

Some Parasites of *Sagitta bipunctata*.

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With text Figures 1-6.

Sagitta has been several times noticed as a host for various parasitic worms, notably a larval nematode and several trematodes. Larval cestodes have also been seen in it. It is exceeding voracious and apparently eats almost any animal food, especially its own species and small crustacea, so that it is not to be wondered at if it forms a convenient intermediate host for many worms, and as *Sagitta* itself is an important fish food it naturally follows that the adults of these parasitic worms are usually found in fish as their final hosts. So far, however, the life histories of the larval forms hitherto found have not been determined, so we are pleased to be able to identify two trematodes belonging to well-known species which inhabit *Sagitta* as intermediate host and fish as the final host.

Busch (1851) and Leuckart and Pagenstecher (1858) have described several larval trematodes and a nematode from *Sagitta*, Ulianin (1871) a nematode, and Pierantoni (1913) a nematode. The latter nematode is probably the same worm found in *Sagitta* in Plymouth Sound. Busch's description of a nematode in *Sagitta* is too vague to recognise it, and unfortunately Ulianin's paper has not been available for reference. Leuckart and Pagenstecher mention two larval trematodes from *Sagitta germanica* (= *Sagitta bipunctata* Q. and G.), one a monostome and the other a distome. Although these are figured, they are neither described nor named. The distome (Plate XXI, Fig. 9) is probably the larval *Derogenes varicus* which occurs in *Sagitta bipunctata* in Plymouth Sound. Busch's trematode larvæ found in *Sagitta cephaloptera* (= *Spadella cephaloptera*) were identified by him as *Distomum papillosum* Diesing (= *Distomum beroë* Will (1844)) and two new species, one of which he names *Distomum fimbriatum* and the other *Distomum crassicaudatum*. *Distomum papillorum* appears to be a larval *Hemiurus*, *D. fimbriatum*

is not described sufficiently to recognise, and *D. crassicaudatum* seems also to be a species of *Hemiurus*. As *Derogenes* is a genus closely related to *Hemiurus* it is interesting to find that both inhabit *Sagitta* as an intermediate host.

In Plymouth Sound the only species of *Sagitta* is *S. bipunctata* Q. and G. In 1916 Mr. Smith called my attention to the number of parasitic nematodes in it from old plankton samples. Afterwards it was found to be very common in the fresh samples and quite the commonest parasite of *Sagitta*. It is a larval *Ascaris*, and in all probability is the same species as that described by Pierantoni (1913) from *Sagitta* in the Bay of Naples, and he has also found them from Villafranca, Wimereux and Trieste. In his brief note on the worm he suggests that it may be identical with an *Agamonema* described by Stossich from a *Ranzana*, one of the *Molidae*. The final host of the nematode from the Plymouth *Sagitta* is quite unknown, but one would expect it to be something common judging from the frequency of its occurrence.

This larval *Ascaris* occupies the body cavity of *Sagitta*, lying lengthwise, and sometimes is three-quarters the length of its host. The figure here given (Fig. 1, Plate I) is from a small specimen. The body is colourless and measures 3 to 17 mm. in length and is very narrow. The anterior end is provided with a large larval hook for boring; the œsophagus is long and prolonged behind by the side of the intestine into a blind œsophageal sac: the intestine which occupies nearly the whole of the body, since the reproductive organs are not yet present, gives off forwards a second blind sac, the blind intestine, which runs along by the side of the œsophagus. The anus is near the tail, the latter ending in a small sharp spike. The brain is plainly seen as a broad band anteriorly running round the œsophagus, and just behind it is the excretory pore from which can be traced the thin excretory duct. A large proportion of the *Sagittæ* brought in by the tow nets is infected with this nematode.

Two trematode larvæ are also common in the local *Sagitta*, the larva of *Derogenes varicus* (O. F. Müller) and the larva of *Pharyngora bacillaris* (Molin). Both of these inhabit common fish in their adult state.

Derogenes varicus is one of the commonest trematodes with a wide distribution, and occurs in a number of different fish. Odhner (1906) states that about a dozen and a half northern fish are recorded as its hosts. Nicoll (1914) quotes twenty-eight different fish as its hosts from the Channel, *Cottus*, various *Gadidæ* and a few Plemonectids are the common hosts. It occupies the stomach of these fish.

