An Attempt to Classify Earthworms.

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THE hard and fast line between Earthworms and Freshwater worms, as indicated by Claparède's terms[1] "Terricolæ" and "Limicolæ," is gradually becoming less distinct; and as new knowledge in both these groups is acquired we are led to recognise that the plan adopted by Vejdovsky is the more natural one: although I believe that it is possible to arrange the various families into which he divides the Oligochæta into certain groups.

The anatomical characters which served Claparède as points of distinction between his two groups were drawn from the knowledge of Lumbricus alone. They were (1) the possession of two blood-vessels below the intestine, the subintestinal and subneural vessels; (2) the presence of nephridia in the genital somites; (3) the position of the clitellum behind the male apertures; and (4) the presence of a plexus of capillary blood-vessels on the nephridia. The investigations of Per-

[1] Claparède, "Rech. sur les Oligochétes," 'Mém. de la Soc. de phys. et d'hist. nat. de Genève,' t. xvi, 1862.

rier,[1] and later of Beddard, Horst, Rosa, myself, and others, have shown that, of these four characters, only the last can be retained; and at the same time numerous points of agreement between "Limicolæ" and "Terricolæ" have been brought to light, especially by the help of microscopic research. For example, Beddard has pointed out the similarity between the genital organs of the earthworm Moniligaster and the water-worm Stylaria.

From his observations of the various specimens of earthworms in the Paris Museum, Perrier suggested a subdivision of the "Terricolæ" into four groups: (1) Anteclitellian; (2) Intraclitellian; (3) Postclitellian; and (4) Aclitellian.

Beddard and Horst have already shown that the second and third of these names cannot be always applied to all species of the same genus, one species being Intraclitellian, others Postclitellian; and A. G. Bourne[2] has described a species of Moniligaster, for which the fourth group was formed, in which a clitellum is present.

Vejdovsky,[3] in his beautiful monograph on the Oligochæta, divides the members of the group into seventeen families, each of equal value. These are—

Family 1. Aphanoneura.
2. Naidomorpha.
3. Chætogastridæ.
4. Discodrilidæ.
5. Enchytræidæ.
6. Tubificidæ.
7. Phreoryctidæ.
8. Lumbriculidæ.
9. Pontodrilidæ.
10. Criodrilidæ.
11. Lumbricidæ.
12. Eudrilidæ.

[1] Perrier, "Rech. pour servir à l'hist. des Lombriciens terrestres," 'Nouv. arch. du Mus. d'hist. nat. de Paris,' t. viii, 1872.

[2] A. G. Bourne, 'Proc. Zool. Soc.,' 1886.

[3] Vejdovsky, 'Systeme und Morphologie der Oligochaeten,' Prag., 1884.

13. Acanthodrilidæ.
14. Perichætidæ.
15. Plutellidæ.
16. Pleurochætidæ.
? 17. Moniligastridæ.

He gives the characters of the first eleven of these families, but does not characterise the remaining six. As will be seen below, I shall split up some of his families, and unite others into one family.

Rosa[1] does this to some extent; but I have not taken quite the same lines as he has. He retains Claparède's "Terricolæ" for the members of the last nine families, and groups these into six families; and regards "Terricolæ" as of equal value to any of the first eight of Vejdovsky's families.

Vaillant, in the recently published volume 'Annèles' ('Suite à Buffon'), divides the Oligochæta into two groups:

(1) Naidina, including Vejdovsky's first three families;

(2) Lumbricina, including the remainder with the exception of Discodrilidæ.

But, as he only deals with the genera and species of earthworms known up to and including Perrier's memoir in 1872, his subdivisions are not of that value that we should expect in such a work.

I. Nomenclature of Certain Organs.

Before proceeding to the classification which I have to suggest, I will make a few remarks on the words and terms employed therein.

The setæ in a large number of worms are arranged, as in the common earthworm, in "twos." These are nearly always spoken of as "pairs" by writers on the subject; but this word seems to me to be ill-chosen: by "pair" we usually understand a right and a left organ of a bilaterally symmetrical animal. I suggest, therefore, the word "couple" to denote the

[1] Rosa, "Nuova Classificazione dei Terricoli," Boll. d. Mus. Zool. ed Anat. Comp.,' tom. iii, 1882.

two setæ placed close to one another; and in place of the terms "dorsal" and "ventral" setæ I shall employ the words "outer" and "inner" in describing the couples in reference to their position relative to the ventral mid-line of the body. When the eight setæ become wider and wider apart it sometimes becomes advisable to speak of such setæ as being "separated."

The four setæ on each side may be termed, with Perrier,[1] 1, 2, 3, 4; the first being most ventrally placed, the fourth most dorsally.

The prostomium is frequently a lobe nearly as wide as the first somite of the body, and sometimes separated from it by a transverse groove; but very frequently grooves extend back into this first somite, one starting from each side of the prostomium, so that the prostomium appears as a narrow or broad lobe embedded in, or "dovetailed into," the first somite. Sometimes these lateral grooves stop after traversing the first somite for only a short distance; the prostomium is then only "partially dovetailed" into the first somite. If, as in Lumbricus agricola, Hoffmeister, the lateral grooves reach the intersegmental groove dividing the first from the second somite, the prostomium is said to be completely "dovetailed."

The first somite, that surrounding the mouth, is frequently called the "buccal segment or somite;" but, following the nomenclature used in works on Polychætes, I have adopted the word "peristomium" or "peristomial somite" in the following classification.

Most of the writers of the present day regard this as the first somite, and this is the view I shall take. It may be noted that Vaillant[2] retains Dugés' enumeration, and speaks of the first setigerous somite as the "first" somite.

In referring to the position of an aperture between two somites I use the form "x/xi," for example, meaning that such an aperture lies between Somites x and xi.

[1] Perrier, "Sur un nouv. Gen. des Lombriciens terrestres," 'Arch. f. Zool. Exp. et Gen.,' t. ii, 1873.

[2] Vaillant, "Annèles," 'Suite à Buffon,' 1889.

The glandular modification of the epidermis indicated by the word "clitellum" is in many cases equally developed all round the body, as in Perichæta; this is indicated by using the word "cingulum," or speaking of the clitellum as "complete." In Lumbricus and many others the glandular modification does not extend across the ventral surface: this is a true "clitellum" in the strict sense of the word, or an "incomplete clitellum" using the word in its wider sense.

Intermediate conditions are sometimes met with, where, as in Acanthodrilus, the clitellum is "complete" in the anterior part of its extent, and "incomplete" over the last two or more somites. The lower edge of the incomplete clitellum is sometimes, as in Lumbricus and Rhinodrilus, further modified, presenting the appearance of a linear band, or group of glands over more or fewer somites. To these the name "tubercula pubertatis" has been applied by Eisen.

The external openings of the sperm-ducts are the "male or spermiducal pores;" those of the oviducts, "oviducal pores;" those of the spermathecæ, the "spermathecal pores." The first of these is frequently placed on a more or less prominent papilla, and in many worms other papillæ, median or paired, are present in their neighbourhood. These "copulatory papillæ" are probably of value for the diagnosis of species; but it is only recently that exact observations have been recorded as to the number and position of these papillæ in different worms, and as they appear to be fully developed only at the breeding season they are not of value for absolute identification. Of this nature are the depressed reddish papillæ in Somite XXVI in the common earthworm.

The setæ in certain somites are not unfrequently modified for the purpose of copulation: those in more or less immediate relation to the male pores are known as "penial setæ" (Lankester); whilst those which are found, for instance, in Acanthodrilus layardus and other species, in connection with the spermathecæ, have been distinguished by Horst as "copulatory setæ." These two terms are, to all intents and purposes, identical: so that I shall distinguish penial setæ in the neighbourhood of the prostates, or spermiducal pores as "male copulatory setæ," or "posterior penial setæ," and those in neighbourhood of spermathecæ, as "female copulatory," or "anterior penial setæ."

Certain terms in connection with the internal reproductive apparatus may require definition. The testes are usually present to the number of two pairs, and these are nearly always placed in Somites x and xi. The difficulty in counting the somites, or the delicacy and fragility of the septa, sometimes render it difficult to be certain of the true position of the testes, especially as in some worms the septa do not correspond exactly in position to the true limits of the somites; hence it may be that some, at any rate, of the exceptions are apparent rather than real. The ovaries likewise are nearly universally placed in the Somite xiii; the oviducts open externally on the Somite xiv.

The terms vesiculæ seminales, and seminal reservoirs, are conveniently replaced by "sperm-sacs" (i. e. the "testes" of the older authors). Similarly the rather clumsy term "receptaculum ovorum," which has been observed in several worms, may be replaced by "ovisac;" a word at the same time simpler than the original term, and also in agreement with "sperm-sac," both in nomenclature and in function.

I shall use the word "sperm-duct" for the more old-fashioned "vas deferens;" however, I shall retain "ciliated rosette" as a more convenient and shorter term than "funnel of the sperm-duct."

In many genera there is, attached to the sperm-duct near its external pore, a glandular diverticulum, which may be lobed as in Perichæta, or tubular and coiled as in Pontodrilus, and others. Most writers have referred to these structures as "prostates;" but Beddard has recently, in two papers ('Zool. Anz.,' No. 268, 1887, and 'Quart. Journ. Micr. Sci.,' xxix, p. 117), sought to establish an homology between these prostates and the "atrium," or enlarged part of the sperm-duct of Tubifex, into which the cement gland opens; and in his various papers on earthworm anatomy uses "atrium" to signify the prostate of authors, and by "prostate" refers to the peritoneal (? glandular) covering of the terminal portion or "atrium" of Moniligaster and Stylaria.

I will not, here, enter into a discussion of this subject; I shall, however, reject "atrium," and retain the older word "prostate" for these glands, which either pour their secretion into the sperm-duct, or open, independently, to the exterior.

This prostate is a hollow structure, the wall of which is formed of club-shaped cells similar to those found in the clitellum: sometimes, a layer of columnar epithelial cells intervenes between the clitellar cells and the lumen; sometimes the columnar cells are absent. A layer of muscles usually surrounds the clitellar cells; or the muscular layer may be confined to the proximal region of the prostate.

In many cases, as in Perichæta, Pontodrilus, Eudrilus, &c., the prostate opens into the sperm-duct, so that we only have one "male pore." In other genera, as in Acanthodrilus, Deinodrilus, &c., the prostates open to the exterior independently of the sperm-ducts: in these cases we must distinguish "spermiducal pores" from "prostate-pores."

The word "spermatheca" is retained, in preference to the "receptacula seminis" of other authors.

The glandular structures met with in Lumbricus, Perichæta, Brachydrilus, and others, and usually called "capsulogenous glands," are misnamed. As far as we know they have nothing to do with the formation of the capsule or cocoon, which is formed by the hardening of the secretion of the gland-cells of the clitellum; but they give rise to the albuminous fluid found in the cocoon, in which the ova and spermatozoa are deposited, and which serves as nourishment for the developing embryos. Vejdovsky suggests the word "albumen-glands" for these structures, a term which I retain.

The excretory system has quite recently had a new light thrown upon it by the researches of Beddard[1] and of Baldwin Spencer.[2]

Perrier, in 1872, noticed that the nephridia were replaced in Perichæta by small tufts of tubules; and a similar arrangement is found in many other worms.

Beddard[3] described a species of Acanthodrilus with eight "nephridia" per somite; these he more recently[4] discovered were not really large tubules, but eight groups of small tubules opening to the exterior by numerous apertures. Again, more recently he has shown us that in Perichæta armata there is a network of delicate tubules in addition to a pair of large nephridia in each somite; and this network of delicate tubules is provided with many external apertures, sometimes without internal funnels, rarely with them.

Baldwin Spencer, in his detailed description of Megascolides australis, demonstrates the transition between the large nephridia in the posterior part of the body and the delicate small tubules which line the inner surface of the body-wall in the anterior somites. Anteriorly there is a network of these delicate tubules, which have no internal funnels, but numerous external openings, the network being continuous somite to somite. About the middle of the body this network becomes confined to a band of small tubules round the somite, of which one tubule is larger than the rest. Further back this tubule increases in size, and ultimately attains a size almost equal to that of a nephridium in Lumbricus; moreover, this tube communicates with the cœlom by means of a funnel, but still retains a connection with the network of smaller tubules. Both Beddard and Spencer favour the idea of the development of a "nephridium" from such a network of tubules.

1 Beddard, 'Quart. Journ. Micr. Sci.,' vol. xxix, and see literature therein.

2 Baldwin Spencer, "The Anatomy of Megascolides australis," 'Trans. Roy. Soc., Victoria,' vol. i, 1888.

3 Beddard, 'Proc. Roy. Soc.,' 1885.

4 Beddard, 'Quart. Journ. Micr. Sci.,' vol. xxviii.

The possession by earthworms either (1) of such a network or "tuft" of small tubules (a "plecto-nephric" condition), or (2) of a pair (rarely two pairs) of large "nephridia" (a "mega-nephric" condition), suggested to me the possibility of dividing the earthworms into two groups, according to conditions of the excretory system. This has formed the basis of the classification here put forward; but we are instantly met by the fact that some species of certain genera comprised in the first set—i. e. those with a network of small tubules—have apparently large "nephridia;" but is this really the case?

Both in Acanthodrilus and in Perichæta species have been originally described as having large nephridia; but a renewed and more careful microscopical examination has proved either that this large nephridium is accompanied by a network of tubules as in P. armata (Beddard), or that the supposed "nephridium" really consists of a mass or tuft of small tubules as in Ac. multiporus. So that when Fletcher states that several species of Cryptodrilus, a genus which is usually "plecto-nephric," have three pairs of large "nephridia" per somite, I think we are justified in assuming that these will turn out to belong to one or other of the above categories.[1] I may add that Fletcher's descriptions of numerous species are unaccompanied by figures, except in a few instances of external characters.

The genus Perionyx, formed by Perrier for the reception of a worm very similar to Perichæta, has always been closely associated with this latter genus, and I feel considerable hesitation in removing it from association with Perichæta; but it differs from the latter in possessing a pair of large nephridia in each somite unaccompanied by smaller tubules, as well as in some other small details. This I have ascertained by the examination of sections, and by mounting a portion of the body-wall, with nephridia, complete.

[1] Beddard has recently ('Quart. Journ. Micr. Sci.,' xxx, Feb.), described these new species of Acanthodrilus, in which only large nephridia are mentioned. Here again, I think, we may suspect that a network of small tubules is present in addition.

The nephridium here has all the appearance of that in the common earthworm.

For this reason I have separated it from its former allies; and although, at present, we know but few points of apparent difference between Perionyx and Perichæta, yet it may be possible to separate some of the species of the latter genus and place them in the former genus.

Assuming with Beddard and Baldwin Spencer that the excretory network is more primitive than paired nephridia, and regarding the perichætous condition as secondary, it is not impossible to conceive this condition making its appearance both in worms which still retain the network, and in those which have acquired the large nephridia; or perhaps Perionyx is a descendant from forms which had become perichætous whilst still retaining the network, but which have lost this latter character and retained the former.

The histological structure of the nephridia still remains to be worked out, although, thanks to Beddard and Spencer, we have a fair knowledge of the details in the case of the small tubules of the network in Acanthodrilus and Megascolides. These, like the larger nephridia, are made up of a series of "drain-pipe" cells—no doubt ciliated in some part of the tubule—which form the mass of the tubules; but this intracellular lumen becomes converted into an intercellular lumen near its external opening, and the wall is here frequently provided with muscle-fibres.

Of the exact arrangement of the convolutions of the more or less elongated tube of the nephridia of other forms we have little or no information. Gegenbaur's well-known figure of the nephridium of Lumbricus still remains the only accurate drawing of such a nephridium. The recent drawing given by Goehlich ('Schneider's Beiträge,' Bd. ii) is not quite accurate; and he is mistaken in thinking that the cilia are continuous from the funnel to the muscular duct. This is not the case; certain regions of the duct are provided with cilia, and others are deprived of them.

Goehlich's drawing of the funnel of the nephridium of Lumbricus is wrong; and in the various genera we find nephridia with more and with less complicated convolutions of the tubule; for instance, Microchæta and Moniligaster or Rhinodrilus. The character of the muscular region or "duct" also varies.

In many cases it is, as in Lumbricus, a mere continuation of the tube; in other cases the muscular region is, in proportion, very much larger, and the tube does not enter it at its extremity, but at some point along its side, so that the muscular region is produced as a "cæcum," or bladder; and to some extent the families are in part characterised by possessing either a simple "duct" or a "cæcum."

The family Eudrilidæ, for instance, all possess simple nephridia; the tube is comparatively short, and the duct simple and in many cases ill-marked. In the accompanying diagrams I have inserted the nephridia—so far as I have been able to obtain information on the point—in order to show, first, the presence or absence of a "cæcum;" and secondly, the somite in which the series commence.

In the family Rhinodrilidæ all the genera have cæcal prolongations of the nephridial duct, more or less marked. And frequently this cæcum is less developed in the most anterior than in the greater number of nephridia: for example, Urobenus and Microchæta; in the latter genus the muscular portion attains the greatest relative size, and the coiling of the tubule the greatest complexity to be found amongst earthworms. In Rhinodrilus the more anterior nephridia have a simple duct, those more posteriorly possess a cæcum.

Plutellus is noticeable for the alternation, from somite to somite of the position of the nephridiopore, which is placed in front of the second or the fourth seta on each side, counting from the most ventral seta.

Perionyx saltans, A. G. B., presents a somewhat similar condition, and according to Fletcher, certain species of Cryptodrilus;[1] but see above as to whether large nephridia are really present in this genus unaccompanied by a network.

Brachydrilus possesses four nephridia per somite, all alike.

In a large number of genera the anterior nephridia—both in those retaining a network and those with large nephridia—are more or less modified. For instance, Beddard was the first to show for Ac. dissimilis that a group of tubules on each side of the pharynx is connected, by means of a strong duct, with the buccal cavity; the same is the case with Dichogaster and Digaster—all genera in which the nephridia are in the form of a network elsewhere in the body.

In Megascolides, Baldwin Spencer has described and figured the presence of numerous nephridial tubules around the pharynx, which open separately into the cavity of the alimentary tract.

In other cases, e. g. Typhæus and Deinodrilus, the tubules of the network are much more abundant in the first two or three somites, but do not communicate with the cavity of the pharynx.

We are, therefore, entitled to consider that these anterior nephridia are used by the worm for some other purpose in addition to excretion: they are probably used for softening or otherwise acting on the food, either when the everted buccal region has seized the food, or previously to this. How the external aperture of a group of tubules has shifted from its position on the body-wall to the pharyngeal wall, and how at the same time, in some cases, the numerous apertures have united into a duct, we do not know. We can only form conjectures on the subject. The epiblast is known to grow in at the blastopore, so as to form the lining of the pharynx; and the shifting of the nephridiopores may perhaps be connected with this invagination.

I have used in my diagnoses of the genera the term "pepto-nephridium[2]" to indicate this modification of the

[1] Beddard describes a similar alternation in Ac. rosæ and Ac. dissimilis.

[2] Πεπτω=I soften.

anterior nephridia for the purposes of alimentation, both for cases where they open into the digestive canal and where they merely open to the exterior, i. e. intra-buccal pepto-nephridia, and extra-buccal pepto-nephridia.

This modification of the anterior nephridia is also found in some of the families in which large nephridia have replaced the network. In the Geoscolecidæ, this is the case: and although in Geoscolex the first nephridium is not very greatly modified, it will be seen to be slightly different from the following ones; and in fact the coiled tubule is thicker, and is distinctly glandular in appearance. The following ones are somewhat similar. The point of entrance of the tubule into the duct gradually shifts towards the pore, so that the cæcum becomes more and more marked. But in the other two genera of the family, Diachæta and Urochæta, the first pair of nephridia are very different from the following ones, both in regard to their size and complexity, and are "pepto-nephridia." From a glance at the diagrams it will be seen that Diachæta presents an intermediate stage between the more simple condition in Geoscolex and the more complicated in Urochæta.

Rhinodrilus and Microchæta also present variations in their nephridia, not so markedly as in the last family, and not so pronounced in Microchæta as in Rhinodrilus, where the first pair of nephridia are much larger than the following ones, and lie underneath the pharynx.

In connection with the nephridia it is worthy of note that in Criodrilus and Pontodrilus they are entirely aborted in the first dozen or more somites. Is this connected with their aquatic habits? Is the absence of anterior nephridia analogous to the absence of salivary glands in fishes?

The position of the nephridiopore is not in all cases characteristic of genera, though this is usually the case.

The Alimentary Canal.

The regions that I have distinguished are—(1) buccal region, (2) pharynx, (3) œsophagus, (4) gizzard, (5) tubular intestine, (6) sacculated intestine.

The buccal region is always present, and is bounded posteriorly by the circumpharyngeal nerve-collar: this region is thinner-walled than the pharynx, and is eversible.

The pharynx occupies some two to four of the following somites: it is probable that the buccal region occupies always the first and second somites,[1] and the pharynx the third to fifth; but as there are no septa in this region the pharynx frequently appears more extensive than this: the thick muscular wall is confined nearly entirely to the dorsal surface.

The following region, up to the gizzard, is the œsophagus. As will be readily seen by a glance at the diagrams, this region is extremely variable in extent, according to the position of the gizzard, which may lie in Somite v or in Somite xvii, or, as in Moniligaster, still further back.

The presence of two or more gizzards is by no means uncommon, and this leads to a repetition of the œsophagus. How far the position of the gizzard is a generic characteristic it is impossible to say: descriptions of the alimentary tract are in most cases very brief, and it is well known that the gizzard rarely lies opposite to the somite to which it belongs; the septa are very frequently pushed backwards, so that the septum bounding a somite may, in the middle of the body, come to lie at the level of a somite some little way behind: in addition to this, the septa in the region of the gizzard are not unusually very thin, and easily broken; and it thus comes about that, whereas the positions of the various parts of the reproductive apparatus are carefully noted, the real situation of the gizzard has sometimes been less accurately observed. From the peculiar constancy in position of the parts of the generative organs, and the variability in the position of the gizzard, I believe it will repay future observers to turn their attention more particularly to

[1] In the diagrams I have represented the buccal region as occupying the first somite only: so little positive information is available on this point, that I have not attempted to mark out the limits of the region accurately.

the latter organ. For instance, most species of Perichæta have the gizzard occupying three somites, viz. VIII, IX, X. Some species have been credited with a gizzard in Somite V or VI. I believe that the former is the typical position for Perichæta, and that a further examination of the forms with a forward position of the gizzard will lead to a separation of these species.

The absence of a gizzard in Criodrilus and Pontodrilus, in addition to the absence of the anterior nephridia, is a point worthy of note, both negative characters being, no doubt, connected with their habitat and characters of food.

The fixity of the ovary and testes in the thirteenth and tenth somites respectively—or, rather, their nearly constant position—gives us a fixed point or centre from which to count the variations in position of other organs. And I am greatly tempted, with Rosa, to regard the ovary as always in the thirteenth: notwithstanding the apparent exceptions—Microchæta and Brachydrilus, where they appear to be in Somite XII, the error may be due to fusion of two of the anterior somites to form a single "peristomium."[1] However this may be, the majority of earthworms possess an ovary in Somite XIII—this may be taken as a fixed point, and we may compare the position of other structures in regard to their greater or less distance from this point: thus the gizzard lies so many somites in front, or behind, in the various genera. This fact seems to indicate that the gizzard of Eudrilus in Somite VI is not homologous or homogenetic with the gizzard in Lumbricus in Somites XVII and XVIII; but that a similar modification of the wall of the gut has occurred in different somites in different worms.

The region following the gizzard, and before the typhlosole commences, is in Lumbricus very short, occupying only a

[1] This is certainly the case in Microchæta beddardi, where small setæ can be detected in the apparent peristomium: and as this somite never carries setæ, we have here one somite occupying the position of two morphological somites. In M. rappi I can detect no setæ on the peristomium; the fusion is here complete.

couple of somites; but in those cases where the gizzard is far forwards there is a greater extent of intestine in which the typhlosole is absent, and in which the walls are not distinctly sacculated or nipped by the septa. This non-typhlosolar region is the "tubular intestine;" and on it, instead of in the œsophagus, are situated the calciferous or other diverticula of the gut in genera with an anteriorly situated gizzard.

The typhlosolar region appears to begin, in the majority of cases, somewhere about Somites XIV to XVI; but we have very scanty material for generalising on this point. Many of the diagrams of the canal are correct only so far as the position of the calciferous glands go. In the majority of cases authors confine themselves to the position of gizzard and glands, and rarely state where the typhlosolar or sacculated region commences.

Only a few cases is this typhlosole absent, e.g. Pontodrilus, Microscolex. It is sometimes a mere thin, compressed fold; or it is cylindrical, and nearly fills the cavity of the intestine. Rhinodrilus is peculiar—at any rate, no record of this has been published—in having its typhlosole, which is a mere fold, attached along a spiral line running round the intestine, instead of hanging down from the dorsal mid-line.

In a few cases—Perichæta, Urobenus, Hormogaster—the hinder part of the "tubular" region is distinctly pouched; not merely nipped by the successive septa, but with thick walls, giving rise to a number of paired pouches, the walls of which are probably more vascular than elsewhere. This thrusts the commencement of the sacculated or typhlosolar region backwards; and the point of union is marked by a pair (rarely more pairs in some sp. Perichæta) of blind cylindrical outgrowths or "intestinal cæca." These lie in Somite XXI in Hormogaster, in Somite XXVI in Perichæta and Urobenus. I may mention once more that some worms, referred to Perichæta, are deprived of these cæca; and I believe this negative character goes hand in hand with a forward position of the gizzard.

