REMARKS ON THE FLUKE *(FASCIOLA HEPTICA)*.

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Having lately had an opportunity of examining and dissecting specimens of Fluke, and in consequence having had to refer to some of the literature extant relating thereto, I venture to lay before your learned Society a few remarks, bearing more particularly on the generative organs, and reproduction of this parasite.

I beg to offer for examination by the Members, preparations as follows:—

Slide No. 1. *Fasciola hepatica*, taken from liver of sheep killed in the Midland District, showing oral and ventral suckers.

Slide No. 2. Portion of uterus, with eggs packed in situ.

Slide No. 3. Eggs of *Fasciola hepatica*.

Slide No. 4. Same; with operculum off, and vitelline contents extruded, also showing filamentoid spermatozoa.

These parasites are perfectly hermaphrodite. Their generative organs are well understood, and in proportion to the size of the animal, the extent and complication of these organs are astonishing. The male apparatus, the uterine cavity and oviduct, the yelk forming glands, occupy by far the greatest portion of the body.

Siebold says, "the female apparatus of the trematodes consists of a germ forming organ (ovary), with its excretory duct; then two others for forming the vitellus, which have also excretory ducts, and then a simple uterus with its vagina. The male apparatus consists of testicles with their excretory canals, an internal seminal vesicle, a cirrhus-sac, an external seminal vesicle, and a penis."

This simple and concise description fails to convey a sufficiently enlarged idea of the beautiful arrangement and extent of the organ devoted to reproduction in the species under consideration. The whole circumference of the body just beneath the skin is occupied by the ovaries, from these oviferous canals arise, and uniting on each side of the body, convey their contents into the large oviducts which terminate in the uterus. The male apparatus takes up the centre of the body. The testes, consisting of a great number of small and much convoluted vessels, terminate in two large tubes which convey the spermatic fluid to the vas deferens, which becoming attenuated, terminates at the root of the penis.

The uterus consists of a tortuous tube filled with eggs. A portion of the uterus is shown in preparation No. 2. The eggs

are of a yellowish color, have an operculum, and are found in vast numbers in individual specimens of the entozoon. Slides Nos. 2 and 3 exhibit the eggs as taken from the uterine tube, and on slide No. 3, near some of the eggs, are to be seen some spermatic filaments.

Alternate generation is the term applied to the various transformations these entozoa undergo in the course of their full development. There is a missing link in some of the stages, but sufficient is known for a thorough comprehension of the subject. The eggs being formed by the elaborate and beautiful reproductive system above described, escape from the uterus one at a time, and when perfectly mature the operculum is pushed off by the energetic action of the ciliated embryos within. An examination of slide No. 3, will show embryos (unfortunately not sufficiently advanced to exhibit cilia) amongst the extruded vitellus. In some cases these embryos make their escape whilst the egg is within the uterus, but more frequently they escape whilst the egg lies on the marshy or moist pastures. According to Siebold the development of the egg is as follows :—" After the disappearance of the germinative vesicle, large transparent embryonic cells appear in the midst of the vitellus, which undergo fissuration. These multiply by division, increasing at the expense of the vitellus, which in the end they completely replace. When this has taken place there is a mass of extremely small cells, which being covered with a delicate epithelium having cilia, form a round or oval embryo." The ciliated embryo can progress in moist grass or water, and, sooner or later, attaches itself to the surface of the body of some mollusk, most commonly the limneus, planorbis, or paludina, when it loses its ciliated epithelium and gains access to the interior of its host. When there the germ bud contained in the embryo developes rapidly into a non-ciliated larva, within which another family is developed. The enlarged larva is now transformed into a cyst, and is then called a " nurse," and its contained family develope into cercariæ. These cercariæ have an independent life of their own, and it is not absolutely necessary to their existence that they should enter the viscera and liver of a vertebrate, but when there, they meet their highest form of development in the mature liver entozoon. I regret much that I have not been able to prepare specimens of the cercariæ, but when I do so I will forward some for inspection.

Let us recapitulate these powers of reproduction, commencing with the full-grown fluke :—In each individual a vast number of eggs are matured, and each one of these eggs contains a ciliated embryo, capable, after entering a molluscan host, of developing into a non-ciliated larva ; this larva

undergoes further development, has a considerable progeny of its own, which escape and are known as cercariæ; here follows under certain conditions, a separate existence not fully traced out, but each cercariæ can enter the viscera of a vertebrate, when, in the liver, it attains its final development in the full grown and sexually mature fluke. Let preparation No. 2 (in which only a portion of the uterus is shown) be examined under the microscope, and the number, and dense packing of the eggs be observed, we shall then be astounded at the capabilities of increase made manifest, and no longer wonder at the rapid spread of this parasite.

From this knowledge of the reproduction of the fluke, we may fairly deduce the following conclusions:—

First. That the immediate progeny of the Fasciola is innocuous to vertebrates, for certain metamorphoses or alternations of generation must be passed through before it can develope into the mature animal.

