ON THE MORPHOLOGY AND SYSTEMATIC POSITION OF THE CESTODE *GIGANTOLINA MAGNA* (SOUTHWELL).

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(Plates V, VI.)

In 1915 Southwell (8, pp. 326-328, pl. xxvii, figs. 6, 7) published the description of a very interesting Amphilinid from the body cavity of a teleostean fish, *Diagramma crassispinum*, of the family Pristipomatidae. He named it *Amphilina magna*. Three specimens of the species were collected by Southwell in Ceylon where he found them in as many specimens of their host during his examination of a number of these from the pearl banks. Already in 1912 (7, p. 273, pl. iii, fig. 41) he had published a description of its external characters together with a short note on its most conspicuous internal features (evidently as they were to be seen in unmounted specimens) and a figure of the animal. He did not have time to make a full examination of the parasite then and stated: "I am at present uncertain of its strict zoological position. The worm is to all appearance a huge *Trematode.*" He also refrained from naming the animal at the time. Nevertheless the description then given by him is of value as containing information on the dimensions of living and freshly preserved specimens and on the colour of the latter (in formalin).

On reading Southwell's description (8) and still more on studying the accompanying figures I had serious doubts as to the correctness of his interpretations of two of the organs of the animal, *viz.*, the supposed germarium and the supposed shell-glands. Being engaged at that time on a study of the Amphilinidea, an elucidation of these points was of great interest and importance to me. On my request Dr. Baini Prashad of the Zoological Survey of India, Indian Museum, Calcutta, very kindly sent me material of the cestode in question for examination and later gave me information on an important point of its morphology, *viz.*, the position of its uterine pore (see below p. 3). I offer him my best thanks for his great amiability. He further most obligingly offered to publish the results of my researches on the material in the "Records of the Indian Museum" My heartiest thanks are also due to the renowned arachnologist, Counsellor of the Government, E. Reimoser, to whom I am much indebted for taking the photographs reproduced on plate VI.—Since this was written, Dr. Prashad has placed me under further obligation by having these photographs retaken, the negatives of which had been broken during their transport to India, and by carefully revising the wording of my paper.

According to Dr. Prashad's accompanying letter, the material sent to me consisted of "pieces of one or two (?) specimens in spirit" and "a mounted slide of the posterior end of probably one of the above",

this being "the only material with the exception of one complete type-specimen" A comparison of the mounted fragment (see pl. VI, fig. 4), which is unstained, with Southwell's fig. 7 shows beyond any doubt that it is identical with the original of the latter and is thus one of or a portion of one of the paratypes. As there is also a posterior end among the two pieces in spirit, it further follows that, if the mounted posterior end actually pertains to one of these, they must belong to two different individuals. In the tube containing them there was a label in Southwell's handwriting which reads: " Types. *Amphilina magnum,* Southwell "

Doubt can, however, arise whether they and the mounted fragment represent paratypes or cotypes. Southwell, it is true, uses the term " types " rather loosely, as is obvious from the label quoted above and from his speaking in 1915 of his " types " [of the species in question] on p. 328. As he however (*l.c.*) also definitely says: " The type of *Amphilina magna,* n. sp. is deposited in the Indian Museum ", it would seem that he ultimately designated a single individual as type, and this apparently was the complete specimen (see the above quotation from Dr. Prashad's letter).[1] Granting this, the other specimens are of course paratypes, and as such I shall speak of them in the following pages.

In 1922 (4) when creating the new genus *Gigantolina* (see below p. 25) for *Amphilina magna* I promised to publish elsewhere a fuller and illustrated account of *Gigantolina magna* and also to discuss therein the discrepancies existing between Southwell's description of this species and the definitions given by me of the family and subfamily to which I assigned the animal. Availing myself of Dr. Prashad's kind offer mentioned above, I propose to do this in the following pages.

The two fragments of *Gigantolina magna* in spirit received by me consisted of (i) the posterior part of an individual, as already mentioned above, having in the mounted condition a length of 13 cm. and an average breadth of 1·2 cm., and (ii) a smaller piece measuring 9 cm. in length, 0·37 cm. in thickness and on the average 1·45 cm. in breadth, but not representing either end of the body. I thus had to my regret no anterior end at my disposal, and my remarks on this interesting part of the cestode must, therefore, remain limited to the little that can be gathered from Southwell's fig. 6 and from his description.—The posterior part referred to above I stained with borax-carmine and

[1] Dr. Poche is right about his assumption that Southwell used the term " types " in a rather general sense. He considered all the three specimens as the "types" or the type-series of this species and as such they were entered in the registers of the Indian Museum by the author. At present there are in the Indian Museum collection (i) the complete specimen which is the original of Southwell's fig. 6 on pl. xxvii of vol. XI of the " Records of the Indian Museum " and which Dr. Poche calls the " type " of the species in the present account, (ii) the posterior part of an individual which was reproduced as fig. 7 by Southwell and is refigured as fig. 1 on pl. V and its photograph as fig. 4 on pl. VI in the present paper, and (iii) the posterior part of the third individual figured in the present paper as fig. 2 on pl. V and its photograph as fig. 5 on pl. VI. The fragment of another individual which was also sent to Dr. Poche for examination is probably the anterior part of the third specimen. In it the anterior tip is missing. I have not been able to find the anterior part of the second specimen in the collections of the Indian Museum. The last two specimens are, in accordance with Dr. Poche's suggestion, now designated as the " paratypes " of the species. (*B. Prashad.*)

mounted in Canada balsam. The other fragment I examined in spirit. It is true that in this state almost nothing of the internal organization could be made out, but the mounting of it could not reasonably be expected to shed any more light on the structure of the animal except possibly on the frontal glands, which are doubtlessly present (see below p. 5), and on the configuration of the uterus in the different regions of the body (see pp. 18-21). Any information thereon gained from the fragment would moreover be greatly discounted by the fact that its place in the complete animal is not known for certainty. Further, the very characteristic sculpture on the surface of the animal is greatly obliterated in mounted material (see below p. 4).

Southwell (8) in the explanation of his plate xxvii gives the scale of fig. 6, to which I shall frequently have occasion to refer further, as reduced to $\frac{1}{3}$. This figure has a length of almost 16 cm., so that the real length of the animal would be about 48 cm. In his earlier paper (7, p. 273) however he gives the length of the preserved specimens (and it is evident that the figure in question was taken from a preserved individual) as $9\frac{1}{2}$ inches [=241·3 mm.], and in 1915 (8, p. 327) that of the largest specimen as taken recently as 250 mm. It is, therefore, obvious that the scale attributed by him to the said figure cannot possibly be correct and that the latter is about $\frac{2}{3}$ of the size of the animal.[1]

As in most species of Amphilinidea there is no difference in the arching between the two surfaces of the body. Preserved material may sometimes show a difference; but this is quite accidental. This is clear from the fact that the unmounted fragment mentioned above is quite flat with incurved margins on one surface and distinctly convex on the other in about one half of its length, while in therest of its length the configuration of the two surfaces is exactly the reverse. For the determination of the ventral surface and the correct dorso-ventral orientation of the animal we must, therefore, have recourse to the situation of the uterine pore, which is situated on the *ventral* surface. (The correctness of this assertion with regard to the Amphilinidea and with due reference to the other Cestoidea provided with a superficial uterine pore too I have fully discussed elsewhere (6).) As mentioned already, I had, however, no anterior end of *Gigantolina magna* at my disposal, in which the uterine pore is situated, while from Southwell's fig. 6 it is not clear as to which surface carries the said pore. In his text also he makes no reference to this point. I, therefore, wrote to Dr. Prashad asking him to decide this question by an examination of the type in the Indian Museum. He very kindly informed me that, when the animal is so oriented that its anterior end is directed towards the observer and the second ascending branch of the uterus is situated to his right (as in Southwell's fig. 6), the uterine pore is on the under surface. *This surface is therefore the ventral one.* This result is in full accordance with the conditions found in *Schizochoerus liguloideus* (see Poche, 6) and likewise with the situation of the posterior nerve commissure relative to the terminal part of the male genital duct (see below p. 5 and Poche, 5, p. 589 f.).

[1] I have re-examined the type-specimen in the Indian Museum which was reproduced as Southwell's figure 6 on plate xxvii in 1915. The scale of reduction of this figure as stated by Dr. Poche should be × $\frac{2}{3}$ or reduced by $\frac{1}{3}$ and not × $\frac{1}{3}$, as is given in the explanation of the plate. (*B. Prashad.*)

As regards the general external form of *Gigantolina magna* reference must be made to Southwell's paper (*l. c.*), who had the advantage of being able to examine the cestode in the fresh state and had a complete specimen of it.—The posterior end of both specimens examined by me is distinctly asymmetrical up to a line lying somewhat in front of the accessory receptaculum seminis (see below p. 16), the left margin of the body beginning much further forward to trend medially than the right one (pl. V, figs. 1, 2, pl. VI, figs. 4, 5). A similar asymmetry exists in *Schizochoerus liguloideus* (*vide* Poche, *t. c.*).—The stained specimen shows at its hind extremity, which is otherwise obtuse, in the sagittal plane a small, gently rounded, relatively broad prominence projecting backwards and measuring approximately 0·2 mm. in length and 1·3 mm. in breadth (see pl. V, fig. 2, *p*). As it carries the male genital pore (*vide infra* p. 11) it evidently represents the male genital papilla which I have also recently (5, p. 611-613) described for *Amphilina foliacea*. In the unstained specimen, however, whose hinder end is more fully rounded, no corresponding structure is to be detected (see pl. V, fig. 1), neither in Southwell's fig. 6 which represents another individual. The same is often the case in *Amphilina foliacea*, especially in unsectioned specimens.

