OBSERVATIONS
ON THE
STRUCTURE OF THE ENTOZOA
BELONGING TO THE
GENUS CYSTICERCUS.

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Communicated by Dr. CLENDINNING.

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THE structure and economy of the lower entozoa is extremely interesting, because it is intimately connected with the theory of generation ; and the physiology of the cyst-worm is peculiarly important, as it not only occurs in man, but is one of the very few parasites that infest the muscular fibre of the animals most commonly used by him as food.

In a short note, "on certain oval corpuscles obtained from the genus cysticercus," read to the Zoological Society last March, I drew attention to the fact that, if the white part near to the head of the entozoon be gently pressed, a little rather viscid fluid will escape, in which will be found a great number of oval corpuscles, presenting a beautiful microscopic object.*

The intention of the present communication is to show the situation and extent which these bodies

* Proc. Zool. Soc., Mar. 10, 1840.

occupy in the worm, and their probable use in its generation ; with an attempt to elucidate some other points in the structure of the parasite, which, I believe, have hitherto either been imperfectly illustrated, or altogether neglected. In the pursuit of this object it is not proposed to give an account of the observations of preceding anatomists, because, in a memoir of this kind, it appears desirable to be as brief as may be consistent with perspicuity ; and all that is known on the subject may be found in a valuable paper by Dr. Knox of Edinburgh, or in the more recent article by Professor Owen in Dr. Todd's *Cyclopædia of Anatomy*.

1. *Of the Oval Corpuscles.* (Figs. 2, 3, 8, and 9.)—The figure of these bodies is that of a short ellipse, generally somewhat flattened, their length being to their breadth rather less than one and a half to one. Sometimes, however, they are nearly circular. Their diameter is indicated by the following measurements, in fractions of an English inch, the common-sized corpuscles being first noted, then those of small and large size, and lastly the average deduced from a computation of the whole.

Long diameter,

1—1500	} Common Sizes.
1—1333	
1—1103	
1—2666	} Extremes.
1—1000	

1—1352 . Average.

Short diameter,	
1—2000	} Common Sizes.
1—2666	
1—2900	} Extremes.
1—1333	
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1—2030	. Average.

They are of a whitish colour, smooth on the surface, and have a glistening appearance when seen by reflected light ; by transmitted light, they present a darkish tinge towards the circumference, often with much brilliancy of the surface, and a remarkably clear and regular outline, although they sometimes appear with a dull white tint and an uneven margin. The majority of them are so far opaque that their interior cannot be seen ; but in some, which are more transparent, a nucleus or cell is visible, generally oval, though occasionally circular in shape, for the most part situated in the centre of the corpuscle, but sometimes near to its edge. The texture of the nucleus is commonly granular ; and this may be shown by breaking the corpuscles by compression, as seen in fig. 9.

The neck of the worm (figs. 2 and 3) is so thickly studded with the corpuscles, that its colour and opacity seems to be caused by them, as the intervening tissue is nearly transparent. They are most numerous about the middle of the neck, where the interspaces of the superficial layer are hardly larger than the corpuscles themselves, and those situated more deeply are closely clustered together.

Towards the head their number diminishes, and they are but thinly scattered in the neighbourhood of the suctorious orifices. But, notwithstanding the corpuscles are so abundant in the neck, they suddenly terminate where this part expands into the bladder-like body of the worm. (Pl. I., fig. 2. *a*.) Those forming the superficial layer appear ready to be cast off, for many of them will fall into a drop of water dabbed with the part, and they may be obtained in great numbers by gently scraping the surface of the corium.

When treated with muriatic or acetic acid, the corpuscles are quickly dissolved, and a plentiful extrication of gas takes place. The solution yields a white precipitate with oxalic or sulphuric acid. During the solution, the nuclei often become visible, and these sometimes appear to inclose a minute spherule, or nucleolus.

The corpuscles are not contained in any visible sac or cyst, but are situated in the parenchyma, which tissue much resembles that of the caudal vesicle, a fact which it would have been difficult to determine, but for the ready solubility of the corpuscles in some acids which have no effect on the spherules of the vesicle.

