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The Oligochæta of Natal and Zululand.

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With Plate XXXII.

Contents.

INTRODUCTION.

This memoir on the Oligochæta of Natal and Zululand is based largely on an examination of a series of specimens which I collected in Natal during my visit to South Africa, 1911. My collection has been amplified by a considerable amount of material from the Natal Museum, which Dr. E. Warren kindly entrusted to me for examination. I am also indebted to Mr. E. C. Chubb, of the Durban Museum, for certain specimens.

With the material at my disposal it has been found possible to treat the oligochæte fauna in a monograph form. In this undertaking I have received valuable assistance from Dr. R.

Collett, of the Christiania Museum, Dr. Jägerskiöld, of the Gotenborg Museum, and Prof. H. Théel, of the Riks Museum of Stockholm, who have been so good as to allow me to re-examine the types of certain formerly described species of oligochætes from Natal and Zululand.

HISTORY AND BIBLIOGRAPHY.

Our knowledge of the earthworms from Natal and Zululand extends back to the year 1866, when J. G. H. Kinberg presented to the Academy of Sciences at Stockholm a preliminary paper on the "Oligochæta of the Eugenie Expedition." This paper, as well as a few others published in the nineteenth century, give only scanty information with reference to the oligochætes of Natal. In the present century only two papers dealing with the earthworms of the districts now being considered have been published. These papers, however, are far from giving an even fairly adequate picture of the oligochæte fauna, since the larger of them deals with only six different species.

In the following list of papers there is given all the literature up to the present which contains descriptions or revisions of the Oligochæta of Natal and Zululand. To the titles of these papers I have added the names of the species described, while the modern synonyms are given in square brackets.

1866. Kinberg, J. G.—"Annulata nova" [Continuatio]. 'Öfv. Vet. Förh.,' nr. 4, 1866.

Tritogenia sulcata *n. sp.* [Microchætus sulcatus (*Kinb.*) f. typicus.]

Geogenia natalensis *n. sp.* [Microchætus natalensis (*Kinb.*).]

Hegesipyle hanno *g. e. sp. n.* [*Gen. et spec. spur.*]

1886. Benham, W. B.—"Studies on Earthworms, II," 'Quart. Journ. Micr. Sci.' (n.s.), 26, 1886.

Microchæta beddardi *n. sp.* [Microchætus beddardi *Benh.*]

1892. Benham, W. B.—"Description of Three New Species of Earthworms," 'Proc. Zool. Soc. Lond.,' 1892.

Microchæta papillata *n. sp.* [Microchætus papillatus *Benh.* f. typicus.]

Microchæta beddardi *Benh.* [Microchætus beddardi *Benh.*]

1893. Beddard, F. E.—"On some New Species of Earthworms from Various Parts of the World," 'Proc. Zool. Soc. Lond.,' 1892.

Eudriloides durbanensis *n. sp.* [Eu. durbanensis *Bedd.*]

Ilyogenia africana *n. sp.* [Ocnerodrilus (Ilyogenia) africanus (*Bedd.*)]

1899. Michaelsen, W.—"Revision der Kinberg'schen Oligochæten-Typen," 'Öfv. Vet. Förh.,' nr. 5, 1899. The same species as in l.c. 1866, J. G. H. Kinberg.

1906. Cognetti de Martiis, L.—"Nuove Specie dei Generi Pheretima e Tritogenia," 'Atti. Acc. Torino,' xli.

Tritogenia morosa *n. sp.* [Microchætus sulcatus (*Kinb.*) f. typicus.]

Microchætus *n. sp.* [*Gen. et spec. spur.*]

1907. Beddard, F. E.—"On Two New Species of the African Genus Microchætus belonging to the Collection in the Museum of Christiania," 'Proc. Zool. Soc. Lond.,' 1907.

Microchætus colletti *n. sp.* [M. colletti *Bedd.*]

Microchætus zuluensis *n. sp.* [M. zuluensis *Bedd.*]

1907. Michaelsen, W.—"Oligochæten von Natal und dem Zululand," 'Ark. Zool.,' iv, nr. 4.

Fridericia bulbosa (*Rosa*) var. [F. peregrinabunda *n. sp.*]

Chilota trägårdhi *n. sp.* [Ch. trägårdhi *Mich.* f. typicus.]

Microchætus papillatus *Benh.* [M. papillatus *Benh.* f. typicus.]

Microchætus zulu *n. sp.* [M. zuluensis *Bedd.*]

Microchætus gracilis *n. sp.* [M. gracilis *Mich.*]

Microchætus ivari *n. sp.* [M. ivari *Mich.*]

The above list shows that we were acquainted with only twelve different species of oligochætes from Natal and Zululand, excluding the doubtful Hegesipyle hanno *Kinb.*, which is probably a form with acanthodrilid sexual apparatus and belongs to one of the following genera: Dichogaster, Kerria, Chilota, Microscolex, or Acanthodrilus.

Considering that Natal and Zululand have been under scientific exploration since about the middle of the nineteenth century, we must regard this as a very poor result; but we shall see in the following that it cannot be laid to the charge of the collectors. It would appear that we have in Natal and Zululand a region with a poor oligochæte fauna, that is to say, poor relatively to that of the Cape Province, which is a rich one.

GEOGRAPHICAL DISTRIBUTION.

Before discussing the general character of the oligochæte fauna of Natal and Zululand, I will give a list of all the species found in the large collection at my disposal.

LIST OF OLIGOCHÆTA FROM NATAL AND ZULULAND.

(Species known to April, 1913.)

Fam. ENCHYTRÆIDÆ.

Fridericia peregrinabunda *n. sp.* (peregrine).
Fridericia perrieri (*Vejd.*) (peregrine).

Fam. MEGASCOLECIDÆ.

Sub-fam. Acanthodrilinæ.

Chilota warreni *n. sp.* (endemic in Natal).
Chilota trägårdhi *Mich.*, f. typicus (endemic in Zululand).
Chilota trägårdhi var. major (endemic in Natal).
Chilota wahlbergi *Mich.* f. typicus (endemic in Natal and Transvaal).
Chilota braunsi *Mich.* (endemic in Natal and Eastern Cape Province).

Sub-fam. Megascolecinæ.

Pontodrilus bermudensis *Bedd.* f. typicus (widely distributed littoral species).
Pheretima heterochæta (*Mich.*) (peregrine).

Sub-fam. Trigastrinæ.

Dichogaster bolaui (*Mich.*) (peregrine).
Dichogaster crawi *Eisen.* (peregrine).

Sub-fam. Ocnerodrilinæ.

Kerria gunningi *Mich.* (endemic in Natal and South Transvaal).
Ocnerodrilus (Ilyogenia) africanus (*Bedd.*) (endemic in Natal).

Sub-fam. Eudrilinæ.

Eudriloides durbanensis *Bedd.* (endemic in Natal?).

Fam. GLOSSOSCOLECIDÆ.

Sub-fam. Glossoscolecinæ.

Pontoscolex corethrurus (*Fr. Müll.*) (peregrine).

Sub-fam. Microchætinæ.

Microchætus natalensis (*Kinb.*) (endemic in Natal).
Microchætus papillatus *Benh.* f. typicus (endemic in Natal).
Microchætus papillatus *Benh.* var. cæmenterii *n. var.* (endemic in Natal).
Microchætus sulcatus (*Kinb.*) f. typicus (endemic in Natal).
Microchætus sulcatus (*Kinb.*) var. howickianus *n. var.* (endemic in Natal).
Microchætus zuluensis *Bedd.* (endemic in Zululand).
Microchætus colletti *Bedd.* (endemic in Zululand).
Microchætus gracilis *Mich.* (endemic in Natal).
Microchætus ivari *Mich.* (endemic in Natal).
Microchætus parvus *n. sp.* (endemic in Natal).
Microchætus beddardi *Rosa* (endemic in Natal).

Fam. LUMBRICIDÆ.

Helodrilus caliginosus (*Sav.*) f. trapezoides (*Dug.*) (peregrine).
Helodrilus constrictus (*Rosa*) (peregrine).

This list contains twenty-five species and three varieties, which are about twice as many as formerly known in this region. Considering the quantity of materal at my disposal, I expected at the beginning of my studies, a larger gain of new species; but I soon perceived that the great majority belonged to known forms. Indeed, there are only three new species and three new varieties of old species in the list; and one of the new species, Fridericia peregrinabunda, is but a new nomination for an oligochæte formerly described as a variety of another species. The collection has, however, a considerable value, as it has enabled me to re-examine old species, such as those of Kinberg, which were very imperfectly known.

A reference to the list will show that many of the species are peregrine, or non-indigenous, and were doubtless introduced by man; these have nothing to do with the real oligochæte fauna.

The foreign species are: two species of the genus Fridericia of the family Enchytræidæ, the widely distributed Pheretima heterochæta, the two species of Dichogaster, the cosmopolitan Pontoscolex corethrurus, and the two species of the Lumbricid genus Helodrilus.

The locality of Eudriloides durbanensis *Bedd.* is somewhat doubtful. The headquarters of the genus Eudriloides are the coast districts of British East Africa and German East Africa. Beyond this region, Eu. parvus *Mich.* was found at Quilimane at the month of the Zambezi River. This species has been regarded as an outpost of the genus, and we may perhaps in a like manner regard Eu. durbanensis as an outpost of the tropical African fauna continued farther to the south. Similar outposts are known extending as far south, such as Nemertodrilus kellneri *Mich.* from the Orange Free State. This is likewise a member of the Ethiopian sub-fam. Eudrilinæ, and allied to N. griseus *Mich.* from Mozambique. The doubt about Eudriloides durbanensis is due not so much to the improbability of the locality, as to the manner in which it was found. The species was not collected at Durban, but at Kew Gardens, in England,

from a box containing plants sent from Durban; and there is consequently no real security that the specimens came from Durban. Even if they actually did come from there, the species may have been introduced with foreign plants. Also Eu. durbanensis is one of the very few of the older species which has not been found again in Natal. This is a suspicious circumstance, and it would be unwise to base any conclusions with regard to geographical distribution on such an insecure foundation.

In addition to the peregrine species we have to remove the littoral species Pontodrilus bermudensis *Bedd.* f. typicus. Such littoral species, to which the sea is not an impassable barrier, have a very different kind of distribution to the bulk of the Oligochæta, which avoid salt water, and to which the sea-shore is a strict limit. Pontodrilus bermudensis is a species occurring on the sea-shore of all oceans in the warmer zones, and therefore its presence does not assist in characterising the oligochæte fauna of our region.

The remaining species on the list are endemic, and represent the typical, i.e. the primordial, oligochæte fauna of the country. These alone are of use in establishing the geographical relations, which will be found are in accord with the geological history of the continent. The indigenous oligochæte fauna is composed of three different groups, belonging to different families or sub-families, and exhibiting quite different faunistic relations.

These three groups are: (1) The genus Chilota of the section Chilotacea, sub-fam. Acanthodrilinæ, fam. Megascolecidæ; (2) the sub-fam. Ocnerodrilinæ, fam. Megascolecidæ; (3) the sub-fam. Microchætinæ, fam. Glossoscolecidæ. To these might be added a questionable fourth group represented by Eudriloides durbanensis with doubtful origin.

(1) Section Chilotacea.—This group is represented by four species and one variety of the genus Chilota.

The distribution of the genus Chilota appears to be restricted as follows. In the southern parts of Africa there are

many species in the Cape province, one in the Transvaal, several in Natal and one in Zululand. In the southern parts of South America there are many species in South Patagonia, Fireland, Falkland Islands, and Chile northwards as far as Coquimbo. The only known species which occurs elsewhere is Chilota exul (*Rosa*) from the Cape Verde Island, San Antonio; but it is very doubtful if it is an indigenous species there. The South African group of Chilota is accompanied by the single species of the genus Udeina (U. kinbergi (*Mich.*)), from the banks of the river Vaal, whilst that of South America is living together with the allied great genus Yagansia.

This group of Chilotacea of Natal and Zululand consequently forms an integral part of the typical South African fauna, and especially exhibits the singular faunistic connection between the southern corners of the two continents of Africa and South America.

(2) Sub-fam. Ocnerodrilinæ.—This group is represented by a single species of the genus Kerria, occurring in the meantime as far north as Pretoria, Transvaal, and a single species of Ocnerodrilus (Ilyogenia).

The sub-family Ocnerodrilinæ is a typical Ethiopian group, and all the known genera are represented in the tropical regions of Africa. But it is not restricted to Africa, and just these two genera found in Natal, viz. Kerria and Ocnerodrilinus, are also found in the tropical parts of South America, Central America, and West Indies.

In the Cape Province no Ocnerodrilinæ have been found. In the eastern districts Natal appears to be the southern limit of this sub-family. In the more western districts the southern limit is further north; Pygmæodrilus arausionensis *Mich.* occurs at Bathville in the north of the Orange Free State, and there are some species in German South-West Africa.

This second group of the oligochæte fauna of Natal thus includes an outpost of the fauna of tropical Africa, which has extended to the south-east of the continent; and it is also related, as we have seen above, to the fauna of South America, Central America and the West Indies.

(3) Sub-fam. Microchætinæ.—This sub-family, belonging to the family Glossoscolecidæ, forms with its nine species of the genus Microchætus the bulk of the original indigenous oligochæte fauna of Natal and Zululand. The genus Microchætus is strictly confined to South Africa, and is distributed throughout the whole of the Cape Province, but it is more prevalent in the eastern (and northern?) districts. It passes northwards as far as the north-west corner of the Cape Province, also to the northern frontier of the Orange Free State and to Zululand.

The nearest terricolous ally of this genus is Kynotus of Madagascar; but the relationship is not very close, and intermediate steps are exhibited by certain aquatic forms. The genus Microchætus was doubtless derived from the aquatic genus Glyphidrilus, whilst the aquatic genus Callidrilus must be regarded as the ancestor of Kynotus. Both of these aquatic ancestors are living in the eastern parts of tropical Africa. Glyphidrilus also occurs in the East Indies and in the Malay Archipelago. In the regions of their presumed descendants these genera have not been found, neither Callidrilus in Madagascar nor Glyphidrilus in South Africa.

