

## THE EARTHWORMS OF THE HAWAIIAN ARCHIPELAGO.

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SOME of the specimens which I have received from the Hawaiian archipelago have been already described by me<sup>1</sup>. Since the publication of that paper Mr Perkins has sent a second series of bottles containing a large number of fresh individuals. In the present memoir upon the earthworm fauna of this part of the world I deal with the entire series of specimens and attempt to give a complete account of all the earthworms which have been described from the Hawaiian islands, whether they are or are not contained in the collections which I have myself examined. The collections made by Mr Perkins consist of so many individuals that they probably present a very fair specimen of the Oligochaetous fauna of Hawaii. It is therefore permissible to point out what appear to me to be justifiable deductions from the material examined. The fact that the second set of specimens contained hardly anything that was not in the first set supports my contention that I have been able to study a very representative collection.

Dr Michaelsen<sup>2</sup> in criticising my previous paper upon this subject advanced the opinion that there are no truly indigenous worms in these oceanic islands. I myself pointed out the absence of really peculiar forms, a general feature of oceanic islands and which at least argues their comparatively short existence. Dr Michaelsen attributes the entire earthworm fauna to transference by man. A further study of the matter inclines me to agree with him.

There are many species of Lumbricidae contained in the collections which I have examined; and the list which I gave originally can be increased. But the subject does not demand, I believe, more than a mere list of the species. They are clearly to be regarded as importations due to man.

<sup>1</sup> On some Earthworms from the Sandwich Islands, &c. P. Z. S. 1896, pp. 194-211.

<sup>2</sup> Oligochaeten von den Inseln des Pacific. Zool. Jahrb. Syst. XII. 1899, p. 211.

## ALLOLOBOPHORA Savigny.

- (1) *Allolobophora putris* Hoffm. (This apparently is the same as Kinberg's "*Hypogaeon havaicum*.")
- (2) *A. foetida* (Savigny).
- (3) *A. caliginosa* (Savigny).
- (4) *A. nordenskioldii* Eisen.
- (5) *A. limicola* Michaelsen.
- (6) *A. rosea* (Savigny).

## PONTOSCOLEX Schmarda.

*Pontoscolex hawaiiensis* Beddard, P. Z. S., 1896, p. 196.

The ubiquitous genus *Pontoscolex* occurs in the Hawaiian archipelago. I formed a new species for the representatives of this genus which were collected by Mr Perkins chiefly on the ground that the dorsal vessel was usually double for a certain extent. Dr Michaelsen has criticised my conclusion; and it may be that he is right. In any case the genus and species which are at least hard to distinguish from the South American *P. corethrurus* occur in the most widely separated regions of the globe. Dr Eisen however<sup>1</sup> has lately commenced a detailed study of this genus, so that the matter of the specific identity or difference of the specimens of *Pontoscolex* found scattered over the world had better be left alone for the present.

## AMYNTAS Kinberg.

The main earthworm inhabitants of this archipelago belong to the genus *Amyntas* as I think (following Michaelsen<sup>2</sup>) it should now be called. The much better name *Perichaeta* was used for a Dipteran genus before it was applied to an earthworm; and it appears to me, in spite of the ingenious protest of Horst<sup>3</sup>, that there is no way of escaping from the conclusion that a name once used cannot be resuscitated. One unrecognisable species "*Perichaeta corticis*" has been described by Kinberg<sup>4</sup>. The remaining species are the following:—

- (1) *Amyntas peregrinus* Fletcher.

*Perichaeta peregrina* Fletcher, Proc. Linn. Soc. N. S. W. (2), I. p. 969.

*Perichaeta molokaiensis* Beddard, P. Z. S. 1896, p. 201.

*Perichaeta floweri* Benham, Journ. Linn. Soc. XXVI. p. 217.

<sup>1</sup> Researches in American Oligochaeta, &c. P. Calif. Ac. Sci. (3), II. p. 87.

<sup>2</sup> Terricolen von verschiedenen Gebieten der Erde. JB. Hamb. wiss. Anst. XVI. Beiheft 2.

<sup>3</sup> Zool. Anzeig. 1890, p. 6.

