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The young one consists of a rounded prostomium, followed by 6 chaetigerous segments, and a rounded anal segment, which is nearly as large as the prostomium.

The mouth lies between this and the 1st segment, which is not ventrally perforated by it as in the adult. The 1st segment bears only the dorsal bristles; the rest have the ventral hooks in addition. The dorsal chaetae, as in the adult, are long capilliforms, 3–6 in a bundle; the four ventral hooks, which are precisely like those of the adult, are sunk in a pit, but are capable of being protruded, as a slight pressure on these soft-bodied young ones readily demonstrates.

There are no gills, and the dorsal cirrus is at present represented by only a small spherical bladder-like structure just behind the ventral limit of the dorsal bundle of bristles.

It may be noted that Baird records that amongst his specimens several had "attached to their under-surface animals which are doubtless parasitic on them." It seems, however, to be likely that he had before him the young ones.

It is perhaps remarkable that all those *Hipponoe gaudichaudi* that have been examined microscopically have proved to be females. I found that to be the case; McIntosh and Moore both described their specimens as being distended with eggs. It seems, then, that the male is yet to be discovered, and no doubt the worm would repay anatomical study if we could get wellpreserved material.

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ART. XXII.—Oligochaeta from the Kermadec Islands.

By W. B. BENHAM, D.Sc., F.R.S.

[Read before the Otago Institute, 7th July, 1914.]

THE only species of earthworm hitherto recorded from the Kermadecs is Rhododrilus kermadecensis, described by myself* in 1904, and this species was founded on a single specimen collected by Captain Bollons. It was therefore with feelings of interest that I received from Mr. Oliver a considerable number of earthworms which I expected would afford further material for determining the faunistic relations of the group of islands. Some of the smaller worms appeared on a first inspection to agree in general size and colour with Rhododrilus, and, owing to various calls on my time, I set the tubes aside till I was at liberty to examine them thoroughly. When, however, I came to investigate them it was with great disappointment that I found that all the earthworms belong to the family Lumbricidae, characteristic of the Northern Hemisphere, and to species which have been widely disseminated by human agency. This is the more surprising as but little cultivation has been carried on, for the only inhabitants have been Mr. Bell and his family. But while it is certain that these Lumbricids have been introduced, the exact means by which this introduction has been effected is not in all cases evident. It may be that the cocoons were amongst seeds imported for grass or vegetables or other plants, or perhaps they were in the material used for packing, or, if living plants have been imported into the Kermadecs from New Zealand with a fair amount of soil at the roots,

* Trans. N.Z. Inst., vol. 37, p. 298.

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then it is possible that living worms were also present, provided that these were of small or moderate size. But similar importations have been recorded in many parts of the world—see Michaelsen (11)*—and there is no doubt that it has occurred in this case.

In addition to the earthworms, or "megadrilous Oligochaets," Mr. Oliver also collected two species of "microdrilous" genera, and on a previous occasion I received another species from Captain Bollons. These belong to the two families *Enchytraeidae* and *Tubificidae*. The *Microdrili* are small in size, and the majority are aquatic in habit, and, owing to the fact that very little is known of the *Microdrili* outside North America and Europe, and of recent years India, it is impossible to use the facts in any discussion as to geographical relations of the islands. For instance, three species of Enchytraeids, all introduced northern forms, have been recorded from New Zealand by Beddard (5) and myself (1); and three species from the sub-antarctic islands described by myself (2, 4) as new. From Australia, in addition to two introduced species, Michaelsen (12) has described two species from south-west Australia.

Of the family Tubificidae, two species were described by me from the lakes of New Zealand (1) and two from the subantarctic islands (4), while one species described by me as new is identified by Michaelsen as being in reality an introduced European form. From Australia one species of Clitellio has been recorded by Michaelsen (12), while I described two species (a Tubifex and a Branchiura) from Mount Kosciusko (3). We are thus in need of very much further work on these smaller worms before they can be employed as evidence for geographical purposes. So far as is known, however, the " home " of the Enchytraeidae is, like that of the Lumbricidae. the Northern Hemisphere; and though I describe these as new species I am quite prepared to admit that they may have been introduced into the Kermadecs. Since it is known that a single cocoon formed by such a worm as an Enchytraeid may contain several eggs or embryos, the arrival of such a cocoon, by whatever means it may be transported, in an island such as Sunday Island is sufficient to start a new colony of that species. For instance, Michaelsen (9, p. 11) records for Lumbricillus maximus that in one cocoon he opened there were as many as 33 eggs; in others, from 20 to 30 embryos.

