

## CHAPTER VI.

### LINEAR SERIES—*continued.*

#### CHÆTOPODA, HIRUDINEA AND CESTODA.

##### *Imperfect Segmentation*<sup>1</sup>.

Though from the circumstance mentioned at the beginning of Chapter II, that the total number of segments in the Annelids is generally indefinite, true Meristic Variation cannot be easily recognized in this group, there is nevertheless a remarkable group of cases of *imperfect* segmentation, in which by reason of the incompleteness of the process of Division, the occurrence of Variation is at once perceived. The following cases were all originally described by CORI, who speaks of them as instances of "intercalation" of segments. For reasons sufficiently explained in the Chapter on Vertebræ, there are objections to the use of this term, if only as a mode of expression, and the evidence concerning these cases has therefore been re-cast.

- \*88. **Lumbricus terrestris**: the 46th segment having the form shewn in Fig. 21, I. being normal on the right side, but double on the left. Internally a septum divided the two parts *a* and *a'* from each other. Each of them contained a nephridium, setæ, &c. CORI, C. J., *Z. f. w. Z.*, LIV. 1892, p. 571, fig. 1.
- \*89. Specimen having, in the region close behind the clitellum, three consecutive segments, each resembling that just described. Of these the first was double on the right side, the second on the left, and the third on the right again. Fig. 21, II. shews the internal structure, the nephridia and other parts having doubled in each of the doubled half-segments. CORI, *l. c.*, p. 572, fig. 2.
90. **Lumbriconereis**: case similar to the first case in *Lumbricus*, Fig. 21, III. CORI, C. J., *l. c.*, p. 572, fig. 4.
91. **Halla parthenopeia**. A specimen 50 cm. long presented numerous abnormalities of which two are represented in Fig. 21, IV. At the point marked *a'* the lines of division between the segments

<sup>1</sup> Numerous facts illustrating this subject are given in a recent paper by BUCHANAN, F., *Q. J. M. S.*, 1893.

enclose a small spindle-shaped island of tissue. Three segments lower a wedge-shaped half-segment is similarly formed. At

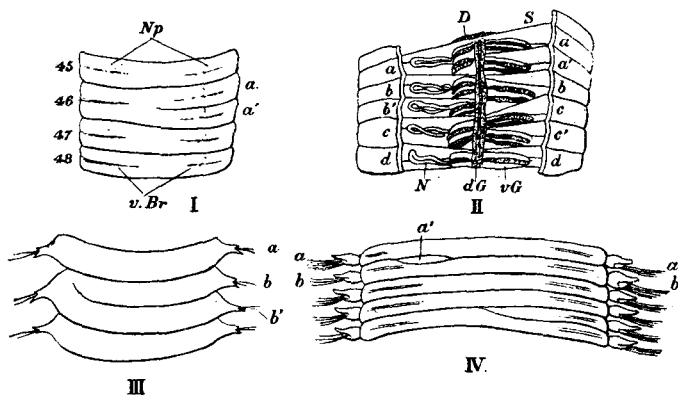


FIG. 21. Examples of imperfect segmentation in Annelids (after CORI).  
I. *Lumbricus terrestris* (No. 88). II. *L. terrestris* (No. 89), as seen when laid open on the dorsal side. III. *Lumbriconereis* (No. 90). IV. *Halla parthenopeia* (No. 91).

N, nephridium; *Np*, nephridial pores; D, alimentary canal; *dG*, dorsal vessel; *vG*, circular vessel.

The letters *a*, *b*, *c*, &c. indicate the parts belonging to the respective segments.

another point in the same animal (not shewn in Fig. 21) one of the segments was partly divided into two in the right dorso-lateral region. CORI, p. 572, figs. 8 and 9.

#### *Spiral Segmentation*<sup>1</sup>.

92. **Lumbricus terrestris.** Fig. 22, I. *A* shews a part of an Earthworm seen from the dorsal side, the ventral side being normal in appearance. By following the groove indicating the plane of the septum between *b* and *c* on the right side to the ventral surface, it could be traced to the left side between *b* and *c*, so across the dorsal surface, between *c* and *d* on the right side, across the ventral surface and between *c* and *d* on the left, reaching nearly to the middle dorsal line again. This is shewn diagrammatically in Fig. 22, I. *B*.
93. A simpler case affecting one segment only is shewn in Fig. 22, II.
94. Another specimen exhibited a similar arrangement near the tail-end (Fig. 22, III.). The lettering of the figure sufficiently explains the course of the spiral septal plane. [Cori does not state that the septa internally formed a spiral division, but it can scarcely be doubted that they did so, following the external groove,

<sup>1</sup> Further observations on this subject have been lately published by MORGAN, T. H., *Journ. of Morph.*, 1892, p. 245, and by BUCHANAN, F., *Q. J. M. S.*, 1893.

like the spiral valve of an Elasmobranch's intestine.] CORI, *Z. f. w. Z.*, LIV. 1892, p. 573, figs. 5, 6 and 7.

