

OTODISTOMUM PLICATUM N. SP. (TREMATODA, DIGENEA)
FROM HEXANCHUS GRISEUS (BONNATERRE)

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An *Otodistomum*, differing in certain respects from the *Otodistomum veliporum* so frequently encountered in *Raja binoculata* at Friday Harbor, Washington, was obtained from the pyloric stomach of a specimen of *Hexanchus griseus* caught there during the summer of 1942. The worms, about one hundred in number, were at once noticeable because of their marked dorso-ventral compression, and because of their extreme variation in size. Living, extended specimens were observed from 10 to 105 mm. in length, with a maximum breadth of about 8 mm. Further study of fixed material has failed to identify these worms with *Otodistomum cestoides*, *O. veliporum*, or *O. pristophorus*; the species recognized in the genus. Accordingly, in spite of the somewhat tenuous distinctions which exist between the reported species it seems advisable tentatively to recognize the worm from *Hexanchus griseus* as distinct and hitherto undescribed. For this species I propose the name *Otodistomum plicatum*.

SPECIFIC DIAGNOSIS

Otodistomum plicatum n. sp.

This is an elongated, dorso-ventrally flattened worm which may exceed 100 mm. in length; with a maximum breadth of 8 mm. It is distinguished from other members of the genus by the possession of an exceptionally large cirrus pouch (1.43-2.36 x 0.84-1.57 mm.); an exceptionally small, compressed ovary (0.45-0.7 x 0.29-0.34 mm.); and an egg of unusual size (0.11 x 0.07 mm.) with a very thick shell (0.0075-0.008 mm.).

Locality: Friday Harbor, Washington.

Host: *Hexanchus griseus* (Bonnaterre).

Location in host: Pyloric stomach.

Type specimen: U. S. N. M. Helminthological Collection No. 36908.

DESCRIPTION

The living worm is elongated, ribbon-like, dorso-ventrally flattened; it is creamy white in color with the region just posterior to the ventral sucker darkened by the brown uterine eggs. Fifty-one fixed specimens varied in length from 8 to 83 mm. (average, 47 mm.) and in breadth from 3 to 7.5 mm. (average, 5.2 mm.). Both large and small worms are, rather constantly, about 1 mm. thick; as much as 1.5 mm. at the level of the egg-filled uterus. The body is covered with folded, smooth cuticle which varies in thickness from 0.03 mm. on a 10 mm. worm to as much as 0.075 mm. on a specimen of 41 mm. As has been reported from other species, the cuticle is much thinned over the suckers; generally not exceeding 0.01 mm. in these areas.

The suckers are large and well-developed, with the oral sucker occasionally partially retracted into a fold of the anterior body. Numerous oblique bands, derived from the longitudinal muscle layer, and occupying the anterior dorsal portion of the body, control its extension and retraction. The ventral sucker extends nearly to the dorsal surface, but may be protruded considerably. The sucker diameter ratio is about 2 : 3; oral sucker from 0.9-1.5 mm., ventral sucker from 1.3-2.4 mm. in diameter.

The alimentary canal possesses no unusual features (Fig. 1). It consists of a buccal opening through the anterior sucker giving immediately on a large, muscular pharynx. This communicates with a pouch-like, thin-walled esophagus which branches laterally, and passes slightly anteriorad to either side of the pharyngeal bulb before giving way to the intestinal crura. The pharynx and esophagus are lined with a structureless membrane which is presumably continuous with the cuticle. The intestinal branches are large, more or less folded, and lined anteriorly with flattened or cuboidal epithelium from which protoplasmic processes extend into the lumen (Fig. 4). Posteriorly, particularly in immature worms, the epithelium is of a tall, columnar form, and two types of cells are present (Fig. 5); ill-defined cells bearing protoplasmic processes, and large, club-like cells filled with granules. The two crura extend almost to the posterior end of the body and may be somewhat unequal in length.

The excretory system resembles that of other members of the genus (Fig. 1). A posterior, terminal, excretory pore opens from a very large vesicle which occupies most of the posterior two-fifths of the body. Anteriorly this bladder is continued by two irregular canals which pass dorsal to the intestinal crura and continue along the lateral margin to the anterior tip of the body. The thin epithelial lining of this entire system is coated with masses of densely staining, globular bodies such as have been reported from a number of trematodes. Flame cells are abundant and widely distributed through the body.

The nervous system has not been studied in detail, but, as far as observed, it conforms to the general pattern of related species.

