70—78	39	39

Gills.—The branchial fossa at the posterior end is generally kept completely closed (text-fig. 13*a*) when the worm is under the microscope,

and one is tempted to put it down as a species of *Nais*. When fully opened, the fossa is seen to be a wide shallow circular cup (text-fig. 13*b*) with a rounded ventro-posterior border. Springing from the floor of the fossa are two pairs of small, knob-like, almost rounded gills, covered with a layer of pear-shaped cells. The gills do not project beyond the margin of the fossa even when they are fully extended. The dorsal anterior margin is straight and ciliated and is not cut up to form secondary gills.



TEXT-FIG. 13.—*Dero pectinata* : Branchial region. *a.*, Branchial fossa closed; *b.*, fossa fully open (semi-diagrammatic) ; *c.*, fossa open (preserved specimen).

Internal anatomy.—Septal glands, consisting of masses of glassy transparent cells, are present in segments III-V

There is a stomachal dilatation in segment VIII. Chloragogen cells begin in segment VI.

The dorsal vessel lies on the ventral side of the alimentary canal, to the left of the middle line. It crosses over the oesophagus and comes to lie dorsally in segment VI. There are only two pairs of contractile vascular loops in segments VI and VII.

There are no coelomic corpuscles.

The first nephridium is in segment VIII. The neck of the funnel of each nephridium on passing through the septum into the segment behind widens to form a non-ciliated, non-glandular, bladder-like bag which narrows posteriorly and forms the duct. The duct is ciliated and has a few windings.

The cerebral ganglion is deeply indented both in front and behind.

In asexual reproduction η=14 or 15. The individuals sometimes separate before the anterior segments of the posterior animal are fully formed.

A single sexually mature specimen was obtained. The clitellum in this specimen extends over segments V-VII (=3). The ventral setae of segment VI are absent. I hope to give a complete account of the sexual organs of this species when I have secured a few more sexual specimens.

Dero palmata, sp. nov.

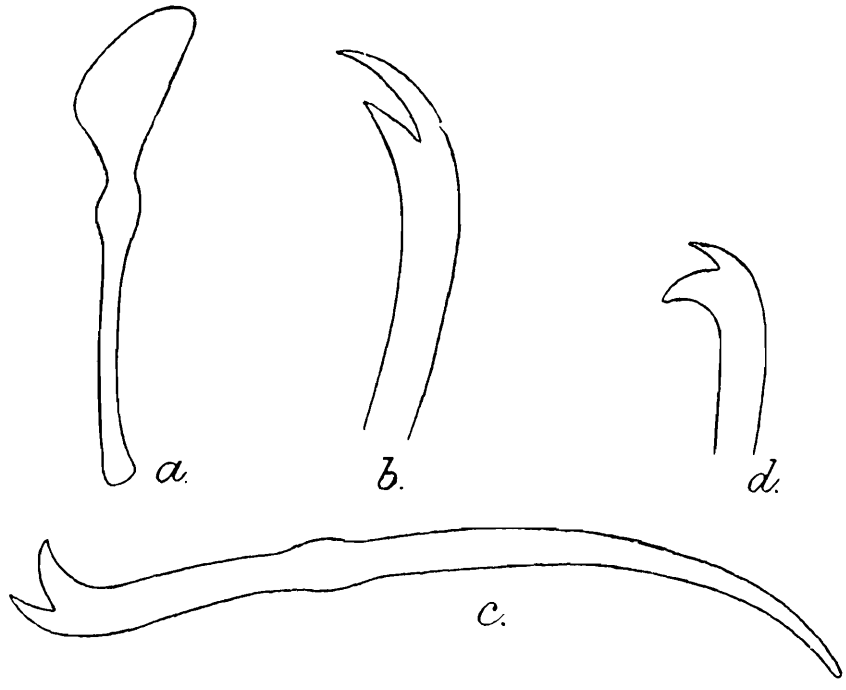
Trivandrum. 14-V-1927. A few specimens.

External characters.—Length of single individuals 2·5 to 3 mm. and of chains a little more than 3 mm. Number of segments 19-33.

The prostomium is bluntly conical with an almost rounded anterior margin.

The dorsal setae begin in segment VI and consist of one palmate needle and one hair seta per bundle. The palmate seta (text-fig. 14*a*) is 52μ long with a straight shaft and the nodulus distal to the middle of the shaft (dist. : prox. : : 15 : 25). Immediately beyond the nodulus the shaft expands to form the 'palm,' which resembles that of the dorsal needle of *Aulophorus tonkinensis* and is 13·5 to 15μ wide at its distal end. The two lateral margins of the palm are slightly raised. The hair seta is without any ornamentation.

The ventral setae of segments II-V are about twice as long as those of the succeeding segments. The outer prong (text-fig. 14*b*) is twice as long as the inner and the nodulus is proximal (dist. : prox. : : 30 : 20). The number per bundle is four. The ventral setae from segment VI onwards have the nodulus distal (dist. : prox. : : 15 : 23). The outer prong (text-fig. 14*c*, *d*) is thinner and shorter than the inner prong. The

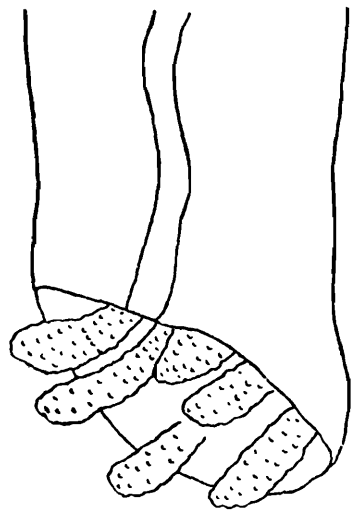


Text-fig. 14.—*Dero palmata : a.*, palmate seta, × *ca.* 1520 ; *b.*, distal end of ventral seta of segment III, × *ca.* 2820 ; *c.*, ventral seta of posterior segment, × *ca.* 2400 ; *d.*, the same, distal end.

number per bundle is 4 in the anterior segments, while posteriorly it diminishes to 3 and then to 2.

Lengths of setae—			
No. of segments	II to V	VI	XII
Palmate needles		52	52
Hair setae.		90	90
Ventral crotchets	90	49·5	48

Gills.—There are three pairs of true gills, short and finger-shaped (text-fig. 15). The first pair originate from the lateral walls of the fossa and the second and third pairs from the floor of the fossa. When the gills are fully extended they project beyond the margin of the fossa. The ventro-posterior border of the fossa is rounded and the dorso-anterior margin is straight and ciliated. There are no secondary gills.



TEXT-FIG. 15.—*Dero palmata* ♂ Hinder end of a preserved specimen to show branchial region, slightly flattened by pressure.

Internal anatomy.—Chloragogen cells begin in segment VI. There is a stomachal dilatation in segment VIII.

The dorsal vessel occupies the same position as in the other species of the genus. The ventral vessel is formed at the level of the ventral setae in segment II. There are three pairs of contractile vascular loops in segments VI, VII and VIII; the loops in segment VI are less stout than those of the two succeeding segments.

There are no coelomic corpuscles.

The first nephridium is in segment VIII. The brain is deeply indented in front and less so behind.

Fission was observed in six specimens. In three of these η was 14 and in three others 15.

Dero niveum, sp. nov.

Trivandrum. 24-V-27. Several specimens.

External characters.—Length of single individuals 2·5 to 3·5 mm.; of chains 5 mm. Number of segments 23-30.

Prostomium more or less rounded.

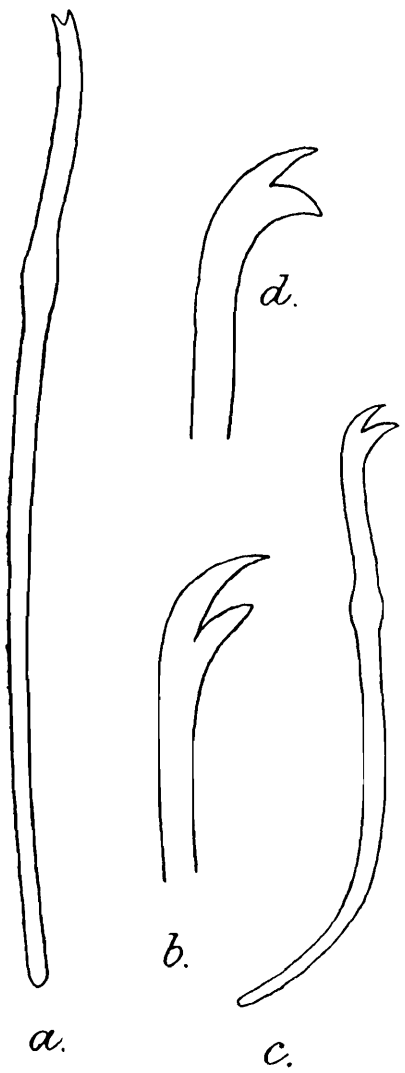
The dorsal setae begin in segment VI and consist of one needle and one hair seta per bundle. The shaft of the needle (text-fig. 16*a*) is straight with an indistinct distal nodulus beyond which is a slight sickle-shaped curve. The tip is bifid and the prongs minute. The hair seta is smooth, without ornamentation.

The ventral setae of segments II-V are longer and less curved than those of the succeeding segments. The outer prong (text-fig. 16 *b*), which has about the same thickness at the base as the inner, is longer than it and the nodulus is proximal (dist. : prox. : : 28 : 17). The number per bundle is four.

The ventral setae from segment VI onwards have the nodulus distal (dist. : prox. : : 17 : 23) and the prongs are equal in length (text-fig. 16*c*, *d*).

Lengths of setae—

No. of segments	II to V	VI	XII
Needles	..	45·5	48
Hair setae	..	108·0	118
Ventral crotchets	81–84	52–54	52–58



Text-fig. 16.—*Dero niveum*: *a.*, dorsal needle × *ca.* 3000; *b.*, distal end of ventral seta of segment III; *c.*, ventral seta of segment VI, × *ca.* 1860; *d.*, distal end of the same, more magnified.

The branchial region (text-fig. 17 *a*, *b*) is conspicuous.

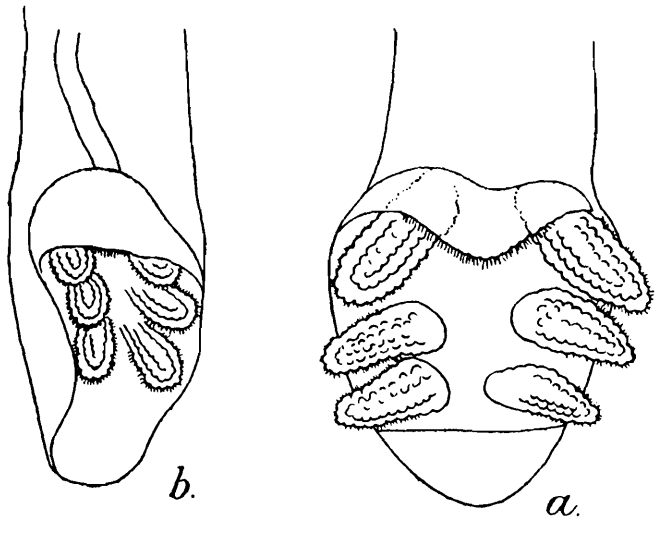
The fossa is prolonged anteriorly into a pouch or diverticulum above the terminal portion of the intestine as in *D. zeylanica*. The ventro-posterior border of the fossa is rounded and the dorso-anterior margin is either straight or produced into a median triangular lobe. There are three pairs of true gills. The most anterior of these originate from the diverticulum into which they can be completely withdrawn when the fossa is closed. The second and third pairs spring from the floor of the fossa.

Internal anatomy.—Chloragogen cells begin in segment VI. There is a stomachal dilatation in segment VIII. There are no coelomic corpuscles. The first nephridium is in segment VIII.

The dorsal vessel occupies the usual position on the ventral side of the alimentary canal to the left of the middle line. There are three pairs of contractile vascular loops in segments VI, VII, and VIII; the loops in VII are much stouter than the other two.

The brain is indented both in front and behind.

Asexual reproduction was observed in eleven specimens, the value of η was 14



Text-fig. 17.—*Dero niveum*: Branchial region. *a.*, gills expanded (diagrammatic); *b.*, gills (preserved specimen).

in one specimen, 15 in one, 16 in 8 specimens and 17 in one. Sexual organs were not present in any of the specimens.

Note on the genus *Dero*.

As a result of the discovery of four new species since the "Fauna" volume by Stephenson (20) was published, the diagnosis of the genus as stated by him has to be slightly altered as follows :—

"Prostomium well marked, rounded. No eyes. Ventral bundles of segments II-IV or II-V longer than the others. Dorsal bundles beginning in IV, V or VI with hair setae and needles. The needles may be bifid, *pectinate* or *palmate*. Hinder end with branchial fossa, with gills but no palps. Genital organs in general resemble those of *Nais*; sperm sac single; its hinder end encloses the ovisac; spermathecae in V *may enter sperm sac*. Alimentary canal degenerates in the fully mature (sexual) animal."

