NOTES ON *LAMPITO MAURITII* KINBERG 1867 (OLIGOCHAETA).

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During four years spent in India, a considerable number of specimens of *L. mauritii*, from various portions of India, in a region from Madras north through Bombay and Cuttack to Saharanpur, came into the author's possession. Advantage has been taken of the opportunity provided by this mass of material to check on certain disagreements in previous descriptions, to look for evidence of geographical variation (which was not found), to ascertain how much could be learned about regeneration in natural conditions, and to obtain some information as to variation and abnormality. Localities from which material was obtained are in course of publication elsewhere and need not be repeated here. Results of study of regeneration will be presented separately. Certain portions of the remainder of the information secured are presented herewith.

Several specimens from each locality were dissected, a total of more than fifty. Most of the material examined was preserved by the simple and quick methods that must ordinarily be used when dealing with large amounts of material. In these circumstances it is not surprising that some blood vessels or portions of vessels in all dissected specimens appear to be inadequately preserved for study of the circulatory system. However, when carefully anaesthetized specimens that had been fixed in Bouin's fluid were examined, it was again found that certain vessels, or portions thereof, were either unrecognizable or traceable only with difficulty, of ten presumably because they were empty at time of fixation. That even major blood vessels, as for instance a subneural trunk in species of *Perionyx*, may be temporarily quite or nearly empty can be confirmed from examination of living worms. At one moment the subneural may be clearly visible through the body wall as a solid red line that shortly after may be quite unrecognizable. In these circumstances it probably will be desirable to try, when conditions once more permit, coloured latex injections for detailed study of circulatory systems. Ordinary methods of preservation are not satisfactory for study of the excretory system, especially in the pharyngeal region and accordingly only one brief reference to that system is made below.

Number of segments.—Number of segments in clitellate specimens varies up to 190. In the smallest juveniles that were available, 20-30 mm. long and about one mm. thick, the number of segments varies only between 100 and 135. In most of these specimens there is at the hind end of the body a region in which the anterior part has several slight grooves, apparently rudimentary intersegmental furrows marking off still incompletely differentiated segments, in which setae are either lacking or are externally unrecognizable. A fairly long posterior portion of the region in which no rudiments of furrows are recognizable

apparently is still more embryonic, with the size possibly indicative of fairly rapid production of new cells and tissues. The furrowed anterior part, apparently without setae, externally seems to be a portion of the region in which metameric differentiation is taking place.

Several juveniles of smallest size have tail regenerates, showing that a tail may be lost very early in life. The remainder of the smallest size juveniles are characterized at posterior ends by one or the other of these conditions that develop on loss of tail prior to or without tail regeneration.

Very rarely a clitellate and fully sexual specimen was found with a terminal portion comprised of the two zones of no metameric differentiation and of metameric differentiation as in the smallest juveniles. Along the whole axis of such specimens, segment size posteriorly decreases gradually to and through the terminal zone and indications of regeneration are unrecognizable.

The evidence available from these collections seems to indicate that in *L. mauritii*, the young hatch out from cocoons with much smaller number of segments than may characterize fully grown specimens; that young juveniles have a growth zone which is of two parts, a posterior more embryonic region possibly of fairly rapid production of new cells and tissues, and an anterior region of metameric differentiation; that occasionally an individual may become sexually mature while the terminal portion of the body is still in a condition characteristic of the smallest juveniles. All this is of importance in connection with an assumption, apparently supposed to be applicable generally to earthworms, to the effect that growth does not take place by addition of new segments. In fact, Sun and Pratt (1931) seem to indicate that just-hatched juveniles of at least one species may have more segments than are ever found in adults of the same species.

Male pore region.—On small juveniles, setae and apertures of follicles are usually lacking on *a* lines of xviii, but on or very close to each *b* line there are two very closely paired setae or follicle apertures. On a specimen nearly one mm. thick, the medianmost follicle aperture is at mid *ab* the next on the *b* line. On large juveniles only one aperture, on or close to *b* line, has been recognizable.