A more usual variety of diverticulum of the canal is that found in Lumbricus, and known as "calciferous glands," or "glandes de Morren." Here there are three apparent pouches on each side of the œsophagus, two pairs lying in Somite XI, and one pair in Somite XII. But of these, only the first pair actually communicates with the gut; the other two pairs are not pouches, but thickenings of the œsophageal wall, which is here hollowed out by a number of horizontal, antero-posteriorly directed cavities, which end blindly behind, and open into the first "pouch" in front. The horizontal lamellæ separating the chambers from one another contain blood-sinuses, and are lined by large cells which secrete $CaCO_3$; this escapes from the cells, or more probably the cells themselves break away, and find their way by means of the anterior pouch into the œsophagus.

We have little or no detail as to the "calciferous glands" in other worms; in some cases we do not even know whether they produce lime; but throughout I speak of them as "calciferous glands." They are very frequently absent, and when present are very variable in number and position.

In some cases "salivary glands" are said to be found amongst the muscles of the pharyngeal wall.

II. Outlines of the Classification.

The class Oligochæta may be divided into two sub-classes, according to the presence or absence of asexual reproduction.

Sub-class I. Naidomorpha.

Order 1. Naidina.

Families 1. Aphanoneura.
2. Naididæ.
3. Chætogastridæ.
[And the genus Ctenodrilus.]

Small worms of relatively few somites; blood uncoloured; male genital pores in front of Somite VII, or in this somite.

Asexual as well as sexual reproduction occurs. The anterior few somites of the body are frequently different from the following somites, e.g. in Naids and in Chætogaster the setæ have a different arrangement or form in the anterior somites ("cephalization" of Lankester); or the prostomium is pigmented and ciliated, as in Æolosoma and Ctenodrilus. Eye-spots are frequently present.

Sub-class II. Lumbricomorpha.

Reproduction only by sexual process; no "cephalization;"[1] somites behind the peristomium all similar; and setæ are similar throughout the body, except in special regions, e.g. on clitellum.

Male genital pores behind Somite VII.

No eye-spots (? Helodrilus, Hoffmeister).

The various families included in this sub-class cannot really be separated by any very marked anatomical characters; but they may be divided roughly into—

Order 1. Microdrili (Lumbricomorpha minora);
2. Megadrili (Lumbricomorpha majora);

which correspond to "water-worms" and "earthworms" respectively. The only constant difference between these two groups is the absence in Order 1 of a capillary network of blood-vessels on the nephridium, and the presence of such blood-vessels on the nephridium in Order 2; and this is very likely due to the difference in size, and to the character of the medium in which the members of the two groups live.

Other characters which are usual to Order 1, and rarely present in Order 2, are as follows:

Small size, and thin, transparent body-wall.

Prostomium not separated from the peristomium by a groove.

Setæ always in four groups per somite, and usually more than two in each group: frequently the setæ are of two sorts

[1] In a paper on a new species of Diachæta, a proof of which Professor Lankester has very kindly allowed me to see, Mr. Beddard states that no setæ are present on the first five somites.

in each somite, and may be capillary, uncinate, forked, or simple. The clitellum is always developed round the male pores, and generally occupies only two somites. There are no nephridia in the genital somites. There is no true gizzard, no typhlosole, no subneural vessel. [These last four negative characters, however, hold for some "earthworms."]

The characters nearly constant in Order 2, in which "earthworms" differ from water-worms, are—

Large size, varying from two inches (or less) to six feet; thick, pigmented, and opaque body-wall, though the pigment may be absent and the wall more or less transparent on the ventral surface.

Prostomium separated by a groove from the peristomium.

Setæ frequently not arranged in groups; when they are so arranged there are never more than two setæ in a group (?Echinodrilus, Vaillant). These setæ are nearly always simple, or the modification when present takes a different direction from that in Order 1.

The clitellum varies in position with regard to the male pores, and always occupies more than two somites (? certain species of Perichæta).

A gizzard is nearly always present, except in such cases as Criodrilus, Pontodrilus, Microscolex, and Photodrilus, where the character of the food renders it useless.[1]

With the exception of a few genera, nephridia occur in all somites after the third or fourth, including the genital somites.

Order 1 includes Vejdovsky's "families" Discodrilidæ, Enchytræidæ, Tubificidæ, Phreoryctidæ, and Lumbriculidæ.

Order 2 contains the remainder of his families, and these I will now proceed to group as follows:

Branch I. Plectonephrica.[2]

Excretory system in the form of numerous delicate tubules

[1] In Pontodrilus there is a modification of the gut-wall which probably represents the gizzard.

[2] Πλεκτη = a net.

in each somite, uniting to form a network, with more or less numerous external apertures: a large "nephridium," with cœlomic funnel, may be present in addition to these tubules.

a. Setæ, eight per somite (rarely twelve), either in couples or separate.

1. Spermiducal pores on Somite XVII or XVIII; one pair of prostates in the same somite.

Family I. TYPHÆIDÆ.

Genera:—

1. Typhæus.
2. Megascolides.
3. Cryptodrilus.
4. Didymogaster.
5. Perissogaster.
6. Dichogaster.
7. Digaster.

2. Spermiducal pores on Somite XVIII; two pairs of prostates in Somites XVII and XIX.

Family II. ACANTHODRILIDÆ.

Genera:—

8. Acanthodrilus.
9. Trigaster.
10. Deinodrilus.

b. Setæ more than twelve, usually twenty to eighty per somite; arranged in a continuous or discontinuous circle.

Family III. PERICHÆTIDÆ.

Genus 11. Perichæta (including Megascolex).

Branch II. Meganephrica.[1]

Excretory network absent; replaced by a pair (rarely two pairs) of large nephridia in each somite.

[1] Μεγας = large.

A. Prostates present.

a. Spermiducal pores intersegmental, and placed far forwards; sperm-duct traversing only one somite; clitellum on Somites X to XIII.

Family IV. MONILIGASTRIDÆ.

Genus 12. Moniligaster.

b. Spermiducal pores on Somite XVII or XVIII; clitellum occupying all or any of the Somites XIII to XVIII.

1. Eight setæ per somite, in couples or separate.

Family V. EUDRILIDÆ.

Genera:—

13. Eudrilus.
14. Teleudrilus.
15. Pontodrilus.
16. Photodrilus.
17. Microscolex.
18. Rhododrilus.
19. Plutellus.

2. More than eight setæ, usually thirty or more, per somite, arranged in a ring.

Family VI. PERIONYCIDÆ.

Genus 20. Perionyx.

B. No prostates present.

1. Spermiducal pores behind Somite XVIII, within the area covered by the clitellum.

a. One pair of sperm-sacs occupying several somites; eight setæ, separate or alternate in some part at least of the body.

Family VII. GEOSCOLECIDÆ.

Genera:—

21. Geoscolex.
22. Urochæta.
23. Diachæta.

b. Two or more pairs of sperm-sacs; setæ in couples, and exhibiting no tendency to alternate.

Family VIII. RHINODRILIDÆ.

Genera:—

24. Rhinodrilus.
25. Microchæta.
26. Urobenus.
27. Hormogaster.
28. Brachydrilus.

2. Spermiducal pores in front of Somite XVIII, anterior to the clitellum.

Family IX. LUMBRICIDÆ.

Genera:—

29. Lumbricus.
30. Allolobophora.
31. Criodrilus.
32. Allurus.

III. CHARACTERS OF THE FAMILIES AND GENERA IN EXTENSO.

Branch I. PLECTONEPHRICA.

The excretory system is in the form of a number of delicate tubules in each somite, more or less united to form a network, and having numerous external apertures in each somite. Added to this, there may be a pair of larger "nephridia," each possessing one external aperture and a funnel communicating with the cœlom.

a. **The setæ are never more than eight (with the exception of one genus) per somite; and these may be arranged in couples, or are more or less separated from one another.**

1. Spermiducal pores in Somite XVII or XVIII; only one pair of "prostates," which lies in the same somite as these pores.

Family I. TYPHÆIDÆ, mihi (= part Eudrilidæ, Rosa).

The clitellum, which is more feebly developed on the ventral than on the dorsal surface, begins on Somite XIII or

XIV, and includes from five to ten of the following somites. "Copulatory" papillæ are usually present in the neighbourhood of the spermiducal pores. The "prostates" are tubular and convoluted, or are lobed structures.

Genus 1. TYPHÆUS, Beddard, 1883.

Setæ in couples, all on the ventral surface.

Clitellum occupies Somites XIV to XVII.

The male pores are on Somite XVII, in line with the inner couple of setæ; sacs with penial setæ present. The "prostates" are convoluted tubes.

Sperm-sacs.—A single pair in Somite X, which may occupy more than one somite.

One pair of testes and ciliated rosettes in Somite X, enclosed in a median portion of the sperm-sac.

[Prostomium[1] nearly as broad as the peristomium, and not dovetailed into it.

A single pair of spermathecæ in Somite VIII; the aperture is placed in the anterior part of this somite.

Dorsal pores present.

A single pair of calciferous glands in Somite XII. The gizzard occupies Somites VI, VII; peculiar intestinal glands farther back.]

Species 1. T. orientalis, F. E. B., 1884; India.
2. T. gammii, F. E. B., 1888; India.

See Beddard, 'Ann. Mag. Nat. Hist.,' 5th ser., vol. xii, 1883; and 'Quart. Journ. Micr. Sci.,' vol. xxix, 1888.

Genus 2. MEGASCOLIDES, McCoy, 1878 (= Notoscolex, Fletcher, 1886).

Setæ in couples, all on the ventral surface.

Clitellum occupies Somites XIII to XXI (or XXIII), and though feebly developed, extends across the ventral surface.

The male pores are on Somite XVIII, on slight papillæ. No penial setæ.

[1] The characters placed in square brackets are less easily observed, or are more subject to specific variation.

Sperm-sacs.—Four pairs in Somites XI, XII, XIII, XIV (in one species a less number has been described).

Prostates tubular, and very greatly coiled.

[Prostomium broad, not dovetailed into peristomium. Dorsal pores are present.

Testes and ciliated rosettes in Somites X, XI, free; the two sperm-ducts on each side are separate throughout their course, only uniting at their junction with the prostate.

Spermathecæ, with appendices, two pairs in Somites VIII and IX (or four pairs).

The nephridia are in form of network anteriorly, continuous from somite to somite, one tubule of which gradually enlarges till posteriorly there is a pair of large nephridia, together with a network of small tubules in each somite.

Gizzard in Somite V or VI; no œsophageal glands; no typhlosole.

Intestine dilated in Somites XII to XVIII.

Numerous intra-buccal pepto-nephridia are present.

The septa of anterior segments greatly thickened.]

Species 1. M. australis, McCoy, 1878; Australia.
2. M. camdenensis, Fletcher, 1886; Australia.
3. M. grandis, Fletcher, 1886; Australia.
4. M. tasmanicus, Fletcher, 1887; Australia.
5. M. tuberculatus, Fletcher, 1887; Australia.
6. M. mawarræ, Fletcher, 1887; Australia.
7. M. pygmæus, Fletcher, 1888; Australia (? genus).
8. M. illawarræ, Fletcher, 1888; Australia.

See Baldwin Spencer, 'Trans. Roy. Soc. Victoria,' vol. i, 1888; and Fletcher, 'Proc. Linn. Soc. N.S.W.,' vols. i and iii.

Genus 3. CRYPTODRILUS, Fletcher, 1886.

Setæ separate.

Clitellum on Somites XIII to XVII (or less), complete ventrally.

Male pores on Somite XVIII, not on papillæ; no penial setæ.

Prostates lobate, and sometimes extending beyond their proper somite.

Sperm-sacs.—Two pairs in Somites IX and XII.

[Prostomium small; dorsal pores present.

Testes and ciliated rosettes in Somites X and XI, free.

Spermathecæ with appendices, usually two pairs in Somites VIII and IX (rarely more).

Gizzard in Somite V or VII.

" Salivary glands " are present, but do not appear to open into the pharynx.

Intestinal calciferous glands occur in Somites IX or X to XIII.]

Species 1. C. rusticus, Fletcher, 1886; Australia.
2. C. saccarius, Fletcher, 1886; Australia.
3. C. fletcheri, F. E. B., 1887; Australia.
4. C. rubens, Fletcher, 1887; Australia.
5. C. mediterreus, Fletcher, 1887; Australia.
6. C. fastigatus, Fletcher, 1888; Australia.
7. C. unicus, Fletcher, 1888; Australia.
8. C. singularis, Fletcher, 1888; Australia.
9. C. canaliculatus, Fletcher, 1888; Australia.
10. C. manifestus, Fletcher, 1888; Australia.
11. C. mediocris, Fletcher, 1888; Australia.
12. C. tenuis, Fletcher, 1888; Australia.
13. C. illawarræ, Fletcher, 1888; Australia.
14. C. mudgeanus, Fletcher, 1888; Australia.
15. C. sloanei, Fletcher, 1888; Australia.
16. C. oxleyensis, Fletcher, 1888; Australia.
17. C. purpureus, Michaelsen, 1889; Australia.

See Fletcher, 'Proc. Linn. Soc., N.S.W.,' vols. i, ii, iv; Beddard, 'Proc. Zool. Soc.,' 1887; Michaelsen, 'Jahrb. d. hamburgischen wiss. Anstalten,' vi, 1889.

Genus 4. DIDYMOGASTER, Fletcher, 1886.

Setæ separate, nearly equidistant.

Clitellum feebly developed; occupies Somites XIV to XVIII.

Male pores on Somite XVIII, on papillæ.

Prostates flattened, equally bilobed.

Sperm-sacs.—Two pairs in Somites IX, XII.

[Prostomium small; dorsal pores present.

Spermathecæ, three pairs, greatly elongated, in Somites VII, VIII, IX; their apertures in IX, X, XI; not intersegmental in position.

Two gizzards in Somites VI, VII.

No accessory intestinal diverticula.

The intestine is dilated and very vascular in Somites X to XVI; the following region of the intestine is stated to be coiled like a corkscrew.

Anterior septa greatly thickened.

Dorsal vessel doubled in each somite.]

Species 1. D. sylvaticus, Fletcher; Australia.

See Fletcher, 'Proc. Linn. Soc. N.S.W.,' 2nd ser., vol. i, 1886.

Genus 5. PERISSOGASTER, Fletcher, 1887.

Setæ not in couples, but all close together on the ventral surface.

Clitellum on Somites (XIII) XIV to XVIII, complete ventrally except on last somite.

Male pores slit-like in Somite XVIII (?); penial setæ present.

Prostates unequally bilobed.

Sperm-sacs.—Two or four pairs in Somites IX, X, XI, XII.

Testes and ciliated rosettes free, in Somites X, XI.

Three gizzards in Somites V, VI, VII.

[Prostomium wide; no dorsal pores.

Spermathecæ with appendices, two pairs, in Somites VIII; IX; apertures anterior, intersegmental.

Intestine with (?) calciferous glands in Somites IX to XIV; salivary glands present around pharynx.]

Species 1. P. excavatus, Fletcher, 1887; Australia.
2. P. nemoralis, Fletcher, 1888; Australia.
3. P. queenslandica, Fletcher, 1888; Australia.

See Fletcher, 'Proc. Linn. Soc. N.S.W.,' 2nd ser., vols. ii, iii.

Genus 6. DICHOGASTER, Beddard, 1888.

Setæ in couples; ventral setæ absent in Somites XVII, XVIII, XIX.

Clitellum on Somites XIII to XX; more feebly developed ventrally.

Spermiducal pores on Somite XVII; no penial setæ.

Two pairs of prostate-pores on Somites XVIII, XIX.

Sperm-sacs.—Three pairs in Somites X, XI, XII, connected across the middle line both above and below the intestine. Testes and ciliated rosettes in Somites X and XI, enclosed in sperm-sacs.

Prostates tubular, slightly coiled, in Somite XVII.

Additional club-shaped prostates, two pairs in Somites XVIII and XIX, without connection with sperm-ducts.

Two gizzards, each occupying two Somites, VII, VIII, and IX, X.

[Dorsal pores are present. Only one pair of spermathecæ in Somite VIII; aperture near ventral mid-line.

Calciferous glands in XV, XVI, XVII.]

Species 1. D. damonis, F. E. B., 1888; Fiji.

See Beddard, 'Quart. Journ. Micr. Sci.,' xxix.

Genus 7. DIGASTER, E. P., 1872.

The setæ in four couples.

The clitellum on Somites XIV to XVII, complete ventrally, though not so well marked as on the dorsal surface.

The male pores on Somite XVIII (XVII, Perrier).

Penial setæ present.

Sperm-sacs in Somites IX, XII (or X, XI, Perrier).

Prostates lobulated.

Two gizzards in Somites V and VII.

In Somites V and VII nephridia in groups, forming "peptonephridia," the duct of which opens into the pharynx.

Nephridia tufted; though apparently, according to Fletcher, large ones are present in addition.

Dorsal pores are present.

Species 1. D. lumbricoides, E. P., 1872; New South Wales.

2. D. armifera, Fletcher, 1886; New South Wales.

3. D. perrieri, Fletcher, 1888; New South Wales.

See Perrier, 'Nouv. Arch. du Mus. d'Hist. Nat. Paris,' viii, 1872; Fletcher, 'Proc. Linn. Soc. N.S.W.,' 2nd ser., i and iii.

Remarks on the Typhæidæ.

The beautiful monograph on Megascolides australis by Professor Baldwin Spencer gives the details of the anatomy generally found in this group. Many of the genera are very closely allied, no doubt. Fletcher's descriptions of the various species are only verbal, and unaccompanied, except in his first paper, by any figures. For instance, the description given by him of Perissogaster and of Didymogaster rather lead me to think that the two genera should be included in one genus. In the former the prostates are said to be unequally lobed, i.e. the posterior lobe occupies two somites; in the latter the two lobes are equal. In Perissogaster, however, no dorsal pores are present; in Didymogaster they are present. In Didymogaster the spermathecal apertures are not intersegmental as is the case in Perissogaster and other germs. This seems to be the only point of real difference; for, as I have remarked, the number of gizzards cannot of itself furnish a generic character. Dichogaster differs from any other genera in possessing three pairs of prostates; the first pair being in connection with the sperm-ducts, the two hinder pairs being independent of them. Typhæus, again, is a well-marked genus, in possessing a single pair of sperm-sacs and testes.

In some species of Cryptodrilus, Fletcher and Beddard describe large nephridia in all somites, and nephridiopores which have an alternate or irregular arrangement with regard to setæ. It is very probable that a network will be found, in all cases, in addition to these large nephridia.

In one species, Cr. purpureus, there are five median spermathecæ, instead of two pairs usual to the genus.

2. Spermiducal pores on Somite XVIII; two pairs of tubular, more or less convoluted prostates, in Somites XVII and XIX, and opening to the exterior on these somites.

Family II. Acanthodrilidæ, Rosa (=partly L. postclitelliens, E. P. = partly Acanthodrilidæ, Claus, Vejdovsky).

Setæ, eight or twelve per somite, in couples or separate.

Clitellum occupies XIII or XIV to XIX, or fewer somites, or extends to Somite XL; either complete ventrally throughout or only anteriorly.

Spermiducal pores, one pair on Somite XVIII, in line with the inner setæ.

Prostate-pores on Somites XVII and XIX, in same line as spermiducal pores.

Genus 8. ACANTHODRILUS, E. P., 1872 (= Mandane, Kinberg, 1866).

Setæ eight, in couples or separate.

Clitellum usually occupies Somites XIII to XIX; sometimes one additional somite at each end, sometimes fewer; usually complete in anterior somites, but leaving a non-glandular ventral area on Somites XVII, XVIII.

Sperm-sacs.—Two pairs in Somites XI, XII.

Prostates usually accompanied by sacs containing special "penial" setæ.

[Prostomium more or less dovetailed into the peristomium. Dorsal pores are present.

Testes and ciliated rosettes in Somites X and XI.

Spermathecæ with appendices, and sometimes accompanied by sacs containing "anterior penial" setæ; apertures in a line with the inner couple of setæ.

Gizzard usually single, occupying two somites; rarely two separate gizzards in VI and VIII.

Pepto-nephridia are frequently present in the anterior somites. Calciferous glands present.

Dorsal vessel sometimes double.

Some species have been described as possessing large nephridia without a network of small tubules (see above).]

Species 1. A. obtusus, E. P., 1872; New Caledonia.
2. A. ungulatus, E. P., 1872; New Caledonia.
3. A. verticillatus, E. P., 1872; Madagascar.
4. A. kerguelenensis, E. R. L., 1879; Kerguelen.
5. A. capensis, F. E. B., 1884; Cape of Good Hope.
6. A. buttikoferi, Horst, 1884; Liberia.
7. A. schlegelii, Horst, 1884; Liberia.
8. A. layardi, F. E. B., 1886; New Caledonia. (Horst believes this species to be identical with A. ungulatus.)
9. A. novæ-zelandiæ, F. E. B., 1885; New Zealand.
10. A. multiporus, F. E. B., 1885; New Zealand.
11. A. dissimilis, F. E. B., 1885; New Zealand.
12. A. neglectus, F. E. B., 1887; New Zealand (? = dissimilis).
13. A. annectens, F. E. B., 1888; New Zealand.
14. A. beddardi, Horst, 1888; Liberia.
15. A. australis, Michaelsen, 1889; Australia.
16. A. georgianus, Michaelsen, 1889; South Georgia.
17. A. littoralis, Kinberg, 1866; Magellan.
18. A. scioanus, Rosa, 1888; Africa.
19. A. bovei, Rosa, 1889; Magellan.
20. A. antarcticus, F. E. B., 1889; New Zealand.
21. A. rosæ, F. E. B., 1889; New Zealand.
22. A. dalei, F. E. B., 1890; Falkland Isles.

For descriptions of this genus and its species see Perrier, 'Nouv. Arch. du Mus. d'Hist. Nat. de Paris,' viii, 1872; Beddard, 'Proc. Zool. Soc.,' 1885—1887; 'Quart. Journ. Micr. Sci.,' xxviii, xxix, and xxx; Horst, 'Notes from Leyden Museum,' ix, x; Michaelsen, 'Jahrb. d. hamburgischen wiss. Anstalten,' vi, 1889; Rosa, 'Ann. d. Mus. Civico d. Stor. Nat. di Genova,' ser. 2, vi, 1888, and vii, 1889.

Genus 9. TRIGASTER, Benham, 1886 (= Benhamia, Michaelsen, 1889).

Setæ in four couples, all on the ventral surface; individual setæ of each couple close together.

Clitellum occupies Somites XIV to XL; complete ventrally only on the first few somites.

Spermiducal pores in XVIII, and prostate-pores in XVII and XIX, in a large pit or fossa occupying the middle of the ventral surface of Somites XVII to XX, the margins of which are formed by two papillæ.

Sperm-sacs not observed.

Prostates as in Acanthodrilus. No penial setæ.

[Prostomium not dovetailed into peristomium. No dorsal pores are present.

Spermathecæ simple pear-shaped sacs without appendices, opening close to mid-line on ventral surface.

Three gizzards in Somites VII, VIII, and IX. No calciferous glands. Anterior masses of nephridial tubules in Somites IV, V, VI, grouped to form "pepto-nephridia."]

Species 1. T. lankesteri, W. B. B., 1886; St. Thomas, West Indies.

2. T. rosea, Michaelsen, 1889; West Africa.

See Benham, 'Quart. Journ. Micr. Sci.,' xxvii; Michaelsen, 'Jahrb. d. hamburgischen wiss. Anstalten,' vi, 1889.

Genus 10. DEINODRILUS, Beddard, 1888.

Setæ twelve per somite, nearly equidistant.

Clitellum complete ventrally; occupies only Somites XIV to XVI.

Spermiducal pores, prostate-pores, sperm-sacs, &c., as in Acanthodrilus.

[Prostomium dovetailed into peristomium.

Spermathecæ with three small globular appendices, two pairs in Somites VIII and IX.

A single gizzard occupies Somites VI, VII. No calciferous glands.

The dorsal vessel is double throughout its length, and is enclosed in a special cœlomic tube.]

Species 1. D. benhami, F. E. B.; New Zealand.
See Beddard, 'Quart. Journ. Micr. Sci.,' xxix.

Doubtful Genus.

Neodrilus monocystis, F. E. B., New Zealand.

Founded on a single specimen, and differs from Acanthodrilus in possessing a single pair of prostates and a single pair of spermathecæ. It appears to me very doubtful whether this should be considered as a new genus, or whether the characters are merely some peculiar variations of Acanthodrilus.

Remarks on the Acanthodrilidæ.

The genus was originally characterised by the presence of two pairs of male pores; it is only recently that Beddard has shown that these pores belong to the prostates, and that the sperm-ducts open by a pair of pores on the eighteenth somite. The chief points of difference between Acanthodrilus and Trigaster lie in the fact that the male pores and atriopores in the latter genus are in a pit (in my original description I placed the atriopores in XVI, XVIII; I believe that this statement is wrong, and that the prostate-pores and spermiducal pores are placed as in Acanthodrilus), and in the absence of penial or copulatory setæ and the presence of three gizzards. When the genus was formed, the only worm with more than one gizzard (except Moniligaster) was Digaster. That the existence of three gizzards is not generic is now established by the formation of Michaelsen of a species, T. rosea, with only two gizzards.

