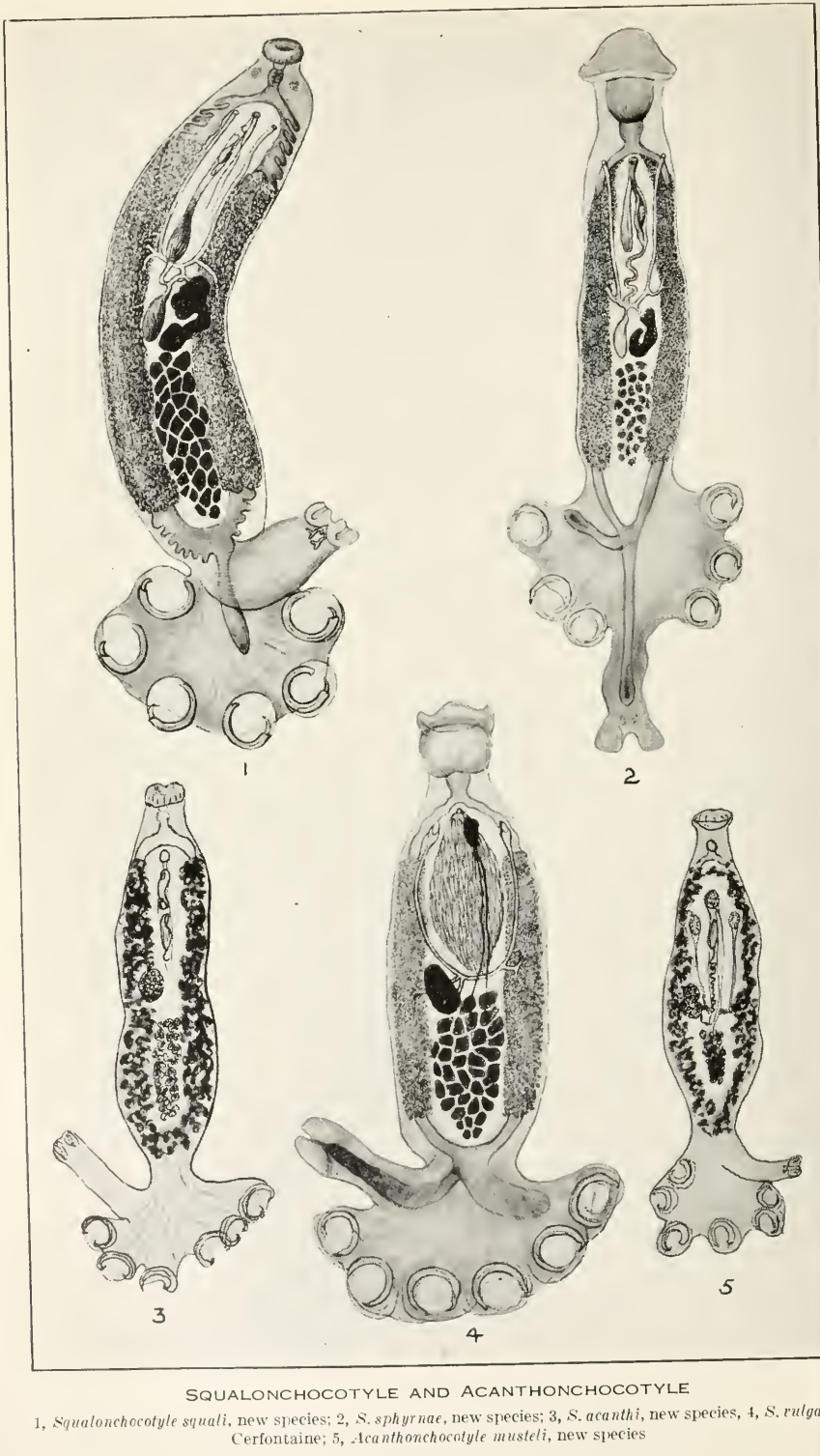


SQUALONCHOCOTYLE AND ACANTHONCHOCOTYLE

1, *Squalonchocotyle squali*, new species; 2, *S. sphyrnae*, new species; 3, *S. acanthi*, new species, 4, *S. rulgaris* Cerfontaine; 5, *Acanthonchocotyle musteli*, new species