The colour of the parasites which was described as milky-white in formalin by Southwell had changed to a dirty yellow grey when I received them in spirit. They were very little transparent and only outlines of some of the main features of their internal organisation could be made out in the unmounted condition. In the unstained mounted fragment the posterior tip of the body for a length of 1·5 mm., *i.e.*, up to the hindermost part of the muscular ring surrounding the vaginal pore (see below p. 15), is throughout its breadth conspicuously darker than the rest of the animal, being as it is of a gold-brown colour (see pl. V, fig. 1). This part is separated by a rather sharp, straight transverse line from the main portion of the animal. In the stained specimen no marking of this type was found.

The surface of *G. magna* is not smooth, but shows a fine, irregularly honeycomb-like sculpture, as is also characteristic of *Amphilina foliacea* and *Nesolecithus janickii*. It is visible even to the naked eye, when it appears to consist of very minute granules. It is best discernible when the specimen is taken out of the spirit and begins to dry superficially, while almost nothing of the said sculpture can be detected even with the microscope so long as the animal is immersed in spirit. Also in mounted specimens it is greatly obliterated in most places except on the margins of the body, which in consequence of it appear finely serrated under the microscope. The individual combs are always very minute and more or less dish- or cup-shaped, but vary considerably among themselves as to shape and size, and are separated from one another by sloping ridges whose breadth diminishes to a narrow crest at their apices. A comb of fair size measured 200 μ in length and 120 μ in width from apex to apex of the adjacent ridges, another one was 240 μ in length and 100 μ in width and a third one 150 $\mu \times 100\,\mu$.—No difference in regard to this sculpture on the dorsal and the ventral surfaces of the tape-worm was noticeable. No transverse wrinkles or furrows exist on the body of the animal, as are found in *Nesolecithus janickii* and *Schizochoerus liguloideus* (see Poche, 6) respectively.

In his short description of this animal Southwell makes no mention of the frontal glands, which are undoubtedly present, as is also the case with all other known Amphilinidea. That the structures in question are really enormous unicellular glands and not, as Woodland (9, pp. 60-64) has maintained, the fibres of a mighty boring muscle, I have fully shown elsewhere (6; see also 5, p. 591 f.). As I had no anterior part of an individual for examination, I can say nothing further about their condition in *Gigantolina magna* except that they certainly do not, as is the case in *Amphilina foliacea*, extend into the posterior part of the body, therein agreeing with those of the Schizochoerinae.

The body musculature consists of very fine fibres. It is composed of a dense outer layer of longitudinal muscles, a much smaller number of diagonal oblique fibres and a dense internal layer of transverse muscles.

Like the other Amphilinidea *Gigantolina* possesses a pair of large lateral nerves which run near the margins of the body and, as far as the testicular bands extend, between these and the vitellaria (pl. V, fig. 2, *n*). I could distinguish them only in the stained specimen and even there not throughout their course. In some places they are best seen by holding the slide against the light.—Where in the hind end of the body the testicular bands curve inwards and secede from the vitellaria (see below p. 6), the nerves run next to the inner margin of these to a point where the vitellaria (or in specimens where these, whose extent is not always exactly the same, have already terminated, the paired vitelloducts) in their turn bend medially and in doing so cross the nerves ventrally. This crossing point lies a little behind the posterior bend of the first ascending branch of the uterus on the right side of the cestode, and in the specimen before me at a slightly more anterior level on the left side. From these points backwards the nerves gradually approach the posterior margin of the body, until at their posterior extremities they are only about 0·5 mm. distant from it; this is less than a third of their distance from the margin throughout the greatest part of the animal. At these points they are approximately equidistant from the sagittal plane and the posterior margin of the body. From here they turn medially and slightly forwards and unite with each other in the middle line dorsally to the terminal portion of the male efferent duct. and form by their union a rather flat transversely placed arc whose convexity is directed towards the anterior end of the tapeworm. From the posterior side of this arc there arises on either side about midway between its beginning and the male efferent duct a short and somewhat thinner nerve. It runs obliquely backwards and laterally at an angle of approximately 45° to the sagittal plane till it almost reaches the hind margin of the body a little medially from the place where, in the specimen under consideration, the male genital papilla referred to above begins (see p. 4). It evidently represents a male genital nerve. The whole arrangement shows a striking similarity to that described and figured by me for *Amphilina foliacea* (5, p. 589 f).

Of the excretory system I could only distinguish some portions in the stained specimen. These suffice, however, to show that it is of the reticular type, as is also characteristic of *Amphilina foliacea* and the

Schizochoerinae, while main longitudinal channels as are found in *Amphilina paragonopora* (Woodland, 9, p. 65) are apparently absent. More especially I have observed two narrow parallel excretory vessels running from the anterior and middle part of the seminal vesicle obliquely forwards and towards the right to the first, backwardly directed portion of the first ascending branch of the uterus (pl. V, fig. 2, *c*). The anterior of these vessels reappears on the right side of the uterus and continues its course towards the right and somewhat backwards till it is again obscured from view by that organ. Both of them give off lateral branches, which anastomose with one another and with the branches of the other vessel. They are mostly too fine to be shown in a drawing of so small a scale as my fig. 2, on pl. V The whole network lies ventral to the vitelloducts, the vagina and the uterus. The anterior vessel is narrowest on the left side and very gradually increases in width towards the right, where it attains a breadth of 36 μ. I was also able to distinguish a dense, irregular network of fine excretory vessels at the posterior extremity of the animal near the dorsal surface, occupying approximately a semicircle whose anterior end lies near the vaginal pore and which extends to the posterior end of the body.—Immediately to the right of the male genital pore, but a little more anteriorly than the latter and some distance below the surface of the body, I have, in the specimen referred to, observed a small, slightly oval vesicle with perfectly smooth, thin walls and with the longer diameter of 45μ (pl. V, fig. 3, *ve*). From its shape and position it may perhaps erpresent an optical section through the excretory vesicle, but I am by no means certain that this is the case.

The male genital organs Southwell (8) described as follows: "The testes lie scattered about through the parenchyma. At a point about 15 mm. from the posterior extremity, the paired vas deferens unite in the middle line, and open by a minute pore 1 mm. from the posterior extremity." Brief as this account is, it is incorrect in more than one respect. In the first place the testes do not lie scattered about through the parenchyma, as is the case in *Amphilina foliacea*, but are strictly limited to two narrow, regularly arranged bands (pl. V, figs. 1, 2, ; pl. VI, figs. 4, 5, *t*). This arrangement is also clearly shown in Southwell's figs. 6 and 7, pl. xxvii. These bands I have (4, p. 281) designated as "Hodenstreifen", and will accordingly speak of them as the testicular bands in the following account. They stretch over the greatest part of the length of the animal and, except in their hindermost part, are situated symmetrically throughout on the sides of the body a little internally to the vitellaria and just outside the two ascending branches of the uterus. At many places they are even partially or in the whole of their breadth covered over dorsally or ventrally by coils of the uterus. Only from the anterior part of the left testicular band the corresponding section of the uterus seems to be slightly further removed (see below p. 20). Anteriorly these bands, according to Southwell's fig. 6, extend to near the anterior end of the animal, reaching here a little further than the uterus, but not so far as the vitellaria (see below p. 12). Posteriorly the testicular bands run internally to the vitellaria, etc., till they almost or quite reach the level of the anterior end of the accessory receptaculum seminis (see below p. 16). Here the