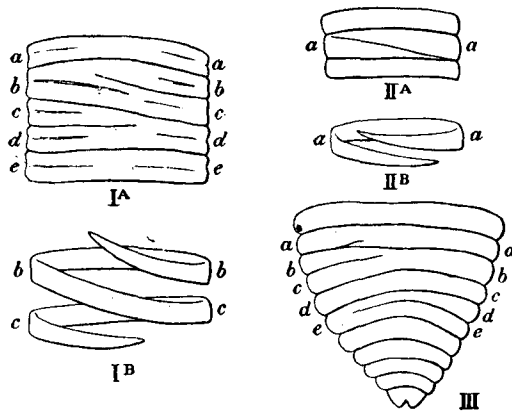


FIG. 22. Spiral segmentation in *Lumbricus terrestris*.  
I, A, the case No. 92; I, B, diagrammatic representation.  
II, A, the case No. 93; II, B, diagrammatic representation.  
III, the case No. 94. (After CORI.)

Two other cases described by CORI may be mentioned here, though there is a presumption that they are not really examples of Variation in the segmentation along the axis of a Primary Symmetry, but rather belong to the class of Secondary Symmetries. They are alluded to here as it is convenient to illustrate this distinction by taking them in connexion with the examples just given.

- \*95. **Hermodice carunculata.** (Fig. 23, III.) Between two normal segments is what seems at first to be a segment double on the left side with two complete sets of parapodia, but imperfectly divided on the right (left of figure), the septal groove stopping short before it reaches the parapodial region. The lower half on this side is represented with a normal ventral ramus of the parapodium, but the ventral ramus in the upper was itself *partially doubled*, having in particular two cirri *Cv. I.* and *Cv. II.* and two branches of setæ. The condition of the dorsal ramus is not described. Of course without seeing this specimen it is impossible to say more than this, but the figure strongly suggests that the division between the two halves of this parapodium was a *division into images* and not into successive segments. The figure represents the lower cirrus *Cv. II.* as standing in the normal position for the cirrus, on the posterior limb of the parapodium, but the anterior cirrus is distinctly shewn as placed on the *anterior* limb of the elevation and anterior to the bristles. If this were actually the case, this double parapodium must be looked on as a kind of bud, with a distinct Secondary Symmetry of its own. Described afresh from CORI, C. J., *Z. f. w. Z.*, LIV. 1892, p. 574, fig. 3.

96. **Diopatra neapolitana.** In the middle of a specimen 35 cm. long was an arrangement somewhat similar to the above. The part marked

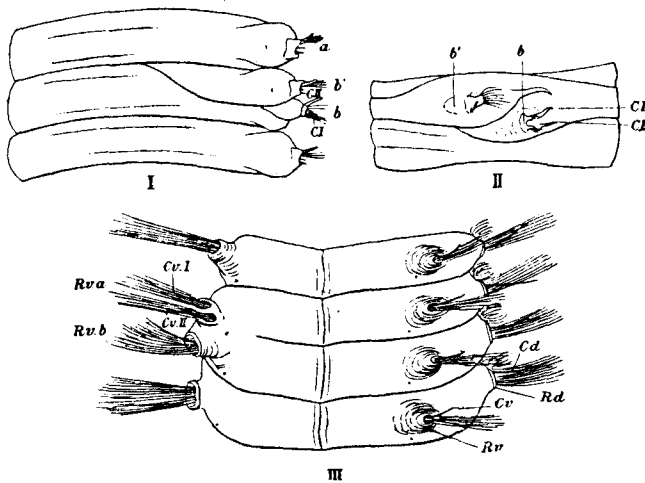


FIG. 23. I. The case of *Diopatra neapolitana* (No. 96) from the side. II, the same looking upon the parapodia. C I. C II, the two supernumerary cirri.

III. The case of *Hermodice carunculata* No. 95. *Cv*, cirrus of ventral branch of parapodium; *Cd*, dorsal cirrus; *Cv*. I, *Cv*. II, the two cirri borne on the supernumerary parapodium. (After CORI.)

*b'* was cut off as shewn in Fig. 23, I., it bore a normal cirrus, and the other part of the segment, marked *b*, bore *two* cirri and two bunches of bristles. The figure does not indicate that there was any relation of images between these two parts, but this would scarcely appear in this case unless specially looked for. Described afresh from CORI, C. J., *l.c.*, p. 573, figs. 10 and 11.