It is doubtful in what region the terricolous genera Microchætus and Kynotus have arisen. They may have originally developed from their aquatic ancestors in eastern tropical Africa, and have spread from there to the southern regions, becoming extinct in the land of their birth. On the other hand, we might assume that their ancestors in former times had a wider distribution, Glyphidrilus extending over South Africa and Callidrilus over Madagascar, and that they have become extinct after giving rise to their terricolous descendants.

Be this as it may, the time of the descent of Microchætus and its allies from their aquatic ancestors must be placed in a far-distant geological period; and we must regard the genus Microchætus as typically South African.

Even if we have to assume that the genus originally

invaded South Africa from the northern regions in past geological time, yet its presence forms the sharpest contrast between the modern oligochæte fauna of South Africa and that of tropical Africa. The latter is dominated by the phyletically much younger groups of the Trigastrine genus Dichogaster and the sub-family Eudrilinæ. These are living in South Africa with the Ocnerodrilinæ and with some other aquatic and amphibial groups. The Ocnerodrilinæ have only a portion of their dominion in this region, and they stand somewhat apart owing to their different habitat.

To recapitulate, the endemic fauna of the Oligochæta of Natal and Zululand proves to be an integral portion of the Cape fauna with a small addition of outposts from the tropical African fauna.

But the oligochæte fauna of the Cape region is not homogeneous, the Microchætinæ prevail in the eastern districts, whilst the Chilotacea occur especially in the western parts. In this respect Natal and Zululand seem to even surpass the south-eastern districts of the Cape Province.

The faunistic character of the numerical preponderance of Microchætus over Chilota is accompanied by a peculiarly local distribution. All Microchætus species are found in very restricted areas of Natal and Zululand, although they are true endemic species. Somewhat different is the distribution of the Chilota species. It is true that Ch. warreni has up till now been found only in Natal, but the three other species have a much wider distribution: Ch. trägårdhi occurs both in Natal and Zululand, Ch. wahlbergi in Natal and the Transvaal, and Ch. braunsi in Natal and the Cape. These species may be regarded as peregrine to a certain extent, since probably they invaded Natal and Zululand at a fairly recent geological period; but the Microchætus species are the real aborigines of the eastern parts of South Africa.

The eastern fauna of the Cape is distinguished from the western by the non-occurrence of certain genera. The genera in question both belong to the section Acanthodrilacea [Eodrilacea] of the sub-family Acanthodrilinæ.

Acanthodrilus [Eodrilus] is archaic in character, and in far-distant geological periods was spread presumably over all the continents of the southern hemisphere as well as over the neighbouring portions of the northern hemisphere, such as Cameroon and Central America as far as Mexico. But this wide region of distribution has been much restricted and split up, and in recent times we only find the genus in scattered and widely separated localities. One of these localities is the southernmost corner of the African continent in the vicinity of Cape Town. Here we find a small number of species of Acanthodrilus, which give an archaic character to the oligochæte fauna of the Cape region. In other parts of South Africa, including Natal and Zululand, this archaic genus has been exterminated and replaced by phyletically younger oligochætes. In addition to the Cape Town residue we have several different species of Acanthodrilus surviving in Madagascar, and a single species in the Cameroons.

In the other genus, Microscolex, the distribution is quite different. This genus is represented by a small number of species in the southernmost coastal districts of the Cape Province. These extend eastwards as far as Port Elizabeth. The genus Microscolex is phyletically younger than Acanthodrilus, and has acquired the power of enduring salt-water, and thus it has the power of spreading widely across the sea. It probably originated in the southern corner of South America, and was distributed by means of the west-wind drift over all the region of the subantarctic seas, Patagonia, Falkland Islands, South Georgia, Crozet Islands and Kerguelen as far as the islands south of New Zealand.[1] In the course of distribution, which has probably occurred in relatively recent times, the southernmost coast of Africa was affected and became colonised with Microscolex. It would appear that there has not been time for the genus to spread further north, and so the oligochæte fauna of Natal and Zulu-

[1] Michaelsen, W., "Zur Kenntnis der Eodrilaceen und ihrer Verbreitungsverhältnisse." 'Zool. Jahrb. Syst.,' xxx, p. 540 a. f., map p. 436.

land is distinguished from that of the Cape Province by the absence of species of Microscolex.

SYSTEMATIC ACCOUNT.

Fam. ENCHYTRÆIDÆ.

Fridericia peregrinabunda *n. sp.*

Fridericia sp. (? bisetosa *Levins*); Michaelsen, "Die Oligochæten der deutschen Südpolar-Expedition 1901–1903," Deutsche Südpol.-Exp. 1901–03, IX, Zool. i, p. 19, 1905; Michaelsen, "Die Oligochæten Deutsch-Ostafrikas," Zeitschr. wiss. Zool., lxxxii, p. 310.

Fridericia bulbosa (*Rosa*) var.; Michaelsen, "Oligochæten von Natal und Zululand," Arkiv. Zool., iv, nr. 4, p. 2, 1907.

Hab.—Howick, Natal; valley just beneath Shelter Falls in rather dry earth, W. Michaelsen, September 2nd, 1911. Umgeni near Durban; at the roots of carnations, W. Michaelsen, September 7th, 1911.

Pietermaritzburg (teste Michaelsen); Zanzibar (teste Michaelsen); ? St. Paul (teste Michaelsen); ? New Amsterdam (teste Michaelsen); ? St. Helena (teste Michaelsen).

In my material there were many specimens of an Enchytræid which belonged to the group of Fridericia bulbosa (*Rosa*), but which differed somewhat from all the species of the group. It is not quite clear whether the small differences which are present really justify a specific separation, or whether such differences should be regarded as characterizing varieties of a somewhat variable species, as I assumed in 1907. Although still inclined to my former view, I here adopt the method of my colleagues, and treat the supposed variety as a true species; but in the future revision of this family it is quite likely that these forms will be re-united in one species.

External Characters.—Dimensions of mature specimens (the figures in parenthesis refer to stretched specimens from Pietermaritzburg): length 10–12 (15–18) mm., diameter 0·4–0·45 (0·25–0·33) mm. Number of segments 60–70.

Colour light grey, irregularly mottled by the contents of the alimentary canal shining through the body-wall.

The setæ are straight for nearly the whole length, but are bent slightly at the proximal end. They occur regularly in pairs throughout the body.

Dorsal pores are distinct; they begin on the seventh segment and are placed in the middle of the segments.

Clitellum ring-shaped, but ventrally it is flatter. It extends from the beginning of the twelfth segment to the end of the middle third of the thirteenth segment. The pellucid gland-cells of the clitellum are arranged in more or less regular transverse rows or zones.

Internal Anatomy.—Septa between segments 6 and 7, 7 and 8, 8 and 9 are somewhat thickened.

Alimentary Canal.—There are three pairs of main septal glands situated in the fourth, fifth, and sixth segments, two pairs of smaller intermediary ones in the fifth and the sixth segments and a less distinct pair in the fourth segment. The main septal glands are nearly globular, those of each pair are connected together by a narrow median transverse bridge.

The peptonephridia are provided with an irregular main portion, which is widest at the ends and somewhat narrow in the middle. In the widened fore-part the lumen shows an irregular undulation, and in the widened hind-part the walls show bladder-like projections, some two of which are prolonged into narrow diverticula or branches.

The œsophagus ends and the intestine begins in the middle of the twelfth segment. The front part of the intestine from the middle of the twelfth segment to the end of the fifteenth is provided with a system of "chyle-channels."

Nervous System.—The brain is only a little longer than broad, rather thick and somewhat convex behind; it projects in front in a short convex bow. Commissural bands arise laterally from the underside somewhat behind the frontal curve.

Excretory System.—The nephridia were examined in the segments of the fore-body only as far as the sixteenth

segment. They have a large pre-septal portion which is only a little shorter and somewhat narrower than the post-septal part. The pre-septal and post-septal portions are connected together by a rather narrow neck. The duct arises from the underside of the post-septal part at a small distance from the neck, but as the long axis of the post-septal part mostly runs transversely in the body it often appears that the duct arises from the hinder end of the apparently shortened and much broadened post-septal portion.

Reproductive System. — Spermiducal funnel rather thick, not quite twice as long as broad, with a narrow collar, and pierced excentrically. Sperm-duct very thin, rather long and coiled irregularly.

Spermathecæ with a very slender curved duct without glandular appendages, and with a single bulb-shaped ampulla without diverticula. The duct enters the broad pole of the ampulla, and its proximal end projects somewhat into the lumen of the ampulla. Proximally the ampulla narrows into a moderately long prolongation, which enters the œsophagus laterally in the hinder part of the fifth segment in front of the septum between the fifth and sixth segments. In this, F. peregrinabunda differs from F. pulchra, where the prolongation opens in the sixth segment, in front of the septum between the sixth and seventh segments.

Remarks.—Fridericia peregrinabunda belongs to the group of F. bulbosa (*Rosa*), and is particularly related to F. pulchra *Friend*.[1] It differs from the latter species in certain minor points, principally in the more complex shape of the pepto-nephridia which are long and quite simple and smooth tubes in F. pulchra; also in the shape of the nephridia, and in the normal course of the spermathecæ which enter the œsophagus in the fifth segment, whilst in F. pulchra they run backwards nearly as far as the septum between the sixth and seventh segments.

F. peregrinabunda is doubtless a peregrine species imported by man into Africa. It seems to be rather widely dis-

[1] Friend, H., 'Journ. Micr. Sci.,' 1912, p. 21, text-figs. 9, 10.

tributed. It is also densely distributed, since there are no less than three localities in Natal—Howick, Pietermaritzburg, Durban. The worm was doubtless introduced in earlier times and has spread widely. Various statements have been made of a Fridericia being found on various islands associated with Africa—Zanzibar, St. Paul, New Amsterdam, St. Helena. In all these cases the worm referred to is a species of the small "bisetose" group of this genus. In my opinion all these worms are Fridericia peregrinabunda; but since the specimens from these islands were immature it is not possible to be absolutely sure.

Fridericia perrieri (*Vejd.*).

Fridericia perrieri (*Vejd.*); Michaelsen, "Oligochæta." Tierreich, x, p. 98, 1900. Contains synonymy and bibliography.

Loc.—Howick, Natal; found in detritus near the Umgeni Falls, W. Michaelsen, August 30th, 1911 (2 specimens).

This is a peregrine species spread over most European countries.

Fam. MEGASCOLECIDÆ.

Sub-fam. Acanthodrilinæ.

Chilota warreni *n. sp.* Pl. XXXII, figs. 1, 2.

Hab.—Howick, Natal; found in detritus near the Umgeni Falls, W. Michaelsen, August 30th, 1911 (many specimens).

Farm "Camin" between Pietermaritzburg and Greytown, Natal; found at the roots of fern, Mrs. Liebermann, November 11th, 1911 (one specimen).

Game Pass, Drakensberg, Natal; H. C. Burnup, June, 1912 (a number of mature specimens).

External Characters.—Length 42–65 mm., diameter 2·5–3 mm., number of segments 102–114. Many apparently complete specimens are considerably shorter, and they without doubt represent pieces with regenerated hinder ends.

Colour dark violet-grey dorsally. The intensity diminishes on passing backwards from the fore-end, and the colour changes into a reddish-brown. Ventral side yellowish-grey, and laterally somewhat abruptly separated from the dark colour of the dorsal surface.

Setæ rather large, especially at the hinder part of the body; ventrally they are widely paired, dorsally they are separated. Generally the middle lateral distance is equal to the width of the dorsal pairs; it is distinctly larger than the width of the ventral pairs, and a little smaller than the ventral median distance[1] ($aa : ab : bc : cd = 7 : 4 : 6 : 6$). Median dorsal distance rather small; at the fore-end twice as large as the width of the dorsal pairs, at the hind-end even smaller, measuring only once and half times the length ($dd = 1\frac{1}{2}$–$2\ cd$). The width of the ventral pairs diminishes in the region of the male pores.

Nephridial pores are in the lines of setæ *c*.

Clitellum ring-shaped, ventrally not very conspicuous. It extends over five segments, 13–17. At the thirteenth and at the seventeenth, or at one of them, the clitellum often appears incompletely developed.

Male area: prostate pores are in two pairs on the seventeenth and nineteenth segment in the lines of setæ *b*, each on a transversely ovate papilla which is often provided with a deep transverse furrow. Male pores not seen, probably on the eighteenth segment in the lines of setæ *b*; in most cases there is to be seen a pair of transverse furrows in these places. There are no seminal longitudinal furrows.

The whole ventral surface of the seventeenth and eighteenth segments is often glandular, and this modification sometimes extends a little beyond these segments.

Female pores are in front of setæ *a* in the fourteenth

[1] For the sake of convenience in referring to the various distances the four setæ of the two pairs on each side are lettered respectively *a*, *b*, *c*, *d*, passing from the ventral to the dorsal surface. The letter *u* stands for the whole circumference.

segment, and are reflected slightly towards the middle ventral line.

Spermathecal pores in two pairs are on the furrows between the seventh and eighth segments, and the eighth and ninth segments in the lines of setæ *b*.

Internal Anatomy.—The septa of the gizzard region are extraordinarily tender. Septa between the ninth and tenth segments, tenth and eleventh segments and the eleventh and twelfth segments are very little thickened, and must still be regarded as thin.

Alimentary Canal.—Gizzard small, hardly broader than the neighbouring part of the œsophagus; occurs in the fifth and sixth segments. Œsophagus without calciferous glands. Intestine without typhlosole.

Circulatory System.—Dorsal vessel simple; the last hearts are in the twelfth segment.

Reproductive System.—Male organs: one pair of great sperm-duct funnels occur free in the tenth segment, they are not enclosed in seminal vesicles. There are two pairs of great grape-like sperm-sacs depending from the septa between the ninth and the tenth segments and tenth and eleventh segments. They project into segments 9 and 11.