# FOUR NEW SPECIES OF TREMATODE WORMS OF THE SUBFAMILY ONCHOCOTYLINAE

By Dr. G. A. MacCallum

*Baltimore, Md.*

## INTRODUCTION

For many years the differentiation of species among the Onchocotylinae has been in a state of great confusion. The name *Onchocotyle appendiculata* has been given indifferently to many different forms, and others have been set apart as distinct species without sufficient warrant. This, as usual, has resulted from the extremely incomplete study of the various worms found, and from the misinterpretation of organs and the neglect of characteristic features. Even now, although the anatomy of these forms has become fairly clear, their systematic arrangement is full of difficulties, because the meagerness of description makes comparison so nearly impossible.

The literature has been so well reviewed by Cerfontaine (1900) in his admirable paper that it is unnecessary to repeat it, and indeed his success in collecting practically all known forms for renewed study makes it impossible to do otherwise than accept his conclusions. Only one new form seems to have been described since his paper; namely, *O. somniosi* from *Somniosus microcephalus* (sleeper shark), by David Causey (1926).

Cerfontaine divides the subfamily Onchocotylinae into three genera: *Acanthonchocotyle*, *Squalonchocotyle*, and *Rajonchocotyle*. *Acanthonchocotyle* includes forms in which the penis is armed with spines; eggs with a single filament; parasites of Scyllidae. *Squalonchocotyle* includes forms with large mouth sucker; rectangular fixation disk without intestinal ramifications within it; vaginal orifices near the same level as the genital atrium, the two vaginal canals remaining separate to their union with the yolk duct; eggs with two polar filaments; parasites of Squalidae. *Rajonchocotyle* includes forms with small mouth sucker with transverse orifice, large round fixation disk with ramifications of the intestine within it; vaginal orifices behind the level of the atrium, the vaginal canals uniting in a single median canal; eggs without polar filaments and at most a small tubercle at one or both ends, and with meridional thickenings or ribs; parasites of the Rajidae.

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Out of the confusion Cerfontaine rescues the worm first described by Kuhn from *Scyllium catulus* as *Onchocotyle appendiculata*, giving it the name *Acanthonchocotyle appendiculata.* This certainly has nothing to do with the form described by P. J. van Beneden (1858) as *O. appendiculata* from *Mustelus vulgaris*, nor with others described under that name. The other known species of the genus is *Acanthonchocotyle caniculi* Cerfontaine from *Scyllium canicula.*

### ACANTHONCHOCOTYLE MUSTELI, new species

PLATE 1, FIGURE 5

*Specific diagnosis.—Acanthonchocotyle:* The present form, a very minute worm from the gills of *Mustelus canis*, must belong to this genus, but it does not agree with either of the two forms described by Cerfontaine, and we have therefore regarded it as a new species. In general form it agrees precisely with the generic description but differs in detail.

The body measures 2 mm. to 2.5 mm. in length by 0.5 mm. in breadth. The fixation disk is rather fan-shaped, the appendix starting up from its junction with the body. The large suckers are all about the same size. The form of the hooks (fig. 1, *c*) differs slightly from either of those shown by Cerfontaine (1900) in his Plate 19, Figures 5 and 6. The small hooklets are of moderately stout build (fig. 1, *c'*). The mouth sucker is not so wide as the body, but is thin walled and flares a little. The pharynx is small and compact and situated a short way behind it. The intestine is inconspicuous and does not visibly enter the fixation disk.