In juvenile specimens only 20 mm. long and one mm. thick, perisetal follicles are already protuberant into coelomic cavity. In one such follicle, *i.e.*, the whole mass of tissue median to a prostatic duct, there are five setae. Each of the two ectalmost has a simple tip, rounded or slightly clawed and is ornamented with spines, which are more shortly triangular and not so closely crowded as on adult penial setae. The other three setae have tip only slightly bifid and relatively broader and flatter than in adults; ornamentation is again sparse.

In specimens of adult size, there is very considerable variation in appearance of the male pore region, even on fully clitellate specimens. Male porophores may be sharply demarcated or indistinctly delimited

with lateral margins more or less deeply trilobed or without indications of such lobing, markedly protuberant from general surface or not at all protuberant. On a number of specimens with the scattered brown flecks on clitellar segments that indicate last stages of clitellar regression, male porophores may be almost or entirely unrecognizable. Apparently then the porophores also, like the clitellum, regress as period of sexual function ends.

No evidence was found to indicate that presence or absence of a trilobate condition of male porophores has any taxonomic value as was thought in case of *L. trilobata.*

Digestive system.—The gizzard is always in v. (Always in this connection, as well as below, refers only to normal specimens without metameric or organ location abnormalities.) The delicate funnel-shaped septum 5/6 is in contact with the gizzard, to which it may be more or less firmly adherent, but with care can be lifted off at least back to posterior margin of gizzard. In those few specimens in which there is an unusual amount of coelomic coagulum in v, the coagulum is quite obviously between the gizzard and 5/6. The intestinal origin is always in xv.

Vascular system.—The dorsal blood vessel, when empty, may be scarcely recognizable anteriorly, but when filled with blood is large to commissures of v, then anteriorly gradually decreasing in size. In several specimens, a small median branch, which passes forwards over the cerebral ganglia, is visible. This vessel, apparently without deeper exploration, in the past, in other genera as well as in *Lampito*, has been regarded as the dorsal trunk. However, a larger vessel, more or less deeply buried in tissues of the pharyngeal bulb, continues the dorsal trunk forwards to and under cerebral ganglia, where after bifurcating two branches pass ventrally along with the nervous commissures, then turn mesially and unite above the subpharyngeal ganglia to form a median vessel, which passes posteriorly, as the ventral trunk.

The dorsal trunk is said to have an embryonic double origin and in this connection it is of interest that in one worm the dorsal vessel is double throughout the whole of xiv. In one head regenerate, the dorsal trunk is double throughout.

Lateroparietal trunks have never been recognizable behind xix in any specimen. One worm has a large ventral connective between the two lateroparietals, in xvii.

Each segmental commissure of x-xiii bifurcates dorsally, the anterior branch passing into supra-oesophageal trunk, always distended with blood, the posterior branch passing to dorsal trunk, always white, very slender and without blood. To indicate the double dorsal connections and the function, these commissures are referred to as latero-oesophageal hearts. Ventral bulbs of hearts of x-xiii are close to ventral trunk. No branch vessels have been found opening into hearts of x-xiii.

Commissures of segments ix anteriorly are always different from those behind and no variation in this respect has been found in worms of any locality. In ix, commissures are slenderer than in x-xiii, slightly

thicker than those of v-viii, and always open directly into dorsal trunk. Connections with supra-oesophageal trunk have not been found, though commissures are often in contact with a pair of midsegmental vessels that pass ventrally on wall of gut from the supra-oesophageal. Even if a connection with supra-oesophageal does exist, relationships to dorsal trunk would still be exactly opposite from those in x-xiii, for commissures of ix are always filled with blood clear to dorsal trunk. Ventral bulbs of commissures of ix are further from median plane than in x-xiii, and from region of the bulb there are always given off several small branch vessels.

Passing anteriorly from ix, ventral bulbs of segmental commissures are progressively further, though only slightly in each segment, from median plane and branches in region of the bulbs more conspicuous. As branches become larger, the portion of the commissure passing from bulb region to ventral trunk certainly becomes less conspicuous, perhaps actually smaller, and at times quite unrecognizable, possibly actually lacking. Thus in v only one commissure, either right or left, usually can be traced to the ventral trunk. In vi, usually no connection with ventral trunk is recognizable. In vii, only one connection may be visible but in viii connections on both sides usually are recognizable. The commissures of vi do not encircle the gizzard but are well behind posterior margin of gizzard and of course in a different segment. Commissures of v pass near to or actually come in contact with extra-oesophageal trunks but in none of the specimens has any indication been found of segmental commissures opening into extra-oesophageals. As in case of commissures of ix, no connection with supra-oesophageal has been found in vii and viii, and even if connections are present, relationships of commissures to dorsal vessels would be like those of ix rather than of x-xiii, as the vessels are filled with blood clear to dorsal trunk. Pending demonstration of definite connection to other longitudinal trunks, commissures from ix anteriorly should be characterized as lateral.