Prostates are tubular; the glandular part is very long and richly folded in broad and narrow coils, which extend from the segment of the prostate pores into the segment in front. Duct is relatively short, somewhat bent, and much thinner than the glandular part.

Penial setæ are of two kinds; each prostate is accompanied by one of both kinds. (1) Length 1·2 mm., thickness at proximal end about 35 μ. The seta gradually diminishes towards the tip, close to which the thickness is about 20 μ. The seta of this kind is distinctly bent, and ends in a very sharp point. With the exception of the terminal pointed portion, the distal third of the seta is ornamented with a somewhat close annulation. The edge of the annulets consists of densely crowded, irregular triangular teeth closely clinging to the surface, and forming irregular zigzag transverse rows.

(2) This kind is somewhat more slender than the first. Length 1·4 mm., thickness of proximal end 30 μ. Seta gradually tapers; at a distance of 0·2 mm. from the tip the thickness is about 16 μ. The seta is only very slightly bent. A distal length of about 0·16 mm. is flattened and somewhat broadened, being 26 μ broad, forming a slender and fine lancet ending in a simple acute-angled often somewhat reflected tip. With the exception of the lancet extremity the distal third is ornamented like the other penial seta, but the ornamentation is somewhat more delicate.

Female organs: a pair of great ovaries project free into the thirteenth segment.

The spermathecæ have an ampulla which is broad and irregularly puffed out. Duct short and narrow, coming off abruptly from the ampulla. Into the duct there open two short, broad and rounded diverticula which are scarcely longer than it. The diverticula are nearly opposite to each other, but their bases are confluent on the front side of the duct of the ampulla. The central lumen of the diverticula is small, and the thick walls contain numerous minute cavities filled with sperm.

Remarks.—Chilota warreni is one of the few South African species with two spermathecal diverticula. It comes nearest to Ch. trägårdhi *Mich.* from Zululand; and resembles this species in the lines of setæ *a* and *b* converging towards the male pores, but more distinctly so; also in possessing two spermathecal diverticula and two kinds of penial setæ and in many other characters. The two species may easily be distinguished from one another by the shape of the penial setæ and by other less obvious characters, such as seminal furrows, copulatory papillæ, colour, etc.

Chilota trägårdhi *Mich.* f. typicus.

Chilota trägårdhi *Michaelsen*, "Oligochæten von Natal und dem Zululand," Ark. Zool. iv, nr. 4, p. 3, text-figs. 1, 2. 1907.

Hab.—Lake Sibayi, a freshwater lake near the coast, N. Zululand (teste Michaelsen).

Chilota trägårdhi *Mich.* var. major *n. var.* Pl. XXXII, figs. 4, 5.

Hab.—Hilton Road, eleven miles N.W. Pietermaritzburg, Natal; Dr. M. A—, July 28th, 1905 (one nearly mature specimen).

Natal; Miss Blackmore, 1905 (several immature specimens with only two showing the first signs of sexual organs, one nearly mature specimen).

External Characters.—Largest specimen, length 130 mm., diameter 3·5–4 mm., number of segments 124.

The colour and arrangement of setæ are as in the typical form. The lines of setæ *a* and *b* converge very gradually towards the male pores, and the setæ are distinctly enlarged at the hinder end as in the typical form. In the original description of typicus I omitted to record these facts.

Internal Anatomy.—As far as the sexual development and the state of preservation permitted me to see, the general anatomy resembles that of typicus with the exception of the shape of the penial setæ. In typicus each prostate is accompanied by two penial setæ of distinctly different shape, while in major these setæ closely resemble one another and differ only slightly in size. The penial setæ of major are very slender, being 1–1·1 mm. long and 13 μ thick at the proximal end; the seta tapers very gradually towards the distal end, where the thickness is about 5 μ. The setæ are only slightly bent, and they are quite smooth and transparent without any ornamentation, while in typicus one kind of the penial setæ has an external ornamentation, which, however, is rather faint and irregular, and perhaps has no great systematic value.

In typicus the distal tip is simple and sharp-pointed; but in major it has a very characteristic shape, and in both of the penial setæ the distal extremity ends in two minute claws, which are connected together by a membrane like that of a webbed foot. In the plane of the membrane the extremity is slightly widened, but in profile there is no broadening.

Chilota wahlbergi *Mich.* f. typicus.

Chilota wahlbergi *Michaelsen*, "Revision der Kinberg'schen Oligochæten-Typen," Öfv. Vet. Förh., lvi, p. 441. 1899.

Hab.—Farm between Pietermaritzburg and Greytown, Natal; at the roots of ferns, Mrs. Liebermann, November 11th, 1911 (one specimen). "Kafferlandet" (teste Michaelsen).

The form pulchrior *n. f.* from Witpoortje in the Middleburg district, Transvaal (teste Michaelsen).

When examining the material from the Transvaal I was of the opinion that the main difference between these specimens and the type specimen of Kinberg was that the latter had lost its colour through remaining in spirit for nearly fifty years.[1] But recently I obtained a specimen that had been in spirit only for a few hours, and it had the same pale coloration as the type. It may therefore be stated that there does exist a difference between the specimens from the Transvaal and those from other localities, and consequently I distinguish the Transvaal intensively coloured race from the typical form as f. pulchrior *n. f.*

Chilota braunsi *Mich.* Pl. XXXII, fig. 3.

Chilota braunsi *Michaelsen*, "Terricolen von verschiedenen Gebieten der Erde," Mt. Mus. Hamburg, xvi, p. 102, fig. 21. 1899.

Hab.—Zwaartkop Valley, three and a half miles west of Pietermaritzburg, Natal (one not quite mature specimen).

Port Elizabeth, Cape Province (teste Michaelsen).

The penial setæ of this species are characteristic in being of a light wine-red colour. This was observed both in the type and in the Natal specimen. The scales ornamenting the penial setæ are distributed rather irregularly, and their arrangement is somewhat variable. They are scattered in the type, but in the specimen from Zwaartkop Valley they tend to be grouped so as to form irregular transverse rows.

[1] Michaelsen, W., "Oligochæten vom tropischen und südlich-subtropischen Afrika, I," 'Zoologica,' Heft 67, p. 146.

Sub-fam. Megascolecinæ.

Pontodrilus bermudensis *Bedd.* f. typicus.

Pontodrilus bermudensis *Bedd.* f. typicus; Michaelsen, "Oligochæten von verschiedenen Gebieten," Mt. Mus. Hamburg, xxvii, p. 85. 1910.

Hab.—Kosi Bay, Zululand; collected December, 1905. Distributed along the coasts of the Pacific, Indian, and Atlantic Oceans in the warmer zones.

The specimens were badly preserved. When copulatory papillæ were visible, a single median ventral papilla could be seen at the furrow between the nineteenth and twentieth segments.

Pheretima heterochæta (*Mich.*).

Amyntas heterochætus (*Mich.*); Beddard, "A Revision of the Earthworms of the genus Amyntas," Proc. Zool. Soc. Lond., 1900, p. 615. Contains synonymy and bibliography.

Hab.—Howick, Natal; in detritus near the foot of the Umgeni Falls, and in rather dry earth beneath stones on veld, W. Michaelsen, August 30th, 1911.

Hilton Road, Natal; Dr. M. A—, July 28th, 1905.

Dorp Spruit, Pietermaritzburg, Natal; October 30th, 1904.

Zwaartkop Valley, near Pietermaritzburg, Natal.

Scottsville, Pietermaritzburg, Natal; W. G. Rump, December, 1911.

Durban, Natal; J. Clark, 1911.

This is a peregrine species distributed far over the warmer zones, and doubtless introduced by man into Natal.

Sub-fam. Trigastrinæ.

Dichogaster bolaui (*Mich.*).

Dichogaster bolaui (*Mich.*); Michaelsen, "Oligochæta," Tierreich, x, p. 340. 1900. Contains synonymy and bibliography.

Hab.—Scottsville, Pietermaritzburg, Natal; W. G. Rump, 1912.

This is a peregrine species of the warmer zones, imported by man into Natal.

The specimen from Scottsville represents the larger form, which was formerly separated from the typical form as the variety octonephra (*Rosa*), where in most of the segments there are four micronephridia on each side, but the ventralmost micronephridium is very small. In many segments of the Scottsville specimen the innermost micronephridium is altogether absent, and these segments are in the condition of the typical form. The specimen may be regarded as intermediate.

Dichogaster crawi *Eisen*. Pl. XXXII, figs. 6 and 7.

Dichogaster crawi *Eisen*, "Researches in American Oligochæta, with especial reference to those of the Pacific Coast and adjacent Islands," Proc. Cal. Ac. (3) ii, p. 228, pl. x, figs. 82–94. 1900.

Hab.—Scottsville, Pietermaritzburg, Natal; W. G. Rump, December, 1911.

Chapel Street, Pietermaritzburg, Natal; H. C. Burnup, December, 1911.

Also San Francisco, California, and Del Monte in conservatories (teste Eisen).

The specimens from San Francisco were said to have been introduced from Honolulu, Hawaii; but I have shown elsewhere[1] why I regard these statements of Mr. Craw as being incorrect, and it is probable that the worms entered the plant receptacles after their arrival at Mr. Craw's nursery. In any case most of the species of this genus, including D. crawi, have been widely transported hither and thither by man into numerous localities.

Remarks.—The specimens from Natal show in general such a striking conformity with Eisen's Dichogaster crawi that there is no doubt about the identity of the species; but at the same time there is an apparently very important difference in a certain structural character. If Eisen's statement is correct, it must be assumed that there is great variability in the character in question. According to Eisen the spermathecæ

[1] Michaelsen, W., "Die geographische Verbreitung der Oligochäten," Berlin, 1903.

are provided with one simple diverticulum. In the specimen from Natal, carefully examined by myself, each of the four spermathecæ was provided with two diverticula, and one of these in three of the four spermathecæ was even doubled. Each diverticulum carried a completely separated globular seminal chamber. The diverticula seem to be rather fragile and easily torn off, and perhaps in Eisen's specimen one of the diverticula had been overlooked through being broken away accidentally.

Further, Eisen's statement with regard to the larger of the two penial setæ requires modification. Eisen[1] describes it as being "strongly wavy" in outline, "but with no other ornamentation," and it may appear thus in a balsam preparation. Mounted in spirit or in water the waviness is seen to depend on the presence of a number of convex longitudinal ridges, which are sharply truncated distally. The ridges on one side correspond to grooves on the opposite side, and when the seta is viewed in profile a wavy appearance is produced.

In all other points the penial setæ of the Natal specimen agree with Eisen's description.

Dimensions: large penial seta, length 0·6 mm., diameter at proximal end 10 μ; smaller penial seta, length 0·4 mm., diameter at proximal end 7 μ.

Sub-fam. Ocnerodrilinæ.

Kerria gunningi *Mich.*

Kerria gunningi *Michaelsen*, "Oligochäten vom tropischen und südlich-subtropischen Afrika, ii," Zoologica, Heft 68, p. 1. 1912.

Hab.—Howick, Natal; in detritus near the Umgeni Falls, W. Michaelsen, August 30th, 1911.

Umgeni near Durban, Natal; in the mud on the marshy banks of the Umgeni River, W. Michaelsen, November 7th, 1911.

Pretoria, Transvaal (Michaelsen).

[1] Loc. cit., p. 229, and pl. x. fig. 87.

In the original description of this species I stated that the clitellum was saddle-shaped, being interrupted ventrally between the lines of setæ *a*. This statement is not quite correct, or at least it is not in accord with the condition seen in all the specimens of this species. In the Natal specimens the clitellum is ring-shaped; but ventrally, and especially between the lines of setæ *a*, it is less strongly developed. Even in the type-specimens from the Transvaal there are no distinct ventral borders to the clitellum, and it is not easy to be sure that the glandular structure is entirely lacking medio-ventrally. It is obvious, therefore, that such a slight difference in structure does not justify a separation of the Natal specimens from those of the Transvaal.

Ocnerodrilus (Ilyogenia) africanus (*Bedd.*).

Ilyogenia africana *Beddard*, "On some New Species of Earthworms from various parts of the World," Proc. Zool. Soc. Lond., p. 703. 1892.

Ocnerodrilus africanus (Bedd.); Michaelsen, "Die Regenwürmer Deutsch-Ost-Afrikas," Deutsch-Ost-Afrika, iv, p. 43. 1896.

Ocnerodrilus (Enicmodrilus) africana (*Bedd.*); Eisen, "Researches in American Oligochæta, with especial reference to those of the Pacific Coast and adjacent Islands," Proc. Cal. Ac. (3), ii, p. 112. 1900.

Ocnerodrilus (Ilyogenia) africanus (*Bedd.*); Michaelsen, "Oligochæta," Tierreich, x, p. 380. 1900.

Hab.—Chapel Street, Pietermaritzburg, Natal; H. C. Burnup, December, 1911.

Durban, Natal (teste Beddard).

Five rather poorly preserved specimens, two of which are mature, enable me to make some additional statements about this incompletely known species.

External Characters. — Dimensions of the two mature specimens: length 25 mm. and 35 mm., maximum diameters 1·0 mm. and 1·3 mm., number of segments 78 and 82.

Colour greyish without special pigmentation.

Head epilobous,[1] about $\frac{1}{2}$.

Setæ tend to be strictly paired. Median ventral distance about equal to the middle lateral ones. Median dorsal distance a little smaller than half the circumference of the body ($aa = bc$, $dd < \frac{1}{2}$ u).

Internal Anatomy.—The calciferous glands, or chyle-sacs as I think they should be called, are characteristic in this species. Externally they are sac-like and broader than the œsophagus which is very narrow in the ninth segment. Ventrally they extend forward in the longitudinal axis of the body from the hinder part of the ninth segment to the front end. They arise laterally from the œsophagus. The lumen is divided by a number of longitudinal septa which spring from the external wall and meet in the mid-axis of the organ. A transverse section has, therefore, a wheel-like appearance. The number of radiating septa varies somewhat in different parts of the organ. The maximum number is in the middle, where I have found seven. The external walls, as well as the septa of the organ, are rather thick and are provided with a system of very narrow canals ("Chylusgefässe").