In considering the evidence as to Secondary Symmetries reference to these cases will again be made.

#### GENERATIVE ORGANS OF EARTHWORMS<sup>1</sup>.

The number and ordinal positions of the primary and accessory generative organs and of their ducts differ in the several classificatory groups of Earthworms. In the evolution of these forms it may therefore be supposed that Variation in these respects has occurred. To this subject the following evidence relates. The difficulty which was mentioned in the case of Variation in vertebræ, that there is no clear distinction between Homœotic and strictly Meristic Variation, will here also be met, inasmuch as the total number of segments in these forms is indeterminate; but

<sup>1</sup> For information and references on this subject I am indebted to Mr F. E. Beddard and Mr W. B. Benham.

probably we shall be right in regarding the majority of these variations as Homœotic.

**LUMBRICUS.** Throughout this genus there is normally a single pair of ovaries, placed in the 13th segment, on the posterior surface of the septum between the 12th and 13th segments. The following cases of supernumerary ovaries are recorded:

97. **Lumbricus turgidus**: specimen having an extra pair of ovaries in the 14th<sup>1</sup> segment.
98. Specimen having an extra ovary on the *right* side in the 14th segment.
99. **L. purpureus**: specimen having an extra ovary on the *left* side in the 14th segment.

In all these cases the extra ovaries were in size, form and position like the normal ovaries. There was no extra oviduct or receptaculum ovarum, but the normal ovaries and oviducts were present as usual. BERGH, R. S., *Zeit. f. wiss. Zool.*, XLIV, 1886, p. 308, *note*.

- \*100. **Allolobophora** sp. [partly = *Lumbricus*, the common Earth-worm]: specimen having, in all, seven pairs of ovaries; viz. a pair in the 12th, 13th, 14th, 15th, 16th, 17th and 18th segments. Of these all except the pair of the 13th segment are supernumerary. Each of these ovaries was placed on the posterior face of a septum in the usual position. The three anterior pairs in shape, structure and position closely resembled the normal structures. Of these the most anterior were slightly the largest. The four posterior pairs were smaller and resembled the ovaries of a very young or immature worm, but on examination all were found to contain ova. The normal pair of oviducts were present and no extra oviducts could be found, though carefully sought for. WOODWARD, M. F., *P. Z. S.*, 1892, p. 184, *Plate XIII*.

- \*101. **Lumbricus herculeus**, Savigny (= *L. agricola*, Hoffmeister), having an asymmetrical arrangement of the generative organs, &c. On the *left* side the arrangement was normal; the ovary being in the 13th segment, the oviducal opening in the 14th, and the opening of the vas deferens in the 15th segment (Fig. 24).

On the *right* side each of these structures was placed in the segment anterior to that in which it is normally found: the right ovary was in the 12th, the external opening of the right oviduct was in the 13th, and the external opening of the right vas deferens was in the 14th segment. The spermathecae were normal on the left side, being placed in the 9th and 10th segments, but on the right side one spermatheca only was present, that of the 9th segment. The vesiculæ seminales were present as usual in the 9th and 11th segments, but there was no vesicula in the 12th

<sup>1</sup> In BERGH's enumeration the ordinal number of these segments is one less than in that commonly used: the latter system is adopted above.

segment on the right side, while that of the left side was fully

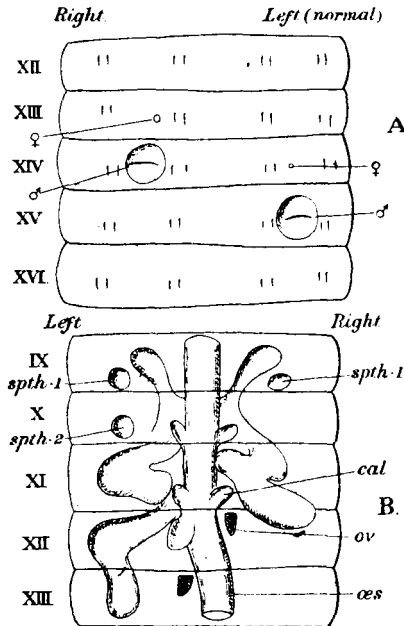


FIG. 24. *Lumbricus herculeus*, having the generative organs of the right side one segment higher than usual. A, external view from below. B, view of the organs from above. *spth*, spermathecæ; *ov*, ovary; *oes*, œsophagus; *cal*, calciferous glands. After BENHAM.

formed. It is remarkable that in this case, the calciferous gland of the 12th segment was absent on the right side. [I am indebted to Mr Benham for an opportunity of examining this specimen.] BENHAM, W. B., *Ann. & Mag. N. H.*, 1891, Ser. 6, VII. p. 257, Pl. III.

