On the earthworms collected during the 'Skeat expedition' to the Malay peninsula, 1899-1900 / by Frank E. Beddard.

(7.)

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On the Earthworms collected during the "Skeat Expedition" to the Malay Peninsula, 1899–1900.

By FRANK E. BEDDARD, M.A., F.R.S.

The Earthworms upon which I now report were collected by Mr. R. Evans of Oxford, during the Skeat Expedition in the Malay Peninsula. They belong for the most part to the characteristic and abundant Oriental genus *Amyntas*.

The collection contains, however, a number of examples of the ubiquitous *Pontoscolex corethrura* and of a small *Benhamia*. Since so many species of *Amyntas* are now known—I allow 109 or so in my recently published[1] revision of the genus—I was not prepared for the large number of novelties that occur in the collection. It must be remembered, however, that this region of Asia has been but little explored from the point of view of its earthworm fauna.

It is also important to notice that the greater proportion of the entire list of species recorded here are peculiar to the mainland, and do not, so far as is known at present, occur upon the islands of the Malay Archipelago; these latter are regarded by Michaelsen, and apparently with justice, as the headquarters of the genus *Amyntas*. Further to the west, though still in the Oriental Region of zoogeographers, the genus becomes scarcer and scarcer, the forms occurring in India itself and in Ceylon being but very rarely peculiar forms[2], and being far from numerous altogether.

It is interesting to find that the condition hitherto peculiar to *A. stelleri*, *A. phakellotheca*, and *A. biserialis*, of an increased number of spermathecæ in each segment, is also characteristic of *A. minutus* and *A. polytheca* described as new species in the present communication. The interest lies of course partly in the more widely-spread occurrence of this geoscolecid characteristic, but also in the fact that small species like the two described here may show a character which is more intelligible in a large species such as *A. stelleri*, where there is more room for a reduplication of these organs.

Another novelty of structure for the group which is recorded in the present communication, is the curious intersegmental position, and the single row, of numerous genital papillæ, which is the principal characteristic of the new species *A. evansi*. I am not aware that any closely similar arrangement of such papillæ occurs elsewhere among Earthworms of this genus.

The large size of the various organs belonging to the reproductive system is, as a very general rule, a marked feature in the

[1] P. Z. S. 1900, p. 609.

[2] In Ceylon there is only *A. taprobanæ* (Beddard, P. Z. S. 1892, p. 163) and in India only *A. alexandri* (Beddard, P. Z. S. 1900, below), and *A. travancorensis* (Fedarb, J. Bombay Nat. Hist. Soc. xi. p. 435), which occur in those regions and are not found elsewhere.

anatomy of Earthworms. The extraordinary reduction in size of the spermathecæ in the new species *A. virgo* must therefore be considered as one of the more important new facts which I detail here. It is interesting to notice that the reduction in size is apparently not accompanied by a reduction in number, and certainly not by an increase in number, as with the small but numerous spermathecæ of such a form as *Microchæta*.

The marked resemblance in *A. biporus* between the "genital papillæ" of segment xix. and the male pores, confirmed by microscopic investigation, seems to indicate the remnant of a second pair of spermiducal glands, which is new to the genus.

In other respects the species represented in the collection show no particularly noteworthy divergences in structure from other species of *Amyntas*.

We shall now proceed to the description of the new species, after mentioning the forms already known to science.

(1) **Amyntas posthumus** [1] Vaillant.

(2) **Amyntas cingulatus** [1] Vaillant.

These two species, the latter, as I believe, with many synonyms, are so widely spread, and have been so frequently reported upon and described, that I have nothing of novelty to add to existing descriptions.

(3) **Amyntas bosschæ** Horst.

Perichæta bosschæ, Horst, Notes Leyd. Mus. xv. p. 324.
Perichæta bosschæ, Michaelsen, Abh. Senck. Ges. xxiii. p. 238
Amyntas bosschæ, Beddard, P. Z. S. 1900, p. 625.

It is rather curious that the collection contains a number of specimens of a species of Earthworm which really does appear to be identical with *A. bosschæ*. It is at least extremely near to that species, and I do not attempt at present to separate it. Nor do I give a full description, since that has been done. In size and general external appearance *A. bosschæ* is very like *A. pulanensis*, which I describe later; but it has no genital papillæ.

I find, as did Michaelsen, that there are three pairs of sperm-sacs in segments x.–xii. The spermiducal glands, however, are not compact and small; they extend through segments xv.–xx. and are much broken up into lobules. Their short duct is coiled into a circle or is perfectly straight. The spermathecæ agree rather with Michaelsen's than with Horst's description.

Hab. Khota Bharu.

(4) **Amyntas papulosus** Rosa.

Perichæta papulosa, Rosa, Ann. Mus. Civ. Genova, (2) xvi. p. 525.
Amyntas papulosus, Beddard, P. Z. S. 1900, p. 644.

I have examined two specimens which are undoubtedly referable

[1] For synonymy and localities see Beddard, P. Z. S. 1900, pp. 641, 615.

to this species. I am able in a few small points to supplement Dr. Rosa's account. I find, for example, that in both specimens there are more setæ upon the clitellum than he found, *i. e.* 6 or so upon the last two segments. The figure given by Rosa (*loc. cit.* tav. i. fig. 14) of the very remarkable arrangement of the genital papillæ entirely bears out and admirably illustrates the appearances detected by myself. This being so, I was surprised to find on opening one of the two specimens not a trace of the cæca which Rosa has very emphatically stated to be present. To make certain about this point, which is of some systematic importance, I dissected the second specimen, in which I also failed to find these appendages.