<sup>4</sup> Annulata nova. Öfv. k. Svensk. Ak. Förh. 1866.

Michaelsen has suggested that the species which I described in my preliminary paper as *Perichaeta molokaiensis*, is really identical with Fletcher's *Perichaeta peregrina*, or is at least to be regarded as a "fragliches synonym." At the time that I described that species I was not so convinced as I am now of the unimportance of size as a distinguishing characteristic of species of this genus. Fletcher described his species as being 19 cm. in length, i.e. nearly double the length of the individuals of "*Perichaeta molokaiensis*" examined by myself. Moreover Fletcher has not given any details about the clitellar setae, beyond stating that they are present. This again is a matter which is apparently not of such importance as I thought; that is to say, the same species may have setae upon one, two or three or perhaps even none of the clitellar segments.

There can I think be no doubt as to the identity of Benham's "*Perichaeta floweri*" with the present species. Benham states that there are 12 setae between the male pores, which is the number given by Fletcher. I counted 15 in my specimens. But the difference is clearly negligible. Benham particularly mentions the clitellar setae as being present on segment 16 only, a state of affairs which I found also. None of the three forms comprised in the present species possess copulatory papillae; hence it is now probably to be taken as a character of this species. In this as in all other points I can detect no differences between the descriptions of Benham and of myself. We are clearly dealing with the same species, which being with very great probability—almost amounting to certainty—identical with that described as "*Perichaeta peregrina*" by Fletcher, must bear that name. I now give for the sake of others who may doubt this identification a description of my specimens.

The two individuals of this species which I have examined were 103 and 81 mm. respectively in length. The former specimen possessed 88 segments, the latter 93.

The prostomium is small and continued by grooves on to the first half of the first segment.

The dorsal pores commence upon segments 10, 11, and are visible upon the clitellum.

The clitellum occupies the usual segments, 14—16, and has few setae upon its last segment.

The male pores are not prominent and are separated by 15 setae.

I observed no genital papillae.

The first septum separates segments 4, 5; none are thickened specially.

The gizzard occupies the usual segments which are not divided by septa.

The intestine begins in 15; the caeca are present and not large.

The sperm sacs are large and occupy segments 11, 12.

The spermiducal glands extend from segments 17—21 or 22; they are broken up into lobes which have to some extent a relation to the segmentation of the gland. The curved duct communicates directly with the exterior and not through the intermediary of a terminal dilated sac.

The spermathecae are four pairs in 6—9. The pouch is sharply marked off from the long duct. The diverticulum ending in an oval dilatation is about as long as the duct part of the main pouch.

HAB. Molokai and Mauna Loa.

(2) *Amyntas heterochaeta* Mich.

*Perichaeta heterochaeta* Michaelsen, Abhandl. nat. Vereins Hamb. xi. p. 6.

*P. indica* Michaelsen, Arch. f. Naturg. 1892, p. 33; nec *P. indica* Horst, Vermes in Midden Sumatra, iv. p. 4.

It is rather a curious fact that the non-identity of the worm which has been called by many persons, including myself, *Perichaeta indica* with the species described by Dr Horst under that name in the memoir quoted above has not been noticed. In that memoir Dr Horst distinctly figures a terminal sac ("Kopulationstasche") to the duct of the "prostate" gland. His figures of "Eine *Perichaeta* von Java"<sup>1</sup> on the other hand do not show this duct with such a terminal swelling and refer to the species which has since been called *Perichaeta indica*. It is clear that the proper name to refer to this specimen of Dr Horst must be Dr Michaelsen's name of *Perichaeta heterochaeta*, in which no such copulatory pouch is mentioned and which in other respects agrees with the worm which has everywhere received the name of *Perichaeta indica*. If it were certain, which it is not, that M. Vaillant described only one species under the name of *Perichaeta cingulata*, then that would have to be the name for the species described by Horst, for it agrees in the presence of the terminal sac where the male gland opens on to the exterior, and in some other points.

Dr Michaelsen would include as synonymous with this species my *Perichaeta nipponica*; I think that that species may be synonymous. But that is a matter which I shall enter into on a future occasion.

