On the anatomy of a new species of pentastoma found in the lung and air-sac of an Egyptian cobra / by George Harley.

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On the Anatomy of a new Species of Pentastoma found in the Lung and Air-sac of an Egyptian Cobra.

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(Annulosa, Pl. XLVI., XLVII.)

Having lately had the opportunity of dissecting a fine specimen of Entozoon, which, as far as I am aware, is an entirely new and undescribed species, a brief description of its anatomy may perhaps prove interesting to the members of the Society.

The worm which I am about to describe was found in the lung of the Egyptian Cobra, Naja Hage, kindly sent to me for examination by D. W. Mitchell, Esq. I was fortunate enough to obtain four fine specimens, nearly all of equal size, from the same animal. They measure from 4 to 5 inches in length, and from 5 to 8 lines in circumference. In external characters they seem to resemble an Entozoon found in the lung of a Cobra by Dr. Crisp, a short description of which was given in the Proceedings of the Society for 1853, p. 22, Annul. pl. 30. fig. 7, by Dr. Baird; who spoke of it as an undescribed species of *Pentastoma*, and gave it the name of *Pentastoma annulatum*. Dr. Baird's description of the specimen is, however, very short, and unfortunately incomplete, in consequence of his having seen only a small specimen, and that even imperfectly, on account of the most important fact, the head remaining imbedded, and hidden from view in the lung of the snake. I think it probable, however, that the animal which he described is one of the same species as I have obtained specimens of.

External characters.

The body of the entozoon is of a white colour, elongated, cylindrical and strongly ringed (Pl. XLVI. fig. 1). It begins with a round obtuse head, attached to the trunk by a short somewhat narrow neck. The body then gradually widens for the first three lines, where it measures in the largest specimen ($4\frac{3}{4}$ inches long) 8 lines in circumference, and from here down to within a few lines of the caudal extremity, continues of nearly the same diameter. Below this point it becomes regularly narrower the nearer we approach to the posterior end, which terminates obtusely. The caudal extremity is almost of the same diameter as the head. The rings which are, as before mentioned, very strongly marked, commence close to the posterior part of the head, and for the first three or four lines, gradually in-

crease in size and distance from each other. They then continue of the same relative size and distance apart (2 lines) till within about half an inch of the posterior extremity, when they again, however, become smaller and more closely approximated. In all the four specimens which I examined, the rings were twenty-seven in number, and where largest, projected nearly half a line from the surface of the body.

In the fresh specimen, when examined with a pocket lens, the exterior of the rings appeared mottled with faint white-coloured spots. They were and still are quite opaque, whereas the intervening tissue is so thin and transparent, that the internal viscera can be seen through it. A number of white bands or cords appear to connect one ring with another; the bands are largest in the lateral and dorsal regions. A dark-coloured line extends along the back throughout the whole length of the body: this, as I shall afterwards have occasion to show, is the digestive canal.

On the under surface, in the centre and near to the anterior margin of the head, which is slightly flattened from before backwards, is a round foramen, the mouth. On either side of this opening are two depressions, equidistant from each other, each containing a prehensile hooklet of a bright yellow colour. These hooklets in shape closely resemble a cat's claw, which can be extended and retracted at pleasure, and when completely drawn in, the points of them can be neither seen nor felt. The obtuse posterior extremity has a deep cleft across it, and on its under surface are two openings, one in front of the other: the anterior is the entrance to the vagina, the posterior the anal aperture.

Anatomy of the Entozoon.

Parietes.—The whole body is invested with a delicate, smooth, transparent cuticle, which can be readily detached by slight maceration. Beneath the cuticle are two layers of striated muscular fibres (Pl. XLVII. fig. 13), a vertical and a transverse layer;—the longitudinal fibres are by far the most developed;—the circular are in some places entirely wanting. The projecting rings, on the other hand, are not composed of striated muscular fibres, but consist of fibro-areolar tissue. They seem to serve as fixed points of action for the longitudinal muscles; appearing to supply, in fact, the place of a hard skeleton. The interior of the abdominal cavity is lined by a fine transparent membrane, on which I thought I could detect a single layer of delicate pavement epithelium.