Levinsen (1881) records the larval form of this trematode from *Harmothoe imbricata*, and finds the remains of this annelid in the stomach of *Cottus*. It is very interesting to find the larva in the Sound inhabiting

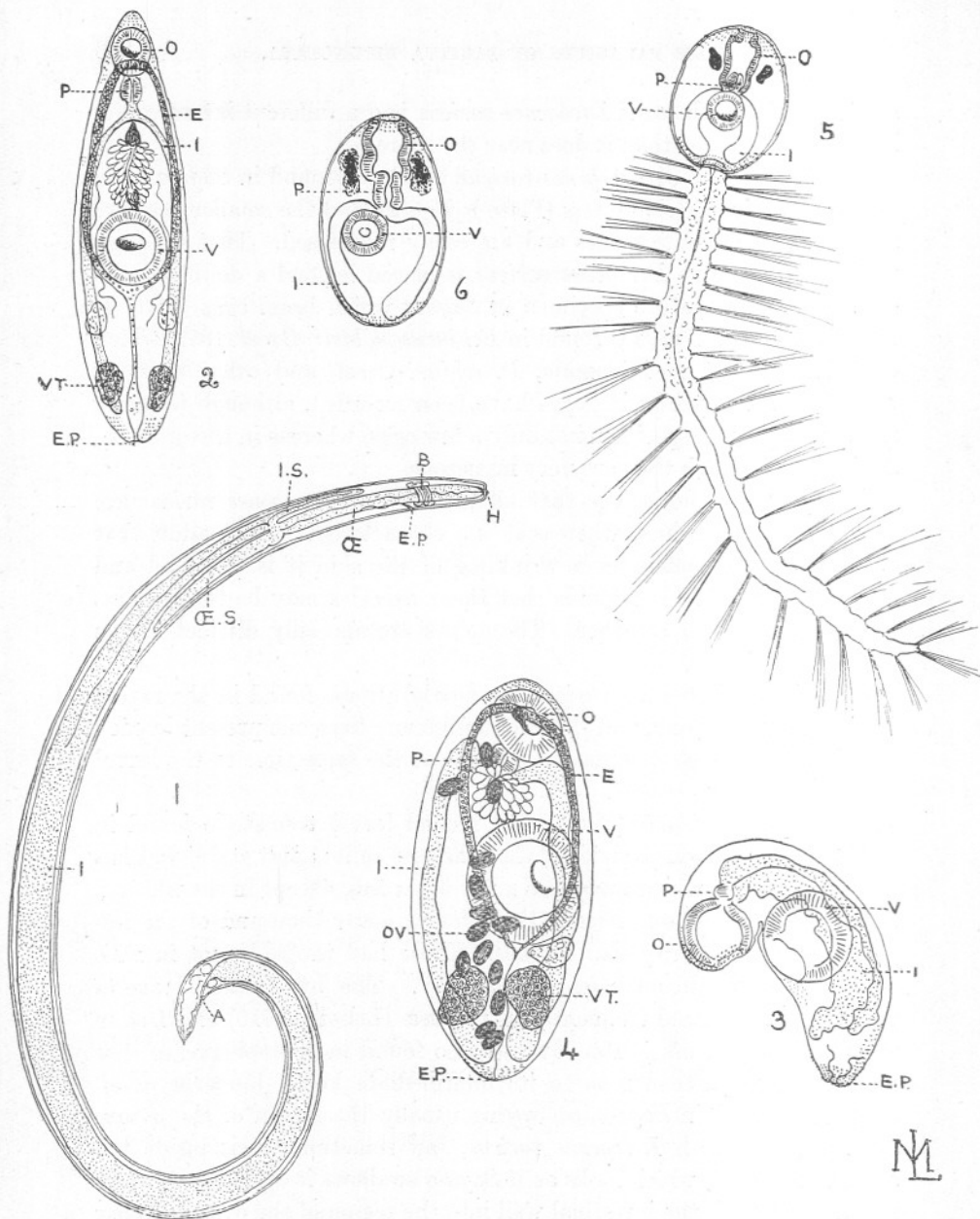
Sagitta, which looks as if *Derogenes varicus* had a different intermediate host in the open sea than it does near the shore.