102. Another specimen presented the same variations as the foregoing, both as regards the asymmetrical arrangement of the genital pores and the absence of the calciferous gland: but in it there were vesiculæ seminales on the right side in segments 10 and 11, but none in segment 9; and there was a spermatheca on the right side in segments 8 and 9. [In the normal form the spermathecæ are in segments 9 and 10, so that, in this individual in the matter of the spermathecæ as well as of the genital pores, structures were formed in particular segments which are normally found one segment lower down.] BENHAM, W. B., *in litt.*, March, 1891.

103. Table shewing position of ovaries in forms having two or more pairs of ovaries, and in the Variations found (slightly altered from M. F. WOODWARD, P. Z. S., 1892):

Segments	9	10	11	12	13	14	15	16	17	18
<i>Acanthodrilus</i> .....					×	×?				
<i>Eclipidrilus</i> .....	×	×	×							
<i>Eudrilus</i> .....					×	×				
<i>Lumbricus terrestris</i> (normal) .....					×					
<i>L. herculeus</i> (? = <i>terrestris</i> ) Benham's { l. 2 specimens..... } rt.				×	×					
<i>L. turgidus</i> Bergh's spec. (abnorm.).....					×	×				
do. do. do. (abnorm.)... { l. rt.					×	×				
<i>L. purpureus</i> do. do. (abnorm.)... { l. rt.					×	×				
<i>Allolobophora</i> sp. (Common Earthworm, abnorm.) .....				×	×	×	×	×	×	×
<i>Perionyx</i> (two pairs, varying from 9—16)..	←—————→									
<i>Phreodrilus</i> .....			×	×						
<i>Phreoryctes</i> <sup>1</sup> .....				×	×					
<i>Urochaeta</i> .....				×	×					

104. ***Allolobophora*** sp. [♂ pores normally in 15th and ♀ pores in 14th, as in common Earthworm]: specimen having on the right side ♂ pore in 20th and ♀ pore in 19th; on the left side, ♂ pore in 17th and ♀ pore in 16th. MICHAELSEN, W., *Jahrb. Hamburg. wiss. Anstalt*, 1890, VII. p. 8. In each case the ♂ pore is in the segment behind the ♀ pore, as normally. The position of ovaries not given.

105. ***Lumbricus agricola*** Hoffm. (= *terrestris* L.): amongst 230 specimens in which the position of the male pores are determined, 6 specimens were found in which these openings were not normally placed (viz. one on each side in the 15th segment). In two of these specimens, both pores were in the 14th segment; in one case the left pore was in the 14th segment and the right was in the 15th: these three worms were German. One specimen was found in Savigny's collection in Paris which had two pores on the left side [and none on the right (?)]. In one English specimen the "vulva" [sc. the two male pores] was in the 14th segment and in another it was in the 16th. [The author speaks sometimes of both pores as the "vulva," and at other times he uses this term for one pore only, but the meaning is plainly that given above.] HOFFMEISTER, W., *Uebersicht aller bis jetzt bekannten Arten a. d. Familie Regenwürmer*, Braunsch., 1845, p. 7.

<sup>1</sup> *Phreoryctes*, a N. Zealand Oligochæt, has 2 pairs of testes and 4 vasa deferentia opening separately; 2 pairs of ovaries and 4 oviducts. BEDDARD, F. E., *Ann. and Mag.*, 1888, I. p. 339, Pl.

\*106. **Perionyx excavatus.** In this earthworm a very remarkable series of variations has been observed by Beddard. The accompanying table shews the varieties in number of spermathecae and position of the generative openings which were found. The spermathecae are generally 4, and are placed in the 7th and 8th segment, but in several specimens there were 8 and their position varied from the 6th to the 11th segment. In all the varieties, however, they were in segments adjacent to each other. In four specimens the spermathecae were in the 8th and 9th segment on the right side and in the 9th and 10th on the left. In normal specimens the male pores are 2, but individuals with 4 (and perhaps 6) were found. There are generally 2 pairs of ovaries and oviducts. In Var. No. 11 an additional ovary was found on the right-hand side in the 11th segment and in Var. No. 10 there were three pairs of ovaries.