I now think that I was wrong in differentiating the species *P. perkinsi*. Dr Michaelsen, chiefly for the reason that he received an example from Ceylon with papillae near to the male pores, identified my species with the one called here *Amyntas heterochaeta*. I should mention however that the fact that the union of the vas deferens with the male duct is not until near to the external orifice appears to characterise at least the individual which I examined. I found in glycerine preparation of two examples of undoubted "*indica*" that there was the more general union shortly after the duct emerged from the gland.

Dr Michaelsen and I myself have called attention to the variability which this species exhibits in the presence and number of the anterior papillae and in the presence or absence of the glandular part of the male terminal apparatus. Among the very

<sup>1</sup> Niederl. Arch. f. Zool. iv.

numerous examples which I have examined from the Sandwich Islands I find the following state of affairs with regard to these variable structures. In 22 examples there were no glands at all; 13 had glands; in 26 specimens the glands were either small and on both sides or only present and small or well developed on one side. The proportions seem to show that the gland is disappearing. As to the head papillae—there were none at all in 24; in 14 there were three pairs on 7, 8; in 3 there were pairs on 7, 8, 9; in one there were pairs on 8, 9; in 10 there was a pair on 8; in one there were pairs on 6, 7, 8; in 52 there were various degrees of asymmetry, sometimes none being present on one side.

Examples of the species were obtained on Maui, Mauna Loa Hawaii, Halemanu Kauai, Kilauea Hawaii, Oloa Hawaii, Haleakala Maui, Iao valley Maui, Honolulu in imported earth from China.

(3) *Amyntas hesperidum* Beddard.

*Perichaeta hesperidum* F. E. Beddard, Proc. Zool. Soc. 1892, p. 169.

*Perichaeta sandvicensis* Id., ibid. 1896, p. 203.

In my earlier paper upon this species founded upon the first gathering of Hawaiian worms I instituted a new species for some smallish worms from several islands of the archipelago. I have since re-examined the two original specimens of *Amyntas hesperidum* which I have still by me, and have compared them with some fresh individuals undoubtedly belonging to the same species but coming from Hong Kong. The result is that I have to make one or two slight corrections in my earliest account of *A. hesperidum*. I thought that I had noted a small terminal muscular bursa in that species; but on again studying the specimens and comparing them carefully with others I find that what I took to be this distinctive structure was only the commencement of the thick investing layers of the spermiducal gland duct as it traverses the body wall. There is in fact no terminal bursa. In all the specimens the spermathecae, though lying in segments 7 and 8, as I correctly stated, open backwards, i.e. in the intersegmental furrows 7, 8; 8, 9, as I also stated. I now find that this is also the case with *Perichaeta sandvicensis*. The spermathecae as a rule lie in the 7th and 8th segments but open at the posterior margins of those segments. In both worms the diverticulum is coiled and the spermiducal gland has a rather sinuous duct which passes rather forwards on its way from the gland to the exterior. In short I can detect no differences at all between the individuals which I have referred to two species. The older name must clearly have the priority and thus I must term these Sandwich Island worms *Amyntas hesperidum*, inapt though the name undoubtedly is.

This is a prevalent species in the gatherings from the islands. In my preliminary account of the Sandwich Island worms I recorded it from Mauna Loa, Lanai, Hawaii

and Molokai. I have seen in the second collection forwarded to me additional specimens from Mauna Loa. I can thus improve somewhat upon my original description of this species. It is a smallish slender worm measuring up to 100 mm. in length with a diameter of about 3 mm. The number of segments is curiously constant in the individuals which I selected for counting. In two the number was 105, in a third 104. The lengths of these specimens varied somewhat—from 82 through 98 to 100 mm. It is interesting to note the constancy of the number of segments. The differences in length are of course not sufficient to be of importance and are to be accounted for by the different degrees of contraction of the individuals.

The dorsal pores commence between segments 11, 12, and are visible upon the clitellum.

The setae of a given series of segments number as follows: 1. 21; 5. 33; 12. 52; 16. 53. The setae of the first two segments are small; those of the next four are stronger, after which segments they again diminish in size.