Three species of Acanthodrilus are known with two gizzards—A. buttikoferi and A. beddardi of Horst; and A. scioanus, Rosa.

Horst also figures the prostate-pores in A. schlegelii as situated in a fossa.

But the great extent of the clitellum in Trigaster, together with the position of the spermathecal pores close to the ventral mid-line, and the general appearance of the worm, warrant the retention of the genus. I may mention here that frequently a mere description of the position of pores and organs, unaccompanied by figures, might lead to the association of two worms, an examination of which would leave a very different impression as to their relation.

The genus Deinodrilus is sufficiently interesting and peculiar in the possession of twelve setæ per somite; but this interest is greatly enhanced on comparison of the internal organs with those of Acanthodrilus on the one hand and of Perichæta on the other.

Some species of Acanthodrilus have large nephridia, the power of which alternate in position; but no statement is made as to whether these nephridia are accompanied by a network: I believe we may expect this to be the case. Many species have the dorsal vessel double to a greater or less extent.

b. Setæ more than twelve (usually many more) in most of the somites, arranged in a ring, which is continuous all round, or interrupted dorsally and ventrally.

Family III. Perichætidæ, Claus (= partly L. postclitelliens, E. P. = Perichætidæ + Pleurochætidæ, Vejdovsky).

Clitellum completely surrounding the body, obliterating entirely the intersegmental grooves, and extending over all or some of the Somites XIII—XVII.

Spermiducal apertures on Somite XVIII, on the ventral surface.

Oviducal apertures close together on Somite XIV.

Genus 11. PERICHÆTA, Schmarda, 1861 (includes Megascolex, Templeton, 1844; Pleurochæta, Beddard, 1883; and many of Kinberg's genera).

Setæ from twenty to eighty, or even 100 per somite, on a ridge (at least in spirit specimens), either in a continuous ring or interrupted by a greater or less gap in the dorsal or ventral mid-line, or both. Setæ usually small and of equal size, and generally equidistant, though in some species more or fewer of the more ventral ones are larger than the rest. On the clitellum the setæ are invisible.

Clitellum on Somites XIV to XVI or XVII, rarely only two or more than four; well defined, and altogether obliterating the intersegmental grooves.

Spermiducal pores in Somite XVIII, usually rather laterally placed.

Oviducal pores in Somite XIV very close together, or more usually single and median.

Penial setæ and various "copulatory papillæ" are frequently present.

Sperm-sacs, in Somites XI and XII, two pairs, rarely more, and sometimes connected by median sacs enclosing testes.

Prostates.—A pair in Somite XVIII, lobed or greatly subdivided, or even digitate; the duct after being joined by the sperm-duct is very muscular and probably protrusible; it may be called a "penial duct."

[Worm cylindrical; prostomium sometimes dovetailed into peristomium, sometimes not dovetailed.

Dorsal pores present.

Testes and ciliated rosettes in Somites X and XI, sometimes, at any rate, enclosed in the median portion of the sperm-sac.

Ovaries in Somite XIII.

Spermathecæ, usually only two pairs, in Somites VIII and IX, opening anteriorly; sometimes only one pair; sometimes more than two pairs. Usually with an appendix which varies in shape.

Gizzard occupies any position between Somites V and X.: usually occupying three Somites, VIII, IX, and X.

In most species a pair of tubular cæca in Somite XXVI are present.]

Species 1. P. houlleti, E. P., 1872; Calcutta (and Nice); Bahamas (F. E. B.); Manila (F. E. B.).

2. P. posthuma, Vaillant, 1869 = P. affinis, E. P., 1872; Cochin China; Java (Horst); Philippines (F. E. B.).

Species 3. P. robusta, E. P., 1872 = partly P. cingulata, Sch. and Vaillant; Mauritius, Manila, Nice, Bahamas.

4. P. aspergillum, E. P. 1872 (loc.?); Bermuda (F. E. B.).

5. P. quadragenaria, E. P. 1872 = partly P. cingulata, Sch. and Vaillant; East Indies.

6. P. elongata, E. P., 1872; Peru (? indigenous).

7. P. indica, Horst, 1883; Sumatra; New Caledonia (F. E. B.).

8. P. sumatrana, Horst, 1883; Sumatra.

9. P. hasseltii, Horst, 1883; Sumatra.

10. P. sieboldii, Horst, 1883; Japan.

11. P. japonica, Horst, 1883; Japan.

12. P. musica, Horst, 1883; Java.

13. P. capensis, Horst, 1883; Cape of Good Hope.

14. P. annulata, Horst, 1883; Malay.

15. P. cœrulea, Templeton, 1844; Ceylon.

16. P. ceylonica, F. E. Beddard, 1885; Ceylon.

17. P. armata, F. E. Beddard, 1883; Calcutta; Burmah (Rosa); Nias, near Sumatra (Rosa).

18. P. horsti, F. E. Beddard, 1886; Manila.

19. P. newcombei, F. E. Beddard, 1887; Australia.

20. P. upoluensis, F. E. Beddard, 1887; Upolu, Pacific Isles.

21. P. lawsoni, A. G. Bourne, 1886; India.

22. P. bivaginata, A. G. Bourne, 1886; India.

23. P. gracilis, A. G. Bourne, 1886; India.

24. P. stuarti, A. G. Bourne, 1886; India.

25. P. burliarensis, A. G. Bourne, 1886; India.

26. P. hulikalensis, A. G. Bourne, 1886; India.

27. P. mirabilis, A. G. Bourne, 1886; India.

28. P. salettensis, A. G. Bourne, 1886; India.

29. P. australis, Fletcher, 1886; Australia.

30. P. coxii, Fletcher, 1886; Australia.

31. P. tenax, Fletcher, 1886; Australia.

Species 32. P. austrina, Fletcher, 1886; Australia.
33. P. barronensis, Fletcher, 1886; Australia.
34. P. darnleiensis, Fletcher, 1886; Australia.
35. P. gracilis, Fletcher, 1886; Australia.
36. P. peregrina, Fletcher, 1886; Australia.
37. P. queenslandica, Fletcher, 1886; Australia.
38. P. bakeri, Fletcher, 1887; Australia.
39. P. dorsalis, Fletcher, 1887; Australia.
40. P. canaliculata, Fletcher, 1887; Australia.
41. P. exigua, Fletcher, 1887; Australia.
42. P. fecunda, Fletcher, 1887; Australia.
43. P. hamiltoni, Fletcher, 1887; Australia.
44. P. monticolla, Fletcher, 1887; Australia.
45. P. raymondi, Fletcher, 1887; Australia.
46. P. stirlingi, Fletcher, 1887; Australia.
47. P. wilsoniana, Fletcher, 1887; Australia.
48. P. birmanica, Rosa, 1888; Burmah.
49. P. feæ, Rosa, 1888; Burmah.
50. P. modigliani, Rosa, 1887; Nias (Sumatra).
51. P. antarctica, Baird 1873; New Zealand.
52. P. intermedia, Beddard, 1889; New Zealand.
53. P. attenuata, Fletcher, 1888; Australia.
54. P. enormis, Fletcher, 1888; Australia.
55. P. dissimilis, Fletcher, 1888; Australia.
56. P. macleayi, Fletcher, 1888; Australia.

Doubtful Species.—Some of Perrier's, viz. P. bicincta, P. luzonica, P. cœrulea, P. biserialis, P. juliana. Schmarda's P. leucocycla, P. viridis, P. brachycycla, P. cingulata. Kinberg's genera, Amyntas, Nitocris, Pheretima, Rhodopis, Lampito.

See Perrier, 'Nouvelles Arch. du Mus. d'Hist. Nat. de Paris,' viii, 1872. Beddard, 'Ann. Mag. Nat. Hist.,' 5th ser., vol. xvii, 1886; 'Proc. Zool. Soc.,' 1886; 'Proc. Roy. Soc. Edin.,' xiv, 1887. Rosa, 'Ann. d. Mus. Civico d. Storia Nat. di Genova,' 2nd ser., vi, 1888, vol. vii, 1889; Fletcher, 'Proc. Linn. Soc. N.S.W.,' 2nd ser., vols. i, ii, iii; A. G. Bourne, 'Proc. Zool. Soc.,' 1886.

Remarks on the Perichætidæ.

Although some fifty species of this genus have been formed within the last few years (besides those which have been characterised only by their external anatomy, and which must be in many cases discarded), yet very frequently insufficient data have been given. On the whole it is a well-defined family, but the single genus may really be capable of subdivision.

I have already mentioned my reason for removing Perionyx from the family, a proceeding which may at first appear arbitrary.

The character of the prostomium and the presence or absence of the characteristic intestinal cæca, as well as the position of the gizzard, may prove to be of generic value. The observations on the excretory system are in most cases very superficial and incomplete, and frequently no mention is made as to whether in a particular species large "nephridia" or a small network of tubules is present. Where these observations have been carefully made the presence of a pair of large nephridia[1] appears to be associated with the absence of the intestinal cæca, a forward position of the gizzard in Somite v or vi, and with the existence of three pairs of spermathecæ. But there are too many apparent exceptions to generative on this point at present.

Amongst the more peculiar species may be mentioned P. indica, Horst, where some of the more ventral setæ are larger than the rest; P. hasseltii, Horst, in which the ventral setæ are more closely placed; P. stuarti, Bourne, with two pairs of male pores and two pairs of prostates. P. bakeri and P. intermedia have prostates resembling those of Acanthodrilus.

The number of setæ per somite, position of copulatory papillæ, extent of clitellum, number of spermathecæ and shape of appendix, and of the prostates, serve as the leading characters in which the species differ from one another.

The worms figured by Schmarda are only described so far

[1] Probably accompanied by a network.

as their external anatomy is concerned, and cannot be recognised with certainty. Kinberg's genera must be relegated to oblivion.

Branch II. MEGANEPHRICA.

The excretory system is in the form of large, greatly coiled tubes unaccompanied by a network of small tubules. Each nephridium opening into the cœlom by a funnel: usually a pair in each somite, though the most anterior somites may be deprived of nephridia.

A. A prostate is present.

a. **Male pores intersegmental, immediately behind Somite x or xi; clitellum developed around this and the adjacent somites.**

Family IV. Moniligastridæ, Claus, Vejdovsky Rosa (= L. aclitelliens, E. P.).

Genus 12. MONILIGASTER, E. P., 1872.

Setæ in four couples.

Clitellum observed in only one species (M. sapphirinaoides, A. G. B.), where it occupies Somites x to xiii; it is ill-marked.

Male pores between Somites x/xi; or xi/xii.

Oviducal pore on Somite xii (or xiv).

Sperm-sacs, one pair occupying Somite xi (Horst), or ix and x (Beddard).

Ovisac in Somites xiv to xvi, or fewer somites.

Nephridiopores *in a line with the outer couple of setæ.*

Prostates small, or large and tubular.

Testes in Somite ix (Beddard).

Spermathecæ in Somite viii or ix.

The nephridium has a long cæcal prolongation of the duct beyond the point at which the short slightly coiled tubule enters. There is apparently no modification of the anterior nephridia.

Gizzard moniliform, four-lobed, in all or some of the Somites xiii to xxii (sometimes there is an additional gizzard anteriorly).

Species 1. M. deshayesii, E. P., 1872; Ceylon.
2. M. barwelli, F. E. B., 1886; Manila.
3. M. houteni, Horst, 1887; Sumatra.
4. M. grandis, A. G. B., 1886; India.
5. M. uniquus, A. G. B., 1886; India.
6. M. sapphirinaoides, A. G. B., 1886; India.
7. M. robustus, A. G. B., 1886; India.
8. M. papillatus, A. G. B., 1886; India.
9. M. rubens, A. G. B., 1886; India.
10. M. minutus, A. G. B., 1886; India.

See Perrier, 'Nouv. Arch. du Mus. d'Hist. Nat. de Paris,' viii, 1872; Beddard, 'Ann. Mag. Nat. Hist.,' 1886; 'Zool. Anzieger,' 1887, No. 268, and 1889; 'Quart. Journ. Micr. Sci.,' vol. xxix, 1888; Horst, 'Notes from Leyden Mus.,' ix; Bourne, 'Proc. Zool. Soc.,' 1886.

Remarks on Moniligastridæ.

The three authors who have studied the internal anatomy of the genus Moniligaster differ from one another in their statements as to the position of the male pores and other organs.

Perrier, in his description of M. deshayesii, describes, as is well known, two pairs of male organs; the ducts of the first pair opening between Somites VII and VIII, those of the second pair between Somites X and XI. In connection with each of the first pair of ducts is a double gland (his "prostate"); and similarly there is a gland in connection with the other pair of ducts, which is fairly elongated (his "seminal vesicle").

Beddard's original description in 1886, as well as his more recent figures, shows considerable differences from this arrangement, apart from the question of numbering. He identifies Perrier's first pair of "testes" as spermathecæ; the "prostates" (which are not represented in M. barwelli) he suggests may be accessory sacs, which are so frequently found in connection with spermathecæ, whereas Horst identifies these "prostates" of Perrier as the true spermathecæ.

Horst's figures are much more like those of Perrier than are Beddard's; and were it not that the spermathecæ and sperm-sacs in M. houteni occur one somite behind those of M. deshayesii we might believe that he was dealing with the same species. In fact, we have here another example of the difficulty of accurately counting the somites in earthworms. Beddard has quite recently (October, 1889) altered his previous numbers for M. barwelli, owing to the discovery of a small setigerous somite following the peristomium, so that the male pores of M. barwelli are, as in M. deshayesii, between Somites x and xi. The spermathecal pores, too, which were previously given as between vi and vii, now agree with the pores of Perrier's "anterior sperm-ducts," in being placed between Somites vii and viii.

The diagram accompanying this paper is taken from Horst's figure of M. houteni, and the position of the various organs differs somewhat from that in the other two species. As will be seen, the sperm-sacs are in Somite xi (and probably also the testes and funnels of the sperm-ducts which open externally between Somites xi and xii). The ovipore is in Somite xiv, and probably the ovary is in Somite xiii, these organs being therefore in the normal position. Here the prostate is a large structure, whilst in M. barwelli it is extremely small.

The spermatheca in Somite ix has a long duct opening anteriorly.

The "ovary" of Perrier's species is not the true gonad, but the "ovisac," or receptaculum ovorum, and recalls the way in which the ova push their way back through several somites in Microdrili. The ovary is unknown. Beddard has figured ('Quart. Journ. Micr. Sci.,' xxix, pl. xi) the oviduct with its funnel and external aperture; but the numbering here given is revised in the 'Zool. Anzeiger,' No. 318, where the external aperture is placed on Somite xii, and the funnel in Somite xi, so that in all probability the gonad is in Somite xi.

Prof. Bourne has given us a few facts about seven new species of the genus, chiefly as regards the position of the gizzard, but says nothing about the genital organs. The most interesting point in this connection, however, is his description of a clitellum in M. sapphirinaoides occupying Somites x—xiii, a structure previously denied to the genus.

The recorded absence of a clitellum is probably due to the fact that, as in the water-worms, this structure is only developed at the breeding season.

The anterior gizzard, which Perrier described, has not been recognised in the later species.

I believe Moniligaster to be more nearly related to the ancestors of earthworms than any other genus we know of, as I have pointed out in Part VI of this paper.

b. **Male pores on Somite xvii or xviii.**
Clitellum occupies all or any of the Somites xiii to xviii.

1. Eight setæ per somite, in couples or separate.

Family V. Eudrilidæ, Claus (=Lumbriciens intraclitelliens, E. P., in part=part of family Eudrilidæ, Vejdovsky, Rosa).

The eight setæ are in couples or separate; the clitellum, complete ventrally, extends over all or some of the Somites xiii to xvii.

The male pores are behind the clitellum, or just within its limits.

The prostate is simply tubular, convoluted, or lobed.

Spermathecæ usually with diverticulum.

Typhlosole absent.

The duct of the nephridium is not produced into a cæcum, nor is there any modification of the anterior nephridia.

Genus 13. Eudrilus, E. P., 1872.

Setæ in four couples.

Clitellum covers Somites (xiii) xiv to xviii.

Male pores large, on Somite xvii (from it the curved chitinous penis sometimes protrudes), in line with inner couple of setæ.

Female pores on Somite XIV, slit-like, large, dorsad of the inner couple of setæ.

Nephridiopores in line with outer setæ (or inner setæ in E. sylvicola, Beddard).

Generative Apparatus.—Three pairs of sperm-sacs in Somites X, XI, XII. Testes and ciliated rosettes in Somites X, XI, enclosed in median sperm-sacs. The two sperm-ducts of each side run separately to the prostate, which is much elongated, and occupies Somite XVII and following somites. This communicates with a "bursa copulatrix" in Somite XVII, into which also open two small glands. The bursa contains a curved chitinous penis.

There appear to be two pairs of ovaries (Beddard) in Somites XIII and XIV, enveloped in membranes which are continuous with the wall of the spermatheca. Into the neck of the latter there also opens an albumen gland. The "ovary" in Somite XIV is also an ovisac.

[The gizzard occupies Somite VI.

In Somites X, XI, there are ventral diverticula of the alimentary tube; in Somite XII, lateral calciferous diverticula.

The nephridium consists of a slightly coiled tubule, the terminal portion of which is only slightly dilated to form a duct.]

Species 1. E. decipiens, E. P., 1872; Antilles.
2. E. lacazii, E. P., 1872; Martinique.
3. E. peregrinus, E. P., 1872; Rio Janeiro, Surinam.
4. E. boyeri, F. E. B., 1886; New Caledonia.
5. E. sylvicola, F. E. B., 1887; British Guiana.

Note.—Horst believes that the first four of these are in reality the same species, and proposes to retain the name of E. decipiens for them.

See Perrier, 'Nouv. Arch. du Mus. d'Hist. Nat. de Paris,' viii, 1872; Beddard, 'Proc. Roy. Soc. Edin.,' xiii, 1885-6; 'Proc. Zool. Soc. Lond.,' 1886-7; 'Journ. Anat. and Phys.,' xxii, 1887; 'Zool. Anzeiger,' 1888, No. 293; 'Encycl. Brit.,' 9th edition, "Worms;" Horst, 'Notes from Leyden Museum,' ix; Beddard, 'Quart. Journ. Micr. Sci.,' xxx.

Genus 14. TELEUDRILUS, Rosa, 1888.

The eight setæ, in couples, are rather far apart.

The clitellum includes Somites XIV—XVII.

The male pore is median on Somite XIX; the pair of oviducal pores between Somites XIV and XV; a median spermathecal pore between Somites XIII and XIV.

Nephridiopores in line with outer setæ.

The testes in Somites X and XI, enclosed in a sac-like continuations of the sperm-sacs, which lie in Somites XI and XII. The ciliated rosettes are in the latter somites.

The two prostates open into a median copulatory sac, communicating with the exterior and receiving another median sac.

The ovary is continuous with the wall of the ovisac, into which the funnel of the oviduct opens. There is a communication between the ovisac and the neck of the spermatheca on each side.

[The gizzard occupies Somites VI and VII (? also V); there is a pair of lobed calciferous diverticula in Somite XIII, and ventral diverticula in IX, X, XI.

Nephridia simple, as in Eudrilus.]

Species 1. T. raggazii, Rosa, 1888; Africa.

See Rosa, 'Ann. d. Mus. Civico del Storia Nat. d. Genova,' Series 2, vi, 1888.

Genus 15. PONTODRILUS, E. P., 1881.

The eight setæ are separate.

The clitellum, which is complete, occupies Somites XIII to XVII.

The male pores in Somite XVIII.

The prostate is tubular and convoluted.

Sperm-sacs.—Two pairs, in XI and XII. Testes and funnels in IX, X. Ovary and oviduct as usual.

The nephridia do not commence till Somite XV; the pores are in line with the second seta. The "duct" of the nephridium is feebly marked.

There is no gizzard, no typhlosole, no subneural vessel, no dorsal pores.

[Found on the sea-shore.

Two pairs of spermathecæ, which have small appendices in Somites VIII and IX, opening anteriorly.]

Species 1. P. littoralis, Grube, 1855; Villa-Franca.
2. P. marionis, E. P., 1874; Marseilles.

See Perrier, 'Arch. d. Zool. Exp. et Gen.,' ix, 1881.

Genus 16. PHOTODRILUS, Giard, 1887 (=Lumbricus phosphoreus, Dugés).

The eight setæ are separate. No. 1 seta is near the middle line.

Clitellum on Somites XIII to XVII.

The male pores on Somite XVIII. There are "penial" setæ in this somite, and anterior penial setæ in Somites XII and XIII.

Genital organs as in previous genus.

The nephridia commence in Somite XIV; the pores are in a line with the second seta.

There is no gizzard, no typhlosole, no subneural vessel.

[One pair of spermathecæ in Somite IX.

The prostomium does not encroach on the buccal somite. "Septal glands" in Somites V to IX, probably open dorsally.

Four œsophageal swellings in Somites X to XIII.

Small, transparent, rose-coloured worm, clitellum orange; phosphorescent.]

Species 1. P. phosphoreus, Dug., 1837; Europe.

See Giard, 'Comptes Rendus,' 1887; Rosa, 'Boll. Mus. Zool. ed Anat. Comp. Univ. Torino,' iii, 1888.

Genus 17. MICROSCOLEX, Rosa, 1887.

The setæ in four couples; those of outer couple further apart than those of the inner couple.

The clitellum, complete, covers Somites XIII to XVI (XVII).

The male pores are in Somite XVII.

Sperm-sacs, testes, ovaries, as in preceding genus.

The prostates lobate; penial setæ present.

The nephridia commence in Somite IV; nephridiopores in front of the third seta.

There is no gizzard, no typhlosole, no subneural vessel, nor dorsal pores.

[Small, transparent; white clitellum.

One pair of spermathecæ in Somite IX.]

Species 1. M. modestus, Rosa; Italy.

See Rosa, 'Boll. Mus. Zool. ed Anat. Comp. Univ. Torino,' ii, 1887, and iii, 1888.

Genus 18. RHODODRILUS, Beddard, 1889.

The setæ separate, in eight series.

The clitellum occupies Somites XIV to XVII.

The prostates are tubular; penial setæ present; the male ducts open independently of the prostates—all in Somite XVII.

The sperm-sacs in Somites XI, XII.

Prostomium incompletely dovetailed into the peristomium.

[Spermathecæ.—Four pairs, in VI, VII, VIII, IX; each with appendix.

A gizzard is present in Somite V.

No calciferous glands.

Nephridiopores in front of third seta.

Dorsal pores are present.]

Species 1. R. minutus, F. E. B.; New Zealand.

See Beddard, 'Proc. Zool. Soc.,' 1889.

Genus 19. PLUTELLUS, E. P., 1873.

Setæ eight, equidistant.

The clitellum covers Somites XIV to XVII, complete ventrally.

The male pores on Somite XVIII.

Oviducal pores on Somite X (?).

The nephridial pores in line alternately with setæ two and four except anterior four pairs, which open in front of third seta; nephridia simple, slightly coiled tubule, lying entirely within one somite (?).

The sperm-sacs in Somite xii.

Prostate tubular, convoluted.

[Spermathecæ.—Five pairs, in Somites v to ix; very small, with coiled diverticulum.

Ovary in Somite x (?).

Gizzard in Somite vi; œsophageal glands in Somites x, xi, xii.

The dorsal pores begin behind Somite vi. Lateral hearts in Somites x, xi, xii.]

Species 1. P. heteroporus, E. P.; Pennsylvania.

See Perrier, 'Arch. d. Zool. Exp. et Gen.,' ii, 1873.

Remarks on Eudrilidæ.

I have here united with the peculiar genera Eudrilus and Teleudrilus a number of other genera which are much more normal in the arrangement of their genital organs than are these two; for I think, with Rosa, that Eudrilus need not form a type of a separate family.

It is only lately that we have had a thorough description of the female genital organs of Eudrilus; and though from Perrier's descriptions, and the earlier ones of Beddard, it appeared as if we had to do with a very abnormal type, Beddard's more recent papers on the subject, and Rosa's description of Teleudrilus, remove some of the apparent peculiarities. But they both remain very different from other worms, in that the ovary is not freely dependent in the cœlom, but enclosed in a sac, the walls of which are continuous with those of the oviduct; a similar condition of things is present in Microchæta in regard to the testis. And no doubt both these cases are in reality similar to the enclosure of the testes and rosettes in a common sac in Lumbricus and other forms. Here, however, the portion of cœlom separated by the wall of the sperm-sac is very considerable, whereas in the case of the ovary of Eudrilus and the testis of Microchæta, this separated cœlomic space is smaller, and has appeared more peculiar than it really is. As above mentioned, Eudrilus possesses two pairs of ovaries according to Beddard, the posterior pair serving apparently as ovisacs.

Rosa has already pointed out the close relation between Pontodrilus, Photodrilus, and Microscolex. These three forms serve to show the invalidity of Claparède's characteristics of "Terricolæ." The absence of a gizzard is, no doubt, connected with the character of the food.

Plutellus is altogether a peculiar form; the only description we have of it is that by Perrier. The position of the oviducal pore and of the ovary is so abnormal that a renewed examination is desirable.

2. Setæ more than eight (30—40) per somite.

Family VI. Perionycidæ.

Genus 20. PERIONYX, E. P., 1872.

Setæ thirty to fifty per somite.

Prostomium dovetailed incompletely into peristomium.

Clitellum on Somites XIV—XVII or less, complete ventrally; intersegmental grooves not completely obliterated.

Male pores close together, in a depression on Somite XVIII.

Oviducal pore median, in Somite XIV.