*Table of Variations seen in P. excavatus (from BEDDARD).*

	Spermathecae	♀ pores	♂ pores	Clitellum
Normal (412 specs.)	8, 9	14	18	14—17
Var. 1 (1 spec.)	7, 8	11	16	12—15
" 2 "	.....	13, 14	18	
" 3 "	8, 9	13, 14	17	13—17
" 4 "	.....	15, 16	20	
" 5 (2 specs.)	8, 9	14, 14	18	13—17
" 6 (1 spec.)	6, 7	10	14, 15	
" 7 "	7, 8, 9, 10	15, 16	18	
" 8 "	.....	14, 15	18	
" 9 "	7, 8, 9	14	17	
" 10 "	8, 9, 10, 11	15, 16	19	15—18
" 11 "	6, 7, 8	13, 14	16	
" 12 (2 specs.)	8, 9, rt.; 9, 10, l.	14	18	
" 13 "	8, 9, rt.; 9, 10, l.	14, 15	18	
" 14 (1 spec.)	8, 9	15, 17	21	
" 15 "	.....	15, 16	18	

Though the position of both varied greatly, the male pores were always posterior to the female ones.

In some specimens certain of the segments were only divided from each other on one side of the body, being confluent on the other. For example in Var. No. 14, segments 11 and 12 and also segments 18 and 19 were only divided from each other on the left side (cp. Nos. 88—91).

Out of 430 individuals 15 variations in these structures were seen; of 12 of these variations single specimens only were found, but two specimens occurred with each of the other three forms of variation. In a single case a nephridium was found nearer to the dorsal line in one segment than in the adjacent segment. Many of the conditions here occurring as variations are found normally



in other genera and species. BEDDARD, F. E., *Proc. Zool. Soc.*, 1886, p. 308, figs.

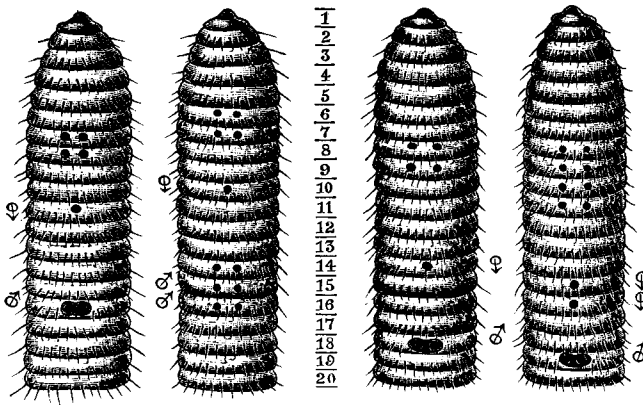


FIG. 25. *Perionyx excavatus*. Diagrams shewing some of the variations in respect of the number and positions of the openings of the spermathecae and generative pores. From BEDDARD, *P. Z. S.*, 1886.

***Perionyx grünewaldi***, Michaelsen. Normally a pair of male genital pores on the 18th segment, and a single oviducal opening for the two oviducts in the middle line of the 14th segment.

107. In two specimens a different arrangement was found. One of these had the oviducal opening in the 15th segment [position of male openings not specified and presumably normal].
108. The other had two oviducal openings, one in the 13th and one in the 14th segment [not stated whether these openings were median or lateral, nor whether each of them was a double structure as of course the normal female opening is]. In this specimen the male openings also were placed anteriorly to their normal position, being in the 17th segment. MICHAELSEN, *Jahrb. d. Hamburg. wiss. Anstalt*, 1891, VIII., p. 34.

ALLURUS. In *Terricolæ* generally, the ♂ pores are on the 15th, and the ♀ pores on the 14th, as in the common Earthworm.

109. ***Allurus tetraëdrus***, a widely distributed form, has ♂ pores on the 13th and ♀ pores on the 14th, the ♂ pores being thus *in front* of the ♀ pores as a specific character. Under the name *Allurus dubius* Michaelsen described two specimens having the male pores on the 14th instead of on the 13th, and the ♀ pores on the 15th instead of on the 14th, each being thus one segment in advance of its normal place [backward Homeösis]. MICHAELSEN, W., *Jahrb. Hamb. wiss. Anst.*, 1890, VII., p. 7; see also *Arch. f. Naturg.*, 1892, LVIII., p. 251. Compare No. 111.
110. Besides these is a batch of 8 specimens of *A. tetraëdrus*, loc. unknown, 6 specimens had both ♂ and ♀ pores in the 14th. Clitellum began in 23rd, tuberc. pubert. in 24th. These specimens are thus intermediate between *A. hercynius*, which has the pores as in *Lum-*

*bricus*, and *A. tetraëdrus*. MICHAELSEN, W., *Arch. f. Naturg.*, 1892, LVIII., p. 251.