The penis is armed with about 60 minute spines, which take different positions according to its degree of evagination. The vaginal orifices appear at first sight to be armed with chitinous spines folded together in a bundle, but in one specimen the position is such that one can look into these orifices, and it is then found that there is a radiate chitinous margin with a starlike arrangement of wavy chitinous points about the central orifice. The wide vaginal canals run all the way back to join the vitelline duct (pl. 1, fig. 5). The ovary is much lobulated and situated at about the middle of the body. The uterus is a long straight tube without any coils or definite ootype. Testes form numerous small lobules with a wide, coiled vas deferens. The eggs measure 176$\mu$ by 56$\mu$, and while the anterior pole is blunt, there is an extremely long, fine filament at the posterior end that coils far back in the uterus.

*A. musteli* is distinguished from other species of this genus by the form of the hooklets and hooks and by the chitinous armature of the vaginal orifices.

*Type specimen.*—U.S.N.M. Helm. Coll. No. 8131; paratypes No. 8132.

### SQUALONCHOCOTYLE SQUALI, new species

PLATE 1, FIGURE 1

*Specific diagnosis.—Squalonchocotyle:* On the gills of *Squalus acanthias* (spiny dogfish) there were found several examples of this worm.

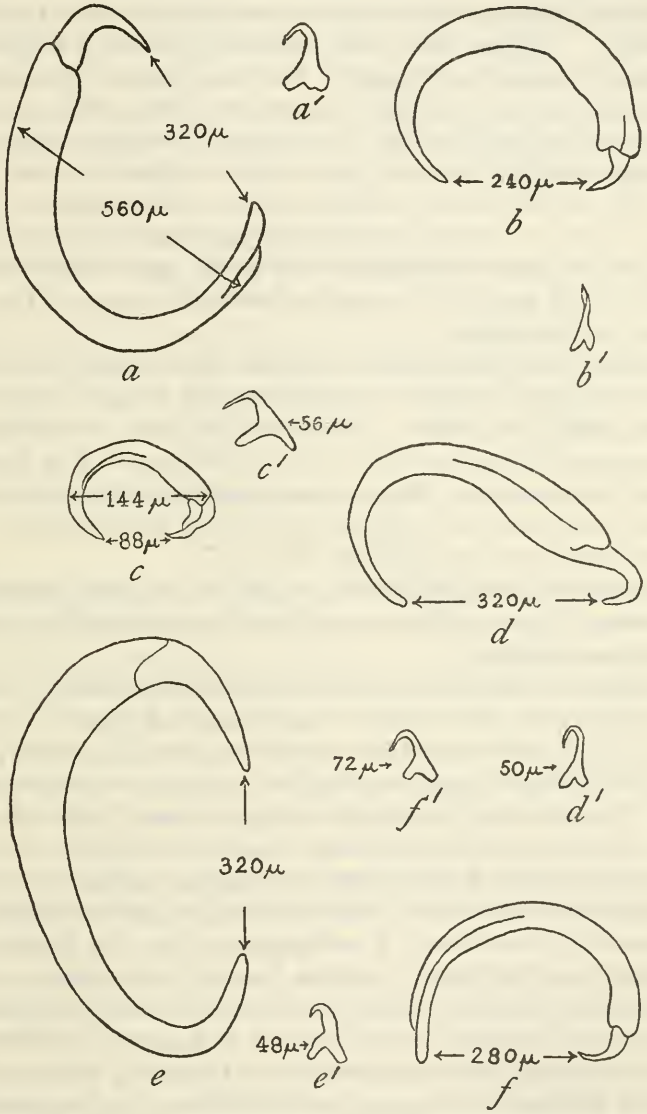


FIGURE 1.—Form of hooks of mouth suckers and small hooklets in appendix of: *a, a′* (respectively), *Squalonchocotyle canis; b, b′, S. acanthi, c, c′, Acanthonchocotyle musteli; d, d′, Squalonchocotyle vulgaris; e, e′, S. sphyrnae; f, f′ S. squali*