Prostate flattened, rounded; its pore common with the spermiducal pore.

[Genital organs as in Perichæta, but without a median sperm-sac.

Gizzard in Somites VI and VII; no cæca or other diverticula of the canal.

Nephridia large, paired; the duct not provided with a cæcum; apertures irregularly arranged in some species, as in P. saltans.]

Species 1. P. excavatus, E. P., 1872; Cochin China, the Philippines, and Burmah.
2. P. McIntoshii, F. E. B., 1883; Burmah.
3. P. saltans, A. G. B., 1886; India.

See Perrier, 'Nouv. Arch. du Mus. d'Hist. Nat. de Paris, viii, 1872; Beddard, 'Ann. Mag. Nat. Hist.,' 5th Series, vol. xii, 1883; 'Proc. Zool. Soc.,' 1886; Bourne, 'Proc. Zool. Soc.,' 1886; Rosa, 'Ann. d. Mus. Civico d. Storia Nat. d. Genova,' vi, 1888.

Remarks on Perionycidæ.

In external characters Perionyx agrees exceedingly closely with Perichæta. In the former, however, the male pores are close together in a median pit, whereas in most species of Perichæta they are rather wide apart, and on papillæ. Again, the clitellum does not so completely obliterate the segments and the grooves in Perionyx (nor are its limits so distinctly defined) as in Perichæta. The absence of cæca, and of any other diverticula of the alimentary canal, and the presence of large nephridia, are characters said to be found in some species of Perichæta. The median position of the oviducal pore has certainly a striking resemblance to that of Perichæta. It may be possible to transfer those worms with large nephridia, with forward position of the gizzard, without cæca, and with closely approximated male pores, which are at present regarded as species of Perichæta, to the genus Perionyx.

At present only three species have been described: P. excavatus, E. P.; P. McIntoshii, F. E. B.; and P. saltans, A. G. B.—the last two very briefly.

B. There is no hollow prostate in connection with or in the region of the male pore.

1. The male apertures are behind Somite XVIII, within the area occupied by the clitellum.

a. Eight setæ, separate or even alternate in some part of the body. There is only one pair of sperm-sacs, which extend through several somites.

Family VII. Geoscolecidæ, Rosa (=partly L. intraclitelliens, E. P.=partly Eudrilidæ, Claus, Vejdovsky=partly Geoscolecidæ, Rosa).

The eight setæ have a tendency to separate, or even to be arranged alternately in consecutive somites, either throughout the body or only posteriorly.

The clitellum commences behind Somite XIV usually, and extends over nine or more somites, intersegmental grooves not being obliterated.

The sperm-sacs are very long; there is but one pair of testes and rosettes; the genital pores are very small, and may be accompanied by glandular swellings.

A few of the anterior nephridia are larger than the following ones, and may even be collected into a mass forming a peptonephridium.

The typhlosole is a mere dependent fold.

Genus 21. GEOSCOLEX, Leuckart, 1841 (=Titanus, E. P., 1872).

The separation of the setæ occurs posteriorly, but no alternation seems to occur.

Clitellum is incomplete ventrally, and extends over Somites XV to XXIII.

Spermiducal pores are intersegmental between Somites XVIII and XIX, surrounded by an internal thickening of epidermis.

Oviducal pores are on Somite XIV.

Sperm-sacs extend from Somites XII to XX or XXV.

[Testes and ciliated funnels are in Somite XII.

No spermathecæ are known.

Gizzard is in Somite VII; calciferous glands in Somite XIII.

Nephridia commence in Somite IV; the pores are in front of the inner couple of setæ. The nephridium consists of a short, slightly and loosely coiled tubule, opening into a strongly developed duct, which is produced into a blind sac: this cæcum varies in its proportions in different parts of the body. The first nephridium is rather different from the following, as the coil of the tubule is larger and more compact; it serves probably as an extra-buccal pepto-nephridium. Both Leuckart and Perrier were unable to see the nephridiopores in front of the fourteenth somite, but nephridia are present although the pores are difficult to see.]

Species 1. G. maximus, Leuckart, 1841 (=T. brasiliensis, E. P., 1872), Brazil.

2. G. forguesii, E. P., 1881; La Plata.

See Leuckart, 'Zool. Bruchstücke,' Stuttgart, part ii, 1841; Perrier (Titanus), 'Nouv. Arch.,' &c., viii, 1872; and ibid., ix, 1881, foot-note, p. 235; Rosa, 'Boll. d. Mus. Zool. ed Anat. Comp. Univ. Torino,' iii, 1888.

Genus 22. UROCHÆTA, E. P., 1872.

Setæ eight; anteriorly in couples, then they gradually become separate; and finally, alternate in consecutive somites.

Clitellum on Somites XIV to XXII, complete ventrally; intersegmental grooves not obliterated.

Spermiducal pores between Somites XX and XXI (on Somite XX, E. P.; between XIX and XX, Rosa).

Nephridiopores in line with the 3rd seta.

Sperm-sacs, one pair, occupying Somites XIII to XV, or even more.

[Prostomium appears to be absent.

Penial setæ on Somites XIX, XX, XXI, and XXII.

Testes and ciliated rosettes in Somite XII.

Three pairs of spermathecæ, in Somites VII, VIII, IX (Rosa), VI, VII, VIII (Beddard, Horst), or VIII, IX, X (Perrier).

The nephridia, except the anterior pair, are simple, slightly coiled tubes, without any or only with very feebly developed duct.

The anterior nephridia are massed together to form "pepto-nephridia," the tubules of which open at one end into the cœlom by ciliated funnels, and at the other into a large duct which communicates with the exterior in front of Somite III.

The gizzard occupies Somite VII; and there are three pairs of flask-shaped calciferous diverticula, in Somites VIII, IX, X.

"Pyriform" sacs occur in posterior part of the body, on the ventral surface.]

(N.B.—The enumeration of the somites is given differently by the three authors who have described Urochæta. Rosa has pointed out that there is some reason to believe that Perrier counted a portion of the extended buccal region as the first somite; with the result that his first setigerous somite, instead of being the second, as in all other worms, is the third; hence it becomes necessary to subtract one, in some cases, from Perrier's numbers. Beddard has elucidated the position of the gonads by means of longitudinal sections—the only reliable means of deciding their position; and on this point I have followed him. The position of the external organs, and some of the internal structures, I have been able to decide for myself by an examination of some specimens kindly given to me by Mr. W. Sclater, who obtained them in Demerara.)

Species 1. U. corethrura, Fr. Muller, 1857; Brazil, Java, Martinique, Fernando Noronha, and Australia.

2. U. dubia, Horst; Sumatra.

See Perrier, 'Arch. de Zool. Exp. et Gen.,' iii, 1874; Beddard, 'Proc. Roy. Soc. Edin.,' 1887; 'Quart. Journ. Micr. Sci.,' xxix; Rosa, 'Ann. d. Mus. Civ.,' Genova, viii, 1889.

Genus 23. DIACHÆTA, Benham, 1886.

Setæ 8, separate, alternate from somite to somite throughout the body, except Seta 1, which always retains a linear arrangement.

Clitellum complete; covers Somites XX to XXXIII, intersegmental grooves distinct all round.

Spermiducal pores on Somite XXII; no penial setæ.

Sperm-sacs extend through Somites XII to XXXVIII.[1]

Nephridiopores in front of the outer setæ.

[No prostomium.

Testes (?) and ciliated rosettes in Somite XI.

[1] In a paper by Beddard (a proof of which Prof. Lankester has kindly allowed me to see) on a new species of this genus, two pairs of sperm-sacs are described.

Spermathecæ.—Three pairs in Somites VI, VII, and VIII, opening at the posterior edge of the somites.

Gizzard in Somite VI; no accessory glands or cæca.

Septa in anterior somites strong as in the other two genera.

Nephridia large, the duct simple without a cæcum. Those of the first pair, which open externally in Somite III, are much larger than the rest; the coil of tubules compact, and having a glandular appearance. It no doubt serves as a "pepto-nephridium." I have not observed any funnel to this first nephridium.]

Species 1. D. thomasii, W. B. B., 1886; St. Thomas, W. Indies.

See Benham, 'Quart. Journ. Micr. Sci.,' xxvii.

Remarks on Geoscolecidæ.

I have divided Rosa's family of this name into two families, retaining his name to include three genera which agree closely with one another, especially in having a single pair of testes and sperm-sacs. But the structure of the nephridia do not here serve as a family character, since the cæcum of Geoscolex is not present in other two genera.

The position of the male pores is noticeably different from that in most other families, and resembles that in the Rhinodrilidæ.

The fact that Perrier's worm Titanus is identical with a worm described by Leuckart some thirty years before was apparently discovered by Rosa, who pointed out the curious agreement even in the words used by these two zoologists in their description of the worm.

b. The eight setæ are in couples and exhibit no alternation in their arrangement. There are two or more pairs of sperm-sacs.

Family VIII. Rhinodrilidæ, mihi (= partly L. intraclitelliens, E. P., partly Eudrilidæ, Claus, Vejdovsky, Rosa).

The eight setæ are in four couples, the individual setæ of each couple being close together.

The clitellum, incomplete ventrally, commences in front of Somite XVIII, and occupies ten or more somites.

The spermiducal pores are behind Somite XVIII (with the exception of Hormogaster), and are usually nearly in the middle of the clitellum.

There are two or more pairs of sperm-sacs, and two pairs of testes and rosettes.

The spermathecæ are either small, or if large are quite simple, without appendices.

The gizzard is in front of Somite X.

Nephridia are provided with a large duct, usually produced into a cæcum; nephridiopores are in a line with the outer couple of setæ (except in Hormogaster).

Genus 24. RHINODRILUS, E. P., 1872 (= Thamnodrilus, Beddard, 1887).

Prostomium is two or three times longer than the first somite [and can be withdrawn into the buccal cavity; at any rate, it is so in spirit specimens].

The setæ are ornamented near their distal ends with several rows of crescentic ridges, which are slightly more marked in the clitellar setæ.

The clitellum, which does not extend across the ventral surface, occupies seven or more somites, XV to XXV (XX—XXVI, Horst). Along its ventral boundary, on each side, is a glandular band—tubercula pubertatis—on Somites XX—XXV.

The spermiducal pore is intersegmental between XX and XXI (according to my own observation) (XIX/XX, E. P.).

The nephridiopores are in a line with the outer setæ.

Sperm-sacs are two pairs, in Somites XI, XII, with median sacs.

[Two pairs of testes and ciliated rosettes in Somites XI, XII.

Spermathecæ are long and club-shaped, in Somites VII, VIII, IX (Horst), or globular, in Somites V to VIII, in a species examined by myself.

The nephridium has only a short and slightly coiled tubule; the duct is produced into a cæcum. The anterior six or seven pairs of nephridia are larger than the following ones; and the duct is simple. The first pair, or extra-buccal pepto-nephridia, opening externally on Somite II, is particularly large, and lies below the œsophagus.

Gizzard in VII or VIII.

Typhlosole is a small fold, with a spiral line of origin.

Œsophageal glands, six or eight pairs, in the next following somites.

In addition to the dorsal vessel, there is a supra-intestinal trunk below it, from which two or three pairs of large "intestinal hearts" go to the sub-intestinal vessel.]

Species 1. R. paradoxus, E. P., 1872; Venezuela.
2. R. tenkatei, Horst, 1887; Surinam.
3. R. gulielmi, F. E. B., 1887; Brit. Guiana.
4. R. ecuadoriensis, W. B. B., 1889 (MS.); Ecuador.

See Perrier, 'Nouv. Arch. du Mus. d'Hist. Nat. de Paris,' viii, 1872; Beddard (Thamnodrilus), 'Proc. Zool. Soc.,' 1887; Horst, 'Notes from Leyden Museum,' ix.

Genus 25. MICROCHÆTA, F. E. B., 1885.

Setæ extremely small, in couples.

Clitellum occupies ten to twelve somites between X and XXV.

Spermiducal pore on Somite XIX or XX.

Oviducal pore between Somites XII and XIII.

Nephridiopores very large, in a line with outer setæ.

Sperm-sacs in Somites X and XI, each pair being connected by a median sac in Somites IX and X.

[Prostomium small. No dorsal pores.

Testes in Somites IX, X, in special sacs communicating with sperm-sacs.

Ovary in Somite XII.[1]

[1] The peristomium in M. beddardi is provided with setæ, and is therefore homologous with the peristomium + the second somite of Lumbricus, hence the position of the ovary and other structures is typical, although dissection shows them one somite anterior to their real somites. In

Spermathecæ very minute and numerous, being from two to four pairs in all or some of the Somites XII to XV.

Nephridia very large, and of a peculiar form, each consisting of a greatly coiled tubule, arranged as a tuft, communicating with a large duct, which is produced into a great sac-like outgrowth. This cæcum is less developed in the anterior somites; and is most feebly marked in the first pair of nephridia.

Gizzard in Somite VI.

A single pair of œsophageal glands in Somite IX, or partly in VIII and partly in IX.

The dorsal vessel is doubled anteriorly and specially enlarged in Somite VIII.

Lateral hearts, VI—XI.]

Species 1. M. rappi, F. E. B., 1885; Cape of Good Hope.

2. M. beddardi, W. B. B., 1886; Natal.

See Beddard, 'Trans. Zool. Soc.,' xii, 1886; Benham, 'Quart. Journ. Micr. Sci.,' xxvi and xxvii.

Genus 26. UROBENUS, W. B. B., 1886.

Setæ in couples.

Clitellum occupies Somites XIV to XXV, incomplete ventrally.

Spermiducal pore on Somite XX.

Nephridiopores in a line with the outer setæ.

Sperm-sacs two pairs, of which one pair is in Somites XII and XIII, the second pair in Somite XIV.

Peculiar "pyriform sacs" occur in pairs on the ventral surface of the body-wall opening externally ventrad of the inner setæ, commencing in Somite X.

Testes and ciliated rosettes in Somites XII and XIII.

[Spermathecæ three pairs, in Somites VII, VIII, and IX.

Gizzard in Somite VIII.

Three pairs of flask-shaped calciferous glands in Somites IX, X, XI.

M. rappi I find no trace of setæ in the peristomium—the fusion is complete.

Intestinal pouches in Somites XVI to XXV.

A pair of tubular intestinal cæca in Somite XXVI resembling those of Perichæta.

All the nephridia have a large cæcum; the duct being very long in the first seven nephridia.]

Species 1. U. brasiliensis, W. B. B., 1886; Brazil.

See Benham, 'Quart. Journ. Micr. Sci.,' xxvii.

Genus 27. Hormogaster, Rosa, 1887.

Setæ in couples; those of the inner couple rather far apart.

Clitellum occupies Somites XV to XXV.

Tubercula pubertatis along the edge of the clitellum on Somites XVIII to XXIV.

Spermiducal pores between Somites XV and XVI.

Nephridiopores in line with Seta 2.

Sperm-sacs in Somites XI and XII.

Gizzards three, in Somites VI, VII, VIII.

[Globose intestinal cæca in Somite XXI, and smaller ones in following few somites.

Spermathecæ in Somites X, XI, XII.

Testes and rosettes in Somites X, XI.

Nephridial ducts provided with slight cæcal prolongations.]

Species 1. B. redii, Rosa, 1887; Italy.

See Rosa, 'Sulla Struttura dello Hormogaster Redii,' Torino, 1888.

Genus 28. Brachydrilus, Benham, 1888.

Setæ very small, in four couples.

Clitellum occupies Somites XVI to XXI (though probably more).

Spermiducal pores in a deep fossa occupying Somite XVIII.

Two pairs of sperm-sacs, in Somites X, XI, enclosing the ciliated rosettes.

Large and muscular thickening of body-wall, through which the sperm-ducts pass to the exterior, occupies Somites XV to XX.

Spermathecæ small; two or three pairs on hinder margin of Somite XI.

Two pairs of nephridia in each somite, each a simple tubule without a distinct duct.

[Sixteen globular "albumen-glands" are present, as four sacs on each side of Somites X, XI.

Ovaries in Somite XII.[1]

The worm is very short in proportion to its width.]

See Benham, 'Zool. Anzeiger,' 1888, No. 271.

Remarks on Rhinodrilidæ.

I include in this family the remaining genera grouped by Rosa in his Geoscolecidæ; the two families together nearly correspond with Perrier's "intraclitellian worms."

The most aberrant form is Hormogaster, with its male pores far forwards, and nephridiopores in line with the inner couple of setæ. In these two points, showing a decided affinity to Lumbricus, and perhaps it belongs to the family Lumbricidæ.

Brachydrilus is of interest in possessing two pairs of large nephridia in each somite; evidently an intermediate condition between a network in which the tubules have become grouped, as in Cryptodrilus, into three masses on each side, and the ordinary condition of a pair of nephridia. It is quite conceivable that, as in Megascolides, one tubule becomes gradually larger, whilst at the same time the rest become fewer, in some other form two such tubules might increase in size, and so result in two pairs of nephridia per somite.

The testes and spermiducal pores have abnormal positions very usually in this family; for instance, in Microchæta testes and ovaries are placed one somite further forwards than is normally the case;[2] in Urobenus and Rhinodrilus the

[1] The fusion between peristomium and first setigerous somite appears complete.

[2] See foot-note on p. 254.

funnels are further back, as I have ascertained by longitudinal sections, in addition to dissection.

2. Male pores in front of Somite XVIII, anterior to the clitellum.

Family IX. Lumbricidæ, Claus and Rosa (=L. anteclitelliens, E. P. = Lumbricidæ + Criodrilidæ, Vejdovsky).

The eight setæ are either in couples, the individual setæ being very close together; or they may gradually separate so as to give eight equidistant setæ per somite.

The clitellum, incomplete ventrally, usually commences behind Somite XX (in one case on Somite XV), and occupies from six to nine, sometimes more, somites.

The spermiducal pores are on Somite XV, or on an anterior somite.

There are three or four pairs of sperm-sacs in Somites IX to XII.

Testes and ciliated rosettes in Somites X, XI.

The oviducal pores are on Somite XIV.

Spermathecæ may be absent, or when present are nearly spherical sacs without diverticula.

Nephridiopores in a line with the inner couple of setæ.

Each nephridium is a greatly coiled tube, terminating in a large muscular duct without a cæcum.

The gizzard when present lies behind Somite X.

There are no pepto-nephridia.

Genus 29. LUMBRICUS, Eisen (= partly Lumbricus, Limnæus, &c.).

Prostomium dovetailed completely into the peristomium.

Setæ always in couples, the individual setæ of which are close together.

Clitellum occupies six or seven somites, commencing somewhere between Somites XXVI and XXXII.

Spermiducal pores on Somite XV.

Sperm-sacs three pairs, in Somites IX, XI, XII, connected across the middle line in Somites x, xi, by sacs enclosing the testes and ciliated rosettes.

Tubercula pubertatis, four on each side, forming a band along the ventral limit of the clitellum. These, and the spermathecæ are absent in L. eiseni.

[Colour reddish brown, iridescent.

Form cylindrical, more or less flattened posteriorly.

First dorsal pore may begin between Somites vii and viii, or posteriorly to this.

Anus terminal.

Spermathecæ.—Two pairs in Somites ix and x, opening posteriorly nearly in a line with the lateral setæ.

Spermatophores, in the breeding season, fixed to the body behind the genital pores.

Gizzard occupies Somites xvii and xviii.

Œsophageal calciferous glands xi and xii.]

Species 1. L. agricola, Hoffm., 1845; Europe, N. America (= L. terrestris, L., partly).
2. L. rubellus, Hoffm., 1845; Europe, Newfoundland.
3. L. castaneus, Sav., 1829; Europe, Newfoundland.
4. L. meliboeus, Rosa, 1884; Europe.
5. L. eiseni, Levinsen, 1883; Europe.
6. L. caucasicus, Kulagin, 1888; South Russia.

See Hoffmeister, 'Die bis jetzt bekannten Arten aus d. Fam. der Regenwürmer,' 1845; Eisen, 'Ofvers. af Kong. Vetensk. Akad. Förhandlungen,' 1870, 1873, &c.; Rosa, 'Il Lombricidi del Piemonte,' Torino, 1884, and later papers in 'Boll. Mus. Zool.,' Torino.

Genus 30. ALLOLOBOPHORA, Eisen (=Lumbricus, L., partly).

Prostomium only partially dovetailed into the peristomium.

Setæ either in four couples, or individual setæ more or less widely separated.

Clitellum occupies five to nine somites (rarely more), commencing somewhere between Somites XXVI and XXXII.

Spermiducal pores on Somite XV.

Sperm-sacs.—Four pairs, in Somites IX, X, XI, and XII, unconnected from side to side, so that the testes and ciliated rosettes lie freely in Somites X and XI.

Tubercula pubertatis are two or three pairs, sometimes in consecutive somites, sometimes on alternate somites (ten pairs in one species): rarely absent as in A. subrubicunda.

[Colour more varied than in Lumbricus; from deep sienna-brown to light transparent grey, sometimes green. First dorsal pore may begin as far forwards as Somite IV, or more posteriorly.

Spermathecæ usually two pairs (sometimes more, or they may be absent as in A. subrubicunda), opening either anteriorly or posteriorly, either near the lateral setæ or near the dorsal line.

Spermatophores fixed behind the genital pores.

Œsophageal pouches in Somite X, and calciferous glands in XI.

Gizzard as in Lumbricus.]

Species 1. A. chlorotica, Sav., 1832; Europe, N. America (= L. riparius, Hoffm., 1845).
2. A. fœtida, Sav., 1829; Europe, N. America, Australia (= L. olidus, Hoffm., 1845).
3. A. submontana, Vejd., 1875; Bohemia.
4. A. fraissei, Orley, 1881; Balearic Isles.
5. A. mediterranea, Orley, 1881; Balearic Isles.
6. A. nordenskjoldii, Eisen; Scandinavia, Siberia, Azores, Newfoundland.
7. A. subrubicunda, Eisen, 1873; South Siberia, Europe, Magellan.
8. A. tumida, Eisen, 1874; Denmark, N. America.
9. A. parva, Eisen, 1874; Denmark, N. America.
10. A. arborea, Eisen, 1874; Denmark.
11. A. dubiosa, Orley, 1881; Europe.

Species 12. A. norvegica, Eisen, 1873; Norway.
13. A. mucosa, Eisen, 1873; Europe, Siberia, N. America.
14. A. trapezoides, Dug., 1828; Europe.
15. A. turgida, Eisen, 1873; Europe, N. America, Australia.
16. A. longa, Uhde, 1885; Germany.
17. A. hispanica, Uhde, 1885; Spain.
18. A. profuga, Rosa, 1884; Italy.
19. A. transpadana, Rosa, 1884; Italy.
20. A. minima, Rosa, 1884; Italy.
21. A. constricta, Rosa, 1884; Italy.
22. A. alpina, Rosa, 1884; Italy.
23. A. veneta, Rosa, 1886; Italy, Portugal.
24. A. ninnii, Rosa, 1886; Italy.
25. A. tellinii, Rosa, 1888; Italy.
26. A. molleri, Rosa, 1889; Portugal.
27. A. orleyi, Horst, 1887; Hungary.
28. A. (Dendrobæna) rubida, Sav. 1832; Europe, Siberia, N. America (= L. octohedra, Sav., = A. boeckii, Eisen, 1870; = L. puter, Hoffm., 1845).
29. A. bagdonowi, Kulagin, 1888; Russia.
30. A. nassonowi, Kulagin, 1888; Russia.
31. A. celtica, Rosa, 1886; Brittany.
32. A. camplanata, Dug., 1828; Europe.
33. A. icterica, Sav., 1832; Europe.
34. A. gigas, Dug., 1828; Europe.

Genus 31. Criodrilus, Hoffmeister, 1845.

Prostomium not dovetailed into the peristomium.

Setæ in couples, which are so placed as to give the body a quadrangular outline in section.

Clitellum, ill-marked, extends from Somite XIV to about Somite XLV.

Spermiducal pores on Somite XV, on a large rounded papilla almost lateral in position.

No tubercula pubertatis.

[The worm is aquatic in habit; in colour, brownish green.

In the breeding season one or more "spermatophores" are found fixed to the body in the neighbourhood, and in front, of the genital pores.

Cocoons spindle-shaped, dark green.

The anus is dorsal.

Genital apparatus as in Allolobophora; the male duct passes through a glandular thickening of epidermis situated around the aperture.

No spermathecæ.

No gizzard and no œsophageal glands are present.

The typhlosole, frequently denied, is present.

The nephridia commence in Somite x (according to Collin, Zeit. Wiss. Zool.,' xlvi, 1888).]

Species 1. C. lacuum, Hoffm., 1845; Europe.

See Benham, 'Quart. Journ. Micr. Sci.,' xxvii; Orley, 'Quart. Journ. Micr. Sci.,' xxvii; Rosa, 'Sul Criodrilus lacuum,' Torino, 1887.

Genus 32. Allurus, Eisen (= L. tetraedrus, Dugés).

Prostomium partially dovetailed into the peristomium.

Setæ in four couples, latero-ventral and latero-dorsal in position.

Clitellum occupies Somites xxii to xxvii.

Spermiducal pores on Somite xiii, lateral in position.

Sperm-sacs as in Allolobophora; sperm-duct opens through a glandular thickening of epidermis as in Criodrilus.

[Body posteriorly quadrangular.

Spermathecæ minute sacs (visible only in sections) in Somite viii; aperture not intersegmental, but close to the lateral setæ.

Gizzard in Somite xvii.