right band suddenly changes its direction, running obliquely backwards and medially at an angleof about 45° to the sagittal plane—and crossing the first ascending branch of the uterus on the ventral side—till it reaches the right margin of the broad part of this receptaculum approximately about the middle of its length. According to Southwell's fig. 7 the point of meeting would be at the hind end of the anterior third of this part of the said receptaculum, which he calls germarium (see p. 11). Having examined the same specimen I find that his drawing is inexact in this respect (*cf.* my fig. 1 on plate V). From here the testicular band, at least in the individuals examined by me (see below p. 8), takes a course which is somewhat more transverse and less backwards. It crosses the broad part of the accessory receptaculum seminis on the ventral side, reaching its left margin in the posterior third of its length, but always more or less anterior to its hind margin. It continues further for a short distance till it meets and unites with the left testicular band at a more or less obtuse angle. This latter band at the level referred to above, though not always at exactly the same level as the right testicular band, also changes its direction, but in a lesser degree and more gradually, running posteriorly and more or less medially till it is joined by the band of the other side at the level of the posterior third of the broad part of the accessory receptaculum seminis and somewhat nearer this receptacle than the vitellarium, but far to the left of the middle line of the animal. From here the united testicular band in the specimens examined by me forms a very obtuse angle with the left and an angle of not much more than 90° with the right testicular band, and runs backwards as a more or less direct continuation of the former. Its trend towards the sagittal plane is always distinctly less marked than that of the immediately preceding part of the left testicular band. It traverses from a quarter to a third of the distance between the point of union of the two testicular bands and the hind end of the cestode and then ceases at a level which may be cephalad or caudad of the posterior margin of the germarium, but which always lies considerably anterior to the ends of the vitellaria. According to Southwell's figures 6 and 7, the testicular bands do not extend so far backwards as described by me; on the contrary the right testicular band in his figures ceases shortly before or just at the point of reaching the right margin of the accessory seminal receptacle (Southwell's germarium) and the left one at a somewhat more posterior level; this is however distinctly anterior to the point of union of the vasa deferentia and also anterior to the anterior extremity of the germarium (Southwell's shell-glands). Naturally, therefore, the two testicular bands are not shown as uniting in these drawings. As a result of my examination of the individual represented in Southwell's fig. 7 I find that his figure is incorrect in the points noted above, which in this specimen are as described by me and shown in my fig. 1 on plate V Southwell's mistake was probably due to the fact that the testes are difficult to see in unstained specimens, especially the more isolated ones towards the ends of the testicular bands. They are best seen when the light is slightly cut off, while I could best distinguish the few lying ventrally to the accessory receptaculum seminis with the naked eye by holding the slide against the light. Also the course of the corresponding parts of the vasa deferentia in Southwell's fig. 7

does not agree with that of the testicular bands as traced by me, in or along which they (see below p. 9) are situated (though I have not been able to actually see the paired vasa deferentia in this unstained specimen). The right vas deferens in this figure trends far too much backwards, so that its point of union with the left one comes to lie almost at the level of the posterior margin of the (real) germarium instead of anteriorly to the foremost point of the latter. Further the left vas deferens as well as the vas deferens commune are shown too far laterally. Thus it seems that the right vas deferens in Southwell's figure has only been drawn by concjeture. Regarding his fig. 6 I cannot positively say that it also is incorrect as to the position of these structures, for I have not been able to examine the specimen from which the figure was made and very considerable individual variation does occur regarding the backward extension of the testicular bands in the Amphilinidea, as was found by me in specimens of *Schizochoerus liguloideus* (6). In view, however, of the unreliability of Southwell's fig. 7 in these respects on the one hand and the striking discrepancy between the condition in the two specimens examined by me and that represented in his fig. 6 on the other, one can reasonably doubt the correctness of the latter drawing as well.—The union of the testicular bands at their posterior ends is a feature of great morphological interest as it constitutes a link between the disposition of the testes as found in *Amphilina foliacea*, where they occupy a single field in the central area of the body, often more or less forked in its anterior part, and that in the other Amphilinidea, where they are restricted to the sides of the animal.

Each testicular band is composed of a very large number of testicles, roughly numbering at least about 2,200. Throughout the main portion of the bands the testicles are for the greatest part arranged in two irregular, in general closely juxtaposed rows, only occasionally however showing a paired disposition in their arrangement. Some of the testes partly overlap each other. Sometimes three, very rarely four testes are situated more or less side by side in a line, while in other places there is only one in the breadth of the band. The successive testicles mostly lie quite close to each other, but here and there short spaces intervene between them. Areas with testes arranged more densely, as described above, alternate quite irregularly with areas in which they are sparser. The average breadth of the testicular bands is about 350—400μ. Shortly before reaching the right margin of the accessory seminal receptacle the right testicular band, and shortly before its union with the band of the left side the latter gradually increases to about 600μ in width in consequence of the large number of more or less juxtaposited testes (see pl. V, figs. 1, 2, *t*). I cannot describe the behaviour of the right testicular band in the stained specimen ventrally of the said receptacle, as the sperm contained in the latter organ is so deeply stained as to make the overlying structures quite invisible. In the unstained individual the above-mentioned broader portion of this band abruptly ceases immediately after reaching the right margin of the receptaculum in question and is followed by a very poorly developed section composed of only a few testicles arranged more or less in a single line and for the greater part separated from each other by a

small or (on the left side of the receptaculum) a rather larger interspace. This condition persists down to the point of union of the two testicular bands. No conclusions can, however, be drawn therefrom as to the configuration of the right testicular band ventrally to the accessory receptaculum seminis in the stained specimen; for in it the band on again becoming visible at the left margin of the receptacle shows the same strong development which it had attained on the right side of this organ and preserves this character to its junction with the left band. Posterior to this junction the development of the now united testicular band shows in both individuals a rapid decline, consisting except at its foremost end of only a single row of testicles partly separated from each other by short but distinct interspaces and continuing so for the rest of its length.—At the anterior ends of the testicular bands the testes, as is apparent from Southwell's fig. 6, are for a short distance also arranged in a single row and for the greater part slightly separated from one another. I all the more consider this as a correct representation of the facts as it is in full harmony with what I have observed in *Schizochoerus liguloideus* (6).

The individual testicles have a more or less circular, oval or even a somewhat irregular contour, while a few of them show an indentation of the margin. Their long axis may be directed longitudinally, transversely or obliquely. Their size also varies to a certain degree in the same individual. In the stained specimen a middle-sized circular testis measured 250μ in diameter; a middle-sized and a rather large oval one 340μ and 400μ respectively, while the big hindermost one was 300$\times$400μ. As is to be expected from their size they are easily seen with the naked eye. In the stained specimen most of the testicles contain several dark-brown balls of a granular appearance which are mostly more or less circular with a diameter of about 40—75μ; more rarely, they are ovoid with a long axis measuring up to 96μ. Besides these there are other similar but lighter coloured balls, which have, probably because of their being in a different stage of development, taken the stain in a lesser degree or not at all and are, therefore, much less conspicuous. From the situation and appearance of these balls and moreover from my observations on *Schizochoerus* (*t. c.*), in which the details were better discernible, I can confidently say that they represent the different generations of the descendants of the germ cells, perhaps held together by a cytophore.

The testicular bands are traversed longitudinally by the vasa deferentia (pl. V, fig. 2, *vd*). These are for the greatest part situated more or less in the middle of the bands; the testes, however, are not all arranged along their sides, but in part also just above or below them. The vasa deferentia are only discernible in certain parts, especially where the individual testicles are separated from one another by interspaces. As in the case of *Schizochoerus* (6) the testes are of course connected with them by short vasa efferentia, which in whole mounts were nowhere visible. The point of union of the vasa deferentia lies, as is evident from the preceding, at the junction of the testicular bands. They therefore by no means unite in the middle line as Southwell says (see above p. 6), but very much to the left of it, as is also quite apparent from his figures. Further, their point of union lies posterior to the posterior turning point of the uterus and laterally to the descending branch

of the latter—characters in which *Gigantolina* differs from the Schizochoerinae. The distance between their point of union and the posterior end of the animal is 10·5 mm. in my unstained specimen.

The part of the male genital duct between the junction of the vasa deferentia and the genital pore is represented in Southwell's figures as an almost straight tube which in its whole length is very gently curved outwards and shows no differentiation whatever. Neither its course nor its structure, however, is so simple in either of the specimens examined by me; and as one of these is the one figured by Southwell as his fig. 7, I am convinced that, making full allowance for the small scale of his drawings, his fig. 6 also is incorrect in this respect. As far as the vas deferens commune (pl. V, figs. 1, 2, *vc*) traverses the united testicular band, its course has already been treated of above (p. 7). From the end of this band the male genital duct continues caudad and somewhat medially in at least essentially the same direction till it reaches the sagittal plane a short distance in front of the hind end of the animal. In the beginning of this section the duct is formed by the continuation of the undifferentiated vas deferens commune, which gradually widens a little and after a rather short distance, increasing considerably in width, differentiates itself as a long, but relatively narrow, and slightly undulated vesicula seminalis (pl. V, figs. 1, 2, *vs*). The latter rapidly attains its greatest breadth and then very gradually narrows again till it reaches the muscular ring described below (p. 15). It is empty in both the specimens before me. The outlines of its anterior portion are not regular, but show complications rather difficult of exact interpretation which vary considerably in the two individuals before me and are, for the sake of clearness, only partly represented in the drawings. They are probably due partly to dorsoventral flexures of the seminal vesicle and partly either to foldings caused by the collapsing of its walls in consequence of its being empty or to evaginations of the organ, an apparently more highly developed type of which I have described for *Schizochoerus liguloideus* (6). At the level of the above-mentioned muscular ring there follows a part which shows no sharp demarcation from the preceding section, but attains a somewhat greater width than the hindermost part of the latter (pl. V, figs. 1, 2, *ap*). It probably represents the propulsory apparatus (see Poche, 6), which is characteristic of the Amphilinidea. If so, it is, however, evidently much less strongly developed, as instead of the powerful mass of muscles which are so conspicuous in the other members of the order, strong circular muscles are to be seen only at its hindermost end. The structure in question reaches to a point just left of the sagittal plane. From here the genital duct, suddenly turning at an obtuse or almost a right angle, runs backwards with slight lateral undulations in the middle line of the animal. With the exception of its foremost part this portion of it is surrounded by a rather thick structure which is doubtlessly composed of the prostate glands, and is therefore the pars prostatica (pl. V, figs. 1, 2, *pp*). The latter in its course gradually narrows, passes ventrally to the posterior nerve commissure and sometimes, trending a little to the right, transgresses the sagittal plane and continues just to its right. The pars prostatica is succeeded by a very short section which has very thick and seemingly strongly