The organs of the male reproductive system are subject to considerable variation in size. Two testes lie one behind the other just anterior to the middle of the body (Fig. 1). The posterior testis is consistently slightly larger than the anterior (posterior, 23 mm. worm, 1.09 x 0.88 mm., anterior, 0.96 x 0.63 mm.; posterior, 58 mm. worm, 1.43 x 1.39, anterior, 1.35 x 1.31 mm.; posterior, average of ten specimens, 1.17 x 1.05, anterior, 1.08 x 0.99 mm.). From the anterior, median surface of each testicle a thin-walled, convoluted vas deferens, about 0.03 mm. in diameter, passes towards the anterior part of the body. These fuse beneath the anterior border of the ventral sucker, and immediately enter a large cirrus pouch to enlarge into a swollen, comma-shaped, seminal vesicle (Fig. 3). The seminal vesicle is lined by flattened epithelium and surrounded by sparse bundles on longitudinal muscle fibres which are continuous with the outer muscle layer of the ejaculatory duct. This duct arises from the anterior end of the seminal vesicle. It is lined with a low cuboidal epithelium and has both circular and longitudinal muscle layers. After coiling considerably, it emerges from the cirrus pouch near the anterior end, losing its epithelium which is replaced by thin cuticle. The ejaculatory duct terminates within the genital cone where it unites with the uterus before opening through the tip of the cone into the genital atrium. The cirrus pouch is a large, encapsulated, ovoidal structure lying dorsal and anterior to the anterior border of the ventral sucker in the left half of the body. In length it varies from 1.43 mm., in a 23 mm. worm, to 2.36 mm. in a 48 mm. worm; the average is about 1.97 mm. The peripheral portion of the pouch contains many cells similar to those which have been described as prostatic cells; the central portion is largely made up of loose fibres ramifying about the seminal vesicle and its associated ducts. The entire pouch is surrounded by a thin, irregular layer of muscle fibres.

The ovary is small and antero-posteriorly compressed. Size: 0.45 x 0.29 mm. in a 23 mm. worm; 0.7 x 0.34 in a 48 mm. worm; average, 0.61 x 0.30 mm. At most a few dozen developing ova are present at any one time, and a very few primitive oocytes. The organ is invested with a fibrous capsule which, on the anterior surface, is reflected inward to surround the funnel-like beginning of the oviduct (Fig. 7). A peculiar ring of ciliated cells lies on the ovarian side of this

membrane, immediately about the opening of the oviduct (Fig. 8). These possibly aid in directing the mature ovum into the duct.

Initially the oviduct is lined with a flat, pavement epithelium. The posterior portion takes a somewhat tortuous, anterior course and is joined, dorsally, by Laurer's canal and the common yolk duct (Fig. 2). It then enlarges slightly, and its lining changes to cuboidal, apparently ciliated, cells while it is surrounded by a thick layer of Mehlis' glands (Fig. 2, 7). At this point the duct may be considered an ootype. This ootypical portion is thrown into one or two transverse folds before losing its epithelial lining and becoming the membranous, egg-filled uterus.

Laurer's canal passes from its opening in the dorsal body wall to the oviduct along a variable course which typically passes just anterior to the ovary in the mass of loose connective tissue surrounding the ootype and terminates in the portion of the oviduct immediately posterior to the ootype. The common vitelline duct enters the oviduct at approximately the same point. This vitelline duct is the terminal portion of a dorsal yolk reservoir which is partially imbedded in the ootype capsule. The reservoir (Fig. 2) is an irregularly triangular body formed by the fusion of the lateral vitelline ducts which collect material from vitellaria distributed along the surface of the intestinal crura.

Anterior to the ootype the uterus is thrown into a series of transverse folds extending slightly beyond the posterior border of the ventral sucker. The anterior portion of the uterus (Fig. 1) passes dorsad to the right margin of the sucker to emerge ventrad to the median surface of the cirrus pouch in the mid-line of the body where it continues, with few convolutions, to enter the genital cone near its apex. The terminal portion of the uterus forms a strongly muscular metraterm, and well-developed circular and longitudinal muscle layers extend to the point where it fuses with the ejaculatory duct.

Eggs are very numerous and yellowish to dark brown in color. They are about 0.11 x 0.007 mm. in size and are surrounded by an exceptionally thick shell, 0.0075-0.008 mm. in thickness (Fig. 6). No attempt was made to study the intrauterine development of the egg, but the miracidia are apparently well-differentiated in the terminal part of the uterus.

