

XXII. ON A COLLECTION OF OLIGO-
CHAETA MAINLY FROM NORTHERN
INDIA.

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The present paper contains an account of a number of Oligochaeta, collected mainly from localities in Northern India. Only the smallest part of the actual labour of collecting has been done by myself; and I have to thank the many helpers whose

names are given in connection with the various species for the trouble they have taken in supplying me with the material on which the present paper is based; I must especially mention L. Bishambar Das, M.Sc., Assistant Professor of Biology in this college; my pupil Baini Parshad, B.Sc., at present Alfred-Patiala Student in Zoology in the Punjab University; and my laboratory assistant Md. Ibrahim.

It will perhaps be convenient to mention first the more interesting results of a general nature.

Having regard to the general facts of distribution of the Naididae, it is neither surprising to find two new species of well-known genera (*Nais raviensis*, *Naidium minutum*), nor to meet with forms which are specifically identical with those of Europe (*Dero limosa*, *Aulophorus furcatus*). The two Enchytraeidae also belong one to an already known and one to a new species; the records are interesting, because the list of Indian Enchytraeidae grows very slowly; indeed with the exception of a form described by Beddard, of which the genus is doubtful, only one species (*Enchytraeus indicus*, 12) of this family has so far been found. *Enchytraeus harurami*, of which an account is given below, is noteworthy as being one of the few Enchytraeids in which sperm-sacs have so far been described. In the genus *Mesenchytraeus* they are present, as is well known, and have the same relations as in the Naididae; Eisen apparently records them (in a paper which I am unfortunately unable to consult) in some species of the genus *Enchytraeus*, though they are certainly not present in all (*cf.* Welch, 17). In the present species the sacs are of the nature of the testis-sacs seen, for example, in *Ocnerodrilus* (*O.*) *occidentalis* (to mention only another worm in the present collection), not of the seminal vesicles of the Naididae; each consists of a peritoneal membrane in the form of a bag, which surrounds the testis (but not, as for example in *Eutyphoeus*, the funnel also), and within which the sexual cells, ripening and freeing themselves from their attachment, undergo the change into sperm-morulae. Exactly how the sexual cells escape, and as ripe spermatozoa find their way to the mouth of the funnels, is not evident in the preparations of the present form.

Perhaps the most curious, though not the most important, fact recorded is the occurrence of the genus *Microscolex* in a remote spot in the extreme north of India, 700 miles in a direct line from the sea. The species (*M. phosphoreus*) is widespread; its original home is probably (Michaelsen, 7) in the temperate zone of South America, whence, with other representatives of the genus, it has been carried by the drift due to the prevalent westerly winds across the South Atlantic and Indian Oceans, and so has become widely dispersed in the Southern Hemisphere. Direct importation by the agency of man is apparently, however, the only means by which it could have reached Northern India; its isolated occurrence at Peshawar is certainly strange. This is the only record of a member of the acanthodriline group in India.

Of the same nature is the occurrence of *Ocnerodrilus* (*Ocnerodrilus*) *occidentalis*, curiously enough also not far from Peshawar (Mardan in Peshawar District), as well as at Rawal Pindi, 120 miles east of Peshawar. The species has been recorded by Michaelsen (6) from Ceylon and Travancore.

Of the two species of *Lampito*, *L. mauritii* is a well-known wanderer; *L. barodensis*, however, would seem to represent an extension northwards of the proper range of the genus.

The three species of *Pheretima* are of course also well-known peregrine forms. But it is curious to note that while *Pheretima* is the commonest genus in the Punjab, as it is certainly one of the commonest in Bengal (i.e. "the lower provinces," used as including Bihar), it is nevertheless almost absent from the intervening territory. Though the United Provinces (the upper Gangetic plain) is one of the best investigated regions in India in the matter of terrestrial Oligochaeta, *Pheretima posthuma* has hitherto been found nowhere within its limits; though it is on the one hand the commonest worm of the Punjab, and on the other has been recorded by Michaelsen (4) from no fewer than ten places in Bengal. A few species of *Pheretima*, including those found in the Punjab, have indeed been recorded from one or two places in the Himalayas bounding the United Provinces on the North; but never, I think, from the upper Gangetic plain.

Before the publication of Michaelsen's paper of 1907 (4) on the Oligochaete fauna of India, the genus *Eutyphoeus* comprised about half a dozen species, and it could scarcely have been suspected that it was one of the large and dominant genera of the country. Michaelsen added fourteen species (though he subsequently slightly reduced the number); I found four more in the material gathered during the Abor expedition (15), and several new species appear also in the present paper. The United Provinces and Bengal (including Assam) are the head-quarters of the genus, outside which territories it has hitherto scarcely been found at all. The present records extend the range of the archaic species *E. incommodus* into the Punjab (as far as Hoshiarpur District at the foot of the Himalayas), and that of the widespread and variable *E. waltoni* to Baroda on the West Coast on the one hand and to Hoshiarpur district (the same place as for *E. incommodus*) on the other. The South-East Punjab is also, owing to the discovery of a new species (*E. ibrahimi*) at Kapurthala near Jullundur (Jalandhar), to be included in the endemic area of the genus.

Similarly the range of the genus *Octochaetus* is considerably extended by the record of *O. fermori* and also of a new species (*O. bishambari*) from Saharanpur (extreme north-west of the United Provinces, on the border of the Punjab); while another new species (*O. dasi*) makes its appearance at Baroda on the West Coast.

The Lumbricidae are all peregrine forms.

As regards the Punjab and North-West Frontier Province, the curious fact emerges that, so far as is known at present, this

region can scarcely be said to have a proper earthworm fauna of its own. The territory of the genus *Eutyphoeus* must be extended to include a part of the South-East Punjab; but for the rest, the terrestrial Oligochaeta have come from outside. There are earthworms in Lahore, for example, in any abundance; but they are species of *Pheretima* from the South-East, or of *Helodrilus* from the North-West.

It may be added that, except from the Simla hills, the only previous records of earthworms from the Punjab and North-West Frontier Province are those of *Pheretima hawayana* and *Lampito mauritii*, both from Lahore; examples of which were some years ago transmitted from me by the Indian Museum to Dr. Michaelsen.

Fam. NAIDIDAE.

Nais raviensis, sp. nov.

Specimens of this worm were found in material taken from the river Ravi near Lahore in February 1914.

The worms are minute in size, and are only to be discovered by a systematic search with a dissecting binocular microscope. The length of a chain of two is only 3 mm.; in breadth they are about .12 mm.; their colour is whitish.

The prostomium is blunt and short, shorter in length than the breadth of its base. There are no eyes. The number of segments in a double animal is about 26, that is about 13 in each half.

The *setae* are arranged in the manner usual in the genus. The first four pairs of ventral setal bundles are used actively, apparently as claws by which the animal pulls itself along; the bundles are first thrust forwards, the setae being together and parallel to the long axis of the body; then, as they are drawn backwards, they are spread out fan-wise, and lastly come together again parallel to each other. When in action, the points of the setae are directed backwards, like claws, the convexity of the curve of the distal (free) portions of the setae facing forwards.

The *dorsal setae* begin in segment vi, each bundle consisting as a rule of one hair-seta and one needle-seta; occasionally two needles are met with. The hair is short and fine, in length 83μ or less. The needle (text-fig. 1c) is of the double-pronged type; the shaft is almost straight for the most part, slightly curved distally; the two teeth of the forked end are short, stoutish at their base, separated by a considerable angle, and of equal length; the nodulus is about $\frac{2}{7}$ of the length of the shaft from its distal end; in length these setae are 40μ .

The *ventral setae* are usually four, sometimes three, per bundle; they may be divided into two groups, an anterior comprising those belonging to segments ii-v, and a posterior comprising the remainder; those of the anterior group are longer and thinner, with proximal nodulus, those of the posterior have the opposite characters.

More particularly, the anterior setae (fig. 1*a*) may reach a maximum length of 90μ ; their breadth is approximately 2.2μ . The distal prong of the free forked end is considerably longer than the proximal, and the two prongs are of equal thickness at their base; the angle between the prongs is narrow. The shaft is comparatively straight; the nodulus is very markedly proximal to the middle of the length of the shaft, the proportions of the sections of the shaft proximal and distal to the nodulus respectively being 1 : 2 or 3 : 5.

The posterior ventral setae (text-fig. 1*b*) reach a length of 48μ , and are in breadth about 2.5μ . The proximal prong of the forked end is slightly longer, and is twice as thick at the base as the distal; the angle between the prongs is moderately wide. The

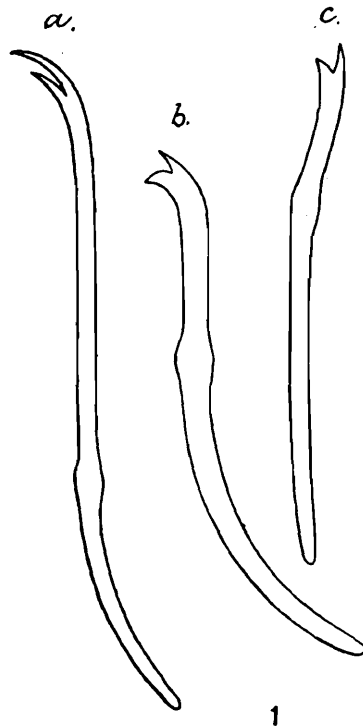


FIG. 1.—*Nais raviensis*; setae; *a*, anterior ventral, *b*, posterior ventral; *c*, dorsal needle. *a* \times 830, *b* \times 1150, *c* \times 1350.

curves of the shaft are more marked than in the anterior setae; and the nodulus is distal, the ratio being:—proximal to nodulus; distal to nodulus : : 5 : 3.

No *coelomic corpuscles* were seen.

On the dorsal side of the *pharynx*, and back as far as segment v, are a number of large, oval or pyriform, perhaps glandular cells, with well-marked nucleus, not very unlike the cells of the septal glands in the genus *Pristina*. *Chloragogen cells* begin in segment vi. No *stomach* was noted in the living animal; the oesophagus was narrow as far as segment viii, where it widened to form the *intestine*; in a stained specimen, however, there appears to be a stomachal dilatation in viii, followed by a narrower portion for a short distance, but this part of the tube quickly

dilates again to become the intestine before it has quitted segment ix. The *anus* is dorsal.

A lateral *commissural vessel* was seen in segment vi; no others were noted, but it would perhaps be rash to say they do not exist. The blood is yellow.

The first *nephridium* is in segment vii; thenceforward they occur regularly. Each nephridial tube dilates to form a small chamber in the parietes just before it opens externally in front of the ventral setal bundle.

The *cerebral ganglion* is large, extending forwards nearly to the tip of the prostomium and back to the level of the first bundle of ventral setae. It is bifid posteriorly (text-fig. 2).

Reproductive organs were not present in any of the specimens examined. Asexual division, however, was taking place; $n=13$ in the specimens examined. The first five segments and prostomium of the hinder animal are formed in the budding zone.

This species differs from most of those of the genus in having no eyes. It resembles in some respects two specimens insufficiently described by Walton (16) under the name of *N. tenui-*

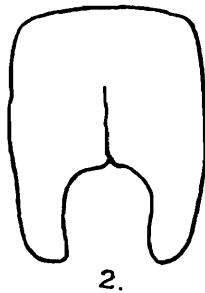


FIG. 2.—*Nais raviensis*; cerebral ganglion.

dentis. It is useless, as Walton does, to describe the "ventral setae"; in at least most species of the genus *Nais* and also of some allied genera these differ widely in the anterior and in the succeeding parts of the body. The points of difference usually extend to the length, thickness, curve of shaft, position of nodulus, and relative and absolute proportions of the teeth; and no description can fit both sets. In the present state of our knowledge, and with the multiplication of species differing from each other in comparatively minute points, the setae furnish the chief characters for their discrimination; and it is unfortunately impossible to make use of a description which does not specify whether the anterior or posterior group of ventral setae is meant, or whether, as may perhaps happen, these are similar in character throughout. The two groups are not distinguished by Walton in any of the four species which he describes; yet it is in the highest degree improbable that in all four cases both anterior and posterior setae should be capable of description in the same terms.¹

¹ The figure of the ventral setae given by Walton is stated to be of those of segment ii; the position of the nodulus, however, resembles what is usually found in more posterior segments.

In the present case the teeth of *N tenuidentis*, as described by Walton, have a considerable resemblance to those of the anterior, though widely different from those of the posterior, setae of the present form.¹

The value of *n*, however, which is much smaller in the present species, should serve easily to distinguish it. The smaller size of the present form may also be mentioned, though of subsidiary importance.

Naidium minutum, sp. nov.

Specimens of this worm were found in material taken from the river Ravi near Lahore in February 1914. The animal is too small to be seen except by hunting through the material with a dissecting binocular over a black background; with the exception, perhaps, of *Chaetogaster punjabensis*, it is the smallest Oligochaete known to me.

The length of a chain of two animals, moderately extended, is 2 mm.; its breadth in the extended condition 0.1 mm. Each animal is a small whitish thread, often marked, when seen by reflected light against a black background, by spots or transverse bands of a brilliant opaque white; these represent masses of coelomic corpuscles. When the worm retracts the anterior part of the body, the snout, from the level of the first ventral setae forwards, is somewhat kinked upwards.

The prostomium, with rounded end, is longer than it is broad at its base; it is not elongated to form a proboscis. There are no eyes. The number of complete segments in a double animal is 17 or 19, excluding new segments just forming in the budding zone between the two; *n* = 12, —constantly, so far as observed. The segments in the hinder part of the body, behind the stomach, are much longer than those in front; the first six segments are all quite short.

The *dorsal setae* begin in segment ii, each bundle consisting of one needle-seta and one hair-seta; the hair-seta is tapering, and very slender, in length 80–90 μ (thus less than the diameter of the body), and in thickness about 1 μ . The needle-seta (text-fig. 3) is 35 μ in length, and in thickness rather stouter than the hair, something over 1 μ ; its shaft has a slight double curve, and its distal end is forked, the prongs being almost equal in length,



FIG. 3.—*Naidium minutum*; dorsal needle-seta, $\times 1,600$.

¹ The longer of the two prongs in Walton's specimens measured as much as 20 μ in length; here the longer prong of the anterior setae is only 7–8 μ , but the animal itself is only about half the size of Walton's form.

and separated by a fairly wide angle; there is a slight nodulus one-third of the length of the shaft from its distal end.

The *ventral setae* are usually 3, occasionally 4, and rarely 5 per bundle; there is no sharp division into an anterior and a posterior group. They are 30–40 μ long, approximately 1.25 μ thick, of the usual double-curved and double-pronged type, the nodulus generally distal.

Differences between different segments may be illustrated by a few further details. In segment iv, as an example from the anterior region, the length was 35 μ , the nodulus was distal in the ratio:—distal portion of shaft: proximal portion :: 2 : 3; the distal prong of the fork was slightly longer. In segment x the prongs were equal in length, but the proximal prong was the thicker at its base; the nodulus here also was distal.