The anterior connectives between dorsal and ventral trunks are regarded as commissures of segment i. Between these commissures of i and those of v, segmental commissures seem to be most modified, and, if present, represented only by short branches passing out from dorsal and ventral trunks, major middle portions of commissures being quite unrecognizable. Ventrally portions of only two pairs are usually recognizable, where three pairs are expected—those of ii, iii and iv. Occasionally, however, one of the supposed pairs is markedly assymmetrical in its junctions with the ventral trunk, and if each of the assymmetrical vessels is regarded as one remaining member of a segmental pair, the full number is attained. Dorsally, paired branches from the dorsal trunk are usually unrecognizable. In one specimen, however, and in which no median vessel to prostomium is recognizable, five pairs of branches are clearly recognizable between commissures of i and v, one more than is expected.

Abnormality.—Abnormality was found most frequently in connection with the spermathecae. In the list below all other organs, aside from spermathecae, appear to be normal and in normal segmental locations.

Abnormality in spermathecal battery. (Normal, three pairs of spermathecae in vii, viii, ix, with pores on 6/7, 7/8, and 8/9.)

Intersegmental furrow.	Spermathecal pore lacking on side.	Extra spermathecal pore present on side.	Number of specimens.
6/7	right	..	19
6/7	left	..	22
6/7	right left	..	4
6/7	..	right	2
6/7	..	left	1
7/8	right	..	3
7/8	left	..	5
7/8	right left	..	3
7/8	..	right	5
7/8	..	left	3
7/8	..	right left	1
8/9	right	..	11*
8/9	left	..	10
8/9	right left	..	1
8/9	..	right	3
8/9	..	left	3
..	left 6/7, right 6/7, left 7/8, right 8/9	..	1
..	left 6/7, left 8/9	..	2
..	left 6/7, right left 8/9	..	1
..	right 7/8, right 8/9	..	1
..	right 7/8, right and left 8/9	..	1
..	right left 6/7, right 7/8, right left 8/9	..	1
..	..	left 6/7, right 7/8	1
..	..	left 7/8, right 8/9	1
..	right and left 6/7	right 8/9	1
..	right left 6/7	right 7/8, left 8/9	1

* One specimen, not included above, has on right side in ix a testes and male funnel instead of a spermatheca.

In each case presence or absence of a spermathecal pore indicates presence or absence of a spermatheca. An extra spermathecal pore, wherever present, is usually fairly close to a normal positioned pore.

In both groups shown in the table, all of the spermathecae may be normal or one or more of the spermathecae may lack one diverticulum, either median or lateral. Most interesting perhaps is a condition shown by several specimens with an extra spermatheca, the normal positioned spermatheca having no lateral diverticulum, the extra spermatheca, which is lateral, having no median diverticulum.

Abnormality may involve only the male terminalia, male porophore and pore, penial setae, prostate and duct: right terminalia lacking (2), left terminalia lacking (2), left terminalia in xvii (1), left terminalia in xix (1). In case of absence of terminalia on one side of xviii, the setae of *a-b* lines may be lacking (1), the setae of *a-e* or *a-f* lines lacking, or the *a*, *b*, and *c* setae may be present and normally sigmoid.

More complicated abnormalities are shown in the table below. In none of these, as well as those above, are metameric abnormalities present.

Spermathecal pores.	Female pores.		Male pores.	
2. 5/6-7/8	13.		17	
3. L 7/8	13.		17.	
4. 5/6-8/9. Extra on R 7/8		14.		18
5. 6/7-R 9/10		14.		18.
6. L 6/7, L 7/8-8/9		14.	L 17.	R 18.
7. R 6/7, 8/9		14.	R 17.	L 18.
8. 6/7-8/9	13.	14.	R 17.	L 18.
9. 6/7-L 8/9	13.	14.	R 17.	L 18.