111. **Allurus putris**: specimen having ♂ pores on 13th (instead of 15th) as an abnormality; in it the other external generative organs (and doubtless the internal also) were 2 segments higher than usual, the ♀ pore being on the 12th instead of 14th. Tuberc. pubert 26—28. MICHAELSEN, *Jahrb. Hamburg. wiss. Anst.*, 1891, VIII., p. 8. Compare No. 109.
112. **Allurus** sp.: specimen having 1. side normal; right side, ♂ pore in 12th, ♀ in 11th, clitellus and tuberc. pubert. one segment higher than usual. *Ibid.*
- \*113. ENCHYTRÆIDÆ. ♂ pore generally in the 12th segment. In *Buchholzia appendiculata* (Buch.) it is on the 8th, as a specific character. In **Pachydriulus sphagnetorum** (Vejd.) it is either on the 8th or on the 9th, according to individual variation, the other parts being then disposed as follows:

	♂ pore on 8th	♂ pore on 9th
Testes on dissep. ....	7/8	6/7
Ovaries on dissep. ....	8/9	7/8
Vas def. in front of dissep.	8/9	7/8
♂ pore .....	9	8
Oviduct on dissep. ....	9/10	8/9
♀ pore .....	10	9
Clitellum .....	9 and $\frac{1}{2}$ 10	8 and $\frac{1}{2}$ 9

MICHAELSEN, W., *Arch. f. mikr. Anat.*, 1888, XXXI. p. 493; see also *Jahrb. Hamb. wiss. Anst.*, VII. p. 8.

114. **Perichæta hilgendorfi**, n. sp. Mich. 7 specimens. Variation in number of spermathecal openings, as follows. 5 specimens had 2 pairs in the groove between segments 6/7 and 7/8; 1 specimen had 3 pairs, between 5/6, 6/7 and 7/8; 1 specimen had only one, on the left side between 6/7, which corresponded internally to a single spermatheca [other variations also observed in these specimens, q. v.]. MICHAELSEN, W., *Arch. f. Naturg.*, 1892, LVIII. p. 236.
115. **Perichæta forbesi** (an Earthworm from New Guinea). In this animal a pair of spermatheca is placed in the 8th segment and another pair in the 9th. Two specimens only have been examined and in both of these an additional spermatheca was found on the left side, internal to the other. In one individual the 5th spermatheca was in the 8th segment, and in the other it occurred in the 9th. BEDDARD, F. E., *Proc. Zool. Soc.*, 1890, p. 65, *Plate*.
116. **Allolobophora liasiensis**. Similar variation in spermatheca, MICHAELSEN, W., *Jahrb. Hamb. wiss. Anst.*, VIII., 1891, p. 19.

HIRUDINEA.

117. **Hirudo medicinalis**. The number of pairs of testes is variable, but 9 pairs most often found. Of 31 specimens of this species, 21 had 9 pairs, 6 had 10 pairs, and 4 had 9 on one side and 10 on the other. CHWOROSTANSKY, C., *Zool. Anz.*, 1886, p. 446.

118. **Hirudo officinalis**: of 7 specimens, 5 had 9 pairs of testes, 1 had 10 pairs, and though in the 7th specimen there were 2 pairs, the vas deferens of the last pair of testes ended blindly. *Ibid.*
119. **Hirudo medicinalis**. Fairly often the vas deferens is prolonged beyond the 9th testis, and having passed through five annuli, ends in a glandular mass of irregular form. Case given in which the 7 last testes of right side were absent or only represented by amorphous material, the testes of the left side being abnormally large. ÉBRARD, *Nouv. monogr. des Sangsues méd.*, Paris, 1857, p. 99.
- \*120. **Hirudo officinalis**: an individual having a supernumerary penis, and vesicula seminalis of the right side, in the 5th somite.

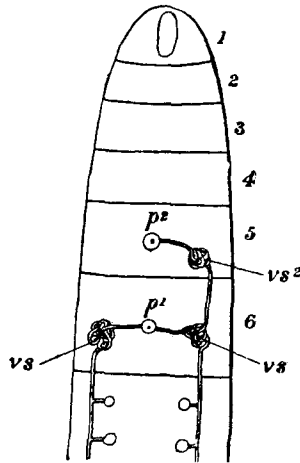


FIG. 26. Case of *Hirudo officinalis*, No. 120.

$p^1$ , penis in normal position;  $p^2$ , supernumerary penis;  $vs$ , the usual vesicula seminalis;  $vs^2$ , supernumerary vesicula seminalis. (From a diagram sent to me by Mr Gibson.)

The normal penis in the sixth segment was fully formed and into it opened on either side a vas deferens, provided with a vesicula seminalis as usual. But the vesicula of the right side gave off in addition a vas deferens, which passed forwards into the fourth segment and there enlarged into another vesicula seminalis. This additional vesicula was connected by a duct with a supernumerary penis placed and opening in the middle of the fifth segment. The parts of the left side as well as the female organs were normal. [I have to thank Mr Gibson for furnishing me with a diagram (Fig. 26) supplementing the published account.] GIBSON, R. J. HARVEY, *Nature*, 1887, XXXV., p. 392.