Fam. ENCHYTRAEIDAE.

Fredericia bollonsi sp. n.

Three well-preserved specimens were received from Captain Bollons in 1904, without any definite information as to the conditions under which

they were collected. One of these was stained and mounted as an entire object, and later cut into sagittal sections; another was similarly studied, and then cut into a series of transverse sections.

As the specimens are all more or less curved or curled, it is only possible to give approximate measure-



FIG. 1.—F. bollonsi. A chaeta.

ments; they measure from about 12 mm. to 16 mm., and in a shorter one I counted 56 segments.

The chaetae are two in each of the dorsal and ventral bundles, and this number is retained throughout the worm; only here and there in a very

* These numbers refer to the list of works given in the bibliography at the end of the paper.



few segments was a third chaeta present in a bundle. The chaetae are straight and of equal lengths.

The clitellum covers segments xii and xiii, and about half xi.

The head pore lies between the prostomium and peristomium; the first dorsal pore occurs in segment vii. These dorsal pores, as Eisen has pointed out in his account of some American species of the genus, do not lie in the intersegmental furrows, but at a little distance from the anterior septum of the segments, at about one-quarter the distance between the two septa.

The brain is convex posteriorly.

The pharynx lies in segment iii, and has the usual bisymmetrical, nonciliated pad of long columnar cells on its dorsal wall, through which the ducts of the septal glands open.

The oesophagus passes through the following segments as a straight narrow tube lined with low ciliated cells, outside which is a rich vascular



FIG. 2.—F. bollonsi.

A coelomic corpuscle, seen edgewise and in face (from camera outline). plexus. In segment xiv the gut enlarges, and this enlarged region, which traverses segments xiv, xv, and xvi, is constricted at the septa. In these segments the epithelial cells assume a very characteristic form and arrangement, which has been utilized by Eisen (7) as one of the diagnostic features of the genus. The cells are very tall, and bear long cilia, and amongst them, as that author has shown in a series of beautiful drawings, are found other cells, each of which is hollowed out by a canalicule which at its base curves at right angles to the

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axis of the cell. These cells, which were studied years ago by Michaelsen, who termed them "chylus cells," are not all of the same height, so that the surface of the epithelium is very irregular.

In segment xvii this region of the chylus cells passes into the ordinary intestine, in the cavity of which dirt accumulates. The epithelium is lower, the cells being only about one-quarter the height of those in the preceding region, and the cilia shorter. There are here no chylus cells.

The dorsal vessel becomes evident at about the 20th segment: in one case I noted it in the 19th; in another in the 21st. I did not attempt to trace out the vascular system.

Septal glands lie in segments iv, v, and vi.

There is on each side a simple peptonephridium, lying below the oesophagus in segments iii to vi; at its hinder end it branches or rather bifurcates, one branch being narrow and short.

The nephridia have a large ante-septal region, consisting of the usual mass of connective tissue traversed by a fine canal which winds about therein. After passing through the septum it enters and traverses the post-septal region, which is distinctly less in extent than the ante-septal. It is difficult to trace out the details or to reconstruct the outlines from the study of sections, but in the series of transverse sections I counted 13 sections through the ante-septal and 9 sections through the post-septal regions respectively. The duct leaves the latter near its commencement, close behind the septum.

The Genital Apparatus.—The testes are lobulated. The sperm-funnel has the usual massive form; it is apparently somewhat pyriform in shape, though it is abruptly bent on itself, and it appears to be rather broader than long, unless it has shrunk unequally. This region is made up of



glandular cells radiating from the narrow sperm-duct which traverses it in an eccentric course, for in sections, both longitudinal and transverse,

it is seen to lie nearer the mesial than the lateral, nearer the ventral than the dorsal surface. At its anterior free end the gland carries a plate of low ciliated cells, which surrounds the entrance to the duct-the true "funnel." This plate has only a slight elevation above the gland-cells. After leaving the funnel the spermduct passes through the septum as a narrow tube which is fairly convoluted before it enters and traverses the glandular "prostate." The prostate, or "atrium" as it is usually termed, is a hemispherical mass of gland-cells surrounded by a thin sheath of muscle, and resembles the organ figured by Eisen for several of the American species. The male pore,



FIG. 3.-F. bollonsi. Longitudinal section through the sperm-funnel. a, ciliated cells; b, glandular (prostate) cells; b', the same cut transversely and obliquely; c, por tion of the sperm-duct traversing the glandular region; c', the same outside.

situated in segment xii, in line with the ventral chaetae, which, of course, are absent in this segment, lies in a slight depression of the surface, surrounded by a distinct folded lip, as seen in the entire worm.