The chief diagnostic characters of the Indian species of the genus may be stated as follows :—

1. *Dero zeylanica* Steph.
   Dorsal setae begin in VI, 3 bifid needles and 3 hairs per bundle in anterior segments. Four pairs of true gills. Stomach in IX and X. Vascular loops, four pairs in VI-IX. η= 31-33, usually 32.
2. *Dero limosa* Leidy.
   Dorsal setae begin in VI, 1 bifid needle and 1 hair seta per bundle. 2, 3 or 4 pairs of true gills and 1 pair of secondary gills. Stomach in IX-X. Four pairs of vascular loops in VI-IX. η=19-24.
3. *Dero austrina* Steph.
   Dorsal setae begin in IV, 1 bifid needle and 1 hair seta per bundle. 4 pairs of true gills and 1 pair of secondary gills. Stomach in X-XII. Vascular loops in V-XIV η=34-53.
4. *Dero pectinata*, sp. nov.
   Dorsal setae begin in VI, one pectinate (trifid) needle and one plumose hair per bundle. Two pairs of true gills, rounded and knob-like. Stomach in VIII. Two pairs of vascular loops in VI-VII. η=14 or 15.
5. *Dero palmata*, sp. nov.
   Dorsal setae begin in VI, one palmate needle and one hair seta per bundle. Three pairs of true gills. Stomach in VIII. Three pairs of vascular loops in VI-VIII. η=14 or 15.
6. *Dero niveum*, sp. nov.
   Dorsal setae begin in VI, one bifid needle and one hair seta per bundle. Three pairs of true gills. Stomach in VIII. Three pairs of vascular loops in VI-VIII. η=14-17 (usually 16).

Key to the Indian species of Dero.

1. Dorsal setae begin in segment IV	*D. austrina.*
Dorsal setae begin in VI	2
2. Dorsal needles palmate	*D. palmata.*
Dorsal needles pectinate	*D. pectinata.*
Dorsal needles bifid	3
3. Dorsal bundles of 3 needles and 3 hairs	*D. zeylanica.*
Dorsal bundles of one needle and one hair	4
4. Stomach in VIII; η=14-17	*D. niveum.*
Stomach in IX or IX-X; η=19-24	*D. limosa.*

Genus **Aulophorus** Schmarda.

Aulophorus furcatus (Oken).

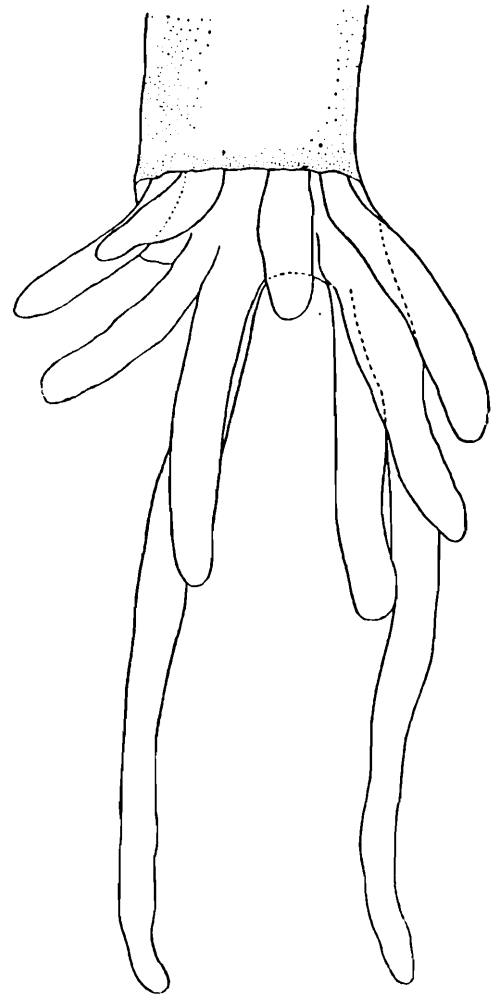
Tanks in Trivandrum. Collected on several occasions.

The specimens that occur here have three pairs of true gills only. No accessary gills are present.

Aulophorus michaelseni Steph.

Trivandrum. December, 1925. A few specimens.

The palps vary in length from 332-840μ.
η=28 (in four specimens).



Text-fig. 18.—*Aulophorus michaelseni :* Hinder end (preserved specimen).

The first nephridium is in segment XI.
Four pairs of vascular loops in segments VI-IX.

Family Tubificidae.

Genus **Aulodrilus** Bretscher.

Aulodrilus trivandranus Aiyer.

Nagercoil. 16-IV-1927. Numerous specimens, three sexual.

Family ENCHYTRAEIDAE.

Genus **Enchytraeus** Henle.

Enchytraeus barkudensis Steph.

Kovilam, 7 miles south of Trivandrum. From wet sand by the side of a rock, occasionally washed by the tide. Four specimens, one fully mature. The specimens occurred along with *Pontodrilus bermudensis*

Family MONILIGASTRIDAE.

Genus **Moniligaster** E. Perr.

Moniligaster deshayesi E. Perr.

(Plate I, figs. 5, 6, 7, 8 9.)

Tenmalai, Travancore. 11-IX-26; 15-X-26; 5-VII-27. Four specimens, one sexually mature.

Two of the specimens were found gliding along the roadside during the rains and two others were dug up from the ground. I add a few notes on certain features of these specimens with an account of the glands surrounding the vas deferens in this species.

External characters.—The length varies between 140 and 150 mm. Diameter 6 mm. Number of segments 136-156. There is no secondary annulation. Colour during life, an iridescent dark blue dorsally, somewhat lighter ventrally. There is a broad greyish band along each side of the body. The two lateral bands extend ventralwards and fuse in front of segment XIII so that the ventral side of the anterior part of the body is of the same colour as the bands themselves.

The setae are absent in segment II. Both ventral and lateral setae are present from segment III backwards. The lateral setae of each side are in the middle of the lateral band mentioned above. The setal interval *aa* is only very slightly less than *bc*, and *dd* is exactly half the circumference.

The clitellum was fully developed and well marked in one specimen. It extends over segments X-XIII (=4). The intersegmental grooves are intact. The male pores in $\frac{10}{11}$ are midway between *b* and *c*. The female pores are in $\frac{11}{12}$ in *ab*. The spermathecal apertures are in $\frac{7}{8}$ in *cd*.

Internal anatomy.—The gizzards are five in number, in XV-XIX, in all the four specimens. The testis sacs, suspended from septum 9/10, are confined to segment X, except in the case of the single mature specimen in which the anterior third of the left sac projects into segment IX and is slightly constricted by the septum. The sacs are oval or rounded bags with the posterior part distinctly rounded. The sacs are filled with a loose spongy tissue composed of cells with narrow elongate nuclei and with different stages of the developing sperms. A mass of ripened spermatozoa is seen at the mouth of the funnel (Plate I, fig. 5).

The funnel, which is fused with the wall of the sac, is situated at the anterior side close to the testis, and is 500μ in width at its broadest part. It is made up of a single layer of columnar ciliated cells.

The testis, composed of 5 or 6 lobes, is suspended from the anterior wall of the testis sac, close to the funnel. (In plate I, fig. 5 a small part of a testis lobe is seen on the left of the funnel.)

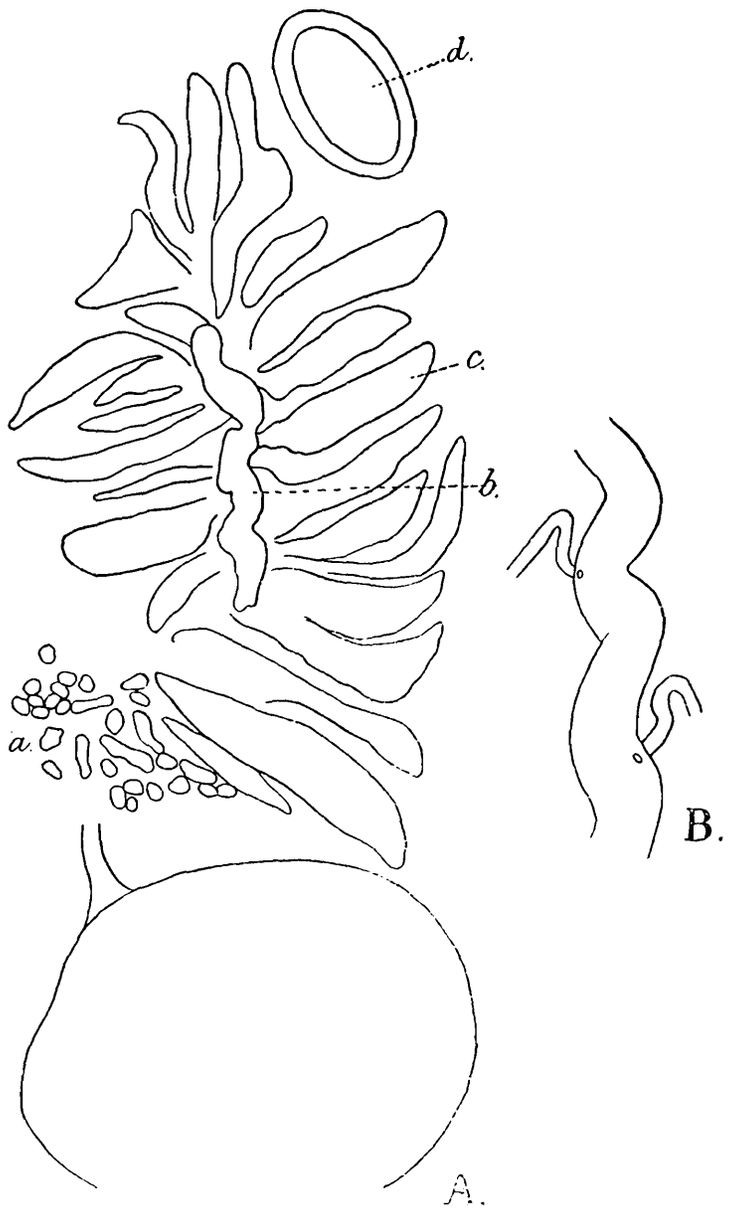
The vas deferens at its beginning is about 50μ in diameter and the epithelium is strongly ciliated. The tube soon gets convoluted and the numerous coils are massed together into one or sometimes into two bunches (Plate I. fig. 6) on the ventral side of the anterior part of the testis sac. Attached by membrane to the anterior side of the testis sac is a cluster of leaf-like bodies (Plate I, fig. 7): this structure is dealt with in detail below. The vas deferens enters this cluster and emerges from its anterior end as a wide tube, about 150μ in diameter. It now passes into segment IX, curves round the ventral limb of the heart in this segment and passing ventrally to it returns to segment X, runs backwards along the side of the long prostate, and enters it near its ental end (Plate I, fig. 6).

The leaf-like bodies referred to above are, I believe, a feature not only of the present specimens but of the species. Perrier, who described this species more than 50 years ago, appears to have noticed this structure. As I am unable to consult Perrier's original account and figures of this worm, I quote below the following from Beddard's monograph. " The sperm duct is figured and described by Perrier as possessing a quantity of little leaf-like bodies attached to it." Beddard, however, summarily disposes of Perrier's observation with the remark " these can be nothing else than the folds of the sperm duct, which in this, as in other species of the genus, is extremely convolute."

Michaelsen, who has recorded the occurrence of this species in Travancore, does not in his account (8) make any mention of these bodies. Stephenson records the species from two localities in the Cochin State (20) and later in 1926 from Courtallum, Tinnevelly District, about 15 miles north of Tenmalai, where my specimens were obtained. He too appears to have overlooked the structure. In his notes on the specimen from Courtallum (24) Stephenson says " The anterior portion of the testis sac is much cut up, while the posterior portion constitutes a rounded bag." The leaf-like bodies which in mature specimens are of the same pale flesh colour as the testis sac are compactly arranged at the anterior end of the sac, the outer ones slightly overlapping the inner. I suspect that Stephenson has mistaken the cluster of appendages as a part of the testis sac itself and has referred to it as " the much cut up anterior portion of the testis sac."

Each body is broad and leaf-like, thicker at the base than at the free margin and is made up entirely of an extremely convoluted fine tubule (Plate I, figs. 8 and 9), the convolutions of which are pressed together into a plate-like body. The tubule is about 25μ in diameter and is non-ciliated. The basal parts of the bodies are in contact and consequently in dissections a ' fleshy ' central core is seen in the cluster. The vas deferens on entering this cluster becomes wider and non-ciliated, and taking a slightly wavy course through the ' fleshy ' core emerges from it at its anterior end. The vas deferens is thus surrounded by these leaf-like bodies.

By simple teasing under the dissecting binocular it is seen that each leaf-like body (each mass of tubules) opens into the vas deferens by a short duct. Text-fig. 19-B shows a small portion of the vas deferens with two such ducts opening into it.



TEXT-FIG. 19.—*Moniligaster deshayesi* : A., Longitudinal section of testis sac and glands ; *a.*, *b.*, vas deferens ; *c.*, glands ; *d.*, heart. B., portion of vas deferens with ducts of glands entering it.

These bodies are highly vascular, being supplied by a branch of the intestinal commissure in segment X. Both transverse and longitudinal series of sections of the testis sac with the attached appendages were prepared, and the points made out by means of dissection were fully confirmed. There is no doubt that these bodies are glands discharging their secretion into the vas deferens. The nature of the secretion is worth investigation since this species appears to stand unique not only among the Moniligastridae but among the order Oligochaeta in the possession of such glands in connection with the male genital duct.

The atrial glands are contained in segment VII close to septum 7/8. Each is composed of two distinct portions, one of which is anteriorly situated and is more or less hemispherical in shape and reaching only to less than half the height of the other. The latter is oval with the ental portion broad and rounded. Each part has its own muscular duct. The ducts of the two parts join in a Y-like manner to form a common duct. The spermathecal duct opens into this common duct just where the latter is formed.