The larger larvæ of *Derogenes varicus* which are found in *Sagitta* have nearly all the adult characters (Plate I, Fig. 2), and the smaller ones are found in intermediate stages and are easily recognised. That we have to do with the true *Derogenes varicus* is placed beyond a doubt by the occurrence of a mature specimen in *Sagitta* which bears eggs (Plate I, Fig. 4). A parallel case is found in *Echiurus pallasii* (Greef, 1879) which contained a mature *Distomum*, *D. echiuri* Greef, and other cases of trematode larvæ producing eggs have been recorded, although they are rare. The present specimen has only a few eggs, whereas in the ordinary adult stage in a fish they are very numerous.

A curious fact noticed is that all these larval *Derogenes varicus* are beset with small spines, whereas it is a characteristic of the adult that although it has sometimes a wrinkling of the skin it is unarmed and usually smooth. It is possible that these wrinkles may be the remains of the spines fused together. The spines are specially distinct in the younger specimens.

These larval *Derogenes varicus* are nearly always found in the region of the ovary of *Sagitta*, and there is rarely more than one present in each individual, although one may be present at the same time as the larval *Ascaris* described above.

Pharyngora bacillaris (Molin), the second larval trematode found in *Sagitta*, is a common parasite of the mackerel in its adult state, and has been found in the whiting and also a few other fish, except in the whiting, in an immature state. Nicoll (1914) found many thousand of the immature form in *Cyclopterus lumpus*. These had probably got in with the food and would not come to maturity. The late cercaria stage of this worm was found frequently in medusæ (Lebour, 1916) and free in the plankton (Nicoll, 1910). It was also found in ctenophores, so it is evidently not particular as to its intermediate host. Cercariæ of all ages were found in *Sagitta* occupying usually the region of the ovary, as is the case with *Derogenes varicus*, but sometimes it is inside the alimentary canal, which looks as if *Sagitta* swallows it and afterwards it migrates through the intestinal wall into the region of the ovary. What I have no doubt is the free-swimming cercaria of this trematode was found once in tow nettings on January 28th, 1916. *Sagitta* from the same samples contained these cercariæ without their tails, and it could be traced up to the ordinary *Pharyngora* late cercaria stage, such as was found in the medusæ and free in the plankton. The free-swimming cercaria is extremely interesting (Fig. 6). It is provided with a large tail several times the length of the body and armed with bunches of



EXPLANATION OF FIGURES.

FIG. 1.—Larval *Ascaris* from *Sagitta* $\times 60$. A anus, CE oesophagus, CES blind sac from oesophagus, B brain, I intestine, I.S blind sac from intestine, H boring hook.

FIGS. 2-3.—*Derogenes varicus* from *Sagitta* $\times 60$.

FIG. 4.—Ditto containing eggs $\times 60$.

FIG. 5.—Free-swimming cercaria of *Pharyngora bacillaris* $\times 60$.

FIG. 6.—Cercaria of *Pharyngora bacillaris* from *Sagitta* $\times 60$. O oral sucker, V ventral sucker, E excretory duct, E.P excretory pore, I intestine, P pharynx, VT vitellaria, OV ova.

long bristles placed at regular intervals and giving it the appearance of an annelid. The tail is an efficient swimming organ, and the bristles no doubt serve for keeping the whole animal floating. Two large kidney-shaped black eyes are conspicuous, the oral sucker has the typical *Pharyngora* form which is more like a pharynx in shape, the true pharynx leading from it to a short œsophagus and intestinal cœca reaching to the end of the body. The whole body is covered with small spines. In the specimens inside *Sagitta* the eyes have begun to show diffuse pigment as in the older specimens instead of its being in a thick black mass as in the free-swimming form.

Neither *Derogenes varicus* nor *Pharyngora bacillaris* have been found encysted, and it is presumed that the encysted stage is omitted as the cercariæ develop in *Sagitta* and the other hosts into a late form which is ready to enter its final host. The first host which presumably is a mollusk is yet to be discovered for both of these trematodes.

Two larval cestodes were also found in *Sagitta* from the Sound, one with four suckers and one with none. These were not identified. It is evident that we have in *Sagitta* an exceptionally good host for many parasites, and probably further investigation would be amply repaid.

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* Not seen by the present writer.