XII

XIII

FIG. 4.—F. bollonsi. Diagrammatic reconstruction of the reproductive organs in side view. The extent of the clitellum is indicated by the thicker body-wall dorsally; the segments are numbered. a, sperm-sac; b, testis; c, funnel of the sperm-duct; d, ovary; e, atrium and male pore; f, ovum in ovisac; g, nephridium.

This is but a single sperm-sac, which occupies segment x, and communicates with segment xi, itself filled with developing spermatozoa. There is no posterior sac.

The egg-sac contains a large ovum, lying in segments xii, xiii, pushing the septum backwards so that it rests against the hinder end of xiii. Other eggs of less size lie free in xii, and the ovary has the usual position on the anterior septum of this segment.

The spermatheca is a nearly spherical but somewhat pyriform sac, which communicates with the oesophagus at the hinder end of segment v by a narrow duct. The wall of the "ampulla" is differentiated by the character of its epithelium into two moieties-that moiety nearer the oesophagus is lined by gland-cells which are of small height over about half the circumference of the ampulla, as seen in longitudinal section; but at about the equator the cells rather suddenly increase in height, forming a ring-shaped diaphragm projecting into the cavity. Below this, nearer

the exit of the duct to the exterior, the epithelium again becomes low, and the cells have lost the glandular character. It is in this moiety that the spermatozoa are found; it corresponds to the diverticula, which in most species of *Fredericia* form prominent outgrowths round the exit of the duct; but in this species, as in a few others, this "storage-chamber" does

FIG. 5.—F. bollonsi. A spermatheca, drawn from a cleared specimen. a, duct; b, sperm-reservoir; c, furrow; d, ampulla; e, opening into the oesophagus; f, opening to the exterior.

FIG. 6.—F. bollonsi. Longitudinal section through the spermatheca, but not in its median plane. a, duct; b, sperm-reservoir; c, "diaphragm-cells"; d, ampulla; e, the dotted lines indicate the position of the oesophageal communication, which is present in the neighbouring sections; f, circular muscles of duct. The position of the nuclei in the cells is diagrammatic.

not project beyond the outline of the ampulla. As seen in transverse section it is single, it is not a double rudiment; it surrounds the ampulla continuously, and in the entire specimen it can be seen, too, to be separated from the ampulla by only a slight constriction, which I did not observe in the sections. The duct of the spermatheca takes its origin at the apex of a conical group of cells which project far into the cavity of the ampulla; hence in longitudinal sections the cavity is divided into three chambers—a pair of smaller and one median larger, the "pair" being really continuous round the circumference. The duct, after leaving the ampulla, remains as a narrow tube, which passes obliquely downwards and forwards to its pore at the anterior end of segment v; here it opens directly to the exterior without any glandular annexe. The wall of the duct consists of an epithelium surrounded by a coat of muscle. The duct is about twice the length of the ampulla. Remarks.—So far as my acquaintance with the literature enables me to compare this worm with those previously described, it must be regarded as new, for amongst those species of the genus in which the spermatheca is without diverticula, as enumerated by Michaelsen (10), Eisen (7), Bretscher (6), and others, I find none that agrees in all points with the present one. From a superficial examination it seemed likely that it would fall into the species F. bisetosa Levinsen, with which it agrees in the limited number of chaetae per bundle, and in one or two other features ; but, as Michaelsen states that the spermathecae are provided with "zwei sich gegenuberstehenden, kugeligen frei abstehenden Divertikeln," it is impossible to bring it within that species; moreover, it disagrees on other grounds. All the species hitherto described in which the diverticula are absent differ from the present in one or more other characters, such as the number of chaetae in the bundle, the presence of glands at the external opening

of the spermathecal duct, the distribution of the chylus cells, relative size of ante- and post-septal portions of nephridium, and so forth.