For the remainder of the anatomy reference must be made to the original description by Beddard.

Sub-fam. Eudrilinæ.

Eudriloides durbanensis *Bedd.*

Eudriloides durbanensis *Bedd.*, "On some New Species of Earthworms from various parts of the World," Proc. Zool. Soc. Lond., 1892, p. 696, pl. xlvi. figs. 11, 14. 1893.

[1] There are certain terms to express the relationship between the prostomium and the peristomial segment: (1) zygolobous, where the prostomium is completely fused with the peristomial segment without showing a dorsal furrow; (2) prolobous, where the dorsal furrow between them is transverse; (3) pro-epilobous, where the furrow is concave in front; (4) epilobous, where the furrow is split dorsally to form two longitudinal grooves running backwards, and the extent to which they pass backwards is expressed by a fraction of the length of the peristomium; (5) tanylobous, where the two longitudinal grooves reach the transverse furrow between the peristomial segment and the segment behind.

Hab.—Found in Kew Gardens, England, in a box of plants from Durban, Natal (teste Beddard).

In the general part of this paper I showed that there was much doubt about the original home of this species. Even if the specimens actually came from Durban, there is nothing to prove that the species was not introduced by man into Natal.

Fam. GLOSSOSCOLECIDÆ.

Sub-fam. Glossoscolecinæ.

Pontoscolex corethrurus (*Fr. Müll.*)

Pontoscolex corethrurus (*Fr. Müll.*); W. Michaelsen, "Oligochæta," Tierreich, x, p. 425. 1900.

Hab.—Chapel Street, Pietermaritzburg; H. C. Burnup, December, 1911.

Umgeni, Durban; in plantation, W. Michaelsen, September 7th. 1911.

This is a peregrine species of the warmer zones, found wherever there is horticulture.

Sub-fam. Microchætinæ.

Microchætus natalensis (*Kinb.*). Pl. XXXII, figs. 8, 9.

Geogenia natalensis *Kinberg*. "Annulata nova [Continuatio]," Öfv. Ak. Förh., 1866, nr. 4, p. 100. 1867.

Geogenia [? Microchæta ?] natalensis *Kinb.*; Michaelsen, "Revision der Kinberg'schen Oligochæten-Typen," Öfv. Ak. Förh., 1899, nr. 5, p. 428, text-fig. 1.

Geogenia [? Microchætus ?] natalensis Michaelsen, "Oligochæta," Tierreich, x, p. 462. 1900.

Hab.—Scottsville, Pietermaritzburg, Natal; W. G. Rump, December, 1911.

Pietermaritzburg; in a garden, Dr. E. Warren, September 5th, and December, 1911.

Also Natal, Port Natal (teste Kinberg).

I have examined seven specimens in addition to the type-

specimen. I am convinced that the specimens collected by Dr. Warren and W. G. Rump at Pietermaritzburg belong to this species, although they seem to differ considerably from the type. It is probable that these differences depend upon the different state of development, as the type is not quite mature. At any rate the difference in the shape of the sexual setæ is to be so regarded.

Since the type was immature and badly preserved, I now give a complete description founded on mature and better preserved specimens.

External Characters.—Dimensions of the smallest and largest specimens: length 118 and 170 mm., breadth 4·5 to 7 mm. and 6 to 7 (at clitellum 9) mm., number of segments 232 and 297.

Colour smoke-grey dorsally, and yellowish-grey ventrally.

Head prolobous. The prostomium, first, second and fore-half of third segment are longitudinally furrowed. The first and second segments are simple, third segment irregularly biannulated. The furrow of annulation and the furrows between the first and second segments and the second and third segments are not quite regular. The fourth to the ninth segments are divided into two segment-like ringlets. Front ringlet of the fourth segment is slightly biannulated; all the other ringlets, are simple. Fore-ringlets, bearing setæ and nephridial pores, of fourth to the eighth segments are somewhat larger than the hind-ringlets. The tenth and following segments are simple or indistinctly biannulated.

Setæ begin in the third segment; in general they are rather small. One from the sixth segment measured 0·5 mm. in length, and 45 μ in thickness, and was rather strongly bent into an S. The setæ had an indistinct ornamentation, consisting of irregular and broad scales running mainly in a transverse direction. The setæ are strictly paired. The median dorsal distance of the setæ is a little smaller than half the circumference of the body (*dd=circa*, $\frac{1}{2}\frac{1}{3}$ *u*). Median ventral distance of setæ about as large as the middle lateral distance (*aa=circa bc*). Towards the region of the clitellum

the median ventral distance diminishes, while the median dorsal distance is enlarged. The degree of this dislocation of the lines of setæ varies somewhat in different specimens, and may depend on the state of contraction of the body.

The ventral setæ of the fifteenth to twenty-first segments are transformed into sexual setæ and are not as strictly paired as in the case of the normal setæ. In some specimens the median ventral distance of setæ is hardly larger than twice the distance of the setæ of a ventral pair: $aa = 2\frac{1}{3}-3\ ab$ at segments 15 to 21.

Nephridial pores are in the lines of setæ *c*.

Clitellum is saddle-shaped, and in all specimens extends over ten segments, thirteenth to the twenty-second inclusive.

Copulatory Organs.—At each side there is a very broad and flat copulatory ridge ("Pubertätswall") extending over four segments, fifteenth to eighteenth, and ventrally nearly reaching the line of setæ *b*, while dorsally it reaches the middle lateral line, transgressing considerably the line of the setæ *d* and of the nephridial pores, which line is bent ventrally in the region of the clitellum. The nephridial pores are seen distinctly on the copulatory wall. The fore-part of this copulatory wall belonging to the fifteenth segment is somewhat differentiated, being thicker than the other parts, and, especially laterally, it overhangs the borders of this segment. In two of the specimens it looks like a narrow, laterally rounded shield. From the fifteenth to the twenty-first segment the ventral borders of the clitellum are formed by a more or less distinct undulating white line. Between these lines the body-wall is glandular and bears the sexual setæ. Only a very narrow medio-ventral strip of the body-wall is free from this glandular modification.

The male pores are in the middle of the copulatory walls in the furrows between the sixteenth and seventeenth segments and somewhat beneath the lines of setæ *c* and of the nephridial pores.

Female pores are somewhat medial to the lines of setæ *a* in front of the zone of setæ of the fourteenth segment.

Spermathecal pores are inconspicuous; they are in groups of about ten to thirteen in the furrows between the thirteenth and fourteenth segments and the fourteenth and fifteenth segments. They occur ventro-laterally between the lines of setæ *b* and *c*.

Internal Anatomy.—The septa between segments 4–5, 7–8 and 8–9 are extraordinarily strong, while those between 5–6 and 6–7 are very tender, if not quite rudimentary or absent. Septum between ninth and tenth segments and all the following septa are tender and thin.

Alimentary Canal.—There is a very large gizzard in the seventh segment. A pair of nearly globular calciferous glands spring laterally from the œsophagus in the ninth and tenth segments. The tender septum between the ninth and tenth segments seemed to be fixed to the middle zone of the calciferous glands.

Circulatory System.—Dorsal blood-vessel simple; the last heart is in the eleventh segment.

Reproductive System.—Male organs: there are two pairs of large glittering spermiducal funnels in the tenth and eleventh segments; each pair is enclosed in a median transverse seminal vesicle. The lateral ends of the seminal vesicles are prolonged into sperm-sacs which project into the eleventh and twelfth segments respectively.

Spermathecæ are in four groups of about eleven each, and are totally embedded in the thick body-wall; they may be seen shining through the semi-pellucid wall. The spermathecæ are elongated, being 0·3–0·7 mm. in length and 0·09 mm. in diameter; they open to the exterior by a very thin and short duct.

Sexual setæ: the ventral setæ of fifteenth to twenty-first segments are enlarged and transformed into sexual setæ. They are about 2½–3 mm. in length, that is, about five or six times longer than the ordinary setæ. At the proximal end they have a thickness of about 60 μ, which diminishes to about 45 μ at the middle of the setæ. The sexual setæ are distinctly bent at the proximal end, while distally they are

nearly straight. The distal end is thickened and broadened to a diameter of about 80 μ just beneath the tip. One side of this broadened portion is strongly convex, the other side is flat or slightly concave or provided with a longitudinal cleft. The seta ends in a simple and rather clumsy tip, or in two tips with a slightly concave edge between them. In the type-specimen all the sexual setæ had only one point. In one of the specimens from Pietermaritzburg about half of the sexual setæ were provided with two tips while the other half had only one. There is a very characteristic external ornamentation consisting of somewhat irregular, rather densely crowded annulations, the distal borders of which are rather prominent and almost scale-like. From the distal border of these annulations a closely set row of very slender teeth, clinging to the surface of the seta, extend distalwards, and nearly reach the distal border of the next annulus. This ornamentation was not very clearly seen, as the sexual setæ were enclosed in a fine cuticular sheath difficult to remove. In the type-specimen the sexual setæ are not fully developed, and hence they differ in shape and structure.

There are no special glands connected with the sexual setæ projecting into the body-cavity as are found in other species of this genus.

The sexual setæ of M. natalensis are provided with a very strong mantle of longitudinal muscles, which at one end are fixed to the proximal portion of the setal sac, and at the other to the body-wall in the immediate neighbourhood of the setal pore.

Microchætus papillatus *Benham* f. typicus. Pl. XXXII, fig. 10.

Microchæta papillata *Benham*, "Descriptions of Three New Species of Earthworms," Proc. Zool. Soc. Lond., 1892, p. 141, pl. vii, figs. 5, 7; pl. viii, figs. 9, 10, 11, 13.

Microchætus papillatus *Benh.*; Michaelsen, "Oligochæta," Tierreich, x, p. 450. 1900.

Microchætus papillatus *Benh.*; Michaelsen, "Oligochæten von Natal und dem Zululand," Arkiv. Zool., iv, n. 4, p. 5. 1907.

Hab.—Durban, Natal; T. H. Bowker, 1898, Dr. Purcell, 1907, E. C. Chubb, 1911.

Pietermaritzburg; W. G. Rump, December, 1911.

Also, Durban (teste Benham) and Stamford Hill, near Durban (teste Michaelsen).

Ten specimens in all were examined, and these I call Microchætus papillatus *Benh.* f. typicus.

External Characters.—The dimensions of the mature specimens vary considerably; length 220–350 mm., diameter 10–16 mm., number of segments 324–490.

Colour yellowish-grey with sometimes a slight violet-grey tint on the upper anterior surface.

Head prolobous. Segments 1–3 simple, fourth to the ninth all divided by a furrow into two ringlets of about equal size, but the hinder ringlet, especially of the ninth segment, is often somewhat shorter than the front one. The tenth and following segments are simple or slightly biannulated.

Setæ are rather tender; they begin on the third segment and are strictly paired. The median ventral distance is equal to the middle lateral ($aa = bc$). The median dorsal distance equals about one-half of the circumference of the body ($dd = circa\ \frac{1}{2}u$).

The nephridial pores are in the lines of setæ *cd*.

Clitellum is saddle-shaped and extends over the segments 10–29 or 30 = 20 or 21; but it is not always sharply bordered in front and behind.

Copulatory Organs.—A pair of copulatory walls extend laterally over the five segments 16–20, being very prominent in the middle segments 17–19. These walls broaden the body at this region, especially in the nineteenth segment, and here ventrally the body is flattened. There are no copulatory cushions, or at least no distinct ones. There are generally two pairs of large copulatory papillæ with sexual setæ which are always in the lines of the ventral pairs of setæ. The position of these papillæ is rather constant. There is always a pair on the tenth segment, and a second pair either on the twenty-third segment (in seven specimens) or on the twenty-

ninth segment (in four specimens). In one specimen there was found a supernumerary papilla on one side of the twenty-third segment besides two normal pairs on the tenth and twenty-ninth segments. Another specimen possessed a supernumerary pair of papillæ on the eleventh segment besides the normal ones. Often there are to be seen a great number of very much smaller papillæ carrying all the ventral pairs of setæ of the clitellum region extending from the eleventh to the twenty-ninth segment. These, together with the large papillæ, form two continuous longitudinal series in the lines of the ventral pairs of setæ. Generally these smaller papillæ are indistinct or quite inconspicuous.

Male pores were not seen; probably they occur at the same points as in var. cæmenterii, i.e. at the furrow between the seventeenth and eighteenth segments, beneath the lines of setæ *c*.

Female pores are just in front of setæ *b* of the fourteenth segment.

Spermathecal pores are in groups of two to twelve in the lateral parts of the furrows between the twelfth and thirteenth segments and thirteenth and fourteenth segments, or between segments 12 and 13, 13 and 14, and 14–15.

Internal Anatomy.—It has been described by Benham. The following additional statements may be made. The sexual setæ are about 1·75 mm. in length and 75 μ in thickness in the middle. They are slightly sigmoid. The thickness diminishes towards the distal end, being only about 20 μ just beneath the distal tip. The tip is not simple and conical, but is sharpened to form a triangular pyramid, the lateral sides of which are deeply excavated. The distal third of the seta, with the exception of the extreme end, is ornamented. This ornamentation in the proximal parts consists of transverse or more or less oblique annulations, the scaly margins of which are irregularly toothed or pronged. Towards the distal end the annulations become interrupted, and ultimately pass into more or less irregular transverse lines which finally disappear.

Setal glands: the pairs of sexual setæ are provided with two or four setal glands. These are sac-like and compressed on the longitudinal axis so as to be much broader than long. Benham describes two glands, one in front and one behind the setæ. I generally found four of these glands forming a square, the centre of which was occupied by the pair of sexual setæ. In one specimen there was a transitional arrangement; here only two glands were obvious, and they were placed laterally; but in front and behind in the middle line the body-wall was distinctly elevated on the inner surface. Doubtless these elevations were due to the formation of two setal glands which did not break through the muscular layer of the body-wall. These specimens with only two setal glands in connection with each pair of sexual setæ come nearer to the variety cæmenterii described below. The difference between Benham's type and the specimens that I have examined must be regarded as being due to a casual variation.