2. *Of the bladder-like body, or caudal extremity of the worm, and its containing cyst.* (Figs 4. and 5.)—The semi-pellucid body, or caudal vesicle, is composed of a homogeneous and obscurely granular substance, throughout pervaded by oil-like spherules, having the characteristic variation in size of such

particles, their diameter ranging from $\frac{1}{20000}$ th to $\frac{1}{3000}$ th of an inch.

Excepting some contraction, acetic and muriatic acids produce no change in the tissue, no elimination of gas ; neither affect the colour of the part, nor alter the character of the oil-like globules.

The cyst, containing the worm, nearly resembles condensed cellular tissue or thickened serous membrane ; and, when highly magnified, presents an indistinct cellular arrangement, sometimes with an appearance of very delicate filamentous bands, either parallel or crossing each other ; to exhibit this, however, requires a very deep object-glass. Several minute blood-vessels ramify through the walls of the cyst ; but it is hardly necessary to add that none of these could be detected in the worm.

Muriatic acid only causes the texture of the cyst to swell ; but it is immediately made transparent by acetic acid, though it will be recollected that the substance of the entozoon is not thus changed by the acid.

The fluid of the hydatid exerts no action either on litmus or turmeric ; and the quantity of albumen present in the fluid must be very small, as only slight turpidity was produced by heat, nitric acid, or corrosive sublimate.

3. *Of the Hooks or Spines of the Worm.* (Figs. 6, 7, and 10.)—The hooks, from their shape, might more properly be called claws. Each has a club-shaped arm, continued into a taper, sharp, and slightly-curved spine ; and at the point where the

latter begins to form from the arm, arises a short blunt lateral branch or process. This latter is generally naked, as shown in fig. 7, but in some species has a sort of sheath-like appendix, as in fig. 10. In this variety there seems to be a hollow or cancellous texture near to the base of the claw. The appendix occasionally appears on the process like the cup on the acorn. These peculiarities are remarkable in the cyst-worm infesting the liver of the rat and mouse.

The claws form a double circle around the proboscis, there being in fact two circles, or in other words, a long and a short set of claws, one of each set being arranged alternately : their figure is identical, although their size differs remarkably ; and this difference is chiefly confined to the length of the club-shaped arms of the claws. The arms are fixed in the parenchyma ; the base of each points to the centre of the extremity of the proboscis, and the free spines, like the spokes of a wheel, to the circumference. In the *Cysticercus tenuicollis* each set consists of sixteen, making the whole number thirty-two. The disc thus surrounded at the end of the proboscis appears to be imperforate, and merely calculated for adhesion or locomotion ; but the four lateral mouths are often distinctly patent.

The claws are not acted on by muriatic or acetic acid, but are more easily seen and counted by the aid of these re-agents.

In the interesting memoir by Dr. Knox, the following observations occur: "Whilst examining the hooks or spines under powerful glasses, I remarked that they were arranged in a double row, and that at the base of each alternate one, so far as I could observe, there was a small rounded body, resembling an ovum or egg, and their appearance has suggested to me the idea that these rounded bodies may be the young cysticerci developed at the base of each hook. Further observation has led me to think that this appearance was confined to one entire row, and they only appeared to be alternate in consequence of the arrangement of the two rows. But this opinion of the uses of these two parts I throw out only as a conjecture." *

If the claws be examined detached from the proboscis, their real configuration will immediately become manifest; and it may also be clearly seen without disturbing their connections, if a small quantity of one of the acids before mentioned be added to the part. Otherwise, the blunt lateral processes may easily be mistaken for tubercular bodies, particularly when seen foreshortened, as very frequently happens. (*a a a*, fig. 6.) Indeed this was the case in some of my first observations; but Mr. Siddal, the excellent veterinary surgeon of the Blues, soon enabled me to correct the error, while he was executing the drawings.

