

1000
04
301
T73
ms. 3
c. 1

HETEROBOTHRIUM AFFINIS (LINTON) AND ITS POSITION IN THE
SYSTEMATICS OF MONOGENETIC TREMATODES OF THE
FAMILY DICLIDOPHORIDAE (FUHRMANN)

by

L. F. Nagibina

Edited

by

William J. Hargis, Jr.

Translated

by

Pierre C. Oustinoff

TRANSLATION SERIES NO. 3

VIRGINIA INSTITUTE OF MARINE SCIENCE
Gloucester Point, Virginia
1964

Preface
to Translation¹

Translation of this paper was undertaken as part of a long-term research project on the systematics, host-specificity and zoogeography of monogenetic trematodes.² Translation and editing were accomplished in the following manner:

1. Oustinoff³ read translation on tape.
2. Mrs. Morales transcribed translation from tape to first typescript.
3. Hargis edited typescript.
4. Typescript retyped by Mrs. Morales.
5. Hargis again edited typescript for final corrections.

A conscious effort has been made to keep this translation as near the original as possible. It is probably inevitable, however, that some of the nuances of meaning in the original have been distorted or lost. For this we apologize to Dr. Nagibina and the reader.

Certain passages were difficult to translate. Where a different English phrase seems to fit Dr. Nagibina's meaning better or serves to clarify the text, it has been inserted in parentheses with the Latin notation -- nobis-- by us. Certain obvious errors or misspellings in the original text were changed, less obvious ones are noted with (sic).

¹Virginia Institute of Marine Science Translation Series, Number 3.

²Translation and editing supported by funds from Grant No. E-2389 of the National Institutes of Health.

³Chairman, Department of Modern Languages, College of William and Mary, Williamsburg.

For convenience in referring to the Russian text the original pagination is given in the margin of the translation opposite the place where the new page begins. Occasionally figures or tables are somewhat displaced from their original page location; however, since they, themselves, are numbered sequentially, no confusion should result.

The citation of numbers for measurements and numbered structures are generally given in the translation as they were in Dr. Nagibina's paper. This should further facilitate checking with the Russian.

Thanks are due to Mrs. Patricia C. Morales of the Virginia Institute of Marine Science who transcribed, typed, and assembled the manuscript.

William J. Hargis, Jr.
Institute Director and
Dean, School of Marine Science of the
College of William and Mary
in Virginia

L. F. Nagibina

HETEROBOTHRIUM AFFINIS (LINTON) AND ITS POSITION IN THE
SYSTEMATICS OF MONOGENETIC TREMATODES OF THE
FAMILY DICLIDOPHORIDAE (FUHRMANN)

In the summer of 1949 during the expedition to the sea of Okhotsk p137 B. E. Bychowsky discovered 4 specimens of monogenetic trematodes belonging to the family Diclidophoridae on the gills of Atheresthes evermanni (J. et St.). Furthermore, A. P. Andriiashev kindly placed at our disposal his collection of Atheresthes evermanni and A. stomias (J. et Gilb.) from the Bering Sea (southeast of Cape of Naverin) among which we found 8 more specimens of the same parasite.

While establishing the systematic position of these worms we found that they belonged to genus Heterobothrium Cerf. and the species Heterobothrium affinis (Linton).

Thus, Heterobothrium affinis was first found in the Soviet Union on a new host. Only three cases of the discovery of this parasite on the gills of Paralichthys dentatus (L.) (Linton, 1898, 1940; Melugin, 1940) are mentioned in literature.

Because the first description of the species given by Linton (1898) was inaccurate and very short, as was the subsequent description made by Price (1943) from Linton's materials, we found it advisable to make a more detailed study of the morphology of these worms.

The work was conducted under the direction of B. E. Bychowsky. The study was made on whole mounts stained in aluminous carmine and from a series of sections (transverse and sagittal) stained in iron hematoxylin and azocarmine. The graphic method of reconstruction was used to clarify the structure of the sex system. Study of the structure of the clamps of the attaching disc was made from glycerin-gelatin preparations and from transverse sections of the attaching disc and the clamps themselves.

Heterobothrium affinis (Linton, 1898) (Fig. 1).

Syn. Octoplectanum affinis Linton; Diclidophora affinis (Linton) Linton; Choricotyle affinis (Linton) Llewellyn; Dactylocotyle affinis (Linton) Brinkmann.