Genus **Drawida** Mich.

Drawida barwelli (Bedd.) var. **impertusa** Steph.

(Plate II, figs. 10, 11, 12, 13.)

Thiruvella, from the edge of a tank. 15-XI-26. Six specimens.
Vandiperiyar, from the edge of a streamlet. 24-XII-26. Eight specimens.

As the variety has till now been recorded only from Bombay I add an account of the present specimens from Travancore.

External characters.—Length 58-65 mm., diameter 2·5-3 mm. Number of segments 136-140. The colour of this worm during life is chocolate, the ventral side being paler than the dorsal. The body wall is thin and some of the internal organs such as the testis sacs, ovary and the dorsal blood vessel are just visible through it.

Dorsal pores are absent.

The setae are very closely paired. In the middle of the body *aa* is equal to *bc* and *dd* is slightly greater than half the circumference. Setae are present in segment II.

The clitellum is of a pale brick-red colour in preserved specimens and extends over segments X-XIII. The segments are swollen but the intersegmental grooves are not obliterated.

The male pores are in furrow $\frac{10}{11}$, midway between the lines of setae *b* and *c*. The pores are situated in transversely elongated oval whitish papillae (Plate II, fig. 10) separated by an interval equal to the length of a papilla. Each papilla is broad on the outer side and narrow on the inner side and extends from the line of setae *d* to the line of setae *a*. The groove $\frac{10}{11}$ cuts through the middle of each papilla and divides it into two equal halves. The minute male pore itself is surrounded by a circular puckered lip. On segment X are a pair of ovoid papillae, each extending from the anterior margin of the male papilla to furrow $\frac{9}{10}$. The longitudinal axis of each of these papillae is slightly raised into a whitish ridge. The female pores are in $\frac{11}{12}$ in *ab*. The spermathecal apertures are in $\frac{7}{8}$ in *cd*.

Internal anatomy.—In three specimens dissected from the batch from Thiruvella there are only three gizzards, in segments XIII-XV The specimens from Vandiperiyar have four gizzards, in segments XIV-XVII. The gizzards are separated by vascular thin-walled intervals.

The testis sacs are ovoid, pear-shaped or irregular. The anterior half of each sac may project into segment IX or only very little.

The prostate (Plate II, fig. 13) is flattened and circular and is sessile on the parietes. It is covered with a layer of finely granulated gland

cells. The vas deferens enters it on its anterior border a little internal to its longitudinal axis.

A completely closed ovarian chamber is formed by the approximation of septa 10/11 and 11/12. The ovary was so well developed in one specimen that the mid-dorsal portion of the chamber was considerably swollen and projected into segment X in front and extended backwards into segment XII. The ovisacs are confined to segment XII or may extend into XIII.

The spermathecal ampulla (Plate II, fig. 11) in segment VIII is ovoid and of a chalky white colour. The duct, after much coiling behind septum 7/8, passes down it to open to the outside in furrow $\frac{7}{8}$. The duct gets slightly thickened at its ectal end (Plate II, fig. 12).

There is no atrium.

Drawida ghatensis Mich.

Mukkunni Reserve Forest. 7-IX-22; 26-XI-22; 1-VII-26. Ten specimens.
Thiruvella. 15-XI-26. Three specimens.

On the first occasion when the specimens were collected the ground was perfectly dry and the worms lay in the hard soil under granite blocks nicely coiled up in little hollows lined by mucus. When the granite stone is lifted and the worm in the hollow is disturbed, it jumps out and runs on the dry ground like a snake with an agility that is astonishing for an earthworm. Though there is not much of the slimy secretion on the body a specimen caught in the hand manages to slip out with remarkable ease. The colour during life is an iridescent blue on the dorsal side and pale grey ventrally.

Internal anatomy.—The gizzards are five in number, in segments VI-XX in the specimens taken from Mukkunni, while they are in segments XIV-XVIII in the batch from Thiruvella.

The atrium differs in the two batches of specimens. In the lot from Mukkunni the atrium is bilobed, the lobes placed one behind the other. The ectal half of the atrium is embedded in the body wall. The shiny spermathecal duct enters the atrium on its inner side (side facing the gut), a little below the depression between the lobes. The cavity of the atrium is also bilobed. In the specimens from Thiruvella the atrium is a teat-like sac with a long narrow U-shaped cavity. The basal third of the atrium is embedded in the parietes. The spermathecal duct joins the atrium on its inner side and enters it close to the body wall.

Drawida pellucida (Bourne) f. **typica.**

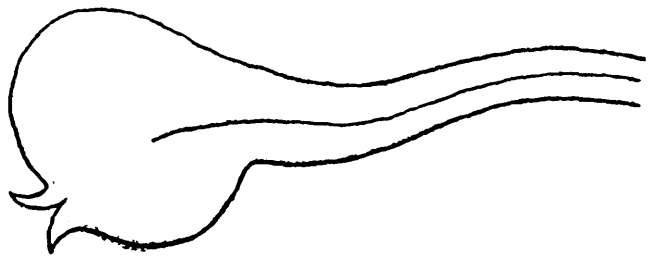
Ponmudi, 3,000 ft. September, 1922. A few specimens.

External characters.—Length 75-95 mm. Diameter 4 mm. Number of segments 145-155. The dorsal side of the worm (a fourth of the circumference) is light dark brown; the ventral and ventro-lateral sides up to *d* are of the same colour as the dorsal side. There is a pale grey band on each side extending from *d* to the lower edge of the dorsal brown area.

The prostomium is prolobous.

Setae are present in II.

The male pores are narrow longitudinal slits in $\frac{10}{11}$, rather nearer *c* than midway between *b* and *c*.



TEXT-FIG. 20.—*Drawida pellucida* f. *typica* : Atrium.

The spermathecal pores are in line with *c*.

Internal anatomy.—The gizzards are five in number in XIV-XVIII or XV-XIX or XVI-XX.

The testis sacs are confined to segment X, suspended by septum 9/10, by a narrow neck.

The atrium in segment VII is a small simple rounded dilatation of the end of the spermathecal duct and is embedded in the parietes close to septum 7/8.

Remarks.—The present specimens appear to me to be identical with the type-form of the species since the male pores are between *b* and *c* and an atrium is present. They differ from the type in the presence of setae in segment II and in the male pores being nearer *c*. But these points by themselves may not be sufficient to rank them as a new variety.

Drawida travancorensis Mich.

Tenmalai, from the edge of river. 11-IX-26. Eight specimens.
Vembayam. 5-XII-26. Five specimens, three sexual.

I add a few notes on certain features of the present specimens.

Length 90-140 mm. Diameter 3·5-4 mm. Number of segments 132-186. Colour during life dark grey above, paler ventrally.

The prostomium is prolobous, long and conical. It gets considerably retracted when the worms are killed.

The male pores are narrow, transversely elongated slits, in $\frac{10}{11}$ about midway between *b* and *c*. The pores are bordered in front and behind by a thickened glandular lip the margin of which is much cut up.

The female pores are minute in $\frac{11}{12}$ in line with *b*.

Internal anatomy.—The gizzards are two in number in segments XIII-XIV, that in XIV being much larger and almost spherical.

The testis sacs in three of the four specimens dissected project into both IX and X and are not constricted by the septum. In the fourth specimen one sac projects slightly into segment IX and the other extends backwards a little beyond the ovarian chamber.

The prostates are pear-shaped with a ' furry ' surface. The ectal end of the prostate is rounded and fits into a cup-shaped depression in the body wall. Strong muscle bands run transversely across the parietes in this region. The vas deferens enters the prostate a little below its ental end.

The atrium in segment VII has the shape of an inverted flask, the neck being half as wide as the rounded body. The spermathecal duct enters the atrium at its ectal end. In one specimen, while the right atrium was of the usual shape, the left was bilobed in the longitudinal direction, the septum 7/8 cutting the atrial sac into two halves.

Drawida circumpapillatus, sp. nov.

(Plate II, figs. 14, 15.)

Nedumangad. 10-IX-26. Four specimens, two of which were sexual.
Vembayam. 5-XII-26. Four specimens, three sexual.

External characters.—The length varies between 40 and 45 mm. Diameter of body 1·5 mm. Number of segments 128-148.

The prostomium is prominent during life and is prolobous. It gets very much contracted on killing the worms and is seen in preserved specimens as a small lobe under the first segment.

Dorsal pores are absent.

The setae are small and very closely paired. In the middle of the body *aa* is equal to or very slightly less than *bc*, and *dd* is half the circumference. Setae are present on segment II.

The clitellum is well marked and extends over segments X-XIII. This region is conspicuously swollen and is of a much paler colour than the rest of the body. The male pores are in furrow $\frac{10}{11}$ in *ab*, each being situated on a minute conical elevation in the centre of a large neatly circular papilla (Plate II, fig. 14). The papillae in some specimens almost touch each other in the mid-ventral line and in others are separated only by a narrow interval Each papilla extends outwards to about half *bc* and anteriorly and posteriorly as far as the setal zones of the 10th and 11th segments respectively. The papillae have a narrow whitish border and in some specimens the outer edge stands out from the body wall and not touching it.

The female apertures are not distinguishable.

The spermathecal pores are in furrow $\frac{7}{8}$ in *ab*.

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

The gizzards are three in number in segments XII-XIV or XIII-XV; none being very large.

The last hearts are in segment IX.

The excretory system is meganephridial.

The testis sacs are large ovoid sacs, yellowish in colour, in segment X, not projecting or only slightly into segment IX; in the latter case, not constricted by the septum. The anterior portion of the vas deferens lies on the anterior face of septum 9/10 in segment IX, where it twines round the heart once or twice.

The prostates are in segment X. They are whitish in colour, short, cylindrical and slightly curved (Plate II, fig. 15). The surface is 'furry' or papillose, being densely covered with large, finely granulated gland cells. The vas deferens enters the prostate on its anterior side near the ectal end.

A conspicuous ovarian chamber is formed by septa 10/11 and 11/12.

The ovisacs are yellowish in colour and very long and extend backwards through eight or ten segments. They present a beaded appearance being strongly constricted by the septa. The hinder end is dilated in some specimens.

The spermathecal ampulla is an almost spherical sac in segment VIII. The atrium in segment VII is an ovoid sac, the basal part of which is half as wide as the upper part. The duct opens into the atrium at its ectal end.

Remarks.—The present form shows resemblances to *D. annandalei* Steph. and *D. ramnadana* Mich. in several respects but the large circular papillae in 10/11 are quite distinctive of this species.

Family Megascolecidae.

Sub-family *Megascolecinae.*

Genus **Plutellus** E. Perr.

Plutellus variabilis, sp. nov.

(Plate II, figs. 16, 17.)

Tenmalai, from wet mud along with *Glyphidrilus.* 11-IX-26. A number of specimens, about a dozen sexual.
Vembayam, September, 1926. A number of sexual specimens.
Peermade, 4,000 ft. 23-XII-26. Three mature specimens.
Kumily, 2,500 ft. 26-XII-26. Five specimens, all sexual.
Kottayam. From *bunds* in paddy fields. 27-XII-26. A number of sexual specimens.

External characters.—Length 50-65 mm. Diameter 1-1·5 mm.
Number of segments 82-96.
Colour during life, pale red.
Prostomium epilobous $\frac{1}{2}$-$\frac{2}{3}$.
Dorsal pores begin in $\frac{9}{10}$.

The setae are widely paired. In segment VIII $ab=\frac{1}{2}aa=\frac{1}{2}bc=\frac{3}{4}cd$; behind clitellum $ab=\frac{1}{4}aa=\frac{1}{3}bc=\frac{1}{2}cd$; in the middle of the body $ab=\frac{1}{3}aa=\frac{1}{3}bc=\frac{3}{4}cd$. While *cd* remains constant throughout, *aa* becomes wider behind the clitellum and *bc* becomes wider about the middle of the body. *dd* which is $\frac{1}{4}$ of the circumference in the anterior segments becomes reduced to about one-seventh of the circumference in the middle of the body. Setae are sometimes absent on segment II.

The clitellum is smooth and ring-shaped and includes segments XIV-XVII (=4). Dorsal pores and setae are visible on the clitellum. The male pores are on transversely elongated papillae (Plate II, fig. 16) in the line of setae *b* in the setal zone of segment XVIII. Each papilla extends beyond the lines of setae *a* and *b* and is separated from the other by a short interval. Running along the middle of each papilla is a transverse groove.

The female pores are paired, very minute, in front of the setal zone of segment XIV.

The spermathecal apertures, when present, are either one pair in the setal zone of segment VIII in the position of *b*, or only one (on the right

side only). Both the setae *b* are absent in this segment when both spermathecae are present; seta *b* of one side is absent when only one spermatheca is present; both setae are present in specimens in which spermathecae are not developed.

Internal anatomy.—Septa 6/7–9/10 are thickened, 10/11–12/13 moderately so.