The species without diverticula to the spermathecal ampulla are: F alba Moore, F. bulbosa Rosa, F. striata Levinsen, F. harrimani Eisen, F. johnsoni Eisen, F. fuchsi Eisen, and F. sonorae Eisen. All these have more than 2 chaetae in each bundle. F. alba has, moreover, the first dorsal pore on segment vi, instead of in the usual segment vii; F. bulbosa has generally 4 chaetae per bundle, though this number is reduced to 2 in the posterior segments.

Hence the present worm does not fall into any of the above species; but how far the number of chaetae may be relied on as diagnostic when certain other structures agree in two species I do not attempt to decide (see below); there may be a certain range of variation, and it is also to be noted that in F. bulbosa glands may (according to Ude and Moore) or may not (fide Rosa) be present at the exit of the spermatheca.

The species in which the number of chaetae is limited to 2 per bundle are: F. bisetosa Levinsen, F. leydigi Veydovsky, F. oligosetosa Nusbaum, F. monopera de Martiis, F. diachaeta Bretscher, and F. clitellaris Bretscher; but each of these differs from the species under discussion in various other anatomical features.

As to the extent of the chylus cells, it is only by Eisen that this is used as one of the specific characters.

The majority of the species of Enchytraeids has, it seems, only been studied in the fresh state on the entire or dissected specimens, hence such a matter has been overlooked; moreover, it is only of recent years that these chylus cells have been investigated outside one or two common European species. Certain features can only be properly and accurately noted in fresh specimens which can be teased out: such things as the relative lengths of the spermathecal duct, the funnel of the sperm-duct, the exact form of the nephridium-these cannot be well noted in sectionized worms. It thus comes about that when one is limited to preserved material it is difficult to compare one's observations with those recorded by other observers who had fresh and perhaps an abundant supply of such worms; and it is therefore with some hesitation that I bestow a new name on this worm, for I feel that it is by no means unlikely that it is already known, for Michaelsen (9, p. 19) writes of a species found at St. Paul and New Amsterdam in the Subantarctic region: "Whether this Fredericia is F. bisetosa or some other species doubtless it has been introduced into these islands of the Southern Hemisphere. The 'home' of Fredericia is the north temperate region. The species of Fredericia of the Southern Hemisphere are, so far as can be decided, all wanderers."

The only species of the genus that has been recorded from New Zealand is a widely distributed form—F. galba (or F. antarctica of Beddard), from which the present one differs in several respects.

Fredericia bollonsi var. oliveri.

A collection of five specimens of this variety was forwarded to me by Mr. W. R. B. Oliver with the other material. They were found "under nikau-palm leaves, on damp ground, on the terraces, Sunday Island, July, 1908."

They measure from 10 mm. to 15 mm. in length, and have from 48 to 50 segments. From a study of entire specimens I supposed that this was a different species from the above, but after examination of sections, both

transverse and longitudinal, I can find no difference from it except in the chaetal formula.

The chaetae are straight rods, arranged in a fan-shaped manner; the dorsal bundles contain usually 6 anteriorly to the clitellum, and 4-6

FIG. 7.—F. bollonsi var. oliveri. A group of lateral chaetae from the 10th segment (camera); the tips are restored. posteriorly. The ventrals have 6 or 7 anteriorly, and posteriorly may have but 4, though usually the number is greater. The number in both bundles occasionally drops to 3 in some of the segments. The chaetae are not all alike in length, those in the middle being shorter than those on the outside.

All the specimens collected by Captain Bollons agreed in having, practically throughout the body, only 2 chaetae; all these in Oliver's collection have the above arrangement. Had I found the numbers mixed in the two lots, there would be

no doubt as to the validity of placing them in one and the same species; but I am faced with a doubt as to whether this marked difference in the chaetal formula warrants one in forming even a new variety, for it does not appear that any study has been made as to the extent to which variation in this feature may go. Usually the number of chaetae forms one of the diagnostic features; but it seems to me preferable to make this a variety under the circumstances of their collection.

Fam. TUBIFICIDAE.

Rhizodrilus kermadecensis sp. nov.