The clitellum is sharply marked off from the segments adjacent to it and both commences and ends with its own proper segments. I could not discover any setae upon it.

Neither could I find anywhere upon the body of the worms genital papillae. The male pores are upon the usual segment; they are slightly expanded transversely and have therefore an eye-like outline. They are fairly conspicuous; in one case the end of the spermiducal gland duct was protruded for a little way. The two pores are separated by 18 setae.

There are three fairly stout intersegmental septa in front of the gizzard which are bound to each other by numerous muscular threads in the usual way; after the gizzard come two strong septa to the anterior of which the gizzard itself is bound at its posterior end by at least five muscular straps. In a specimen from Lanai septum 8/9 was present but thin.

The gizzard has the usual position that it has in this genus. The intestinal caeca are present, but are small and simple; they occupy not more than two segments.

The last of the "hearts" is in segment 13.

The two pairs of sperm sacs are in segments 11, 12; the sperm reservoirs as also usual in segments 10, 11; of the latter the anterior pair are sometimes larger than the posterior.

The spermiducal glands are much incised and occupy not more than three segments. Their muscular duct is longish and curved and is unprovided with a terminal copulatory dilatation. As to the form of the spermiducal glands it is often possible to use their characteristics as apparently valid specific distinctions. But it is necessary to be accurate in their delineation and cautious as to laying too much stress upon certain features in distinguishing species, as is shown by the present species. In most of those which I examined the gland had a somewhat ear-like form, the lower

margin curving upwards and forwards like the lobe of the ear. But in one example the gland was quadrangular though only occupying four segments and deeply incised in correspondence therewith.

The spermathecae are two pairs and lie in segments 7 and 8, but open on 7, 8 ; 8, 9. The oval pouch has a moderately long duct to which is appended a small twisted diverticulum which is sometimes longer and sometimes shorter.

We can extract from the foregoing the following definition of the species :

Size small, 100 mm. ; number of segments 105. Dorsal pores from 11, 12.

Number of setae per segment up to 53. Clitellum 14—16, without setae.

No papillae. Septum 8/9 missing. Caeca present. Last heart in 13.

Sperm sacs 11, 12. Spermiducal glands not very large ; duct without end sac.

Spermathecae 7, 8, with twisted tubular diverticulum.

*Remarks.* Dr Michaelsen has put forward grounds for believing that this species is really Dr Horst's *Amyntas annulata*. I myself suspected a possible identity. Dr Horst's original description of *annulata*, written some years ago when there was no difficulty in distinguishing from each other the very few species of the genus at that time known, was hardly complete enough for present requirements. He gives me moreover by letter good reasons for denying the identity.

Nor is there much change required to derive this form from the prevalent *Amyntas hawayanus*. I desire again to refer in connection with this possibility to a species described by myself some years since as *Perichaeta hesperidum*. That species, two individuals, arrived together with a form which I shall refer to here, *barbadensis*. The worm differs however from *barbadensis* (I have satisfied myself by a renewed examination) in a number of points. The clitellum begins and ends sharply at the boundary lines of segments 13, 14, and 16, 17, and has no setae. The spermathecae are in segments 8, 9, or at any rate open on to the boundary lines 7, 8 ; 8, 9. The pouches differ from those of *hawayanus* in having much coiled diverticula ; the duct of the spermiducal gland thins towards its end, is longish and rather curved and has not really a terminal bulbous as I said in my original description. I have since met with other examples of the same worm from Hong Kong in a bottle containing also examples of *barbadensis*. I have examined four of these, all that I had. They have no setae on the clitellum, which commences and ends "sharply." The length is from 80—100 mm. There are no genital papillae nor are there setae upon any segment of the clitellum. The last heart is in segment 13 as is usual ; the caeca are quite normal in position and present no special features of interest. The sperm sacs have a constricted-off free end as in so many forms. The spermathecae are two pairs and lie in 8 and 9 or at least open in the intersegmental grooves 7, 8 ; 8, 9. The diverticulum of the pouches is only of moderate length—not so long or not longer than the pouch—and is more or less

closely coiled. The duct of the spermiducal gland is directed rather forward, as is so often the case in *barbadensis*, and is rather curved, especially at the end, where it is distinctly thinner. This thin termination was not observable in one individual in which the male pores had the appearance of being somewhat everted. These worms are undoubtedly my *hesperidum*.