Digestive System.—The alimentary canal, in consequence of its peculiar dark saffron tint, is readily traceable from its commencement to its termination. It begins at the mouth, and runs in an almost perfectly straight line to the opposite extremity of the body, terminating, as was before mentioned, immediately behind the orifice of the vagina (Pl. XLVI. fig. 4, *a*). Close to its commencement it is of the diameter of a fine crow-quill, and may be said to continue of nearly the same size throughout its whole course. It lies directly

in front of the ovary and great nerves, and is almost entirely concealed from view by the innumerable tortuosities of the oviduct. It has four distinct coats, an internal mucous, an external serous, and two muscular layers, one running vertically and the other horizontally; both of which consist in great part of the striated variety of muscular fibres *. The interior of the alimentary canal is marked by longitudinal rugæ, from the surface of which long pyriform villi project.

Nervous System.—The distribution of the nervous system of this highly organized Entozoon is, in some respects, identical with that found in the *Linguatula tænioides*, so beautifully described by Professor Owen. The large ganglion, or brain, is situated close to the mouth, and is intimately connected with the œsophagus, to which it seems to send two filaments (Pl. XLVI. fig. 4, *b*). I could not, however, satisfy myself of the existence of an œsophageal ring. The distribution of the large pair of nerve cords, which extend almost throughout the whole length of the body, differs very materially from that found in the *Linguatula tænioides*; for, after passing over the fallopian tubes, instead of running down the sides of the ventral aspect of the body, they continue along the dorsum, behind the alimentary canal and close to the ovary (Pl. XLVI. fig. 4, *c*). They are at last gradually lost sight of a few lines above the anus.

Organs of Reproduction.—In attempting to describe the organs of reproduction in this animal, I shall begin at the vagina and trace them gradually upwards, for it was by following this course that I was enabled, with the aid of the microscope, to distinguish the different organs, and to ascertain the function of their various parts.

The orifice of the vagina is situated immediately in front of the anal aperture (Pl. XLVI. fig. 4, *d*). The vagina itself is about the thickness of a pin, and from 3 to 6 lines in length; it gradually widens out into the oviduct, or more correctly speaking, the uterus (Pl. XLVI. fig. 4, *e*). For about the first 6 inches the uterus has a greater diameter than the alimentary canal; it then however becomes gradually narrower, till its diameter does not exceed that of a fine knitting-needle, and continues of this size till within a few lines of its termination, where it contracts still more. At its upper point of attachment, which is opposite the third or fourth ring, its diameter is not greater than that of the vagina. In two of the specimens I measured the length of the uterus, and found it to be 40 inches from the orifice of the vagina to the place of its attachment opposite the third or fourth ring. Thus it is seen to be nearly ten times the length of the entozoon in which it is coiled up. Although it conceals the alimentary canal, it is not, as in the case of the *Linguatula tænioides*, coiled round it; neither has it the ferruginous tint spoken of by Owen as belonging to the oviduct of the latter species. It is, on the contrary, of a pale straw-colour when full of ova, and almost quite colourless when empty. Its parietes are thin

* Ficinus and Valentin found indistinctly striated muscular fibres in the human stomach.

and transparent, and when viewed with the microscope are seen to be muscular, both longitudinal and circular fibres being distinctly visible. They consist of the non-striated variety of muscular fibre (Pl. XLVII. fig. 14). The fully developed ova are not attached to the parietes of the uterus by any connecting cellular substance, for on being cut across, the ova immediately flow out, and the parietes collapse. On the other hand, the imperfectly developed ova found in the upper portion of the uterus have a darker colour, and seem to be adherent by a glutinous material not only to each other, but also to the walls of the organ.

At the upper point of its attachment to the abdominal parietes are two oblong bodies of a dull white colour (Pl. XLVI. fig. 4,*ff*). These bodies open directly into the uterus. On examination they were found to be filled with spermatozoa in all the various stages of development, from the primitive granule up to the perfectly formed spermatic filament (Pl. XLVII. fig. 8). The filaments are of considerable length, and are amassed together in bundles of tolerable size (Pl. XLVII. fig. 8, *a*). Some of the fully formed spermatozoa with large heads measured $\frac{1}{40}$ mm. in length, and a few were even longer still.

A question of great interest and importance might be here raised regarding the special function of these oblong bodies, which, as I have just mentioned, contain innumerable spermatozoa in various stages of development. Are they the spermatheca or copulatory pouches of a female; or are they to be regarded as the testicles or male organs of generation of a hermaphrodite? I shall defer the consideration of this important point until after I have terminated the description of the animal.