**Aulastoma gulo** (Horse Leech). In this form as is usual among the *Gnathobdellidæ* there are from 9 to 12 pairs of tes-

ticular sacs which communicate with a tortuous vas deferens on each side which together enter a single penis. The paired ovaries are placed behind this and the oviducts unite to form a common vagina.

- \*121. In a specimen found amongst a large series investigated, each vas deferens opened by a separate penis, of which the most anterior opened in the 20th annulus and the posterior in the 25th. The female apparatus was similarly divided. One ovary was placed near the penis in the 25th annulus and from it a vagina passed down to open with the penis. The other ovary, with a similar vagina, lay in the 30th annulus. ASPER, G., *Zool. Anz.*, 1878, I., p. 297.

*Recapitulation of evidence as to OLIGOCHÆTA and HIRUDINEA.*

Variation in these two groups appears in such similar modes that points of special consequence in both may conveniently be spoken of together.

1. As elsewhere seen, so here, there are forms, e.g., *Perionyx excavatus* or *Pachydriilus sphagnetorum*, shewing great variability, while others, the common Earthworm for instance, rarely vary.

2. Both forward and backward Homœosis may occur; a form normally having the ♂ pores, for instance, on the 15th segment, may as an individual variation have them on the 16th (No. 105), while an individual of another genus, starting from the same normal, may have them on the 13th (No. 111).

3. As in other cases of Homœosis, when a member of a Meristic Series, in this case a segment, develops an organ proper to another segment, this organ is formed in a place serially homologous with its normal place. (To this principle certain limitations must hereafter be introduced.)

4. Variation may, or may not, be simultaneous and correlated in the several systems. The position of the ♀ openings, for example, may or may not vary similarly and simultaneously with that of the ♂ openings, though on the whole the evidence suggests that such correlation is not uncommon. The facts seen in the genus *Allurus*, in which one species (*A. tetraëdrus*) has the ♂ pore normally in front of the ♀ pore, sufficiently indicate that the variation in the position of these two openings is not always so correlated. It may be further mentioned that variation in number of ovaries seems to occur generally without correlated variation in the number of oviducts.

5. Such Variation may or may not be simultaneous on the two sides of the body. When not thus bilaterally symmetrical, there may nevertheless be a full correlation between the parts of the same side.

6. The evidence does not indicate any limit to the number of segments which may take on a certain character, or approxi-

mate to a given pattern. The highest number of ovaries, for instance, recorded, is 7 pairs; but there is nothing to shew that more segments might not undergo similar Homœosis. (The progressive diminution in size of these ovaries from before backwards in this case is worth noticing.)

7. The principle so often manifested in the evidence of Variation, that the magnitude, completeness, and symmetry of a variation bears no necessary proportion to the frequency of occurrence of that variation, is here strikingly exemplified.

8. The evidence as to the existence of two varieties of *Pachydrilus sphagnetorum*, the one with all the organs a segment higher than their place in the other variety may be well compared with SHERRINGTON'S observation, that in the Frog and in several Mammals (see No. 70) the individuals could be roughly divided into two classes according as the lumbo-sacral plexus was formed more anteriorly ("preaxial class") or more posteriorly ("postaxial class").

9. In the evidence as to *Perionyx*, it was seen that many of the arrangements found occurred in single specimens only, suggesting the inference that the systems do not fall into one of these conditions more easily than into others; nevertheless of each of three abnormal arrangements two examples were found, a circumstance hardly to be expected on the hypothesis of fortuitous Variation.

10. It is perhaps unnecessary to point out that the examples of Variation given are in their several degrees Discontinuous, and that by the nature of the case the Variation by which the several specific forms have attained their particular numbers and characteristic disposition of organs, must almost of necessity have been thus Discontinuous.

#### CESTODA.

The following facts respecting Variation in Cestoda are chiefly taken from LEUCKART, *Parasiten des Menschen*<sup>1</sup>.

Besides the variations here enumerated, abnormalities of several other kinds (variation in number of suckers, prismatic segments, bifurcation, &c.) are known in this group, but as these do not directly illustrate the Variation of Linear Series, consideration of them must be deferred.

The degree to which the parts bearing sexual organs are separated from each other differs greatly in the various groups of Cestodes. In some (*Tricænophorus*) the segmentation amounts to an inconsiderable constriction, while in *Ligula* the generative organs are repeated several times in a common body. L., p. 347.