It is interesting to find from three distant parts of the world specimens of a worm associated with a form from which they can be easily derived, by a reduction of the number of spermathecae, and by an emphasising of the slightly coiled diverticulum of the parent (?) form, by the loss of genital papillae and setae on the clitellum. The coincidences are at least noteworthy.

If we are to assume that the migration of the genus *Amyntas* from the Oriental region is due always to the interference of man, it is most peculiar that they should have been exported in lots of corresponding species. I do not however at present do more than emphasise the facts which are as has been stated above.

(4) *Amyntas hawayanus* Rosa.

*Perichaeta hawayana* Rosa, Ann. k. k. Hofmus. Wien, 1891, p. 396.

*Perichaeta bermudensis* Beddard, P. Z. S. 1892, p. 160.

*Perichaeta barbadensis* Beddard, ibid. p. 167.

*Perichaeta morrиси* Beddard, ibid. p. 166.

*Perichaeta mauritiana* Beddard, ibid. p. 170.

*Perichaeta mandhorensis* Michaelsen, Arch. f. Naturg. 1892, p. 241.

*Perichaeta pallida* Michaelsen, ibid. p. 227.

*Perichaeta amazonica* Rosa, Atti R. Ac. Torino, 1894, p. 4.

*Perichaeta cupulifera* Fedarb, Proc. Zool. Soc. 1898, p. 445.

The collection contains a considerable number of examples of *A. hawayanus*. These show so many variations that I believe myself to be able to justify the above rather formidable list of synonyms, which are a little more extensive than the list given by Dr Michaelsen<sup>1</sup> in a recent paper. My original description of *Perichaeta bermudensis* was published when I was unaware of Dr Rosa's *Perichaeta hawayana*, though his publication<sup>2</sup> seems to antedate mine. I was led in my "Monograph of the Oligochaeta" to adhere to my species *bermudensis* on account of the fact that Dr Rosa did not mention in his description the larger size of the setae upon the anterior segments, nor the presence of setae upon the last segment of the clitellum. The number of papillae in the neighbourhood of the male pores seemed too to be different in the two series of worms from Hawaii and from the Bermudas. In the series of specimens in the

<sup>1</sup> Die Terricolen des Madagassischen Inselgebietes. Abh. senck. naturf. Ges. 1897, p. 234.

<sup>2</sup> Die exotischen Terricolen, &c. Ann. k. k. Hofmus. Wien 1891, p. 396.



collection made by Mr Perkins I find the following variations in structure, from what may perhaps be regarded as the typical organisation of this species. The number of the papillae in the neighbourhood of the male pores varies; I have found only one or two, three or four; Rosa says two or three. In one example however I found six of these papillae on each side.

The number of the papillae therefore does not allow of a separation of *hawayanus* and *bermudensis*.

The setae upon the anterior segments are larger than those which follow; in one example segments 4—7 were furnished with these larger setae. This was originally one of the reasons for separating *bermudensis* from *hawayanus*.

The clitellum was described by Rosa to stop short at the middle or thereabouts of the 16th segment. I have observed both this arrangement and that generally found in *bermudensis*, i.e. that the clitellum does not commence accurately at the beginning of the 14th segment while it stops short as in the typical *hawayanus*. In one example the clitellum was exactly coincident with segments 14—16.

The clitellum has usually setae upon its last segment, i.e. the 16th of the body. There are ten to fifteen of these setae. In two examples I could see no setae anywhere upon the clitellum. This seems to have been the case with the individuals examined by Rosa. *A. bermudensis* appears to always have setae upon this segment.