muscular walls and is, therefore, somewhat broader than the terminal part of the former. It may represent a penis-pocket, such as is characteristic of the Schizochoerinae. From it a short, steeply ascending part leads to the male genital pore, which lies exactly in the middle line or, probably in consequence of inequal contraction of the body, just to the right of it. It is situated very near the posterior end of the animal, but distinctly on the dorsal surface (see pl. V, figs. 1, 3, *pm*), and where a genital papilla is visible, halfway between the base and the end of the latter. Only slightly behind the pore the steep declivity of the dorsal surface towards the margin of the animal sets in. In the unstained specimen the distance of the pore from the nearest point of the margin is 405μ and from the posterior tip of the body 500μ, while the latter distance amounts to only 135μ in the stained specimen, whereas it is recorded by Southwell as measuring 1 mm. Relatively considerable differences are thus seen to exist in the species in regard to the exact position of the male genital pore, the difference in size of the various individuals being by no means very great (see above p. 2); probably they are partly due to differences in the state of contraction of the different individuals.

Immediately to the right of the male genital pore but at a deeper level in the body I have observed in the unstained specimen a slender, slightly curved rod of a length of 34μ lying transversally and bent almost at a right angle at its outward end. I am inclined to regard it as a persisting embryonic hook. These hooks, which are ten in number in the embryo, have been recorded by me (6; 5, p. 600ff.) as persisting in full number in *Schizochoerus liguloideus* and *Amphilina foliacea*. That it is longer than those measured by me on the embryos themselves (see below p. 24) presents no serious objection against this interpretation; for in that portion of the uterus the eggs and the embryonic hooks had probably not yet attained their maximum size. Further, certain hooks of some embryos reach a length considerably greater than is usual (6; 5, p. 604). Having, however, been able to discover only one such structure I cannot positively say that it really represents an embryonic hook.

Regarding the interpretation of the different parts of the female genital apparatus I have come to conclusions differing very considerably from those of Southwell. Southwell says (8, p. 327): "The germarium is situated in the middle line 15 mm. from the posterior extremity. It is 7 mm. long and 3·5 mm. broad. Immediately posterior to it are the paired follicular shell-glands. These are each 3 mm. long and together are 3 mm. broad." He further states that our species differs "from *A. liguloidea* in the absence of a vagina, anterior to the germarium" Now what Southwell regards as the germarium is in reality the anterior prolongation of the vagina, *i.e.*, the accessory receptaculum seminis as I have called it (4, p. 280f.; 6), as is proved beyond doubt by its contents (see below p. 17). What he calls the paired follicular shell-glands is the two-winged germarium as is clearly shown by its structure (see p. 12). Further, paired shell-glands for a single germarium would be a unique occurrence among the Platodaria. The real shell-gland lies posterior to the germarium.

The germarium lies approximately in the sagittal plane, sometimes a little more to the right or to the left, at a distance of 6 mm. from the posterior end of the parasite (pl. V, figs. 1, 2, pl. VI, fig. 4, *g*). It is distinctly two-winged in shape, consisting as it does of rather broad right and left wings which are only approximately symmetrical with one another, and a narrow median connecting part. Each wing has more or less the shape of a fan with a very long base and is composed of a number of moderately narrow tubes. The tubes are arranged irregularly radially, and are straight or somewhat curved and rounded and often also somewhat dilated at their peripheral ends. They lie more or less horizontally in two layers one above the other. A few of them bifurcate, each branch being about as broad as the original tube. They are composed of a compact mass of rounded germ-cells, while the median part of the germarium shows a less dense structure. In the stained specimen the wings of the germarium measure 2 mm. and 1·7 mm. in length, whereas the width of the whole organ is 3·3 mm. In the unstained individual the respective dimensions are 3·3 mm., 3·35 mm. and 4·9 mm. This is at variance with Southwell's statement (see above p. 11) according to which the length of each wing (regarded by him as follicular shell-glands) would be as great as the breadth of the whole organ, *viz.*, 3 mm. These measurements are probably taken from the specimen represented in his fig. 6, but according to his own figure the breadth of the germarium in this individual also is noticeably greater than the length of either of its wings. In view of my measurements of the individuals examined by me I regard it as very probable that in this point Southwell's figure is correct while his account is wrong and not *vice versa*.

The moderately developed vitelline glands are situated very near the margins of the body and extend as two narrow stripes over nearly the whole length of the cestode (pl. V, figs. 1, 2, and pl. VI, fig. 5, *v*). Anteriorly, according to Southwell's fig. 6, the left gland extends to a point midway between the anterior end of the testicular bands and that of the animal, while the right gland extends almost to the anterior extremity of the latter. Posteriorly in the specimens examined by me the right vitellarium extends almost or quite to the level of the muscular ring already referred to above (p. 4), while the left one ends a little more anteriorly and always noticeably ahead of the level of the ring. The hindermost parts of the vitellaria, besides coming nearer to the sagittal plane owing to the narrowing of the body towards its posterior extremity, gradually shift away a little from its margins and run more or less media for a somewhat varying distance. Accordingly the ends of the glands in question lie at a greater or lesser distance from the median line, but always considerably lateral to it. The end of the left one lies external to the vesicula seminalis and that of the right one at almost or exactly the same distance from that line. In at least some specimens the extreme ends of the vitellaria pass very obliquely inwards below the lateral nerves (pl. V, fig. 2, *v*). It is, however, very doubtful whether this is always the case (see pl. V, fig. 1 ; in this specimen unfortunately the nerves could not be made out). In the case of individuals in which the vitellaria do not cross below these nerves, it is the paired vitelloducts, to be described further on, which do so. In Southwell's fig. 6 the left

vitellarium, contrary to the condition found in my specimens, extends somewhat further posteriorly than the right one, and in this as well as in his next figure both these glands end at a noticeably more anterior level than in the said specimens. As a result of my examination of the individual represented in Southwell's fig. 7, I am in a position to say that the drawing is inaccurate in this respect and the backward extension of the vitellaria in this specimen is as described above (pl. V, fig. 1). As to his fig. 6 I cannot speak positively in regard to the point in question as individual differences certainly do occur in this respect, but I must confess that I am rather inclined to doubt the accuracy of his figure. The vitelline glands are composed of an enormous number of follicles of various sizes and shapes, which are partly arranged in groups mostly somewhat indistinctly separated from each other. The follicles are crowded almost through the whole length of the glands; but at the posterior and, so far as one can gather from Southwell's fig. 6, at the anterior tips of the latter they are much sparser. As in the other Amphilinidea each vitellarium is traversed longitudinally by a narrow channel—the long vitelloduct. The vitelline follicles are mostly situated on the two sides of these ducts, but often also directly above or below them, and the duct as a result is often not to be distinguished in these places. Only here and there a very short part of the tube is devoid of them. The course of the vitellaria is mostly straight, but in some places they show short undulations. Bifurcations and subsequent reunions of the two branches, which are characteristic for *Nesolecithus janickii*, do not occur in the vitelline glands of this species. The outer margin of the glands is in greater part smooth, but in some places is provided with projections and indentations. These are much more strongly developed and far more numerous on the inner margin. These complications in the course of their margins as well as the undulations of the vitellaria referred to above are, however, by no means so considerable and the latter are also certainly not so numerous as shown in Southwell's fig. 7, as I can substantiate from my examination of the specimen he figured. His fig. 6, while apparently also somewhat inexact, though in the opposite direction, is certainly much nearer to the mark in this respect. The average breadth of the vitellaria shows no appreciable differences throughout the main part of their length in the fragments examined by me and is 450μ, *i. e.*, at least $\frac{1}{10}$ of that of the animal; towards their posterior ends however it decreases very gradually from the level of the anterior end of the accessory receptaculum seminis on the right side and from approximately the level of the posterior end of the broad part of the organ on the left. According to Southwell's fig. 6 the breadth of the vitellaria likewise gradually decreases, but to a much greater degree, at their anterior extremity, beginning from a point a little behind the level of the uterine pore. Besides, it would seem from his figure that throughout approximately the anterior third of their length the vitellaria are somewhat narrower than further backwards, a condition which would be in full accordance with that found by me in *Schizochoerus liguloideus* (6).