Four specimens were found in a "waterhole, on Meyer Island, 24/4/08." They are a good deal curled and twisted, so that it is difficult to give actual measurements, but approximately they would, I think, be about 40 mm. in length.

The prostomium is somewhat bluntly pointed—a rounded cone.

The chaetae are all alike, bifurcated hooks similar to those of Tubificids generally. The upper or distal prong is longer and slenderer than the lower prong, which is about twice its thickness.

In the dorsal bundle there are 5 or 6 in the ante-clitellar segments and 2 in the rest of the body. The ventral bundles contain 4-6 in the ante-clitellar segments and 3-2 posteriorly.

The clitellum occupies segments $\frac{1}{2}x$, xi, xii, The free e and $\frac{1}{2}xiii$ —that is to say, that in the case of the

first and last the glandular thickening ceases at the level of the chaetal ring.

The male genital pore is median, in segment xi; as is also that of the spermatheca, in x. The pore in each case is longitudinal, with somewhat overhanging lateral lips. These are especially noticeable in the case of the male pore.

The Male Apparatus (fig. 9).—The testes occupy the usual position.

The sperm-funnel is very wide, flattened, and lies in the hinder wall of segment x. From it issues the sperm-duct, which takes a nearly straight course to the hinder end of segment xi. This first portion of the duct is clothed with a continuous covering of tall club-shaped coelomic epithelial

FIG. 8.—R. kermadecensis. The free end of the chaeta.

cells, which constitute a diffuse "prostate," as in other species of the genus. When it enters segment xi it lies low down, close to the nerve-cord; but

by the thicker region of the body prostatic covering of sperm-duct transverse duct with narrow lumen transverse OVARY atrium " d. spermatheca; 01 wide lumen

testis; t with

duct

muscular

ovisac; j, posterior sperm-sac.

sperm-sac;

anterior

a, anterior chamber;

spermiducal

4.5

wall dorsally

it gradually passes outwards and up. wards to lie at the side of the oesophagus at about the middle of the segment. It continues to rise till at the hinder end it is on the level of the roof of the oesophagus, or even higher. At this point the prostate cells cease, the sperm-duct bends abruptly downwards, and passes somewhat forwards and outwards to open into a suddenly enlarged terminal "atrium," or "penial sac" as Moore (13) calls it.* The atrium, in its turn, communicates with the posterior extremity of the invaginated body-wall, which encloses a chamber to which Goodrich has given the name "spermiducal chamber," a median structure which opens by a longitudinal slit-like aperture to the exterior.

The sperm-duct, from funnel to its opening into the atrium, is lined with ciliated epithelium, outside which is a layer of circular muscles, as Goodrich has figured. At its entrance into the atrium the duct traverses a group of large (? gland) cells which project into the wide lumen of the atrium, the wall of which is muscular. The anatomical relations suggest that this region is eversible, or is a part of the "chamber": the muscular duct would then act as a "ductus ejaculatorius." In some species of the genus this region has rather tall gland-cells forming the epithelium, but in the present case the cells are low, and not apparently glandular. However, it may be that in certain phases of sexual maturity they do become higher, and take on a definitely glandular structure. The "spermiducal chamber" (or "atrium" as Moore, unfortunately, calls it) is a hemispherical sac projecting into the cavity of the segment, occupying nearly half its extent. It is, as Goodrich (8) has shown, merely

* It seems to me that this region corresponds to what is usually called "atrium" in the other Tubificids; the term " penial sac " is used in another sense.

a depression of the body-wall, formed during the growth of the worm. It is very muscular, and is provided with muscles which connect it with the

body-wall. It receives the two spermducts on its posterior face, close on each side to the nerve-cord.

Segment x is filled with developing spermatozoa; and there are two median sperm-sacs-an anterior sac, which passes into segment ix, communicating with segment x around the dorsal vessel; and a posterior sperm-sac entering segment xii, and, in another individual, into segment xiv, and lying below the ovisac, from which, however, it is quite distinct; it does not project into it, as it does in R. pilosus, for instance.

The ovary has the normal position attached above the sperm-duct, and there is a large ovisac occupying segment xii, in which are 2 large ova, filled with yolk-spherules. In the individual cut transversely, the sac extends into at least the 13th segment.