Length, 7 to 10 mm.; breadth, about 1.5 mm. The mouth sucker is in the form of a small round knob with transverse slit, and narrower

than the anterior part of the body; pharynx small; intestines apparently much branched, though they are so completely covered by the vitellarium that they can not be plainly seen. A prolongation is sent into the fixation disk and into the appendix. Genital pore small and round, just behind the bifurcation of the intestinal ceca. Vaginal orifices a little posterior to this level, about halfway out to the margin of the body. Vaginae run back separately to the vitelline duct. Ovary much lobulated and folded. There is a large and conspicuous receptaculum seminis. Ootype fusiform, very thick-walled, and distinct, with eight longitudinal ribs formed by deeply stained cells. Uterus runs straight forward from this and contains one or two eggs, which are very large and thin-walled. They measure 320$\mu$ in length and 120$\mu$ in breadth, and have at each pole a short, stout, recurved filament about one-third as long as the egg. There are about 25 lobules of the testis in the midline behind the ovary. The cirrus is narrow and unarmed.

The hooks of the large suckers measure 280$\mu$ from tip to tip (fig. 1, *f*); the terminal hooklet is sharply marked off and is much narrower than the large portion. The other end shows a characteristic abrupt stoppage of one part of its whole thickness so that there is a projecting rounded end. The two small hooklets in the appendix are stout, with long recurved point and very blunt short branches at the base. They measure 72$\mu$ in length (fig. 1, *f'*).

The excretory system can be seen to open on the dorsal surface, far antero-laterally by an orifice on each side surrounded by a sharply outlined mass of cells.

It is difficult to fit this form into Cerfontaine's genera. It has a small rounded oval sucker with transverse slit, followed by a small pharynx. The genital organs are unarmed; there is an ootype with longitudinal ribs and faint longitudinal markings to correspond on the egg. But the egg, instead of ending in a small tubercle, has at each end a short recurved filament. Vaginal orifices are on a level with or slightly behind the genital atrium; the vaginae do not unite to form a single tube but run back separately to enter the yolk duct. The alimentary canal sends a prolongation into the fixation disk, but does not ramify there. And this has not been found as a parasite of one of the Rajidae. It agrees, therefore, with *Rajonchocotyle* in the form of its mouth sucker, ootype, and general conformation, but does not uphold the statement about the union of the vaginae, the lack of filaments on the egg, or the habitat. On the other hand, it differs from *Squalonchocotyle* in the form of the mouth sucker, but agrees in other respects. It is probably best to class it with the latter genus, temporarily at any rate, although it seems that the three genera may have been based on characters not strictly separated in all the forms.

On attempting to compare it with the other forms described, we find that this worm differs in some respects from all. It is much smaller than *S. borealis*, which measures 20 mm. in length, and has not the large open mouth sucker shown in that species. It is closer to *S. vulgaris*, except that that species also has a large bell-shaped mouth sucker, vaginal orifices near the margin of the body, and eggs measuring 200$\mu$ in length with straight prolongations. In other respects it resembles this form, but has no tubercles in the cuticle about the orifice of the mouth sucker. It differs from *S. canis* in that the eggs of that form have two very long, fine filaments, and this too applies to *S. abbreviata.* From *S. grisea*, too, it differs, especially in the size of the eggs, which are there only 175$\mu$ long, while in the present form they measure 320$\mu$ by 120$\mu$.

It seems necessary therefore to separate this as a new species, *S. squali*, with the following characteristics: Parasite of gills of *Squalus acanthias;* 7 to 10 mm. in length; small mouth sucker; simple intestinal prolongation in fixation disk; vaginae separate to vitelline duct; ribbed ootype; eggs with recurved filament at each end.

*Type specimen.*—U.S.N.M. Helm. Coll. No. 8133; paratypes, No. 8134.