A feature not yet recognised in the worms which I referred to the species *bermudensis* was found in two examples of *hawayanus*. In one of them there was a pair of papillae anterior in position lying on the 7th segment near to its posterior end and the orifices of the spermathecae. In a ripe individual there was but one of these papillae, that of the right side. This fact will be seen presently to bear upon the identity of the present species with others hitherto supposed to differ specifically from it. As to internal characters the caecum of the intestine has not always the series of short outgrowths on the under surface that has been described for this species and for *bermudensis*. The spermiducal gland is generally long, occupying segments 17—22 about. Sometimes the duct is given off at the top when the gland commences in segment 17. In one specimen the gland was much abbreviated and lay only in 18, 19 on one side and 17, 18 on the other. This looks like a commencing loss of the gland which is known to occur in some other species, e.g. *Amyntas heterochaeta*. The spermathecae seem always to lie in segments 6, 7, 8. In one example they were particularly large; but, as this individual had no other features which seemed to remove it from the species, the difference in size (the pouches were as large as the gizzard) does not seem to be more than a variation to be neglected for systematic purposes.

The size of *Amyntas hawayanus* varies to some extent. The greatest and least lengths which I observed were 150 and 69 mm. The number of segments varied between 97 and 73.

Next as to the identity of *Amyntas hawayanus* with *A. barbadensis*—the original

specimens of the latter were described by me from Kew Gardens, where they had been received from Barbados. In the collection of Sandwich-Islands worms before me there are a number of specimens of this species found at Honolulu in earth imported from China. Of these I have examined seven individuals.

Their size presents no difficulty for identification. They vary from 99 to 140 mm. The clitellum occupies segment 14 to about the middle of segment 16. In two specimens I found setae to be limited to the 16th segment; in the others there were setae on all the clitellar segments, but very few on 14 and 15. In one specimen the numbers on the three segments beginning with 14 are 8, 3, 15; in another 2, 2, 10. These figures agree broadly with my previous observations upon this species.

In several cases I found that the setae upon the anterior segments of the body are as in *Amyntas hawayanus* larger than those posteriorly. Segments 3—8 appeared to be thus distinguished.

The arrangement of the genital papillae is as follows :

There are either two or three in the neighbourhood of the male pores, sometimes only one. They lie either in an oblique row or in the case where there are two, one behind the other. There is in fact no difference here from the conditions which obtain in *hawayanus*.

In addition to these posteriorly placed genital papillae there are anterior papillae. One individual had a pair on segment 7; another a median papilla on the same segment. There is here again no practical difference from *A. hawayanus*.

As to internal characters the prevalent number of spermathecae is three pairs situated as are those of *A. hawayanus*. In one specimen only were there but two pairs of these organs placed in segments 6, 7. The sperm sacs often, but not always, show a constriction near to the free end, by which a small "knob" is divided off from the rest of the sac. As in *A. hawayanus* there are at least often two pairs of egg sacs in segments 13, 14. The spermiducal glands are long, occupying segments 17—21, as in *A. hawayanus*, and as in that species there is no terminal "Kopulationstasche" into which the duct of the gland opens. A character which seems to be peculiar to these worms is the occasional duplication of the dorsal vessel. I found this in four out of seven examples; the doubling commenced at the 20th segment or thereabouts, and the tube became single again about the 25th. The doubling was complete, the two halves not uniting at the septa where they traversed those plates. Of these variable characters there are only three which do not seem to occur in examples which have been referred to *A. hawayanus* and *A. bermudensis*. These are: setae upon segments 14, 15; occasional doubling of dorsal vessel; knob-like processes of sperm sacs; the presence of only two pairs of spermathecae. Were these or some of these characters united invariably together we might indeed separate the specimens as a different species; but they do not. The one example with spermathecae in 6 and 7 only had, it is true, no

marked difference in size between the anterior and the posterior setae found elsewhere among the examples ; and it had a median papilla upon the 7th segment, this segment being occupied in others by a pair of similar papillae. These characters however do not always coincide, for in my original paper describing the species *Perichaeta barbadosis*, I recorded the fact that in an individual with two pairs of spermathecae there was a single median papilla upon the 7th segment, as well indeed as another occupying a similar place in the 18th. To make a species of this worm we must characterise it by the two pairs of spermathecae and the median anterior instead of paired anterior papillae, as well as by the greater uniformity in the size of the body setae generally. In view of the variations which occur in individuals which no one would thus separate it seems to be unreasonable at least in the meantime to do this.