Second. That the eggs (being provided with a hard shell) having passed out of the Fasciola, may be blown about the country and not develope until they meet with favorable conditions.

Third. That an estate may have the reputation of being perfectly free from fluke and yet the germs may be there in myriads, ready to develope when favourable conditions arise, may be through an overmoist season, may be through increase in molluscan life, may be through subtle influences not yet explored.

Fourth. That on a comparatively dry estate, having the marshes well drained, the disease will never be very serious, unless the seasons happen to be peculiarly mild and moist.

Fifth. That molluscan, or aquatic insect life is necessary to the development of the ciliated embryo, but it is not known how long this embryo can live without moisture; yet it has been proved that infusorial life generally will bear extreme dessication and yet survive.

Sixth. That the offspring of flukey sheep are not born diseased; but in consequence of the systems of the parents being disordered, the offspring may be more predisposed to attacks of the worm, than those born of healthy sheep.

It is stated in a report on fluke, which recently appeared in the newspapers, that "when once a sheep becomes the host of flukes it is doomed, as the parasite will continue in the liver ducts until the life of the animal be exhausted." This does not appear to be the fact, for I have it not only on the authority of Cobbold, that the entozoon after entering the liver ducts, passes into the biliary outlet, thence into the intestinal canal, and is so expelled; but also from the observation of practical

flock owners, that when sheep not 'badly flukey' are brought into dry healthy pastures they get round again. And it is also known, that the eggs are not, in most cases, expelled from the uterus until the fluke has passed from its host. Now this knowledge, removes, in some measure, the gloom from the terrible picture of the disease and its results portrayed in the report. The conclusion is almost beyond controversy, namely, given healthy, well-drained pastures and the fluke will disappear in a great degree; although the germs of the disease will always be there ready to spread in any flocks that may be exposed to attack by being placed in conditions favorable to their development.

Good drainage and occasional salt diet appear to be the only remedies known at present; but it is quite possible that certain breeds or crosses may, from having more vigorous systems and better digestive powers, withstand the entrance of the parasite into the tissues better than others.

Perhaps, I may be pardoned if, before concluding, I pass from the scientific side of the subject to the consideration rapidly and curtly, of its politico-economic relations.

The disease and its causes has been well known for the last century. Its internal microscopic structure has certainly, only comparatively recently been elucidated, but all that which relates to its dire effects on sheep, that which tends to irritate or to subdue its prevalence, has been intimate knowledge for a long time. Turning to the first edition of Cuvier, published in 1817, I find, under Les Trematodes, the following:—

"La plus celebre est la douve due foie (*Fasciola hepatica*, Linn), qui est si commune dane les vaisseaux hépatiques des moutons, mais qui se trouve aussi dans ceux de beaucoup d'autres ruminans, du cochon, du cheval, et même de l'homme.

"La douve des moutons se multiplie beaucoup, quand ils paissent dans des terrains humides, et leur occasionne l'hydropisie et la mort."

It is very evident, then, that the disease and causes of its aggravation have been known amongst sheep farmers for a long time. A sheep farmer, understanding his business, must have known well enough that, in taking up his flocks to the marshy lands of the Lake district he was taking them to certain disease; and without the slightest precaution, bringing them down to winter in the warmer country below, was taking as certain means to spread that disease. It may be presumed that some sheep farmers desirous of larger gains, have carried more sheep than their cultivated estates would bear in summer, and that during those months they sent them to depasture on lands utterly unprepared by drainage for their reception. The result was inevitable; for a time greater profits

accrued, but a swift and dire Nemesis overtook those who offended against experience and reason, unfortunately, in many cases, causing the innocent alike to suffer with the culpable. I should not have thought of making these remarks if it were not that it has been proposed to render Government assistance in draining and firing the lands of flockmasters. I venture the opinion, in all deference, that it would be highly improper to render any such aid. The spread of the disease, for the germs are everywhere, has been caused through the cupidity or ignorance of flockmasters. Is it right that the public should pay because they are now suffering the consequences ? It is no new thing, no sudden and hitherto unknown visitation, but, on the contrary, we know well its cause, and, therefore, the means of its alleviation. As soon would we think to live unsheltered in the fen country and escape ague, as to keep sheep on marshy grounds and expect them to escape the fluke.

It would be more in accordance with the dictates of political economy to let matters take their course until flockowners found it to be to their interest to study the sheep, its food, and requirements, with the same attention as they would any other animal from which profit is expected. There are times, perhaps, when for the general benefit, a government may resort to special measures, but in such case, whatever pecuniary outlay may be thought requisite should be met by a special tax on those who have caused the evil, either by their avarice, ignorance, or carelessness, and not on the public, who have obtained no benefits but rather absolute harm, the result of mismanaged property, which, although private, should not be used to the general disadvantage with impunity.