In segments ii and iii the setae were shorter, 30 μ ; and the nodulus at the middle of the shaft, or slightly or obviously proximal. In vi and viii setae were met with in which the nodulus was at the middle or only slightly distal.

Coelomic corpuscles are numerous. They appear black, i.e. are opaque, under the low power; by reflected light they cause the white spots and bands previously mentioned. With the high power they are seen to consist of aggregations of minute oil-like refractile globules, the proper colour of which is apparently yellowish. In shape they are circular or occasionally oval, and in size from 6 to 13 μ in diameter; a fairly large one would be 10 μ ; in stained specimens they are seen to be nucleated. The corpuscles can move forwards as far as the tip of the prostomium; in the first few segments they travel about with no apparent hindrance.

A second type of corpuscle was seen in fresh specimens, but in smaller numbers; these were of about the same size, but hyaline; no nucleus was observed in the living condition.

The *pharynx* is bulky, and occupies segments ii and iii. The *oesophagus* begins in segment iv. The *septal glands* are rather variable; they are apparently always present in segments iv and v, with the addition usually of a smaller pair in segment iii, or in segment vi, or (in one specimen) in both iii and vi. The *stomach* is in viii, of a pyriform shape with the broad end directed forwards; it has a somewhat streaked appearance, due apparently to the chloragogen granules being arranged more or less in rows. The alimentary tube is still narrow for some distance behind the stomach, and in contracted specimens forms here a small loop directed backwards; this is not quite straightened out even when the animal extends itself. The *intestine* begins in segment ix.

I failed to discern any transverse *vascular commissures*.

The first *nephridium* is in segment ix; the next is in xi, and there are no more in the anterior animal of a chain of two; in the posterior animal a nephridium occurs opposite the second pair of setal bundles, i.e. as will appear immediately, in what will be the ninth segment of this individual after separation.

The *cerebral ganglion* (text-fig. 4) is slightly bifid posteriorly, and has a concave anterior border.

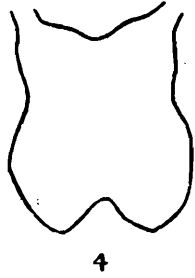


FIG. 4.—*Naidium minutum*; cerebral ganglion.

Sexual organs were not present in any of the specimens. *Asexual reproduction* was going on, and chains of two were usually observed; a chain of three, with two budding zones, was also seen. The budding zone establishes itself behind the twelfth segment ($n = 12$); and of the new segments formed in the zone, the hinder seven, with a prostomium, are apportioned to the posterior animal (text-fig. 5); in other words, in an animal which is about to

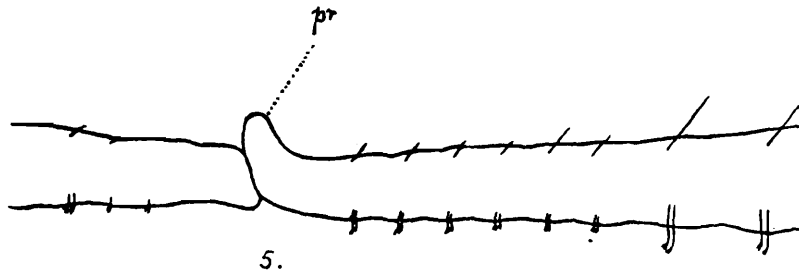


FIG. 5.—*Naidium minutum*; zone of budding.
pr., prostomium.

separate, the rudiments of six pairs of setal bundles are seen forming in its anterior part. In such a specimen the prostomium of the hinder individual may be seen projecting dorsalwards just behind the line of approaching division (*cf.* text-fig.); although after separation it is a small structure and not at all proboscis-like.

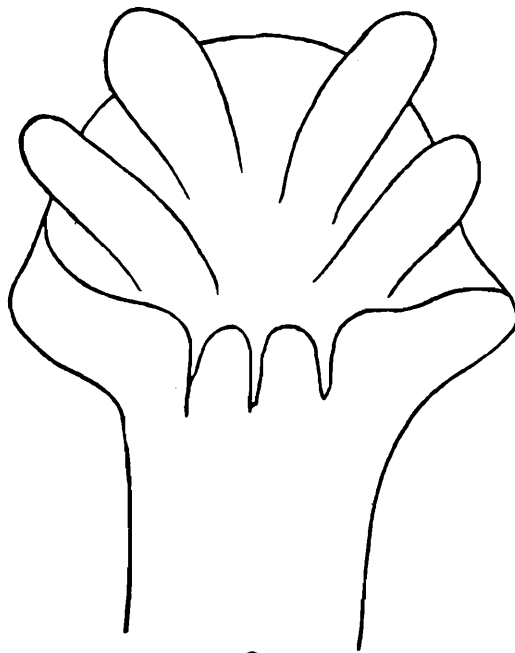
Michaelsen (5) has recently united the genera *Naidium* and *Pristina* under the latter name; though Piguet (9) still more recently prefers to retain them as separate. Without claiming to decide the point, and reserving judgment till the genital organs of *Naidium* have been described, it may be noted that an indication of the close relationship between the two is furnished by the facts of asexual reproduction. In *Pristina*, as I have previously stated (12), the number of segments at the anterior end which have been produced in the budding zone is seven,—i.e. six seta-bearing segments, a first segment without setae, and a prostomium. This is exceptional in the Naididae; the number of such segments is in the majority of cases five, or two less than in *Pristina*; and it is interesting now to find that in a species of *Naidium* (on which

there were no previous observations on the budding zone) the number turns out to be the same as in *Pristina*. The genital organs of *Naidium* have not so far been described; but since in *Pristina* their exceptional position in segments vii–viii (two segments further back than usual) is correlated with the presence of the two additional segments produced in the budding zone, it seems not improbable that the same will hereafter be found to be the case in *Naidium* also.

Dero limosa, Leidy.

This species was found at Lahore by my pupil Mohammed Afzal Husain, who kindly gave me a number of living specimens, in October, 1912.

The worms are about 6 mm. long, filiform, and pale grey in colour. When disturbed, they often execute wriggling movements



6.

FIG. 6.—Posterior end of *Dero limosa*.

like those of insect larvae; in trying to escape from under a cover-glass they may progress with the posterior end in advance. Of the specimens submitted to examination, none were undergoing asexual division.

The *prostomium* is bluntly conical. The number of *segments* is 47, 48 or 49, plus an undifferentiated region posteriorly in which setae are not yet developed. A feature of the Lahore specimens of this species is the occurrence of a number of segmentally arranged bright *orange-coloured spots*, due to a granular pigment in the surface epithelium and superficial to the muscular layer of the body-wall. They are situated on each side slightly ventral to, and approximately in the same vertical plane as, the insertion of the dorsal setal bundles. Their distribution is rather variable; they are perhaps usually best marked in the anterior segments,

but are sometimes present in the posterior portion of the body also.

Two pairs of *gills* (text-fig. 6) stumpy and cylindrical, arise within the margin of the anal funnel; a third pair is formed anteriorly to these by a projection of the funnel margin; and there is a similar small fourth, most anterior or dorsal pair, which might be considered as a portion of the third pair separated off by a cleft in the margin of the funnel. The appearance is sketched in text-fig. 6, and resembles that figured by Bousfield (2), except that the interval in the middle line between the fourth gills of each side is much less in my specimens. It is usual (Michaelsen, 3; Bousfield, 2) to describe only one pair of secondary branchiae, or projections of the funnel margin, in *D. limosa*; but, as Bousfield's figures (drawn probably in a more completely expanded condition of the funnel than mine) very plainly show, there are really two such pairs. All four pairs of gills are vascular and all four show in their interior a regular series of star-shaped or spindle-shaped cells, stretching by means of their processes across the cavity of the gill-process.

The *dorsal setae* begin in the sixth segment, and each bundle consists as a rule of one capillary and one needle seta. The capillary setae are on an average 190μ long. The needles are 66μ long, are bifid at the end, with the prongs small, equal or subequal; the nodulus is about 19μ from the distal end, and the shaft has a slight sickle-shaped curve between the nodulus and the free extremity.

The *ventral setae*, beginning in segment ii, are either three or four per bundle. There is a marked difference between those of segments ii—v and of the rest of the body.

In the anterior segments (ii—v) the curves of the shaft are slight; the total length is about 127μ , and the breadth 2.5μ . The prongs of the fork are separated by a very narrow angle, and both prongs are comparatively long; the distal is the longer,—one and a half times as long as the proximal, and equal to it in thickness. The nodulus is proximal to the middle of the shaft, thus:—

proximal to nodulus : distal to nodulus :: 50μ : 78μ .
or again ,, ,, ,, : ,, ,, :: 51μ : 75μ .

In the remaining segments (vi to posterior end) the setae are much shorter, and the curves of the shaft more pronounced. The prongs are comparatively short, and the angle between them is moderately wide. The distal prong of the fork is very slightly longer than, and is only half as thick at the base as, the proximal prong. The average length is 70μ , and thickness 3μ . The nodulus is distal to the middle of the shaft; but its position varies, as will be explained immediately.

Where these setae are four per bundle, they can be distinguished as two couples, an inner and an outer (or a more ventrally and a more laterally situated); the outer couple is the shorter, and is especially short from nodulus to tip; thus,—outer couple

length 66μ , nodulus 20μ from end; inner couple 75μ long, nodulus 31μ and 33μ from end.

In a bundle of three, the outer (most laterally situated) seta is the shortest, and is especially short from nodulus to tip; the innermost seta has the opposite characters, and the intermediate seta is intermediate also in measurements; thus:—

outer,	length	64μ ,	nodulus to tip	21μ .
middle,	,,	71μ ,	,,	26μ .
inner,	,,	75μ ,	,,	34μ .

In the outer setae of the bundles the nodulus is therefore relatively nearer the distal end.

Of the remaining anatomical characters it may be noted that there are no coelomic corpuscles; that chloragogen cells begin in segment vi, and that there is a fairly well-marked stomachal dilatation in x, or ix and x; that the first nephridium is in x; and that there are four vascular loops, in segments vii—x (Michaelsen gives the loops as 5-6; Bousfield as 5, and notes that the last is much the smallest).

Aulophorus furcatus (Oken).

The material on which the following account is based was brought from a ditch on the borders of Lahore City by L. Shiv Ram Kashyap, Professor of Botany in Government College, who handed it over to L. Karam Narain, Demonstrator in Biology. From him I received thousands of specimens matted together with a filamentous alga.

From the masses of this matted material the posterior ends of the worms projected, the expanded funnels with the gills looking like miniature flowers. These retract immediately if the mass is touched, but not if the table is jarred. From a few small masses, consisting mainly of the tangled bodies of the worms, the anterior end of the animals were projecting; these stretched themselves out and attached themselves to the floor of the glass dish, apparently trying to pull themselves along, the attachment being by means of the mouth, and the pharynx probably acting as the plug of a sucker (compare the action of the pharynx in *A. tonkinensis*, Annandale *ap.* Michaelsen, 4; and Stephenson, 11). In specimens examined on the slide the pharynx was seen to be continually advanced as far as the mouth aperture and then retracted, but it was not actually protruded from the mouth.

The length of the worms is 6—16 mm.; the longer are chains of two individuals. The breadth is about .2 mm. The number of segments, in a double animal, is 46—48, plus an undifferentiated zone posteriorly; but there may be more than 40 in a single animal, without any sign of fission. $N=18, 22, 23, 24, \text{ or } 25$, and is thus not constant.

Four new seta-bearing segments, *i.e.*, five in all, are intercalated at the zone of fission to form the head of the posterior animal. Thus, since the dorsal setae in this species begin on segment v,

the last of these newly formed segments must develop a dorsal bundle as well as a ventral; in one case this was distinctly seen to have occurred. In general in the Naididae the cephalized segments (those distinguished by the absence of dorsal setae) are those which are produced in the budding zone (12); here the budding zone produces one of the body segments also.

The prostomium is blunt and rounded.

The anal funnel at the posterior end of the body can be widely opened, and its margin everted to a much greater degree than is shown in Bousfield's figure (2, fig. 18). There is a pair of palps, and three pairs of gills. The posterior and middle pairs of gills constitute finger-like projections arising from within the funnel; the anterior gill on each side is the folded and projecting margin of the funnel, and disappears, or rather appears merely as a fold in the margin, when the funnel is fully everted. The posterior and middle pairs are about .36 mm. in length, or twice the diameter of the body at its hinder end; and the palps are of about equal length or in some cases rather shorter. All the gills are vascular, and show a number of bipolar or stellate cells, arranged at intervals, crossing the cavity of the gill-process (*cf. Dero limosa, sup.*).

The *dorsal setae* begin in segment v; each bundle consists of one capillary and one needle seta. The hair-setae are on an average 200μ in length, and are quite smooth. The needles are $60-62\mu$ long; the nodulus is situated rather more than one-third of the length of the shaft from the distal end; the free extremity is bifid, and the shaft has a slight sickle-shaped curve in its distal portion.

The *ventral setae* are usually four per bundle, rarely five; posteriorly the number diminishes to three, and in a number of the terminal segments to two only. The setae of the anterior bundles (segments ii-iv) differ from those in the rest of the body.

In the first few segments (ii-iv) their length is about 75μ , and breadth 2.5μ . The distal prong of the fork is $1\frac{1}{4}$ times as long and $\frac{2}{3}$ as thick at the base as the proximal prong. The nodulus is, in the innermost seta of a bundle, proximal to the middle of the shaft, thus:—distal to nodulus: proximal to nodulus:: 7:5. In the middle setae of a bundle, the nodulus is at the middle of the length of the shaft; and in the outermost it is also at the middle, or very slightly distal.

In the remaining segments (v onwards) the length is $62-66\mu$, and the thickness 3μ . The prongs of the fork are equal in length, but the proximal is twice, or even two and a half times, as thick at its base as the distal. The nodulus is usually distal to the middle of the length of the shaft, but its position varies in the same way as in other species of *Dero* and *Aulophorus* (10, and *cf. Dero limosa, ant.*); that is to say, it is more distally situated in the outer setae of a bundle than in the inner.

Thus in the innermost seta of a bundle the nodulus was found to be very slightly proximal to the middle of the shaft; in

the next it was distal, the proximal and distal sections of the shaft being respectively 37μ and 33μ ; in the next, these proportions were 38μ and 26μ ; and in the outermost seta of the bundle they were 41μ and 26μ : i.e., the nodulus is, relatively to the length of the seta, progressively more distally situated in the more laterally placed setae of the bundle. So again:—in the innermost seta of a bundle the nodulus was slightly proximal to the middle; in the next, proximal section: distal: : 37μ : 31μ , and in the outermost, proximal: distal: : 38μ : 28μ .

The innermost seta of each bundle is also a trifle slenderer than the others, and there is a gradual thickening from inner to outer, the outermost being the thickest.

There are no *coelomic corpuscles*.