Microchætus papillatus *Benh.* comes nearest to M. pentheri *Rosa* from the Cape Province; the principal difference is that in M. pentheri there are two strongly thickened septa in front of the gizzard, whilst in M. papillatus the septa in front of the gizzard are very tender.

Microchætus papillatus *Benham.* var. cæmenterii *n. var.* Pl. XXXII, fig. 11.

Hab.—Howick, Natal; in swampy meadows, W. Michaelsen, August 30th, 1911.

St. Peter's Churchyard, Pietermaritzburg, February, 1905.

Pietermaritzburg; E. Warren, May, 1912.

There were three mature specimens with several half-mature ones.

External Characters.—Dimension of the largest: length 540 mm., diameter 9–11 mm., body broadened in the region of the copulatory walls into a breadth of 22 mm.; number of segments about 600. Dimension of the smallest mature specimen: length 330 mm., diameter 7–10 mm., body

broadened in the region of the copulatory walls to a breadth of 22 mm. Number of segments about 530.

Clitellum distinctly bordered in front and behind, extends over the segments 12–24 (=13). Copulatory walls form sharp ridges in the lateral lines, extending over segments 16–20, highest at the eighteenth segment. A pair of flat but very distinct copulatory cushions, surrounded by a wall-like rim, extend medially from the ridges of the copulatory walls from the fore-border of the seventeenth segment as far as the hind-border of the twentieth segment. These cushions are broadest at the seventeenth segment, there reaching from the lines of setæ *d* nearly as far as the lines of setæ *b*, but the latter are distinctly outside the cushions, being separated from them by a distance of about 1·5 mm.

Copulatory papillæ are of very large size and bear the sexual setæ at the twelfth, fifteenth and nineteenth segments (in two mature specimens), or at the tenth, eleventh, twelfth, fifteenth and nineteenth segments (in one mature specimen), or at the fifteenth, sixteenth and twenty-eighth segments (in one half-mature specimen). Smaller papillæ occur on all other segments from the tenth to the twenty-eighth segment. All the papillæ, both large and small, occupy the lines of the ventral pairs of setæ, forming a pair of regular longitudinal series.

Spermathecal pores are in groups of 3–5 on each side on the furrows between segments 11–12 and 12–13.

Internal Anatomy.—The sexual setæ seem to be larger in this variety. The larger seta of a pair was 2·5 mm. in length, and proximally about 90 μ in thickness; the smaller seta was 1·8 mm. long and 80 μ wide. The sexual setæ are slightly sigmoid in shape. Distally they diminish in thickness. The tip is generally broadened in the plane of curvature, and ends in two thick and short teeth which are joined by a web-like membrane nearly as thick as the teeth. The tip is thus wedge-shaped. Sometimes, apparently through wear, the typical shape is not visible. The ornamentation of the distal end resembles that seen in the sexual setæ of typicus; but it

extends further towards the distal tip, where it is also more sharply defined.

Setal glands: each pair of sexual setæ is provided with two great glands lying medially, one in front and one behind the setæ. These glands differ in shape considerably from those of typicus; they have the shape of a sausage, and are about three times as long as thick and project freely into the body-cavity.

Remarks.—Var. cæmenterii differs from the typical form of Microchætus papillatus in the extent of the clitellum, in the possession of distinct copulatory cushions, in the position of the copulatory papillæ and the spermathecal pores, and in the shape of the sexual setæ and of the setal glands; perhaps also in the number of segments, which is larger even in the smallest mature specimen of the variety than in the largest mature specimen of typicus.

Microchætus sulcatus (*Kinb.*) f. typicus.

Tritogenia sulcata *Kinberg*, "Annulata nova [Continuatio]," Öfv. Ak. Förh., 1866, nr. 4, p. 98. 1867.

Tritogenia sulcata *Kinb.*; Michaelsen, "Revision der Kinberg'schen Oligochæten," Öfv. Ak. Förh., 1899, nr. 5, p. 415.

Tritogenia sulcata *Kinb.*; Michaelsen, "Oligochæta," Tierreich, x, p. 453. 1900.

Tritogenia morosa *Cognetti*, "Nuove specie dei Generi, "Pheretima" e "Tritogenia,"" Atti. Acc. Torino, xli, p. 13, t.f. 14–17. 1906.

Tritogenia sulcata *Kinb.* = T. morosa *Cogn.*; Michaelsen, "Oligochæten aus dem Westlichen Kapland," Denksch. med.-nat. Ges., Jena, xiii. p. 32. 1908.

Hab.—Natal; Port Natal (teste Kinberg); Durban (teste Cognetti).

Through the kindness of Prof. Théel I have been enabled to re-examine the type and confirm most of my former statements, but the following corrections are to be made.

The median ventral distance of the setæ obviously diminishes towards the segments which bear the copulatory walls, as I stated; but it does not diminish so far as to vanish, as I

erroneously supposed.[1] In the segments with the copulatory walls the setæ are obliterated, and in the neighbouring segments, seventeenth and twenty-second, the median ventral distance has diminished so as to equal the middle lateral distance, $aa = bc$, and only the converging lines of setæ, if continued over the segments 18–21, would meet each other in the middle line as stated correctly in my earlier description.[2]

The so-called median-ventral "papillæ" at the hinder part of segments 17 and 21 are not really papillæ, but only flat glandular patches; they are identical with the copulatory cushions at the eighteenth and twenty-second segments of var. howickianus (*n. var.*).

A comparison of the type of f. typicus with specimens of var. howickianus makes it probable that the number of segments of the type should be increased by one. From this there would result a greater conformity of the two forms, and since the type-specimen had been cut into pieces it is quite likely that a segment had been lost.

Var. howickianus *n. var.* Pl. XXXII, figs. 13–15.

Hab.—Howick, Natal; found under large stones in the rather dry clayey soil of a meadow, W. Michaelsen, August 30th, 1911 (two specimens).

External Characters.—Dimensions: length 80, 85 mm., diameter 6, 6·5 mm., number of segments 90, 91.

Colour of middle parts of body light greyish with a bluish tint, ends of body yellowish. Clitellum white.

At first sight it appears unintelligible how such a clumsy, soft worm could burrow into the rather hard soil in which it was found. But an examination of the internal anatomy showed that the head-portion is provided with a strong burrowing apparatus in the form of a muscular body-wall, thickened septa and strong gizzard.

Head prolobous.

Segments 1–3 simple; the fourth to the ninth are divided

[1] Michaelsen, W., "Oligochæta," 'Tierreich,' x. p. 453. 1900.

[2] Michaelsen, W., 'Öfv. Ak. Förh.,' 1899. nr. 5. p. 417.

into two ringlets, which are equal to one another in the fourth to the seventh segments, but the front ringlet is larger than the hinder in the eighth segment and even more so in the ninth. Segment 10 and the following are simple or indistinctly biannulated.

Setæ are absent from the first seven or eight segments. They are very small and simple, being 0·25 mm. long and 26 μ thick, quite straight, and have no nodules or ornamentation, strictly paired, and all ventral in position. The two pairs of a side approach one another; generally dd = about $\frac{2}{3}$ u and $aa = 2\frac{1}{2}$ bc. There is no distinct converging of the lines of setæ in the region of the copulatory wall as is seen in f. typicus. In the specimens of var. howickianus the ventral-median distances of setæ remain undiminished in the seventeenth and the twenty-third segments, and there are no setæ on the eighteenth to the twenty-second segments.

The inconspicuous nephridial pores were not detected in this form.

The clitellum is saddle-shaped, sharply interrupted between the lines of the ventral pairs of setæ. It extends over segments 13–22 (= 10).

Copulatory Organs.—There are two broad, pear-shaped copulatory walls extending over three segments, 19–21, and stretching as far as the borders of the clitellum and the lines of setæ a. They are separated from each other by a very small median longitudinal furrow. In front and behind the walls there is a transverse cushion of glandular tissue which differs a little from the glandular copulatory walls. These two cushions occupy the whole length of the eighteenth and twenty-second segments and reach laterally as far as the borders of the clitellum. Towards the copulatory walls the cushions cling closely to the obtuse angles formed by the fore- and hind-margins of the walls. In the first specimen examined the middle portions of the copulatory walls are constricted and somewhat irregularly wrinkled, and the cushions of the eighteenth and twenty-second segments are flat. In the other specimen the copulatory walls, together with the

cushions, form a large, rounded, roof-shaped projection, and the walls are quite smooth. The cushions of the eighteenth and twenty-second segments form the gable ends, the tops of which are connected with each other by the furrow which separates the two copulatory walls from each other. There are three pairs of copulatory papillæ bearing the ventral setæ of the twelfth and twenty-third segments and the lateral setæ of segment 12. The two papillæ of each side of the twelfth segment are placed upon a common glandular cushion. The lateral setæ of the fifteenth to the seventeenth segment are provided in the type-specimen of f. typicus with special glandular papillæ. Even if such glandular specialisations were present in f. howickianus they would not be conspicuous, as the space is occupied by the thick layer of the clitellum. I believe that they are absent in f. howickianus, just as the corresponding glands are also absent.

The male pores (on twentieth segment near the middle line in f. typicus) could not be detected.

The female pores on the top of minute semi-transparent papillæ, which are situated somewhat medially on the inner side of the lines of setæ *a* (not laterally to them as in f. typicus according to Cognetti), are placed at the hinder margin of the fourteenth segment, where there are two small convexities.

Spermathecal pores are inconspicuous; there are generally four pairs placed on the furrows between the eleventh and twelfth segments and the twelfth and thirteenth segments in the lines of the ventral and lateral setæ. The external pore of the left front pair was replaced by two in the specimen which was examined in detail.

Internal Anatomy.—The septa between segments 4–9 are all more or less thickened; septum 4–5 only slightly, 6–7 and 7–8 strongly, 5–6 and 8–9 moderately.

Alimentary Canal.—There is a large gizzard in the seventh segment scarcely reaching into the sixth segment. A pair of large, nearly globular calciferous glands occur dorso-laterally on the œsophagus in the ninth and tenth segments. The hearts of segments 9 and 10 cling closely

to the calciferous glands. The intestine is provided with a large typhlosole.

Circulatory System.—The dorsal vessel is single in the middle portion of the body as far as the fore-part of the twelfth segment; it is double in segments 11–9. The doubling of the dorsal vessel is complete, there being no union of the two vessels at the septa. Large moniliform hearts occur in segments 11–9.

Excretory System.—Excretory organs consist of small meganephridia.

Reproductive System.—Male organs: the male organs of the two sides are entirely separated from each other. There are two pairs of moderately large spermiducal funnels in segments 10 and 11; those of each side are enclosed in a common seminal vesicle which, ventrally to the œsophagus, extends through the tenth and eleventh segments. The vesicles expand laterally and are constricted by the septum between the tenth and eleventh segments. The basal parts of each seminal vesicle are prolonged into a very small fore and a moderately small hind sperm-sac, the former lying in segment 9 and the latter in segment 12. The vasa deferentia are very delicate, and are separate from one another at least as far as the fifteenth segment. I could not trace them to the external apertures.

Spermathecæ: there are generally four pairs which project freely into the body-cavity in the form of thin-walled blind sacs. In the specimen which was opened, the outer spermatheca of the left fore pair was replaced by two.

Sexual setæ: the ventral and lateral pairs of setæ of the twelfth segment are each replaced by a single sexual seta. These setæ are about 0·68 mm. in length, and at the proximal end 50 μ in thickness. They taper towards the distal end to a width of about 14 μ. They are quite straight and have no external ornamentation; but at the proximal two-thirds there is a conspicuous internal structure consisting of a rather rough annulation. I suppose that the ventral setæ of the twenty-third segment are also transformed into sexual

setæ, for these pairs, like the setæ of the twelfth segment, are provided with setal glands.

Setal glands.—The sexual setæ of the twelfth segment are closely accompanied by a number of rather large pear-shaped setal glands, seven at each side, forming with the two sexual setæ a closely crowded group on each side. The pairs of ventral setæ of the twenty-third segment, which have not been replaced by a single seta, are provided with a group of four pear-shaped setal glands which are distinctly smaller than the setal glands of the twelfth segment. In the fifteenth to the seventeenth segments there were no setal glands in the specimen which was examined.

Remarks.—The var. howickianus may be distinguished from f. typicus of Microchætus sulcatus by some external and internal features. In var. howickianus the lines of setæ are not converging towards the regions of the copulatory walls as in f. typicus. Other differences are to be seen in the position of the female pores, in the thickness of certain septa, and in the number of the setal glands; in typicus there are only four on each side of the twelfth segment, and in var. howickianus there are seven.

Our knowledge of the f. typicus of this species, based upon the study of badly preserved or immature specimens, is far from being complete. For this reason in the foregoing I have given as complete a description as possible of the var. howickianus. The main points in the external and internal anatomy of the variety will presumably agree with those of the typical form, and may be regarded as completing our knowledge of the latter.

Microchætus zuluensis *Bedd.*

Microchætus zuluensis *Bedd.*, "On two new species of Microchætus," Proc. Zool. Soc. Lond., 1907, i, p. 279, with figures.

Microchætus zulu *Michaelsen*, "Olig. v. Natal u. d. Zululand," Arkiv. Zool. iv, p. 6, fig. 3. 1907.

Hab.—Eastern Zululand; E. Warren, June, 1903 (immature

specimen). Mfongosi, Zululand; T. W. Jones, September, 1911 (several mature specimens).

Zululand (teste Beddard). Umfolozi, Zululand (teste Michaelsen).

Almost at the same time Beddard and myself published descriptions of an earthworm from Zululand which refer to the same species. Owing to Beddard's priority, my name, Microchætus zulu, becomes a synonym.

Professor Collett, of the Christiania Museum, has kindly lent to me for re-examination the type of Beddard's species, and I, consequently, am able to confirm the identity of M. zuluensis *Bedd.* and M. zulu *Mich.* The figure given by Beddard[1] differs considerably from the diagnosis given by me for M. zulu. But the text-figure is incorrect in many points, principally in the arrangement of the setæ and in the annulation. It shows all the segments simple and of equal length, while the type-specimen of M. zuluensis exhibits the same difference in the length of the segments of the body in front of the clitellum as the type of M. zulu, and also the same biannulation of segments 4–10.