The gizzard of this worm is rather remarkable in shape; it is wide from side and short in antero-posterior diameter; it is constricted in the middle, and presents somewhat the appearance of a doctor's hat viewed, of course, from the side.

In other points, including size, my specimen seems to agree with that described by Dr. Rosa. The spermathecæ, however, happen to be more globular, no doubt a question of a different degree of distension with sperm, while the diverticula are a little less conspicuous in length than they are figured by Dr. Rosa.

Hab. Biserat.

(5) **Amyntas malayanus**, n. sp. (Fig. 1, p. 894.)

Of this species I have been able to examine a number of examples. The individual selected for measurement was 144 mm. in length and consisted of 105 segments.

The *setæ* on the anterior segments show no differences in size from those of the posterior segments. They are present on all the segments of the clitellum.

The *clitellum* occupies the usual segments, but it does not begin or end sharply.

The *genital papillæ* are highly characteristic. There are four pairs of these in all, which lie upon the xviiith to the xxist segments. The first pair lie behind and to the inside of the male pores; the remaining pairs are in line with them upon successive segments. The papillæ, as shown in the accompanying figure (fig. 1), are small, considerably smaller than the male pores, to which, however, they have a general resemblance in appearance. They are slightly projecting and surrounded by a circular wrinkle of the integument. There are no papillæ upon the anterior segments.

The *male pores* are conspicuous and widely separated. Each is surrounded by several circular wrinkles of the integument. From the tip of each porophore, which is somewhat raised, protrudes a slight conical process, which can be regarded as a penis.

As to internal structure it is noticeable that the septum separating segments viii./ix., which is so often absent in *Amyntas*, is present in *A. malayanus* though rather thin.

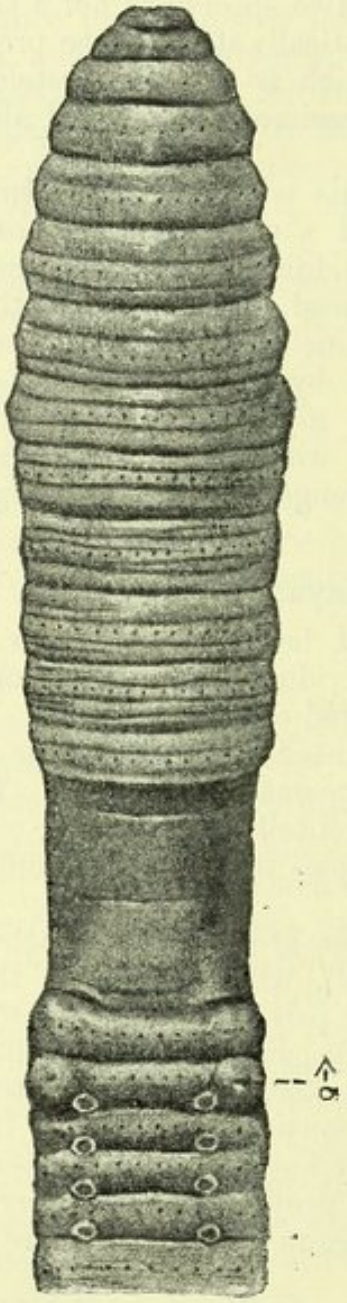
The intestine begins in the xvith segment, and the *cæca* are present,

occupying about three segments; these reach, in fact, as far forward as the second segment in front of that in which they originate.

The last pair of *hearts* are placed in segment xiii.

The *sperm-sacs* lie in segments xi. and xii. and are large and racemose; they are in contact above the œsophagus.

Fig. 1.



Anterior end of *Amyntas malayanus*. × 3.

The *spermiducal glands* are largish, somewhat irregular in shape, and occupy segments xvii.–xix. The duct itself is curved in a horseshoe-like fashion; it has no terminal sac, but widens somewhat towards the orifice.

There are four pairs of *spermathecæ*, situated in segments vi.–ix. The sacs are large, irregularly oval in contour, and with a short

muscular duct. The diverticulum is short, barely one-third of the length of the sac.

Hab. Aring.

The following is the abstracted definition of

Amyntas malayanus, n. sp.

Length 144 mm.; number of segments 105. Setæ of anterior segments not enlarged. Clitellum xiv.–xvi., with setæ. Genital papillæ paired on xviii.–xxi. Male pores far apart. Septum viii./ix. present. Cæca present. Last hearts in xiii. Sperm-sacs in xi., xii. Spermiducal glands in xvii.–xix., with horseshoe-shaped duct and no terminal sac. Spermathecæ in vi.–ix., with shortish diverticulum.

Hab. Malay Peninsula.

(6) **Amyntas virgo**, n. sp.

I have examined seven and dissected four fully mature examples of this species, whose characters do not fit in with those of any other species that has been adequately described.

The largest individual, which, however, like the others, is somewhat softened in the clitellar region, measures 152 mm.

The *setæ* upon the anterior segments are rather larger than upon the following segments.

The *clitellum*, which occupies the usual segments, has no setæ.

The *male pores* are very conspicuous and quite far apart.

There are no genital papillæ.

The gizzard-septum is wanting; two septa following the gizzard are of considerable thickness.

The usual paired *cæca* are present.

The last heart is in segment xiii.

The remarkable feature about this species which at once differentiates it from *A. impudens* [1] and *A. philippinus* [2]—the only two that could be confused with it by reason of their possessing a terminal sac to the spermiducal-gland duct, no setæ upon the clitellum, and 3 pairs of spermathecæ in vii.–ix.—is the very small size of all the parts of the generative apparatus. In this the present species resembles *A. taprobanæ*.