The retractor muscles of the pharynx are a number of strands, inserted into the pharyngeal wall as far forwards as the anterior boundary of the third segment, and passing back obliquely to the parietes, some being attached as far back as dissepiment $\frac{5}{6}$. Surrounding this part of the alimentary tube, in segments iii-vi, and especially on its dorsal side, is a mass of tightly packed fairly large spherical or ovoid cells, apparently glandular. Chloragogen cells begin in segment vi. There is no stomach.

The dorsal vessel is situated dorsally on the intestine, not ventrally or laterally as in a number of related forms. There are four vascular loops, in segments vi-ix; Michaelsen (3) and Bousfield (2) give five as the number in this species.

The first nephridium is in segment vii.

Fam. ENCHYTRAEIDAE.

Fridericia bulbosa (Rosa).

Found at Wagah, a few miles outside Lahore, by Mohammed Afzal Husain, in January, 1912.

Length about 8 mm. *Segments* 30-37. *Prostomium* short, rounded. *Clitellum* including segments xii-xiii.

The *setae* are curved at their inner ends, straight for the rest of their extent, bluntly pointed; their length is about 28μ , and breadth nearly 3μ . In front of the clitellum the ventral setae are usually 4 per bundle, in which case the arrangement is that characteristic of the genus,—the two middle setae of the bundle are shorter and thinner than those on each side of them. In segment ii there may be only one seta on each side; in other segments in front of the clitellum there may be three setae per bundle. Behind the clitellum the ventral setae are usually two per bundle; in one specimen all ventral bundles throughout the body comprised two setae only. The lateral setae are usually two per bundle; in front of the clitellum there may be three. Segment xii is entirely without setae.

Dorsal pores are present from segment vii onwards.

The *pharynx* is in iii; its roof is composed of much elongated columnar epithelial cells, which form a sucker-like plug. *Septal*

glands are present in connection with septa $\frac{4}{5}$, $\frac{5}{6}$, $\frac{6}{7}$, projecting forwards into the anterior of the two segments with which the septum is in relation; except that the most anterior gland appears in sections to project backwards into v with its ventral portion, instead of forwards into iv. The *stomach* is a marked dilatation of the alimentary tube in segments x and xi; its epithelial lining consists of large cells arranged in definite longitudinal rows, each cell with a cavity in its interior. Oesophagus and stomach are markedly ciliated; the oesophagus widens in xiv to become the intestine. The *salivary glands* begin behind in segment vi, and run forwards ventral to the oesophagus through v; in iv they are much coiled, and finally enter the pharynx.

The *lymph corpuscles* are numerous circular or oval bodies, granular and, except for the very distinct nucleus, hardly staining. The largest are 22-27 μ in length.

The *dorsal vessel* begins apparently behind the clitellum, about the level of septum $\frac{1}{4}$.

The *nephridia* are of the compact type, small in size, the anteseptal portion nearly as large as the postseptal; there is a marked constriction at the septum; the duct is short, about equal to the postseptal portion in length, and is directed downwards and backwards. The first nephridium is in vii.

The *cerebral ganglion* is in segment ii; it is somewhat oval in shape, and not indented posteriorly. There are no "copulatory glands" in connection with the ventral nerve cord.

The *genital organs* have the usual situation. There are large numbers of developing spermatozoa in segment xi. The male funnel is short and stumpy, not more than twice as long as broad, without everted margin. The vas deferens is very slender and much coiled, and enters the penial bulb on the dorsal side of the latter; the bulb is approximately spherical.

Segment xii contains ova, septum $\frac{1}{3}$ being bulged backwards as far as the posterior boundary of segment xiii; the condition might be described as the commencement of the formation of an ovisac.

The spermathecae are situated in segment v, in front of the septal gland; the ampulla is small, somewhat irregularly ovoid, elongated transversely, and with thin walls: it probably opens into the oesophagus, though I did not see the actual aperture. The spermathecal duct is long, narrow, coiled, in the main transversely placed behind the septum; there are no gland cells round the duct or round the external aperture.

Enchytraeus harurami, sp. nov.

Specimens were obtained by myself and my pupil, L. Haru Ram, B.Sc., on 24th March, 1914, from the duckpond in the Zoological Gardens, Lahore; they are thoroughly aquatic, living under the same conditions as, and in company with, numerous Naididae.

The worms are 4 mm. in length, and of an opaque white colour; the anterior end is narrower than the posterior, and gently tapering. The prostomium is rounded; segments 35; no head-pore or dorsal pores. The worms are of a sluggish habit.

The *setae* are two per bundle regularly throughout the body in both dorsal and ventral bundles. All are of the same type; the shaft is straight, tapering and bluntly or even moderately sharply pointed distally, with a hook at the proximal end which is curved in an arc of about 90° ; the *setae* are frequently broadest about the middle of their length. In the posterior half of the body they are about 53μ long, and $3.5-4\mu$ broad; anteriorly they are rather smaller, $40-46\mu$ long.

Coelomic corpuscles are very numerous, and float freely in the body-cavity, in greater numbers towards the anterior end. They are small flat discs, oval or pear-shaped, or not infrequently spindle-shaped. In diameter the more nearly circular ones measure 10μ , while the length of the spindle-shaped corpuscles may be 15μ . They show nuclei in stained preparations; and after Heidenhain's iron haematoxylin, a number of black granules of relatively large size. In fresh specimens the corpuscles appear to originate from occasional strands passing between alimentary tube and body-wall, and from the septa in the anterior part of the body; this is confirmed in stained and sectioned preparations, in which a number of cells with the characters of the corpuscles are seen massed together on the anterior septa.

The *buccal cavity* is tubular and extends through segments i and ii. The *pharynx*, in segment iii, is distinguished by the thickening of its dorsal wall; this is composed of a high epithelium very definitely limited in extent both anteriorly and posteriorly, with the nuclei of the cells situated near their bases. The ventral wall of the pharynx is not thickened, its epithelium being almost cubical. A lining of cuticle extends throughout the buccal cavity and over the ventral wall of the pharynx; but on the dorsal wall it stops at the high pharyngeal epithelium, which is ciliated.

The *septal glands*, as seen in the living animal, appear to be in three pairs, in segments iv, v and vi, on the anterior faces of septa $\frac{4}{5}$, $\frac{5}{6}$ and $\frac{6}{7}$, causing the septa to bulge backwards. The examination of longitudinal sections shows that between these masses are others arranged in series with them; so that the glands on each side form a connected mass of five or six lobes arranged longitudinally. The glands of opposite sides are also continuous in each segment dorsally to the alimentary tube.

Salivary glands ("peptonephridia") are present, as coiled tubes, one on each side, opening into the oesophagus close behind the pharynx and extending backwards through segments iv and v. They are quite conspicuous structures, and though their lumen is intracellular they have a maximum diameter of as much as 18μ . The *oesophagus* continues narrow to segment xii, and the tube widens slightly in xiii to form the *intestine*.

The *dorsal vessel* originates in segment xii as a much dilated "heart," which takes up the whole of the length of the segment. The *ventral vessel* is as usual separate from the alimentary tube throughout the body.

The *nephridia* begin in segment vii, and are continued backwards regularly to segment x, after which there is an interval of three segments (xi-xiii); the regular series commences again in xiv. The anteseptal portion is very short, one quarter the length of the post-septal, and consists of an obliquely facing funnel; there is a marked constriction at the septum, and the post-septal portion is continued backwards and slightly downwards to open on the exterior in front of the ventral setal bundle. The narrower terminal portion or duct is a third to a quarter as long as the mass of the post-septal. In longitudinal sections the post-septal portion is sometimes thin and narrow, sometimes relatively broad; which indicates that this part has a flattened shape, and may be cut vertical to, or parallel with, the plane of flattening.

The *cerebral ganglion* (text-fig. 7) is large, of an elongated oval shape in a lateral view of the living animal, and extending

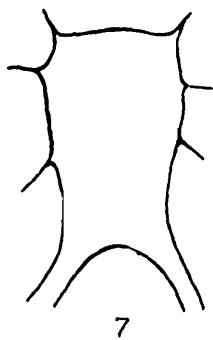


FIG. 7.—*Enchytraeus harurami*; cerebral ganglion.

from the front of the mouth to the level of the anterior border of the pharynx; it is slightly indented behind. The nerve cells along the course of the *ventral nerve cord* form a continuous layer on its lower surface, there being no, or only the very slightest, special aggregations (ganglia) in each segment.

The *clitellum* is not conspicuous; it extends over segments xii-xiii.

The *testes* are in segment xi, attached to the posterior face of septum $\frac{1}{11}$; this septum has a large vacuity in its middle portion, and the testis may be turned forwards through this opening and thus come to lie largely in segment x (*cf.* fig. 1). A pair of *sperm-sacs* are present, but these differ from the structures which are called by this name in the majority of the Limicolae. Here the testis is continuous with a mass of sperm-morulae; the whole, testis and sperm-morulae, are surrounded by a sac of peritoneum, which is attached to septum $\frac{1}{11}$ at the origin of the testis. The sperm-sacs may therefore lie in the anterior part of segment xi, or in segment x, according as the testis happens to be turned forwards through

the vacuity in septum $\frac{10}{11}$ or not (fig. 1). The sacs therefore differ from those of the Naididae and Tubificidae, which are constituted by a pocket-like backward bulging of the septum limiting the testis-segment posteriorly; and correspond rather to the testis-sacs of some of the terrestrial Oligochaeta.

A number of ripe spermatozoa are found in segment ix, round the mouths of the *funnels*. These structures are relatively small, with a well-marked rim succeeded by a globular body, the whole exactly resembling the top of a "thistle-funnel" used in chemical laboratories (fig. 1). The diameter of the funnel is 50μ ; the actual lumen of the funnel is narrowly tubular, the cells of the spherical bulb-like portion being elongated, with peripherally situated nuclei and clear slightly-staining central portion.

The male duct pierces septum $\frac{11}{2}$ immediately beyond the funnel, continuing as the *vas deferens* almost straight backwards through the anterior two-thirds of segment xii, bending slightly dorsalwards to enter the atrium on its dorsal, or dorsal and anterior, aspect. The *vas* is a narrow tube, $6-9\mu$ in diameter.

The *atrium* (penial body) is a small spherical mass, sessile on the ventral body-wall, 55μ in diameter. Its lumen is small, nearer one side, and in horizontal section shaped rather like the figure 3. The body thus consists for the most part of a tightly packed mass of cells, with distinct nuclei, and an investment of muscular fibres. There are no accessory gland-cells. The male pore appears on the surface as a slight papilla.

The *ovaries* are in segment xii, and the ova after being detached are confined to this segment. There are small *ovarian funnels* on the anterior face of septum $\frac{12}{3}$ near the ventral surface. The *oviduct* was seen in one instance as a minute tube passing backwards from the funnel to open on the ventral surface of the anterior part of segment xiii; in other cases it was indistinct.

The *spermathecae* occupy their usual position, opening on the ventral surface just behind septum $\frac{4}{3}$. The ampulla is spherical, of small size, 35μ in diameter, and distinctly marked off from the cylindrical duct. It has no opening into the alimentary canal; in one of my sections a strand, consisting apparently of a single muscular fibre, connected on the one hand with the muscular layer of the oesophagus and on the other with the muscular investment of the spermatheca, can be seen to pass between the two; but otherwise they are quite separate. The duct is about 18μ in diameter, and twice as long as the ampulla; a diverticulum is absent.

Fam. MEGASCOLECIDAE.

Sub-fam. ACANTHODRILINAE.

Microcolex phosphoreus (Dug.)

Peshawar, Shahi Gardens; 29-xii-1913; Bains Parshad. A single specimen, in a poor state of preservation.

Length 50 mm.; breadth $1\frac{1}{2}$ mm.; colour mottled grey, the clitellum being whiter than the rest. Segments 81.

Prostomium epilobous $\frac{1}{2}$.

The setae are widely paired: $ab = \frac{2}{3}aa = \frac{1}{2}bc = \frac{3}{4}cd$.

Clitellum $\frac{1}{3}xiii - \frac{1}{2}xvii = 4\frac{1}{6}$ (according to sections the clitellum includes the whole of $xiii = 4\frac{1}{2}$).

Nephridial apertures easily visible, especially conspicuous on the clitellum; in the lateral line of the body, just below the level of setae *c*, intersegmental.

No genital apertures visible.

The internal anatomy was investigated by sections in a frontal plane. Though the state of preservation was apparently, as noted above, poor, the sections leave nothing to be desired from the point of view of the general anatomy of the specimen.

The first septum is $\frac{4}{5}$; it and $\frac{5}{6}$ are thin, while $\frac{6}{7} - \frac{1}{3}\frac{2}{3}$ are all moderately thickened.

The gizzard is rudimentary, and is represented only by a thickening of the circular muscular coat of the oesophagus in segment v; though this thickening may be called considerable, it does not cause any swelling of the tube as a whole.

Septal glands are present in segments v-viii; in these segments they are paired structures, those in viii being smaller than the rest. In front of septum $\frac{4}{5}$ the series of glands of each side unites dorsally over the pharynx with that of the other side.

Throughout segments ix-xiii the oesophagus is fairly broad, and though not segmentally constricted seems here to have a structure which represents the calcareous glands of other forms. In the ventral portion of the tube the lumen is narrow, and the walls consist of a scaffolding or framework of a spongy appearance, carrying very numerous and large blood vessels; dorsally the lumen is wide, though the epithelium is thrown into conspicuous folds. Had the animal been large enough for dissection, the condition would probably have been capable of description in the same way as for *Eutyphoeus bishambari* and *E. waltoni* (v. post).

Hearts are present in segments x, xi and xii; in front of this the commissural vessels are quite small.

The excretory system is meganephric; each nephridium has a large end-sac.

Testes and funnels are free, in segments x and xi. The vesiculae seminales are paired, small, and situated in xi and xii. The prostates are a single pair, of small size, extending over no more than a segment, and opening behind on segment xvii at the posterior border of the clitellum, close to seta *b* and on its outer side. The vasa deferentia of each side run backwards close together, and curve round the outer side of the prostatic duct, becoming first posterior and then internal to the latter; the two ducts of the same side unite in the substance of the body-wall, and finally, reaching the surface, open at the same level as the prostatic ducts, but on the inner side of seta *b*. Owing to the sections being in the frontal plane, the setae of segment xvii are cut

transversely, and hence it is impossible to discover whether they are modified in any way; the mode of sectioning, however, has the advantage that it allows a very pretty demonstration of the exact relations of ducts and setae.

The ovaries and their funnels are in segment xiii. The spermathecae are in ix, the apertures being in $\frac{8}{9}$, in line with setae *a*; the ampulla is pearshaped; two short diverticula are given off from the duct. On one side the two diverticula arise separately from the duct, on the other by a common stalk.