Both descriptions were based upon immature or badly preserved specimens, and I now take the opportunity of giving a fresh description with the aid of well preserved material.

External Characters.—Dimensions of mature specimens provided with a clitellum: length 90 mm., diameter 8-9 mm. (at the clitellum 11), number of segments 102; length 145 mm., diameter 12–14 mm. (at clitellum 16), number of segments 133; length 185 mm., diameter 9–11 mm., number of segments 135.

Colour grey with a slight greenish tint dorsally, yellowish grey ventrally.

M. zuluensis is a rather clumsy, thick and short worm with a relatively very small number of segments. The variation in number is small, fluctuating in general between 131 and 135. But one extraordinarily small specimen shows a considerable variation, being composed of only 102 segments;

[1] Loc. cit., text-fig. 86.

it is probable that the specimen was not full-grown, although it was sexually mature.

Head indistinctly prolobous, if not zygolobous.

Segments 1–3 simple, 4–10 divided into two ringlets which are about equal in length in segments 4–6 or 7, while the hind one is shorter than the front one in segments 7 or 8–10. Segment 11 and the following are simple or slightly bi-annulated by a rather indistinct furrow in the middle zone.

The setæ begin ventrally on the sixth segment, laterally even further back. The ordinary setæ are extraordinarily delicate, difficult to detect, and very strictly paired. Median ventral distance distinctly larger than the middle lateral, *aa* = 1·5–1·8 *bc*. Dorsal median distance equals about two-thirds of the whole circumference of the body, *dd* = circa $\frac{2}{3}$ *u*. The position of the lateral pairs of setæ is somewhat irregular, and often distinctly different in two neighbouring segments.

Clitellum saddle-shaped; in Beddard's specimen it extends from the fourteenth (?) or fifteenth segment to the hinder border of the twenty-eighth segment, but at the fourteenth segment it is only vaguely developed. In the specimens from Mfongosi the clitellum was not distinctly bordered either in front or behind.

Copulatory organs: a pair of rather thick and rounded copulatory walls extend from the beginning, middle or end of the sixteenth segment to the end of the twenty-second segment. These walls are on the lines of the lateral setæ. They do not extend horizontally, and consequently they do not increase the breadth of the body as in some other species of this group, but they extend down vertically. Besides these copulatory walls there is a variable number of copulatory papillæ, which bear the sexual setæ, and generally occur in the lines of the ventral pairs of setæ. There are two groups of such papillæ. The front group consists of one, two or three pairs on segments 11–13, or on some of them. The most constant is the pair on the twelfth segment; the pair is absent in only one out of ten specimens. This excep-

tion is Beddard's specimen, and it bears only one pair of papillæ on the eleventh segment. Generally there is a pair of papillæ on the eleventh or on the thirteenth segment, if there are not pairs on each of the three segments 11–13. While the papillæ on the twelfth segment are very large and prominent, those of the eleventh and thirteenth are often very small, or at least one is very small, if there are three pairs. The papillæ of the eleventh segment in both specimens examined by Beddard differ from the others by occupying the place of the lateral setæ. In Beddard's figure these papillæ are situated between the ventral and the lateral pairs of setæ, and both of these pairs are shown in the figure in addition to the sexual setæ of the papillæ. A re-examination of Beddard's specimens shows that the sexual setæ of the papillæ on the eleventh segment are really the transformed lateral setæ, and the papillæ lie in the lines of the lateral setæ although somewhat shifted in position. The normal setæ are very small and difficult to detect, and are shown too distinctly in Beddard's figure ; also, the lateral setæ are much nearer to the ventral ones than indicated in the figure.

The papillæ of the hind groups are smaller than the large ones of the fore group. They constantly begin at the twenty-third segment, forming a continuous longitudinal series at each side. At the most there are five pairs on segments 23–27 ; the smallest number, found only on one specimen and on one side, was two papillæ on segments 23–24. There are never less than six papillæ in both series taken together.

Spermathecal pores: in the specimens on which I founded my M. zulu the spermathecal pores formed groups of 1–10 at each side on the furrows between segments 11–12 or 12–13 to 15–16. In one of the two recently examined mature specimens I could not see spermathecæ, just as Beddard failed to find them ; but in a second mature specimen, after having torn away all septa, I discovered a few very small globular spermathecæ. They were, however, very much fewer than in the original type-specimens.

Male pores: I could not detect the male pores in any

specimen. Beddard does not make any direct statement about them; but, from a certain remark,[1] we may assume that he thought that he had seen them in the furrow between the fourteenth and fifteenth segments. He says: "Assuming, however, that the male pores are upon the border-line of segments 14–15, a very usual position for them to occupy in this genus, . . ." In this I am not in accord with Beddard; the usual position for the pores to occupy in this genus is at the beginning of the copulatory walls, which do not begin before the sixteenth segment in this species. Only in certain species of this genus do the copulatory walls reach as far forward as the fourteenth segment, and in these the male pores may be seen at the furrow between the fourteenth and fifteenth segments; for instance, in M. modestus *Mich.* f. typicus. If Beddard is right, the only exception to this rule, in addition to M. zuluensis, would be M. pentheri *Rosa*. But Rosa did not see the male pores in this species, and his statement only depends on the observation that the sperm-ducts enter the body-wall in the fifteenth segment. It is quite likely that the sperm-ducts run backwards in the body-wall, and open to the exterior at the copulatory walls, which begin at the seventeenth segment. Personally, I am convinced that neither M. pentheri nor M. zuluensis are exceptions to the rule, and I believe that the pores seen by Beddard on the furrow between the fourteenth and fifteenth segments, right in front of the copulatory walls, are not the male pores but the female ones.

Female pores: in some of the specimens, including one of Beddard's type-specimens, which I examined, a pair of rather distinct pores could be seen at the hinder border of the fourteenth segment. They occurred between the lines of the ventral and lateral pairs of setæ—that is, in the same position in which Cognetti found them in M. sulcatus (Tritogenia morosa *Cogn.*). Generally they are more obvious by being placed on the top of a circular papilla which slightly presses backwards the border-line of the fourteenth segment. I feel

[1] Loc. cit., p. 279.

no doubt that these are the female pores, even without being able to confirm the opinion by anatomical sections, since the material is scarcely good enough for the purpose.

Internal Anatomy.—The septa between segments 4–9 are thickened; the one between the fourth and fifth segments is moderately strong, while those between segments 5–9 are very strong. The septum between the ninth and tenth segments is very tender, if not rudimentary or absent.

Alimentary Canal.—A large gizzard occurs in the sixth and seventh segments. The septum between the sixth and seventh segments is fixed in the middle zone of the gizzard. The œsophagus bears in the ninth, or ninth and tenth segments, a pair of calciferous glands which are in the form of lateral globular swellings. Intestine begins in the twelfth segment, and there is a large typhlosole.

Circulatory System.—The dorsal vessel is doubled from the fifth to the tenth segment, confluent intersegmentally. The last pair of hearts is in the eleventh segment.

Reproductive System. — Male organs: one pair of large spermiducal funnels occur in the tenth segment. They are enclosed in a pair of seminal chambers which extend laterally and dorsally, and look like sperm-sacs. A pair of flat, rounded sperm-sacs project from the septum between the tenth and eleventh segments into the eleventh segment.

Spermathecæ are globular, they have very tender and short ducts which are hidden in the body-wall.

Sexual setæ: the setæ, situated in the glandular cushions of the copulatory papillæ, are enormously enlarged and are transformed into sexual setæ. They are about 2·5–3·4 mm. in length and 85 μ in thickness at the proximal end; they are nearly straight except at the proximal end, where they are somewhat bent. Towards the distal end the diameter of the seta gradually diminishes to about 36 μ. The terminal portion is somewhat flattened laterally but broadens in the vertical direction to about 42 μ; it is then turned obliquely, or nearly transversely, and ends in an acute point. In profile the distal end is like a bird's head with a short and acute beak. The

fibrous internal structure, which is extremely conspicuous in this part of the seta, follows in its course this oblique bending of the tip, and then converges towards the acute tip. There is a faint annulation on the internal structure of the part of the seta just beneath the modified distal end, and to this annulation is added a more or less distinct external ornamentation consisting of irregular, scale-like projections. These often join to form irregular and bluntly-toothed transverse or oblique lines.

Setal glands: the internal glands surrounding the sexual setæ and corresponding to the external copulatory papillæ are circular in outline, and project more or less into the body-cavity. At most they are hemispherical, and are only indistinctly divided by some narrow furrows.

Microchætus colletti *Bedd.*

Microchætus colletti *Bedd.*, "On Two New Species of the African Genus Microchætus belonging to the collection of Oligochæta in the Museum of Christiania." Proc. Zool. Soc. Lond., 1907, i, p. 277, text-fig. 85.

Hab.—Zululand (teste Beddard).

Dr. R. Collett, of the Christiania Museum, has kindly entrusted to me the type-specimen of this species for a re-examination. I am able thereby to complete Beddard's description.

External Characters.—The number of segments is about 312. The six segments from the fourth to the ninth are all divided into two ringlets. Generally the hind ringlet is scarcely shorter than the front one, but in the ninth the difference in the length of the two ringlets is more obvious. Beddard notes the biannulation of "some" segments, but does not state exactly which segments are biannulated, and in the text-figure there is nothing to be seen of this biannulation, and there is no difference in the length of the first segments.

Setæ: the median ventral distance is somewhat longer than the middle lateral distances ($aa > bc$). The median

dorsal distance is distinctly smaller than half the circumference, at least at the middle and hinder portions of the body. It is difficult to see the condition in the front portion, as the type-specimen is dissected and the body-wall is irregularly stretched (dd = circa $\frac{2}{5}$ u).

Copulatory papillæ: the ventral pairs of setæ of the tenth, eleventh, twelfth and twenty-fourth segments are placed upon the top of copulatory papillæ. The papillæ of the tenth, eleventh and twenty-fourth segments are distinct, but those of the twelfth segment are less obvious.

Internal Anatomy.—Sexual setæ: I have examined the sexual (ventral) setæ of the twelfth and twenty-fourth segments; those of the twelfth segment have a length of 0·6 mm. and a maximum diameter of 32 μ, while those of the twenty-fourth segment are nearly twice as large, being about 1·0 mm. in length and 60 μ in maximum diameter. They are both sigmoid, and are provided with a distinct but not sharply bordered nodulus. They terminate in a simple point. With the exception of the extreme tip the distal third of the seta shows a fine ornamentation consisting of very small, irregularly toothed transverse ridges. The length of the ridges hardly reaches a sixth of the diameter of the seta. They are placed in a somewhat irregular system of two crossing spirals. These sexual setæ have been overlooked by Beddard, but they give to us the best distinguishing character of this species.

Remarks.—M. colletti *Bedd.* is nearly allied to two species from Natal—M. gracilis *Mich.* and M. ivari *Mich.* We might perhaps be justified in uniting these three species into one, M. colletti *Bedd.*, and to consider the examples from Natal as varieties of Beddard's Zululand species, which has the priority. But with the material at hand I think it best to keep them separated provisionally.

Microchætus gracilis *Mich.*

Microchætus gracilis *Michaelsen*, "Oligochæten von Natal und dem Zululand." Arkiv. Zool., iv, nr. 4, p. 8. 1907.

Hab.—Van Reenen's Kloof, Natal (teste Michaelsen).

Prof. Jägerskiöld, Director of the Gotenborg Museum, kindly lent to me the type-specimen for re-examination, and I am thereby enabled to make a certain correction to my former description.

In the original description it is said that segments 4–10 are all divided into two ringlets; but this is a slip, only the fourth to the ninth segments are biannulated. To a specialist this was evident from the statement that the hinder ringlet of the ninth segment was very much shorter than the front ringlet. This great difference between the lengths of the ringlets always occurs in the last of the biannulated segments.

The main difference in the anatomy of this species and M. colletti *Bedd.* is the shape of the sexual setæ. In colletti they are distinctly S-shaped, while in M. gracilis they are quite straight for nearly the whole length, and are only very slightly curved at the distal end. They are not provided with a distinct nodulus; also the elements of ornamentation consist of deep longitudinal scars.

The shape of the copulatory walls is also different in gracilis and colletti.

Microchætus ivari *Mich.*

Microchætus ivari *Michaelsen*, "Oligochæten von Natal dem Zululand," Arkiv. Zool., iv, nr. 4, p. 10, Text-fig. 4. 1907.

Hab.—Estcourt, Natal (teste Michaelsen).

I examined the type-specimen and found it in a worthless condition, and we must therefore rely on the original description.

This species differs from the nearly allied M. colletti *Bedd.* and M. gracilis *Mich.* by the shape of the copulatory walls, by the position of the copulatory papillæ (on the twenty-first segment), and chiefly by some points in the internal anatomy.

The sexual setæ resemble generally those of M. gracilis, but differ in the character of the ornamentation.

Finally, M. ivari differs from both of its allies in the

number of the setal glands; there are four or five of such glands connected with each pair of sexual setæ, while there are only two of them in M. colletti and M. gracilis.

Microchætus parvus *n. sp.* Pl. XXXII, fig. 12.

Hab.—Hilton Road, eleven miles N.W. of Pietermaritzburg, Natal; Dr. M. A—, July 28th, 1905 (one specimen).

External Characters.—Dimensions: length 54 mm., diameter 3–4 mm., number of segments 115. Perhaps the hind end was regenerated.

Colour, yellowish-grey. Head prolobous.

Segments 1–3 simple; the first and second are very short, the third is as long as the first two together. The fourth to the ninth segments are divided into two ringlets, and the furrows of annulation are quite as strongly marked as the intersegmental furrows. The ringlets of segments 4 and 5 are of equal length, and as long as the whole third segment. In the case of segments 6–9 the front ringlet bears the setæ and the nephridial pores, and is longer than the hind ringlet. In the tenth and following segments biannulation is indistinct or absent.