The *sperm-sacs* are small and lie in segments xi., xii.; they do not reach as far as to the dorsal surface of the intestine.

The *spermiducal glands* vary in size, but are small and confined to their segment. The short duct leads into the circular end-sac.

The *spermathecæ* are so small that they might be readily overlooked; and yet the external apertures are quite large and conspicuous. Each pouch has a diverticulum of about the same shape and size, especially resembling in this *A. taprobanæ*. The spermathecæ lie in segments vii., viii., ix., and open between vi./vii., &c.

Hab. Paddy-fields, Tale.

[1] Michaelsen, JB. Hamb. wiss. Anst. xvi. p. 84.

[2] Rosa, Ann. Hofm. Wien, vi. p. 397.

From the foregoing account of its structure may be abstracted the following brief definition of

Amyntas virgo, n. sp.

Length 152 mm. Setæ of anterior segments rather larger. Clitellum xiv.–xvi., without setæ. Male pores far apart. No genital papillæ. Gizzard-septa wanting. Cæca present. Last hearts in xiii. Sperm-sacs small, in xi., xii. Spermiducal glands confined to xviiith segment, with circular terminal sac. Spermathecæ very minute in vii., viii., ix., with equal-sized diverticulum.

Hab. Malay Peninsula.

(7) **Amyntas perichæta**, n. sp.

Although I have had for examination only a single example of this species, there is no possible doubt, in my opinion, of its distinctness as a species. It furnishes, moreover, an excellent example of how necessary it is to dissect an earthworm merely for the purpose of discovering whether it is known or not described. Externally, the present species might readily be confounded with many others. But its somewhat negative external characters combined with several internal features of very positive value enable it to be placed with accuracy.

It is a stoutish worm of 170 mm. in length.

The number of segments is 116.

The *setæ* are more or less equal in size; those of the anterior segments show no special differentiation.

I could find no *genital papillæ* of any kind.

The *clitellum* occupies the usual segments and is quite free from setæ.

The *male pores* are conspicuous orifices separated from each other by a fairly wide interval.

The *gizzard-septa* appear to be wanting. The *intestine* commences in the xvith segment. The usual *cæca* of moderate length are present.

The last *hearts* are in segment xiii.

The *sperm-sacs* lie in segments xi. and xii.; they are fairly large and solid bodies. The two sperm-ducts of each side unite very shortly after they have emerged from the sperm-reservoirs.

The *spermiducal glands* are on the whole very compact, although they are much divided into small lobules. They occupy segments xvii.–xix. and they have a kidney-like outline. Their duct is not long; it runs forward and then backward, after the very prevalent fashion, and then debouches into a fairly large *terminal bursa* of approximately circular outline, which is confined to the xviiith segment.

A pair of small *egg-sacs* occur in the xivth segment, attached of course to the anterior wall of that segment.

There are three pairs of *spermathecæ*. These lie in segments vi., vii., and viii., and are lateral in position, occupying the average place that these organs occupy in the members of the genus

Amyntas. The pouches are not large and have but a short duct; they taper gradually towards the free cæcal extremity, which gives to them a pear-shaped outline.

The diverticulum of each spermatheca is considerably longer than the pouch; it is tubular in form, and the greater part of it is coiled into a tight knot-like coil. This, however, could be unravelled, though I have not done so. There is no external sheath enclosing the whole coil such as exists in *A. peguanus*. The end of the diverticulum is only very slightly dilated to form the sac-like extremity.

Hab. Malay Peninsula[1].

We may thus define

Amyntas perichæta, n. sp.

Length 170 mm.; number of segments 116. Setæ of anterior segments not enlarged. Clitellum xiv.–xvi., without setæ. No genital papillæ. Male pores far apart. Gizzard-septa missing. Cæca present. Last hearts in xiii. Sperm-sacs in xi., xii. Spermiducal gland in xvii.–xix., with not long, horseshoe-shaped duct and terminal sac. Spermathecæ 3 pairs in vi.–viii., with much-coiled diverticulum, much longer than the pouch.

Hab. Malay Peninsula.

(8) **Amyntas polytheca**, n. sp. (Fig. 2, p. 898.)

The same tube which contained the numerous specimens of *A. kelantanensis* contained a single example of a small *Amyntas* which differed from these by its pale (light brown instead of violet) coloration. It proved to be the representative of a distinct new species. The single example was imperfect and I do not therefore give accurate measurements; it is a slender worm and can hardly have been more than two inches in length.

The *setæ* on the anterior segments are larger than on those which follow.

The *clitellum* occupies the usual three segments and has setæ very plainly present upon the ventral side of all of them.

The *male pores* (see fig. 2, p. 898) are exceedingly prominent as large round protruding discs, which are widely apart.

On the segment in front of that which bears the male pore and upon the two segments following are a pair of *genital papillæ* of much smaller size than the porophores and rather closer to the middle ventral line of the body.

The alimentary canal of this species has the usual strong *gizzard*, which is rather elongated in form and not so globular as is often the case. The usually missing gizzard-septa are often absent in the present species. The *intestine* begins in the xvth segment and has not any *cæca*. The typhlosole is quite conspicuous.

The last pair of *hearts* are in segment xii.