Michaelsen (8) has recently subsumed under the one head of *M phosphoreus* no fewer than six forms previously accounted distinct. The diagnoses of these six forms (*cf.* Michaelsen, 3) differed in such details as the relations of the male pores and spermathecal pores to the lines of the setae, the presence of one or of two diverticula of the spermathecae, and the degree of development of the gizzard. So far as these different diagnoses have any value, the present form seems to approach most closely to the description of *M. hempeli* F. Smith, and differs from that of *M phosphoreus* in having two spermathecal diverticula instead of a single one.

Sub-fam. MEGASCOLECINAE.

Lampito mauritii, Kinb.

Lahore, New Shalimar; 30-x-1911; Ibrahim.

Kapurthala (Punjab); July 1913; Ibrahim.

The only feature worthy of note is the considerable break in the setal chain ventrally ($aa=2\frac{1}{2}-3ab$); *ab* was as usual the widest setal interval, but no regular decrease in the intervals could be substantiated on travelling outwards towards the lateral margins.

This species was represented in a small collection which I sent from Lahore to Dr. Michaelsen in 1907 or 1908 (4, p. 179); but it must be very rare near Lahore, since the capture of a single specimen in 1911 constitutes the only occasion on which it has since been met with.

Lampito trilobata, sp. nov.

Baroda; 2-viii-1912; Bishambar Das.

Length 86 mm.; breadth maximum 4 mm. Colour light brown dorsally, with, behind the clitellum, a mid-dorsal purplish streak; pale laterally and ventrally. Ventral surface flattened. Segments 160; only segment xiii is triannular.

Prostomium prolobous, i.e. separated by a transverse groove from segment i; but there is also a pair of longitudinal grooves on the dorsal surface of the first segment, which, extending backwards for half the length of the segment, are not connected with each other behind.

The first dorsal pore is in $\frac{11}{12}$.

The clitellum extends from $\frac{1}{3}$ xiv to xvii= $3\frac{2}{3}$. The separate segments can still be distinguished, and setae and dorsal pores are present.

The setae form a ring, which is almost closed dorsally ($zz=1\frac{1}{2}yz$ approximately), but the interval is irregular. Ventrally the interval is much larger, $-aa=2\frac{1}{2}-3ab$, or in front of the clitellum may be as much as $4ab$. Of the intersetal intervals ab is the largest; but there is no regular decrease on passing outwards. The largest setae in each ring are aa ; the dorsal setae are often difficult to make out, partly because they are smaller, and partly because of the pigmentation. The following numbers were counted $-v/28$, ix/40, xii/44, xix/34, and more posteriorly 32-34.

The male apertures (fig. 2) are on segment xviii, between the lines of setae b and c , with projecting penial setae. Each pore is situated within, and nearer the outer border of, a slightly raised flat glandular area, which takes up the whole of the length of the segment, and may both encroach on segment xix and cause a forward bending of furrow $\frac{1}{8}$. The inner border of each of these areas is semicircular, the outer is indented so as to form three lobes, giving a constant and characteristic appearance (fig. 2). The apertures themselves are nearly a fourth of the circumference apart.

The female pore is perhaps indicated by a minute depression in the mid-ventral line on the anterior part of segment xiv, just in front of the annulation which marks the anterior extent of the clitellum.

The spermathecal apertures are small, in furrows $\frac{6}{7}$, $\frac{7}{8}$, and $\frac{8}{9}$, in about the lateral line of the body. There are no other genital markings.

The first septum is $\frac{5}{6}$, which is not, or only slightly, thickened; $\frac{6}{7}$, $\frac{7}{8}$ and $\frac{8}{9}$ are considerably, $\frac{9}{10}$, $\frac{10}{11}$ and $\frac{11}{12}$ greatly thickened; after this the thickness rapidly diminishes, $\frac{12}{13}$ being moderately and $\frac{13}{14}$ slightly thickened.

The gizzard is in front of septum $\frac{5}{6}$; between the hinder end of the pharynx and septum $\frac{5}{6}$ the alimentary tube forms an ovoid dilatation, of which the posterior half or rather more has the thick muscular wall which constitutes it a gizzard, while the anterior portion is quite soft; the gizzard therefore has the shape of a half ellipsoid, and may be compared to an egg-cup. The oesophagus is slightly dilated in each segment from vii to xii, but no calcareous glands are marked off from the tube, though the wall has a lamellated structure (in segment ix, where the tube was cut into). The intestine begins behind the prostates, in segment xx.

The last heart is in xiii.

From segment xxi onwards there are a meganephridium and a row of very small micronephridia on each side in each segment; the arrangement is the same at the posterior end of the animal, where the meganephridium occupies a lateral position in the segment. In front of xxi only micronephridia are present; while

extremely dense on the body-wall in segments xv, xvi and xvii they are rare or absent on the body-wall elsewhere. They are however found in numbers on the septa; thus they occur plentifully on the posterior surface of the thickened septa from $\frac{9}{10}$ backwards, less abundantly in front of this; they occur as large rosette-like tufts on the anterior surface of septa $\frac{6}{7}$ — $\frac{9}{10}$, one on each side, and as smaller tufts on $\frac{10}{11}$ and $\frac{11}{12}$ similarly. There is also a large tuft on each side of the pharynx.

Testes were not identified, but small iridescent funnels were present in segments x and xi. A pair of seminal vesicles are present in xii, attached to the posterior face of septum $\frac{11}{12}$; they are elongated so as to curve round the alimentary canal, and touch each other in the middle line dorsally; their surface is lobulated. There are no seminal vesicles in segment ix.

The prostates are of considerable size, in segment xviii, septum $\frac{17}{18}$ being rather bulged forwards and $\frac{18}{19}$ markedly bulged backwards; they are cut up on the surface into a number of lobules. The duct arises from the middle of the gland, is stout, white and shining, comparatively short and only slightly bent.

The ovarian funnels are small, in segment xiii.

The spermathecae (fig. 4) lie in segments vii, viii and ix. The ampulla is large, irregular in shape and may be bent on itself, its form varies so much that no two seem exactly to resemble each other. A duct can scarcely be described; it is simply the narrowing of the ampulla where it is attached to the body-wall; from this portion spring the two minute diverticula, one on each side of the base of the ampulla, elongated and very slightly club-shaped.

The genital setae (fig. 3) are 1.2 mm. in length and 36μ in maximum breadth; they are gently curved. The distal .2 or .3 mm. of their length is armed with a number of triangular teeth, of considerable size, pointing distalwards and set on the shaft at an acute angle; they extend further up the shaft on the side which forms the convexity of its curve than on the opposite one. The free end of the seta is broadened, and may be best described as resembling a horse-shoe with a thin lamella spanning the concavity (thus differing from the condition in *L. mauritii*).

The points which distinguish this species from *L. mauritii*,—the species to which apparently it comes nearest,—are the "web" connecting the limbs of the terminal horse-shoe of the penial setae, as just mentioned; the broad, flat, characteristically shaped papillae on segment xviii; the gizzard in segment v; and the presence of only one pair of seminal vesicles.

Pheretima posthuma (L. Vaill.).

Lyallpur (Punjab); Nov. 1911; Madan Mohan Lal.
Saharanpur (United Provinces); 21-viii-1912; Bishambar Das.
Hoshiarpur; July 1913; Ibrahim.
Mian Mir (near Lahore); 15-xii-1913; Bains Parshad.
Jullundur; Dec. 1913; Ibrahim.

Phagwara (Jullundur District); 2-i-1914; Ibrahim.
Ferozepore, river side; 22-ii-1914; Bains Parshad.
Lahore; very common.

This species is one of the commonest in Lahore, and being always procurable it is used as a type of the *Oligochaeta* in our Zoological classes.

***Pheretima heterochaeta* (Mchlsn.).**

Mardan (Peshawar District, N.-W. Frontier Province); 25 and 26-xii-1913; Bains Parshad.

Lahore, quite common.

Peshawar (N.-W Frontier Province); 29-xii-1913; Bains Parshad.

***Pheretima hawayana* (Rosa).**

Lahore; not uncommon.

I give below a few of the external characters of this species as it occurs at Lahore.

The setal ring is always broken dorsally, the interval *zz* being usually equal to *zyz* or rather more. Ventrally also there is a break, which is rather less than the dorsal; $aa=1\frac{1}{2}-2ab$,—rather less in front of the clitellum than behind. Setae are as a rule not visible on the clitellum except ventrally on segment *xvi*; in one instance a few were seen ventrally in *xiv* also.

In two cases out of five it was noted that there was no marked difference in size between the setae of the anterior and subsequent parts of the body; in one they were smaller behind the tenth segment; in one the setae of segments *v-vii*, and in another of *iv-viii* were enlarged.

The clitellum may or may not include the whole of segment *xvi*; in the latter case it is not fully three segments in extent.

The papillae in the neighbourhood of the male pores are variable; but all specimens agree in the fact that none are situated external to the apertures. They are mostly arranged in two transverse lines, one near the anterior border of *xviii*, and another similarly placed in *xix*; the line in segment *xviii* may be composed of as many as eight papillae, the one in *xix* contains fewer. Other papillae may occur on the posterior part of *xviii*, behind the level of the male apertures; and less frequently on the anterior part of *xvii*.

Papillae also occur in the neighbourhood of the spermathecal apertures,—either situated behind the apertures, or in the mid-ventral line on segments *vii* and *viii*.

Length of specimens 100 mm., breadth 4 mm.

The specimens thus agree with the typical form of the species in having stouter setae in the anterior part of the body, and in having a broken setal ring. In the distribution of the genital papillae, and in the extent of the clitellum over three segments, or nearly so, they resemble the subspecies *barbadensis*. The

above description may be compared with those of specimens from Yunnan (13) and Ceylon (14).

Sub-fam. *OCTOCHAETINAE*.

Octochaetus fermori, Mchlsn.

Saharanpur (United Provinces); 12-viii-1912; Bishambar Das. About a dozen mature specimens, all softened.

Length 50-65 mm; breadth, maximum $2\frac{1}{3}$ -3 mm.; colour light grey with an olive tinge no difference between dorsal and ventral surfaces, clitellum yellower. Segments 133-139.

Prostomium epilobous $\frac{1}{2}$ or less. Segments vi-vii biannular, viii-xii triannular (or viii-ix quadriannular), post-clitellar segments triannular.

Dorsal pores are present, the first being in furrow $\frac{1}{3}$ just in front of the clitellum; or apparently in another specimen in furrow $\frac{1}{8}$, on the hindermost part of the clitellum.

Setae paired, but the lateral setae widely, i.e. cd is not much less than bc . In front of the clitellum $ab = \frac{1}{2}aa = \frac{2}{3}bc$; $cd = \frac{3}{4}bc$ or more; behind the clitellum $ab = \frac{2}{3}aa = \frac{1}{2}bc$; cd as before; $dd = \frac{3}{5}$ of the circumference.

Clitellum very distinctly marked off by deep constrictions, xiii-xvii or $\frac{1}{2}xviii = 5$ or $5\frac{1}{2}$; setae present, except the ventral pairs of xvii.

The actual male apertures and prostatic pores are too small to be seen. The seminal grooves have the outwardly curved shape shown in fig. 5; the prostatic pores of segment xix may possibly be in the centre of each of a pair of small rounded whitish areas there shown; if so, allowing for the inward trend of the lines of the setae at this place, they would be in, or a little internal to, the line of setae b . The clitellum may overhang more than is shown, concealing the anterior part of the seminal grooves, a large part of the ventral aspect of xviii and, laterally, a great part of xix also.

The female pores appear to be situated in a transverse groove in front of the setae of xiv, and to be represented by small dots close together near the middle line.

The spermathecal apertures are in slightly raised and glandular-looking areas mid-ventrally situated on the seta-bearing annuli of segments viii and ix: these cushion-like areas apparently represent the papillae described by Michaelsen, here fused in the mid-ventral line.

The first septum is $\frac{1}{5}$, which is thickened; after which there is an interval, the next being $\frac{8}{9}$, which is not much thickened; $\frac{1}{6}$, $\frac{10}{11}$ and $\frac{11}{12}$ are all thickened, the rest thin. The septa $\frac{8}{9}$ - $\frac{11}{12}$ are all rather close together, $\frac{10}{11}$ and $\frac{11}{12}$ especially so,—indeed these are adherent, though they can be separated by needles.

The gizzard is relatively large, and is situated in the middle of the interval between septa $\frac{8}{9}$ and $\frac{9}{10}$. A single pair of calcareous

glands occupy segments xv and xvi, but in two specimens dissected the arrangement was asymmetrical, as follows:—The greater part of the gland of the right side was contained in xv, a small part only being in xvi; while the reverse was the case on the left side. The glands are white in colour, antero-posteriorly compressed, attached round the side of the oesophagus, and meeting each other in the mid-dorsal line above the oesophagus; they are lobed, the lobes being arranged as a single row around the oesophagus; the lamellae in the interior have an antero-posterior direction. The intestine begins in xvii.

The last heart is in xiii.

The excretory system is micronephric, the nephridia being numerous and small; they are especially abundant on the inner surface of the body-wall in the clitellar segments, on the posterior part of the pharynx and on the first part of the oesophagus.

The male organs show the peculiarity described by Michaelsen. In segment x were found a pair of funnels, comparatively small, and not iridescent, but not testes; in segment xi testes were present, of moderate size, and also relatively large iridescent funnels; these organs in segment xi were enclosed with the testes in testicular sacs, in segment x they were free.

The seminal vesicles and prostates agree with Michaelsen's description.

A pair of ovaries, branched, with a number of finger-like processes, occur in segment xiii, with a pair of funnels. A second pair of ovaries occurs in segment xiv; they are of at least equal size with those in xiii, but are more compact, resembling a bunch of grapes; and (at least in one of the two specimens dissected) are more dorsally situated in the segment, being attached to the septum at its junction with the alimentary canal so that they lie dorso-laterally to the latter. In both specimens microscopic examination confirmed the ovarian nature of the structures. Funnels were absent in segment xiv.

The spermathecae are two pairs, remarkable for their small size; they are situated by the side of the ventral nerve cord. The ampulla is ovoid, and is continued by the duct, which is short and relatively broad. The diverticulum is small, half the length of the ampulla, and dilated at its end; it was overlooked at first, since it arises from the very base of the duct where it pierces the body-wall, and itself lies close on the body-wall.

The penial setae differ in some degree from the previous description of this species (Michaelsen, 4), and are therefore illustrated in fig 6. In length they are 550μ , in breadth 15μ ; the shaft is almost straight, except for a simple curve at the distal and a slight bending at the proximal end. The tip is simple, tapering, and pointed. A few teeth lie flat against the shaft in the region of the distal curvature.

There can hardly be any doubt as to the specific identification of these specimens. I have, however, given a pretty full description, because, as Michaelsen says, the species is an interest-

ing one, and because points of difference, in detail at least, are numerous. The presence of two pairs of ovaries is a curious anomaly.

Octochaetus dasi, sp. nov.

Baroda; 2-viii-1912; Bishambar Das. Two mature and one immature specimen.