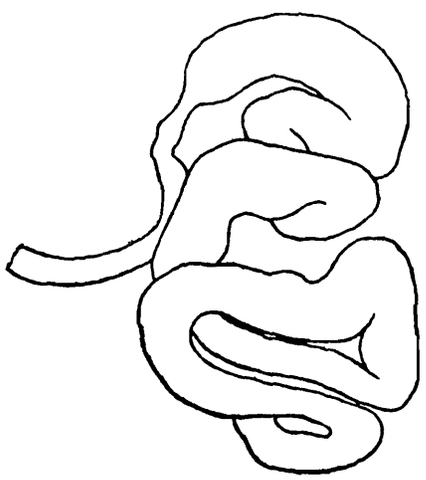
The gizzard in segment VI is rectangular in shape and slightly flattened dorso-ventrally. The intestine begins in segment XIX. There are no calciferous glands. The oesophageal swellings in segments VIII-XIV (rarely in XV and XVI also) are richly supplied with blood vessels, which are seen as numerous transverse striations.

The last heart is in XIII.

The excretory system is meganephridial, one pair per segment. The loops are not transverse but longitudinal and the nephridiopores are in the line of *b*.

The testes and funnels are free in segments X and XI. The seminal vesicles are two pairs in segments XI and XII, racemose.

The prostates are long and tubular with a few windings and occupy segments XVIII and XIX and sometimes project slightly into segment XVII. The duct is short and less than half as wide as the glandular part. It describes a bow-shaped loop with the concavity facing forwards and opens to the outside,



TEXT-FIG. 21.—*Plutellus variabilis*: Prostate.

There are no penial setae.

The ovaries, ovarian funnels and ducts occupy the usual position in segment XIII.

The spermathecae (Plate II, fig. 17) are one pair in segment VIII or a single one (on the right side only) or absent altogether. I give below a table showing the number of specimens dissected and the conditions observed :—

Locality.	No. of specimens dissected.	No. with one spermatheca only.	No. with one pair of spermathecae.	No. without spermathecae.
Tenmalai	11	2	3	6
Kumily	5	0	2	3
Kottayam	5	0	5	0
Peermade	3	1	0	2
Vembayam	6	1	0	5
TOTAL	30	4	10	16

Of the 30 specimens dissected, 16 had no spermathecae, 4 had only one spermatheca and 10 had one pair. These results appear to indicate that the species is undergoing reduction in the number of spermathecae.

The ampulla is roughly oval. The duct, which is distinctly marked off, is about as long as the ampulla and one-third as wide as it. The single diverticulum is pear-shaped and arises from the lower end of the ampulla.

Remarks.—The present form appears to be related to *P. timidus* Cogn. recorded from Travancore. It differs, however, from Cognetti's species in several important respects such as the presence of a spermathecal diverticulum, the position of the spermathecal apertures, the presence of two pairs of seminal vesicles, and the configuration of the male field.

Genus **Pontodrilus** E. Perr.

Pontodrilus bermudensis Bedd.

Kovilam, 8 miles N. of Trivandrum. April, 1927. Six specimens. Numerous specimens of this species were collected by me from Krusadi Island, Pamben, in February 1927.

In the specimens from Kovilam the intestine begins in segment XIV ; in the batch from Krusadi it begins in XV or XVI.

Nephridia begin in segment XIII. They are absent in segment XIV in the specimens from both localities.

Genus **Woodwardiella** Steph.

Woodwardiella kayankulamensis, sp. nov.

(Plate II, figs. 18, 19, 20, 21, 22.)

Kayankulam, Travancore. November, 1926. One dozen specimens, sexually mature.

External characters.—Length 65 mm. Diameter 1-1·5 mm. Number of segments 110-120. Colour of preserved specimen pale-yellow.

Prostomium epilobous $\frac{1}{2}$, the sides converge backwards and meet forming a V

The dorsal pores begin in furrow $\frac{6}{7}$.

The setae are widely paired, the lateral setae very much so. In front of the clitellum $ab = \frac{1}{3}aa = \frac{1}{2}bc = \frac{1}{2}ed$; in the middle of the body $ab = \frac{3}{5}aa = \frac{1}{2}bc = \frac{1}{2}cd$. dd is slightly less than one-third of the circumference in front of the clitellum and about one-seventh of the circumference in the middle of the body.

The clitellum is smooth and ring-shaped and includes segments XIV-XVII (=4), sometimes extending anteriorly over the posterior third or half of segment XIII. Dorsal pores are present on the clitellum and setae are visible.

The male pores are on small tubercle-like papillae on segment XVIII in line with setae *a*. There are no copulatory papillae. The female apertures are in the setal zone of segment XIV in the interval *aa*.

The spermathecal pores are two pairs, in grooves $\frac{7}{8}$ and $\frac{8}{9}$, between the lines of setae *a* and *b*.

Internal anatomy.—The first septum is 5/6. Septa 5/6–8/9 are thickened, and 9/10–11/12 are moderately so.

The gizzard in segment V is short, almost rounded and not very muscular. There are no calciferous glands. The oesophagus is very vascular in segments VIII-XIII (sometimes in XIV and XV also). The intestine begins in XVII.

The last heart is in segment XIII.

The nephridia are one pair per segment throughout the body. In segments V-XXII the nephridia are ' tufts ', large and bushy in V-VI, small and inconspicuous in VII-XIII, large again and flattened in XIV-XXII. From segment XXII onwards the nephridia are small but conspicuously situated with only a few loops lying longitudinally in the line of setae *b*.

The testes and funnels are free, in segments X and XI. The testes are broad, thin and plate-like, attached to the posterior face of septa 9/10 and 10/11.

The seminal vesicles are situated in segments XI and XII. They are flat and tongue-like with the margin deeply cut up.

The prostates (Plate II, fig. 19) are broad, flattened and lobulated and occupy segments XVIII-XIX. The duct is short and passes transversely inwards to open to the outside. The ectal portion of the duct is dilated.

A single penial setal sac (enclosing two penial setae) is attached to the ectal end of each prostatic duct (Plate II, fig. 20).

The penial setae are slightly bow-shaped and 270-338μ long and 9μ thick at the middle. The distal fifth, which projects out of the sac, is ornamented with a few very minute spines (Plate II, figs. 21, 22). The tip is sharply pointed and is often drawn out into a fine needle.

The ovaries are broad, thin and fan-like in segment XIII. There are a pair of ovisacs in segment XIV

The spermathecae (Plate II, fig. 18) are two pairs in segments VIII and IX. The ampulla is oval and the duct, which is sharply marked off, is half as long as it. There is a single diverticulum, two-fifths as long as the ampulla and cylindrical in shape, opening into the duct a little below its ental end.

Remarks.—The nephridial condition in the present form appears to be similar to that in *Woodwardiella bahli* (23).

Genus **Megascolides** McCoy.

Megascolides chengannures, sp. nov.

(Plate II, figs. 23, 24.)

Chengannur. 28-VIII-26. Four specimens, two sexual.
Chengannur. 14-XI-26. Twelve specimens, none sexual.

External characters.—Length 120 mm. Diameter 3 mm. Number of segments 230. The body behind the clitellum is butter coloured during life due to the large quantity of mucus present in this region. The anterior segments are pale red.

Prostomium (?).

Segments VII and VIII are biannular. Segments IX-XIII and the post clitellar segments are triannular. The first dorsal pore is in $\frac{11}{12}$.

The setae are all ventrally situated and are distinctly paired from segment XII. The setae of segments II-VII are stouter than those behind. The relative size of the setal intervals may be expressed as follows :—

In Segment VIII $ab=\frac{2}{5}aa=\frac{2}{3}bc=\frac{2}{3}cd$.
In Segment XIII $ab=\frac{2}{5}aa=\frac{1}{2}bc=cd$.
Behind the clitellum and in middle of body $ab=\frac{1}{4}aa=\frac{1}{2}bc=\frac{3}{4}cd$.

Behind the clitellum the ventral break gets wider and the setae get more closely paired.

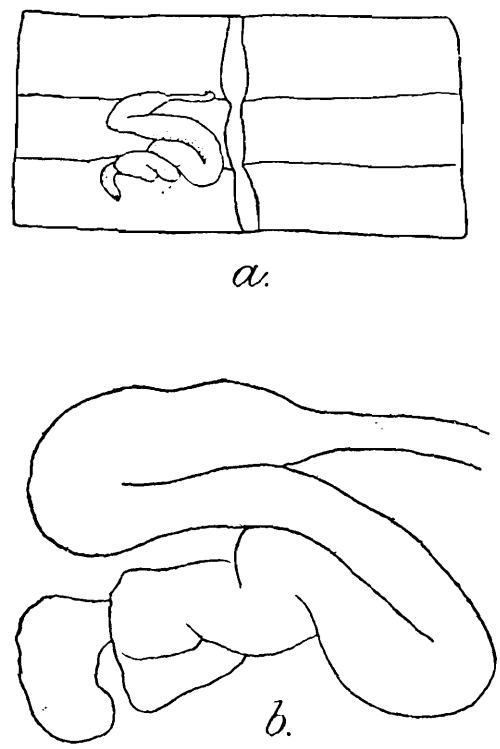
The clitellum is smooth and ring-shaped and extends over segments XIV-XVIII (=5).

On segment XVIII there is a median longitudinal depression that passes anteriorly into segment XVII and expands into a large transverse depression which extends a little beyond the setal zone. Posteriorly the median depression is confluent with a narrow transverse depression occupying the anterior third of segment XIX.

On either side of the median depression in segment XVIII is a papilla with a rounded inner border. The male pores are situated on these papillae in line with setae *a*.

The female pores are paired in a transversely oval narrow whitish area in the setal zone of segment XIV

The spermathecal apertures are two pairs on minute tubercle-like papillae in $\frac{7}{8}$ and $\frac{8}{9}$ in line with setae *a*.



Text-fig. 22.—*Megascolides chengannures* : Prostate. *a.*, showing position of prostate in the segment ; *b.*, prostate, magnified.

Internal anatomy.—Septum 5/6 is thin ; 6/7-12/13 are thickened.

The gizzard in segment V is almost spherical. There are four pairs of calciferous glands in segments X-XIII. The glands are ovoid,

flattened and lamellated internally. The intestine begins in XV. The typhlosole is present as a conspicuous median ridge.

The last heart is in segment XIII.

In the preclitellar region the nephridia are large tufts', one pair per segment at the sides of the oesophagus. From segment XIV onwards a large number of small micronephridia are arranged in each segment in a single transverse row close to the septum. There are no integumental nephridia in any part of the body.

Testes and funnels are free in segments X and XI. Seminal vesicles are two pairs in segments XI and XII, large and racemose.

Prostates are tubular and consist of a few adpressed coils which occupy segments XVIII and XIX. The duct is short, very thin and not shiny. It passes straight inwards to open to the outside.

The spermathecae are two pairs in segments VIII and IX. They are long, simple, club-shaped sacs. The ampulla and the duct are not marked off though the swollen distal third of the sac is twice as wide as the long tubular proximal part. There is no diverticulum.

There are no penial setae.

Remarks.—The present species, which appears to be closely related to *M. pilatus*, is distinguished from it chiefly by the absence of penial setae and integumental nephridia.

Genus **Notoscolex** Fletcher.

Notoscolex tenmalai (Mich.) var. **ghatensis,** nov.

(Plate II, figs. 25, 26.)

Tenmalai, Travancore. 9-X-1926. Seven specimens, all sexually mature.

External characters.—The largest specimen in the collection was 135 mm. long and had 315 segments.

The prostomium is proepilobous.

Dorsal pores begin in furrow $\frac{5}{6}$.

The setae are paired, *ab* more closely than *cd*. The relative size of the setal intervals may be expressed as follows :—

In front of the clitellum $ab = \frac{1}{3}aa = \frac{1}{3}bc = \frac{1}{2}cd$.
Behind the clitellum $ab = \frac{3}{8}aa = \frac{1}{2}bc = \frac{2}{3}cd$.

dd is slightly less than half the circumference in front of the clitellum and one-third of the circumference behind it.

The clitellum is smooth and ring-shaped and includes $\frac{1}{3}$ XIII-XVI ($=3\frac{1}{3}$). Dorsal pores are absent on the clitellum.

The male field is a rectangular area extending from the setae of segment XVII to the end of segment XVIII. The area is composed of two cushions separated by a median depressed interval (Plate II, fig. 25). The outer margin of each cushion is straight and the inner border is bow-shaped, convex to the middle line. Running along each cushion, parallel to its inner border, is a narrow longitudinal groove. The male pores are situated a little to the outer side of the posterior end of the longitudinal groove, in line with setae *b*. The pores are made out by treating the body wall with a weak solution of caustic potash. Setae *a* and *b* are absent on segment XVIII.

The female pore may be single or paired, in a small transversely elongated area in the setal zone of segment XIV

The spermathecal apertures are narrow transverse slits in $\frac{7}{8}$ and $\frac{8}{9}$ in line with setae *a*. Setae *a* of segment VIII are absent.

Internal anatomy.—Septum 5/6 is very thin ; 6/7-8/9 are greatly thickened, 9/10-10/11 less so.

The gizzard is in segment V, strongly developed and rectangular. There are no calciferous glands. The oesophagus is segmentally swollen in VII-XIV and very vascular. The intestine begins in XVI.

The last heart is in XIII.

The excretory system is micronephridial. Large tufted nephridia, one pair per segment, are present in the clitellar and preclitellar segments. From segment XX onwards there are, in each segment, a small number (5-7 on each side) of micronephridia.

The testes and funnels are free in segments X and XI. The vesiculae seminales are two pairs in XI and XII, long conical bags with a wavy margin.

The prostates are long, flattened, much lobulated glands, occupying segments XVIII-XXIV (7 segments). The short duct proceeds transversely inwards and opens to the outside.

There are no penial setae.