The organs just alluded to, which, for the sake of brevity, I shall speak of as testicles, are attached to the parietes of the entozoon by strong bands of striated muscular fibres. At the upper part of their point of union, the uterus divides into two fallopian tubes, which gracefully curve round the digestive canal, pass behind the two great nerve cords, and after getting between them, reunite to form the ovary (Pl. XLVI. fig. 4, *gg*). The ovary is of a ferruginous colour, intimately attached in the mesial line to the dorsal aspect of the animal, and continued downwards between the nerve cords and behind the alimentary canal to within about 5 lines from the anus, where it suddenly terminates in a blind sac.

When viewed through a lens, the coats of the ovary are seen to be thin and transparent, and not closely surrounding their contents. They are here and there thrown into loose folds, and the ova can be distinctly observed in their interior, like a series of bunches of grapes closely strung together (Pl. XLVI. fig. 5). When the ova are highly magnified, they are recognized to be spherical bodies attached together by little peduncles, and to consist of a tunic or yelk-sac, a granular yelk and a germinal vesicle. I even detected in many of them the germinal spot (Pl. XLVI. fig. 6 *d*.).

On tracing the development of the ova, I found that the germinal spot disappeared from them as soon as they had passed out of the

fallopian tubes into the upper attached portion of the uterus,—no doubt, in consequence of the ova having been impregnated during their transit through that portion of the uterus into which the testicles open as already described. From this point downwards the progressive development of the ova can be readily followed. But as this communication has already extended beyond the limits I had marked out for it, instead of giving my readers a detailed description of the process of development, I shall take the liberty of referring them to the accompanying figures, which accurately represent the different appearances observed in the ova from the time of their exit from the ovary till their arrival in the vagina (Pl. XLVI. fig. 7, Pl. XLVII. figs. 9, 10, 11 and 12). I may here only further remark, that impregnation evidently takes place from above downwards, and that no spermatozoa in any stage of development could be detected in any part of the uterus; thus forbidding the idea of the animals having received the vivifying fluid from a separate male organ after the uterus had been filled with ova.

Having now completed my remarks upon the anatomy of the entozoon, I shall proceed to say a few words upon the important question of its sex, and I may premise these words by observing that it appears to me that some naturalists are at present running to extremes in attempting to find separate sexes in all animals, and to prove that there is no such thing as hermaphroditism in nature. Ultra views are at all times to be condemned, and I think in no case more so than the present, when the obstacles besetting the path to a definite conclusion are as complicated as they are numerous. A few years ago several members of the genus *Pentastoma* were regarded as true hermaphrodites by the most distinguished naturalists; and now since some of the species have been ascertained to have separate sexes, a recent writer has ridiculed the idea of a single example of this large genus having male and female organs of generation united in one individual. I do not intend to say that he has erred in jumping too hastily to his conclusion, but merely to remark that the entozoon which I have described in the foregoing pages, if not strictly belonging to the genus *Pentastoma*, is yet in many of its characters very closely allied to it, and that it still remains to be shown that this animal is not a hermaphrodite. As there are two sides to every question, and as it is wrong to give an opinion before both have been examined, I shall briefly state my reasons for thinking it possible that the animal we have just been considering is a female, and that the true male organs of generation are to be sought for in another individual.

The *Linguatula tænioides*, which is the nearest allied species to my entozoon, was described by naturalists of the very highest standing, such as Owen, Valentin, Von Siebold, Dujardin and others, as a hermaphrodite, in consequence of their finding that it possessed, in each individual, organs containing the female and organs containing the male reproductive materials in different stages of their development; and that these organs were not only so arranged as to allow of the vivifying contents of the one coming into contact with those

of the other; but that a common canal resulting from the union of the channels through which the ova from the female and the spermatic filaments from the male organ passed, contained the fructified result of such a reunion, as that of the opposite sexes could alone secure.

The presence of a product in an organ, however, not being sufficient to ensure that it was produced by, and not introduced into, that organ, the question naturally arose in the minds of some, whether we were justified in regarding the organs in the *Linguatula tænioides* containing the ova, as ovaries, and those containing the spermatozoa as testicles. At first some doubted, and at last others have denied, the reunion of the sexes in this species of *Pentastoma*.