The spermatheca is paired in segment x; each is a large ovoidal sac, from which the duct is not distinctly FIG. 10.-R. kermadecensis. Plan marked off from the ampulla externally. of the male ducts, supposed The ampulla lies obliquely across the to be seen from above with the roof of the spermiducal segment, and reaches from near the chamber removed. The prolateral to the median line. The duct is portions are not accurate. The indicated in section by the glandular organs on the right side are and muscular thickening of the wall; shown in section. a, prostate; b, transverse duct; c, atrium; its diameter decreases gradually till it d, cut wall of spermiducal is very slender, where it enters the chamber; e, its external openbody-wall. The right and left spermaing. thecae open into a shallow, wide, median depression corresponding to the median spermiducal chamber.

In the individual sectionized sagittally, I find that the duct of each spermatheca crosses over the median line below the nerve-cord to open externally on the opposite side of the body.

Other Viscera.-There is a complex system of capillary blood-vessels on the inner surface of the body-wall, as has been described for other species. The dorsal vessel lies laterally on the right side in the genital segments. I noted the peculiar unicellular valves in the main vessels, as described originally by Goodrich.

The pharynx is surrounded by glands which fill segments iii, iv, and v, and the necks of these can be traced through the dorsal ciliated pad on the roof of the pharynx to open into its cavity.

I have found it impossible to make out details of the nephridial structure, but it recalls a Tubificid rather than an Enchytraeid organ. The canal coils loosely, and is surrounded by enlarged coelomic epithelial cells.

In the body-cavity I noted a good number of round granular vacuolate cells, the coelomic corpuscles, which in some segments, as in those immedi-

ately behind the pharynx, are so densely massed as to look like a gland; but they occur less packed elsewhere.*

Remarks.—There is still some doubt whether the genus Monopylephorus of Levinsen is or is not identical with Rhizodrilus of Smith (14), as I have pointed out in my account of R. aucklandicus (4, p. 260). Although

Moore (13) retains the former title, I still prefer to use the name Rhizodrilus, associated as it is with the careful illustrated articles by Smith and Goodrich. Seven species of the genus have been described, the description of one of which (R). fluviatilis of Ferronnière) I have not seen.

The only species to which the present one exhibits close resemblances are R. pilosus Goodrich and R. (M.)glaber Moore.

With R. glaber the Kermadec worm agrees, and therein differs from R. pilosus in the following: (1) The arrangement of the chaetae, their number and struc-FIG. 11.—R. kermadecensis. Transverse section (camera outline) ture; (2) in the arrangement of the through the body in the region sperm-sacs, especially in that the posof the male pore. a, dorsal terior sac does not enter the ovisac. blood - vessel; b, oesophagus; On the other hand, the form and strucsperm-duct with pro-С, ture of the spermiducal apparatus is state; d, spermiducal chamber (the dots in its wall indicate distinctly more like that in R. pilosus the circular muscles); e, radial namely, in the proportion of the postmuscles to body-wall. The prostatic region, in the relative size of ventral blood-vessel is in black, and the nerve-cord is dotted. the transverse duct, and other details. But in the present species the prostatic region is more extensive, and the muscular prostatic portion is shorter and takes a definitely transverse course, with a distinct enlarged atrium and without the sigmoid undulations shown in Goodrich's figure. It seems, therefore, to deserve recognition as a distinct species. At the same time, one has to bear in mind that the two methods of study--that by sections and that by examining and dissecting fresh specimensmay account for some of the differences. For instance, while it is comparatively easy to dissect out in a fresh specimen the complete sperm apparatus, and thus determine accurately the proportions of the various regions, it is next to impossible to determine these proportions by means of sections unless one makes models of the sections and then reconstitutes the organ in an enlarged condition-a matter for which I have not sufficient time.

Again, whereas Goodrich was working on the worm from a more or less morphological point of view, and therefore failed perhaps to pay particular attention to such things as the exact number of chaetae per bundle-as

^{*} In these sections I find that the intestine, posterior to the sperm-sacs, is filled with developing spermatozoa. I see no evidence of injury during sectionization, such as the dragging of the cells by the razor, to account for their presence here; but, as the worm is bent in this region, it may be that they entered as a consequence of injury to. the gut owing to a strong contraction on being killed.

one may judge from the wording of his statement with regard to themlater authors having his memoir before them are concerned rather with systematic aspect of their worms, and are on the lookout for points of difference. It may therefore turn out that the present species is identical with Goodrich's, but it must, on the evidence before us, be regarded as distinct.