I may perhaps be allowed to point out that I was justified on the facts as originally known in making a new species for these worms. They then differed as far as was known from *Perichaeta hawayana* in having setae upon all segments of the clitellum, in possessing anterior as well as posterior genital papillae, and finally by generally having but two pairs of spermathecae.

I shall now consider the probable identity of these forms with *Perichaeta morrisoni*. This species was originally distinguished from its allies by the following assemblage of anatomical features : small size, 52 mm. with however 93 segments ; two pairs of spermathecae in 6, 7 ; median papillae in 7, 8 ; glandular bodies in the neighbourhood of the male pores were not seen to open by papillae ; but such glands are usually associated with papillae. Rosa<sup>1</sup> described later examples of what appears to be the same species. His examples were larger (up to 80 mm.) ; setae present on all of the segments instead of only 16 ; clitellum occupying the whole of segments 14—16 instead of stopping towards the middle of 16 ; glands near male pores ; in one example a median papilla upon 18 was noted ; others showed variation in the anterior papillae, in one a median papilla on 6 and a pair on 7 closely approximated in the middle line with a more lateral pair on the same segment and a median papilla on 8. Another had median papillae on 6—8 ; a third one only on 7. Dr Rosa also found, though it was in a rudimentary condition, the septum separating segments 8, 9.

I have been able to compare with these descriptions some worms from Hong Kong among my stores of *Oligochaeta*. I examined many of these which I refer to the same species.

One was 93 mm. long ; two papillae lay by each male pore, and on 7 there were three papillae, one median and two lateral. Setae were present on all segments of the clitellum. In other characters I found no differences from *Perichaeta morrisoni* as described.

In a second individual of 80 mm. length there were also two pores in the neigh-

<sup>1</sup> Lombrichi raccolti a Sumatra &c. Ann. Mus. civ. Genova ser. 2a xvi. p. 516.

bourhood of the male pores, but side by side, instead of one in front of the other. Setae of clitellum only on 16.

In a third there was but one papilla to each male pore, and the setae on the clitellum were limited to 16. None of these latter had any anterior genital papillae. A fourth example was 94 mm. in length, with setae only on the last segment of clitellum; the sperm sacs as in the species generally in segments 11, 12, but provided with the small terminal knobs such as I have just referred to in *Perichaeta barbadensis*. The spermathecae appeared to be in 7, 8, instead of 6, 7. In all the prostates were long and had no terminal bulb. I need not enumerate in detail the various arrangements of the genital papillae in these examples from Hong Kong; but I may state generally that they varied excessively in this particular. There were often two to four papillae on the 18th segment between the male pores; it was very general to find a pair of papillae on segment 19 corresponding in position to the male pores on the foregoing segment. I observed a median papilla on each of segments 6—8 in one individual; one was anomalous by reason of the fact that the 7th segment had no less than six papillae arranged in an irregular line along the middle of that segment. The spermathecae were as a rule two pairs in 6, 7. But this character was not absolutely fixed. One specimen had an additional spermatheca in the 8th segment, but on the right side only. In this individual moreover the generally missing septum 8 was present, a circumstance which Rosa has stated for *Perichaeta morrissi*. Among the same worms there were three specimens of rather larger size. One of these was 135 mm. long and was the largest. It has 90 segments. In it the papillae were as much reduced as they ever are in this species. The larger worms with the fewer papillae and three pairs of spermathecae I consider to be the more typical *hawayanus*. In this individual (to resume) the sperm sacs had constricted apices; the spermathecae three pairs in 6—8. One papilla only to inside of male pore; setae on 16, those of segments 3—7 about enlarged. Obviously the same as this, but a little smaller, was a worm with two papillae by male pore and a single median one on 7. These larger specimens have the duct of the spermiducal gland bent into an U-shape; in the smaller and more papillated worms the duct is usually slightly curved more in the direction of a large semicircle. If we are to accept this as a species we can find no character not found in examples of the forms already treated of, except that the two pairs of spermathecae may be a segment further behind. This seems to be hardly enough as a character whereby to separate the species.