Small œsophageal glands in Somites x—xiv, not very distinct.

The nephridia commence in Somite iv.

First dorsal pore between Somites iv and v.]

Species 1. A. tetraedrus, Sav., 1832; Europe.
See Beddard, 'Quart. Journ. Micr. Sci.,' xxviii.

Remarks on Lumbricidæ.

Eisen was the first to subdivide the genus Lumbricus into two sub-genera, according to the relative amount of dovetailing of the prostomium into the peristomium. This is accompanied by certain other characters, which have been held sufficient to characterise genera in other cases. So that I retain his subdivisions Lumbricus and Allolobophora; but as his genus Dendrobæna is only distinguished from the latter genus in having all the setæ equidistant, and as all stages occurring in this separation are found in Allolobophora, I agree with Rosa that we ought not to recognise it.

The anatomy of Criodrilus, recently worked out by Rosa and myself, and again by Collin, is not very greatly different from that of Allolobophora. The most important points of difference are in the extent of the clitellum—which, till my discovery of it, had been denied, and in which Collin confirms me—and in the fact that this glandular modification of the epidermis commences in Somite xv; together with the absence of spermathecæ. This last character—which at first sight seems to mark it off from the rest of the family—serves in reality as a further link; for spermathecæ are absent in Lumbricus eiseni, Levinsen,[1] and in Allolobophora constricta, Rosa.[2] This negative character is, as Rosa has recently[3] pointed out, accompanied by another negative character, viz. the absence of tubercula pubertatis—structures almost limited to the family Lumbricidæ, as they have only been mentioned or figured in the species of Rhinodrilus, and in Hormogaster.

The spermatophores, so noticeable a feature in nearly every adult specimen of Criodrilus, are also known in many

[1] Levinsen, 'Syst. geogr. oversigt over de nordiske annulata,' &c., Copenhagen, 1883.

[2] Rosa, 'Il Lumbricidi del Piemonte,' 1884.

[3] Rosa, 'Boll. Mus. Zool. ed Anat. Comp.,' Torino, vol. iv, November, 1889.

species of Lumbricus and Allolobophora; and unknown elsewhere.

Criodrilus, in fact, must be regarded as a degenerate Allolobophora, owing to its altered mode of life; its aquatic habit has no doubt a connection with the absence of a gizzard, and very likely with the absence of nephridia in the anterior somites, which may probably be used in ordinary earthworms, as salivary glands—that is, for the purpose of moistening the food. At any rate, we find the same absence of anterior nephridia in another aquatic form, Pontodrilus; and the fact that in so many worms the anterior nephridia are specially large, or modified in some way (as in Urochæta, Diachæta, &c.), and even open into the pharynx instead of externally, bears me out in this idea.

In this connection it is interesting, though contradictory, to find that Allurus, which is also an aquatic form, but lives in the soil below the water, whilst Criodrilus lives actually in the water, has nephrida in the anterior somites.

Allurus has no true spermathecæ. Beddard describes a minute sac embedded in the body wall, and opening externally on the somite, but no spermatozon were observed in it; and it may perhaps be either degenerate, or of the nature of an albumen ("capsulogenous") gland.

The species both of Lumbricus and Allolobophora are in a state of great confusion; even modern authors make two species out of one, or split up one into two. The list I have given is taken from Vejdovsky's 'System und Morphologie,' with additional species described since the date of his monograph.

Incertæ sedis.

HELODRILUS, Hoffmeister, 1845.

Setæ black, in couples.

Clitellum absent.

Spermiducal pores on Somite xv.

Gizzard present.

Pigment spots are present on peristomial somite, but are absent in young individuals.

ECHINODRILUS, Vaillant, 1869 (= L. multispinus, Grube, 1851).

Setæ four bundles of 5 in each somite.
Clitellum absent.
Spermiducal pores in Somite XII.

ANTEUS, E. P., 1872.

Setæ four couples.
Clitellum ill-defined, on Somites XV to XXIX.
Spermiducal pores unknown.
Sperm-sacs, two pairs, in Somites IX, X.
Gizzard, Somite VI.
Nephridia large; pores in line with outer setæ.
Anterior septa very thick.

Vaillant points out that in many respects Perrier's description agrees with that given by Beddard and myself for Microchæta rappi. Size: Anteus, 1·16 m. (i.e. 45 inches); Microchæta is 3 feet 6 inches to 6 feet.

The arrangement of setæ and indistinctness of the clitellum are also points of resemblance. To show the difficulty of deciding where the clitellum commences in Microchæta, it is noteworthy that whereas Beddard puts the extent of this structure as Somites X to XXX inclusive, I reckoned it as occupying Somites XIII to XXV.

Both Beddard and I were unable to recognise the spermiducal pore externally.

The annulation of the somites rendered it difficult to count them; thus Beddard figures the gizzard in Somite VII, whilst I found it to be in Somite VI. He states that the spermiducal pore is on Somite XVIII; I found it to be on XIX.

In both Anteus and Microchæta the anterior septa are especially thick and infundibuliform. Perrier places the last of these thick septa behind Somite IX; Beddard places it in Microchæta behind the eighth, and I found it behind the seventh. These discrepancies are no doubt due to the difficulty of counting the somites.

A nephridium of Anteus is figured by Perrier. He represents it as a long, narrow tube, equal in diameter throughout, and thrown into a number of curves. It ends in what he regards as the cœlomic funnel—"une sorte de houpe formée par une série de replis membraneux implantés sur sa portion terminale libre." This I take to be in reality a tuft of loops of the coiled tube, such as exists in the nephridium of Microchæta (see my paper, 'Quart. Journ. Micr. Sci.,' xxvi, pl. xvi, figs. 21, 25, 26). It is possible that the wide muscular duct there figured might in an ill-preserved specimen shrink, and have the appearance of such a duct as Perrier figures. Perrier states that behind the twentieth somite the nephridia are smaller and somewhat different from those anteriorly; such is also the case in Microchæta.

The fact that the spermathecæ in Microchæta are very small, and quite differently situated from what is the rule in other earthworms, might be suggested in explanation of their having been overlooked by Perrier.

In Microchæta the dorsal vessel becomes doubled in each of the Somites IV, V, VI, VII, and VIII, and in the last is very much thickened. In Anteus Perrier figures and describes it as ampullate and bent aside in Somites XII—XVII, and does not note any doubling.

It would be exceedingly interesting to investigate more fully the anatomy of Anteus, for its locality, Cayenne, in Brazil, is so far removed from the home of Microchæta in South Africa that it seems scarcely credible that the two are identical.

EISENIA, Vaillant, 1889 (= Tetragonurus, Eisen, 1874).

Prostomium does not dovetail into peristomium.
Setæ in couples.
Male pores in Somite XII.
No further details are given.

Species 1. E. pupa, Eisen, 1874; Canada, N. America.

See Eisen, 'Ofvers af. Kongl. Vetensk. Akad. Förhandl.,' 1874.

IV. Tabular Summary of Generic Characters.

I have here brought together the main characters of the various genera in a tabular form, the genera being arranged alphabetically. The information is, of course, condensed, and the terms employed are defined in the chapter dealing with nomenclature.

V. Index to Identification of Genera.

In addition to the following "tabular summary" it has occurred to me that it would be useful to zoologists examining earthworms to have the genera arranged in such a manner that identification to some extent may be rendered less difficult, as it is by no means an easy matter to distinguish many of the genera from one another, and I have found a table of this sort a great help to myself.

In order to add to its usefulness I have appended to each genus the page in this memoir in which will be found further details and references to papers on the genus.

IV.—Tabular Summary.

Name with Author.	Date.	Setæ.	Clitellum.	Male Pore.	Prostomium.	Nephridia.	Nephridiopore. In line with—
1. Allolobophora, Eisen	1874	Sometimes in couples, or more or less separate	5, 6, 7, 8, 9 somites, beginng. between 26 and 32	15	Dovetailed incompletely into peristomium	Meganephric, simple	Inner couple
2. Acanthodrilus, E. P.	1872	4 couples, or 8 separate	13–19, complete anteriorly	18	Partially dovetailed into peristomium	Plectonephric	Numerous
3. Allurus, Eisen	1874	Couples, ventro-lateral and dorso-lateral	22–27	13	Partially dovetailed into peristomium	Commencing in 4, simple	Inner couple
4. Brachydrilus, W. B. B.	1888	Small, in 4 couples	16–21 [? more]	In a deep pit, 18	—	Two pairs, simple	Inner and outer couple
5. Criodrilus, Hoffm.	1845	Couples, ventro-lateral and dorso-lateral	Ill-marked, about 15–45	15	Large, not dovetailed into peristomium	Large, simple, commencing in 10	Inner couple
6. Cryptodrilus, Fletcher	1856	8, separate	13–17 complete, ventrally	18, no papillæ	Small, partially dovetailed into peristomium	Tufts, or 1 or 3 pairs, large tubes. Plect.	—
7. Deinodrilus, F. E. B.	1888	12 per somite, nearly equidistant	14, 15, 16 complete, ventrally	18	Dovetailed into peristomium	Plectonephric	—
8. Diachæta, W. B. B.	1886	8, separate, distant, alternate	20—33 complete, not developed intersegmentally	22	None	Large, simple	Outer couple
9. Dichogaster, F. E. B.	1888	4 couples, ventral and lateral	13–20, not well developed ventrally	17	—	Plectonephric	Numerous
10. Didymogaster, Fl.	1886	8, nearly equidistant	[13] 14–18, not greatly developed	18, on papillæ	Partially dovetailed	Plectonephric	—
11. Digaster, E. P.	1872	4 couples	14–17, complete ventrally	18 [17, E. P.]	Partially dovetailed	Plectonephric	—
12. Eudrilus, E. P.	1872	4 couples	[13] 14–18 complete	17	Partially dovetailed	Meganephric, simple	[Inner or] outer couple
13. Geoscolex, Leuckart	1841	4 couples, but separate posteriorly	15–23, incomplete ventrally	18/19	Broad	Meganephric; cæcal; commencing in 4	Inner couple
14. Hormogaster, Rosa	1887	Couples, those of inner couple far apart	15–25 incomplete	15/16	Not dovetailed	Meganephric; cæcal	Seta 2
15. Lumbricus, Linn.	1757	Always in couples	6 or 7 somites, commencing 26–32	15	Dovetailed completely into peristomium	Meganephric, simple	Inner couple
16. Megascolides, McCoy	1878	In couples, all ventral	13–21 complete, feebly marked	18, on papillæ	Broad, not dovetailed	Network anteriorly, network with large tubes posteriorly	Numerous
17. Microchæta, F. E. B.	1885	Very small, in couples	12 somites, incomplete, somewhere between 10–25	19 or 20	Small	Meganephric; cæcal	Outer couple
18. Microscolex, Rosa	1887	4 couples	13–16 (17) complete	17	Dovetailed into peristomium	Meganephric, simple	Third seta; begin in fourth somite

Ref. No.	Sperm-sacs.	Testes and Funnels.	Prostate.	Gizzard.	Remarks.
1.	4 pairs, 9, 10, 11, 12, unconnected across the middle line	10, 11, testes and ciliated rosettes free	None	17, 18	Tubercula pubertatis on some of the clitellar somites; œsophageal diverticula in Somites 10 and 11. Number of spermathecæ variable.
2.	11, 12	10, 11, free	2 pairs, convoluted 17, 19; penial setæ	8, 9	Diverticula behind gizzard; pepto-nephridia frequently present. Spermathecæ with appendages.
3.	4 pairs, 9, 10, 11, 12, no median sac	Free, 10, 11	None	17, one somite	Slight dilatation of œsophagus, 10–14.
4.	10, 11	10, 11	None	6	Spermathecæ, 1 or 2 pairs of small sacs in Somite 11. Albumen-glands, 10, 11; thickening of body-wall in Somites 15–20.
5.	4 pairs, 9, 10, 11, 12, no median sac	Free, 10, 11	None	None	No spermathecæ, body square, anus dorsal; aquatic.
6.	9 and 12	10, 11, free	Lobate; no penial setæ	5 [6 or 7]	Intestinal calciferous dilatations in Somites 9–13; usually several copulatory papillæ.
7.	11, 12	10, 11	2 pairs, 17, 19, convoluted	6, 7	Dorsal blood-vessel double throughout and enclosed in special cœlomic tube. Spermathecæ with appendices; no calciferous glands.
8.	1 pair, 12 to 38	11	None; no penial setæ	6	Extra-buccal pepto-nephridia; no diverticula.
9.	10, 11, 12, median sac and dorsal connections	10, 11	3 pairs, 17, 18, 19, tubular	Two, 7, 8, and 9, 10	Calciferous diverticula in 15, 16, 17; only 1 pair of spermathecæ in 8, near median line. No penial setæ.
10.	9, 12	10, 11	18, equally bilobed	Two, 6, 7	Intestine dilated in 10–16, spirally twisted; dorsal vessel doubled. Spermathecal apertures not intersegmental.
11.	10, 11 [9, 12, Fl.]	Funnels free	Lobulated; penial setæ	Two, 5, 7	—
12.	10, 11, and 12	10, 11, sperm-ducts separate	Elongated; chitinous penis in sac	6	Diverticula lateral and calciferous in 12, and ventral in 10, 11; no typhlosole; the genital apparatus is peculiar.
13.	1 pair, 12 to 25	12	None	7	Calciferous diverticula large, 13; typhlosole; no spermathecæ known.
14.	2 pairs, 11, 12	10, 11	None	Three, 6, 7, 8	Globose diverticula of intestine, 21; tubercula pubertatis on Somites 18–24.
15.	3 pairs, 9, 11, 12, with median sac	10, 11, enclosed in sac	None	17, 18	Calciferous diverticula 11, 12, and a pouch in 11; tubercula pubertatis.
16.	Racemose, 11, 12, 13, 14	10, 11, free	Tubular, much coiled; no penial setæ	5 or 6	No œsophageal diverticula, but intestinal dilations in all or any of Somites 12–18. Intra-buccal pepto-nephridia. No typhlosole.
17.	10, 11	9, 10, testes in special sacs	None	6	Pair of œsophageal diverticula in 9; nephridia very conspicuous. Spermathecæ numerous and inconspicuous.
18.	11, 12	10, 11, free	Lobed; penial setæ	None	One pair spermathecæ in 9; no typhlosole, no subneural vessel; small transparent worm.

IV.—Tabular Summary (*continued*).

Name with Author.	Date.	Setæ.	Clitellum.	Male Pore.	Prostomium.	Nephridia.	Nephridiopore. In line with—
19. Moniligaster, E. P.	1872	4 couples	10–13, ill-marked	Intersegmental, 10/11 or 11/12	—	Meganephric; cæcal	Outer couple
20. Perichæta, Schmarda	1861	20–100 on ridges, continuous or discontinuous	14, 15, 16 [or more], complete	18, latero-ventral	Sometimes dovetailed into peristomium	Plectonephric	Numerous
21. Perionyx, E. P.	1872	30 or more, continuous	14–17, complete ventrally	18, close together	Dovetailed partially	Meganephric, simple	Irregular on each side
22. Perissogaster, Fl.	1887	All close together on ventral surface	[13] 14–18, complete, except in the hinder part, 16, 17	18 [?]	Wide, dovetailed into peristomium	Plectonephric	—
23. Photodrilus, Giard	1887	8, separate, No. 1 near middle line	13–17 complete	18	Not dovetailed	Megan., simple, commence in Somite 14	Second seta
24. Plutellus, E. P.	1873	8, equidistant	14–17, complete ventrally	18	Dovetailed into peristomium	Entirely within one somite. Meganephric	Alternate, 2 and 4 setæ
25. Pontodrilus, E. P.	1881	8, separate	13–17 complete	18	—	Megan., simple, commence in 15	Second seta
26. Rhinodrilus, E. P.	1872	4 couples, ornamented	7 or more somites incomplete, 15–25=[20–27]	Intersegmental, 19/20 (20/21)	Elongated	Meganephric; cæcal; anterior 6 or 7 pairs very long	Outer couple
27. Rhododrilus, F. E. B.	1889	8, separate	14–17	17	Partially dovetailed into peristomium	Meganephric	Third seta
28. Teleudrilus, Rosa	1888	4 couples, though setæ are far apart	14–17 complete	Median, 19	—	Meganephric, simple	Outer couple
29. Trigaster, W. B. B.	1886	4 couples, all ventral	14–40 incomplete	18, in deep fossa	Broad, not dovetailed into peristomium	Plectonephric	—
30. Typhæus, F. E. B.	1883	4 couples, all ventral	14–17	17	Broad, not dovetailed	Plectonephric	—
31. Urobenus, W. B. B.	1886	In couples	14–25 incomplete	20	Distinct	Meganephric; cæcal	Outer couple
32. Urochæta, E. P.	1872	Anteriorly in couples; the 8 equidistant alternate posteriorly	14–22, not developed intersegmentally, complete ventrally	20/21 [20, E. P.]	None	Meganephric, simple	Third seta

Ref. No.	Sperm-sacs.	Testes and Funnels.	Prostate.	Gizzard.	Remarks.
19.	1 pair, occupying partly 9, partly 10	Testes 9	Tubular and long, or very small	Long, 13–22, or fewer somites	Ovisac occupies two or three somites, 14–16; a single pair of spermathecæ in 8 or 9.
20.	11, 12	10, 11	Lobed, or deeply incised	Usually 8, 9, 10, or any 2 segments between 5 and 8	Usually a pair of intestinal cæca in Somite 26, sometimes metamerically repeated; accessory glands anteriorly; spermathecæ with appendix.
21.	11, 12	10, 11	Flattened, slightly lobed	6, 7	No cæca, no accessory digestive glands, no copulatory papillæ; spermathecæ without appendix.
22.	9, 10, 11, 12	10, 11, free	Lobed, one lobe long and extends into 19; penial setæ	Three, 5, 6, 7	Intestinal calciferous (?) diverticula in 9–14.
23.	11, 12	Testes and ciliated rosettes 10, 11	Penial setæ	None	Septal glands in anterior somites appear to open near dorsal surface. No typhlosole; no subneural vessel.
24.	12 ?	?	Tubular, convoluted	6	Œsophageal diverticula, 10, 11, 12. The ovary in 10 [?]. Five pairs of spermathecæ in 5–9.
25.	11, 12	Testes free, and ciliated rosettes 10, 11	Convoluted, tubular	None	Lives on sea-shore. No typhlosole, nor subneural vessel.
26.	2 pairs, 11, 12	11, 12	None	7 or 8	Six or more pairs of diverticula in 9–14. Tubercula pubertatis, 20–25.
27.	11, 12	—	Tubular 17, independent aperture; penial setæ	5	No alimentary diverticula. Spermathecæ have appendices.
28.	2 pairs, 11, 12	10, 11 enclosed in a special sac, funnels 11, 12	Two prostates enter a median sac, which passes to exterior and also receives another sac	6, 7	Calciferous diverticula in 13. Dorsal vessel is doubled in anterior somites. Generative apparatus peculiar, and characteristic; median spermathecal pore, 13/14; and paired oviducal pore, 14/15.
29.	—	—	17, 19, tubular; convoluted; no penial setæ	Three, 7, 8, 9 [or two]	Pepto-nephridia are present. Spermathecæ simple.
30.	1 pair, 10, or occupying more than 1 somite	1 pair, 10 in median sperm-sac	Convoluted; penial setæ	6, 7	Calciferous diverticula in 12, and intestinal dilatations. One pair of spermathecæ in 8, opening anteriorly.
31.	2 pairs, 12, 13, 14	12, 13 free	None	8	Three pairs of calciferous diverticula, 9, 10, 11; intestinal cæca, 26; pyriform sacs opening externally, ventrad of inner setæ.
32.	1 pair, 13 to 15, or further	12	None; penial setæ	7	Three pairs of calciferous diverticula, 8, 9, 10. Pyriform sacs in posterior part of body on ventral surface. Extra-buccal pepto-nephridia.

V.—Index to Identification of Genera.

Setæ per somite

- 16 to 80 or more, in a ring. Male pores
  - Far apart . . . . Perichæta (small tufts of nephridia), p. 233.
  - Very close together . Perionyx (large nephridia), p. 247.
- 12 . . . . Deinodrilus (clitellum XIV, XV, XVI), p. 231.
- 8
  - Alternate in consecutive somites.
    - Throughout the body . . Diachæta (male pore XXII), p. 251.
    - Only posteriorly . . . . Urochæta (male pore XX/XXI; clitellum XIV—XXII), p. 250.
  - In rows, not alternating. Male pores on Somites
    - X/XI or XI/XII . . . . Moniligaster, p. 238.
    - XIII . . . . Allurus, p. 262.
    - XV. Prostomium
      - Dovetailed completely into peristomium . Lumbricus, p. 258.
      - Dovetailed incompletely . . . . Allolobophora, p. 259.
      - Not dovetailed into peristomium . . . . Criodrilus, p. 261.
    - XV/XVI . . . . Hormogaster, p. 256.
    - XVII. Clitellum on Somites . . .
      - XIV—XVII. Setæ
        - Separate; prostomium dovetailed into peristomium . . . . Rhododrilus, p. 245.
        - In couples; prostomium not dovetailed . . . .
          - One pair of sperm-sacs Typhæus, p. 223.
          - Two pairs of sperm-sacs Digaster, p. 227.
      - XIV—XVIII . . . Setæ in couples; prostomium dovetailed Eudrilus, p. 241.
      - XIII—XVII . . . Lobed prostates; one pair . . . . . Microscolex, p. 244.
      - XIII—XX . . . Tubular prostates; two pairs, XVIII, XIX Dichogaster, p. 227.
    - XVIII. Prostates
      - Two pairs, in Somites XVII and XIX. Male pores
        - In deep fossa . . . Trigaster, p. 231.
        - Not in a fossa . . . Acanthodrilus, p. 229.
      - One pair, in XVIII. Clitellum on Somites . . . .
        - XIII—XVII. Prostomium . . .
          - Dovetailed into peristomium. Prostate
            - Convoluted Pontodrilus, p. 243.
            - Lobate . . Cryptodrilus, p. 224.
          - Not dovetailed . . . . Photodrilus, p. 244.
        - (XIII) XIV—XVII. Prostomium . . Dovetailed into peristomium; setæ separate Plutellus, p. 245.
        - XIV—XVIII. Prostomium . . .
          - Dovetailed slightly into peristomium; setæ equidistant . . . . Didymogaster, p. 225.
          - Not dovetailed; setæ in couples. . . . . Perissogaster, p. 226.
        - XIII—XXI (or more). . . . . Megascolides, p. 223.
      - None . . . . . Clitellum XVI—XXI . . . . . Brachydrilus, p. 256.
    - XVIII/XIX. Prostomium . . .
      - Broad; setæ simple . . . . Geoscolex (clitellum XV—XXIII), p. 249.
      - Elongated, narrow; setæ ornamented . Rhinodrilus (clitellum XV—XXV; tubercula pubertatis), p. 253.
    - XIX . . . . .
      - Paired; clitellum X—XXV . . . . . Microchæta, p. 254.
      - Median; clitellum XIV—XVII. . . . Teleudrilus, p. 243.
    - XX . . . . . Clitellum XIV—XXV . . . . Urobenus, p. 255.

VI. Phylogeny.

I will now endeavour to trace the phylogeny of the group of earthworms, but owing to the scanty information as to their ontogeny, it is impossible to found anything like a true phylogenetic tree.

First of all it will be desirable to say a few words as to what may be considered "primitive characters," as two widely different families have been regarded as the more primitive, viz. Perichæta by Beddard, and Acanthodrilus by Rosa. I hope to be able to bring forward sufficient reason for denying to either of them an archaic condition.

The excretory system, the setæ, clitellum, prostate, and sperm-ducts may be taken as the more important characters.

The Excretory System.—The recent researches of Beddard and Spencer have resulted in the conclusion that the network of tubules is a more primitive state than the large nephridia; that, in fact, the latter have been derived in some way from the former.

In Megascolides the excretory system in the anterior region of the body consists in a network of delicate tubules, with numerous external apertures, but without cœlomic funnels. Further back, one of these tubules on each side increases in size, and the network diminishes in extent; whilst in the somites quite posteriorly there is on each side a large tubule, which possesses a cœlomic funnel, and which still retains its connection with the network. Spencer regards the anterior plectonephric condition as more primitive, and differs from Beddard in considering the nephridial funnels as new structures, and not as derivatives of the flame-cells of Platyhelmia. It is to be noticed that the modification begins in the posterior somites, whilst the anterior part of the body still retains a primitive condition.

Other instances of the co-existence of large nephridia with the network of tubules have already been given.

In Perichæta we have certainly a primitive condition, but more modified than in Megascolides, in that, at any rate in some species, the plectonephric tubules are provided with funnels, and in others co-exist with large nephridia.[1]

2. The Setæ.—Beddard considers the perichætous condition as antecedent to the octochætous. Now, I believe we have ample evidence that the reverse is the case. Firstly, it is a nearly universal character of the Chætopoda that the setæ are in two bundles on each side of each somite; in the Polychæta there are many setæ in each group, in the Oligochæta only a few, and in a very large number of cases only two. In the Archi-annelida setæ may be absent or only in one bundle on each side in each segment, but it is not unlikely that this group contains degenerate and not primitive forms.

In Perichæta itself it is very usual to find fewer setæ on the anterior somites than posteriorly. Unfortunately, as far as I am aware, we are not in possession of actual details as to the mode of development of the setæ in this genus. But if the modification of nephridia in Megascolides commences posteriorly and works forward, may we not assume that the same has happened in the case of the setæ of Perichæta or Perionyx? If this were so, we should expect to find just what is actually existent, fewer setæ anteriorly, i. e. less modification than posteriorly where greater modification has taken place.