It appears to me probable that the oval corpuscles, described in the present communication,

* *Lancet*, Vol. 2, 1837-38, p. 397.

are, in fact, the ova of the cysticercus ; for it will be difficult to entertain any other view of their nature when we recollect their heterogeneous structure, their regularity in size and shape, their aggregation together in the true body of the worm, and the abundance of carbonate of lime contained in their shells. I am not aware that any gemmæ or sporules have yet been found to possess these characters ; if, therefore, the oval corpuscles should be regarded as sporules, they must be sporules of a peculiar kind. As it is yet questionable how the corpuscles escape from the cyst, it will be necessary to institute a further examination of this part. I have not yet succeeded in detecting an aperture. But Dr. Knox has given an engraving of one instance in which the head and neck of the cysticercus cellulosæ was seen to project through a natural and well-defined opening in the cyst. With what facility the oval corpuscles may be disseminated will be understood, when it is recollected how prone they are to separate from the surface of the corium.

It is an interesting question whether the spherules of the caudal vesicle may not be considered as nuclei, which advance to the neck or body of the worm, and there become invested with cells, and so formed into the complete oval corpuscles.

Although the consideration of the basis of a methodical arrangement of the entozoa forms no part of the object of the present memoir, I may express my belief that an exact knowledge of the structure and arrangement of the claws of the cystoid family is

likely to lead to an accurate discrimination of many genera and species hitherto but imperfectly characterized. Rudolphi, indeed, in the formation of his orders, availed himself of the characters afforded by the tentacles of the parasites ; but although the importance of these parts was thus early appreciated, it does not appear to me that they have ever yet been described with sufficient accuracy.

It will be understood that the true body of the cysticercus is that part which, in compliance with custom, I have frequently called the neck ; and that the globular portion of the hydatid is in reality the caudal or terminal vesicle.

I am indebted to the kindness of my friend, Mr. Siddall, for the accompanying drawings. They are very faithful representations of the objects, having been executed with great care by means of the camera lucida.

*Description of the Figures.**

Fig. 1.—Cysticercus of the natural size, removed from the cyst, and the head and neck of the worm pulled out. From the omentum of the Mexican deer. All the other figures, except the last, are from the same worm.

Fig. 2.—Head and neck of the worm magnified, and exhibiting the situation and extent of the oval corpuscles, which are very abundant in the middle of the neck, diminishing in num-

* See Plate I. at the end of the Volume.

ber about the head and near to the claws, and wholly disappearing at *a*, where the neck, or body begins to expand into the bladder-like extremity of the parasite.

Fig. 3.—Portion of the neck magnified about 130 times in diameter, so as to show more clearly its structure and the disposition of the superficial layer of the corpuscles.

Fig. 4.—Structure of the caudal vesicle, exhibited in a portion magnified to the same degree as in fig. 3. The oil-like spherules are very distinct, and totally different from the oval corpuscles.

Fig. 5.—Portion of the cyst magnified to exactly the same degree as in figs. 3 and 4.

Fig. 6.—The armed proboscis, enlarged about 145 times in diameter, showing the two circles of claws, and the alternate arrangement of those forming the long and the short set. Some of the lateral processes, as at *a a a*, being seen foreshortened, resemble tubercles. Several of the oval corpuscles, of smaller size than those situated in the neck, are scattered through the parenchyma near to the claws.

Fig. 7.—One of the short and two of the long claws, magnified about 500 times, linear admeasurement. *B*, the arms; *c*, the lateral processes; *d*, the spines. (One of the arms is by mistake marked *P*.)

- Fig. 8.—The oval corpuscles enlarged about 480 diameters: some of them appear homogeneous, others have granular nuclei, and one has a cross split in the shell, from drying.
- Fig. 9.—The same, exhibiting their granular interior after the breaking of the shells by compression.
- Fig. 10.—A claw from a worm (*Cysticercus fasciolaris*?) of the mouse's liver. See Sect. 3.

Fig. 5.

Fig. 4.

Fig. 3.

Fig. 6.

Fig. 9.

Fig. 7.

Fig. 8.

Fig. 10.

Fig. 1.

Fig. 1.