The spermathecae (Plate II, fig. 26) are two pairs in segments VIII and IX. The ampulla is oval and hangs down from the upper end of the duct. The duct is distinctly marked off and is more than one-and-a-half times as long as the ampulla. A single club-shaped diverticulum, one-third as long as the duct, arises from it a little above its ectal end. Glandular appendages are absent.

Remarks.—The present form differs from the type form *N tenmalai* in the setal intervals, the smaller extent of the clitellum, the position of the gizzard and the intestine, the form of the spermathecae and the absence of glandular appendages round them, and in the configuration of the male field. As the present specimens were collected from the same locality as Michaelsen's specimens, I was at first tempted to regard them as identical with the type form, but the differences enumerated above are so distinct that the present form should be ranked as a variety. I have noted that slight variations may be caused in the appearance of the male field by the degree of sexual maturity, and also by the degree of contraction of this part of the body during the process of killing. There are in my collection two individuals of this variety in which the cushions are rather oval with the inner border of each straight (instead of bow-shaped) and the depressed interval between the cushions wider.

Notoscolex tenmalai var. **karakulamensis** Steph.

Trivandrum. August, 1926. Numerous specimens.

A few notes may be added to supplement Stephenson's account (17).

Number of segments 148.

Prostomium prolobous.

Dorsal pores begin in $\frac{4}{5}$.

The female pore is single on a small oval patch in the setal zone of segment XIV

Internal anatomy.—The oesophagus is very vascular in segments XI-XIV

There are a pair of ovisacs in segment XIV

In one specimen an abnormality was noted. The oval elevation was repeated on segment XIX on the left side. The specimen was dissected and it was seen that there were two fully developed prostates on this side each having its own duct, the anterior duct opening on segment XVIII and the posterior on segment XIX.

Notoscolex peermadensis, sp. nov.

(Plate III, figs. 27, 28, 29.)

Peermade, Travancore, 3,500 ft. 23-XII-1926. From edge of river amongst roots of grass. Numerous specimens, sexual.

External characters.—Length 75 mm. Diameter 2 mm. Number of segments 164.

Prostomium epilobous $\frac{1}{2}$, tongue either open behind or closed by a cross furrow.

Dorsal pores begin in furrow $\frac{5}{6}$.

Setae eight throughout the body ; *ab* paired and *cd* very widely so. Both behind and in front of the clitellum $ab=\frac{1}{2}aa=\frac{1}{2}bc=\frac{1}{2}cd$ and *dd* is slightly greater than $\frac{1}{3}$ of the circumference.

The clitellum is smooth, ring-shaped and extends over segments XIV —$\frac{1}{2}$XVII ($=3\frac{1}{2}$). Dorsal pores are present on the clitellum and setae are slightly visible.

The male field is a thickened, rectangular area, with more or less rounded sides, occupying the narrow posterior half of segment XVII, segment XVIII, and a portion of the anterior half of segment XIX. Laterally the area extends to the line of setae *b*. The middle portion of this field is slightly depressed longitudinally.

The male pores are on segment XVIII in line with setae *a*.

The female aperture is single, in the setal zone of segment XIV, in the centre of a small oval area in the middle of *aa*.

The spermathecal pores are two pairs in $\frac{7}{8}$ and $\frac{8}{9}$ in line with setae *b*.

Internal anatomy.—Septum 5/6 is thin, 6/7 to 9/10 are thickened and 10/11 to 11/12 are moderately so.

There is a well developed gizzard in segment V The intestine begins in XV, XVI, or XVII. There are no calciferous glands.

The last heart is in segment XIII.

The excretory system is micronephridial. Bushy nephridial tufts, one pair per segment, are present in the preclitellar and clitellar segments. In the post-clitellar region four or five small micronephridia are present on each side per segment.

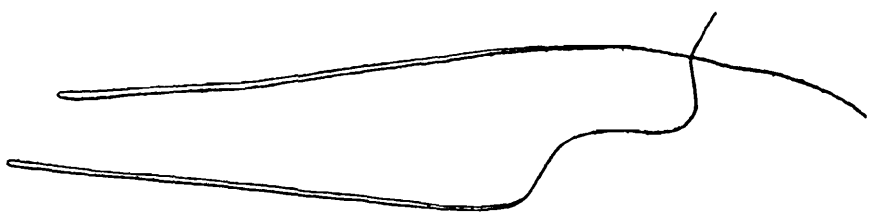
Testes and funnels are free in segments X and XI. Seminal vesicles are two pairs in segments XI and XII, flattened and lobulated, those in segment XI are rather small in some specimens.

The prostates are thick and loosely lobed and extend through three or four segments. The shiny duct makes one or two curves and then proceeds obliquely backwards and inwards to open to the outside. The duct is narrow entally and gets wide towards the ectal end.

A single setal sac containing two penial setae opens to the outside in close connection with each prostatic duct. The penial setae are 1 mm. in length and 9-10μ in thickness. At the end of the proximal half the shaft gets wavy. The distal portion of the shaft is ornamented with two rows of minute spines occurring at relatively long intervals. The tip is pointed (Plate III, fig. 29).

The ovaries occupy the usual position in segment XIII. There are a pair of small ovisacs in segment XIV

The spermathecae are two pairs in segments VIII and IX. The ampulla is club-shaped, narrowing to form the duct, which is not marked off. A single pear-shaped diverticulum arises from about the middle of the duct (Plate III, fig. 28).



Text-fig. 23.—*Notoscolex peermadensis :* penial setae, general form, × 155.

Remarks.—The present species is related to *N. gravelyi* Steph. but is distinguished from it by its large size, the single median female pore, the position of the gizzard and the intestine, absence of meganephridia and the presence of ornamentation on the penial setae.

Notoscolex travancorensis, sp. nov.

(Plate III, figs. 30, 31.)

Peermade, Travancore, 4000 ft. 23-XII-26. Four sexual specimens and a few immature ones.

External characters.—Length 100-110 mm. Diameter 2 mm. anteriorly and 1·5 mm. posteriorly. Number of segments 200-210. Colour pale yellowish-grey, clitellum yellow.

Prostomium is proepilobous. There is a longitudinal mid-dorsal furrow on the anterior half of segment I.

The first dorsal pore in furrow $\frac{10}{11}$. The setae are paired, *cd* widely. Behind the clitellum $ab = \frac{1}{2}aa = \frac{1}{2}bc = \frac{1}{2}cd$, and *dd* is slightly greater than one-third of the circumference. In the middle of the body the relative sizes of the setal intervals are the same but *dd* is only one-fifth of the circumference. At the hinder end ab $\frac{4}{5}aa = \frac{4}{5}bc = \frac{4}{5}cd = \frac{4}{5}dd$.

The clitellum is thick, smooth and ring-shaped and includes $\frac{1}{3}$ XIII—XVII ($=4\frac{1}{3}$). Dorsal pores are absent and setae are seen only very indistinctly.

On the ventral side of segment XVIII are a pair of circular papillae with a broad whitish thickened border. Each papilla takes up the whole length of the segment and extends inwards to the line of setae *a* or slightly beyond and outwards to about two-thirds *bc*. Occupying the middle of each papilla is a bean-shaped elevation with the hilus turned away from the middle line. The male pores are situated in the bean-shaped elevation in line with setae *b*.

The female pores are paired, in the setal zone of segment XIV, in a transversely elongated whitish area which extends from *a* to *a*.

The spermathecal apertures are two pairs in $\frac{7}{8}$ and $\frac{8}{9}$ in line with the setae *b*.

Internal anatomy.—Septum 5/6 is very thin ; 6/7-9/10 are much thickened ; 10/11-11/12 moderately so.

The gizzard is in segment V It is flattened dorso-ventrally and the sides are rounded. There are no calciferous glands. The oesophagus is segmentally swollen and is very vascular in segments XI-XIII. The intestine begins in segment XVI.

The last hearts are in segment XIII.

The excretory system is micronephridial. Large bushy nephridial tufts, one pair per segment, are present in the preclitellar and clitellar regions. In the clitellar segments the tufts look expanded as the loops are long and loose. In the post-clitellar segments four or five small nephridia occur on each side.

The worm is metandric. Testes and funnels are only one pair in segment XI, enclosed in a thin testis sac which curves round the oesophagus on each side.

The seminal vesicles are one pair in segment XII. They are long, and narrowing towards the tip are attached to the septum by a broad base.

The prostates are long, narrow, and loosely lobed, and extend through about two segments ; their outer edges meet above the gut in the mid-dorsal line. The thin proximal half of the duct describes two or three small loops. The duct then becomes wider, describes a large loop, convex in the middle line, and opens to the outside.

The ovaries are in segment XIII. A pair of small ovisacs are present in segment XIV

The spermathecae (Plate III, fig. 31) are two pairs in segments VIII and IX. The ampulla is thin-walled, long and club shaped, the lower narrowed portion being only one-third as wide as the swollen distal part. The duct is very short and is practically embedded in the body wall. A single pear-shaped diverticulum with a simple chamber arises from the ectal end of the ampulla close to the body wall.

There are no penial setae.

Notoscolex minimus, sp. nov.

(Plate III, figs. 32, 33 ; Plate IV, fig. 44.)

Peermade, 4,000 ft. 22-XII-26. One dozen specimens, mostly sexual.

External characters.—Length 37-45 mm. Diameter 1·5 mm. in the anterior part of the body and 1 mm. in the middle and hinder regions. Number of segments 104-124.

Prostomium broad and epilobous $\frac{1}{2}$-$\frac{2}{3}$. Sides parallel and tongue open behind.

The first dorsal pore is in furrow $\frac{6}{7}$.

The setae are paired, the ventral setae rather closely and the lateral setae very widely throughout the body. In segment XII $ab=\frac{1}{2}cd=\frac{2}{5}$ $bc=\frac{4}{7}cd$; and dd is two-seventh of the circumference. Behind the clitellum $ab=\frac{1}{3}aa=\frac{1}{3}bc=\frac{1}{4}cd$ and dd is about $\frac{1}{5}$ of the circumference. Posteriorly $ab=\frac{2}{3}aa=\frac{2}{3}bc=\frac{1}{2}cd$ and dd gets considerably reduced and is slightly less than the ventral break. In the post-clitellar region the intervals aa, bc, and cd remain fairly constant but ab gets wider and

dd narrower. In the last ten segments the arrangement of the setae is slightly irregular.

The clitellum is ring-shaped and includes segments XIV—XVII (=4), but ventrally it sometimes extends over the posterior half of segment XIII.

On the ventral side of segment XVIII are two small circular papillae each taking up the interval between the lines of setae *a* and *b* and nearly the whole length of the segment. The male pores are on these papillae between the lines of setae *a* and *b*, much nearer to *b* than *a*. In three specimens in the collection there was a glandular thickening in the interval *aa* on the posterior half of segment XVII and a similar thickening was present on the anterior half of segment XIX.

The female pore is single and median in the centre of a small transversely elongated area in the setal zone of segment XIV

The spermathecal apertures are two pairs in $\frac{7}{8}$ and $\frac{8}{9}$ in line with setae *b*.

Internal anatomy.—Septum 5/6 is very thin ; 6/7-8/9 are thin ; 9/10-11/12 are slightly thickened.

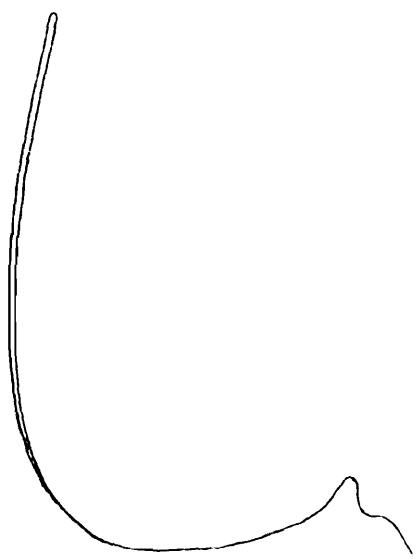
The gizzard is in segment V and is cylindrical. There are no calciferous glands. The oesophagus is vascular in segments XII-XIV The intestine begins in segment XVI.

The last heart is in segment XIII.

One pair of tufted nephridia per segment are present in the anterior segments in front of the clitellum, the pairs at the level of the anterior and posterior ends of the gizzard being conspicuously large. In the clitellar region there are two or three expanded tufts on each side per segment. Each segment behind the clitellum has four or five small flattened nephrida on each side.

The testes and funnels are free, in segment X and XI. The seminal vesicles are in segments IX and XII ; those in segment IX are attached to the anterior face of septum 9/10.

The prostate is flattened and lobed and has branching canals. It occupies segments XVIII and XIX and sometimes extends into segment XX. The duct runs transversely inwards, then forwards, describing a broad loop ; it then proceeds backwards forming a second loop. The distal half of the duct is wide, shiny and S-shaped (Plate III, fig. 32).



Text-fig. 24.—*Notoscolex minimus* : penial seta, general form, × about 170.

A penial setal sac with two setae is present on each side. The sacs are attached to the body wall dorsally by strong muscle bands. Each penial seta is bent in the form of a bow and is 1·1 mm. long, 11μ thick proximally, and 5μ thick at the distal end just before its emergence from the body wall. The seta describes one spiral twist when passing through the body wall and the exposed distal end, which is 63μ in length, is

straight and tapering and is ornamented with a double series of closely-set finely pointed spines. When this distal portion (Plate III, fig. 33*a*, *b*) is examined as the seta lies on one side, only one row of serrations is seen and it presents an appearance like the sting of the honey bee.