From the posterior ends of the vitellaria the paired vitelloducts start as direct continuations of the long vitelloducts (pl. V, figs. 1, 2, *vp*). The right one runs medially and sometimes slightly backwards

to a point lying a little laterally of the muscular ring referred to above. The left one, which commences at a somewhat more anterior level (*vide supra* p. 12), runs medially and somewhat backwards, passing underneath the vesicula seminalis and reappearing on its inner margin at or a little in front of the level of the anterior end of the muscular ring and somewhat lateral to the latter. The duct is at this point on a level with or a little ahead of the last mentioned point in the course of the right vitelloduct. In Southwell's fig. 7 the latter condition is represented, whereas the former was found by me in the specimen (pl. V, fig. 1). At these points the paired vitelloducts turn anteriorly and more or less medially, either suddenly at an obtuse angle or more gradually in the shape of an arc, and continue in this direction till they meet in a right or acute angle in the sagittal plane or slightly to the left of it where they unite to form the unpaired vitelloduct. Their point of union is situated at very different levels. In one specimen it was nearer to the germarium than to the muscular ring mentioned above, while in another it was about three times further from the former than from the latter. It, however, never lies posterior to the level of the hinder end of either of the vitellaria. The paired vitelloducts are broadest at the place of their origin, but soon grow somewhat narrower except for local swellings due to accidental accumulations of vitellocytes.

The unpaired vitelloduct (pl. V, figs. 1 and 2, *vi*) runs forward for a short or a somewhat longer distance, according to the level of the point of union of the paired vitelloducts, with only an occasional slight lateral deviation and sometimes broadening locally due to the cause mentioned above for the paired vitelloducts, till it reaches the complex formed by the shell-gland and the receptaculum seminis (see below). Here it disappears from view in the specimens before me and of course opens into the shell-gland. Its breadth is greater than that of the adjoining parts of the paired vitelloducts. In Southwell's figures 6 and 7 the paired vitelloducts are distinctly shown as not uniting but rather as overlying one another in the median part of the body. In full accordance with it Southwell also says that the *ducts* of the vitelline glands open close to the shell-gland. The union of the ducts as described and figured by me was however clearly to be seen in both the individuals examined by me. This is also the state of things to be expected by analogy with the related forms, while a condition like that represented by Southwell would be an absolutely unique occurrence.

Immediately behind the median portion of the germarium and almost or exactly in the sagittal plane of the animal is a rather small complex which does not lend itself to further optical analysis. From its position relative to the organs surrounding it there can, however, be no doubt that it represents the shell-gland and evidently also the (ordinary) receptaculum seminis (pl. V, figs. 1, 2, *gl*), which, as I have recently shown (6), is similarly often indistinguishable from the former in whole mounts of *Schizochoerus liguloideus*. The whole complex is clearly shown in Southwell's fig. 7 and less distinctly in his fig. 6 but it is neither labelled in the figures nor referred to in his text.

In the unstained specimen one can see rather indistinctly close to the left side of the complex just mentioned what seems to be a narrow duct originating at the hind end of the middle portion of the germarium and extending posteriorly somewhat further than half the length of the said complex (pl. V, fig. 1, *d*). If this is so, the structure in question is certainly the germinal duct and enters the shell-gland.

Backwards from the shell-gland runs the vagina (pl.V, figs. 1, 2, *va*). Southwell's remarks (8, p. 327) about the vagina are as follows :—" The vaginal pore is 2 mm. from the posterior extremity " and " The situation of the male and the vaginal pores also resemble that of *A. liguloidea* and differs from that of *A. foliacea*." The vagina runs approximately in the sagittal plane, sometimes almost in a straight line, sometimes bending sideways for a portion of its length. In its anterior part it lies to the right of and close to the unpaired vitelloduct. According to its further course and that of the latter in the individual specimen it either crosses the unpaired vitelline duct and further backwards the left paired vitelloduct or only the right vitelloduct on the dorsal side. In both cases, however, it crosses the paired vitelloduct near its point of union with its companion. Southwell's figs. 6 and 7 both show the vagina lying entirely to the left of the unpaired vitelloduct. This is, however, not the case in the specimen represented in fig. 7 (see my pl. V, fig. 1), and in view of this and of the exactly opposite condition in the other specimen examined by me (pl. V, fig. 2) I very much doubt whether it is correct for the individual shown in fig. 6. The vagina opens by a single pore situated on the dorsal surface in the sagittal plane near the hind end of the cestode, almost immediately or a short distance in front of the point where the male genital duct reaches the same plane. The distance between the vaginal pore and the posterior extremity of the body is approximately 2 mm. in my unstained specimen. There is thus in this species only one vaginal pore and Southwell is wrong in stating that the situation of the male and the vaginal pores resembles that of *Amphilina liguloidea* (*vide supra*). The character given by me (4, p. 280) for the family Schizochoeridae recognised by me at the time, *viz.*, that the vagina bifurcates in its posterior part and opens by means of two pores, one on the dorsal and the other on the ventral surface, does not, therefore, hold good for *G. magna* which I then included in that family.

The vaginal pore at a distance of about 300μ is surrounded by a broad muscular ring slightly elongated in the transverse direction (pl. V, figs. 1, 2, *a*). The ring consists of a very dense mass of exceedingly fine, circular muscle-fibres which are far more numerous than was found possible to indicate in these small scale drawings. These fibres do not run quite parallel to one another in their whole course, but frequently cross each other obliquely. The ring is sharply limited on its external and on its internal margin. Its dimensions are 1100μ $\times$ 1400μ in the unstained, and 760μ $\times$ 800μ in the stained specimen, while the breadth of the ring itself is 210μ in the former. Southwell makes no mention of this remarkable structure, which is, so far as our present knowledge goes, quite unique amongst the Amphilinidea. It is to be noted, however, that he (figs. 6, 7) represents the vaginal pore as a comparatively large, transversally situated ellipse whose smaller diameter is

far greater than that of the vagina, a condition which does certainly not exist in the specimens. It seems possible, therefore, that the large vaginal pore in his figures wrongly represents the muscular ring in question.

In *G. magna*, as in the Schizochoerinae, there exists besides the ordinary receptaculum seminis a second one extending anteriorly of the former and the shell-gland, which I (4, p. 280 ff.; 6) have termed the accessory receptaculum seminis (pl. V, figs. 1, 2 and pl. VI, fig. 4, *r*). My reasons for regarding the latter as the accessory and the other as the ordinary seminal receptacle and not *vice versa* I have set forth in my second paper cited above to which the reader is referred for details. As in *Schizochoerus liguloideus* the accessory receptaculum seminis of *G. magna* is the direct continuation of the vagina, while the ordinary seminal receptacle evidently is connected with the latter only by a narrow passage not discernible in whole mounts. Southwell's fig. 7, in which the vagina is distinctly represented as opening along its full breadth into an approximately circular structure situated immediately behind his supposed shell-glands, which is neither labelled nor referred to in the text (see p. 14), is therefore incorrect in this respect. The same remark applies to his fig. 6 in which the vagina is shown opening along its full breadth into the cavity of the supposed shell-gland. As to the posterior limit of the accessory receptaculum seminis, I have (6) in *Schizochoerus* drawn it at the place of communication between the ordinary seminal receptacle and the vagina, thus regarding this point as representing the anterior end of the last-mentioned organ. This delimitation is in full accord with the usual termination of the vagina, respectively with the receptaculum seminis and is, in that genus, borne out by the fact that the structure in question does not more anteriorly show any marked differentiation the beginning of which could with any show of reason be considered as the posterior limit of the accessory seminal receptacle. In *G. magna* on the other hand such a differentiation of the structure is certainly present in the very great and more or less sudden enlargement at the anterior end of the germarium (see below); and one would at first be very much inclined to fix the posterior boundary of the accessory receptaculum seminis at this point. This would not, however, be in accordance with the usual place of termination of the vagina, to which the part up to the enlargement referred to above would then have to be reckoned. Further, this delimitation of the organ would not be in harmony with the one adopted with good reasons for the related genus *Schizochoerus*. I, therefore, in *Gigantolina* also consider as the posterior limit of the accessory seminal receptacle the point of communication between the ordinary receptaculum seminis and the vagina, at least till a detailed histological investigation of the structure in question in *Gigantolina* as well as in the Schizochoerinae should show that some other delimitation is more in accordance with the morphological facts. The accessory seminal receptacle begins with a narrow posterior part which is as broad as or only slightly broader than the vagina and runs longitudinally along the median portion of the germarium to a point immediately or almost immediately in front of the latter. Here the organ quite suddenly or, according to Southwell's fig. 6, somewhat

