VIII. — *On the Anatomy of four species of Entozoa belonging to the genus Strongylus, from the Delphinus phocaena, or common Porpoise.* By JOHN QUEKETT, Secretary to the Microscopical Society.

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THE subjects of the present paper, with one exception, were all found in the lungs of the porpoise. Two of them have been long known and described by Rudolphi, Klein and others, under the names of *Strongylus inflexus* and *minor*; a third, from the circumstance of its being found in company with the *inflexus*, has, by many observers, and by Rudolphi particularly, been considered as a younger specimen of that species; whilst the fourth appears hitherto either to have escaped notice, or else to have been confounded with the last. My examinations of this Entozoon lead me to consider it as a distinct species; and from certain peculiarities presently to be noticed, I have named it *Strongylus invaginatus*. The first one which I shall describe is the *Strongylus inflexus*, the largest of the four; it occurred most abundantly in the bronchial tubes, and in such numbers as almost to close them up, but many specimens were found in the right ventricle and auricle of the heart, and in the principal blood-vessels of the lungs as well.

All the specimens invariably presented their tails towards the larynx, and the males were readily distinguished from the females by their bodies tapering away gradually and then becoming slightly expanded at the extremity; the females, on the contrary, were nearly of equal size throughout, and their tails were provided with two inflected points or hooks, from which the name *inflexus* appears to have been derived, (Pl. iv. fig. 1). The average length of the male is about seven inches, whilst that of the female is nine inches. When alive both sexes were of a dirty white colour, and the alimentary canal, which was filled with black matter, was readily discernible through their transparent muscular tunic. The males were much more slender than the females; the head of each was rather blunt, and provided with an orbicular mouth, with which the alimentary canal was continuous, (fig. 17). In some specimens this tube was filled with black matter up to the mouth, in others it was empty for the first half inch or more. The intestine in many of them passed in a straight line from the head to the tail, in others it proceeded in a wavy course, and its contents were very cohesive, and when examined microscopically were found

to consist of very minute black granules, mixed with others much larger and of a fatty nature. The caudal extremity of the male (fig. 2) was slightly expanded, and terminated in two horn-like processes, one on either side, with smaller horns or spines projecting from them, (fig. 2, *a*) ; these and the terminal half inch of the animal were invested with a thin transparent and flattened membrane, (fig. 2), similar in shape but much larger than that represented by fig. 12 as belonging to *Strongylus minor* : some striæ were observable on its inner margin, (fig. 2, *b b*). When placed in spirit this membrane became opaque. Striæ proceeding in a parallel direction from the sides of the worm to the median line, at an angle of 45° , were observable on the last half inch of this extremity of the animal.

In the females, which were not only larger but darker than the males, the genital apparatus (fig. 3) was readily discernible through the abdominal parietes. It occupied about the lower two thirds of the animal, and consisted of two parts precisely alike ; each one commenced about the upper third of the body by a pointed process, which gradually increased in size for the space of an inch, (fig. 3, *a*) ; this space may be termed the ovarium : it then became contracted suddenly into a small duct, which was about three lines in length, and corresponds to the oviduct or Fallopian tube (fig. 3, *b*), which opens into the last portion or uterus (fig. 3, *c*), which is upwards of three inches in length, and presents a series of contractions and dilatations for the first two inches (fig. 3, *d*), which gives it a nodulated appearance ; for the last inch these nodes disappear, and both uteri ultimately unite together and terminate in the small hook by a delicate opening, (fig. 3, *e*).

The alimentary canal is straight throughout its whole length ; it runs between the two uteri to the largest hook, at the side of which it opens externally. In all the females examined the ovaria were full of ova, and they presented these interesting peculiarities. In the upper part of the ovarium the contents consisted principally of minute cells or granules, which were larger and more developed towards the oviduct. In the oviduct the granules had almost assumed the form of ova, in the uterus perfect ova were found ; those taken from the upper part were full of vitelline globules (fig. 4), whilst those examined lower down, in some cases were more opaque in one part than another, and going still lower, the granules were observed to be fewer in number but rather increased in size (fig. 5), and the oval figure in which they were arranged was disturbed (fig. 6), they had disappeared and probably had become absorbed at one point (fig. 7). In examining

them when taken from a part nearer the end of the uterus, the disappearance of the granules was still more marked, and the form of the future worm could now be made out, (fig. 8): when arrived at this point of development the young in the interior of the ovum could be traced progressively until they were perfectly formed (fig. 9), and when slight pressure was made on the lower end of the Entozoon the young escaped readily at the uterine aperture, and were quite lively even after the porpoise from which they were taken had been dead a week. The ova were about $\frac{1}{30}$ of an inch in length and very easily ruptured, especially those which contained the young perfectly developed. In every female the transition from the vitelline globules to the perfect worm was to be seen.