In some of the species (P. attenuata and P. enormis) described by Fletcher ('Proc. Linn. Soc. N.S.W.,' vol. v, 1888) there are only eight setæ in four couples in the first few somites; then twelve in some of the following somites; and posteriorly they become more numerous. In P. dorsalis, only 16 at first, more posteriorly 30. In P. monticolla, only 16 per somite on first few rings, increasing to 27 about clitellar region, and behind to 50.

Again, in Urochæta and in Geoscolex the setæ are arranged

[1] For a discussion of the subject see Baldwin Spencer's monograph on Megascolides, and Beddard's papers in 'Quart. Journ. Micr. Sci.,' xxviii and xxix.

normally—i.e. in couples—anteriorly, but become separated posteriorly, or even, in Urochæta, alternate from somite to somite. That is, according to my view, modification has commenced posteriorly, but has not affected the whole of the body; whilst in Diachæta this change has extended all along the worm.[1]

The perichætous condition, according to my view, has arisen firstly by the separation of the individual setæ, originally in couples, so as to produce eight equidistant setæ (as in species of Acanthodrilus, in Plutellus, and Allolobophora boeckii); and then intermediate setæ have appeared gradually filling up the spaces, leading on through Deinodrilus with twelve, to Perichæta with 20—100 per somite. I conceive this intercalation of setæ to be effected by the gradual increase in length of the accessory setæ ("soies de remplacement" of Perrier), which are very usually found, one to each of the functional setæ in many, perhaps in all earthworms. Supposing all the accessory setæ of a somite became thus fully developed contemporaneously with the existent setæ, we should get a doubling of the setæ, i.e. sixteen per somite. Each of these would, later on, have an accessory seta, and these might develop into functional setæ, and so on, till we get the perichætous condition.

Mr. Beddard would regard the penial setæ in special sacs, found in many earthworms, as vestigial representatives of a perichætous condition. I would regard them, however, as secondary and as developed from ordinary accessory setæ, which if carried to a greater extent would lead to a perichætous condition. If we look upon the perichætous condition, then, in this light, the removal of Perionyx from its associations with Perichæta merely indicates that the condition has been developed twice, and independently; and if we

[1] In a new species, D. windlei, Beddard states that there are no setæ on the first five somites. Here the modification has gone further, and the setæ have disappeared altogether. Microchæta presents a somewhat similar case of disappearance of setæ and fusion of somites. This condition, of course, may have resulted also from a perichætous condition.

remember that the separation of the couples and that penial setæ are present in various genera and families, I think it is allowable to so regard it.

The Position of the Clitellum.—In the fresh-water worms (Microdrili) the clitellum is developed only during the breeding season, and around the somite carrying the male pore, or those immediately on each side of it. That is, the "intra-clitellian" condition is the more primitive.

Now, in Moniligaster sapphirinaoides the clitellum is on Somites x—xiii, and the male pores between Somites x and xi. The reason that it has not been observed in other species of this genus is very likely due to the fact that it is present only for a short period, during the actual breeding season.

When the male pores shifted backwards, as they have done in the rest of the earthworms, the clitellum probably accompanied them, giving rise to what Perrier called "lombriciens intra-clitelliens:" in some cases the extent of the clitellum is small, at other times it is great. But apparently in some cases—Perichæta, Acanthodrilus, &c.—whilst retaining its limited extent, it has not kept up its relative position, coming to lie in front of the male apertures; whilst in the family Lumbricidæ it is still further removed from its primitive position, and lies far behind the spermiducal pores.

The Sperm-ducts.—In the majority of the water-worms (except Lumbriculidæ) there is only one pair of sperm-ducts, and this I regard as the primitive condition—that is to say, when once the position of the genital glands had become fixed to definite somites, and the nephridia specialised for the purpose of conveying generative products to the exterior, there was only one pair serving as sperm-ducts, and one pair as oviducts; previously to this state of things of course we should get a less limited specialization; but from general considerations I believe one pair, and not two pairs (if so, why not three pairs or four pairs?), of sperm-ducts was the typical arrangement.

This condition is retained in Moniligaster, where, too, the ducts are limited in length, passing through only one septum, and have their external aperture more nearly in the position common to the majority of water-worms than in any other earthworm. The single pair of sperm-ducts (and testes) is retained in the family Geoscolecidæ, in which, too, we find the sperm-sacs occupying, as in Tubifex, several somites. In Typhæus, again, this primitive character is retained. The size of the ovisac in Moniligaster recalls the fact that the ova in water-worms after separation from the ovary push the septa back, and come to occupy several somites.

When a second pair of sperm-ducts appeared, each would have its separate external aperture; but (except in Perichæta stuarti, A. G. B.) the two pairs of apertures have disappeared; the two sperm-ducts become more or less fused together; and as in the case of setæ and nephridia this fusion commences posteriorly and gradually extends forwards. Thus in Acanthodrilus, and in Eudrilus and Megascolides, the two ducts remain separate till they join the prostate; in Microchæta they remain separate through several somites; finally, in Lumbricus and others, the two unite immediately behind the second rosette.

The Prostate.—In the majority of water-worms there is an enlargement of the sperm-duct near its pore, and this enlargement may have glandular walls; this condition is retained in Moniligaster barwelli. In the rest of the earthworms, when present, we have either (*a*) a diverticulum of the sperm-duct, (*b*) a single pair of sacs opening independently of the sperm-ducts, or (*c*) a couple of pairs of separate prostates. In all the prostatiferous earthworms except in Acanthodrilidæ we find either (*a*) or (*b*). Dichogaster has prostates of both varieties. No doubt the tubular prostates, as seen in these latter and in other genera, are more primitive than the branched prostates of Perichæta, the flattened condition seen in Cryptodrilus and Perionyx leading towards this.

Moniligaster barwelli is, in this matter, more primitive than the remainder of the earthworms, and closely resembles Stylaria in the condition of its prostate.

As I said above, we have practically no embryological data on which to found our theories as to "primitive" and "secondary" characters in the earthworms. But there is one organ on which we have definite information, and that is that the dorsal blood-vessel is in Criodrilus formed by the fusion of a double vessel. Now, in several earthworms we find this double condition of the vessel.

In Acanthodrilus multiporus and in Deinodrilus benhami there is a pair of dorsal vessels; in A. dissimilis this vessel is doubled in every somite, fusing at the septa: this condition is also present in the anterior somites of Microchæta rappi, and according to Beddard in Perichæta cœrulea (Pleurochæta moseleyi), and this seems to have been the chief reason, in addition to its plectonephric condition, for regarding Acanthodrilus as the more primitive genus.

In which worm are any of these organs retained in their most primitive condition? I think that Moniligaster supplies the answer in most points. The setæ, clitellum, spermducts, and prostate are all in agreement with the above-formulated conditions. The gizzard, too, is very different from what we find in other worms; its walls appear to be much less muscular than is usually the case; it is less marked, extends through several somites, and recalls the enlarged intestine of water-worms, with its wall only slightly thicker than the preceding œsophagus.[1]

Thus, on the whole, I am inclined to regard Moniligaster as the most primitive living earthworm, or rather as approaching most nearly to their original ancestor. At the

[1] I should add that the anterior gizzard mentioned by Perrier has not been found in any of the species recently described—seven by Bourne, one by Horst, one by Beddard; and it is probable that he mistook for gizzard a mere dilatation of œsophagus, as was the case in his description of Perionyx. Here he stated that the gizzard was in Somite XII; Rosa found here a swelling only, the true gizzard being in VII.

same time, in the condition of its excretory system and in the matter of the dorsal blood-vessel, Moniligaster is in a less primitive condition than many other worms, which, whilst advancing in respect of certain of their other organs, retain the primitive network of tubules more or less completely.

My idea as to the relation of the various families is as follows:—From some of the earlier "Limicolous" forms—Lumbricomorpha minora—the earthworms have been derived along two lines.[1] Along one branch (A) the more primitive plectonephric condition has been retained from some Platyhelminth ancestor of the whole Chætopoda. Along the other (B) this has been replaced by the meganephric condition more usually found in the group.

The Typhæidæ, having a single pair of prostates, stand at the end of the main branch of the first line (A); but from this line a branch has given rise to the Acanthodrilidæ, to which Dichogaster has some affinity.

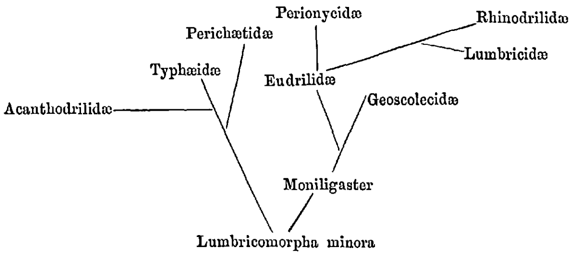
The Perichætidæ appear to have arisen from the Typhæid stem—from some form with flattened prostates, by multiplication of setæ. Deinodrilus, having a dozen setæ, would not necessarily be related to the Perichætidæ, but might point to the possibility of the development of a perichætous condition in the family Acanthodrilidæ.

The branch (B) leads through Moniligaster to the Geoscolecidæ, which retain the single pair of testes, &c., and exhibit amongst the genera stages in the separation of the setæ, but which have lost the prostate, a primitive character of the group. Springing from this branch is another, leading, after the appearance of the second pair of testes, &c., through the Eudrilidæ to the Perionycidæ.

The loss of prostates and the extension of the clitellum gives us a new line leading to Rhinodrilidæ, which, through Hormogaster, presents some affinity to the Lumbricidæ.

[1] It is quite possible, of course, that earthworms have not been derived from water-worms; the latter may have been developed from earthworms, but I think the evidence is in favour of the statement in the text.

Indeed, Hormogaster might perhaps be included in the latter family but for the existence of only two pairs of sperm-sacs.



I would here record my thanks to Professor Lankester for his help and advice on many points during the progress of this paper.

Postscript, April 30th.

While this paper was in the press, I received from Dr. Michaelsen his recently published memoir[1] describing two new species and six new genera from the neighbourhood of Zanzibar.

The two new species are Trigaster stuhlmanni and T. affinis, which are evidently very closely similar. He suggests, with good reason I think, the removal of Horst's species Acanthodrilus schlegelii, A. büttikoferi, and A. beddardi, as well as Rosa's A. scioanus, from the genus under which they have been placed in the present paper to my genus Trigaster (= Benhamia, Mich.), since the male pores are

[1] "Beschreibung d. v. H. Dr. F. Stuhlmann im Mündungsgebiet des Sambesi gesammelten Terricolen," 'Jahrb. d. hamburg. wiss. Anstalten,' vii, 1890.

placed in a deep median fossa, and with the exception of T. schlegelii they each have two gizzards. It is to be regretted that the "law of priority" is so frequently disregarded. The name Trigaster, though losing its structural significance, has every right to be retained as a generic title. The new genera appear to belong to my family Eudrilidæ with one exception; but it is a pity that more figures, in illustration of the very curious arrangement of the genital system in some of these, have not been given. I have diagrammatised four of these genera.

1. Pygmæodrilus.

Setæ in four couples.

Clitellum complete, round Somites XIV, XV, XVI.

Male pores paired on Somite XVII.

Nephridiopores in front of the outer couples of setæ.

The male apparatus resembles that of Eudrilus, but the female system is not aberrant [for further characters see fig. 33].

Species.—P. quilimanensis; from Quilimane.

2. Eudriloides.

Setæ in four couples.

Clitellum complete, on Somites XIV to XVIII.

Male pore single, median, on Somite XVII.

Spermathecal pore single, median, between Somites XIII/XIV.

There is no direct communication between oviduct and spermatheca.

Penial setæ and dorsal pores are present.

The details given are insufficient to diagrammatise.

Species.—E. parvus and E. gypsatus.

3. Nemertodrilus.

Setæ in four couples.

Clitellum on Somites XIII to XVIII.

Male pores paired between Somites XVII/XVIII.

"Spermathecal" (?) pores paired on Somite XIII.

Ovipores on Somite xiv.

Nephridiopores in line with inner couples of setæ.

No penial setæ.

The septa, xiii/xiv and xii/xiii, are fused together except below the intestine, so that Somite xiii is almost obliterated.

There is a connection between the oviduct and "spermatheca" of each side; in fact, the so-called spermatheca appear to be a greatly elongated ovisac, which has, as Michaelsen suggests, taken on the function of spermatheca (see Polytoreutes). Apart from this the genus somewhat resembles Rhododrilus.

Species.—N. griseus.

4. Callidrilus.

Setæ in four couples.

Clitellum only developed ventrally on Somites xvii to xxi.

Male pores paired on Somite xvii.

Spermathecal pores numerous, between Somites xiii/xiv.

Ovipores on Somite xiv.

Nephridiopores in line with inner couple of setæ.

Numerous paired copulatory pits are present on Somites xi to xxiv.

Spermathecæ in the form of small sacs; a dozen in anterior of Somite xiv [cf. Brachydrilus].

Species.—C. scrobifer.

5. Polytoreutes.

Setæ separate, eight.

Clitellum on Somites xiii to xviii.

Male pore median on Somite xvii.

"Spermathecal" pore median, single, on Somite xix.

Ovipores paired on Somite xiv.

No penial setæ.

Each prostate is very long, and provided with two rows of small contiguous diverticula along its whole length. The two prostates unite on Somite xvii. The "spermatheca" is a median sac passing forwards from its pore in Somite xix to

Somite XIV, where it divides into two short processes, one to each oviduct. In Somites XVI and XVIII there are long, paired, blind processes from the spermatheca. These remind one of the elongated ovisacs of the water-worms. This is the only form known with spermathecal aperture behind the male pore, and it appears to me to be doubtful whether this sac is homologous with the spermatheca of the ordinary type. Michaelsen makes no statement as to its contents. It may be, though he gives no grounds for this supposition, that the oviducts are in a state of degeneration, and that the "spermatheca" serves as an enlarged ovisac, in which perhaps the ova are fertilised and retained during development. In fact, the worm may be oviparous.

Species.—P. cœruleus.

6. Stuhlmannia.

Setæ four couples.

Clitellum on Somites XIV to XVII.

Male pore median in Somite XVII.

Spermathecal pore median, single, in Somite XIII.

Ovipores in Somite XIV.

Two long prostates extending from Somites XVII to XXIV, and uniting in XVII.

Median spermatheca; from its proximal end a pair of outgrowths surround the intestine and meet dorsally.

Oviducts communicate with the spermatheca.

These structures are so complicated, and so brief a description of them is given, that I have not attempted to construct a diagram.

Species.—S. variabilis.

Of these six genera, all but one—viz. Callidrilus—are probably referable to the family Eudrilidæ, mihi. The exception appears to belong to the family Rhinodrilidæ, mihi, although it presents one or two points in which it does not agree with my diagnosis of the family, e.g. position of male pore and of nephridiopores. Michaelsen gives no details as to the structure of what he called "prostate," and it may very likely be merely a thickening of the body-wall. If it be a prostate, then Callidrilus, like the rest, will belong to Eudrilidæ; but even here it will form an exception to the general characters of the family in the position of the clitellum, and in the character of the nephridia and spermathecæ.

The chief point in which Pygmæodrilus approaches Eudrilus is in the possession of elongated prostates, and of a penis within a "bursa." The muscular part of the sperm-duct very probably corresponds to a portion of the prostate of Eudrilus, in which the duct enters the prostate some distance along its length.

Polytoreutes and Stuhlmannia present so many abnormal characters that it is desirable that we should have more detail before deciding on their affinities. Apparently they are most nearly related to Teleudrilus.

VII. Explanation of Diagrams.

These diagrams, representing the genital, alimentary, and excretory systems of the genera recognised in the accompanying paper, have been constructed in most cases from drawings published by the various authors mentioned below, or, where no figures have been given, from the descriptions of the different worms. I have usually selected those species which have been most fully and most recently described, as types of the genera. It must be borne in mind that the accompanying figures are merely diagrams, and are not accurate copies from previous figures. I have arranged them in the same order as that in which the genera have been described in the body of the paper, and the numbering of the figures agrees with the numbering of the genera.

In every case the clitellum, if it occurs within the first twenty somites, is indicated by the thickened boundary of the diagram. In all cases the upper figure (*a*) represents genital system; the middle (*b*), alimentary and excretory systems; the lowermost figure (*c*), a few somites seen externally.

In the diagrams of the genital system the testes and ovaries are in black, the genital ducts in outline, the sperm-sacs and ovisacs are dotted; the spermathecæ are outlined; and the prostate and sac with penial setæ are also represented in outline.

In the alimentary canal, the extent of the buccal cavity as represented is not intended to indicate the actual extent, as we have no sufficient data for determining this point; hence the position of the commencement of pharynx is hypothetical; but its posterior limit is true in most cases, although in many genera this point is left vague in the drawings and descriptions of authors: the limit here assigned is, in these cases, deduced from analogy with better known genera. The gizzard is indicated by its thicker outline, and by the transverse line in front and behind it.

In the excretory system the black dots represent the funnels, the thicker line the "duct," and the narrow wavy line the coiled tube: there is no attempt to indicate the arrangement of this coil. In the "plectonephric" genera the short lines are intended to indicate the passage of the duct through the body-wall to the exterior. The external openings are shown in the lowermost diagram as small circles,[1] the setæ as short lines, and any genital apertures as black dots. In cases where the nephridiopores are not indicated their arrangement is not known.

The representation of the excretory system is purely conventional, especially in forms with "tufts" or network, and merely serves to indicate whether the genus is "plectonephric" or "meganephric," and in the latter case whether the duct is "simple" or "cæcal."

The modification of the anterior nephridia or excretory network to serve to moisten the food, and act as "pepto-nephridia," is indicated.

The diagrams represent the worms slit open along the middle line of the dorsal surface, and cut edges of the body-wall pinned aside.

[1] Unfortunately the "process" has in many cases not reproduced the circle, so that the nephridiopores appear as small black dots. The index lines, too, are often not reproduced.

Family I.—TYPHÆIDÆ.

FIG. 1.—Typhæus. The drawings, both the alimentary and the genital systems, are taken from the descriptions and figures of T. gammii by Beddard, 'Quart. Journ. Micr. Sci.,' xxix, p. 111, and pl. xii.

In fig. 1 *a*, the small sac (PS.) in Somite XVII represents the special sac with penial setæ, the external aperture of which is shown in fig. 1 *c*, in front of the male pore on each side, which is indicated by the large black dot. PRO. is the prostate, which joins the sperm-duct before the latter opens externally. The outlined structures in Somite VIII are the spermathecæ.

In fig. 1 *b*, the gizzard is shown in Somite VII; the calciferous diverticula in Somite XII (Ca.). The sacculated intestine commences in Somite XVI. EPN. is the extra-buccal pepto-nephridial network, which is shown in thicker lines than the remaining network.

Fig. 1 *c*, represents Somites XVI, XVII, and XVIII seen externally, when flattened out; showing the arrangement of the setæ, the numerous nephridiopores (as small dots), the penial setæ in Somite XVII replacing the ordinary setæ; and behind these the large black dots indicate the male pores.

Distribution of the genus: India.

FIG. 2.—Megascolides. Modified from the drawings of M. australis, McCoy, given by Baldwin Spencer in 'Trans. Roy. Soc. Victoria,' vol. i, pl. i.

In fig. 2 *a*, the four pairs of lobed, dotted structures marked S., in Somites XI, XII, XIII, and XIV, represent the sperm-sacs. PRO. is the coiled prostate.

In fig. 2 *b*, the plectonephric condition is seen, the network in Somites I to IV communicates with the pharynx by small ducts, and forms an "intra-buccal pepto-nephridial network" (IPN.). G. is the gizzard in Somite V. In Somites XII to XVIII the pouched intestine is shown (PP.), the sacculated, non-typhlosolar intestine commencing in the next somite.

Fig. 2 *c*, represents Somites XVII, XVIII, and XIX externally, showing setæ, nephridiopores, and the male pores which are in XVIII.

Distribution of the genus: Australia.

FIG. 3.—Cryptodrilus. *a*. Genital system, modified from the figure of C. fletcheri, given by Beddard in 'Proc. Zool. Soc.,' 1887, p, 547. PRO., the prostate. *b*. Alimentary system, composed from Beddard's description of C. fletcheri in 'Proc. Zool. Soc.,' 1887, and from. Fletcher's description of various species in 'Proc. Linn. Soc. N.S.W.'

The gizzard occupies two somites. CA. The first of the four calciferous diverticula on each side. The sacculated intestine commences in Somite XVI.

The plectonephridia are not continuous from somite to somite.

Fig. 2 *c*, represents any three somites behind the male pores, showing the setæ: the nephridiopores are probably numerous and irregular.

Distribution: Australia.

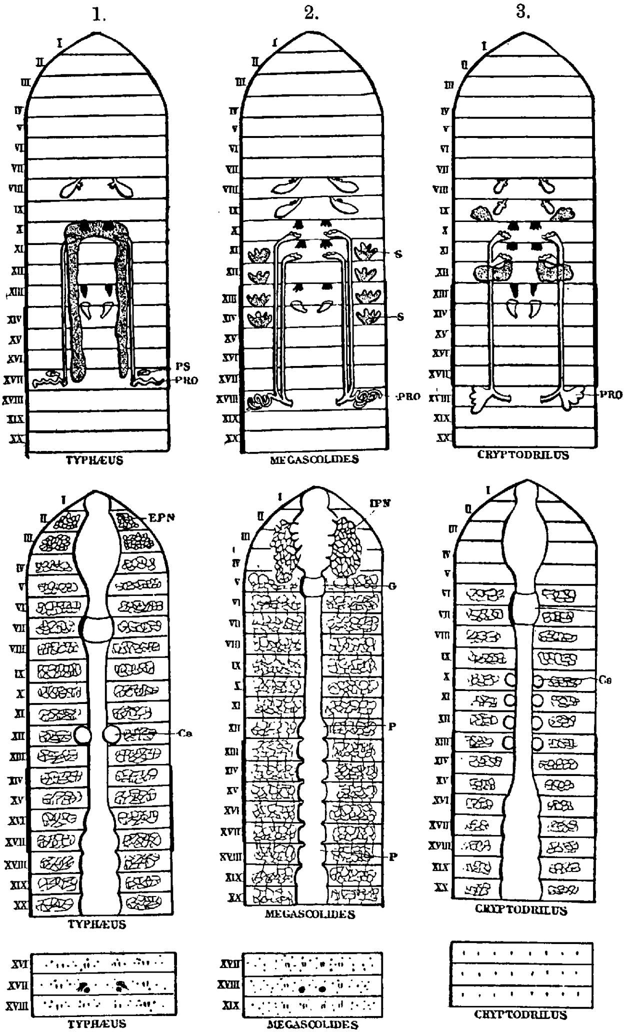

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FIG. 4.—Didymogaster. *a*. Genital system. The clitellum, XIV to XVIII. SP.[1], SP.[3], are the first and third spermathecæ. S. The digitate sperm-sac of Somite IX. PS. The sac of penial setæ; and PRO., the prostate. *b*. Alimentary system. G.[1], G.[2] The two gizzards lying in Somites VI and VII. Both diagrams modified from Fletcher's figures of D. sylvaticus in 'Proc. Linn. Soc. N.S.W.,' i (2nd ser.), 1886. *c*. represents three somites from any part of the body, and shows the arrangement of the setæ; the nephridiopores are probably, as in other plectonephric genera, numerous.

Distribution: Australia.

FIG. 5.—Perissogaster. *a*. Genital system. PS. Sac with penial setæ. PRO. The unequally lobed prostate. *b*. Alimentary system. G.[1], G.[2], G.[3] The three gizzards. D. The first dilatation of the intestine in Somite IX, followed by five others, all of which are doubtfully calciferous. S. The commencement of the sacculated intestine in Somite XV. *c*. shows the arrangement of the setæ. Constructed from the description given by Fletcher for P. excavatus in 'Proc. Linn. Soc. N.S.W.,' vol. ii, ser. 2, 1887.

Distribution: Australia.

FIG. 6.—Dichogaster. *a*. Genital system. PRO.[1] The first prostate, communicating with the sperm-duct. PRO.[2] and PRO.[3] The second and third prostates, which are independent of the sperm-duct. *b*. Alimentary system. C.[1], C.[2] The two gizzards, each occupying two somites. *Ca*. The first of the three calciferous diverticula on each side. S. The commencement of the sacculated intestine. IPN. The intra-buccal peptonephridium with its duct. *c*. represents the Somites XVI, XVII, and XVIII externally. The large black dots in XVII are the male pores, those in XVIII the prostate pores of this somite. In these two and in Somite XIX the inner couples of setæ are absent. Modified from the figures given by Beddard for D. damonis in 'Quart. Journ. Micr. Sci.,' xxix, pls. xxiii, xxiv.

Distribution: Fiji.