The first specimen, not included in table above, at first appeared to have a head hypomeric by one segment, *i.e.*, with all organs one segment anterior to usual location. More careful examination showed that 1/2 is present and that i is represented by only a very narrow strip just in front of 1/2 and the prostomial region which is nearly normal.

The second specimen is characterized by a hypomery of one, throughout, except that the gizzard appears to be in v. The third is characterized by a hypomery of one throughout, except that the gizzard appears to be in vi.

In No. 5, the right testis and male funnel of x is lacking, there is a male funnel in xii on the right side but no testis, and in xiv there is a pair of ovaries but no oviducal funnels.

In No. 9, the clitellum is on xii-xvi on right side, on xiii-xvii on left side. Seminal vesicle in viii is on right side, and there are testis and male funnel, but no spermatheca in ix on right side. In xi seminal vesicle is on right side, and testis and male funnel are on left side. In xii ovary and female funnel are on right side. In xiii left female funnel lacking and right heart. Intestinal origin in xiv is on right side, in xv on left side.

Spiral metamerism.—In region of first 18 segments, 33 specimens have a single spiral metamerism involving two to four segments as shown below.

Single spiral metamerisms in first eighteen segments.

Segments involved	Side on which unrecognizable	Number of specimens.
2-3	D (1) ? (1)	2
3-4	0	1
4-7	0	1
5-6	D (3)	3
7-8	D (1)	1
7-9		1
8-10	D (1)	1
9-10	L (2)	2
10-12	D (1)	1
10-13	D (1)	1
12-13	D (1) L (1)	2
14-16	D (1) L (1)	2
15-17	D (1)	1
16-17	D (1)	1
16-18	D (1) ? (2)	3
16-19	D (2) ? (1)	3
17-18	O (1) R (1)	2
17-20	L (1)	1
18-19	V (1) R (1)	2
18-20	? (1)	1
18-21	? (1)	1
		33

D dorsal, V ventral, R right, L left, O recognizable on all sides.

Segmental enumerations was made by counting on side on which metamerism was unrecognizable. When metamerism was recognizable on all four sides, counting was done on side on which abnormal metamerism was least obvious or was only estimated.

In the majority of these specimens, by thus counting the segments, female and male pores are as usual on xiii and xviii. Number and location of spermathecal pores is more affected.

Four specimens have two spiral metamerisms in region of first eighteen segments : iv-vi (D), xiv-xvii (D) ; v-vii, (D), xi-xiv (O) ; x-xii (O), ixv-xv (V) ; x-xiii (O), xvii-xx (?). Three specimens have three spiral metamerisms in first eighteen segments : iv-vi, viii-ix, xviii-xxi ; vii-viii, xiv-xv, xviii-xix ; viii-ix, (D), xv-xvi (?), xvii-xviii (O). Other specimens have more or less complicated spiral metamerisms involving all of following segments : ix-xx (1), ii-xvii (2). One of the last mentioned specimens doubtless has more than 17 segments involved in the spiral or spirals, perhaps as many as 21, estimation of number of segments is, however, impractical as metamerism is so complicated, but the segment bearing male pores which is just behind the end of the spiral is about at level of xxii on a normal worm.

Six specimens each have one or more abnormal non-spiral metamerisms in region of first eighteen segments, the type or types being different in each individual.

As indicated below, specimens with one or two spiral metamerisms are not very rare, and some with more have been found. Most interesting is a specimen with xxxvii split into two on left side, and in addition with 13 spiral metamerisms involving v-xviii, xxix-xxxi, xlvi-xlviii, l-liii, lvii-lix, lxiii-lxiv, lxvii-lxviii, lxxiii-lxxxiv, lxxix-lxxxvii, xciii-xcv, xcvii-xcviii, civ-cv, cx-cxii. The specimen has a tail regenerate at 112/113.