The next species was found in common with the last, being twisted together in a knot around them, both in the bronchial tubes and blood-vessels. It has been noticed as the young of *Strongylus inflexus*, but on comparing them both together I find that the difference between the two is so marked as to leave no doubt of their being distinct species; and I have since been much pleased to find that the same view of the matter was adopted by Kuhn,* who has described it under the name of *Strongylus convolutus*.

The females are much larger than the males, and both are much inferior in size to the *inflexus*, the one being about two inches in length and the other about an inch and a half. They are of nearly uniform diameter throughout, and their black intestinal canal is very visible through their parietes; in some specimens it took a straight, in others a tortuous course; the head was more pointed than in the *inflexus*, and the commencement of the œsophagus was marked with striæ, (fig. 10). Nothing remarkable was observed in any other part of the body except the tail, which was slightly flattened, and on one side only was provided with a membrane which was continuous with a small semicircular terminal portion, in which were placed three very small horn-like bodies, arranged in a radiated form; in the lower part of the worm two dark curved bodies were placed parallel to each other, which were probably connected with the genital apparatus, (fig. 11 *a*). In the female the genital apparatus was double, as in the last species, but was quite free from the contractions and dilatations; its contents, like those of the *inflexus*, exhibited the gradual transition from vitelline globules to the perfect worm, but in many specimens the disappearance of the globules commenced in the centre, and so went on

* Mémoires du Muséum d'Histoire Naturelle, tome xviii. p. 357.

until a thin margin corresponding to the worm was left. The tail of this Entozoon is represented in fig. 11.

The third species is the smallest of the whole, and from this circumstance has been named *Strongylus minor*, neither the male nor female much exceeding an inch and a quarter in length. It occurred in the venous sinuses of the head and in the cavity of the tympanum, and from living in blood they were of a reddish hue. The females rather exceeded the males in size, and both sexes tapered gradually from the head to the tail, which was much more evident in the male than in the female, in which peculiarity it resembled the male of the *Strongylus inflexus* before noticed. Nothing else remarkable was observed in the male except at the tail (fig. 12), where the membranous investment was thrown into a semicircular fold, and in it three tolerably large horn-like processes, much larger than those of the *convolutus* (fig. 12, *a*), were observed: nearly at the end of the body of the worm there was a dark oval mass, connected either with the genital apparatus or with the intestine, (fig. 12, *b*). In the female the ovarium commenced at the junction of the upper with the middle third of the body. It consisted of two convoluted ducts, which ultimately united into one and terminated on the side of the tail. Ova in different stages of development were observed in all the females of this species, but they were much smaller than in any of the others. The tail of the female is represented at fig. 13.

The fourth species was found in the lungs of the porpoise which I had for dissection on the 9th of last month. On examining minutely the surface of the lung, it was found that its pleuritic investment was raised into little tubercles about the size of a small pea; and on cutting into one of these five very long and slender white worms were drawn out, one being much shorter than the rest, this I subsequently ascertained to be the male. On tearing a portion of the lung, a vast number of these cysts were found imbedded in its substance, and in each one there were several worms coiled up in a very small compass, and the cysts could be readily torn away quite entire from the surrounding tissue with the worms in them. On examining some of these specimens microscopically, I found that it was a distinct species from any of the preceding: it approaches nearest to the *convolutus*, but it differs from this in many points. The males were few in number, and about an inch in length, the female being three inches and sometimes more. Besides this great disparity in size, both sexes were inclosed in a very thin and delicate membrane, which projected from their sides, and made them appear more than as wide again as they really

were, (fig. 14, 15). In the male, around the head, this membrane was thrown into puckers, as represented in fig. 14; immediately below this, on one side, it formed a semicircular fold, and then became parallel to the body of the worm throughout its whole course, until it came to the tail; where again it was slightly puckered, (fig. 15). These folds were more remarkable in the female than in the male, and the only parts of the worm in immediate contact with this membranous sheath were the extremities of the head and tail. Near the tail in the male two curved dark bodies were observed, like those described in the *Strongylus convolutus*, and immediately above them the intestine was slightly enlarged, (fig. 15, *a*). In the female the ovaria were very long and full of ova, like those of the other species, but the external opening of the uterus was seen on the side of the body, near the end, and at this point two small hooks were observed, (fig. 16, *b*). The intestine proceeded a little farther on than the uterus, and terminated where the tail came in contact with the sheath. The manifest differences between this Entozoon and any of the others previously described, alone warrant me in making this a distinct species: and the most striking, and at the same time most constant character, being the investing membrane or sheath, I have given it the name of *invaginatus* at the suggestion of my friend Dr. Willis, in consequence of this peculiarity.* All the authors who have described the genus *Strongylus*, call the membranous investment at the tail both of the male and female, a bursa or sheath for the genital organs; some of them, as Kuhn, describe an intromittent organ; but in these four species I have not seen one protruded, but my friend Mr. Busk has noticed it in a specimen of *Strongylus minor*.