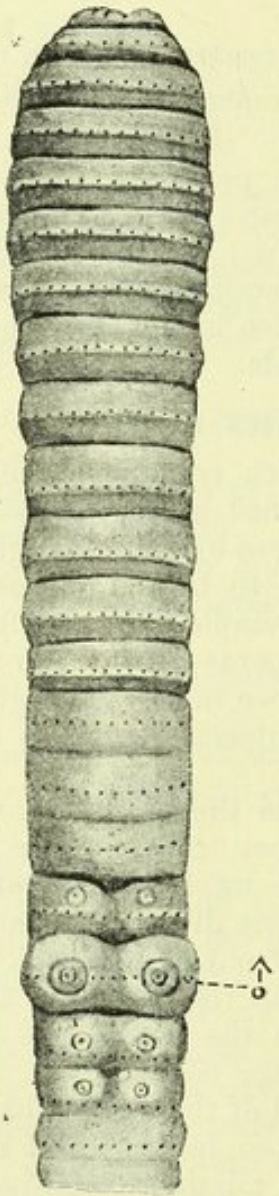
The arrangement of the *sperm-sacs* is rather different from that which usually obtains in this genus. There are large pairs in

[1] I have not seen a label indicating the exact locality.

the xth and xith segments, which are quite distinct, at least in the case of the former pair, from the sperm-reservoirs. In the xiith segment there are a pair of sperm-sacs, but they are quite small and compact bodies.

In the xiiith segment there are a pair of still smaller *egg-sacs*. It may be thought perhaps that I have made an error of a segment, and that the two pairs of small sacs are both egg-sacs and lie, as the two pairs of these sacs sometimes do, in segments xiii., xiv. I believe, however, that this is not the case.

Fig. 2.



Anterior end of *Amyntas polytheca*. × 5.

The *spermiducal glands* are extensive, reaching from segments xvii.–xx.; they are much lobulated. The duct runs forward as a narrow tube into the xviith segment and then runs back, widening out to the xviiith segment, where it opens directly on to the exterior and not through the intermediary of a terminal sac.

The *spermathecæ*, like those of *A. stelleri* and of a number of other species, are present in several pairs in the segments in which they occur. These segments are the vith to the ixth; in each there is on either side of the nerve-cord a group of smallish spermathecæ up to 8 or 9 in number, each of course with its own diverticulum as usual.

Hab. Aring, Kelantan.

The species may be thus defined:—

Amyntas polytheca, n. sp.

Small, slender worm. Setæ on anterior larger than on posterior segments. Clitellum xiv.–xvi., with setæ on ventral surface of all segments. Genital papillæ paired on xvii., xix., xx. Male pores further apart than genital papillæ. Gizzard-septa absent; no cæca. Last heart in xii. Sperm-sacs in x.–xii. Spermiducal glands xvii.–xx., lobate, with not long curved duct and no end-sac. Spermathecæ several pairs in each of segments vi.–ix.

Hab. Malay Peninsula.

(9) **Amyntas aringeanus**, n. sp. (Fig. 3, p. 901.)

This species has a superficial likeness to *A. posthumus* by reason of the fact that the xviith and the xixth segments are provided with papillæ which lie exactly in the same line as the male pores upon the xviiith segment. A closer examination of these papillæ, however, shows that they are not in the least like those of *A. posthumus*.

This species measures up to 115 mm. in length. A specimen which is of that length has 142 segments, a disproportion which is not usual in this genus, where there is generally a very close connection between the number of segments and the number of millimetres in length.

The *setæ* show no differences in size in the anterior segments. They appear to be totally absent from the clitellum.

The *clitellum* occupies all of segments xiv.–xvi.

The most characteristic feature of the new species concerns the *genital papillæ* (see fig. 3, p. 901). These occur both in the neighbourhood of the male pore and more anteriorly. The latter are somewhat unusual in arrangement and position: they commence as early as the fifth segment and there are altogether four pairs of them, the last pair being situated upon segment vii. On segment vi. there are two pairs of papillæ. They are rather large and not very conspicuous and are placed in front of and just overlapping the line of setæ. The additional pair of segment vii. are behind the line of setæ. The two papillæ of segment v. are rather closer together than those of subsequent segments, and there is a slight progressive increase in the distances separating them from first to last. Occasionally two or three pore-like depressions are to be seen like those of the posterior papillæ. The posterior genital papillæ are upon segments xvii. and xix. They correspond exactly in position to the male pores and are of considerable size. Each papilla is in

reality a group of 9–11 small circular papillæ apparently very like those of *A. aspergillum*. They are disposed in two slightly curved lines, one in front of and one behind the line of setæ. The whole area upon which they are borne is not only raised above the area of the surrounding integument, but is slightly different in colour. In one case only the lowest left-hand papillæ merely consisted of the raised area without an indication of the separate papillæ upon it.

The *male pores* are very large and conspicuous, the orifice is much wrinkled. There are about fourteen setæ between the pores.

Dorsal pores are present.

The gizzard of this species shows, more plainly than I have observed in other species of the genus, a disposition of the blood-vessels of the gizzard which has been figured and described in other genera. There are about 8 parallel vessels on each side of the gizzard which run from end to end of that organ. In the gizzard-segments also, which are undivided by a septum, two strong lateral blood-vessels run one on each side; anteriorly each gives off a very strong and much-branched twig to the body-wall. The last heart is in segment xii.

The intestine has *no cæca*.

There appear to be three pairs of *sperm-sacs* in segments x., xi., and xii. Those of the tenth and of the twelfth segments are much smaller than those of the eleventh; but in every case they nearly or quite meet each other above the œsophagus. In the tenth segment the sperm-sacs swell out below into the sperm-reservoirs, which lodge the anterior pair of vas deferens funnels. These reservoirs are not fused together below though they come into contact. Their dorsal extension must, as it appears to me, be regarded as an anterior pair of sperm-sacs.