### SQUALONCHOCOTYLE ACANTHI, new species

PLATE 1, FIGURE 3

*Specific diagnosis.—Squalonchocotyle:* This form, also found on the gills of *Squalus acanthias*, differs from *S. squali* in several particulars although resembling it in some. It measures 5 mm. in length by 0.8 mm. in breadth. The mouth sucker is small with no flowing margin, the pharynx small, and the intestinal ceca simple with a simple prolongation into the disk. The sucker hooks measure 240$\mu$ from tip to tip (fig. 1, *b*). The small hooklets in the appendix (fig. 1, *b'*) are very narrow and delicate, with long, sharply recurved points, and are quite different, therefore, from those of *S. squali.*

In the available specimens it is impossible to make out the position of the vaginal orifices or the course of the vaginae. The ovary is small and round, without lobulation. The uterus is thin-walled and straight without any distinct ootype. Two eggs were found in one specimen, and these measured 304$\mu$ by 96$\mu$ and may be seen to have a short recurved filament at each end. The genital opening is unarmed and lies just behind the bifurcation of the intestine.

The peculiar characters of this form are summarized as follows: Parasite on gills of *Squalus acanthias;* measurements, 5 mm. by 0.8 mm.; small mouth sucker; uterus without ribbed ootype; hooklets in appendix extremely narrow.

*Type specimen.*—U.S.N.M. Helm. Coll. No. 8135.

### SQUALONCHOCOTYLE SPHYRNAE, new species

PLATE 1, FIGURE 2

*Specific diagnosis.—Squalonchocotyle:* Three specimens of a worm from the gills of *Sphyrna zygaena* (hammerhead shark) show a very different body form from these already described and also differences in several details of body structure. The mouth is very large and sunken in the depth of a large, weak sucker with flowing folded margins, which project a little laterally. It communicates at the bottom of this terminal funnel-shaped structure, which can best be appreciated from the drawing, with a small pharynx. The body, which measures 8 mm. by 0.5 mm., differs from the others in that the appendix, instead of arising at right angles from the main trunk, is merely a prolongation of the fixation disk. This is not an accident of fixation, for it appears plainly in each specimen, and there is a long projection of the intestinal canal, which runs through the fixation disk to enter the appendix, while the shorter branch turns forward to enter the fixation disk and end between two of the suckers. These large suckers have the usual form and their hooks measure 320$\mu$ from tip to tip (fig. 1, $e$). The hooks are unusual in that their points, which bend almost at right angles, are not so sharply marked off from the trunk as in other forms. In the appendix the hooklets are short (48$\mu$) and broadly bifurcated (fig. 1, $e'$). There has been discussion as to the nature of this appendix. Van Beneden thought the excretory ducts opened through the tips of the two branches, and there have been other ideas, but it is quite plain that the appendix branches at its extremity, the branches ending in rather powerful deep suckers, which with the intervening hooklets form a sufficiently strong clinging apparatus. The suckers have no relation with excretory or digestive apparatus. They have a deep conical cavity ending in a circular muscular dilatation.

The genital pore is small, round, and unarmed, and lies in the midline, just behind the bifurcation of the intestine. The two vaginal orifices lie just outside the intestinal ceca at this level. The vaginae are very wide, the orifices have a thick hyaline border, which is then surrounded by a band of cells. The uterus runs a straight course but is drawn into short folds. There are six or seven eggs in the uterus. They are large, measuring 200$\mu$ by 50$\mu$, with filaments at both ends, which are rather stout and about as long as the egg. There is a long, thick-walled, club-shaped cirrus, which lies dorsal to the uterus and opens with it at the genital pore. It is quite sharply marked off from the long, folded vas deferens. The ovary, which is in the middle of the body, is elongated and folded on itself, and there is a thick-walled receptaculum seminis. The testes lie behind the ovary in about 50 small lobules.

The peculiar characters may be summarized as follows: Parasites on gills of *Sphyrna zygaena;* measurements, 8 mm. by 0.5 mm.; appendix as prolongation of fixation disk; intestinal projection in both disk and appendix; hooks smooth, bent at right angle; eggs with stout filament at each end; thick-walled cirrus.

*Type specimen.*—U.S.N.M. Helm. Coll. No. 8136; paratypes No. 8137.