Length 80 mm.; breadth 4 mm.; colour pale grey throughout, except clitellum which has an orange tinge. Segments 192.

Prostomium small, with a pointed posterior tongue which extends backwards mid-dorsally through half the length of segment i. Segments v-vi biannulate, vii-x triannulate.

First dorsal pore at anterior border of clitellum, in furrow $\frac{1}{3}$.

Setae all on the ventral surface, paired; behind the clitellum $aa = 2\frac{1}{2}ab = bc = 1\frac{1}{2}cd$; $dd = \frac{2}{3}$ circumference. The setae *aa* approach closer together near the clitellum, both in front of it and behind. In the anteclytellar region there is no great difference in the ratios; *aa* and *bc* are relatively a little smaller.

Clitellum xiii-xvii ventrally, xiii- $\frac{1}{2}$ xviii dorsally (5 or $5\frac{1}{2}$); according to internal dissection it includes the whole of xviii (perhaps due to non-correspondence of septa with furrows). The clitellum is very distinctly marked off, the body being constricted at its anterior and posterior limits as if by a tightly drawn thread. The body-wall in this region is very thick and friable. Setae and dorsal pores may or may not be visible on the clitellum (visible in one specimen, not in the other).

The genital area is characterized by a midventral, rather small, puckered depression, which takes up the length of xviii and just extends on to the adjacent parts of xvii and xix (fig. 7). Segment xviii, as will be evident, is short. The actual apertures are not certainly discoverable; there seems to be a pair of (prostatic) pores at the antero-lateral 'angles' (if such can be described) of the depressed area; it is possible that the male pores are at the lateral border of the area, in line with the setae of xviii, and the posterior prostatic pores at the postero-lateral 'angles' of the area, but this is really no better than a surmise.

The female pores are apparently situated in a transverse groove on the anterior part of segment xiv, which extends from just external to the line of setae *a* to a corresponding point on the other side.

Spermathecal apertures are not visible; from the internal dissection they must be situated very near the middle line in furrows $\frac{2}{5}$ and $\frac{8}{9}$.

The first septum, which is moderately thick, is $\frac{5}{9}$. This is followed by a long interval, after which come $\frac{8}{9}$ - $\frac{1}{3}$, all moderately stout. The rest are thin. Septa $\frac{8}{9}$ - $\frac{1}{2}$ are all close together, especially $\frac{10}{11}$ and $\frac{1}{2}$ which are separable with some difficulty.

A considerable length of the oesophagus is in front of the first septum, being bent under the pharynx. The gizzard is short,

being compressed antero-posteriorly, and so resembling a stout ring; it is obliquely placed, slanting forwards and upwards, i.e. its upper border is anterior to its lower. The gizzard is situated in the middle of the space between septa $\frac{5}{6}$ and $\frac{8}{6}$; in front of it is a length of oesophagus, behind it a somewhat swollen portion of the tube, from which it is separated by a constriction. Behind septum $\frac{8}{6}$ the canal is narrow as far as xviii, where it becomes the intestine. A very prominent double typhlosole begins in xx.

In segments xv-xvi are a pair of large white lobed calcareous glands, one on each side of the oesophagus. The lamellae in their interior ran transversely in one case, longitudinally in another.

The last heart is in segment xiii. The missing septa between $\frac{5}{6}$ and $\frac{8}{6}$ are indicated by the presence of transverse commissures; so that the numbering of the segments is possible even in the absence of the dissepiments. One pair of commissures (those of segment vi) is situated just behind $\frac{5}{6}$; and there are two pairs close together behind the gizzard and in front of septum $\frac{8}{6}$ (those of vii and viii).

The excretory system is micronephridial throughout the body. The nephridia are extremely numerous and close-set in the clitellar region. There are no tufts at the side of the pharynx; but a considerable number occurs dorsally on the pharynx under cover of the first septum.

Funnels of comparatively small size, but no testes, were found in segment x in each of two specimens dissected. Both funnels and testes are present in xi, the funnels being considerably larger than those in x, and the testes also being comparatively large. Testes and funnels are not enclosed; the testes were, however, united with the mouths of the funnels, from which they can be torn apart.

The seminal vesicles are one pair, in segment xii, attached to the posterior face of septum $\frac{11}{12}$; they are small in size and compact in form.

The prostates varied in the two specimens dissected. In the first they were one pair only, each a small glandular tube in segment xvii transversely placed in the segment; in the second they were two pairs, both very small, elongated in shape, in segments xvii and xix.

Ovary and funnel were identified in segment xiii, the former consisting of a number of moniliform processes.

The spermathecae are minute, egg-shaped, lying by the side of the ventral nerve cord. The duct is short, and there is no diverticulum.

No penial setae were discovered.

***Octochaetus bishambari*, sp. nov.**

Saharanpur (United Provinces); 21-viii-1912; Bishambar Das. Two specimens.

Length 35 mm., breadth 1 mm.; thin, small elongated worms, of an indefinite grey colour. Segments 85.

Prostomium epilobous $\frac{1}{3}$ – $\frac{1}{2}$.

Setal ratios estimated as (post-clitellar) $ab = \frac{2}{7}aa = \frac{2}{5}bc = \frac{2}{3}cd$.

Clitellum extends over xiv–xvi = 3. The body is narrower in the segments embraced by the clitellum.

All that could be made out in the genital area was that the setae *a* of segments xvii and xix were enlarged, and running straight between them, longitudinally on each side (i.e. from seta *a* of xvii to seta *a* of xix), was a narrow groove. Setae *b* seem to be absent on xvii and xix, and both *a* and *b* on xviii.

A specimen was sectioned longitudinally in order to study the internal anatomy.

The first septum is $\frac{1}{8}$, which is thin; $\frac{5}{6}$ is slightly thickened, moderately, $\frac{7}{8}$, $\frac{8}{9}$ and $\frac{10}{10}$ considerably, and $\frac{11}{11}$ perhaps slightly. The rest are thin. Septa $\frac{6}{7}$ and $\frac{7}{8}$ are much bulged backwards.

Dorsal to the alimentary canal in segments iv and v, stretching back from the roof of the pharynx over the dorsal surface of the oesophagus is a gland which at its hinder end almost reaches the anterior end of the gizzard; laterally also it extends well round the sides of the alimentary tube. The gizzard is in segment vi; it is small, elongated, with not very thick walls. The oesophagus is narrow in vii, and thenceforward dilated in each segment and constricted at the septa; the epithelium is folded in all the oesophageal segments viii–xiii, but there are no calcareous glands. The intestine begins in xiv.

The excretory system is meganephric.

Testes and funnels are both found in segments x and xi. Seminal vesicles are present as three pairs, in x, xi and xii; they are dorsally situated, above the oesophagus; those in x and xi meet their fellows above the tube, those in xii do not quite meet.

The prostates are two pairs; one pair occupying xvii and xviii, the duct ending in xvii, the other occupying xix and xx, the duct ending in xix. The ducts are bent into a gentle S-shaped curve.

Ovaries and ovarian funnels, the latter small, are situated in xiii. The oviducts are narrow, and end on the anterior part of the ventral surface of segment xiv, each in front of one of the ventral setae, probably *b*.

The spermathecae are situated in segments viii and ix. The ampulla of each is apparently ovoid, and there is a well-marked stoutish duct, longer than the ampulla and bent in its course; the ducts open in intersegmental furrows $\frac{7}{8}$ and $\frac{8}{9}$. There is a considerable diverticulum, approximately spherical in shape, from the base of the ampulla.

Genital setae are present in segments xvii and xix, at the apertures of the prostatic ducts, in bundles of two or more. Each is curved to nearly a quarter of a circle; in length they are approximately 400 μ , in breadth 9–10 μ . The extremity is simple, and bluntly pointed.

The above description is not as full as could be desired, on account of the small size of the animal and the impossibility of examining it by dissection. A number of sections were also damaged through the presence of matter in the alimentary canal which interfered with the cutting. The description will, however, enable the form to be recognized when it is again met with. Its small size, the presence of the large glandular structure in connection with the pharynx, the complete series of septa from $\frac{4}{5}$ onwards, and the characters of the genital setae will serve to distinguish it.

The species is especially peculiar in being meganephric. As to there being one large (relative to the size of the animal) nephridium on each side in each segment there can be no doubt; in my original notes I find a statement to that effect in the middle of the description of the external characters; which indicates, I think, that the nephridia must have been visible through the thin and probably semitransparent body-wall. The statement is borne out by the sections, which I have again carefully examined for this purpose. That the nephridia are comparable to the meganephridia occurring, for example, in the Lumbricidae, is, however, not certain. I have failed to find, in the sections, any evidence of their attachment to the septa, and especially of their piercing the septa in the typical manner, with the funnel on one side and the bulk of the organ on the other. On the contrary, the trend of the tube, where it can be most distinctly made out, is backwards from the external aperture rather than forwards towards the anterior septum. Owing to a lamentable accident, whereby a number of my most carefully preserved specimens were thrown away by an ignorant laboratory boy, any further examination of the original specimens is impossible, and I am left only with a series of longitudinal sections of the anterior portion of one of my examples.

***Eutyphoeus incommodus* (Bedd.)**

Pusa (Bengal); 10-ix 1912; Bishambar Das. Two specimens.

Basi Muda (Hoshiarpur District, Punjab); Aug. 1913; Md. Ibrahim. Numerous specimens.

Ambala (Umballa); Aug. 1913; Ibrahim. Numerous specimens.

Length 90-112 mm.; breadth 4 mm.; colour brownish olive. Segments 141-162.

The prostomium shows a combination of the pro- and tanylobous characters; there are present both the transverse groove which in prolobous species marks off the prostomium from the first segment, and also the two longitudinal grooves between which, in tanylobous species, the prostomium is continued backwards to furrow $\frac{1}{2}$ (compare Beddard's description of *E. nicholsoni*, 1, p. 197, with which he states *E. incommodus* agrees).

First dorsal pore $\frac{1}{2}$ or $\frac{1}{3}$.

Septum $\frac{4}{5}$ is slightly thickened, $\frac{5}{6}$ moderately; $\frac{8}{9}$, $\frac{9}{10}$, $\frac{10}{11}$ are all slightly, or in the case of the last two it may be moderately,

thickened. In most species of *Eutyphoeus* septum $\frac{11}{2}$ seems to be absent as such, and to be represented by a rather dense mass of connective tissue around the oesophagus, which binds down the corresponding lateral vascular commissures; in the specimen from Basi Muda which I dissected, however, septum $\frac{11}{2}$ was present, though thin.

The calciferous glands may certainly, as mentioned by Michaelsen (4), take up two segments (xi and xii). The intestinal glands or diverticula, about the middle of the animal's length, are five pairs; they are all bilobed, the smallest being anterior; they increase in size from before backwards.

The dorsal vessel is continued forwards on to the pharynx. At the posterior border of the pharynx there is a considerable lateral branch on each side; lateral commissures are present in segment v also. The next commissures pass transversely round the side of the gizzard at about the middle of its length; the next are situated at the posterior end of the gizzard, and are closely followed by another pair immediately in front of septum $\frac{8}{9}$. The hearts of segment xi were not, in the example from Basi Muda which I dissected, bound down to the oesophagus as in other species; though in a specimen from Pusa they were noted as being embedded in connective tissue.

Testes and funnels were present in both x and xi, those in x being rather smaller than those in xi (Basi Muda). The example from Pusa which I dissected had large and iridescent funnels in both segments; testes were doubtful, but were perhaps represented by a few thin finger-like processes deep in each of the segments. The sperm-sacs, in ix and xii, correspond to previous descriptions.

The penial setae (fig. 8) are about 1 mm. in length, bluntly pointed, with a very slight bulb-like swelling at the end. The sculpturing consists of short transversely placed rows of very fine points, probably minute prominences, found only near the distal end.

This species was first described by Beddard (1) from specimens from Calcutta. It has since been examined by Michaelsen (4, 6), who has received specimens from Calcutta and Rajmahal. The above short notes will serve to confirm the peculiarities noted by earlier observers, and to add a few details to our knowledge. It is interesting to observe that the species has such a wide distribution.

***Eutyphoeus mohammedi*, sp. nov.**

Allahabad; Dec. 1911; Md. Ibrahim. Seven specimens.

Length 75 mm.; breadth $4\frac{1}{2}$ mm.; colour an equable light grey, with a mid-dorsal purple streak over part of the body anteriorly. Segments 149.

Prostomium combined pro- and tanylobous (*cf. E. incommo-dus*). Segments iv and v biannulate, the succeeding preclitellar segments triannulate.

First dorsal pore in furrow $\frac{1}{1}\frac{1}{2}$.

The setae are paired; in front of the clitellum $ab = \frac{2}{5}-\frac{1}{2}aa = \frac{1}{3}bc = \frac{3}{4}cd$, while behind the clitellum $ab = \frac{1}{4}aa = \frac{1}{3}-\frac{2}{5}bc = \frac{3}{4}cd$; $d\bar{d}$ is rather less than $\frac{2}{3}$ circumference.

The clitellum was invisible in most specimens, though the male pores and spermathecal apertures were present. Where present it is indicated only by a slightly darker colour and by the absence of secondary annulation on the affected segments; its extent is $\frac{1}{2}xiii-xvii = 4\frac{1}{2}$ or thereabouts.

The male apertures are in segment xvii, in the line of setae b ; they are small, with whitish lips, and surrounded outside the lips by a rather darker area.

The female apertures were not seen.

The spermathecal apertures are small, in furrow $\frac{7}{8}$, external to the line b .

There are no other genital markings.

The first septum is $\frac{3}{5}$, which is very slightly thickened, and is connected with the posterior surface of the pharynx by many strands and adhesions. Septum $\frac{5}{6}$ is moderately thickened; in the specimen dissected it was not markedly convex backwards, but was folded on itself, and its attachment to the alimentary canal was almost on a level with its attachment to the parietes. Septa $\frac{6}{7}$ and $\frac{7}{8}$ are absent; $\frac{8}{9}$, $\frac{9}{10}$ and $\frac{10}{11}$ are moderately thickened and close together; $\frac{11}{12}$ is present and slightly thickened, and the rest are thin.

The gizzard is of moderate size, marked off from the succeeding part of the alimentary canal by a distinct constriction; the portion of the tube between this constriction and the following septum ($\frac{6}{9}$) is dilated, and has soft walls of a yellow colour.

The oesophagus is swollen in segments xi, xii and anterior part of xiii, forming a pair of calcareous glands. The intestine begins in xv.

The dorsal vessel is continued forwards as far as the pharynx; a transverse vessel is seen in front of septum $\frac{4}{5}$, another in front of $\frac{5}{6}$. There are three lateral commissures between $\frac{5}{6}$ and $\frac{6}{7}$, one crossing the anterior part of the gizzard and two behind it. The heart of segment xi has the usual relations to a normally developed septum $\frac{11}{12}$. The last heart is in xiii.