gradually widens very considerably to form a large pouch of the shape of a bag, "a straight-sided ellipse" (see pl. V, figs. 1, 2, *r*) or, as shown in Southwell's fig. 6, a flask. The hindermost extremity of this pouch for a short distance lies between the anterior ends of the wings of the germarium. It is by no means always situated symmetrically in respect to the narrow posterior part of the organ as is represented in Southwell's figure, but may, on the contrary, extend very considerably further on either the right or the left side of the former. The shape of the whole vesicle may likewise show a more or less pronounced asymmetry. In the specimen represented in Southwell's fig. 7 this is, however, much less pronounced than is shown in his figure. My figures (pl. V, fig. 1, pl. VI, fig. 4), which are taken from the same individual, represent the vesicle correctly. The posterior margin of the vessel may in its whole extent form a long straight transverse line, while its anterior end is always rounded and its sides often more or less so. Its outline is in general smooth, but may occasionally show a broad and deep notch near the anterior end of the organ. The relative size of the vesicle varies considerably. It measures 6·3 mm. in length and 3·9 mm. in width in the unstained fragment before me, while the respective dimensions are 2·67 and 2·9 mm. in the stained one. Southwell gives these dimensions as 7 mm. and 3·5 mm., evidently from the specimen shown in his fig. 6. It is situated submedially, lying more to the right side in the two specimens examined by me, while it is shown slightly more to the left side in Southwell's fig. 6. Hence his statement that it is situated in the middle line (see above p. 11) is inexact. Its distance from the hind end of the animal is 7·8 mm. in my unstained specimen, while Southwell gives this distance as 15 mm., obviously for the complete individual represented in his fig. 6. It is densely filled with a yellowish brown mass which stains very deeply and appears nearly homogeneous when seen with a low power of the microscope and only very finely granular under strong magnifications. This mass obviously consists of sperm. The wall of the accessory receptaculum seminis including its narrow posterior part is distinctly thinner than that of the vagina. The distance traversed by the organ in question is always less than $\frac{1}{20}$ of the length of the body, which is a striking though morphologically not a very great difference between *Gigantolina* and the Schizochoerinae, in which subfamily the organ is tube-shaped and extends through at least $\frac{1}{6}$ of the length of the body.

Regarding the uterus of the tapeworm Southwell (8, p. 327) only says: "The uterus is a long convoluted tube having exactly the same form as that figured for *A. foliacea*. It opens by a minute pore which is situated at the base of the small anterior end of the worm. In this respect it agrees with *A. liguloidea*, Diesing, and differs from *A. foliacea* (Rud., 1819)." The uterus certainly possesses the three branches, each of which traverses the greatest part of the length of the animal, as is characteristic of all the Amphilinidea (pl. VI, figs. 4, 5, ua_1, *ud* and ua_2); but otherwise its form differs very considerably from that of *Amphilina foliacea* (*cf.* p. 21). These three branches of the uterus of the Amphilinidea I have (4, pp. 277, 280 ff.; and 6), in accordance with the corresponding terminology used in Trematodes and for facilitating reference, designated as follows: the one arising from

the shell-gland and running forward for nearly its entire length as the *first ascending branch* of the uterus, the one which follows it and runs backwards as the *descending branch* of the uterus, and the last one which turns forwards and runs to the uterine pore as the *second ascending branch* of the uterus. I have further (4, p. 281f. ; 6) called the point where the first ascending branch of the uterus passes into the descending branch the *anterior turning point of the uterus* and the spot where the descending branch passes into the second ascending one the *posterior turning point of the uterus.* The uterus is in consequence of its containing hundreds of thousands of eggs by far the most conspicuous internal organ in this cestode. Its first ascending branch arises from the shell-gland at or near the posterior margin of the latter and runs backward and somewhat to the right for a short distance, lying a little to the right (in Southwell's fig. 6 considerably so) of the sagittal plane, of the vagina, the unpaired vitelloduct and the anterior part of the right paired vitelloduct (pl. V, figs. 1, 2, *ua*↑). After traversing approximately two-thirds of the distance between its point of origin and the hindermost portion of the right paired vitelloduct it turns cephalad in a short curve directed laterally and continues in this direction up to a point which, according to Southwell's fig. 6, lies well within the short rapidly narrowing anterior end of the body. In its short section running backwards and to the right the course of the branch in question is comparatively simple, being in the main more or less straight and only here and there forming one or two short spiral coils. From the beginning of the curve just referred to, however, in the material at my disposal, at least in the fragments of specimens which are mounted on slides and apt for detailed examination, the uterus forms irregular spiral coils which run preponderantly transversely and mostly lie close to one another. In the hindermost portion of the said curve the individual coils are short and the uterus is separated by a relatively large interspace from the posterior part of the right paired vitelloduct and sometimes (see above p. 12) also from the hindermost end of the vitellarium and by at least an equal space from the germarium. Immediately in front of this portion the coils grow larger and extend laterally almost or quite to the lateral nerve, which the outermost margin of one or the other of them occasionally even transgresses dorsally. Medially the coils extend almost or fully to the germarium and the accessory receptaculum seminis. This increase in the size of the individual coils is at first rapid, but approximately from the level of the posterior end of the germarium becomes very gradual and ceases entirely a little anterior to the level of the accessory receptaculum seminis. Where the uterus crosses the testicular band (*vide supra* p. 6) its general outline shows distinct, deep indentations on both the outer and the inner sides due to the divergence or shortening of the respective coils Immediately anterior to this point the first ascending branch of the uterus shifts slightly more towards the sagittal plane and its lateral contour further on lies generally just medially to the testicular band, while in some places it is even separated from the latter by a narrow space. Some coils on the other hand overlap the testicular band and a few of them may extend right to the vitellarium. The breadth that this branch in consequence of the length of the indivi-

dual coils has attained somewhat anteriorly to the level of the accessory seminal receptacle it surpasses nowhere in its further course, while in many places it is only three-fifths and in some only half of it. Broader and narrower sections of varying lengths alternate quite irregularly throughout its extent. Throughout these fluctuations in its breadth its inner outline is much more irregular than its lateral one (see pl. VI, figs. 4, 5, *ua*↑). Its hindermost part, from the beginning of the short curve referred to above to a distance of about 2·5—4·5 cm. from this point, is further distinguished by the coils composing it being closely crowded together. The average width of the uterine tube in its first ascending branch very gradually increases from its place of origin to approximately the level of the anterior part of the germarium. From this latter point onwards it remains fairly constant, although the width of the individual coils varies to some extent. Southwell in his figs. 6 and 7 represents the branch under consideration as consisting from its origin to the end of the above-named curve of a simple arcuate tube without any coils whatever. This is wrong for the specimen from which figure 7 was made (see pl. V, fig. 1), and in view of this and of my similar finding in the other specimen examined, I am inclined to regard it as wrongly represented in Southwell's fig. 6 also. Figure 7 is further inexact in that the lateral contour of this uterine branch as a whole is shown as much more irregular than is actually the case (*cf. supra*, p. 18). As to the anterior part of the first ascending branch of the uterus, which was not present in either of the whole mounts with me, it appears from Southwell's fig. 6 that it is identical in position and character with the portion preceding it, except that in approximately the anterior third of the animal its coils are represented as less closely placed. At its end it turns medially and passes into the next branch. This, the descending branch of the uterus, according to Southwell's fig. 6 lies somewhat to the right of the sagittal plane at first, but after a short distance trends inwards into the middle of the body. Otherwise his figure reveals no difference between the anterior part of this branch and the rest of it. In the mounted fragments examined by me the descending branch of the uterus occupies in general the middle region of the body (pl. V, figs. 1, 2 and pl. VI, figs. 4, 5, *ud*); only here and there for a short distance it is shifted to the left of the sagittal plane by the first or to the right by the second ascending branch of the uterus. For the greater part it runs in irregular zigzags or lateral bends and does not form spiral coils. Where, however, the coils are formed, they are shorter and mostly decidedly wider than those of the first ascending branch. Its course in places where it is devoid of eggs is sometimes difficult to trace. The area of the body occupied by this branch is considerably narrower than that taken up by either of the ascending branches of the uterus. The space between the descending branch and the first ascending branch of the uterus is in general fairly narrow, while that between it and the second ascending branch is still narrower; as a result the exact delimitation between these two branches is not at all clear in some places. On reaching the anterior end of the accessory seminal receptacle the descending branch of the uterus trends more or less to the left and runs backwards next to the margin of the said organ till it almost or quite

reaches the hindmost part of the right testicular band. Here in a sharp, laterally directed curve it passes into the second ascending branch of the uterus. The representation of the descending branch of the uterus in Southwell's figures 6 and 7 differs markedly from the above description. From my examination of the specimen represented in figure 7, I can positively say that the latter is incorrect in this respect. Especially the branch in question is by no means restricted to so narrow an area of the body and in accordance therewith neither separated from the two ascending branches by such broad interspaces as it is represented in that drawing (*cf.* my pl. VI, fig. 4, *ud*). Further, it is in reality considerably wider and its whole configuration is different. Concerning Southwell's fig. 6, I am unable to speak with certainty, as I have had no opportunity of examining the particular specimen and individual differences may possibly occur in this respect. From the study of the specimens before me and the general inexactness of Southwell's respective drawings (*vide supra* pp. 7, 10, 13-16 etc.), I am, however, very doubtful about the accuracy of his figure in this respect.