The *spermiducal glands* are squarish in outline and occupy segments xvii.–xix. Their duct leaves them as nearly as possible exactly in the middle; it is quite slender and is curved back upon itself in a horseshoe-like form; there is no terminal sac, the presence of which might possibly be inferred by the large size of the male pore.

A moderately large pair of *egg-sacs* are appended to the front wall of segment xiii. They are transversely elongated.

The *spermathecæ* are constituted upon the plan of those of *A. stelleri*, and occupy the same segments as do the spermathecæ of that species. There are in fact in segments vi. and vii. 8 to 10 spermathecæ on each side in each segment. Each spermatheca is pear-shaped, lessening gradually in calibre towards the duct; it has a diverticulum of about half its own length which is slender. The diverticulum has the form that has been noted in *A. stelleri*; there is a marked constriction between the swollen end of the diverticulum and another swollen region which gradually diminishes in calibre to the duct.

Hab. Aring, Kelantan.

From the foregoing account may be extracted the following definition of

Amyntas aringeanus, n. sp.

Length 115 mm.; number of segments 142. Clitellum xiv.–xvi., without setæ. Genital papillæ paired upon segments v., vi. (two pairs), vii., on xvii. & xix. paired groups of 9–11 papillæ in line with

Fig. 3.

Anterior end of *Amyntas aringeanus*. × 3

male pores. Male pores large and far apart. Septum viii./ix. absent. Last heart in xii. No cæca. Sperm-sacs in x.–xii. Spermiducal glands in xvii.-xix., compact and square in outline;

no terminal sac to their duct. Spermathecæ 8 to 10 pairs in vi. and vii.

Hab. Malay Peninsula.

It is clear that this species comes nearest to *A. stelleri*, from which, however, it can readily be differentiated by the nature and position of the genital papillæ.

(10) **Amyntas kelantanensis**, sp. n. (Fig. 4, p. 903.)

I have examined some thirty individuals of this new species, hich cannot be confused with any of its allies. It is a long and slender species, measuring up to 105 mm. in length by about 3 mm. in breadth. The number of segments in the longest individual is 100.

The *setæ* on the anterior segments are fewer and larger than those upon the following segments.

The *clitellum* occupies fully its usual segments and is entirely without setæ.

Genital papillæ are rarely to be seen. When present (fig. 4, p. 903) they consist of three pairs of whitish round patches, one pair on each of segments vi.–viii., lying in front of the line of division between each segment and that which follows. They are related to stalked glands, which will be described when the internal viscera are treated of. The *male pores* are conspicuous and widely separated. There are about a dozen setæ between them.

The gizzard-septa appear to be absent. The last heart is in the xiiith segment. The large *intestine* begins in segment xv., and has the usual pair of *cæca*, which are of fair length.

The *sperm-sacs* are racemose in form and lie in segments xi. and xii.

The *spermiducal glands* extend from segment xvii. to xxi. They are much broken up into lobules; that part of the gland which lies behind the male pores is wider from side to side than the part lying anterior to them. The duct is not particularly long and is coiled into a circle. There is no terminal sac.

The *spermathecæ* are present to the number of three pairs and are situated in segments vii., viii., ix. The pouch has a round or oval contour and communicates with the exterior by a duct which is almost as long as the pouch. The diverticulum has a characteristic form; it is very long and if unwrapped would be considerably longer than the spermathecæ. The greater part of the diverticulum is much coiled, and it is dilated at its extremity into an oval chamber; the muscular duct is comparatively short. An oval gland, whiter in colour than the diverticulum and with a long stalk, opens in common with the spermathecal duct. The arrangement, in fact, is very like that of *Amyntas houlleti*, with which species, however, there is no possibility of confusing the present.

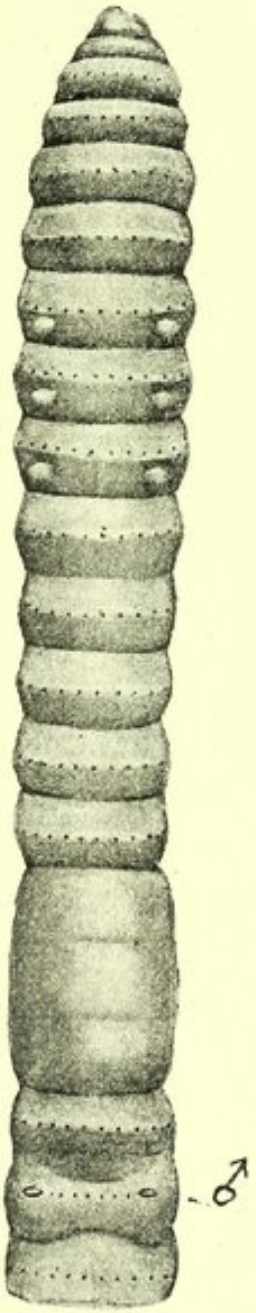
Hab. Aring, Kelantan.

The following definition embodies the principal characters of this new species:—

Amyntas kelantanensis, n. sp.

Length 105 mm.; number of segments 100. Setæ on anterior segments large. Clitellum xiv.–xvi., without setæ. Paired papillæ upon vi.–viii. Male pores far apart. Septum viii./ix. absent. Last

Fig. 4.



Anterior end of *Amyntas kelantanensis*. × 4.

heart in xiii. Cæca present. Sperm-sacs xi., xii. Spermiducal glands xvii.–xix., with curved duct and no terminal sac. Spermathecæ vii.–ix., with long coiled diverticulum and a stalked gland.