The micronephridia are few and of moderate size in each of the post-genital segments; they are arranged in a transverse row in each segment. They are numerous round the base of each spermatheca, and there is a tuft on each side anteriorly, by the side of the pharynx.

There are two pairs of testes, in segments x and xi, of equal size. Funnel-like structures are present in the same segments; they are free, and folded but not iridescent. The vasa deferentia of the two funnels of the same side are separate as far as the level of the prostatic duct; they unite as they pass underneath the transversely placed prostatic duct, and form a tube about as thick as this

latter; this single tube then turns inwards and ends just posterior to the ending of the prostatic duct.

The vesiculae seminales are two pairs, small, in segments ix and xii.

The prostates are in segment xviii. Each is a narrow coiled tube, of greyish colour (not opaque white), the whole gland being of comparatively small size. The windings of the glandular tube are simple; on the left side in the specimen dissected they consisted merely of seven simple loops laid closely side by side. The gland is continued at its anterior end into the duct, which lies in xvii, is of about the same diameter as the gland, and is looped once, the convexity of the loop being directed outwards.

The female organs have the usual situation.

The spermathecae are very small. The ampulla is approximately hemispherical in shape, and might be said to be sessile by its base on the body-wall. At any rate there is only a slight constriction there, so that if a duct is described it must be said to be broad and extremely short. There is a complete ring of seven diverticula round the base of the ampulla.

The penial setae (fig. 9) are small, in length up to .5 mm., in breadth 18μ (maximum). The shaft is very gently curved, the curvature increasing just at the tip, which is bluntly pointed. Sculpturings are to be seen near the free end as a few fine dots here and there,—so fine that they are hardly visible with the ordinary high power; under the oil immersion they are revealed as minute triangular teeth, either singly placed or in very short rows.

The two pairs of testes and funnels, and two pairs of seminal vesicles, mark this as one of the more primitive species of the genus, along with *E. incommodus*. The continuation of the dorsal vessel forwards to the pharynx, and the correlated extension of the series of lateral loops, are also primitive features which occur in both forms. Septum $\frac{1}{2}$, too, is here well-developed, and the heart of segment xi has its normal relations (again compare *E. incommodus*). The great distinction from this latter is the entire absence of genital markings.

Eutyphoeus waltoni, Mchlsn.

Pusa (Bengal); Aug. 1911; Bishambar Das. Several specimens

Same place; 10-ix-1912; Bishambar Das. Eight specimens.

Baroda; 2-viii-1912; Bishambar Das. Numerous specimens.

Basi Muda (Hoshiarpur District, Punjab); Aug. 1913, Ibrahim. Three specimens.

Lucknow; Aug. 1913; Ibrahim. Two specimens.

Length 160 mm.; breadth 4-5 mm.; colour buff to light brown. Segments 156-195. Prostomium as in *E. incommodus* (v. ant.).

First dorsal pore $\frac{1}{2}$ (only once $\frac{1}{3}$).

Curiously, the clitellum began with segment xii in one of the Baroda specimens.

Copulatory areas vary considerably; those in $\frac{18}{10}$ are the only quite constant ones, though the pair in $\frac{15}{10}$ are almost so. The marks in $\frac{9}{10}$ (or rather on the posterior border of segment ix, abutting on furrow $\frac{9}{10}$) were constant in the second batch of Pusa specimens, but only occasional otherwise. The areas in $\frac{11}{15}$ are found occasionally, in $\frac{12}{20}$ were seen altogether three times only; once there was a similar pair in $\frac{20}{11}$.

I differ a little from Michaelsen (4) in the estimation of the septa in the anterior part of the body. This author mentions septum $\frac{6}{7}$ as being thickened, and since he does not refer to any septum in front of this, it is to be inferred that this is the first. I find two septa, both thick and muscular, in this region (i.e. in front of the space in which the gizzard is lodged); and these are apparently $\frac{4}{5}$ and $\frac{5}{6}$; so that $\frac{6}{7}$ and $\frac{7}{8}$ are both absent, not $\frac{7}{8}$ only. Septum $\frac{5}{6}$, as I have called it, is attached distinctly in front of the intersegmental furrow $\frac{6}{7}$, though it does not correspond to furrow $\frac{5}{6}$. From the eighth to the twelfth segment also the internal and external segmentation do not correspond; septum $\frac{8}{9}$ is actually situated in segment x as delimited externally by the furrows, if not on a level with groove $\frac{10}{11}$; septum $\frac{10}{10}$ is in the anterior part of xi; and $\frac{11}{11}$ is further back in xi or at furrow $\frac{11}{12}$; septum $\frac{11}{12}$ in this as in most species of the genus is not well marked; correspondence between internal and external segmentation is however re-established with the thirteenth segment. The above refers especially to the insertion of the septa into the dorsal body-wall; ventrally, septa $\frac{8}{9}$ and $\frac{10}{10}$ are a little further forward.

There is thus a wide interval between septa $\frac{8}{9}$ and $\frac{8}{9}$, equal to four external segments or more, but the internal segments ix, x, xi and xii (i.e. as delimited by the septa) on the contrary are narrow from front to back. Septa $\frac{8}{9}$, $\frac{10}{10}$, $\frac{11}{11}$ are all thick. A pair of very definite longitudinal muscular bands, one on each side of the alimentary canal, and nearer the ventral than the dorsal surface, stretch from septum $\frac{8}{9}$ near its insertion into the oesophagus backwards to septum $\frac{8}{9}$.

It has been mentioned that septum $\frac{11}{12}$ is not well marked. It might indeed, as in a number of other species of the genus, be called absent; it is however represented by a mass of connective tissue, which binds down the heart or lateral commissural vessel of segment xi to the oesophagus; this member of the series of commissural vessels is in a number of species less obvious on dissection than the others, since it both lies at a deeper level and is covered over by the thick investment mentioned above.

The numbering of the segments during the dissection of most of the species of *Eutyphoeus* is, as will be seen, not without some difficulty, at least until some familiarity with the genus has been obtained; for in spite of external dissimilarities the main points of the internal anatomy are very uniform. The confusion arising from the absence of some septa and approximation of others can,

however, be avoided by observing the lateral vascular commissures. Starting behind in the ovarian segment, xiii, they form a regular series as far forwards at least as the gizzard. Here, however in many species they stop, as indeed does the dorsal vessel itself; in the present species, for example, the lateral commissures of viii are situated in front of $\frac{5}{8}$, in the normal manner; and just in front of this the dorsal vessel itself comes to an end by dividing into two branches, one to each side, the equivalents of the lateral commissures of vii, which pass laterally round the alimentary canal. In *E. incommodus* and *E. mohammedi*, more primitive in this respect, the dorsal vessel is continued on to the pharynx, giving off a complete series of commissures; three pairs of which, situated in the long free space which contains the gizzard, indicate the three segments (vi, vii, viii) of which this is composed.

Few other points require remark. About the middle of the length of the body, situated dorsally on the intestine and on each side of the longitudinal vessel, is a series of five pairs of alimentary glands or diverticula, white in colour, each bilobed, and increasing in size from before backwards. Such diverticula are known in certain other species, and might not improbably be found in all, if looked for.

In one specimen the penial setae reached the great length of 4.7 mm. I could not identify the fine sculpturings near the free end as distinct spines, even with the oil-immersion lens.

The calcareous glands are of the nature of those described for *E. bishambari* (v. post.)—lateral projections into the oesophagus, which leave a T-shaped lumen in a transverse section of the tube.

Eutyphoeus nicholsoni (Bedd.).

Saharanpur (United Provinces); 21-viii-1912; Bishambar Das. Numerous specimens.

Lucknow; Aug., 1913; Ibrahim. Four specimens.

This species varies within rather wide limits; the chief character which distinguishes it externally is the presence of the large raised circular or oval papillae in $\frac{1.5}{8}$. If oval, the long diameter may be transverse or longitudinal; each papilla may or may not be surrounded by a "wall."

The male apertures and field show very considerable variations. The pores may appear as two slits; or the two may be fused into a single slit, transverse or slightly convex backwards or forwards, with slightly puckered margins, extending from between the lines of setae *a* and *b* on one side to a corresponding point on the other; or the separate apertures may be visible near the ends of a common groove,—may indeed be indicated by papillae sunk below the surface in the groove. The Lucknow specimens were different; here the apertures were present as large and conspicuous pits, extending somewhat beyond the lines *a* and *b*, i.e. somewhat internal to *a* and external to *b*; a papilla, bearing the penial setae, was seen projecting upwards from the depth of

each pit; each pit had puckered margins, and the pair were situated in a whitish circular area, with slightly raised margin, which extended from the setal zone of xvi to that of xviii.

Twelve of the Saharanpur specimens examined for the female apertures, gave the following result: the aperture of the left side was present alone in 9, there was a large left aperture and a very small right aperture in 2, and no female pore could be distinguished in one (cf. Beddard, 1).

The penial setae vary from 2 to 3 mm. in length. The distal portion may be bent on itself to form a loop. I saw no ornamentation on the setae of the Saharanpur specimens; those of the Lucknow specimens seemed all to be corroded.

The septa agree exactly with what has been said concerning *E. waltoni*. The dorsal vessel stops behind the gizzard, there dividing to form the first pair of commissural vessels (those of segment vii).

***Eutyphoeus bishambari*, sp. nov.**

Pusa (Bengal); 10-ix-1912; Bishambar Das. A single specimen.

Length 180 mm.; breadth maximum $5\frac{1}{2}$ mm.; colour dark brown dorsally, with a purplish strip in the middle line except at anterior and posterior ends, pale grey ventrally. Segments 164.

Prostomium a minute projection, within the mouth aperture; a pair of longitudinal grooves dorsally on the first segment, slightly diverging as they approach furrow $\frac{1}{2}$.

Secondary annulation in front of clitellum; segment iii is biannulate, but dorsally only; segment iv biannulate all round, v-vi triannulate, vii indistinctly 5-annulate, viii-ix have six annuli or even more; xii and xiii are smooth, and behind the clitellum also the segments are not divided.

The first dorsal pore is in furrow $\frac{1}{2}$; none are visible on the clitellum.

Setae are present on the clitellum; behind the clitellum their position may be expressed as $ab = \frac{2}{3}aa = \frac{1}{7}bc$, while $bc = cd$ and $dd = \frac{2}{3}$ circumference; in front of the clitellum $ab = \frac{5}{8}aa$, and is somewhat less than cd .

The clitellum extends from $\frac{2}{3}xiii$ to $\frac{2}{3}xvii = 4$ dorsally; ventrally the anterior border is at the level of the setae of xiii ($\frac{1}{2}xiii$).

The male apertures (fig. 10) are conspicuous, somewhat triangular in shape, with base anterior and narrowest angle internal; their margins are puckered. Each extends between and rather beyond the lines of setae *a* and *b*, and the centre of the pore is thus between the two lines. The penial setae project close to the outer margin of the aperture.

The female apertures were not recognized.

The spermathecal apertures are slit-like, in furrow $\frac{7}{8}$; the whole slit takes up the space between the lines of setae *b* and *c*

and extends inwards a little beyond b (internal to b); the centre of the slit is thus between b and c , slightly nearer to b .

The genital markings are characteristic (fig. 12). On the ventral surface of segment xvi behind the setae, is an unpaired shallow **V** shaped depression, the legs of the **V** being wide apart, and rather broadened at their anterior, separated, ends. In these swollen ends small rounded papillae are present, projecting sufficiently to reach the level of the general surface: these anterior broadened ends of the **V** are situated just behind the setae ab on each side.

There are also three pairs of rather indistinct eyelike markings in furrows $\frac{1}{9}$, $\frac{1}{10}$ and $\frac{2}{11}$, transversely oval, with their centres in or just internal to b , extending inwards to a and outwards to a corresponding distance on the other side of b .

Septa $\frac{4}{5}$ and $\frac{5}{6}$ are stout and muscular; $\frac{6}{7}$ and $\frac{7}{8}$ are absent; $\frac{8}{9}$, $\frac{9}{10}$ and $\frac{10}{11}$ are all thick and placed close together; $\frac{11}{12}$ is absent as a septum, being represented by a mass of connective tissue between the seminal vesicle and intestine, which binds down the heart of segment xi; the rest of the septa are thin.

The oesophagus is moderately broad behind the pharynx and in front of septum $\frac{4}{5}$, narrow between $\frac{4}{5}$ and $\frac{5}{6}$; it is again wider in the anterior part of the space between $\frac{5}{6}$ and $\frac{6}{9}$, where it is situated between the spermathecae; this portion is followed by a comparatively small subglobular gizzard. The rest of the oesophagus is narrow, except in segment xii where it is slightly dilated. This dilatation corresponds to the calciferous glands of some of the other species of the genus; on opening the tube an elongated mass is seen to project on each side into the lumen of the oesophagus from its lateral and ventral wall; a narrow vertical cleft is left between them in the middle line, and a continuous passage above them, between the projecting masses and the dorsal oesophageal wall, so that in transverse section the lumen of the tube here appears **T**-shaped; calcareous particles occur in the oesophagus in this region, dorsal to the projecting masses, i.e. in the cross limbs of the **T**.

The intestine begins in segment xv.

The circulatory system resembles that of *E. waltoni*. The dorsal vessel ends anteriorly by dividing to form the lateral commissures of segment vii; the last heart is in segment xiii.

The excretory system is micronephric; tufts of micronephridia are present one on each side anteriorly by the sides of the pharynx; behind this they are irregularly scattered as far as segment xii, but beyond this point they are arranged in transverse lines in each segment.

The testes were not identified. There is a single pair of large, folded, iridescent funnels in segment xi, touching each other in the middle line, and contained in a common sac continuous from side to side beneath the alimentary canal. The vesiculae seminales, a single pair, are flattened against the sides of the alimentary canal, and are deeply lobed; they are doubtless to be considered as

arising from septum $\frac{11}{2}$, and as contained in segment xii; septum $\frac{11}{2}$ however does not exist as a definite septum (*v. ant.*), and actually the seminal vesicles extend forwards as far as $\frac{10}{11}$; backwards they reach $\frac{13}{14}$, which is bulged posteriorly by the vesicles so as to reach the level of $\frac{14}{15}$.

The vas deferens is conspicuous, on the body wall. The prostates are large, tubular, and occupy xvii-xx. The duct is narrow at first, but soon becomes stouter, more shining and more muscular; it is much coiled and of considerable length; its middle part is the widest.

Ovaries and funnels have the usual position.

Each spermatheca has an elongated egg-shaped ampulla, the end opposite the duct being the narrower. The duct is broad and very short, so that the ampulla is almost sessile on the body-wall by an attachment at the middle of its under surface. There are two diverticula; one, the smaller, on the posterior and inner side of the duct, with about six chambers; the other on the outer side, larger, with more numerous chambers. The chambers are only slightly separated from each other externally, though they can be distinguished by means of their contents.