I cannot conclude this paper without alluding to some curious facts which present themselves for our consideration. Entozoa, from the time of their first discovery to the present day, have exhibited more astonishing and wonderful phenomena than any other tribe of animated beings; and perhaps throughout the whole kingdom of Nature no class has been so frequently the subject of opposite opinions, and on the matter of their generation we are now nearly as much in the dark as ever. We have, nevertheless, in the specimens before us, the startling truth of one and the same species of Entozoon living in directly opposite media, viz., in blood and in air; for it has been stated that the *Strongylus inflexus* was found in the bronchial tubes, in the prin-

* By means of a higher power than was used by me, Mr. Busk has found that the sheath may even be seen around the minute animal whilst in ovo.

cial blood-vessels of the lung, and even in the heart itself; and the venous sinuses at the base of the brain and the cavity of the tympanum were literally clogged with *Strongylus minor*. Now we cannot but imagine that any animal so infested must, as a necessary consequence, have both the functions of respiration and circulation greatly impeded. Three porpoises which I have dissected within the last two months, have all contained Entozoa, and all these were taken in the Thames; and it is probable that this may be the reason of their leaving the ocean and running up the rivers at particular seasons of the year, and it would be curious to ascertain whether those taken at sea about the same period were so infested. Some light, I trust, may be thrown on the occurrence of Entozoa in particular parts of an animal, when we have them, as in this instance, actually living in the blood. We can now readily imagine how the young, when emitted from the parent, can be transported to all parts of the body by means of the circulation, and analogy would lead us to conclude that the blood of other animals may contain Entozoa, as well as that of the porpoise. There is another curious circumstance connected with these *Strongyli*:—all the specimens of the four species just described are nearly constant in their size, we meet with no young ones amongst them; these probably are to be found in parts of the body where the scrutinizing eye of the anatomist has as yet failed in detecting them. But however, this is mere matter of speculation; and I will no longer detain the Society on a subject which, from time immemorial, has been to reflecting minds a wonder, how Entozoa “live, and move, and have their being.”

EXPLANATION OF PLATE IV.

- Fig. 1. The tail of the female of *Strongylus inflexus*.
 a. Outlet of the alimentary canal.
 b. Outlet of the oviduct.
- Fig. 2. The tail of the male of *Str. inflexus*.
 a. Horn-like processes, with smaller ones projecting from their sides.
 b b. Parallel striæ on the expanded membranous investment.
- Fig. 3. Female genital apparatus of *Str. inflexus*.
 a. Ovarium.
 b. Oviduct.
 c. Uterus.
 d. Moniliform appearance of the uterus.
- Fig. 4. Ovum from the upper part of the uterus full of vitelline globules.
- Fig. 5. Ovum in which the vitelline globules have diminished in number, but those remaining are much increased in size.
- Fig. 6. Ovum showing the disappearance of the globules in one part.
- Fig. 7. Ovum exhibiting the same appearance as the last, only more marked.
- Fig. 8. Ovum exhibiting the young worm nearly developed.
- Fig. 9. Ovum exhibiting the young worm perfectly developed.
- Fig. 10. Head of male of *Strongylus convolutus*.
- Fig. 11. Tail of male of *Str. convolutus*.
 a. Two dark curved bodies near the anal outlet.
 b. Three very minute horn-like bodies attached to the small semicircular fold of investing membrane.
- Fig. 11 a. Head of female of *Str. convolutus*.
- Fig. 11 b. Tail of female of *Str. convolutus*.
- Fig. 12. Tail of male of *Str. minor*.
 a. Three horn-like bodies attached to the investing membrane.
 b. Dark oval body near the termination of the alimentary canal.
- Fig. 13. Tail of female of *Str. minor*.
- Fig. 14. Head of male of *Str. invaginatus*.
- Fig. 15. Tail of male of *Str. invaginatus*.
 a. Two dark curved bodies similar to those in fig. 11 a.
- Fig. 16. Tail of female of *Str. invaginatus*.
 b. Two minute hooks near the vulva.
- Fig. 17. Head of male of *Str. inflexus*.
 A represents the average length of the female, *Str. invaginatus*.
 B " " " male, *Str. invaginatus*.
 C " " " male, *Str. convolutus*.
 D " " " female, *Str. convolutus*.
 E " " " male, *Str. minor*.
 F " " " female, *Str. minor*.
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