Hab. Malay Peninsula.

(11) **Amyntas pulauensis**, n. sp. (Fig. 5, p. 905.)

The present species is represented by a number of specimens, all of which do not show the principal diagnostic character of the species, and led me to confuse it with Dr. Horst's *Amyntas bosschæ*, from which it appears to be perfectly distinct, provided that there are no lacunæ in the descriptions given by Horst[1] and Michaelsen[2].

The length of the largest individual is 165 mm.; the number of segments I am unable to state with accuracy.

The *clitellum* occupies the whole of segments xiv.–xvi. and appears to have no setæ upon it.

The *genital papillæ* are the distinguishing feature of the species so far as concerns external characters. On segments xvii. and xviii. in front of the line of setæ is an area which presents the appearance of a sieve owing to the presence of 40–50 pore-like depressions, which are the external expression of numerous white glands which are visible on dissection. These groups of papillæ are median and unpaired. There appears to be a similar area upon the viith, viiith, and ixth segments, which is very like that of *A. hilgendorffi* as figured by myself[3].

The *male pores* are very conspicuous and widely separated; 13 setæ lie between them.

The gizzard-septa are absent. The *intestine* begins in the xvith segment, and is furnished with a pair of *cæca*, which are rather short, barely reaching to the level of the xxvth segment.

The last pair of *hearts* are in segment xiii.

The *sperm-sacs* are large, solid, and compact. They lie in segments xi. and xii.

The *spermiducal glands* are not of a compact structure; they are much lobulated and occupy segments xvii.–xix. Their duct is short and thick and opens into a rounded, rather flattened terminal sac.

The *spermathecæ* are four pairs and lie in segments vi.–ix. Each sac is oval or more or less pear-shaped in outline; its duct is sharply marked off and about $\frac{1}{3}$ the length of the sac. The diverticulum is not large and not a great deal longer than the duct of the spermatheca. It is divisible into an oval sperm-holding receptacle and a narrower folded duct.

Hab. Pulau, Bidang, Kelah, and Aring.

The following is a brief definition of

Amyntas pulauensis, n. sp.

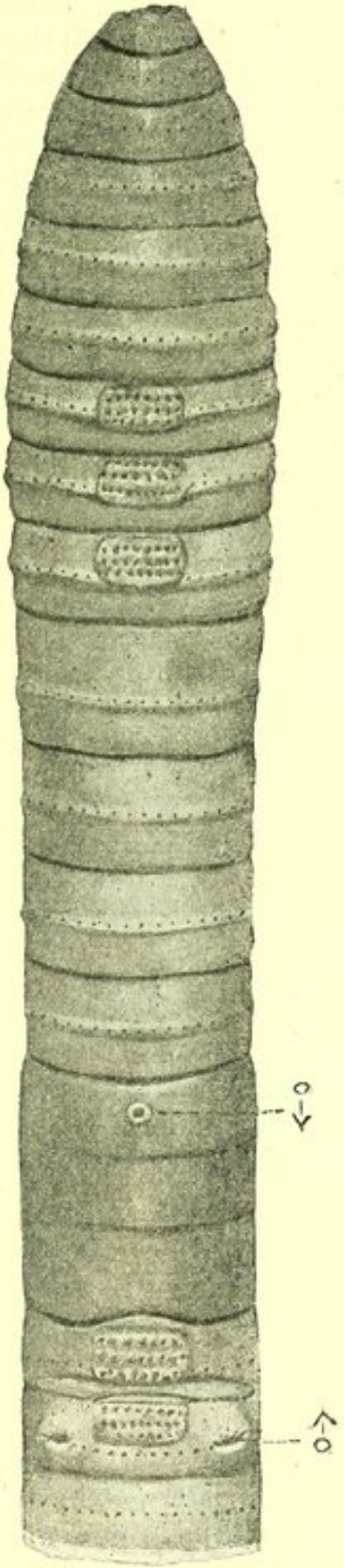
Length 165 mm. Clitellum xiv.–xvi., without setæ. Genital papillæ median unpaired group of pores upon viii., ix., xvii., xviii., in front of setæ. Male pores large and far apart. Septum viii./ix. absent. Last heart in xiii. Cæca present. Sperm-sacs xi., xii.

[1] Notes Leyden Mus. xv. p. 324.
[2] Abh. Senck. nat. Ges. xxiii. p. 238.
[3] Zool. Jahrb., Abth. f. Syst. vi. pl. fig. 1.

Spermiducal glands xvii.–xix., loose-textured; terminal sac present. Spermathecæ in vi.–ix., with short diverticulum.

Hab. Malay Peninsula.

Fig. 5.



Anterior end of *Amynthas palauensis*. × 3.

(12) **Amyntas minutus**, n. sp.

Of this very small species I have examined only a single specimen, which is 48 mm. in length. I counted 103 segments. The setæ upon the anterior segments are very large.

The *clitellum* occupies the whole of segments xiv.–xvi. It has setæ upon it. The median region of the xvith segment is not invaded by glandular tissue, so that it presents the appearance of a papilla. There is a swollen area of corresponding position and extent upon segment xvii.

Apart from these there are a series of paired *genital papillæ* which follow the male pores upon segments xix.-xxi. They are paired upon the first two segments, but the xxist has only the left-hand one. They are much smaller than the male pores and lie nearer to the middle line.

The *male pores* are very large indeed. They are shallow but large depressions borne upon very conspicuous porophores. They are sucker-like in appearance.