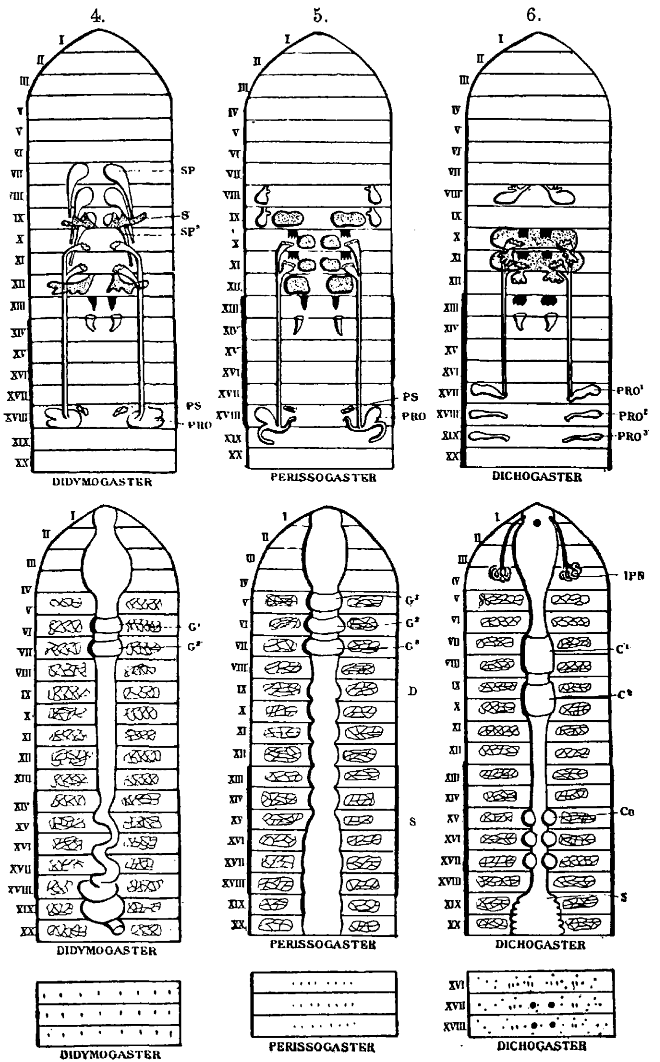
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FIG. 7.—Digaster. *a*. Genital system. PS.[1] The anterior sac with penial setæ. The posterior sac, which is described as lying in this somite, is omitted to prevent crowding. PRO. Prostate. *b*. Alimentary system. G.[1], G.[2] The two gizzards lying in Somites V and VII. The intra-buccal pepto-nephridia are indicated at IPN. *c*. The exterior of Somites XVII, XVIII, and XIX to show the setæ; male pores represented by black dots, and the openings of the two pairs of sacs with penial setæ, PS.[1], PS.[2], lying one in front of the other.

Modified from the figures of D. lumbricoides given by Perrier in 'Nouv. Arch. du Mus. d'Hist. Nat. de Paris,' viii, 1872, pl. ii; the modifications being in accordance with Fletcher's description of D. armifera in 'Proc. Linn. Soc. N.S.W.,' vol. i, p. 943.

Distribution: Australia.

Family II.—ACANTHODRILIDÆ.

FIG. 8.—Acanthodrilus. *a*. Genital system. Modified from Beddard's figure of A. dissimilis in 'Proc. Zool. Soc.,' 1887, p. 388, in accordance with his more recent observations in regard to the independent opening of sperm-duct and prostates. PS.[1], PS.[2] The sacs of penial setæ in Somites XVII and XVIII. PRO.[1], PRO.[2] The prostates in Somites XVII and XVIII. *b*. Alimentary system.

Modified from Beddard's figure of A. multiporus in 'Proc. Zool. Soc.,' 1885, pl. liii. *Ca*. The first pair of calciferous diverticula. S. Commencement of sacculated intestine in Somite XVI. IPN. Intra-buccal pepto-nephridia. The grouping of the nephridial network so as to form eight groups, six of which only are represented, is indicated in Somites XVI, et seq. See Beddard, 'Proc. Zool. Soc.,' 1885. The clitellum in A. dissimilis and A. multiporus commences in Somite XII. I have represented it as beginning at Somite XIII, which appears to be more usually the case. *c*. External view of two Somites, A, B, of A. multiporus, and others in which the eight setæ are separate. C, somite of A. novæ-zealandiæ, and other species in which the setæ are in couples.

Distribution: New Zealand, Australia, West Africa, New Caledonia, Kerguelen Island, the shores of Magellan Strait.

FIG. 9.—Trigaster. *a*. Genital system. SP. Spermathecæ. O. Ovary. PRO.[1], PRO.[2] The prostates. Sperm-ducts, sperm-sacs, and testes unknown.[1] *b*. Alimentary system. Slightly altered from my own figures of T. lankesteri in 'Quart. Journ. Micr. Sci.,' xxvii, pl. ix, after a renewed examination as to the position of some of the structures.

G.[1], G.[2], G.[3] The three gizzards. S. Commencement of sacculated intestine. The anterior nephridial network is more evident than that more posteriorly, but it is uncertain whether there is any communication with the pharynx. *c*. Three somites seen externally to show the arrangement of the setæ.

Distribution: St. Thomas, West Indies.

[1] Michaelsen, however, has in his last paper described the testes and ciliated rosettes in Somites X and XI, and sperm-sacs in Somites XI and XII.

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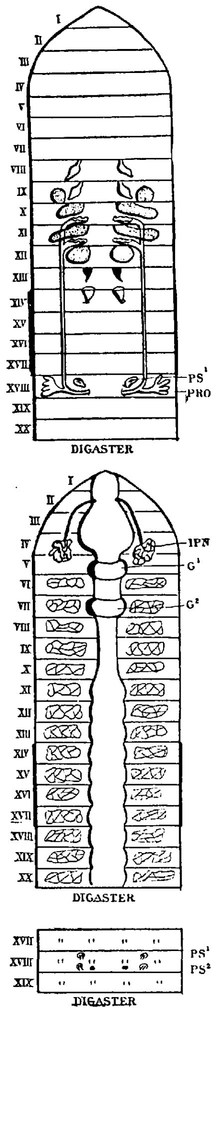
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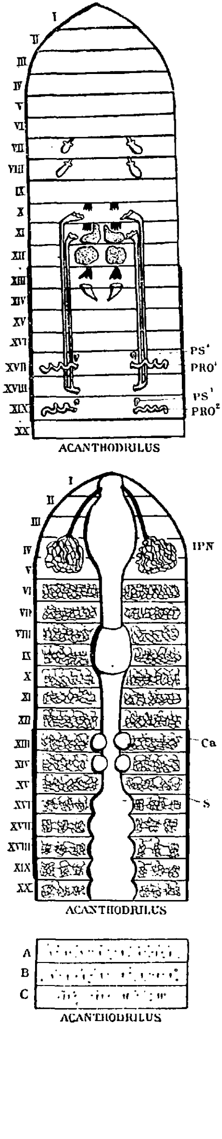
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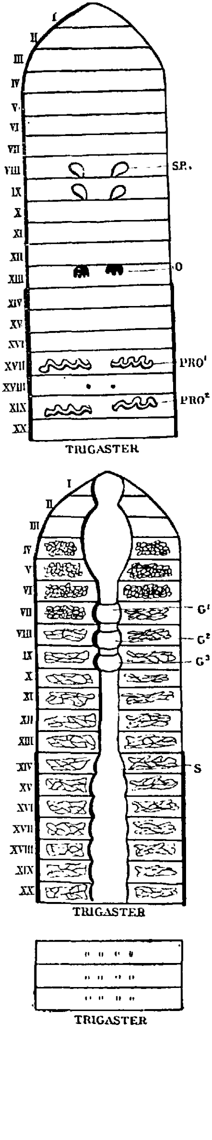
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FIG. 10.—Deinodrilus. *a.* Genital system. SP. Anterior spermatheca. PRO.[1], PRO.[2] The two prostates of one side. *b.*[1] Alimentary system. G. Gizzard occupying two somites. EPN. The extra-buccal pepto-nephridia. A connection exists here and there between the nephridial network of neighbouring somites. Beddard says but little of the alimentary canal or the nephridia, but special groups (EPN.) of the latter occur in Somites II, III, and IV. *c.* Exterior of these somites, showing the characteristic twelve setæ and numerous nephridiopores. Constructed from Beddard's description of D. benhami in 'Quart. Journ. Micr. Sci.,' xxix, p. 105.

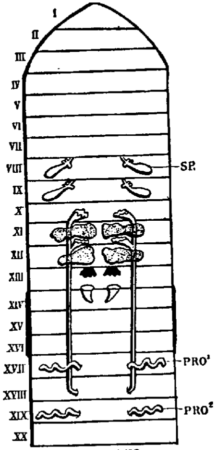
Distribution: New Zealand.

Family III.—PERICHÆTIDÆ.

FIG. 11.—Perichæta. *a.* Genital system. Modified from Rosa's figure of P. feæ in 'Ann. Mus. Civico d. Stor. Nat. di Genova,' vi, 1888, pl. iii. *b.* Alimentary system. G. Gizzard, occupying more or less of three somites. P. The first, and P.[1] the last, of the thirteen pouches. Nine somites are cut away, as they are merely a repetition of these pouches. C. The characteristic cylindrical cæcum of one side. [These are absent in some species.] S. The commencement of the sacculated, typhlosolar intestine. Composed partly from Perrier's and Rosa's description. The excretory system is taken from Beddard's figure of P. aspergillum in 'Quart. Journ. Micr. Sci.,' xxix, pl. xxiv. The black dots represent the funnels of the nephridial network. *c.* represents three somites from different regions of the body of P. monticolla, Fletcher, 'Proc. Linn. Soc. N.S.W.,' vol. ii. In Somite A, from anterior part of body, only sixteen setæ are present; in Somite B, from about Somite xv, there are thirty setæ, and posteriorly in Somite C fifty or more. This same variation in numbers occurs in other species. The nephridiopores (represented as small dots) are drawn from Beddard's description of P. aspergillum.

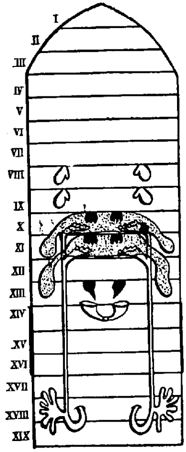
Distribution of the genus: India (with Ceylon), Malaya, Australia, and islands between the two continents.

10.

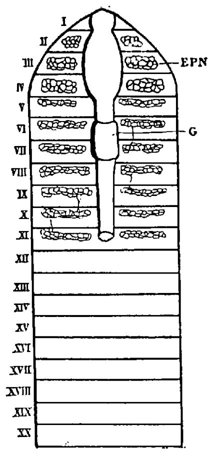


DEINODRILUS

11.



PERICHÆTA



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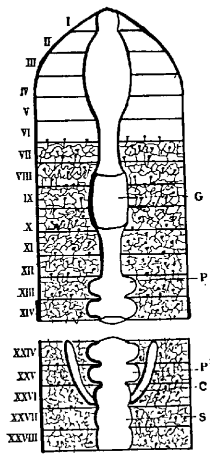
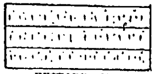


PERICHÆTA



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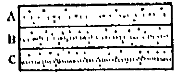


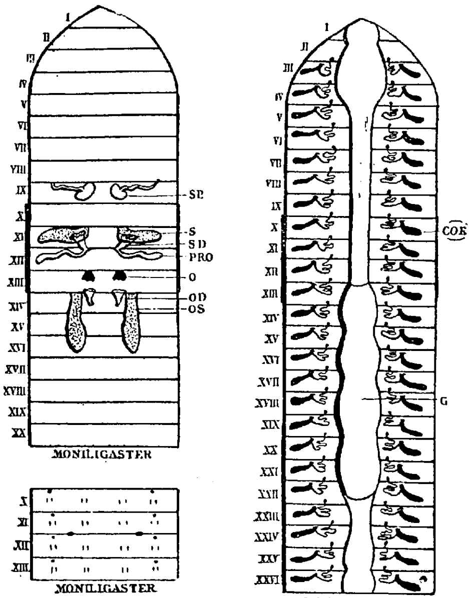
PERICHÆTA

Family IV.—Moniligastridæ.

Fig. 12.—Moniligaster. *a.* The left upper figure, genital system. Modified from Horst's figure of M. houteni in 'Notes from the Leyden Museum,' ix, pl. i, fig. 1, in accordance with Beddard's more recent figures and descriptions ('Quart. Journ. Micr. Sci.,' xxix, pl. xii, fig. 12; and 'Zool. Anz.,' No. 318, 1889). sp. Spermatheca, with its long duct, in Somite ix. These are the "anterior testes" of Perrier. s. Sperm-sacs—Perrier's "posterior testes." sd. Sperm-duct and ciliated rosette. pro. Prostate. *o.* Ovary. *od.* Oviduct. os. Ovisac. *b.* The right figure, alimentary system. Modified from Perrier's figure of M. deshayesii in 'Nouv. Arch. d. Mus. d'Hist. Nat.,' viii, 1872, in accordance with the more recent descriptions of Beddard, Horst, and Bourne, who have not observed Perrier's anterior gizzard. g. The characteristic elongated gizzard region. The nephridia are after Horst. cœ. The cæcum of the nephridial duct. *c.* The left lower figure, the exterior of Somites x to xiii—the region of the clitellum, showing the setæ, nephridiopores, and male pores, which lie between Somites xi and xii.

Distribution: India, Ceylon, Sumatra.

12.



MONILIGASTER

MONILIGASTER

MONILIGASTER

Family V.—EUDRILIDÆ.

FIG. 13.—Eudrilus. *a.* Genital system. Modified from Beddard's figure of E. sylvicola in 'Proc. Zool. Soc.,' 1887, p. 381, in accordance with his subsequent descriptions and figures of the female apparatus, which are peculiarly arranged.

It will be seen that the ovary (o^1.) in Somite XIII is enclosed in a sac, the neck of which communicates with the true oviduct (OD.); into the latter also open an albumen-gland (GL.), a large spermatheca (SP.), and the ovisac ($o.^2$),[1] which functions also as a second ovary, and lies in Somite XIV. PRO. is the prostate, into which the sperm-ducts open about halfway along its length. X. is one of two glands communicating with B.C., the bursa copulatrix, which contains a chitinous penis: the bursa opens externally at P. in XVII, a dotted ring[2] indicating the male pore. *b.* Alimentary system. Modified from Perrier's figure of E. decipiens in 'Nouv. Arch. Mus. d'Hist. Nat.,' viii, 1872, pl. ii, fig. 26, in accordance with Horst's more recent description in 'Notes from the Leyden Museum,' ix. G. The gizzard. CA. Calciferous diverticula. Commencement of the sacculated intestine in Somite XV. The nephridia are original; they present no cæcum, but the duct is continuous with the tubule as in Lumbricus. *c.* External view of a normal somite of E. decipiens, showing (A) setæ and nephridiopores; (B) Somite XVII of the same species, showing the male pores—as black oval dots—occupying the position of the inner couples of setæ, which are absent; (C) is a normal somite of E. sylvicola, in which the nephridiopores are in line with the inner couple of setæ, instead of with the outer couple, as in other species.

Distribution: South America and New Caledonia.

FIG. 14.—Teleudrilus. *a.* Genital system. Notice the peculiar recurved ciliated rosettes; the median position of the male pore in Somite XIX (represented as a dotted semicircle P.) and spermathecal pore in Somite XVII is peculiar.

The female organs present some difference from the typical arrangement, analogous to that in Eudrilus in that there is a connection between the oviduct and spermatheca, but a less direct communication in that genus. O. Ovary. OD. Oviduct. OS. Ovisac.[3] SP. Spermatheca. B.C. Bursa copulatrix, opening externally at P in XIX. It is in communication with the sperm-ducts, prostates (PRO.), and a sac (S.), probably glandular. *b.* Alimentary system. After Rosa's figures of T. raggazii in 'Ann. Mus. Civ. d. Stor. Nat. di Genova,' vi, 1888, pl. ix. G. Gizzard. CA. Calciferous diverticula. S. The commencement of sacculated intestine. *c.* represents the exterior of Somites XVIII, XIX, and XX, showing setæ, nephridiopores, and median male pore in Somite XIX.

Distribution: Scioa, Africa.

FIG. 15.—Pontodrilus. *a.* Genital system. PRO. Prostate. SP. Spermatheca. *b.* Alimentary system. Note absence of gizzard. S. Sacculated but non-typhlosolar intestine. Note: the nephridia do not commence till Somite XV. *c.* shows the exterior of Somites XVI, XVII, and XVIII, with setæ, nephridiopores, and male pores. After Perrier's figures for P. marionis in 'Arch. de Zool. Expér. et Gén.,' ix, 1881.

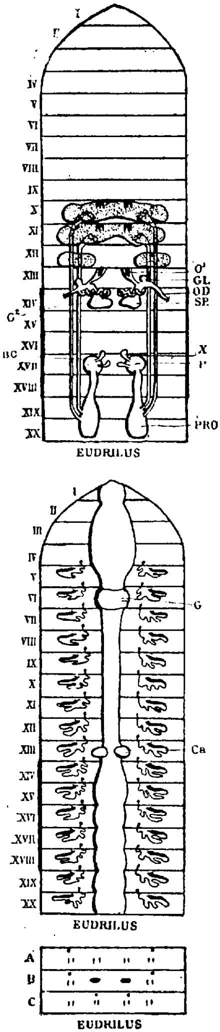
Distribution: Europe (France).

[1] The index line does not go quite far enough; it should extend to the small round sac at the end of the tortuous tube.

[2] This is very feebly indicated in the diagrams.

[3] The index line should extend to the round dotted area.

13.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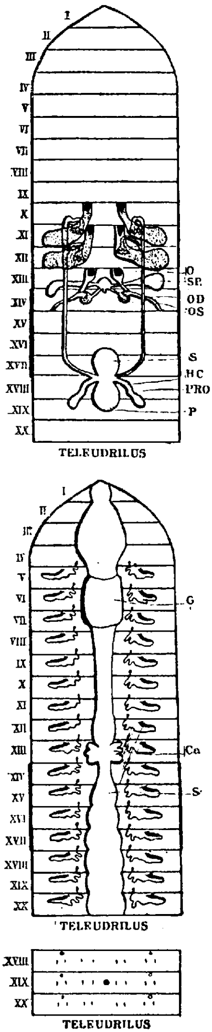
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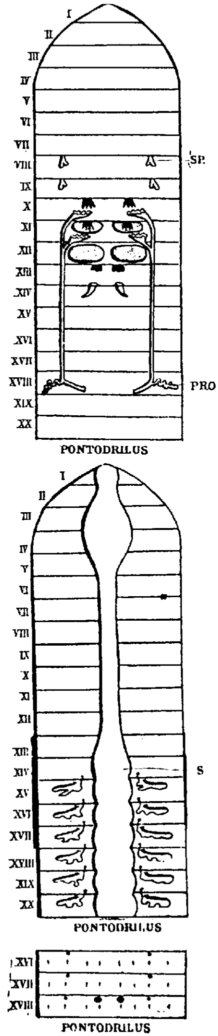
SP.
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PONTODRILUS
PONTODRILUS

FIG. 16.—Photodrilus. *a.* Genital system. SP. Spermatheca. PRO. Prostate. *b.* Alimentary system. Both diagrams are constructed from the description given by Giard for P. phosphoreus in 'Comptes rendus,' 1887. Here the nephridia do not commence till Somite XIV. Their pores are between the outer and inner couple of setæ as shown in fig. *c.*

Distribution : Europe (France).

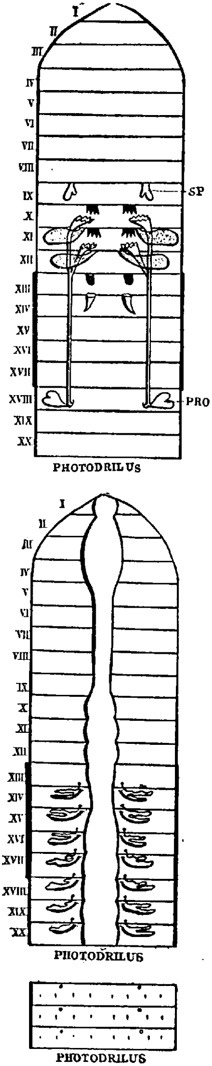
FIG. 17.—Microscolex. *a.* Genital system. PRO. Prostate. PS. Sac with penial setæ. *b.* Alimentary system. Constructed from Rosa's descriptions of M. modestus in 'Boll. Mus. Zool. ed Anat. Comp. Torino,' ii and iii. Although closely allied to the two preceding genera, the nephridia, as usual, commence far forwards. *c.*, taken from Rosa's woodcut, represents Somites XVI, XVII, XVIII. He does not state that the setæ are absent on this somite, but he does not figure them. The male pore is in line with the seta 1.

Distribution : Italy.

FIG. 18.—Rhododrilus. *a.* Genital system. SP. The first of the four spermathecæ on one side. PRO. Prostate opening independently of the sperm-duct. *b.* Alimentary system. G. Gizzard. S. Commencement of sacculated intestine. *c.* Exterior of three somites. Diagrams constructed from Beddard's brief diagnosis of R. minutus in 'Proc. Zool. Soc.,' 1889, p. 381.

Distribution : New Zealand.

16.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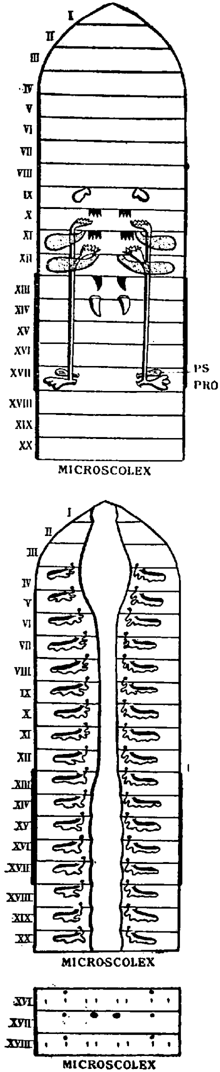
17.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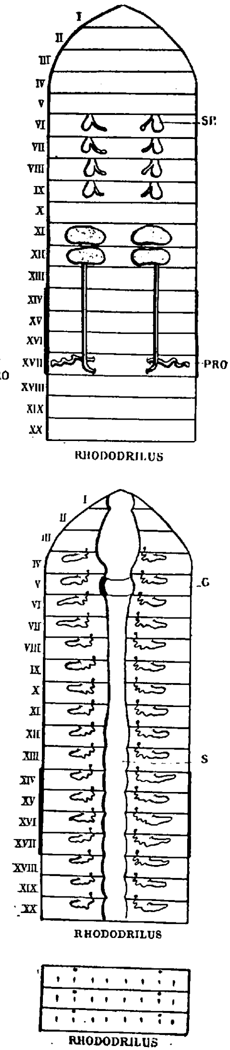
18.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RHODODRILUS

FIG. 19.—Plutellus. *a*. Genital system. The position of the genital organs is very abnormal, and requires confirmation. S. The sperm-sacs in Somite XII. SP. The first of the five spermathecæ. PRO. Prostate. The sperm-funnels and ducts are unknown. O. Ovary in Somite X; and OD., the oviduct opening externally in Somite XI. *b*. Alimentary system. G. Gizzard. ca. Calciferous diverticula. S. Commencement of sacculated intestine. The nephridia are shown alternating in position, the first four pores being in line with the third seta, the rest alternating with second and fourth setæ. Moreover, the funnels are said to be in the same somite as the coiled tubule and external aperture. N.[1] The first of the series of nephridia which open in line with the third seta. N.[2] The first of the series which open in line with the fourth seta. N.[3] The first of the series in line with second seta. *c*. An external view of Somite VI, to show spermathecal pore (black) in line with second seta, and nephridiopore (N[1]) in line with third seta; of Somite XII, to show the normal arrangement in the even numbered somites; and of Somite XIII, to show normal arrangement of the odd numbered somites. Composed from Perrier's description of P. heteroporus in 'Arch. de Zool. Expér. et Gén.,' ii, 1873, p. 331.

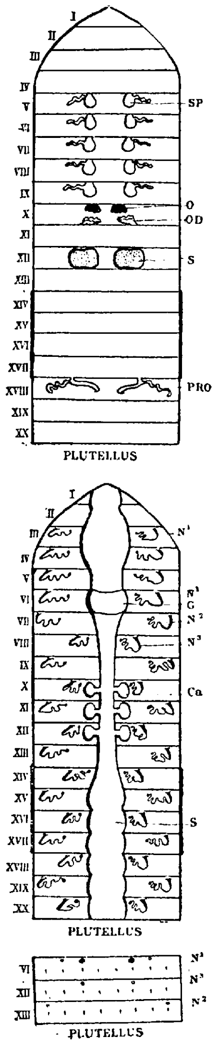
Distribution: Pennsylvania.

Family VI.—PERIONYCIDÆ.

FIG. 20.—Perionyx. *a*. Genital system. O. Ovary. OD. Oviduct. PRO. Prostate. *b*. Alimentary system. G. Gizzard. S. Commencement of sacculated intestine. Modified from Perrier's figures of P. excavatus in 'Nouv. Arch. d. Mus. d'Hist. Nat.,' 1872, in accordance with Rosa's description of the same species in 'Ann. Mus. Civ. d. St. Nat. di Genova,' vi, 1888. *c*. External view of three somites, showing the numerous setæ and the paired nephridiopores.

Distribution: India, Burmah, Philippines.