The common portion of the genital apparatus consists of a cone (0.15 x 0.225 mm. in a moderately expanded specimen) in which the genital ducts unite, a genital atrium, and a genital pore. The atrium (Fig. 3) is an elongated chamber extending antero-ventrad from the genital cone to the genital pore. It may be subdivided into two parts: a posterior, enlarged chamber enclosing the genital cone, and an anterior tube terminating at the pore. The whole structure is lined with cuticle which becomes very thin near the tip of the cone. The musculature is complex; a circular layer extends the length of the atrium and is thickened into heavy rings in the wall of the posterior chamber; a number of longitudinal bundles are present, forming an incomplete layer; and fibres from the longitudinal muscles of the body wall extend obliquely to the wall of the anterior tube. These probably function together in the eversion and retraction of the cone. The total length of the atrium approximates a millimeter about equally divided between the two sections; the maximum diameter of the posterior portion is about 0.3 mm. while the anterior portion is half as broad. While the spatial relationships of the parts vary the structural details seem rather constant. Unfortunately no worms were available with the cone everted so that it was impossible to determine what changes in relationship this action would produce. The genital pore lies ventral to the esophagus and just posterior to the pharynx. About its margin the cuticle is thrown into folds which often take the form of small, inwardly directed papillae.

DISCUSSION

The characters by which species of *Otodistomum* are distinguished are far from satisfactory. Between the reported species there is very considerable overlapping

of characters. Yet Manter's careful and detailed study (1926) left him unwilling to disturb the existing taxonomy although, after critical comparison of *Otodistomum cestoides* and *O. veliporum* he ends by finding that, "The most certain distinction is egg size." *O. pristophorus* (Johnston, 1903) is distinguished by its peculiar, coelomic habitat; but, morphologically, Odhner (1911) considered it identical with *O. veliporum*. The confirmation of its coelomic occurrence (Woolcock, 1934) suggests that it is probably specifically distinct.

In comparing *Otodistomum plicatum* with *O. veliporum* collected in the same area, and with published descriptions of *O. veliporum* and *O. cestoides* the condition observed by Manter is evident; the worm is visibly different, but clear-cut, diagnostic characters are few. As he found, the egg size seems to be the most constant character, and this size is considerably above any previously reported in the genus. The ovary is regularly compressed and is smaller than that of comparable specimens of *O. veliporum* which I have examined or of *O. veliporum* and *O. cestoides* as given by Manter. However, the latter's work makes it doubtful that either size or position of gonads can be considered as distinguishing factors in this genus. The genital atrium appears distinctive, but the absence of specimens with everted cones makes it impossible to assess the diagnostic value of this character. The relatively immense cirrus pouch is the most clear-cut point of divergence between *Otodistomum plicatum* and its congeners. This difference appears early; an incompletely mature worm of 14 mm. had already a pouch length of 1.31 mm., i.e., greater than that of the average adult of *O. cestoides* or *O. veliporum* (Manter, 1926). On the basis of these differences, then, if we recognize more than a single species in the genus, *Otodistomum plicatum* must be regarded as specifically distinct.

SUMMARY

A new species of *Otodistomum* is described from *Hexanchus griseus* (Bonnaterre). It is distinguished by unusual size of egg and cirrus pouch.

LITERATURE CITED

- Johnston, S. J. 1903. Contributions to a knowledge of Australian Entozoa. II. On a n. sp. of *Distomum* from the sawfish shark *Pristophorus cirratus* Lath. *Por. Linn. Soc. N. S. Wales*, 27: 326-330.
- Manter, H. W. 1926. Some North American Fish Trematodes. III. *Biol. Mon.*, 10: 2, 3-138.
- Odhner, T. 1911. Zum natürlichen System der digenen Trematoden. IV. *Zool. Anz.*, 38: 513-531.
- Woolcock, V. 1934. Digenetic trematodes from some Australian fishes. *Parasit.*, 27: 309-331.

EXPLANATION OF PLATE

All stated magnifications are those at which the figures were drawn; reduction in reproduction is indicated by a five centimeter line accompanying the plate. The following abbreviations have been used:

A..... genital atrium.	P..... cirrus pouch.
E..... ejaculatory duct.	SV..... seminal vesicle.
L..... Laurer's canal.	U..... uterus.
M..... Mehlis' gland.	VD..... vas deferens.
O..... ootype.	YD..... vitelline duct.
OV..... oviduct.	YR..... yolk reservoir.

- FIG. 1. Ventral view of entire worm. $\times 10$.
- FIG. 2. Reconstruction of the ootype and related structures. The parenchymatous capsulæ has been omitted. $\times 120$.
- FIG. 3. Reconstruction of the terminal genital ducts. $\times 40$.
- FIG. 4. Section through the anterior intestinal wall showing low cells and filamentous processes. $\times 1000$.
- FIG. 5. Section through the posterior intestine of an 11 mm. worm showing two cell types. $\times 1000$.
- FIG. 6. Uterine egg. $\times 200$.
- FIG. 7. Section through the ootype capsule. $\times 200$.
- FIG. 8. Section through beginning of oviduct showing ciliated ring. $\times 1000$.