With regard to the internal structure, I have been able by dissection to note the principal structural features which fix the position of and distinguish the present species. I am not certain, however, whether the gizzard-septum is present. The gizzard itself is large and typically 'perichætous'; the failing or vanished gizzard of some small Earthworms is sometimes put down to smallness of size and consequent simplification by degeneration; instances like the present appear to show that the reduction of the gizzard is rather to be referred to difference of habitat and food. The intestine has no *cæca*. I could not fix the position of the last heart.

There are undoubtedly three pairs of large *sperm-sacs*, which lie in segments x.–xii.

The *spermiducal glands* are large, loose in texture, and much incised. The duct is rather long; it runs forward and then back, opening directly on to the exterior, and not by the way of a terminal sac. The gland itself extends through segments xvi.–xxi.

The *spermathecæ* present the unusual character of being massed in considerable numbers in a single segment. There are 6–10 pairs of them, not only in segments vi. & vii. as in *A. stelleri*, but also in segment viii. behind the last thick septum and alongside of the gizzard.

Hab. Aring.

The following will be the definition of

Amyntas minutus, n. sp.

Length 48 mm.; number of segments 103. Setæ on anterior segments larger. Clitellum xiv.–xvi., with setæ. Papillæ paired on xix.–xxi., smaller and nearer to the middle line than the prominent, widely separate male pores. Cæca absent. Sperm-sacs in x.–xii. Spermiducal glands xvi.–xxi., with longish duct and no end-sac. Spermathecæ 6–10 pairs in each of segments vi.–viii.

Hab. Malay Peninsula.

(13) **Amyntas evansi**, n. sp. (Fig. 6.)

Three examples of an *Amyntas*, unfortunately not fully mature, cannot, I believe, be included in any known species of the genus, though they come near to well-known forms with four pairs of spermathecæ.

The largest specimen measures 120 mm. and consists of about 120 segments. The anterior setæ are at least not markedly larger than those upon the segments which follow.

The position of the *clitellum* cannot be fixed.

The only distinctive external feature of this species is the one which leads me to separate it specifically. Between segments vii. and viii. are a closely-set row of small cup-shaped *papillæ*, 8 on each side, a small space separating each 8. I took these at first for numerous spermathecal pores such as are found in *A. stelleri* and one or two allied forms. They are, however, only genital papillæ, though of unusual position.

Fig. 6.

Anterior end of *Amyntas evansi*. × 4.

The spermathecal pores, four pairs, are quite obvious, and lie to the outside of these papillæ; they are of course intersegmentally placed, and lie between segments v./ix.

The *male pores* are placed upon very conspicuous porophores, which are widely separated and directed outwards, *i.e.* away from each other. There is no *gizzard-septum*. The last hearts are in xiii.

The *intestine* commences in segment xv. and has a pair of *cæca*, which arise in segment xxvii. and extend forward so far as xxiv. or xxiii.

The *sperm-sacs* are large in x., xi., xii. The *spermiducal glands*

(defective on the right side of one specimen) occupy segments xvii.–xix.; they are lobate and have but a short duct.

The *spermathecæ* (in vi.–ix.) have a diverticulum which is very short.

Hab. Biserat.

We may thus define the species :—

Amyntas evansi, n. sp.

Length 120 mm.; number of segments 120. Anterior setæ not larger than those upon following segments. Clitellum ? Genital papillæ 8 pairs on intersegmental groove vii./viii. Male pores far apart. Gizzard-septum absent. Cæca present. Last heart in xiii. Sperm-sacs in x., xi., xii. Spermiducal glands xvii.-xix., with short duct and no terminal sac. Spermathecæ in vi.–ix., with short diverticulum.

Hab. Malay Peninsula.

(14) **Amyntas biporus**, n. sp. (Fig. 7, p. 910.)

Of this species I have been able to examine a large number of individuals. They are all of moderate size. The length is fairly illustrated by a specimen which measured 115 mm. and consisted of 93 segments.

The *setæ* are a trifle stouter upon the anterior segments of the body; they are particularly small upon the xth and, though the difference is less marked, upon the xith segment. The xth segment, as is so often the case, is larger than the others.

The *clitellum* completely occupies its usual segments. I found setæ upon all of its three segments.

Genital papillæ are found both anteriorly and posteriorly; in nearly all of the specimens which I examined there are a pair of papillæ upon the viith segment, lying just behind the circle of setæ; these are not large and have an elliptical contour; they are almost eye-like in form. In one specimen there were, in addition to these, an exactly similar pair of papillæ lying on the viiith segment, but in front of the circle of setæ and rather near to each other in the median line. In another worm the right-hand one only of the additional pair of papillæ was present. As the great majority of the specimens had but the single pair of papillæ on segment vii., that may be regarded perhaps as the normal arrangement for the species.

The posterior pair of papillæ are upon the xixth segment, and they showed no variations at all; there was always one pair and one only. The curious fact about these papillæ is that they are exactly like the male pores which precede them. It would be quite impossible from an examination of the external characters of the worm alone to say definitely which was male pore and which papilla. Indeed the opinion arrived at would probably be that this species possessed two pairs of male pores. The first specimen that I examined was put down by me as an abnormality until the examination of others showed that it was a constant character. It

naturally suggested the specific name. The papillæ in question have a transverse direction and are oval in form, bearing a conspicuous slit; they interrupt the line of setæ, and correspond exactly in position to the male pores.

The *male pores* need no special description, as they are exactly like the copulatory papillæ of the nineteenth segment. As to the internal anatomy, the gizzard-septum appears to be wanting. *Cæca* are present. The last heart is in segment xii.