Some indication as to frequency of metameric abnormalities is available. In one series, of 22 specimens from one locality that were examined, ten have one or more spiral metamerisms in region behind 18/19. Postprostatic metameric abnormalities in a series of 240 specimens from a single locality are shown in a table below. In neither of the two series just mentioned were the specimens selected wholly at random. All those specimens with abnormalities in region of first eighteen segments were set aside for further study. Then all those specimens having tail regenerates were selected and the abnormal metamerisms were noted while determining level of regeneration. Metameric abnormalities may be present in tail regenerates but are not included in the table.

	Number of specimens.
One spiral abnormality	38
Two spiral abnormalities	11
Three spiral abnormalities ..	1
Six spiral abnormalities ..	1
One segment split into two parts on left side	10
One metamere split into two parts on right side	12
One metamere split into two parts dorsal half (3) . . dorsal three-fourths (1)	4
An anteroposterior half segment .	1
Two split segments, one on right side and one on left side	1
Four spiral abnormalities and two split segments	1
Total	80
Duplications	6
Number of specimens with metameric abnormalities	74
Percentage ..	31%

Split metamere.—On the split side there is an intersegmental furrow marking off the two portions each of which has setae. If the split is dorsal the furrow between the halves contains a dorsal pore. In these cases the furrow between the two halves of a split side ends abruptly without connection with another intersegmental furrow, thus distinguishing a split portion from a wedge-shaped fractional segment one of the boundaries of which joins the other.

An anteroposterior half segment is marked off by intersegmental furrows containing dorsal pores but is about half the length of adjacent segments and has no setae.

DISCUSSION.

Although frequently referred to as "The Indian Earthworm", *Pheretima posthuma* (L. Vaillant) 1868, is almost certainly an immigrant or importation from regions to the east. Widely distributed throughout the Indo-Gangetic Plains, though more or less restricted to a special, sandy soil habitat, the species has been recorded to the south only from Bombay, Poona, Baroda and Gwalior. If any one form is to be called "The Indian Earthworm" it should be *L. mauritii*. The original home of this species is in India, not in the eastern archipelago (Bahl, 1924), and presumably in or close to an area that includes the Cardamom and Palni Hills, from whence it has migrated or been carried into the whole of India from Cape Comorin to Siliguri, Lahore and Kapurthala, at elevations from sea level to 2,500 feet (Gates, 1938). South of the Indo-Gangetic Plains, *L. mauritii*, because of its common occurrence and the ease with which it is secured in numbers, is often the megadrilid type that is studied in the laboratory even though the syllabus may prescribe *P. posthuma*. In these circumstances, it is unfortunate that a species so characteristically Indian has not been more thoroughly studied. Aside from the information scattered through primarily taxonomic articles (*vide* Gates, 1938 for references) our knowledge of the species is based on two publications.

The earlier of these (Bahl, 1924), dealing with the excretory system, makes no mention of nephridia in segments i-iv and x-vix. While nephridia may be absent in i-iv, though Vasudevan mentions nephridia in iii (p. 315), nephridia are definitely present in x-xiv and on the anterior faces of the septa as are the larger tufts of pharyngeal nephridia in v-ix. It is hardly to be expected that nephridia as far back as in x-xiv are pharyngeal, but if not pharyngeal they appear to be of a type hitherto undescribed in the species and which needs adequate characterization.

The other publication, on the circulatory system (Vasudevan, 1939) both in text and figures, in definite statements and implications, disagrees with previous records as well as the account above. In these days of paper shortage it would appear to be unnecessary to list all these disagreements. Accordingly all that need now be said is that while certain discrepancies, as for instance in connection with the anterior portion of the dorsal trunk, may be attributable to varying morphological interpretation, others, such as those with regard to segmental commissures of v-ix, segmental location of the gizzard, etc., cannot be so regarded.

SUMMARY.

Smallest juveniles have a definite growth zone and fewer segments than fully grown normal adults, indicating that growth does take place in this species by addition of new segments after hatching. In the smallest juvenile, penisetal follicles are already protuberant into coelomic cavity but setae are unlike penial setae of adults. On basis of dissection of more than fifty specimens, location of gizzard in v is confirmed.

Segmental commissures of v-ix are lateral, or theoretically so in v-vii where connection to ventral trunk may be unrecognizable on one or both sides. Frequency of occurrence of various types of organ-location and metameric abnormalities is indicated.

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