The penial setae (fig. 11) are 4 mm. in length, and 36μ in breadth about the middle of the shaft. For the greater part of their length they are almost straight; the terminal quarter of a millimetre is bent at an angle of 120° ; and at the distance of only 1 mm. from the pointed tip there is a second, much sharper kink, in such a way that this terminal portion is not in the same plane as the rest of the seta. There are short transverse rows of very fine sculpturings near the free end.

Eutyphoeus ibrahimi, sp. nov.

Kapurthala (Punjab); July 1913; Ibrahim. A single specimen, in bad condition.

Length 70 mm.; breadth, maximum 3 mm.; colour light olive green with a browner tinge anteriorly. Segments 185.

Prostomium tanylobous, the longitudinal grooves traversing the first segment dorsally being parallel to each other.

The first dorsal pore is in furrow $\frac{1}{3}$.

The intersetal distances may be expressed as follows:—behind the clitellum $ab = \frac{1}{3} - \frac{2}{3}aa = \frac{4}{7}bc$ and approximately $= cd$; in front of the clitellum $ab = \frac{1}{2}aa = \frac{2}{3}bc$ and is slightly less than cd ,—i.e. the setae of the respective pairs are rather closer together, rather more definitely paired, behind than in front of the clitellum; $dd = \frac{2}{3}$ circumference.

The clitellum was indefinite.

The male apertures, on segment xvii, are just external to the line of setae *b*; they are represented by small papillae, on the outer side of each of which is a slightly raised whitish horseshoe-shaped ridge, partially surrounding the papilla, with the concavity of the horseshoe directed internally.

A female pore appeared to be present on the left side, in front of seta *a* of segment xiv.

The spermathecal apertures are small, with tumid lips, in furrow $\frac{7}{8}$ in the lines of setae *c*.

There were no other genital markings.

The first septum is $\frac{5}{6}$, and the next $\frac{6}{7}$, both being strong; $\frac{7}{8}$ is absent, and $\frac{8}{9}$, $\frac{9}{10}$ and $\frac{10}{11}$ are thick and close together.

The gizzard is of moderate size, cylindrical in shape, and situated in the interval between septa $\frac{6}{7}$ and $\frac{8}{9}$. Calciferous glands are represented by a pair of ovoid swellings, not sharply set off from the oesophageal wall, in segment xii; on being cut into these show a structure of transverse lamellae. The intestine begins in xv.

The last heart is in xiii; the series is continued forwards to segment vii.

Testes were not identified. Funnelles are present in xi, each enclosed, to the best of my observation, in a separate sac. The vesiculae seminales are a single pair, in the usual situation, flattened against the alimentary canal on each side. The prostates are tubular, of moderate size, but so softened and transparent in this specimen that they were actually in some little danger of being overlooked.

The spermathecae are small; the ampulla small and ovoid in shape, the duct short, broad, about as long and nearly as broad as the ampulla. The diverticula were, in the organ of one side, two rounded knobs at the upper part of the duct rather towards its posterior side; on the other side there were four, surrounding the duct except on its anterior aspect.

The penial setae (fig. 12) are approximately 2 mm. in length, measured across the curve,—the whole seta being curved through about a quarter of a circle. The breadth is rather variable, maximum 20μ . The end is spoon-shaped, with a curved tip; there is a slight constriction some little distance proximal to the spoon. The ornamentation consists of very fine hairs, which occur both distal and proximal to the slight constriction just mentioned, though mainly on the proximal side. There is also apparently a faint longitudinal grooving immediately distal to the constriction.

I am not thoroughly satisfied of the value of the above description, seeing that the specimen was in a bad condition of preservation, and may (on account of the absence of genital markings and of a distinct clitellum) be thought to be immature. Still well developed male organs were present, and penial setae also; and since these latter are of principal importance in the discrimination of species in this genus I have decided to include the present account.

Subfam. TRIGASTRINAE.

Eudichogaster barodensis, sp. nov.

Baroda; 2-viii-1912; Bishambar Das. A number of specimens.

Length 74-100 mm.; breadth $3\frac{1}{4}$ -4 mm.; colour pale yellowish brown, uniform all over, except clitellum which is darker in colour. Segments 163-167.

Prostomium small, under cover of and marked off by a groove from the first segment. There is a slight cleft running backwards from this groove for a short distance on the dorsal surface, not long enough however to divide the first segment completely. The fourth segment is biannulate, segment v triannulate, vi-xi have four annuli, xii has three principal annuli but six in all; behind the clitellum the segments are triannulate.

Dorsal pores begin immediately in front of the clitellum, in furrow $\frac{1}{3}$; they are quite conspicuous on the clitellum in some specimens, but not to be seen in others.

The setae are closely paired. In general $ab = \frac{1}{3}-\frac{1}{4}aa = \frac{2}{5}bc = cd$; and $dd =$ about $\frac{1}{4}$ of the circumference.

The clitellum extends over $xiii-\frac{1}{3}xviii = 5\frac{1}{3}$ ($xiii-xvii = 5$, or $\frac{1}{2}xiii-xvii = 4\frac{1}{2}$). The region is uniformly arched and smooth laterally and dorsally (unless a few sharp-cut oblique cracks have appeared), flat ventrally and wrinkled in its posterior half.

The male genital field (fig. 13) is constituted by four flat cushions or pads; one of these, transversely elongated, occupies $\frac{1}{8}$, from a point between lines *a* and *b* on one side to a corresponding point on the other; another of the cushions has a similar position in $\frac{1}{10}$; the two remaining cushions form a pair, on xviii, between the ends of those first mentioned, much smaller than these latter, and embracing each the situation of the ventral setal couple of its side. There is thus left a rectangular space in the middle of these four cushions, which represents the ventral portion of segment xviii; in one specimen this rectangular space was reduced to a mere transverse fissure by the encroachment of the pads in front and behind.

The only apertures that can be made out in this region are a pair on segment xviii, just in front of the site of setae *a*, which are absent. The setae of xvii and xix are all present; no prostatic pores separate from those just described are even indicated; and indeed these cannot be said to be distinct, since they are little else than minute dots slightly darker than their surroundings.

The female aperture is indicated by a small whitish area midventrally in xiv, in front of the level of the setae.

What might be called an anterior genital area is present in the neighbourhood of the spermathecal apertures. In furrow $\frac{7}{8}$ is situated a transversely much elongated, slightly raised and flat pad, somewhat rectangular in shape, extending laterally on each side beyond the line of setae *b*, and including the hinder annulus of vii and anterior annulus of viii. The second annulus of viii is also distinctly thickened for some distance on each side of the mid-ventral line. The spermathecal apertures are very probably indicated by a pair of minute white dots, in line with *b*, on the pad described as occupying the ventral portion of furrow $\frac{7}{8}$.

A row of small darkish spots may be present, in a transverse line, over the middle part of the pad in $\frac{7}{8}$; similar minute spots were seen, also in a transverse line, on the anterior of the four pads in the male genital field.

Septum $\frac{5}{6}$ is the first; this, and all the following septa as far as $\frac{10}{11}$ are moderately to considerably thickened.

The first gizzard is in front of the first septum, i.e. in segment v, of considerable size, subglobular and not very hard; a second gizzard resembling the first occupies segment vi. Calcareous glands are two pairs, in segments xi and xii; they are more or less globular, yellowish in colour, and set off from the oesophagus. The intestine begins in xv.

The dorsal vessel gives off a regular series of commissural vessels ('hearts') from xiii to v and can be traced forwards on to the pharynx.

Regular lines of micronephridia are found in all the post-clitellar segments. In front of the clitellum they are less regular in disposition; in segments ii and iii they are numerous and close-set on each side of the pharynx.

Considering in more detail the post-clitellar nephridia:— in the anterior portion of this region, which is exposed during the ordinary dissection, there are eight, or about eight, micronephridia on each side, arranged in a row of which the ventral-most member lies by the side of the ventral nerve cord; the most dorsally situated nephridium in each segment is at some distance from the mid-dorsal line, so that there is a dorsal tract of the body-wall which is free from nephridia. Of the eight (or so) nephridia on each side, the three most dorsally situated are larger than the rest, and consist each of a transversely directed loop, lying in the middle of the length of the segment and without connection with the septa. The inner five or thereabouts of the row of nephridia are considerably smaller; there is no very constant diminution in size on passing ventralwards along the row; still it may perhaps be said that the nephridium which is placed most ventrally, by the side of the nerve cord, is on the whole the smallest of the series.

If now the posterior end of the animal be opened, a difference is found. For the most part the nephridia have the same relations and sizes; but the most ventral nephridium on each side is here much larger than further forward. While anteriorly the ventral-most nephridium was the smallest, here it is, I will not say the largest, but as large as any of the series. It is not, in fact, larger than the dorsalmost of the series; though its tube is thicker and more opaque, and it is coiled more compactly than the transversely elongated loop of the dorsally situated organs. I could not make out that these ventral nephridia are attached to the septa, or pass through to end in a funnel on the other side.

Testes and seminal funnels are present, free, in segments x and xi. Large lobed seminal vesicles are situated in ix and xii, with the usual relations to the septa. In one of the three speci-

mens dissected, what I take to be rudimentary seminal vesicles were present in x also; these were a pair of small roundish excrescences, on the anterior face of septum $\frac{10}{11}$, to which they were attached by a comparatively broad base.

The vasa deferentia from the two funnels of the same side soon converge and run alongside, but do not unite; they pierce the body wall, still ununited, close to, and on the anterior side of, the end of the prostatic duct.

There is a single pair of prostates, which occupy segments xviii-xix, bulging back septum $\frac{19}{20}$. Each is tubular, and much coiled. The duct is gently looped once or twice, and passing on the whole with a forward direction ends on the inner surface of the body-wall of segment xviii.

The ovaries, composed of a number of moniliform strands, and the small female funnels are in xiii.

The single pair of spermathecae (fig. 14) lie in segment viii. The ampulla is somewhat conical, directed with its apex backwards and inwards, and continued forwards at its base into the comparatively narrow and shining duct. The duct is gently bent into an S-shape, in length it is about $\frac{2}{3}$ that of the ampulla, and has a curious diverticulum on its posterior side. This is a large cauliflower-like aggregate of small chambers, bound down to the duct and the base of the ampulla by connective tissue; on the other side of the same specimen the chambers were in two aggregates instead of a single one, the two aggregates being separated by a narrow interval along the posterior side of the duct.

No penial setae were discoverable.

The peculiarity of the above form lies in the disposition of the posterior male organs. I have examined several specimens, and it is unfortunate that the actual apertures are invisible, or almost so, externally; they could be distinguished, and that not with absolute certainty, in one only. In any case there seems to be no more than one pair of pores. The absence of setae *a* of segment xviii seems constant. As seen internally the prostatic duct certainly pierces the body-wall in xviii; but in two out of three specimens the vasa deferentia could not be traced to their end, and the relation of vas deferens to prostatic duct above described was seen in one specimen only.

Subfam. OCNERODRILINAE.

Ocnerodrilus (Ocnerodrilus) occidentalis, Eisen.

Rawal Pindi, March 1911; Ibrahim.

Mardan (N.-W Frontier Province); 26-xii-1913; Bani Parshad.

Length 36 mm. when living and moderately extended; diam. 1 mm.; segments 70. The following points, certain of which confirm Michaelsen's opinion regarding the non-validity of the var. *arizonae*, Eisen, are worthy of mention:—

Of the septa, the first, $\frac{4}{5}$, is thin; $\frac{5}{6}$ - $\frac{11}{12}$ are thickened, — $\frac{5}{6}$ slightly, $\frac{6}{7}$ more so, $\frac{7}{8}$ - $\frac{10}{11}$ markedly, $\frac{11}{12}$ slightly. The septal gland of segment viii is somewhat smaller than those of the foregoing segments, but not very markedly so. A large amount of glandular tissue similar to that of the septal glands exists in front of septum $\frac{4}{5}$, lying on the pharynx and mingling with the muscular strands of this region; the whole forms a considerable mass in front of the first septum, and it therefore seems hardly correct, in the specific definition, to limit the septal glands to segments v-viii. The clitellum extends from $\frac{1}{2}$ xiii to xix or $\frac{1}{2}$ xx (= $6\frac{1}{2}$ or 7). The prostates extend backwards only a short distance behind the male pore, and do not reach the posterior limit of the clitellum.

The circulatory system was examined in the living worm by the microscope; and many of the results were checked by serial sections.

The dorsal vessel lies above and separate from the gut-wall; it is however invested by chloragogen cells above the intestine. It is contractile; the contractions in its anterior part (segments ii-vii) are often antero-posterior in direction.

There is a very short supra-intestinal vessel, connected with the upper ends of the hearts. It extends only over two segments or a little more, appearing posteriorly just behind the second heart, and becoming lost on the oesophagus anteriorly about the place where the oesophageal diverticula are connected with the alimentary tube (segment ix).

Lateral oesophageal vessels are present; they appear, in an examination of the living animal, to be continued back as lateral channels in the intestinal wall, but these are not discoverable in sections. They are connected with the copious plexus on the oesophageal diverticula; they are continued forwards, with a sinuous course, as far as segment ii; they give numerous branches, and in the region of the septal glands run on the inner face of the glands, in the gland capsule, and unconnected with the oesophageal wall.

The ventral vessel is very small in the anterior part of the body, as far back as the hearts; and its connection with the point of junction of the anterior hearts is very narrow. Posteriorly it has the usual relations.

The hearts are in segments x and xi, on the posterior septa of these segments (septa $\frac{10}{11}$ and $\frac{11}{12}$). The hearts of the same side contract as a rule alternately, but irregularly (under chloretone), —seldom simultaneously. Those of opposite sides but of the same pair also seldom contract simultaneously, but here again there is no rule. The contraction of the hearts is independent of that of the dorsal vessel. The hearts are connected below with the ventral, above with both dorsal and supra-intestinal vessels.

There are six loops on each side in front of the hearts, in segments iv-ix; they run in the substance of the septal glands, or on their outer surface. It is possible however that the number is not constant; in one specimen there were five obvious loops on one side, in segments ix to v, of which that in v was the largest;

on the other side there were six loops, of which the anterior, from viii to iv, diminished regularly in size.

These loops are contractile, but only in their dorsal portions. In the case of the loops in segments ix-vii, about the dorsal third is contractile; in the anterior loops, vi and v at least (I have no definite note regarding iv), it is a still smaller portion. The contraction of these vessels is synchronous with the contraction of the dorsal vessel in this region; thus the dorsal vessel and the contractile portions of the loops are all simultaneously invisible during contraction, and the loops seem to start, of full size, from nowhere, so to speak.

A marked red blush in segment ix in the living worm is seen on closer examination to be a network of fine vessels clothing the oesophageal pouches.

Fam. LUMBRICIDAE.

Helodrilus (Eisenia) foetidus (Sav.)

Simla; 12-viii-1913; Bishambar Das. A single specimen.

Helodrilus (Bimastus) parvus (Eisen.)