The second ascending branch of the uterus runs in an anterior direction from its beginning to the uterine pore. This branch in the material examined by me, at least so far as the mounted specimens are concerned, also forms irregular spiral coils which are generally directed transversely and for the greatest part lie close to one another (pl. VI, figs. 4, 5, ua_2). Its lateral outline generally lies just inwards of the testicular band and is in some places even separated from the latter by a narrow space. Some coils, however, overlap the testicular band and a few of them may extend right to the vitellarium. At the hindermost end of this branch the coils are necessarily very short, as the space available for their development here is much restricted, owing to the shifting of the posterior end of the descending branch of the uterus to the left due to the voluminous accessory seminal receptacle on the one side, and to the curving inwards of the testicular band on the other (see above pp.7, 19, pl. V, figs. 1, 2, ua_2). From the very beginning, however, its coils increase rapidly in length, and slightly anterior to the level of the anterior end of the accessory receptaculum seminis they reach their full size. In its further course the breadth of this branch varies considerably, measuring in many places only down to three-fifths and in some only half as much as in others ; broader and narrower sections of varying length follow one another quite irregularly. Throughout these fluctuations in its breadth the inner outline of this branch is far more irregular than its outer one and its average breadth is somewhat greater than that of the first ascending branch of the uterus. The average width of the uterine tube in its second ascending branch is fairly constant throughout its course, although the width of the individual coils varies somewhat, and is more than that of the first ascending branch, being according to the individual greater by $\frac{1}{4}-\frac{1}{2}$ or is even twice as great. As in the case of the first ascending branch Southwell's fig. 7 is incorrect in respect to the second ascending branch in that the lateral outline of this branch is shown as much more irregular than is actually the case. According to Southwell's figure 6 the second ascending branch of the uterus in approximately the anterior third of its

length trends very gradually a little away from the testicular band, without, however, anywhere reaching the sagittal plane, while its course gradually becomes less and less complex, the spiral coils being more and more replaced by simple lateral undulations which are continued right up to the uterine pore. For a short length immediately preceding this pore the width of the branch in question is reduced to about three-fifths of the average width of its main portion. The pore itself, always according to Southwell's figure, lies at exactly the same level as the anterior turning point of the uterus and like it is well within the short rapidly narrowing head end of the body (*cf. supra* p. 18). It, however, lies at a good distance from the anterior extremity of the animal and considerably to the left of the sagittal plane, but nearer to the latter than to the margin of the body. Southwell's statement that it "is situated at the base of the small anterior end of the worm" (see above p. 17) is, therefore, apparently inexact. It is also evident from the above that the uterus of *Gigantolina magna* has by no means exactly the same form as that figured for *A. foliacea*, as was stated by Southwell (see above), but differs markedly from it in several respects. Its descending branch is situated in the medial part of the body and differs considerably in character from the two ascending branches, which in their turn present essentially similar features, and none of its branches forms large transverse coils. In *Amphilina foliacea* the descending branch of the uterus lies well laterally to the sagittal plane next to the first ascending branch, which it resembles very much in shape. The second ascending branch of the uterus is very different, having only a small number of transverse coils, most of which are conspicuous because of their comparatively enormous size.

In both the mounted fragments examined by me the first ascending branch of the uterus is for a distance of about 4 cm. from its origin mostly full and in parts crammed with eggs (see pl. V, figs. 1, 2 and pl. VI, figs. 4, 5, ua_1). In its further course sections of varying lengths more or less densely filled with eggs alternate with others which contain a smaller number of ova, while in some places there are only very few eggs. The descending branch of the uterus throughout the greater part of its length contains a comparatively limited number of eggs. In some places, however, compact masses of them are found collected together as an irregular zigzag rod-like formation with broadened and often prolonged corners (pl. VI, figs. 4, 5, *ud*). The second ascending branch of the uterus is, in the case of the fragments referred to, much less densely filled than the first one, it according to the individual having relatively few and throughout the greater part of its length very few eggs, or showing short sections and single coils which are more or less densely filled with ova alternating with mostly longer portions which contain a much smaller number of ova and in some places even only single ova (pl. VI, figs. 4, 5, ua_2). In view of the possible influence of the season on the production of eggs in the species, a point which is too often neglected by helminthologists, it may be noted that all the three specimens hitherto obtained were collected in February (7, p. 273). Southwell's figs. 6 and 7 represent the uterus as containing a large number of isolated eggs and small groups of such distributed pretty evenly throughout its whole length, with the exception of short areas at the

beginning of the first and at the end of the second ascending branch which are empty. This is, however, not the case in the specimen represented in his fig. 7 (*cf.* my fig. 1, pl. V and fig. 4, pl. VI, which are taken from the same individual). Probably the same is true of the specimen represented in his fig. 6. These inaccuracies in these figures are perhaps due to the small size of the latter.

Of the ova Southwell (8, p. 328) says : "The eggs are large, measuring almost ·1 mm. In shape they resemble half a sphere, the flat surface of which has become concave. No filament was observed." In the mounted specimens almost all the eggs in the posterior 2—4·5 cm. of the first ascending branch of the uterus, provided they are not totally deformed by shrinkage, show the shape ascribed to them by Southwell, their outlines sometimes being oval instead of circular, and also some of those in the further parts of the uterus (pl. VI, figs. 6, 8, 9). They are thus more or less cap-shaped, as I have also observed in the case of the ova of mounted specimens of *Amphilina foliacea* and as has also been recorded for other Cestoidea. This is, however, only due to a certain degree of shrinkage during the mounting, for the numerous eggs from unmounted fragments, which have come under my observation, were all quite spherical without any concavity whatever. I have satisfied myself about their shape by examining the eggs in spirit, under the microscope from all sides (pl. VI, figs. 10, 11, 15, 16). In these eggs also considerable shrinkage immediately sets in when through evaporation of the alcohol they get dry to some extent, and as a result they often become more or less cap-shaped. The egg-shell is thin. It presents no thickening at any place and has no appendages whatever, but possesses a considerable degree of elasticity, flattening under pressure exerted on the coverglass and afterwards regaining its spherical form. Removed from the uterus, the eggs are of a rather pale-drab colour when viewed with the naked eye. Under the microscope their shell appears hyaline, of a pale yellowish hue, approximating the colour of water with a very moderate quantity of white wine mixed with it. The following measurements of intra-uterine eggs refer exclusively to such whose outline had at the most been only slightly affected by shrinkage. Two ova at the very beginning of the first ascending branch of the uterus of the unstained specimen measured 81μ and 83μ respectively, and a dark brown one situated just in the middle of the bend formed by this branch at its posteriormost point 85μ (pl. VI, fig. 7). Such eggs, whose contents are in part or wholly of a dark brown colour, are found among others in limited numbers throughout the three branches of the uterus. They are very rarely cap-shaped, but almost always present an almost circular outline, being evidently more or less spherical. They are eggs whose development has come to a standstill, as is apparent from the fact that their size remains the same throughout the whole uterus. Very often several dark brown vitelline cells can be distinguished in them. They are, therefore, not analogous to the coal-black air-filled ova which are often observed in other cestodes. Besides these brown eggs there are found throughout the uterus others of the normal colour which show the cap-like shape and the size characteristic (in the mounted fragments) of those contained in the beginning of the first ascending branch of the uterus. They thus likewise repre-

sent ova whose development has remained stationary. Their number in comparison with that of the normally developed eggs is small, though they are fairly numerous. A similar phenomenon I have also observed in *Schizochoerus liguloideus* (6). The developing eggs gradually increase very considerably in size during their further way through the uterus, while at the same time their shell grows still thinner. This increase is most marked throughout the posterior 13 cm. of the first ascending branch of the uterus, but apparently continues in a small measure further on as well. From the first 2—4·5 cm. of the first ascending branch of the uterus onward the great majority of the eggs are greatly and irregularly deformed by shrinkage. Ova which I extracted from the foremost point of the first ascending branch of the uterus of the fragment subsequently stained and mounted, *i.e.*, from a place lying a little more than 12 cm. before the germarium, mostly measured 140—150μ in diameter (pl. VI, fig. 10); the smallest one however measured only 78μ, another one 81μ and two others each 87μ; these evidently are eggs whose development had come to a standstill (pl. VI, fig. 11). On the other hand two large ova had a diameter of 165μ each, and the largest one of the set that came under my observation measured 185μ. Those eggs whose development has remained stationary are generally, but not always, completely full (see pl. VI, fig. 11). In others the embryo, which at this place is already formed and has absorbed the yolk, very rarely occupies the whole or the greater part of the egg, but in most cases takes up only a relatively small portion of it (pl. VI, fig. 10, *cf.* also figs. 12, 15 and 16). The embryo is contiguous to the shell and keeps its place throughout all the revolutions that the egg may perform under the microscope, and is often connected with other points of the shell by a small number of fine thread-like plasmatic processes. Its shape is mostly that of an obtuse spindle or an oblong oval; but its appearance naturally differs much according to the position of the ovum. In the majority of cases eggs lying in alcohol so orient themselves that the embryo appears as a narrower or broader belt dividing the egg into two approximately equal parts (pl. VI, fig. 16); the belt, however, does not often extend longitudinally over the whole hemisphere and in breadth is about $\frac{2}{5}$—$1\frac{3}{5}$ of the diameter of the egg. In the comparatively rare cases when the embryo in these developing eggs occupies the greater part or the whole of the egg, the condition is due to the presence of a distinct membranous envelope, which in most places is separated from the body of the embryo by a wide space and evidently represents the enveloping membrane (designated as "yolk envelope" by Beaham (1, p. 71 f. and 111)). As an abnormality I have, among the ova in question, observed one of 180μ in diameter, which was flattened on one side to a plane measuring 155μ in diameter and throughout the whole extent of this plane was connected with a similarly flattened egg which had a diameter of 165μ and thus only slightly projected beyond the plane of union. Both these eggs were otherwise regularly formed and contained embryos which were to all appearance normally developed. Further details of the structure of the embryos were not discernible, and repeated attempts to clear the eggs in glycerine and mount them in glycerine jelly as recommended by Braun (2, p. 101) always resulted in failure, as in spite of all care they shrunk to such an extent as to