Setæ are rather small; they occur apparently from the third segment. Distances: *aa* somewhat larger than *bc*; *dd* equals about half the circumference of the body.

Nephridial pores are in the lines of setæ *c*.

The clitellum is indistinct and extends over about ten segments—from the twelfth to the twenty-first. The copulatory walls are broad longitudinal ridges just above the lines of the nephridial pores. They are distinctly prominent on segments 16 and 17, indistinct on segment 18, and hardly perceivable on segment 15.

The male pores occur on the copulatory walls in the furrow between segments 16 and 17 (or 15–16?). The sperm-ducts do not enter the body-wall before the furrow between segments 15–16.

Spermathecal pores are single or double, and occur in the

furrows between segments 13–14 and 14–15, just above the lines of the nephridial pores.

There are glandular cushions present in relation to the ventral setæ of segments 14, 16–18, 23–27, and on segments 13, 22, and 28 they are indistinct, or only occur on one side of the body. The cushions of segments 16–18 differ somewhat from the others in being not circular and small, but in occupying the whole length of the segments, and in being bordered on the inner side by a common longitudinal line.

Internal Anatomy.—The septum between the sixth and seventh segments is very tender if not absent; in the latter case the septum between the fifth and sixth segments is present and very tender. The septa between segments 7–8 and 8–9 are thickened and very strong, while all the posterior septa are very delicate.

Alimentary Canal.—There is a very large gizzard in the seventh or in the sixth and seventh segments. A single pair of nearly globular calciferous glands occur in the ninth segment as lateral appendages of the œsophagus. The intestine begins in about the thirteenth segment.

Circulatory System.—The dorsal vessel is doubled from the eleventh segment to the middle of the gizzard, that is, to the middle of the seventh segment. The last hearts are in the eleventh segment.

Reproductive System. — Male organs: one pair of sperm-duct funnels occur ventrally in the tenth segment enclosed in an unpaired common seminal vesicle. The lateral posterior corners of the vesicle are prolonged into a pair of somewhat broadened sac-like sperm-sacs which seem to project into the eleventh segment. The sperm-ducts pass backwards in a straight line as far as the end of the fifteenth segment, where they seem to enter the body-wall.

Spermathecal pores are single or in pairs. In the specimen examined they were single on both sides at the intersegmental furrow of segments 13–14, while in the furrow between segments 14–15 they were single on the right side and double on the left side. In this case the additional spermatheca was

placed medially to the normal one, and was smaller than the latter. The spermathecæ are of a stunted pear-shape, shortly and narrowly stalked, and their contents give to them a glittering appearance.

Sexual setæ: the ventral setæ of segments 13, 14, 16 18 and 22–28 or 23–27 are enlarged and transformed into sexual setæ. They are only slightly bent at the distal extremity, and are more or less flattened laterally like a sabre. The maximum dimensions are: length 0·96 mm., breadth 30 μ; and another example, length 0·78 mm., breadth 60 μ. The distal end of the sexual setæ is ornamented in a very characteristic manner, being covered with deep scars or cicatrices irregularly distributed or partly joined into small transverse groups. The proximal border of the scars is sharply marked, and is rounded or straight; they lie parallel to each other and to the border of the seta. The scars are as long as broad, or longer than broad; they flatten out and disappear distally.

Setal glands: a sexual seta is accompanied by two or three setal glands which project freely into the body-cavity. Generally these glands are bluntly pear-shaped, firm and opaque. The glands in segments 16–18 differ a little from the others in that they are mostly much longer, being club-shaped and about four times as long as broad; they are also not quite so firm and they are semi-translucent.

Remarks.—M. parvus is allied to M. modestus *Mich.*, and it differs mainly in the arrangement of the setæ, of the tubercula pubertatis, and of the cushions of the sexual setæ, as well as in the thickening of certain septa.

Microchætus beddardi *Benham.*

Microchæta beddardi *Benham*, "Studies on Earthworms II," Quart. Journ. Micr. Sci., (N. S.) xxvi, p. 78, pl. viii, figs. 1–8, 10, 1886.

Microchæta beddardi *Benh.*; Benham, "Description of Three New Species of Earthworms," Proc. Zool. Soc. Lond., 1892, p. 142, pl. viii, fig. 8.

Hab.—Natal (teste Benham).

I have had no opportunity of examining this species.

Fam. LUMBRICIDÆ.

Helodrilus (Allolobophora) caliginosus (*Sav.*) f. trapezoides (*Dug.*).

Helodrilus (Allolobophora) caliginosus trapezoides (*Dug.*); Michaelsen, "Oligochæta," Tierreich, x, p. 483. 1900.

Hab.—Howick, Natal; in detritus near the foot of the Umgeni Falls, W. Michaelsen, August 30th, 1911.

A peregrine species imported by man.

Helodrilus (Bimastus) constrictus (*Rosa*).

Helodrilus (Bimastus) constrictus (*Rosa*); Michaelsen, "Oligochæta," Tierreich, x, p. 503. 1900.

Hab.—Howick, Natal; in detritus near the foot of the Umgeni Falls, W. Michaelsen, August 30th, 1911.

A peregrine species imported by man.

ANALYTICAL KEYS TO THE OLIGOCHÆTA FROM NATAL AND ZULULAND.

A. KEY FOUNDED CHIEFLY ON EXTERNAL CHARACTERS.

1 *a*. Minute white or dirty grey worms not longer than 20 mm., less than 1 mm. thick. Male papillæ on the twelfth segment. Clitellum at the twelfth segment and the immediately adjoining parts of the eleventh and thirteenth segments. 2

1 *b*. Larger worms, at least 20 mm. long and thicker than 1 mm. Male papillæ further back than the twelfth segment. Clitellum occupies at least three complete segments including the sixteenth segment, if not beginning further back. 3

2 *a*. Constantly two setæ in a bundle.

Fridericia peregrinabunda *n. sp.*

2 *b*. More than two setæ in a bundle, viz. 4–6, the middle ones being smaller than the outer ones.

Fridericia perrieri (*Vejd.*)

3 *a*. At each setal segment there are more than eight setæ; they form nearly complete circles round the body. Prostate pores at the eighteenth segment, spermathecal pores four pairs at the intersegmental furrows 5–6 to 8–9.

Pheretima heterochæta (*Mich.*)

3 *b*. Every setal segment has in general eight setæ. . . 4

4 *a*. Setæ of the hinder end are much enlarged and are not placed in eight longitudinal rows.

Pontoscolex corethrurus (*Fr. Müll.*)

4 *b*. Setæ of the hinder end not, or not much, enlarged, in eight regular longitudinal rows. . . . 5

5 *a*. Six or seven segments of the pre-clitellar part of the body, viz. the fourth to the ninth or tenth segment, divided by a ringlet furrow, quite as sharp as the intersegmental furrows, into two ringlets; the front one bears the lateral nephridial pores and the setæ, if they are present.[1] 6

5 *b*. All segments are simple or only divided by more or less slight ringlet furrows, which are fainter than the intersegmental furrows, and are not restricted to a small number of segments. 14

6 *a*. Setæ all ventral; median dorsal distance of setæ equals about two thirds of the whole circumference of the body. Copulatory walls on segments 19–21, and they touch each other in the median ventral line.

Microchætus sulcatus (*Kinb.*)

α The median ventral distance between the innermost ventral setæ diminishes distinctly towards the copulatory cushions. . . f. typicus

β The median ventral distance between the innermost ventral setæ does not distinctly diminish towards the copulatory cushions. var. howickianus *n. var.*

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[1] This biannulation is not always easy to recognise, as often the setæ, which may be completely absent, and the nephridial pores are difficult to detect. But the biannulation may be distinguished by the fact that on front of the clitellum a certain segment-like part (really the hind ringlet of the hindermost biannulated segment) is somewhat shorter than the segment behind, while the next segment-like part (really the front ring of the hindermost biannulated segment) is distinctly longer than the posterior normal segments. When enumerating the segments of Microchætus species it must be borne in mind that often the first and second segments are retracted into the mouth, and are consequently invisible.

6 *b*. Outermost pairs of setæ in the lateral middle lines or even above them; median dorsal distance of setæ equals one-half of the whole circumference of the body or even smaller. 7

7 *a*. The median ventral distance between the innermost ventral setæ diminishes distinctly towards the copulatory walls, which occur on the fifteenth to eighteenth segments. Microchætus natalensis (*Kinb.*)

7 *b*. The median ventral distance between the innermost ventral setæ does not diminish distinctly towards the copulatory walls. 8

8 *a*. Copulatory walls extend over the whole length of the clitellum, twelfth to twenty-third or twenty-fourth segments. . . . Microchætus beddardi *Beah.*

8 *b*. Copulatory walls occupy only a part of the length of the clitellum, less than half of it. . . . 9

9 *a*. Copulatory walls occupy more than four segments. . 10

9 *b*. Copulatory walls occupy four segments or fewer. . 11

10 *a* Number of segments in mature specimens larger than 300. Copulatory walls stretch over segments 16–20, and are prominent laterally. Microchætus papillatus *Beah.*

α Clitellum extends from the tenth to the twenty-ninth or thirtieth segment; copulatory cushions indistinct . . . . f. typicus

β Clitellum extends from the twelfth to the twenty-fourth segment; distinct copulatory cushions stretch over segments 17–20 . var. cæmenterii *n. var.*

10 *b*. The number of segments in mature specimens is smaller than 150. Copulatory walls extend over the sixteenth (or part of it) to the end of the twenty-second segment, not prominent laterally. . Microchætus zuluensis *Bedd.*

11 *a*. Copulatory walls occupy the three segments from the seventeenth to the nineteenth. . . . 12

11 *b*. Copulatory walls are prominent on the sixteenth and seventeenth segments, indistinct on the eighteenth segment, and hardly recognisable on the fifteenth segment. . . . Microchætus parvus *n. sp.*

12 *a*. Copulatory walls are upon the median slope of a lateral projection occupying segments 17–19, or they may extend over the neighbouring segments 16 and 20. . 13

12 *b*. Copulatory walls are on the flat ventral side of the body, there being no lateral projections. Microchætus colletti *Bedd.*

13 *a*. A pair of large setal papillæ on the twelfth segment.
Microchætus gracilis *Mich.*

13 *b*. A pair of large setal papillæ on the tenth and twenty-first segments, and smaller ones on the eleventh and twelfth segments[1]. . Microchætus ivari *Mich.*

14 *a*. Clitellum begins far back, at least behind the twenty-fourth segment 15

14 *b*. Clitellum includes segments 14–16. . . . 16

15 *a*. Setæ strictly paired. Clitellum begins on the twenty-seventh or twenty-eighth segment, and reaches as far as the thirty-fourth or thirty-fifth. Distinct copulatory walls on segments 31–33.
Helodrilus caliginosus (*Sav.*) f. trapezoides (*Dug.*)

15 *b*. Setæ widely paired. Clitellum extends from twenty-sixth to thirty-first or thirty-second segment. Copulatory walls indistinct or absent. . Helodrilus constrictus (*Rosa*)

16 *a*. Two pairs of prostate pores on seventeenth and nineteenth segments, those of each side united by a longitudinal seminal furrow. 17

16 *b*. One pair of prostate pores or a single median one . 22

17 *a*. Setæ ventrally widely paired; dorsally separated (*dd* = *cd*) 18

17 *b*. Setæ strictly paired. 21

18 *a*. Head tanylobous; the dorsal appendix of the prostomium reaches as far as the furrow between the first and second segments. Clitellum extends from the thirteenth to the eighteenth segment; it may not begin until the middle of the thirteenth. . . Chilota braunsi *Mich.*

18 *b*. Head epilobous, the dorsal appendix of the prostomium does not reach as far as the furrow between the first and second segments. 19

19 *a*. Clitellum extends from the fourteenth to the sixteenth segment, ring-shaped, but ventrally somewhat lower.
Chilota wahlbergi *Mich.* f. typicus

19 *b*. Clitellum occupies at least a portion of the seventeenth segment. 20

20 *a*. Clitellum extends from the middle of the twelfth segment to the middle of the seventeenth segment.
Chilota trägårdhi *Mich.*
α Length, 80–105 mm.; diameter, $1\frac{3}{4}$–$2\frac{1}{3}$ mm. f. typicus
β Length at least 130 mm., diameter $3\frac{1}{2}$–4 mm
var. major *n. var.*

[1] The constancy of these characters is questionable, and it is advisable to examine the internal anatomy for distinguishing these species.