Lyallpur (Punjab); Nov., 1911; Madan Mohan Lal.

Lahore, Lawrence Gardens; Feb. 1912; B. L. Bhatia. Also near the river Ravi; 15-xii-1913; Bains Parshad.

Peshawar (N.-W. Frontier Province); April, 1913; Bains Parshad. Also same place and collector; 29-xii-1913.

Mardan (Peshawar District); 25-xii-1913; Bains Parshad.

Ferozepur; 10-i-1914; Bains Parshad.

Many of the specimens were (for this species) very large and well-grown; length 40 mm., breadth maximum $2\frac{1}{2}$ mm. The clitellum extended over the normal seven segments (xxiv-xxx), xxiii being in some cases however (Mardan specimens) slightly altered also. There were no ridges or tubercles in association with the ventral borders of the saddle-shaped clitellum in any of the specimens that were closely examined.

Helodrilus (Allolobophora) caliginosus (Sav.)

forma *trapezoides* (Ant. Dug.).

Lahore; common.

Mardan (Peshawar District); 25-xii-1913; Bains Parshad.

Peshawar (North-West Frontier Province); 29-xii-1913; Bains Parshad. Also April, 1913; Ibrahim.

Ferozepur; 8-ii-1914; 22-ii-1914; Bains Parshad.

The variations from the usual condition mainly concern the clitellum. This very frequently embraces xxvi, and may encroach slightly on xxv; its extent therefore may be as much as $9\frac{1}{2}$ segments (xxvi- $\frac{1}{2}$ xxxv). The ridges on segments xxxi-xxxiii may be formed of imperfectly fused tubercles; or they may extend

forwards on each side to the anterior limit of the clitellum, becoming more and more distinctly cut up into separate tubercles in the anterior segments. In the clitellar region a number of ventral setal pairs may be situated in the middle of flat, broadly oval, glandular-looking patches, which take up the length of a segment, and transversely extend from the inner border of the ridge to the mid-ventral line (or a corresponding extent in the region in front of the ridges); as an example, such patches occurred in one specimen in segments xxxii and xxx on the right, in xxxi, xxix xxviii and xxvi on the left.

Octolasion lacteum (Örley).

Simla ; 12-viii-1913 ; Bishambar Das.

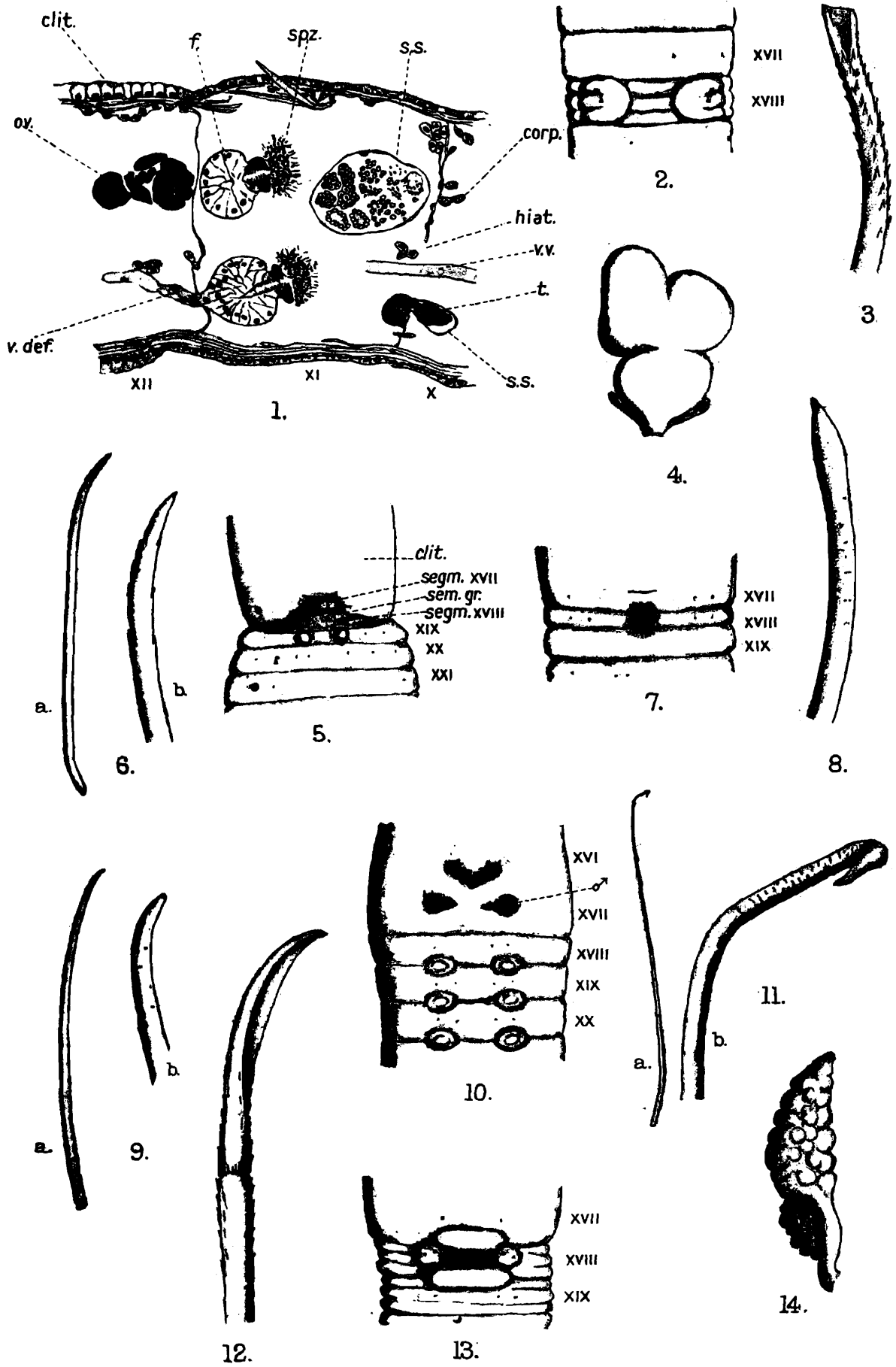
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EXPLANATION OF PLATE XXXVI.

- FIG. 1.—*Enchytraeus harurami*; horizontal section, through segment xi and portions of x and xii, to show funnels and sperm- or testis-sacs. $\times ca. 206$.
Clit., clitellar epithelium; *corp.*, coelomic corpuscles being budded off from septum $\frac{10}{11}$; *f.*, funnel; *hiat.*, hiatus in septum $\frac{10}{11}$, through which the testis in its sac is, in this case, turned forwards into segment x; *ov.*, ovary; *spz.*, spermatozoa entering mouth of funnel; *s. s.*, sperm-sac, on the one side cut near its attachment to the septum round the base of the testis; on the other at some distance from its attachment, the testis having given place to sperm-morulae and ripening spermatozoa; *t.*, testis, attached to the posterior face of septum $\frac{10}{11}$, but turned forwards through a vacuity in the septum; *v. def.*, vas deferens; *v. v.*, ventral vessel.
- „ 2.—*Lampito trilobata*; area of male pores.
 „ 3.—The same; distal end of penial seta, $\times ca. 133$.
 „ 4.—The same; spermatheca.
 „ 5.—*Octochaetus fermori*; male genital area. *Clit.*, clitellum; *sem. gr.*, seminal groove.
 „ 6.—The same; penial seta. *a*, whole seta, $\times ca. 86$; *b*, distal end $\times ca. 300$.
 „ 7.—*Octochaetus dasi*; male genital area.
 „ 8.—*Eutyphoeus incommodus*; distal end of penial seta.
 „ 9.—*Eutyphoeus mohammedi*; penial seta. *a*, whole seta $\times 100$; *b*, distal end $\times ca. 400$.
 „ 10.—*Eutyphoeus bishambari*; male genital area. σ , male pore.
 „ 11.—The same; penial seta. *a*, whole seta $\times 12$; *b*, distal end $\times ca. 100$.
 „ 12.—*Eutyphoeus ibrahimi*; distal end of penial seta $\times ca. 266$.
 „ 13.—*Eudichogaster barodensis*; male genital area.
 „ 14.—The same; spermatheca.



MISCELLANEA

REPTILES.

LIZARDS OF THE SIMLA HILL STATES.—As originally written this paper consisted of some notes on the various lizards collected during the months of July, August and September 1914; but later on, in accordance with a suggestion received from Dr. N. Annandale, a list of all the lizards known from the region, with references to the literature, is also given. In all, lizards belonging to the families *Geckonidae*, *Agamidae*, *Anguidae* and *Scincidae* have been taken from this region. Of these the collection contains representatives of only the *Agamidae* and *Anguidae*. The family *Anguidae*, a single representative of which, *Ophiosaurus gracilis* (Gray), was taken at Simla at an altitude of about 8000 ft., has not been found previously in the Western Himalayas, and has not apparently been recorded from any place the altitude of which exceeded 6000 ft. The occurrence of *Calotes versicolor* (Daud.) is also interesting, as in Dr. Annandale's recent note (*Rec. Ind. Mus.*, vol. x, p. 320) the species is only said to occur in the foothills of the Himalayas.

My sincere and hearty thanks are due to Major J Stephenson, I.M.S., Professor of Biology, and Principal, Government College, Lahore, for the facilities given me in working out this collection, and for the great help in obtaining the literature. I have also to thank Dr. Annandale for his valuable suggestions and kind help given at all times.

List of species known to occur in the Simla Hill States :—

1. *Alsophylax himalayensis*, Annandale.
2. *Gymnodactylus fasciolatus* (Blyth).
3. *Acanthosaura major* (Jerdon).
4. *Calotes versicolor* (Daud.)
5. *Agama tuberculata*, Gray
6. *Ophiosaurus gracilis* (Gray).
7. *Lygosoma himalayanum* (Günther).
8. *Lygosoma punctatum*¹ (Linn.).

Fam. GECKONIDAE.

1. *Alsophylax himalayensis*, Annandale.

Annandale, *Rec. Ind. Mus.*; vol. ix, p. 305, pl. xv, fig. 1 (a-c); vol. x, p. 319.

¹ There is a specimen from Subathu in the Indian Museum.

2. *Gymnodactylus fasciolatus* (Blyth).

Theobald, *Cat.*, p. 92; Boulenger, *Fauna*, p. 1; Annandale, *Rec. Ind. Mus.*, vol. ix, p. 325, pl. xvi, fig. 3.

Fam. AGAMIDAE.

3. *Acanthosaura major* (Jerdon).

Theobald, *Cat.*, p. 113; Boulenger, *Fauna*, p. 128; Annandale, *Rec. Ind. Mus.*, vol. I, p. 152, and x, p. 321.

4. *Calotes versicolor* (forma typica) (Daud.).

Theobald, *Cat.*, p. 109; Boulenger *Fauna*, p. 135, fig. 42; Annandale, *Rec. Ind. Mus.*, vol. i, p. 153; vol. vii, p. 46; vol. viii, p. 41; vol. x, p. 320.

Dr. Annandale adds as a footnote to his recent note on "Three rare Himalayan Lizards" (*Rec. Ind. Mus.*, vol. x, p. 320), that the typical form of the species occupies the foothills of the Himalayas, the Gangetic plain, Assam, Burma, Siam, the northern part of the Malay Peninsula, etc., according to his investigations then the form does not occur in the higher mountains, but specimens of this form were caught by me in the following places:—

1. Three at Saujauli (about two miles from Simla).
2. Two at Kufri (about eight miles from Simla on the Kulu Road).

The altitudes of the two places is approximately 8000 feet. The specimens are not very large and do not show any well marked sexual characters.

5. *Agama tuberculata*, Gray.

Stellio tuberculatus, Theobald, *Cat.*, p. 116; Boulenger *Fauna*, p. 148; Dodsworth, *Journ. Bombay Nat. His. Soc.*, vol. xxii, pp. 404, 405. Annandale, *Rec. Ind. Mus.*, vol. i, p. 154.

This rock lizard is very common at Simla as has been recorded by Mr. Dodsworth (*op. cit.*). Dr. Annandale also obtained two specimens of this form at Simla, while I have always seen them basking on stones on sunny days; specimens were also seen at Kasauli though none were secured.

A female specimen caught on the 22nd of August had five eggs in it, the eggs were quite ready for laying. According to Mr. Dodsworth the breeding season is May, June, July, and probably the first half of August, but my specimen which showed these ripe eggs was taken in the third week of August, hence the breeding season seems to extend up to the end of August. In all, eight specimens of this form were obtained on the Mashobra-Tibet Road, from underneath large stones about four miles from Simla

Fam. ANGUIDAE.

6. *Ophiosaurus gracilis* (Gray).

Pseudopus gracilis, Theobald, *Cat.*, p. 47; (*Ophiosaurus*) Boulenger. *Fauna*, p. 71, fig. 47; Annandale, *Rec. Ind. Mus.*, pp. 42 and 857.

The distribution of the Genus *Ophiosaurus*, Daud., according to Dr. Boulenger, is "South-Eastern Europe, North Africa, South Western Asia, Himalayas and Burma, Central America"; while the habitat of the species is "Eastern Himalayas, Khasi hills, Eastern Bengal, Rangoon, Western Yunnan". The species has been recorded by Dr. Annandale also in the "Zoological results of the Abor expedition" and parts i and iv (*op. cit.*). According to him the range is as follows: "A common species in the Eastern Himalayas at altitudes of between 4000 and 5000 ft.; it also occurs in the Khasi hills in Upper Burma and Yunnan, and probably in the hills of Pegu." Some of his specimens were taken at an altitude of 2000-2150 ft., and others at an altitude of 4000 ft. The single specimen about which the following notes are appended was taken on the 22nd of August on the Mashobra-Tibet Road about three miles from Simla. Now Simla is situated in the South-Western slopes of the Himalayas at an altitude of 7156 ft. This slow-worm then is not confined to the Eastern Himalayas as has been supposed up till now, but occurs in the Western Himalayas as well.

Measurements of the specimen.

Length 22.5 cm. Tail 8.1 cm.

The colour is yellowish brown above while ventrally it is uniform yellow, so also is the posterior one-third of the tail dorsally. The lateral blue-black stripes mentioned by Dr. Annandale are absent; dorsally a large number of black spots, during life rather bluish, which in some parts are like half hoops, are very distinctly seen.

Fam. SCINCIDAE.

7. *Lygosoma himalayanum* (Günther).

Mococa himalayana and *M. blythii*, Theobald, *Cat.*, pp. 57 and 59; (*Lygosoma*) Boulenger, *Fauna*, p. 200; Annandale, *Rec. Ind. Mus.*, vol. i, pp. 154, 155.

According to Dr. Annandale this skink is very abundant in the gardens in the town of Simla in the neighbourhood of which it is common at least as high as 9000 ft. Skinks were seen by me twice at Simla which probably might have belonged to this species but could not be secured.

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[END OF VOLUME X.]