19.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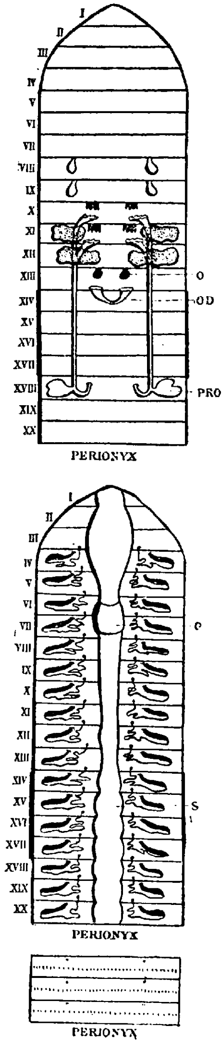
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Family VII.—GEOSCOLECIDÆ.

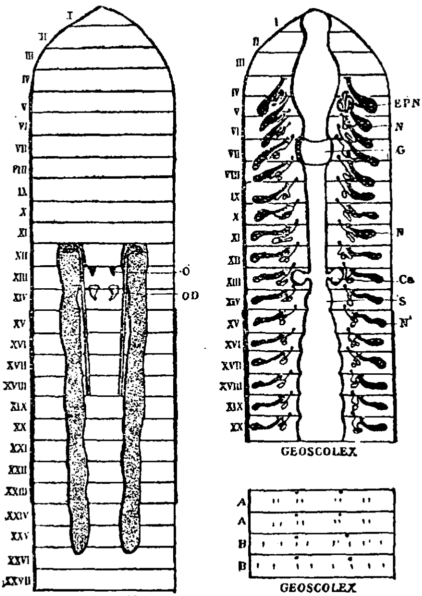
FIG. 21.—Geoscolex (Titanus). *a.* On the left genital system. O. Ovary. OD. Oviduct. No spermathecæ are known. Modified (in accordance with my own observations) from Perrier's figure of G. maximus, Leuckart (T. brasiliensis, E. P.), in Nouv. Arch. Mus. d'Hist. Nat.,' viii, 1872, pl. i, fig. 15. *b.* On the right alimentary system. G. Gizzard. ca. Calciferous diverticulum. S. Commencement of sacculated intestine. The first nephridium is slightly different from the rest, and forms an extra-buccal pepto-nephridium, EPN., the coiled tubule being more compact, and the cæcal part of the duct shorter. NN. The anterior nephridia, in which the tubule leaves the duct about halfway along its length. N.[1] The posterior nephridia, in which the tubule joins the cæcum near its external aperture. Composed from my own observations. *c.* Exterior of four somites: A.A. from the anterior part of the body, where the setæ are in couples; B.B. from the posterior region, where the setæ are separate.

Distribution: Brazil.

FIG. 22.—Urochæta. *a.* Genital system. Composed from Beddard's description in 'Quart. Journ. Micr. Sci.,' xxix, p. 246. SP. The first spermatheca. *b.* Alimentary system. G. Gizzard. ca. Calciferous gland. S. Commencement of the sacculated intestine. Composed from my own observations. The nephridia are modified from Perrier's figures of U. corethrura in 'Arch. Zool. Exp.,' iii, 1874. The first nephridium (EPN.) is much larger than the following ones, both the tubular portion and its duct being greatly developed; there are at least three funnels to this extra-buccal pepto-nephridium. *c.* View of four somites, namely, VI, XX, and two consecutive more posterior somites (PP.), in order to show the couples of setæ anteriorly, and the scattered and alternate arrangement of these posteriorly. In Somite XX, in which the spermiducal pore is situated but not shown, the ventralmost setæ (No. 1) are replaced by groups of larger penial setæ. After Beddard, 'Proc. Roy. Soc. Edinb.,' xiv, 1887, p. 162.

Distribution: South America and neighbouring islands also Australia, Sumatra.

21.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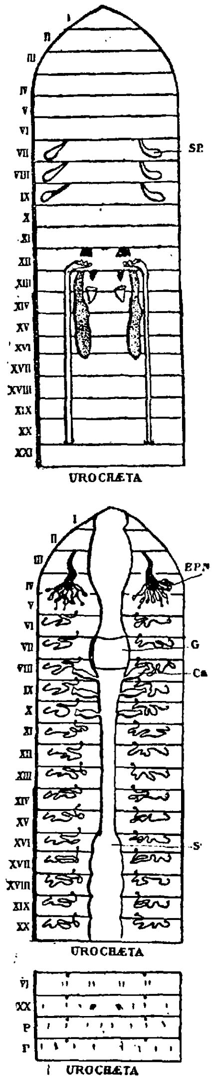
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FIG. 23.—Diachæta. *a*, *b*. Genital and alimentary systems. SP. Spermatheca. G. Gizzard. S. Commencement of acculated intestine. Modified from my own figures in 'Quart. Journ. Micr. Sci.,' xxvii. N. The normal nephridia commence, as in Urochæta, immediately behind the extra-buccal pepto-nephridium (EPN.). *c*. Somites XXI, XXII, XXIII, seen externally, showing the alternation of the setæ with exception of No. 1 on each side, the position of the nephridiopores (rings), and of the spermiducal pores, which are represented as black dots.

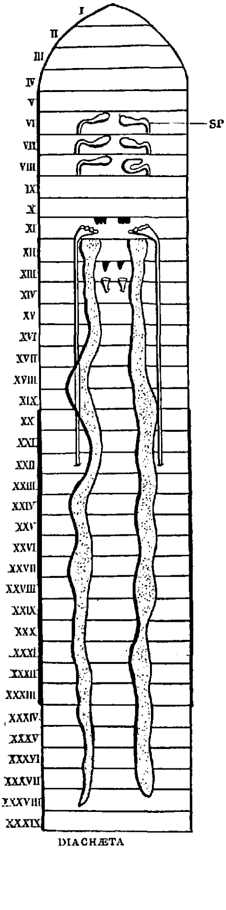
Distribution: St. Thomas, West Indies.

Family VIII.—RHINODRILIDÆ.

FIG. 24.—Rhinodrilus. *a*, *b*. Genital and alimentary systems and nephridia. Composed from my own observations on, and from Beddard's description of, R. (Thamnodrilus) gulielmus, 'Proc. Zool. Soc.,' 1887, p. 154. Following the greatly modified first or extra-buccal pepto-nephridium (EPN.) are seven pairs of nephridia (N.) which differ from the more posterior ones ($N.^1$) in Somite X in having no cæcal prolongation of the duct. CŒ. The cæcum of the posterior nephridia. SP. Spermathecæ. G. Gizzard. CA. The first calciferous diverticulum. S. Commencement of the sacculated intestine. *c*. External view of Somites XIX, XX, and XXI, to show setæ, nephridiopores, and intersegmental spermiducal pores.

Distribution: North of South America.

23.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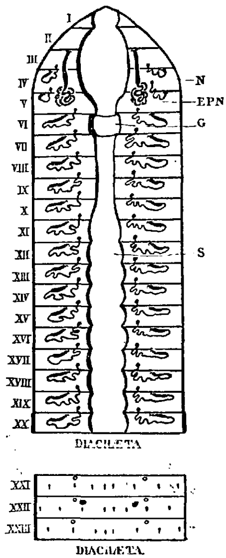
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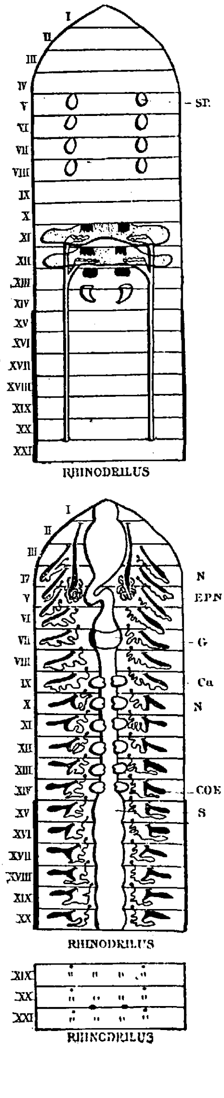
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FIG. 25.—Microchæta. *a, b.* Genital and alimentary systems and nephridia. Copied from my own figures of Microchæta rappi, 'Quart. Journ. Micr. Sci.,' xxvi, pl. XV. The cæcum of the nephridium is less marked in the anterior nephridia (N.). In the posterior nephridia (N.[1]), in Somite X, et seq., the cæcum (CŒ.) is very large. In *a*, O. is ovary; OD. oviduct; OS. ovisac; SP. the numerous small spermathecæ. As mentioned in the body of this paper, the peristomium in M. beddardi is provided with setæ, so that the ovaries and testes are morphologically in their normal position. In M. rappi, however, there is no trace of setæ in the peristomium, so that the gonads appear in one somite in advance of the normal position. In *b*, G. is the gizzard; ca. the calciferous diverticulum; S. the commencement of the sacculated intestine. In *c*, three normal somites are shown.

Distribution: Cape of Good Hope and Natal.

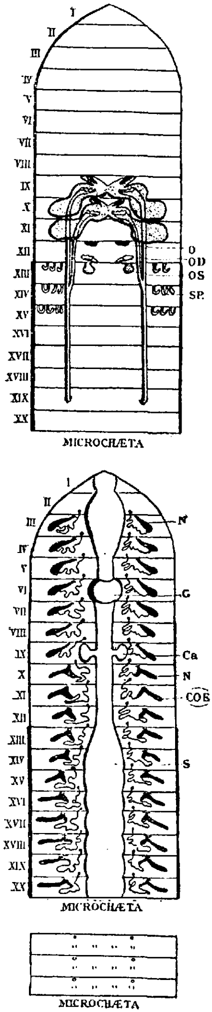
FIG. 26.—Urobenus. *a, b.* Genital and alimentary systems and nephridia. Copied from my own figures in 'Quart. Journ. Micr. Sci.,' xxvii, pl. viii. The anterior nephridia (N.N.) are larger than the following ones (N.[1]), and the cæcal portion (CÆ.) of the duct is less developed. In *a*, SP. marks the first spermatheca. In *b*, G. is the gizzard; ca. the first calciferous diverticulum; P. the first of the series of pouches of the intestines; P.[1] the last of the series,—the intermediate eight somites are removed; C. the peculiar cæcum in Somite XXVI, and S. the commencement of the sacculated intestine. *c* represents Somites XIX, XX, and XXI, to show the setæ, nephridiopores, and spermiducal pores.

Distribution: Brazil.

FIG. 27.—Hormogaster. *a, b.* Genital and alimentary systems and nephridia. Modified from Rosa's figures of H. redii in 'Sulla Struttura dello H. redii,' Torino, 1888. We have no information as to any variation of nephridia. SP. Spermatheca. OS. Ovisac. G.[1], G.[2], G.[3] The three gizzards. C. Globose cæcum in Somite XXI. Six somites are removed. *c* represents three ordinary somites.

Distribution: Italy.

25.



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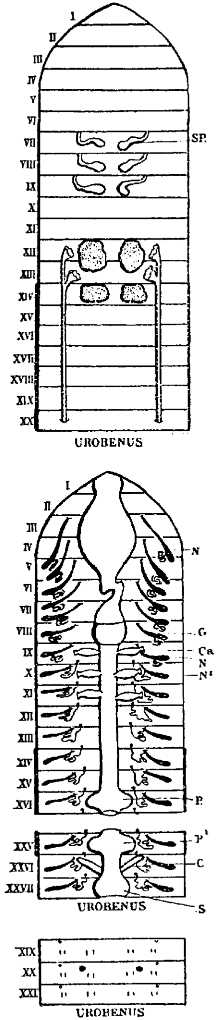

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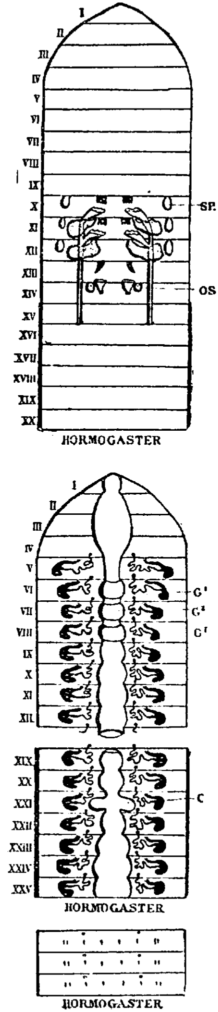

SP.
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G¹
G²
G³
C
HORMOGASTER
HORMOGASTER

Fig. 28.—Brachydrilus. *a, b.* Genital and alimentary systems. Original. See the description, 'Zool. Anzeig.,' 271, 1888. There are two pairs of nephridia which are very simple —IN. the inner nephridia; ON. the outer nephridia in every somite. In the Somites x and xi are four sacs on each side, which are not represented, as they lie underneath the sperm-sacs; these probably correspond to the "albumen-glands" of Lumbricus. I believe the same fusion of somites has gone on here as in Microchæta. In *a*, SP. is one of the small spermathecæ, which in position is abnormal. O. is the ovary. In *b*, G. is the gizzard. ca. Calciferous gland. S. Commencement of sacculated intestine. In *c*, the setæ and nephridiopores are shown.

Distribution: Unknown.

Family IX.—Lumbricidæ.

Fig. 29.—Lumbricus. *a, b.* Genital and alimentary systems. Original. See Hering, 'Zeit. f. wiss. Zool.,' viii, 1856, pl. xviii; Lankester (alimentary canal), 'Quart. Journ. Micr. Sci.,' 1865–6. In *a*, SP. the first spermatheca of one side. os. Ovisac. In *b*, G. is gizzard. PR. Proventriculus. S.[1] Commencement of sacculated intestine. ca. Calciferous glands, bilobed, one lobe in Somite xii, the other in Somite xi; these communicate with a pouch (CP.) which opens into the œsophagus in Somite xi. *c* shows the exterior of Somites xiv, xv, and xvi, with setæ, nephridiopores, oviducal pore in xiv, and spermiducal pore in xv (as black dots).

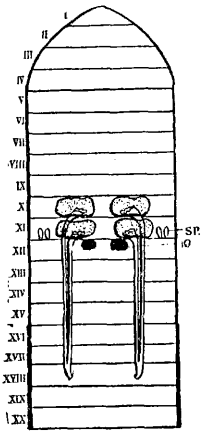
Distribution: Europe.

Fig. 30.—Allolobophora. *a.* Genital system. SP. Spermatheca: three pairs are shown, as is the case in A. chlorotica; in other species more, in others less than three pairs are present. os. Ovisac. Modified from Bergh's figure of A. turgida, 'Zeit. f. wiss. Zool.,' xliv, pl. xxi. *b.* Alimentary canal. G. Gizzard. PR. Proventriculus. ca. Calciferous gland in Somite xi, opening into the pouch (CP.). Original. *c.* External view of a somite from three different species: A. of A. chlorotica; B. of A. subrubicunda; and C. of A. boeckii.[1]

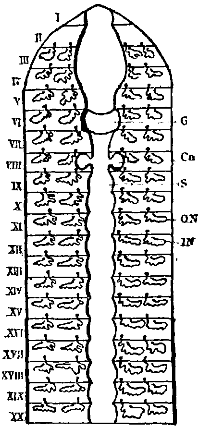
Distribution: Europe.

[1] The nephridipores are too feebly indicated.

28.



BRACHYDRILUS



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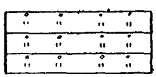

BRACHYDRILUS

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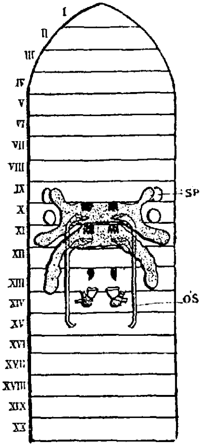
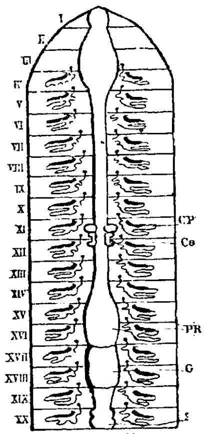


LUMBRICUS



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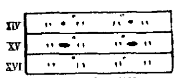

LUMBRICUS

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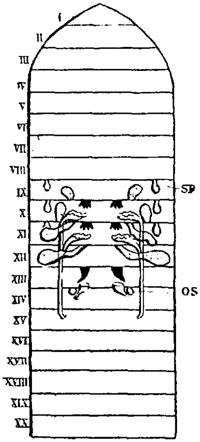
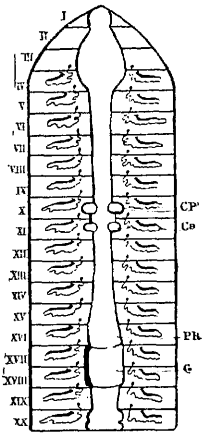


ALLOLOBOPHORA



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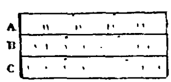


ALLOLOBOPHORA

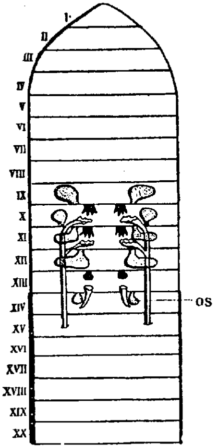
FIG. 31.—Criodrilus. *a, b.* Genital and alimentary systems. os. Ovisac. w. Thick-walled region of œsophagus. From my own figures, 'Quart. Journ. Micr. Sci.,' xxvii, pl. xxxviii. The nephridia, similar to those of Lumbricus, commence in Somite x.

Distribution: Europe.

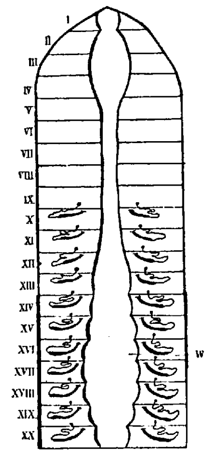
FIG. 32.—Allurus. *a.* Genital system. Modified from Beddard's figure, 'Quart. Journ. Micr. Sci.,' xxviii, pl. xxv, fig. 2. The small white circles (SP.) in Somite VIII represent certain microscopic spermathecæ according to Beddard, but no spermatozoa were found, and perhaps, from their abnormal position, they may be "albumen-glands." os. Ovisac. In *b*, G. Gizzard. s. Commencement of sacculated intestine. ca., ca. The first and last of the four calciferous glands. x. A pouch (? corresponds to the pouch [CP.] in Lumbricus). *b.* Alimentary system. Composed from Beddard's description, 'Quart. Journ. Micr. Sci.,' xxviii, p. 368.

Distribution: Europe.

31.



CRIODRILUS



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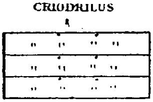
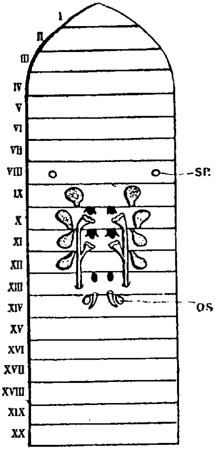
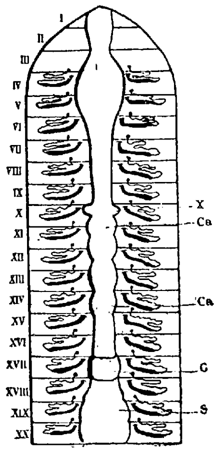


CRIODRILUS

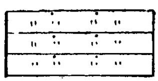
32.



ALLURUS



ALLURUS



ALLURUS

[The following figures are placed out of their proper place, as they have been constructed during the passage of the text through the press.]

FIG. 33.—Pygmœodrilus. *a.* Genital organs, partly from Michaelsen's figure of P. quilimanensis ['Jahrb. d. hamburgh wiss. Anstalten,' vii, 1890]. SP. Spermatheca, with its numerous diverticula. S. Sperm-sac. M. Muscular thickening of the sperm-duct. BC. Bursa copulatrix, which contains a penis. PRO. The lay prostate; the narrow portion is muscular, the distal region is glandular. *b.* Alimentary canal, from Michaelsen's description. ca. Calciferous diverticulum. There is some doubt experienced as to the existence of a gizzard. The nephridia are not described beyond the statement that there is a pair in each somite. *c.* Exterior of three somites, showing setæ in couples; the nephridiopores; and male pores in XVIIth Somite.

Distribution: Quilimane, near Zanzibar.

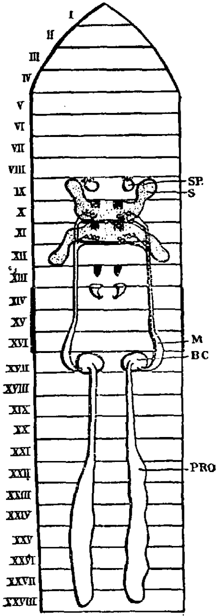
FIG. 34.—Nemertodrilus. *a.* Genital system, from Michaelsen's description of N. griseus in 'Jahrb. d. hamburg. wiss. Anstalten,' vii, 1890. s^1. Anterior sperm-sac. s^2. Greatly elongated posterior sperm-sac. os. Ovisac, which is prolonged backwards (os^1.) and is regarded by Michaelsen as "spermatheca." PRO. Prostate. *b.* Alimentary tract and nephridia, from Michaelsen's description. G. Gizzard. S. Commencement of sacculated intestine. No details as to nephridia are given, except that they are a pair to each somite, and have, apparently, a dilated "duct." *c.* Exterior of Somites XVI, XVII, and XVIII, to show the couple of setæ, nephridiopores, and male pores.

Distribution: Quilimane, Zanzibar.

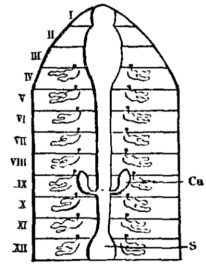
FIG. 35.—Callidrilus. From Michaelsen's description of C. scrobifer, in 'Jahrb. d. hamburg. wiss. Anstalten,' vii, 1890. *a.* Genital system. s. $s.^4$ The first and fourth sperm-sacs. SP. The numerous, small spermathecæ. X. is a structure which Michaelsen identifies as a prostate. He states that it is small, and from the general anatomy of the worm I fancy that it may be merely a thickening of the body, such as is present in Brachydrilus. *b.* Alimentary and excretory system. M. A thickening, which is, according to Michaelsen, not muscular. It probably represents a gizzard. S. Commencement of sacculated intestine. The nephridia are merely said to be paired, and to be provided with a bladder, which I take to mean a "cæcal" outgrowth of the duct. *c.* Exterior of Somites XVI, XVII, and XVIII, to show couples of setæ, nephridiopores, and male pores. [*N.B.*—I believe this worm belongs to my family Rhinodrilidæ].

Distribution: Quilimane, Zanzibar.

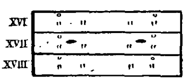
33.



PYGMÆODRILUS

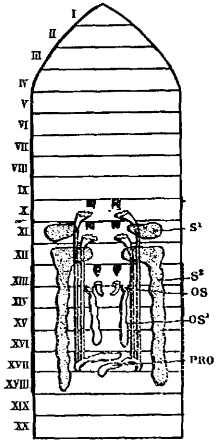


PYGMÆODRILUS

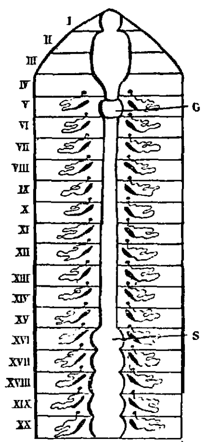


PYGMÆODRILUS

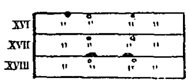
34.



NEMERTODRILUS

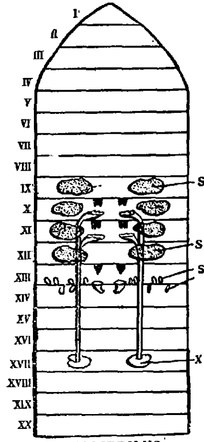


NEMERTODRILUS

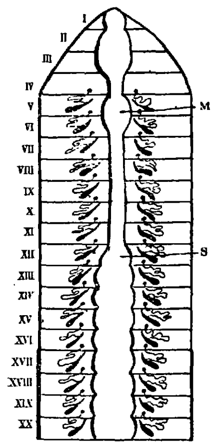


NEMERTODRILUS

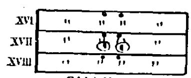
35.



CALLIDRILUS



CALLIDRILUS

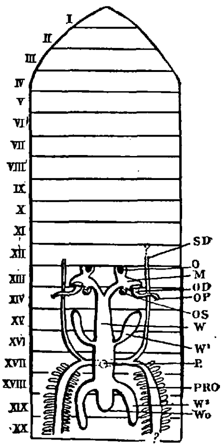


CALLIDRILUS

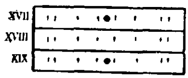
FIG. 36.—Polytoreutes. A very brief description, with a figure, is given by Michaelsen of the hinder portion of the genital system of P. cœruleus, in 'Jahrb. d. hamburg. wiss. Anstalten,' vii, 1890. No details are given of the alimentary system. *a*. Genital system. SD. Sperm-duct. O. Ovary. M. A large sac, into which open (OD.) the oviduct; the ovisac (OS.) and the so-called "spermathecæ" (W.). This has a unique position and shape; it is produced into lateral pouches (W.[1], W.[2]), and opens externally by a median pore (WO.) in Somite XIX. The oviducal pore is shown at OP. The prostate (PRO.) is long, but how long Michaelsen does not say; and is beset with numerous secondary sacs. Its aperture is in front of that of the spermatheca on Somite XVII, and is represented by a dotted circle, and labelled P. *c*. Exterior of Somites XVII, XVIII, and XIX, to show the setæ and median genital pores; that of the spermatheca in XIX, and that of the ducts in XVII.

Distribution: Zanzibar.

36.



POLYTOREUTES



POLYTOREUTES