The spermathecae (Plate IV, fig. 44) are two pairs in segments VIII and IX. The ampulla is ovoid. The duct is marked off and is about one-third as long as the ampulla. A single cylindrical diverticulum, half as long as the ampulla, arises from the upper end of the duct at its junction with the ampulla.

Genus **Megascolex** Templeton.

Megascolex travancorensis (Mich). var. **proboscidea,** nov.

(Plate III, figs. 34, 35, 36).

Tenmalai, 1,000 ft. From a hill slope by the side of a road. 14-IX-26 and 19-X-26. Numerous specimens.

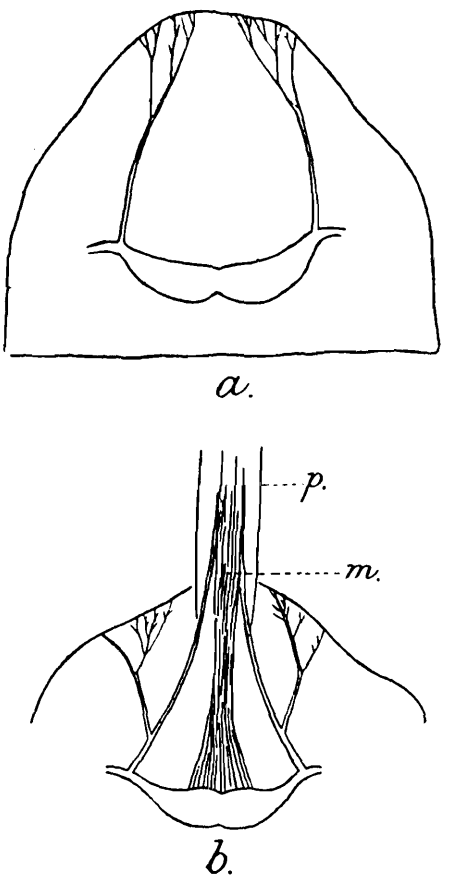
External characters.—Length 105-180 mm. Diameter 2 mm. Number of segments 192-213. Colour pale white, no pigmentation. The prostomium is proepilobous and is an almost conical lobe overhanging the mouth.

Proboscis.—In addition to the prostomium this species possesses a proboscis-like organ comparable to the proboscis of certain groups of worms. The protrusion and retraction of this interesting organ which functions as a feeler in living specimens may be watched. When fully protruded the proboscis measures 4 mm. in length. From dissections and sections (Plate III, fig. 36) it is clearly seen that it arises from the dorsal wall of the buccal cavity from a pocket-like invagination in front of the brain. When the worms are killed in strong spirit the proboscis is retracted and is seen only as a straight knob projecting from the buccal cavity beneath the contracted prostomium and is, therefore, easily overlooked. Many of my specimens were first narcotised in very weak spirit and then transferred to 10 per cent. formalin for 6 hours. I was thus able to preserve the proboscis in a fairly protruded condition. In specimens in which the anterior portion of the buccal cavity gets everted in the process of killing, the proboscis pocket also gets completely everted and the proboscis comes to lie in front of the prostomium and appears to be an extension of it though really it is not.

The proboscis is long and cylindrical (·024 mm. thick at the distal end and ·018 mm. thick at the base), sometimes club-shaped with a swollen distal portion. It has a segmented appearance due to four or five ring-like constrictions round it. Beneath the epidermis is a layer of circular muscle fibres surrounding a stout axial core of longitudinal fibres. These latter are retractor in function and are attached behind to the dorsal wall of the buccal cavity above the brain.

There are, as usual, two cerebral nerves one on each side. Each of these soon divides into two branches. The outer branch supplies the prostomium. The inner, which is stouter, passes into the proboscis

along with its fellow. In *Megascolex mauritii*, in which a proboscis is absent, the two branches of each cerebral nerve are of equal thickness and both supply the prostomium.



TEXT FIG. 25.—*a.*, *Megascolex mauritii* : Brain and cerebral nerves. *b.*, *Megascolex travancorensis* var. *proboscidea* : Brain and cerebral nerves.

Beddard in his monograph mentions two species of earthworms possessing a structure apparently similar to the one described above though he calls it 'prostomium' in both cases. With regard to one of them, *viz.*, *Trichochaeta hesperidum*, he says that " it protrudes from the mouth, and in sections is seen to arise from a slight invagination of the dorsal wall of the buccal cavity just in front of the brain "—a condition almost exactly similar to that obtaining in my worms. The presence in Oligochaeta of a tactile organ distinct from the prostomium is of great interest.

The first dorsal pore is in furrow $\frac{5}{6}$. In a few specimens an indistinct pore was noticed in $\frac{4}{5}$.

The setae are in rings. The dorsal break, which is wide anteriorly, gets reduced in the posterior region till it is about three-fourths of the ventral break. The setae are not paired in the anterior segments. The following numbers were counted :—12/II-III, 16/IV-VIII, 20/IX-XIII, 22/XIX, 24/XXV, 24/hinder end.

The clitellum is ring-shaped and extends over $\frac{1}{2}$XIII—$\frac{1}{2}$XVII (=4).

The male field is a heart-shaped cushion (Plate III, fig. 34) with the broad base anterior, a little behind the setal zone of segment XVII and the rounded narrow apex posterior, at the level of the setae of segment XIX or slightly behind it. The cushion has a median depression beginning from the setal zone of segment XVIII and extending backwards to about the end of the anterior quarter of segment XIX. The male pores are minute apertures in the setal zone of segment XVIII in line with setae *b*. Setae *a*, *b*, *c*, *d* are absent on XVIII, while in segment XIX, *a*, *b*, and *c* are carried slightly backwards by the posterior border of the cushion.

The female pores are paired on a small transversely elongated area in the setal zone of segment XIV

The spermathecal apertures are minute pores in $\frac{7}{8}$ and $\frac{8}{9}$ in line with setae *a*.

There is a longitudinal dumb-bell shaped depression occupying segments VIII-IX (Plate III, fig. 35). The depression, which begins a little in front of furrow $\frac{7}{8}$, extends backwards to the setal zone of IX and is bordered all round by a thickened rim.

Internal anatomy.—Septum 5/6 is very thin and membranous ; 6/7-8/9 are thickened. 9/10-12/13 moderately so.

The gizzard is in segment V There are no calciferous glands. The intestine begins in XVI.

The last heart is in segment XIII.

The excretory system is micronephridial. In the preclitellar segments there are one pair of large tufted nephridia per segment : in the clitellar and post-clitellar regions there are a number of small micronephridia per segment attached to the parietes on each side. The parietal nephridia in the clitellar segments are fewer in number and larger than those of the segments behind.

The testes and funnels are free in segments X and XI. The seminal vesicles are long conical sacs in segments XI and XII.

The prostates are long, flat and much lobulated and extend through about nine segments. The thin ental end of the duct describes a small semicircular loop, the concavity facing forwards. At the end of this loop the duct gets wide, muscular and shiny and proceeds straight backwards to open to the outside. Just before its termination the duct becomes thin and describes a second small loop similar to the first.

The spermathecae are two pairs in segments VIII and IX. The ampulla is a thin-walled pear-shaped sac, narrow in its ectal portion. The duct is short and is not marked off from the narrow ectal part of the ampulla. A club-shaped diverticulum, about half as long as the ampulla, arises from its ectal end. It was noticed that in immature specimens the diverticulum is longer than the ampulla.

There are no penial setae.

Remarks.—The present form is doubtless a variety of the species *M. travancorensis* but differs slightly from the four known varieties of the type-form. The male field approaches very nearly to that of the variety *ghatensis*. The present form differs, however, from that variety in the shorter spermathecal diverticulum, the position of the gizzard, the copulatory cushion in the spermathecal region, and the presence of a retractile proboscis. At the same time, I am conscious of the possibility of the present form turning out to be identical with *ghatensis*. The slight difference in the male field in the case of Michaelsen's specimens may be due to their bad preservation and he might possibly have overlooked the proboscis, which is completely retracted in specimens killed without first being narcotised.

Megascolex auriculata, sp. nov.

(Plate III, figs. 37, 38).

Vandiperiyar, 2000 ft. Edge of a canal. 24-XII-26. A number of specimens, all sexual.

Kumili, 1,500 ft. Edge of submerged rice-field. 26-XII-26. Numerous specimens.

External characters.—Length 85-115 mm. Diameter 2 mm. Number of segments 184-214. The body is dull grey in colour and the clitellum is yolk-yellow.

The prostomium is proepilobous.

The dorsal pores begin in furrow $\frac{9}{10}$.

The setal arrangement is purely lumbricine till the middle of the body, *ab* closely paired and *cd* widely so. The tendency to change to the perichaetine condition is seen to begin here. While the interval *ab* continues to be regular, either the seta *c* or *d* or both often get moved a little inward or outward from their usual position and an extra seta or two are sometimes developed. From about segment CXXV (in a specimen with 214 segments) the usual number of setae per segment is found to be 10, though 8 and very rarely 12 also occur. Towards the extreme hinder end 12 setae become the rule though even here some segments have only 10. The intersetal relations in a few segments are shown in the table below :—

Segment X.

aa : *ab* : *bc* : *cd* : : 10 : 4 : 9 : 8.

Segment XIX.

aa : *ab* : *bc* : *cd* : : 4 : 2 : 5 : 3.

Segment XXXVI

aa : *ab* : *bc* : *cd* : : 6 : 2 : 5 : 4.

dd in all these is slightly less than half the circumference.

The clitellum is yolk-yellow in colour, thick and ring-shaped, and extends over segments XIV-$\frac{1}{2}$XVII (=$3\frac{1}{2}$). In a few specimens the clitellum includes the posterior half of segment XIII also.

On the ventral surface of segment XVIII are two excavations placed obliquely (diverging anteriorly), separated by an interval equal to *aa*. Each excavation is bounded, except on its inner side, by a broad, much thickened, glandular lip. The pit-like depression with the broad lip along three sides of it resembles an ear with the opening of the meatus. In two specimens the excavations have fused to form a single rectangular depression. The male pores are on segment XVIII in line with setae *b*.

The female pores are paired, in the setal zone of segment XIV in the interval *aa*. The pores are separated by $\frac{1}{3}$ *aa*.

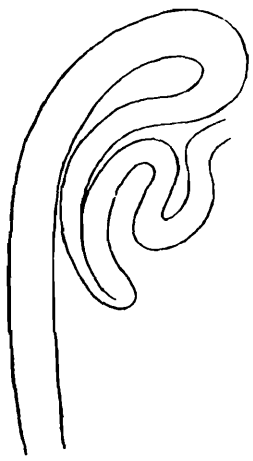
The spermathecal apertures are two pairs in $\frac{7}{8}$ and $\frac{8}{9}$ in line with the setae *b*.

Internal anatomy.—Septa 6/7-9/10 are very thick, 10/11 is slightly thickened and the next two septa very slightly so. There is a strongly developed, barrel-shaped gizzard in segment VI. There are no calciferous glands. The oesophageal swellings in segments VII-XIV are very vascular and the internal surface is thrown into villi. The intestine begins in segment XVI. In segments XVIII-XXI, being pressed upon by the large prostates, it becomes narrower.

The last heart is in segment XIII.

Tufted nephridia, one pair per segment, are present in the anterior segments. In the clitellar region the tufts are flattened and plate-like, and composed of a number of long winding tubes. In the post-clitellar region there are, in each segment, 5 or 6 small tufts on each side, attached to the posterior face of the septum.

Testes and funnels are only a single pair in segment XI, enclosed in a large unpaired testis sac attached to the posterior face of septum 10/11. The sac is narrow in the mid-ventral line below the oesophagus.



TEXT-FIG. 26.—*Megascolex auriculata*: Prostatic duct.

The seminal vesicles are a single pair in segment XII. They are grape-like and long but confined to segment XII.

The prostates are thick and loosely lobed and extend through three or four segments. The duct, which arises from the anterior part of the gland after a few windings, proceeds straight backwards to open to the outside. The ectal half of the duct is twice as wide as the ental portion and very shiny.

There are no penial setae.

Ovaries and funnels are in segment XIII.

The spermathecae are two pairs in segments VIII and IX. The ampulla is long and thickly club-shaped, the basal portion being more than half as wide as the distal half. The duct is very short. A single diverticulum, almost cylindrical in shape, arises from the base of the ampulla.

Remarks.—The present species appears to form the nearest link to *Notoscolex*. The two other species forming a transition from *Notoscolex* to *Megascolex* are *M. willeyi* Mich and *M. zygochaetus* Mich.

Megascolex avicula, sp. nov.

(Plate III, figs. 39, 40, 41, 42.)

Peermade, 4,000 ft. 23-XII-26. A number of specimens, sexually mature.

External characters.—The length of the specimens varies between 50 and 70 mm. Diameter 2 mm. Number of segments 120-154. Colour pale slaty grey, clitellum yellow.

The prostomium is prolobous.

The first dorsal pore is in $\frac{5}{6}$.

The setae are lumbricine in the clitellar and preclitellar regions, *ab* more closely paired than *cd*. In segment IX $ab = \frac{3}{8}aa = \frac{3}{8}bc = \frac{1}{2}cd$; and *dd* is half the circumference. The numbers counted are:—8/II-XIX, 12/XX-L, 14/L-LX, 16/LXI, and 25-30/hinder end. The setae are paired up to the middle of the body. In the post-clitellar region *aa* remains nearly constant while *zz* gets gradually reduced posteriorly. In segment XXXVI *zz* is 2*ac*, in segment LIX it is $1\frac{1}{2}aa$ and in segment XC it is $\frac{3}{4}aa$.