Fam. LUMBRICIDAE.

Eisenia foetida Savigny.

Two specimens found "under leaves, &c., forest terrace, Sunday Island." This worm, which is about $2\frac{1}{2}-3\frac{1}{2}$ in. in length, is familiar to people in New Zealand, where it is fairly common in manure-heaps and accumulations of rotting and fermenting vegetable matter. Its red body is marked with a yellow band round each ring, which band, however, does not completely encircle the body.

The species, like the following members of this family, is a native of Europe, North America, and Asia, but it has been carried by man in his agricultural and commercial intercourse into nearly every part of the world, so that it is now almost cosmopolitan.

These northern worms are evidently capable of existing wherever climatic conditions are suitable, and they can adapt themselves to new conditions readily. Wherever cultivation of the soil has been carried on, there one finds sooner or later these "introduced" earthworms supplanting those native to the country.

Helodrilus (Allolobophora) caliginosus Savigny.

This is an extremely variable species, as all authors who have studied the European worms have pointed out, from Hoffmeister (1845) to Michaelsen (1900). The variation affects the size and coloration chiefly, and it is probably associated in some way with differences in habitat and mode of life. So great is this variability that one can at first scarcely suppose them to belong to the same species till the anatomical features are examined; but in these features there is a fair amount of constancy, accompanied, however, by small variations in such matters as the extent of the clitellum.

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In this collection we have two very marked variations: (A) A larger very dark-grey form, possibly with a bluish tinge when alive, attaining a length of 3-4 in.; and (B) a smaller and slenderer form, pale-coloured, fleshtinted or pinkish in life, attaining a length of $2\frac{1}{2}-3\frac{1}{2}$ in.

Variety A.-Four very dark-coloured worms, anteriorly brownish-grey; the clitellum paler brown. Length, 75 mm. by 5 mm., with 167 segments. These were found "under dead leaves, forest terrace, Sunday Island," July, 1908. Oliver's number, 25.

Variety B.—This is numbered by Oliver 14, and it is said to be "abundant in top soil, Denham Bay." They are in the preserved condition pale, almost colourless, apparently flesh-coloured in life, with a palebrown clitellum. They measure about 50-70 mm., with a diameter of 2-3 mm.

Hab.—(a.) In the soil, Denham Bay (8/3/08), 32 individuals, mostly immature. (b.) "Under leaves, forest terrace, Sunday Island"; one immature individual. (c.) "Under nikau-palm leaves," Expedition Hill (16/10/08). Number, 29. Two specimens, mature.

Helodrilus (Bimastus) constrictus Rosa.

This is a worm of small size, about 1 in. in length. Pinkish in life. "Common everywhere—in forest, on damp ground; under dead nikaupalm leaves and tree-fern fronds." It is numbered by Oliver 29.

Hab.—(a.) "Under dead nikau-palm leaves," Exhibition Hill (16/10/08). Number, 29. There are fourteen specimens, all under 25 mm. in length, with the clitellum about midway along the body. Many are immature. (b.) "From rotten food, Denham Bay" (17/6/08). Eight immature forms, from 6 mm. to 16 mm. (c.) "Under leaves, forest terrace" (1/7/08). Numbered 3 in Oliver's list of stations or gatherings. Twenty-two specimens, some of which are immature, from 12 mm. to 30 mm. in length. (d.) "Under leaves, Denham Bay" (13/6/08)." Number, 20. Colour pinkish. Three specimens immature.

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ART. XXIII.—A Remarkable Case of Bifurcation in Lumbricus rubellus.

By W. B. BENHAM, D.Sc., F.R.S.

[Read before the Otago Institute, 1st December, 1914.];

I. EARLY in the present year I received from Mr. James Jefferys a specimen of Lumbricus rubellus (an introduced European earthworm) which bears on its right side a short narrow branch or outgrowth.

The worm is adult, in that the clitellum is well developed, and the peculiarity about this particular example of what is not a very rare occurrence is that the branch is developed in this clitellar region. This anterior situation of the bifurcation is, so far as I can gather, unique, as it is usually much farther back.

The clitellum commences on the 27th segment, and occupies seven segments. The first of these segments is distinct from the 2nd over the