20 *b*. Clitellum extends from the thirteenth to the seventeenth segment, but often incomplete on the thirteenth and seventeenth segments, or on one of them.
Chilota warreni *n. sp.*

21 *a*. Setæ all ventral in position, median dorsal distance distinctly larger than half the circumference of the body.
Dichogaster bolaui *Mich.*

21 *b*. Outer pairs of setæ lateral in position; median dorsal distance equal to half the circumference of the body.
Kerria gunningi *Mich.*

22 *a*. Setæ separated $ab < bc < cd$. Prostate pores paired at the eighteenth segment.
Pontodrilus bermudensis *Bedd.* f. typicus

22 *b*. Setæ strictly paired. 23

23 *a*. Prostate pores paired at the seventeenth segment. Spermathecal pores paired at the furrows between the seventh and eighth segments and the eighth and ninth segments, or at one of them. . . . 24

23 *b*. Prostate pore and spermathecal pore single and median at the seventeenth and thirteenth segments respectively. Paired copulatory papillæ at the eleventh, thirteenth, and fifteenth segments. . Eudriloides durbanensis *Bedd.*

24 *a*. Setæ are all ventral in position; median dorsal distance distinctly larger than half the circumference of the body. Two pairs of spermathecal pores.
Dichogaster crawi *Eisen.*

24 *b*. Outermost pairs of setæ lateral in position; one pair of spermathecal pores at the furrow between the eighth and ninth segments. . Ocnerodrilus africanus (*Bedd.*)

B. KEY FOUNDED ON INTERNAL ANATOMY AS WELL AS EXTERNAL CHARACTERS.

1 *a*. Minute white or dirty grey worms, not longer than 20 mm., less than 1 mm. in diameter. Male papillæ at the twelfth segment, clitellum extending from the twelfth segment into the neighbouring eleventh and thirteenth segments. No muscular gizzard. (Fam. Enchytræidæ, gen. Fridericia). 2

1 *b*. Larger worms at least 20 mm. long, and thicker than 1 mm. Male papillæ further back than the twelfth segment. Clitellum occupies at least three complete segments, including the sixteenth segment, if not beginning further back (real earthworms). . . 3

2*a*. Constantly two setæ in a bundle. Spermathecæ without diverticula. . Fridericia peregrinabunda *n. sp.*

2*b*. More than two setæ in a bundle, 4–6; the middle ones being smaller than the outer ones. Spermathecæ with two diverticula. . . Fridericia perrieri (*Vejd.*)

3*a*. Clitellum includes the fourteenth to the sixteenth segments. Gizzard, if present, is placed before the region of the sperm-sacs. 4

3*b*. Clitellum begins behind the twenty-fifth segment. A muscular gizzard in the seventeenth and eighteenth segments. (Fam. Lumbricidæ). . . . 24

4*a*. One or two pairs of prostates open at the male pores, or near them, at the seventeenth or eighteenth segment, or at the seventeenth and nineteenth segments. (Fam. Megascolecidæ, with the exception of some scarce species). 5

4*b*. Prostates absent. (Fam. Glossoscolecidæ and some scarce species of Megascolecidæ such as Ocnerodrilus africanus). 14

5*a*. One pair of prostates open at the eighteenth segment. (Sub-fam. Megascolecinæ). 6

5*b*. One pair of prostates open at the seventeenth segment, or two pairs open at the seventeenth and nineteenth segments. 7

6*a*. At each setal segment there are eight widely paired setæ. Two pairs of spermathecæ open in the furrows between segments 7–8 and 8–9. No gizzard.
Pontodrilus bermudensis *Bedd.* f. typicus

6*b*. At each setal segment there are many more than eight setæ; they form nearly complete circles round the body. Four pairs of spermathecæ open at the intersegmental furrows of segments 5–9. A large gizzard. Prostate with racemose glandular portion.
Pheretima heterochæta (*Mich.*)

7*a*. In each post-clitellar segment six to twelve small sac-like micronephridia occur. Setæ all ventral in position. Two muscular gizzards present. (Sub-fam. Trigastrinæ, gen. Dichogaster). . . . 8

7*b*. In each post-clitellar segment there is one pair of large meganephridia. 9

8*a*. One pair of prostate pores at the seventeenth segment.
Dichogaster crawi *Eisen*

8 *b*. Two pairs of prostate pores at the seventeenth and nineteenth segments, those of each side united by a longitudinal seminal furrow. . Dichogaster bolaui (*Mich.*)

9 *a*. Setæ ventrally more or less widely paired, dorsally separated. Œsophagus without glandular or other appendages. One pair of spermiducal funnels in the tenth segment. Two pairs of spermathecal openings at the furrows between segments 7–8 and 8–9. (Sect. Chilotacea of sub-fam. Acanthodrilinæ). . . 10

9 *b*. Setæ strictly paired. 13

10 *a*. Spermathecæ with two diverticula. . . . 11

10 *b*. Spermathecæ with one diverticulum. . . . 12

11 *a*. Distal part of the penial setæ with exception of the outermost end ornamented by closely spaced toothed ridges encircling the seta. . . Chilota warreni *n. sp.*

11 *b*. Distal part of the penial setæ without distinct ornamentation, or with only a few scattered teeth.
Chilota trägårdhi *Mich.*

a Penial setæ of two distinctly different kinds, both of which have a simple distal tip, one of them ornamented with scattered teeth. Length 80–105 mm., maximum diameter $1\frac{2}{3}$–$2\frac{1}{3}$ mm. . f. typicus

β Penial setæ not distinctly different, both without ornamentation; one of them, if not both, ends distally in two minute claws joined together by a web-like membrane. Length 130 mm. or more, maximum diameter $3\frac{1}{2}$–4 mm. . var major *n. var.*

12 *a*. Diverticulum of spermathecæ cylindrical, much longer than the sac-like ampulla. Penial setæ smooth.
Chilota wahlbergi *Mich.* f. typicus

12 *b*. Diverticulum of spermathecæ kidney-shaped, without stalk, much shorter than the ampulla. Penial setæ at the distal part ornamented with triangular teeth grouped together in small transverse rows. . Chilota braunsi *Mich.*

13 *a*. Prostate pore at the seventeenth segment, spermathecal pore at the thirteenth segment, both pores unpaired. Paired copulatory papillæ on the eleventh, thirteenth, and fifteenth segments. Œsophagus with paired, compact, ribbon-like pouches (Sub-fam. Eudrilinæ).
Eudriloides durbanensis *Bedd.*

13 *b*. Two pairs of prostate pores at the seventeenth and nineteenth segments. Two pairs of spermathecal pores at the furrows between segments 7–8 and 8–9. Œsopha-

gus with a pair of chyle-pouches in the ninth segment. No muscular gizzard. (Part of sub-fam. Ocnerodrilinæ). . . . Kerria gunningi *Mich.*

14 *a*. One pair of spermathecal pores at the furrow between the eighth and ninth segments. No copulatory wall in the region of the clitellum. A pair of large chyle-pouches proceeding from the œsophagus in the hind part of the ninth segment and stretching freely forward. (Part of sub-fam. Ocnerodrilinæ).

Ocnerodrilus africanus (Bedd.)

14 *b*. Spermathecal pores more than one pair, either placed further back than the ninth segment, or three pairs at the intersegmental furrows of segments 6–9. Copulatory walls present in the region of the clitellum. A large muscular gizzard. Chyle-pouches, if present, in the ninth segment, not stretching freely forward. (Fam. Glossoscolecidæ). 15

15 *a*. Three pairs of spermathecal pores at the intersegmental furrows of segments 6–9. Setæ at the hinder end of the body distinctly enlarged, not placed in eight regular longitudinal rows. (Sub-fam. Glossoscolecinæ).

Pontoscolex corethrurus (*Fr. Müll.*)

15 *b*. Spermathecal pores further back than the ninth segment. Setæ at hinder end of the body not distinctly enlarged, placed in eight regular longitudinal rows. (Sub-fam. Microchætinæ). 16

16 *a*. One pair of spermiducal funnels in the tenth segment. . 17

16 *b*. Two pairs of spermiducal funnels in the tenth and eleventh segments. 22

17 *a*. Copulatory walls extending over the whole length of the clitellum, viz. over the segments 12–23 or 24.

Microchætus beddardi *Benh.*

17 *b*. Copulatory walls occupy only a part of the length of the clitellum, less than half of it. . . . 18

18 *a*. Copulatory walls occupy more than four segments, viz. sixteenth to the twenty-second segment. Sexual setæ 2·5–3·4 mm. long, nearly straight, distal end of the shape of a bird's head, distal part with internal annulation and external toothed transverse ridges.

Microchætus zuluensis *Bedd.*

18 *b*. Copulatory walls occupy four segments or less. . . 19

19 *a*. Copulatory walls occupy the three segments 17–19. . 20

19 *b*. Copulatory walls are prominent at the two segments 16–17, indistinct at the eighteenth segment, hardly recognisable on the fifteenth segment. Sexual setæ 0·76–0·96 mm. long, 30–60 μ broad, slightly bent at the distal end, flattened like a sabre, ornamented at the distal end by scattered fine scars.

Microchætus parvus *n. sp.*

20 *a*. Copulatory walls at the flat ventral side of the body, no lateral projections in their region. Sexual setæ 0·6–1·0 mm. long and 32–60 μ thick, bent like an S, provided with a nodulus distal to the middle, ornamented at the distal part by very small, irregular, toothed, transverse ridges arranged in two crossing systems of spirals.

Microchætus colletti *Beld.*

20 *b*. Copulatory walls on the medial slope of lateral projections which occupy segments 17–19 in addition to a part of 16 and 20. Sexual setæ without nodules. . . 21

21 *a*. Sexual setæ about 0·75 mm. long and 30 μ thick, nearly straight, bent very slightly only at the distal end, ornamented at the distal part by longitudinal scars arranged in two crossing spiral lines. Microchætus gracilis *Mich.*

21 *b*. Sexual setæ about 1·0 mm. long and 40 μ thick, nearly straight, bent very slightly only at the distal end, ornamented at the distal part by irregularly scattered scale-like projections. . Microchætus ivari *Mich.*

22 *a*. Setæ all ventral in position; median dorsal distance of setæ equals about two-thirds of the whole circumference of the body. Copulatory walls extend from the nineteenth to the twenty-first segment, touching each other in the median ventral line. Sexual setæ 0·68–0·75 mm. long, and at the proximal end about 50 μ thick, quite straight, no external ornamentation

Microchætus sulcatus (*Kinb.*)

α. The median ventral distance between the innermost ventral setæ diminishes distinctly towards the copulatory cushions. . . f. typicus

β. The median ventral distance between the innermost ventral setæ does not distinctly diminish towards the copulatory cushions.

var. howickianus *n. var.*

22 *b*. Outermost pairs of setæ in the lateral middle lines, or even above them. Median dorsal distance of setæ equals one-half of the whole circumference of the body. 23

23 *a*. The median ventral distance between the innermost ventral setæ diminishes distinctly towards the copulatory walls. Copulatory walls extend from the fifteenth to the eighteenth segment. Sexual setæ about $2\frac{1}{2}$–3 mm. long, and at the proximal end about 60 μ thick, distinctly bent at the thinner proximal end, the remainder nearly straight except at the distal end, where it is slightly bent, thickened and broadened to a breadth of about 80 μ. One of the broad sides convex, the other hardly convex. Tip rather blunt, or two tips with a concave edge between them; external ornamentation consists of somewhat irregular, rather densely crowded annulations, the distal borders of which are a little prominent; they are scale-like and covered by dense rows of very minute teeth.

Microchætus natalensis (*Kinb.*)

23 *b*. The median ventral distance between the innermost ventral setæ does not diminish distinctly towards the copulatory walls. Copulatory walls stretch over segments 16–20, and are prominent laterally. Sexual setæ 1·75–2·5 mm. long, and proximally 80–90 μ thick, slightly bent into the form of an S; external ornamentation consists of more or less oblique annulations, the scaly distal margins of which are irregularly toothed or pronged. . . Microchætus papillatus *Benh.*

a. Clitellum extends from the tenth to the twenty-ninth or thirtieth segment. Copulatory cushions indistinct; distal tip of the sexual setæ sharpened to form a triangular pyramid with deeply carved sides. . . . . f. typicus

β. Clitellum extends from the twelfth to the twenty-fourth segment. Distinct copulatory cushions stretch over segments 17–20. Distal part of sexual setæ generally end in two thick, short teeth, which are joined by a web-like membrane nearly as thick as the teeth. . . var. cæmenterii *n. var.*

24 *a*. Setæ strictly paired. Clitellum begins at the twenty-seventh or twenty-eighth segment, and reaches as far as the thirty-fourth or thirty-fifth. Distinct copulatory wall at segments 31–33. Four pairs of sperm-sacs in segments 9–12. Spermathecæ present.

Helodrilus caliginosus (*Sav.*) f. trapezoides (*Dug.*)

24 *b*. Setæ widely paired. Clitellum extends from the twenty-sixth to the thirty-second segment. Copulatory walls

indistinct or absent. Two pairs of sperm-sacs in the eleventh and twelfth segments. No spermathecæ.

Helodrilus constrictus (*Rosa*)

EXPLANATION OF PLATE XXXII,

Illustrating Professor W. Michaelsen's paper, "The Oligochæta of Natal and Zululand."

Fig. 1.—× 100. Chilota warreni *n. sp.* Distal end of a penial seta of the first form.

Fig. 2.—× 100. Chilota warreni *n. sp.* Distal end of a penial seta of the second form.

Fig. 3.—× 100. Chilota braunsi *Mich.* Distal end of a penial seta.

Fig. 4.—× 1000. Chilota trägårdhi *Mich.* var. major *n. var.* Distal end of a penial seta.

Fig. 5.—× 100. Chilota trägårdhi *Mich.* var. major *n. var.* Distal half of a penial seta.

Fig. 6.—× 1000. Dichogaster crawi *Eisen.* Part of a penial seta.

Fig. 7.—× 30. Dichogaster crawi *Eisen.* Spermatheca.

Fig. 8.—× 100. Microchætus natalensis (*Kinb.*). Distal end of a sexual seta.

Fig. 9.—× 1·5. Microchætus natalensis (*Kinb.*). Clitellar region from the ventral side.

Fig. 10.—× 1000. Microchætus papillatus *Benh.* f. typicus. Distal end of a sexual seta.

Fig. 11.—× 1000. Microchætus papillatus *Benh.* var. cæmenterii *n. var.* Distal end of a sexual seta.

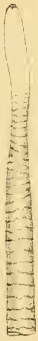
Fig. 12.—× 100. Microchætus parvus *n. sp.* Sexual seta.

Fig. 13.—× 3·5. Microchætus sulcatus (*Kinb.*) var. howickianus *n. var.* Clitellar region from the ventral side.

Fig. 14.—× 3·5. Microchætus sulcatus (*Kinb.*) var. howickianus *n. var.* The clitellar region from the ventral surface of another individual.

Fig. 15.—× 100. Microchætus sulcatus (*Kinb.*) var. howickianus *n. var.* Sexual seta.

1 × 100.



2 × 100.

3 × 100.

4 × 1000.

5 × 100.

6 × 1000

7 × 30.

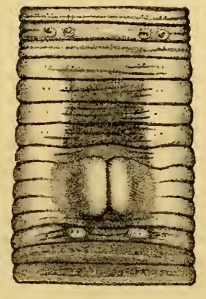
8 × 100.

9 × 15.

10 × 1000.

11 × 1000.

12 × 100.



13 × 3·5.

14 × 3·5.

15 × 100.

Michaelsen del. Huth Lith^{e} London.

OLIGOCHÆTA OF NATAL AND ZULULAND.