Segments I-V are narrow. The remaining preclitellar segments are broad and triannular.

The clitellum is thick and saddle-shaped and extends over segments $\frac{2}{3}$XIII-XVII ($=4\frac{2}{3}$). As the middle ventral region is free from clitellar epidermis the grooves and seta are visible. The grooves are completely obliterated on the dorsal and lateral sides. Dorsal pores are present.

Occupying the whole of the ventral side of segment XVIII is a transverse depression slightly narrowed in the middle and surrounded by a thickened ridge. Situated in the depression on either side of the middle

line is a transversely elongated elevation with a rounded inner end. The male pores are on the inner ends of these elevations almost in line with setae *a*.

The female pores are paired in front of the setal-zone of segment XIV in line with setae *a* or a little internal to it.

The spermathecal pores are two pairs in $\frac{7}{8}$ and $\frac{8}{9}$ internal to the line of *a*.

Internal anatomy.—Septum 5/6 is thin, 6/7-9/10 are thickened and 10/11-11/12 moderately so.

There is a strongly developed cylindrical gizzard in segment V. There are no calciferous glands. The oesophagus is very vascular in segments XII-XIV and lamellated internally. The narrow oesophagus suddenly dilates in segment XVII to form the intestine.

The last heart is in segment XIII.

The excretory system is meganephridial (?). A pair of large tufted nephridia are present in segment V Each of these has a stout duct which opens to the outside through the body wall. In the following preclitellar segments and in the clitellar region there are one pair of tufted nephridia per segment. Behind the clitellum, there are, in each segment, one pair of small flattened nephridia, apparently of the nature of meganephridia. In one of these I made out seven loops, a few of which are transverse, a few lie longitudinally and others obliquely.

The testes and funnels are free in segments X and XI. There is a hardened mass of free spermatozoa in these two segments.

The vesiculae seminales are two pairs in segments IX and XII. The anterior pair are flattened and attached to the anterior face of septum 9/10. The posterior pair are long and racemose and occupy the usual position in XII.

The prostates are thick and loosely lobed and extend through four or five segments. The duct is stout and shiny and runs obliquely forwards and inwards to open to the outside. The distal portion of the duct is wide.

The ovaries occupy the usual position in segment XIII. A pair of small ovisacs are present in segment XIV

The spermathecae are two pairs in segments VIII and IX. The ampulla is ovoid and thin-walled and a single pear-shaped diverticulum arises from its lower end. The diverticulum is one-third as long as the ampulla and is filled with masses of ripe spermatozoa. The duct is one-third as long as the ampulla and one-fourth its width.

The penial setae are 1·1 mm. long and very narrow. being only 5μ thick proximally. The distal portion of the seta is ornamented with long narrow pointed spines arranged in pairs at intervals. The ornamentation does not extend up to the tip. The tip of the seta is slightly recurved (Plate III, figs. 41, 42).

Muscle strands attach the penial setal sac of each side to the lateral body wall of segment XXI.

Remarks.—The condition of the nephridia is similar to that in *Woodwardiella kayankulamensis* described in this paper. If the tufted nephridia are really meganephridia then the condition in the present form is meganephridial throughout.

Megascolex ratus Cogn.

(Plate IV, fig. 43.)

Bonaccord. September, 1923. One specimen.
Mukkunni Reserve Forest. August, 1924. One specimen, sexual.
Trivandrum. August, 1926. Four specimens, two sexual.
Trivandrum. November, 1926. Three specimens, one sexual.

The species has been fully described by Cognetti (6) and his account has been supplemented by Stephenson (17). A few notes on certain features of the present specimens may, however, be added.

The dorsal pores begin in $\frac{6}{7}$. Paired papillae on $\frac{16}{17}$, $\frac{19}{20}$ and $\frac{20}{21}$ are present in all the specimens ; papillae on $\frac{15}{16}$ and $\frac{21}{22}$ are present in three specimens only ; papillae on $\frac{22}{23}$ are present in one only. In the specimen whose clitellar region is figured (Plate IV, fig. 43) only one papilla is present on $\frac{20}{21}$.

Internal anatomy.—Septum 5/6 is thin and membranous. The gizzard is in segment V. There are no calciferous glands. The oesophagus gives off four pairs of vascular caeca in segments XI-XIV, those in segment XI being the smallest. Each sac opens into the oesophagus by a wide opening. The outer surface of the sacs is smooth and the inner surface is strongly lamellated. The oesophageal wall between two successive caeca projects into the lumen as a ridge on which are a few conspicuous vertical lamellae.

One pair of large tufted nephridia are present in segment III by the side of the pharynx, one pair in segment IV by the side of the narrow oesophageal part, and one pair in segment V by the side of the gizzard. Tufted nephridia were not noticed in any other of the anterior segments. Large numbers of minute micronephridia are attached to the parietes from segment IV backwards. In the clitellar region the integumental nephridia are larger and more numerous.

Megascolex trivandranus Steph.

Trivandrum. 20-VII-1926. Numerous specimens.
Chengannur. October, 1926. A number of specimens.

The female apertures are paired.

A pair of small ovisacs are present in XIV

Megascolex peermadensis, sp. nov.

(Plate IV, figs. 45, 46.)

Peermade, 4000 ft. 24-XII-26. Five specimens, two sexual.

External characters.—Length of specimens 50-76 mm. Diameter 1·5 mm. Number of segments 157.

Prostomium epilobous $\frac{1}{3}$; tongue very narrow and open behind.

The first dorsal pore is in $\frac{5}{6}$ (?).

The setae are in rings. The dorsal break is wide anteriorly and gets gradually reduced behind the clitellum, as the setae increase in number. In segment X $zz = 7yz$; behind the clitellum $zz = 3\text{-}3\frac{1}{2}$ yz. The following are the numbers counted :—12/V, 12/XII, 18/XIX, 18/XXXVI, 24/C.

The clitellum is ring-shaped and extends over segments XIV-XVII (= 4). Dorsal pores are present.

The male field, which takes up the whole of segments XVIII and XIX, consists of two circular papillae with a broad transverse lip in front. The papillae nearly touch each other in the middle line and extend anteriorly up to the setal zone of segment XVIII and posteriorly as far as groove $\frac{19}{20}$. The thickened transverse lip in front pushes forward the hinder end of segment XVII. The male pores are situated in the setal zone of segment XVIII in the position of seta *b*.

The female pore is in the setal zone of segment XIV in the centre of *aa*.

The spermathecal apertures are two pairs in $\frac{7}{8}$ and $\frac{8}{9}$ in line with setae *b*.

Internal anatomy.—The septum 5/6 is very thin, 6/7-9/10 are thickened, 10/11 and 11/12 are moderately so.

The gizzard is strongly developed, long and cylindrical, in segment V There are no calciferous glands. The intestine begins in XVI.

The last heart is in XIII.

The excretory system is micronephridial. Tufted nephridia, one pair per segment, are present in the anterior segments. The tufts by the side of the gizzard are large and bushy. Those in VI to XIII are close to the septa on their anterior face and are almost adherent to them. In the clitellar segments the tufts occur on the parietes and are much enlarged. From segment XIX onwards there are four or five small nephridia on each side, attached to the parietes in a single transverse row.

The testes and funnels are one pair, free, in segment XI (metandric). A hardened sheet-like mass of free spermatozoa is present in this segment.

The vesiculae seminales are long and racemose, one pair, in segment XII.

The prostate is long and deeply cut up into lobes and extends through about ten segments. The duct runs transversely outwards, then bending inwards forming a loop proceeds transversely inwards parallel and close to the proximal half, and opens to the outside. The distal half of the duct is stout and shiny.

The ovaries are in segment XIII. A pair of ovisacs are present in segment XIV

The spermathecae are two pairs in segments VIII and IX. The ampulla is long and pear-shaped, gradually narrowing towards the duct. The duct is very short and is not marked off from the ampulla. A single cylindrical diverticulum about half as long as the ampulla arises from its lower end at its junction with the dust (Plate IV, fig. 46).

There are no penial setae.

Megascolex kumiliensis, sp. nov.

(Plate IV, figs. 47, 48, 49, 50.)

Kumili, Travancore, 1500 ft. A number of fully mature specimens.

External characters.—Length 100-120 mm. Diameter 3 mm. Number of segments 212. The post clitellar segments are narrow and triannular.

Prostomium epilobous, tongue narrowed behind. Dorsal pores begin in furrow $\frac{10}{11}$.

The setae are in rings. The ventral break is regular and setae *a* and *b* are paired throughout the body, widely in the most anterior segments, and rather closely from the twelfth segment backwards. The following numbers were counted :—8/II, 12/III—XVII, 8/XVIII, 16/XIX-CXCV, 24/hinder end.

The clitellum is thick and ring-shaped and extends over segments XIII-XVIII (=6). It occupies nearly the whole of segment XIII on the dorsal side but only the posterior two-thirds of the segment on the ventral side. Intersegmental furrows are obliterated on the dorsal side but are visible ventrally. Dorsal pores are present.

The male pores are on two oval papillae on segment XVIII, in line with seta *a*. Setae *a* and *b* are absent on this segment.

The female pores are paired, minute, in front of the setal zone of segment XIV, each pore being a little internal to the line of setae *a*.

The spermathecal apertures are two pairs, on segments VIII and IX *in the setal zone,* very close to the setae *a* on their inner side (Plate IV, fig. 48).

Copulatory cushions (Plate IV, fig. 47).—There is a rectangular transverse cushion with rounded corners on the anterior half of segment XVII. The whitish rim of the cushion is thick and raised. Anteriorly the cushion extends up to furrow $\frac{16}{17}$, pushing the furrow forwards a little, while posteriorly it reaches near to the setal zone and laterally a little beyond the line of setae *b* on each side. Occupying the anterior half of segment XX is a similar cushion of the same size. Anteriorly it encroaches slightly on segment XIX, while posteriorly it extends quite up to the setal zone and laterally to the same extent as the anterior cushion.

Internal anatomy.—Septum 5/6 is thin. Septa 6/7-9/10 are thickened and 10/11-11/12 are moderately so. There is a well developed gizzard in segment V The intestine begins in segment XVI. There are no calciferous glands.

The last heart is in segment XIII.

In the preclitellar region there are one pair of large tufted nephridia in each segment. In the clitellar region there are four or five similar (but smaller in size) nephridial tufts on each side. From segment XXI onwards, in addition to these small nephridial tufts, there is a mega-nephridium on each side.

Testes and sperm funnels, one pair, free, in segment XI. The seminal vesicles are one pair, long and racemose, attached to the posterior face of septum 11/12.

The small prostates occupy segment XVIII only or segment XVIII and a part of XIX. The glandular part is flattened with the margin cut up into lobes. The duct may be divided into three distinct parts—the narrow proximal part running backwards, the wide middle part which runs forwards and the short ectal part which runs backwards, inwards and downwards, gradually narrowing to the ectal end (Plate IV, fig. 50).

There are no penial setae.

The ovaries are broad, flat, and fan-like, in segment XIII.

The spermathecae are two pairs in segments VIII and IX; the ampulla is ovoid and passes without break into the duct which is nearly half as long as it. From the lower end of the anterior third of the duct arise two diverticula, opposite to each other, slightly club-shaped, almost cylindrical (Plate IV, fig. 49).

Remarks.—The present form is very closely related to *M. sylvicola* Mich., *M. sylvicola* var. *marianae* Steph. (21) and *M. vilpattiensis* Mich. The chief differences are the presence in this form of two copulatory cushions, one on segment XVII and the other on segment XX, and the position of the spermathecal apertures in the setal zone of segments VIII and IX. The latter feature is interesting since it appears that in no other species of *Megascolex*, so far known, do the spermathecae open in the setal zone.

Megascolex polytheca Steph. var. **uniquus,** nov (?).

(Plate IV, figs. 51, 52, 53, 54, 55.)

Kumili, 1500 ft. 26-XII-26. A single specimen.

External characters.—Length 135 mm. Diameter of body 3 mm. Number of segments 100 plus a regenerating hind part consisting of a little over 100 segments. Segments V and VI are biannular and VII-XIII are triannular.

The prostomium is epilobous more than $\frac{2}{3}$, tongue with parallel sides, open behind.

Dorsal pores begin in $\frac{6}{7}$.

The setae are in rings and closely set. The dorsal interval diminishes backwards while the ventral break increases. In segment IX $zz = 2yz$, in segment XL $zz = 1\frac{1}{2}yz$ and further backwards it is only yz. In segment IX $aa = 3ab$; in segment XL $aa = 4ab$. The following numbers were counted :—74/IX, 60/XIX, 52/XL.

The clitellum is smooth and ring-shaped and extends over segments XIV-XVII (=4).

The male pores are on segment XVIII in line with *b* in two depressions, each bordered on the outer side by a longitudinal thickening extending over the whole length of the segment.

The female apertures were not distinguished.

Internal anatomy.—Septum 5/6 is thin, 6/7-11/12 are much thickened. The gizzard is in segment V There are no calciferous glands. The intestine begins in segment XIX.

The last heart is in XIII.

The excretory system is micronephridial.

Testes and sperm funnels are free in segments X and XI. Seminal vesicles are grape-like in segments XI and XII.