Van Beneden, the champion of the latter class of naturalists, states* that in four examples of the species of "*Linguatula de Diesing*," and in two others of another kind found in the lung of a Boa, he ascertained the male and female organs of generation to be in different individuals, and that Owen, Valentin, Von Siebold and others, have erred in describing the *L. tænioides* as a hermaphrodite. He describes the testicle in the male as being about $\frac{1}{3}$ of the length of the body, and lying behind the alimentary canal, consisting of a pouch with thin parietes, terminating behind in a cul-de-sac. From the upper part of the testicle branch off two vasa deferentia, and from the end of each, floats an organ which he looks upon as a prostate. These open into round vesicles constricted in the middle, each containing a coiled-up tube, which he describes as a penis.

I have quoted Van Beneden's description of a male *Pentastoma*, because in the nasal fossa of the Cobra, from which I obtained my four specimens of entozoa, I found two small *Pentastoma* of about $1\frac{1}{8}$ inch in length (Pl. XLVI. fig. 2); and on dissecting one I found it to agree in every respect with Van Beneden's description of the male *Linguatula*. The question then occurred to me, whether or not I might look upon them as being two males and my large specimens four females of the same species. The two small entozoa found in the nasal fossa look exactly like some other *Pentastoma* which I obtained from the cellular tissue of a Morocco Cobra. Even taking into account the fact that the male is often much smaller than the female entozoon, their external characters and apparently their mode of life are so very different from those of the large worms found in the lungs, that I can scarcely believe them to belong to the same species of animal. Even admitting that they were the males of my large entozoon, I do not see how they could get their spermatozoa into the spermatheca of the large animals. Van Beneden says he found an opening for the penis to get out immediately behind the mouth, but then this organ, which he calls the penis†, is only a few lines in length, and consequently could project the seminal fluid but a trifling way up the uterus, which, as before mentioned, is 40 inches long. The pouches containing the semen are situated too at the

* Ann. des Sciences Naturelles, 3me série, tome 11–12, p. 325.

† I examined what he took for the penis, and I have some doubts if it, or rather they, for there are two, are really what he supposes them to be.

very top of this immensely long duct. It may be said that the spermatozoa could find the way up themselves. That I admit might be the case if they were fully developed, and consequently moving filaments; but it would be impossible for them to get up in the undeveloped condition in which some of them are found in the pouches. Besides this, if they were injected into the vagina, why did they not impregnate any of the ova on their passage up? Impregnation is distinctly seen to have taken place from above downwards, not from below upwards, or in any irregular manner.

The only satisfactory way of accounting for the presence of spermatozoa in different stages of development in the copulatory pouches, supposing that they were not generated there, would be to find a channel by which they might enter without having to pass through the 40 inches of oviduct. Now I have carefully searched for such a channel and can find no trace of one. Neither can I find any opening into the animal near to the spermatheca except the mouth, and I do not think any one will consider that a likely door for them to enter at.

I admit that my not being able either to detect a tube or an opening into the spermatheca does not incontrovertibly prove that no such tube or opening exists. But I think that fact taken in connexion with the others, especially that of the spermatic filaments being found in various stages of development in the pouches, is tolerable evidence in support of the idea that the organ containing the spermatozoa is the one which generated them. And until we hear some more conclusive arguments on the opposite side, we may consider ourselves justified in regarding the spermatheca as testicles, and calling the entozoon a true hermaphrodite.

In conclusion, I have a word to add regarding the habits of the entozoon I have been describing. I found two of them with their heads projecting through the air-sac of the Cobra, and firmly fixed by their prehensile hooklets to a large blood-vessel; from which I conclude that they feed directly upon the blood of the animal they inhabit. They appear to be blood-suckers in the strictest sense of the word. In order to get to the blood-vessels to which they anchor themselves by their hooks, the worm has to pierce the surrounding tissues, and the hooks are no doubt made retractile into the depression in order to enable the animal again to withdraw its head after it has finished its meal.

I found in the collection of Dr. Sharpey a fine specimen of an entozoon closely resembling the one I have been speaking of (Pl. XLVI. fig. 3); the only difference being that it is shorter and thicker, has only nineteen strong projecting rings instead of twenty-seven, and that its tail is conical and not cleft; farther, that the vagina is about a line in front of the anus. Unfortunately no history is attached to this specimen.

DESCRIPTION OF ANNULOSA, PLATES XLVI. AND XLVII.

Plate XLVI.