render it impossible to distinguish their internal structure. An egg lying in the descending branch of the uterus of the unstained specimen at a distance of 5 cm. before the germarium, whose outline had been only moderately affected by shrinkage, had a diameter of 170μ (pl. VI, fig. 12). The embryo in it showed the ten embryonic hooks (see also pl. VI, fig. 13). The longest of them measured 21μ, another large one 19·5μ and two short ones, which were much the shortest of all, 7μ. From here onwards all the eggs exhibited these hooks except where they were obscured by the folds of the shrunken shell. In another egg lying in the same branch of the uterus of the same specimen 2·5 cm. in front of the germarium and in which likewise all ten embryonic hooks were discernible, the two longest ones had a length of 19μ and the others were approximately 10·5—12μ (pl. VI, fig. 14). As in all Amphilinidea, ten is the normal number of embryonic hooks; often, however, not all of them are visible and sometimes a few of them are perhaps actually missing, as was observed by me in *Schizochoerus* (6). As in the other members of the order the hooklets are by principle arranged in pairs, but this arrangement is often only indistinctly or not at all recognisable in some of them. That the respective hooks belong to individual pairs is indicated by their definite resemblance to each other in regard to shape, size and direction. The hooks are situated near one end of the embryo, the posterior end as is evident from a comparison with the position occupied by them in other cestodes and particularly in the related form *Schizochoerus liguloideus* (*vide* Poche, *t. c.*), in a somewhat irregular and more or less arched transverse row with its convexity directed anteriorly. Most of the hooks are gently curved, the concavity of the curve being generally directed laterally. They appear like more or less slender spines and are thickest at their bases, tapering to an anteriorly and in some of them more or less laterally directed fine point. One or sometimes two pairs of rather fine, long, straight or nearly straight hooklets and, where they occur, the two particularly short ones, referred to above, are not pointed and are equally broad throughout their length. Relative to the long ones the width of these short hooks is much greater. Most of the hooks have a barb or a claw-like prolongation at their base directed upwards or more rarely sideways; often, however, it only appears as a swelling of the base. A sample of eggs extracted from the anteriormost point of the second ascending branch of the uterus of the fragment subsequently stained and mounted, *i.e.*, from a point lying a little more than 12 cm. before the germarium, was composed of only a very limited number of eggs, which is in full accord with the relatively small amount of ova contained in the said branch generally (see above p. 21). The smallest of these eggs measured only 79μ in diameter, another 81μ, two others 140μ and 145μ, while the biggest one observed by me was 150μ. That larger eggs were not contained in the sample or at least were not observed by me is easily explained by the comparative rarity of such large eggs on the one hand and the small number of eggs composing the lot on the other. The ova from this area otherwise exhibited no difference from the sample taken from the corresponding part of the first ascending branch of the uterus (*vide supra* p. 23). Four lots of eggs extracted from both ends of both the first and the second ascending branch of the uterus of the unmounted fragment

(see above p. 2) exhibited no differences among themselves, and will be dealt with collectively. The size of these eggs is within the limits found for those of the last-mentioned sample, the smallest ones measuring 81μ in diameter, other very small ones 84, 90 and 93 , some 135μ and the great majority 144—150μ, while a small number of big ones came up to 180μ. Neither was there any other difference between these and those just referred to, except that the enveloping membrane is often fully developed. In consequence of the opacity of the embryos contained in the eggs lying in alcohol their embryonic hooks were not distinguished in any specimen, although it is evident from the size of the great majority of the eggs and from the uterine areas from which many of them were taken that these must be well developed on the great majority of the embryos in question.—Southwell's statement quoted above (p. 22) that the ova of our species measure almost 0·1 mm. thus in the main only holds good for the eggs in a certain section of the uterus, *viz.*, in the hindermost part of its first ascending branch, where they have a diameter of about 80μ. The smallest egg measured by me was 78μ. Long before having passed through this branch of the uterus, however, the great majority of the normally developing eggs have attained a diameter of 140—150μ and a few even one of 185μ (pl. VI, fig. 16), this being the largest sized egg found by me in *G. magna*. Because of the circumstances mentioned above it was not possible for me to trace the development and structure of the embryos of *Gigantolina magna* in anything like the detail with which I was able to follow in the case of *Schizochoerus liguloideus* (6). From what I have observed of the embryonic development of the former species combined with what is known about that of other forms of the Amphilinidea we may, however, safely assume that in all essential features it is closely similar to that of *Schizochoerus liguloideus*.

In my systematic re-arrangement of the species in 1922 (4), which till then had been assigned to the genus *Amphilina*, I (p. 281) created for *A. magna* the new genus *Gigantolina*, which I placed in the new sub-family Gigantolininae. This latter with the new sub-family Schizochoerinae I placed in my new family Schizochoeridae (4, p. 280). Full definitions of my new family, sub-families and genus, which clearly set forth the reasons for their erection, were given in the paper. Without taking the slightest notice of my statements and without attempting to give any reasons for his conclusions, Woodland (10, p. 462) summarily, and in a most contemptuous manner, rejected the new family and sub-families created by me. As I say elsewhere (6), in view of the discovery of the very interesting species *Amphilina paragonopora* which was described by Woodland (9) after my first paper and which forms a connecting link between the Amphilinidae and the Schizochoeridae, I am myself of opinion that the separation of these two as distinct families is no longer warranted. This was impossible to foresee in 1922 and neither is it the point on which Woodland's censure of my classification rests. Further, it does not impair the validity of the sub-families erected by me, and still less does it afford any justification for the language which Woodland has thought fit to use. The reply due to him

together with a detailed discussion of the facts I am publishing in another place (6), to which those interested in the matter are referred. I may further mention that so competent helminthologists as Fuhrmann and Baer (2a, p. 86) evidently have a very different opinion of my classification of the Amphilinidea (4) than Woodland.

Because of the inclusion of the Schizochoeridae in the family Amphlinidae and the consequent change in the position of the Gigantolininae, which as already stated were originally referred to the former family, a change in the definition of this sub-family as originally given by me becomes necessary. At the same time detailed further study of *G. magna* makes it possible to now render the definition more exact in a few points. I now define the Gigantolininae as Amphilinidae without transverse wrinkles or furrows; with frontal glands not extending into the posterior part of the body; exceedingly numerous testicles arranged in two narrow longitudinal bands lying in the marginal parts of the body laterally to the two ascending branches of the uterus with the exception of the hindermost portion of the right band, which tra erses ventrally to the first ascending branch of the uterus to the left side of the animal and here unites with the left testicular band; paired vasa deferentia extending through the greatest part of the length of the body which do not ramify and unite posterior to the posterior turning point of the uterus and laterally to its descending branch; a short penis; a two-winged germarium branching into numerous tubes; moderately developed vitellaria beginning at the level of the retracted proboscis and ending behind the germarium and reaching a breadth of at least 1/40 of that of the animal; an unpaired vitelloduct running from behind forwards; a large accessory receptaculum seminis extending through less than 1/20 of the length of the body and consisting of a narrow, tube-like posterior and a broad more or less bag-shaped anterior part; an unforked vagina opening on the dorsal surface in the sagittal plane somewhat in front of the posterior extremity; a broad, strong muscular ring encircling the vaginal pore at a short distance; a descending branch of the uterus running approximately medially; a uterine pore situated a considerable distance behind the anterior end of the animal and at the level of the anterior turning point of the uterus, and producing spherical, thin-shelled eggs.

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[Throughout his whole paper Dr. Poche repeatedly accuses Dr. Southwell of inaccuracy and unreliability, especially as regards small details of structure.

Dr. Poche appears to overlook the fact that since Dr. Southwell wrote his account, the specimens have been transferred from formalin to alcohol and have remained in the latter for ten years. Small differences, such as he notes, are in all probability largerly due to shrinkage of the soft tissues, consequent on the treatment of the specimens, and do not justify the wholesale accusation of inaccuracy in which Dr. Poche indulges. *Editor.*]