The prostates (Plate IV, fig. 55) are confined to segment XVIII but the anterior and the posterior septa are slightly pushed forwards and backwards respectively. The glandular part is broad and flattened and is composed of many lobes separated by deep fissures. The short and shiny duct runs first backwards and inwards and then proceeds straight transversely inwards to open to the outside. The ectal portion of the duct is nearly three times as thick as the ental part.

There are no penial setae.

On each side of segment VIII are seven spermathecae disposed in a row, the ducts opening in $\frac{7}{8}$. In segment IX nine spermathecae are present on the left side and eight on the right side. Each spermatheca is a long club-shaped organ messuring 2·5 mm. in length. The ampulla is small and ovoid and ·25 mm. in width. The duct is four times as long as the ampulla and less than half its width. Arising from the ectal end of the duct is a small club-shaped diverticulum, ·4-·5 mm. in length. Filling the cavity of the diverticulum is a tightly packed mass of ripe spermatozoa.

Numbers of minute unicellular bodies, some of which were in various stages of division, were present both in the cavity of the ampulla and in the duct (Plate IV, figs. 53, 54). Portions of the duct were sometimes blocked by aggregations of these bodies. These were identified as a unicellular plant allied to *Protococcus*.

Remarks.—The present specimen differs from the type-form in possessing a larger number of setae and in having spermathecal diverticula. It is distinguished from the variety *zonatus* by the larger number of setae and the form of the spermathecae. The spermathecal duct, which is " rather longer than the ampulla " in *zonatus*, is in the present specimen four times its length. In view of these differences the present specimen may be ranked as a new variety. But I only do so provisionally since I have only a single example and the type-form or its variety *zonatus* are not available to me for comparison.

Genus **Pheretima** Kinb.

Pheretima taprobanae, Bedd.

Trivandrum, Public gardens. 23-XI-1922. Three specimens.

Sub-family *Ocnerodrilinae.*

Genus **Ocnerodrilus** Eisen.

Ocnerodrilus occidentalis Eisen.

Trivandrum. August 1926. Numerous mature specimens.
Chengannur. September, 1926. Six specimens.

Genus **Malabaria** Steph.

Malabaria biprostata, sp. nov.

(Plate V, figs. 56, 57, 58, 59, 60, 61, 62).

Kumili, 1500 ft. 26-XII-1926. From soft mud in a rice field, numerous specimens, mostly sexual.

External characters.—Length 75-90 mm. Diameter 1·8 mm. Number of segments 218. The posterior end is tapering and is reddish-yellow in colour, due to the rich vascularisation of the transparent body wall. The hind end of the body is kept protruded above the surface of the mud and is used as a respiratory organ as in *Glyphidrilus annandalei* Mich.

Prostomium epilobous $\frac{1}{2}$, tongue broad, sides converging posteriorly, cut off behind by a cross furrow.

Dorsal pores absent.

Setae closely paired; *aa*=*bc* ; *dd*= half the circumference.

The clitellum appears to extend over segments XIII-XXI or XXII (=9/10). The exact extent of the clitellum is difficult to determine, since the region is not thicker than the rest of the body. It has to be estimated solely by the indistinctness of the intersegmental furrows on the dorsal side.

The vasa deferentia and the prostatic ducts open separately but very close together on segment XVII on circular papillae placed on a glandular rectangular area with rounded lateral edges. The rectangular field occupies the whole length of segment XVII and sometimes encroaches slightly on segment XVIII. The pores are in the setal zone and in line with the setae *b*. In fully mature specimens all the four pairs of setae are absent in segment XVII ; in less mature individuals setae *a* and *b* are alone absent. The female pores are very minute in the furrow $\frac{13}{14}$ in line with the setae *b*.

The spermathecal pores are one pair, in grove $\frac{8}{9}$, in line with the setae *b*. In a single specimen in the collection an additional pore was noticed on the right side in furrow $\frac{7}{8}$. When the specimen was dissected it was seen to possess a fully developed spermatheca on the right side in segment VIII, in addition to the usual pair in segment IX.

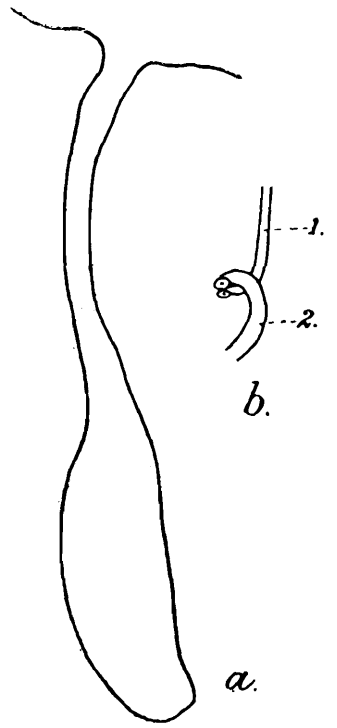
Internal anatomy.—Septum 5/6 is thin, septa 6/7-8/9 are thickened and 9/10 moderately so.

The oesophagus is slightly swollen in segment VII and is fairly muscular and may be regarded as a vestigial gizzard. The oesophagus widens into the intestine in the middle of segment XII.

There is an unpaired swelling on the ventral side of the oesophagus in segments IX and X. A number of transverse blood vessels are seen passing round the oesophagus and " a pair of blood vessels may be seen coursing over the ventral projection, one on each side of the middle line"

Three specimens were sectioned in order to determine the nature of the ventral oesophageal thickening and it was seen that its structure was exactly similar to that of *Malabaria paludicola* Steph. described in detail by Stephenson (21).

The thin-walled oesophagus, on passing into segment IX, increases in thickness on the ventral side by the development of a cellular mass between the columnar epithelium lining the lumen and the peritoneal layer. The columnar epithelial cells are seen to be much elongated and their lower ends pass freely into the cell mass. The thickening is at first most conspicuous in the middle of the ventral wall which consequently projects into the lumen as a conical mass (Plate V, fig. 57). Passing onwards it is noticed that the thickening increases on either side of this central projecting mass, so that the latter becomes less and less conspicuous, till at last the whole of the ventral side gets enormously thickened. The development of the cellular tissue is, however, not confined to the ventral side but extends to the dorsal half of the oesophageal wall which consequently gets slightly thickened. The cell boundaries in this mass are difficult to make out. The cytoplasm appears to be finely granulated and the nuclei are conspicuous. The two blood vessels seen below the gut in the dissection are found to communicate with a number of parrallel blood sinuses running up the thickened ventral wall and dividing the cell mass into a number of thin cell plates. These blood sinuses are in communication with similar but shorter sinuses in the dorsal half of the oesophageal wall and through these with the dorsal vessel.



TEXT-FIG. 27.—*Malabaria biprostata*: *a.*, diverticulum of oesophagus; *b.*, terminal portions of vas deferens and prostatic duct; 1. vas deferens; 2. prostatic duct.

Towards the hind end of IX the lumen of the oesophagus gives off two diverticula into the thickened ventral wall. The diverticula run close together side by side, separated only by a blood sinus, and are lined by columnar epithelial cells of the same type as the cells that line the lumen of the oesophagus. In two series of sections the lower half of each diverticulum is seen to be 2-3 times as wide as the upper half (text-fig. 27*a*).

The oesophageal swelling in segment X has the same structure as in the previous segment and a similar pair of diverticula are present towards the hinder end of this segment.

The last hearts are in segment XI.

The excretory system is meganephridial. The nephridia are large from segment XIII onwards and bright yellow in colour.

Testes and sperm funnels are free in segments X and XI.

The seminal vesicles are two pairs in segments XI and XII. While the vesicles in segment XI are small and confined to that segment, those attached to septum 11/12 are larger and occupy segments XII and XIII.

A hardened mass of free spermatozoa is seen in segments X and XI.

Vasa deferentia.—In dissections only a single tube is seen on each side. Sections show that what looks like a single tube is really composed

of two distinct tubes bound together by a common epithelial covering and musculature (Plate V, fig. 62), the canals remaining separate till the end, where they open to the outside by a common orifice.

The prostates are a single pair, tubular, whitish and very long, extending through a large number of segments. In one specimen they extended back to segment XL, in another to XLIX, and in a third up to segment LIII. The two prostates are loosely coiled together in a few of the anterior segments. They run backwards in a slightly undulating manner, keeping very close together and sometimes twining round each other. The duct, which is 1·8 mm long, is thinner than the gland and somewhat shiny. The ectal end of the duct passes vertically downwards into the body wall to open to the outside. The ectal end of the vas deferens passes *below* the ectal end of the prostatic duct to open to the exterior immediately behind the prostatic pore (text-fig. 27*b*).

The glandular portion of the prostate is only one cell thick. The cells are elongated, broad at the periphery and narrow towards the lumen and uninucleated. The nuclei are situated usually near the periphery. Some sections in the series give the impression that the cells have more than one nucleus. I have satisfied myself that this impression is caused by the sections being more than one cell thick and by some cells not reaching quite up to the periphery but occupying the interstitial spaces between the bases of the longer cells. The cytoplasm, which is granulated, is only slightly stained by Delafield's haematoxylin. In the region of the duct the cells are very short and non-glandular (Plate V, fig. 60). This thin non-glandular part is surrounded by several layers of nucleated circular muscle fibres which in turn are covered by a layer of longitudinal fibres.

There are no penial setae.

The spermathecae are one pair in segment IX. The ampulla is a broad thin-walled sac. The duct, which is sharply marked off, is about half as long as the ampulla and one-fourth its width. There is no diverticulum (Plate V, fig. 56).

Remarks.—The present species is distinguished from *M. paludicola* Steph. by the presence of only a single pair of prostates and by the much greater degree of fusion of the two vasa deferentia of each side.

References to Literature.

1. Aiyer, K. S. Padmanabha.—Notes on the Aquatic Oligochaeta of Travancore. I. *Ann. Mag. Nat. Hist.* (Ser. 9), XV (1925).
2. Aiyer, K. S. Padmanabha.—Notes on the Aquatic Oligochaeta of Travancore. II. *Ann. Mag. Nat. Hist.* (Ser. 9), XVIII (1926).
3. Beddard, F. E.—*A Monograph of the Order Oligochaeta.* (Oxford, 1895).
4. Bourne, A. G.—On *Moniligaster grandis* A. G. B. from the Nilgiris, South India; together with descriptions of other species of the genus *Moniligaster*. *Quart. Journ. Microsc. Sci.* XXXVI (1894).
5. Bousfield.—The Natural History of the genus *Dero*. *Journ. Linn. Soc. Zool.* V (1887).

6. Cognetti De Martiis, L.—A contribution to our Knowledge of the Oligochaeta of Travancore. *Ann. Mag. Nat. Hist.* (Ser. 8), VII (1911).
7. Fedarb, S. M.—On Some Earthworms from India. *Journ. Bombay Nat. Hist. Soc.* XI (1898).
8. Michaelsen, W.—The Oligochaeta of India, Nepal, Ceylon, Burma and the Andaman Islands. *Mem. Ind. Mus.* I (1909).
9. Michaelsen, W.—Die Oligochaeten fauna der Vorderindisch-ceylonischen Region. *Abh. Ver. Hamburg,* XIX (1910).
10. Michaelsen, W.—Oligochaeten von Travancore und Borneo. *Mittheil. Mus. Hamburg,* XXX (1913).
11. Piguet, E.—Observations sur les Naididees, revision systematique de quelques especes de cette famille. *Rev. Suisse Zool.* XIV (1906).
12. Stephenson, J.—The Anatomy of Some Aquatic Oligochaeta from the Punjab. *Mem. Ind. Mus.* I (1909).
13. Stephenson, J.—On Some Aquatic Oligochaete Worms Commensal in *Spongilla carteri*. *Rec. Ind. Mus.* V (1910).
14. Stephenson, J.—On Some Aquatic Oligochaeta in the Collection of the Indian Museum. *Rec. Ind. Mus.* VI (1911).
15. Stephenson, J.—On a Collection of Oligochaeta mainly from Ceylon. *Spolia Zeylanica,* VIII (1913).
16. Stephenson, J.—On the Sexual phase in certain of the Naididae. *Trans. Roy. Soc. Edinburgh,* L (1915).
17. Stephenson, J.—On a Collection of Oligochaeta belonging to the Indian Museum. *Rec. Ind. Mus.* XII (1916).
18. Stephenson, J.—On a Collection of Oligochaeta from the lesser known parts of India and from Eastern Persia. *Mem. Ind. Mus.* VII (1920).
19. Stephenson, J.—On the diffuse production of sexual cells in a species of *Chaetogaster*. *Proc. Zool. Soc. London* (1922).
20. Stephenson J.—*The Fauna of British India including Ceylon and Burma. Oligochaeta.* (London, 1923).
21. Stephenson, J.—On Some Indian Oligochaeta with a description of two New Genera of Ocnerodrilinae. *Rec. Ind. Mus.* XXVI (1924).
22. Stephenson, J.—On Some Oligochaeta mainly from Assam, South India and the Andaman Islands. *Rec. Ind. Mus.* XXVII (1925).
23. Stephenson, J.—Oligochaeta from various Regions including those collected by the Mount Everest Expedition, 1924. *Proc. Zool. Soc. London* (1925).
24. Stephenson, J.—Descriptions of Indian Oligochaeta. *Rec. Ind. Mus.*, XXVIII (1926).
25. Stephenson, J.—The Sexual Organs of *Naidium breviseta* (Bourne). *Ann. Mag. Nat. Hist.* (Ser. 9), XVIII (1926).