Fig. 1. The entozoon ; natural size.
- *a.* The head ; the under surface showing the mouth and four prehensile hooklets (two on either side of the buccal aperture).
- *b.* The caudal extremity, showing the cleft across it.
- *c.* The projecting rings.

Fig. 2. Small entozoon found in the nasal fossa of the Cobra ; natural size.

Fig. 3. Large entozoon found in Dr. Sharpey's collection.
- *a.* Head, with the mouth and four hooklets.
- *b.* The conical caudal extremity.
- *c.* The entrance to the vagina.
- *d.* The anal aperture.

Fig. 4. Entozoon, fig. 1, dissected. Opened on the dorsum a little to the left of the mesial line.
- *a, a.* The digestive canal.
- *b.* The œsophageal ganglion.
- *c.* The great nerve cords.
- *d.* The vagina.
- *e, e.* The uterus or oviduct.
- *f, f.* The copulatory pouches or testicles (?).
- *g, g.* The ovary.
- *h.* The fallopian tubes.

Fig. 5. Portion of the ovary.
- *a, a.* The ova, resembling bunches of grapes.
- *b, b.* The homogeneous membrane loosely covering the ova.

Fig. 6. A bunch of ova highly magnified.
- *a.* The yelk-sac, consisting of a double wall.
- *b.* The granular yelk.
- *c.* Germinal vesicle : indicated by the light-coloured space.
- *d.* Germinal spot.

Fig. 7. Impregnated ovum from the upper portion of the uterus.

Plate XLVII.

Fig. 8. Spermatozoa found in the copulatory pouches or testicles (?).
- *a, a.* Granular cells.
- *b.* The imperfectly developed spermatic filaments amassed together in large bundles.
- *c.* Fully formed spermatozoa.

Fig. 9. Ovum taken from the uterus 6 inches below its upper attachment.
- *a.* The granular yelk becoming condensed and retracted from the yelk-sac.

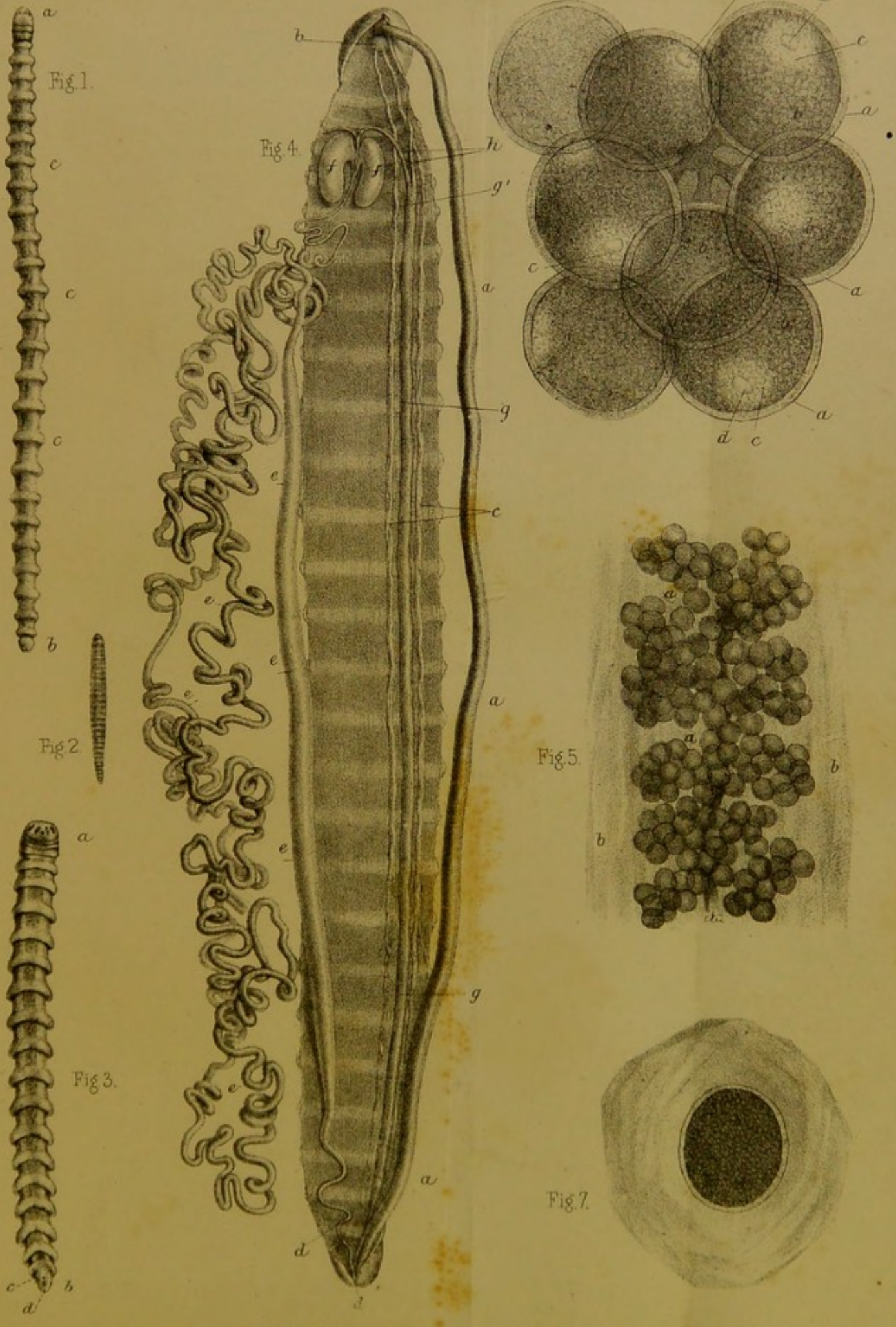
Fig. 10. View of ovum in a more advanced stage of development.