<sup>1</sup> In what follows the letter L. is used in reference to this work.

122. Even in the groups whose segmentation is commonly perfect, variations in the degree of separation between the proglottides are not rare. It frequently happens that specimens of *Tænia* are found in which the external segmentation is partial, being only found on half of the contour. This abnormality, which does not affect the internal organs, occurs several times in the same chain. MONIEZ, R., *Bull. Sci. du Nord*, x., p. 200.
123. ***Tænia saginata***. Cases of the "intercalation" of a triangular, wedge-like segment between two proglottides are recorded. In such cases the generative opening is on the same side as in an adjacent segment, not taking part in the alternation. L., p. 572. Compare with similar phenomena in Chætopoda (p. 156).

The evidence of abnormal repetition of parts occurring in single proglottides bears on the question of the relationship of the perfectly segmented forms to the less fully segmented.

124. ***Tænia saginata***: a specimen 128 mm. long, wanting the head, without any division into segments. The longitudinal vessels were seen, but no transverse vessels were discovered. On the margins were numerous genital openings, of which 41 were counted, each leading from a genital organ. There was no regular lateral alternation between the genital papillæ, but they were disposed without uniformity of pattern, and several were closely approximated to each other. In no part was there any trace of division into proglottides. From the characters of the genital openings and from the number and size of the calcareous bodies together with other histological details, the specimen was determined without much doubt as *Tænia saginata*. GROBBEN, C., *Verh. zool.-bot. Ges. Wien*, 1887, Bd. xxxvii., p. 679, fig.

Such repetition of the generative openings in single segments is very common, especially in *Tænia saginata*, and indeed examples of it may be seen in most chains of segments. Usually such repetition is confined to one segment and is not striking. Five generative papillæ have been seen by L. in one segment, and COLIN [ref. not found, W. B.] described 25—30 genital pores in an unsegmented piece measuring 15 cm. L., p. 571.

125. Repetitions are not confined to the generative openings, but the generative organs themselves are also thus abnormally repeated. In cases in which several sets of generative organs occur in the same segment it is found that those near the middle of the segment are the least developed. In these cases, though the different organs frequently cross each other, Leuckart found no anastomoses between them, but the number of distinct sets of generative organs was the same as the number of pores.

It was not found that the length of the segments increased in the same ratio as the number of the pores they contain. For example, a segment with two pores measured 18 mm. in length

(instead of about 20 mm.), and one with five pores measured 28 mm. (instead of 50 mm.). L., p. 571.

126. **Tænia.** Case quoted by Leuckart from HELLER of a *Tænia* having generative openings placed on the *surface* of the segments. Leuckart himself has never seen an example of this variation. [Original reference not found] L., p. 570, *Note*.
127. **Tænia solium** and **T. saginata.** Specimens are known having *two generative pores opposite each other at the same level*. In such cases each leads to a male and a female duct with cirrus-sac and receptaculum seminis; but the organs for preparing the ova are normal in construction, as the two vaginae lead to a common uterus and shell-gland. Two cases only have been seen by LEUCKART and he cites another from WERNER. L., pp. 529 and 571.
128. **Tænia solium** in which the pores are normally alternating, may be found with symmetrically developed pores; and on the contrary, **T. elliptica** in which they are normally symmetrical, may occur with an asymmetrical arrangement. L., pp. 353 and 529.
129. **T. saginata:** in a chain of about 6·5 metres in length, and containing some 650 joints, there was found a single, heart-shaped, supernumerary joint like those described; a single joint was found with two genital pores, one being on each lateral border at about the same level.  
The largest number of consecutive joints having the genital pores on the same side was six. TUCKERMAN, F., *Zool. Anz.*, XI., 1888, p. 94.
130. **Tænia cœnurus.** Specimen observed by Leuckart in which the last 8 or 10 segments shewed a *transposition* of the generative organs, those which usually lie at the distal end being placed at the proximal. This change of position was especially seen in the case of organs engaged in the preparation of the ova. The proximal proglottides of this individual were normal. The transition segment between these two regions contained two simple vesiculæ seminales and two marginal papillæ which were on opposite sides; but in spite of the resemblance of these structures to genital pores, neither opening, nor cirrus, nor vasa deferentia could be distinguished. L., p. 504.
131. Amongst chains of normal proglottides it is not rare to find a segment containing male organs only. L., p. 504.

Speaking generally, slight abnormalities are far more common than great ones. Nearly every specimen of Tapeworm has individual peculiarities, and these generally repeat themselves in the same chain of proglottides. This repetition of the same abnormality in different parts of the chain is also the rule for the greater abnormalities also. L., pp. 529, 572 and 573.