### SQUALONCHOCOTYLE VULGARIS Cerfontaine

PLATE 1, FIGURE 4

This worm, found on the gills of the dusky shark (*Carcharinus milberti*), measures about 5 mm. by 1.5 mm. It is apparently the same as that described by Cerfontaine as found on the gills of *Mustelus vulgaris*, although he mentions its length as 12 mm.

The mouth sucker is large and strong and surrounded by a bell-shaped fold of skin, which is covered with great numbers of minute tubercles, or nodules. Even the edge of the sucker itself is roughened with them. About the esophagus and pharynx there are masses of cells that may act as a salivary gland or even produce a hirudin-like substance. There is a small pharynx, and the intestines, which are filled with a black pigment, are branched on inner and outer surfaces. The pigmented prolongations after the union of the ceca run down into the appendix and the fixation disk.

The hooks of the large suckers measure 320$\mu$ from tip to tip (fig. 1, *d*). The lips of the sucker are edged with tiny teeth and these too, or small tubercles, are scattered over the lining. The small hooklets in the appendix measure about 50$\mu$ in length (fig. 1, *d'*).

The genital pore lies just behind the bifurcation of the intestine. The penis is a pear-shaped mass covered over with minute, red-stained eminences, which seem to be cells and certainly not a chitinous armature. The uterus in every case is enormously distended with a mass of eggs, usually more than a hundred, so that it occupies the whole central part of the body. The eggs are spindle-shaped and measure 200$\mu$ by 56$\mu$. They have a straight filament at each end about as long as the egg. The vaginal orifices are not, as described by Cerfontaine in his *S. vulgaris*, situated far toward the margin of the body, but lie inside the bend of the intestinal ceca. The vaginae run separately to join the vitelline duct. The ovary is large, lobulated, and folded. One can not see a receptaculum seminis on account of the crowding of the overfilled uterus, but it is described by Cerfontaine. There are about 20 testes in the middle of the body.

*Specimens examined.*—U. S. N. M. Helm. Coll. No. 8183.

### SQUALONCHOCOTYLE CANIS Cerfontaine

Parasites apparently identical with those named *S. canis* by Cerfontaine, and found by him on the gills of *Galeus canis*, were found on the gills of *Carcharinus limbatus.*

The worm measures 5 mm. by 2 mm. The mouth sucker is large, with its margin projected forward in the middle and at each side. It is lined with minute teeth, or spicules. The pharynx is small and opens into the intestinal ceca, which are conspicuous from being filled with black pigment, which extends into the branches in the appendix and the fixation disk.

The genital pore lies just behind the bifurcation of the intestine. The uterus contains 8 or 10 eggs, which are fusiform and measure 144$\mu$ by 48$\mu$. They have a long fine filament at each end. The penis is long and cylindrical and undulates to the point where it connects with a thick-walled seminal vesicle, which in turn receives the vas deferens. The testis forms a finely lobulated mass in the posterior part of the body.

The vaginal orifices lie at the level of the genital orifice, just inside the bend of the intestinal ceca. The vaginae are broad, convoluted, and run back separately to the vitelline duct. There is a rather distinct ootype, although the anterior part of the uterus is so greatly distended. The ovary is lobulated and folded on itself, and there is a large receptaculum seminis filled with spermatozoa.

The suckers of the fixation disk are very large; the hooks measure 320$\mu$ from tip to tip and 560$\mu$ over all (fig. 1, *a*). The whole lining shows a fine roughening with tiny spicules. The small hooklets have a broad base with very slight depression between the two rootlets and with a bend or elbow in the shank of the hook (fig. 1, *a'*). This is not quite so marked in these specimens as Cerfontaine described it, but it is quite visible. Nor are the large hooks of the suckers smaller in these specimens than in *S. vulgaris*—indeed these are the largest we have encountered. Still the agreement seems so close that we have little hesitation in believing that this is really *S. canis*.

*Specimens examined.*—U. S. N. M. Helm. Coll. No. 8139–8140.

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