Fig. 11. Profile view of a fully developed ovum. Two sets of hooklets are here shown.

Fig. 12. Face-view of the same, in order to show the arrangement of the four pairs of hooklets, and general form of the animal.

Fig. 13. Striated muscular fibres from the parietes of the parent entozoon.

Fig. 14. Magnified view of a small portion of the uterus, to shew its double layer of non-striated muscular fibres.



1 2 4 Pentastoma multicinctum, Harley
3 _____ polyzonum, Harley

Fig 8.

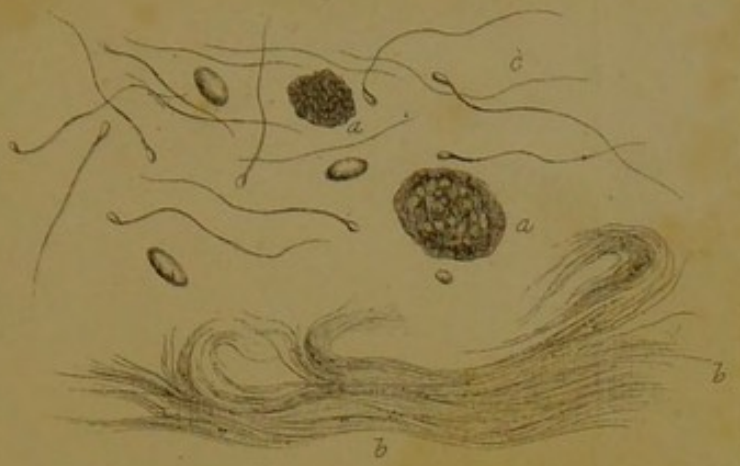


Fig 9.

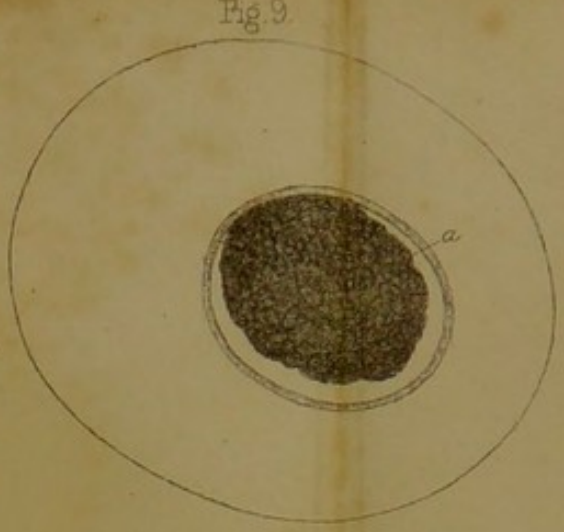


Fig 10.