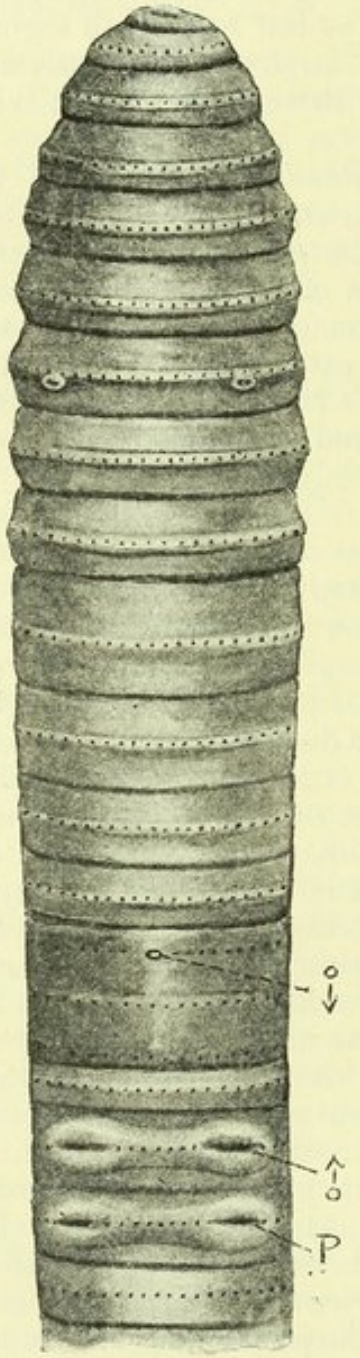
The *sperm-sacs* are large and racemose, meeting in the middle line above; there are three pairs of them lying in segments x., xi., xii.

The *spermiducal glands* are large and rather ragged. They occupy segments xvii.–xix. and a trifle of the adjoining segments also. The duct is thin and curved upon itself in the usual horse-shoe-shape. It opens on to the exterior through a not very large terminal sac. In segment xix. is a similar sac, which corresponds to the papilla on the exterior of the body already described. The likeness between these two sacs, coupled with the external resemblances already referred to, suggests that we may have to do with a species which has only recently lost the primitive double male efferent apparatus.

I have made a series of sections through this region of the body in order to attempt to further elucidate the remarkable appearances seen externally and on a dissection. With regard to the male pores, the duct of the spermiducal gland does not open directly into the terminal sac, but is prolonged into a penis-like process which lies within the sac and does not extend quite so far as to its external orifice; doubtless it can be protruded. The walls of the sac are much wrinkled by deep folds, the interstices between which are reduced to a minimum, as the epithelium on either side is very nearly in contact. It is surrounded by a layer of loosely arranged muscular fibres, which in my sections (transverse to the longitudinal axis of the body) are seen to run over the sac from left to right and to be mingled with numerous fibres running in a longitudinal direction. The actual orifice of the sac, though large, does not occupy the whole of the groove upon the xviiith segment. The orifices upon the xixth segment, which are externally so like the male pores upon the xviiith segment, lead, like them, into a sac. This sac in structure is precisely like that of the bursa copulatrix of the male efferent apparatus. It has a widish mouth; it is lined by tall columnar epithelial cells, and its walls are thrown into close folds. The resemblance to the bursa copulatrix does not, however, end here. A penis-like process depends from the dorsal wall of the sac into the interior; I cannot distinguish this structure from the penis of segment xviii., save for the fact that it has no lumen. For the rest its shape, size, and relations are precisely those of the penis. Instead of by a lumen its thickness is occupied by the ducts of numerous unicellular glands which form a mass above the sac and are surrounded by a special muscular layer. They are precisely like those of other species of *Amynlas*.

It is plain, therefore, that the minute anatomy of this species bears out the very close external resemblance between the male pores upon segment xviii. and the "genital papillæ" upon segment xix. We may possibly regard the mass of gland-cells in the latter as representing the glandular investment of the spermiducal gland of the

Fig. 7.



Anterior end of *Amyntas biporus*. × 4.

P, papilla on segment xix.

former. In any case this is the nearest approach to be seen in a true *Amyntas* of the originally present second pair of spermiducal glands which occur in so preponderant a proportion of Acanthodriloid forms.

The *spermathecæ* are four pairs in segments vi.-ix. The main pouch is circular, sometimes even kidney-shaped in outline; in the latter case the duct arises from the hilum. The duct is quite as long as the pouch [1]. The diverticulum is altogether longer than the spermathecæ; it is made up of an oval pouch and a long duct. In the neighbourhood of the second or third spermatheca is a soft cushion-like gland, bilobed, which appears to be related to the papillæ upon the spermathecal segments.

The following definition of the species includes the principal characters of

Amyntas biporus, n. sp.

Length 115 mm.; number of segments 93. Anterior setæ a little stouter than upon succeeding segments. Clitellum xiv.–xvi., with setæ upon all segments. Genital papillæ upon vii., viii., and upon xix. a pair of slit-like orifices leading into a sac resembling a bursa copulatrix and with penis-like process. Male pores far apart. Gizzard-septum absent. Cæca present. Last hearts in xiii. Sperm-sacs in x., xi., xii. Spermiducal glands in xvii.–xix., with horseshoe-shaped duct and small terminal sac. Spermathecæ in vi.–ix., with long diverticulum.

Hab. Malay Peninsula.

[1] This is not always apparent. Sometimes the diverticulum is shorter; hence the need for care in basing specific distinctions.