With regard to the identity of *Perichaeta mauritiana* I must chiefly refer to Dr Michaelsen. I may observe however that in the position of the spermathecae and the presence of setae upon one segment only of the clitellum, this supposed species agrees with an individual which I found myself unable to definitely distinguish from the form which I have called *Perichaeta morrissi*.

In two individuals which I refer to this species, and which are not the same that

formed the basis of my original description of the species, I found the following characters. The length of one was 76 mm. There are a row of four papillae to the inside of each male pore. The setae on segments 3—7 are particularly strong. I found setae on the last segment of the clitellum, i.e. 16. The sperm sacs have a constricted extremity. The spermiducal glands are long, extending through segments 17—22. The spermathecae are in segments 6—8; on one side of the body was an additional pouch in segment 9. A second individual was much the same, but had only three papillae by each male pore and no traces of an additional spermatheca. In my original description of *Perichaeta mauritiana* I described only two pairs of spermathecae in segments 7, 8. I cannot now lay my hands on that specimen. I may however observe that a renewed examination of one of the worms which I originally referred to *barbadensis*, seems to have its two pairs of spermathecae in 7, 8, and not as I stated in 6, 7. In any case the difference does not seem to me to be important. With the present species will have to be merged I think *Perichaeta cupulifera*. There are at least no differences of great importance to distinguish that form from Dehra Dun. There is to be seen the same kind of range in the variability of the papillae which are from as small a number as only one in front of and behind each male pore to twelve or so in the neighbourhood of those pores.

Dr Michaelsen thinks that his *Perichaeta pallida* is not to be confused with *Perichaeta hawayana*. He bases this distinction upon the fact that in *pallida* the anterior setae are not much enlarged, as they are in *hawayana*, and that the male pores are more closely approximated. As to the former it would be necessary to separate from *barbadensis* one of the individuals which I have described above as belonging to that "species" if this opinion is correct. There is at least quite as much reason for uniting this species with the series concerning which the present remarks are offered, as for including Rosa's *P. amazonica*. Rosa says nothing about the increased size of the anterior setae. The fact that the clitellum has none will not I hope, after the remarks contained in the present paper, be considered as sufficient to discriminate the species.

In Dr Michaelsen's description of *Perichaeta mandhorensis* there are no salient points which serve to discriminate it from the present species. It has larger setae on segments 2—9; the caeca have the crenated appearance below that is at least often found in *hawayana*. There is one papilla near each male pore; the three spermathecae occupy the same segments; the spermiducal glands are without the terminal sac. The sperm sacs are divided (as in some individuals of the present species) by a constriction. There is in short nothing of importance in the description which warrants a separation.

(5) *Amyntas schmardae* Horst.

*Megascolex schmardae* Horst, Notes Leyd. Mus. 1883, p. 194.

*Perichaeta trityphla* Beddard, P. Zool. Soc. 1896, p. 205.

*Perichaeta vesiculata* Goto and Hatai, Annot. Zool. Japon. III. p. 21.

It is rather curious that in an appendix to my account of the earthworms of the Sandwich Islands I should have described from Barbados a species which I regarded as new and described as *Perichaeta trityphla*. Curious since I have subsequently found many specimens of this worm in gatherings from Honolulu at 2000 feet of altitude and also in earth imported from Hong Kong. I think that Michaelsen<sup>1</sup> is probably right in identifying my *trityphla* with the long known species *schmardae*. But at the same time it must be borne in mind that the condition of the caeca, which I thought to be distinctive of *trityphla*, has not been described in the original specimens of *schmardae*. These caeca, I may say, vary in number from three to six on each side, and the two sides are not always symmetrical in this respect. The occurrence of such caeca seems to mark the species as a native of Japan—one of the most prominent characteristics of the species of that island being the frequent complication of the caeca. I think that there can be no doubt that *Perichaeta vesiculata* of Goto and Hatai is the same species. There is positively no feature in their rather short description of the so-called *vesiculata*, which does not fit in with the facts observed in the anatomy of *schmardae* and *trityphla*.

<sup>1</sup> Oligochaeten von den Inseln des Pacific. Zool. Jahrb. Syst. XII. p. 224.

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