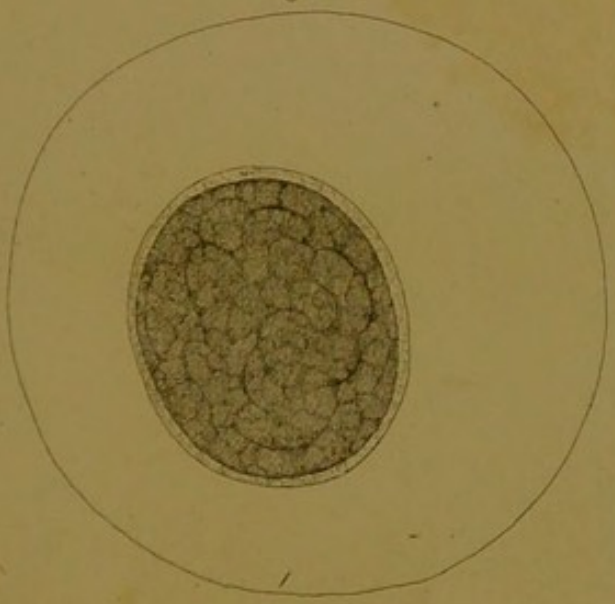


Fig 11.

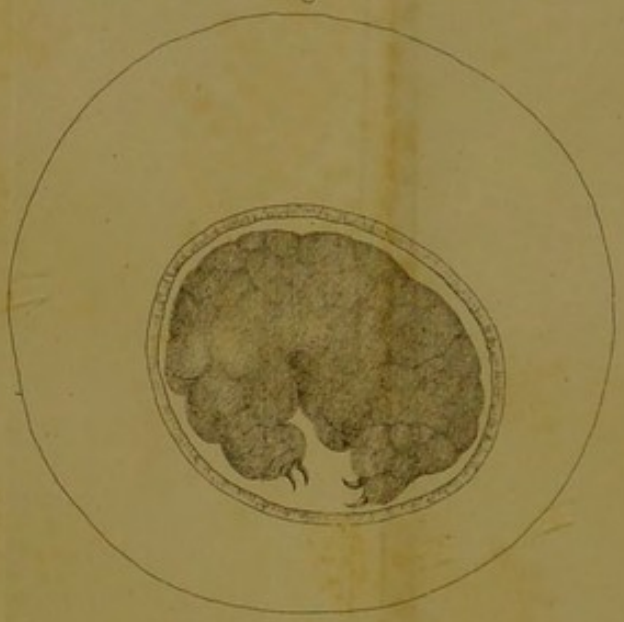


Fig 12.

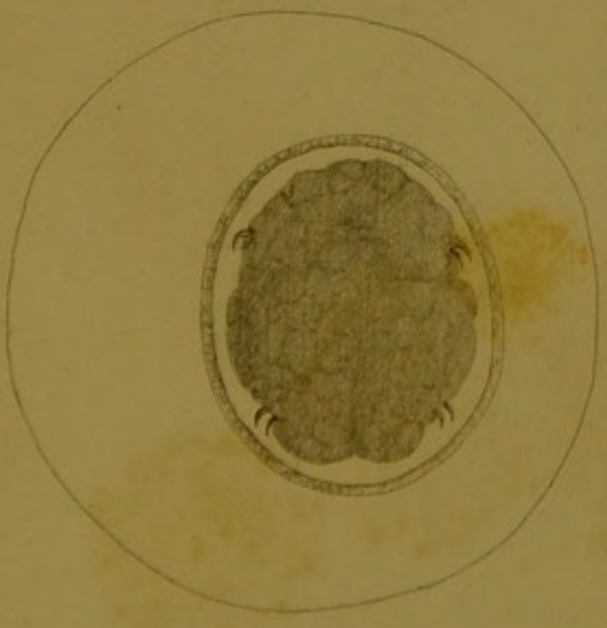


Fig 13.

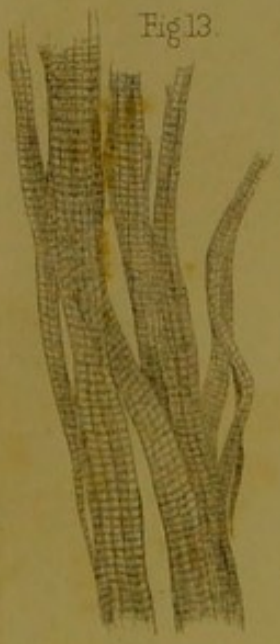


Fig 14.

PENTASTOMA MULTICINCTUM Harley
Ova in different stages of development.

G.H.Ford.

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