Large flat worms. The overall length of the body of fixed individuals is 4.5 - 7.0 mm. The sizes of the worms indicated in the works of Linton and Price are exaggerated because the measurements were apparently made on strongly flattened preparations. Two strongly compressed preparations which we have coincide in their measurements with the description of the above-mentioned authors.

p138

The body may be divided into three sharply delineated parts. The anterior part, which occupies more than one-half the entire length of the worm, is widened and has the shape of an elongated oval. Its width, also the widest part of the entire body, equals 1 - 2 mm. The entire sex complex is located in this part. The middle, narrowed part of the body /the peduncle/ is capable of strongly contracting and extending and connects the body with the third part--the attaching disc /posthaptor/. The length of the middle part is 1.2 - 2.0 mm; the width is 0.2 - 0.5 mm. The attaching disc has four pairs of finger-shaped outgrowths /peduncles/ on the ends of which are located the valves or clamps which open ventrally. The length of the attaching disc along the medial line is 1.0 - 1.2 mm; the width is 0.8 - 1.0 mm.

There is a very small appendix or "little tongue", which bears two pairs of "embryonic" hooks and represents a remnant of the embryonic disc, on the posterior end of the disc between the last pair of outgrowths. The length of this appendix is 0.04 - 0.09 mm; the width is 0.06 mm.

The attaching clamps look like /extensions of the/ walls of the finger-shaped outgrowths of the disc which have grown in the shape of two valves. Inside of each clamp there is a chitinous skeleton consisting of 8 separate pieces articulating with each other which supports the muscular walls of the valves of the clamp (Fig. 2,A).

A rather powerful central supporting plate (1), with a curved, irregular form, thickened edges and a thinner middle part which is pierced by small openings lies across the longitudinal axis of the aperture at the bottom of the clamp (Fig. 2, B). One end of the plate is somewhat elevated toward the dorsal valve of the clamp and forms transverse wings which extend in opposite directions. The opposite end of this plate rises along the middle of the ventral valve of the clamp toward its edge.

The second plate (2) is a continuation of the central support which joins the place of the separation of the wings of the plate (1) and rises along the middle of the dorsal valve of the clamp. From the transverse wings of the plate (1) arcs 3 and 3' extend obliquely toward the ventral valve of the clamp. They then extend along the edge of the ventral valve, representing its supporting skeleton, and join the opposite end of plate 1. The supporting arc of the dorsal valve of the clamp consists of two pairs of chitinous pieces (4, 4' and 5, 5'). Pieces 4 and 4' join arcs 3 and 3' departing from them obliquely upward along the dorsal valve of the clamp. At the places of their junction with arcs 3 and 3' there are articular platforms or surfaces which form the mobile joints.

p139

The opposite ends of pieces 5 and 5' extend along the edge of the valve toward each other and join at the free end of plate 2.

For better attachment of the dorsal valve of the clamp there are also, lying at the base of the dorsal valve, supplementary skeletal formations in the shape of a number of thin chitinous "little arcs" which join plate 2 with the transversal wings of plate 1 and parts of arcs 3 and 3'.

At the bottom of the clamp, close to the longitudinal axis of the disc between plate 1 and arc 3, lies a small muscular sucker (6) which displaces the central supporting complex of the clamp slightly toward the side. As the result of this displacement the clamps of the attaching disc are not symmetrical. They are located on the disc in such a way that the clamps of one side of the disc are bilaterally symmetrical /mirror images/ to the clamps of the other half.

The edges of the valve of the clamp are studded with a large number of very small spines which insure a firmer attachment of the parasite.

The central plates (1 and 2) are the place of attachment of the main muscles of the clamp. The muscular cluster, which extends along the ventral side of the finger-shaped outgrowth of the disc, separates into several bands near the clamp. The bulk of these muscular fibers extends toward the central plates and to the sucker, whereas smaller clusters extend toward the edges of the valves.

The central plates (1 and 2) lying across the valves form a U-shaped spring which plays the main role in the mechanism of the action of the clamp. On contraction of the main muscle cluster, which is attached to the middle part of this spring, the latter is drawn inside the clamp, and its edges are drawn close together, in this fashion, the clamp closes, enveloping the gill filaments of the host. On relaxation of the muscles the spring straightens out and opens the valves of the clamp. But the sucker which is located at the bottom of the clamp possibly plays a supplementary role serving to draw the gill filaments to which the animal attaches itself into the opening of the clamp. p140

The digestive system begins with a small buccal funnel located on the ventral side of the body near the anterior edge of the worm. This funnel contains two laterally placed, half oval muscular suckers /buccal suckers/ having a maximum diameter of 0.12 mm. These suckers are characteristic of the highest monogenetic trematodes. An oval muscular pharynx 0.19 - 0.20 mm in length and 0.11 mm in width with a very narrow 3-edged (triangular) opening is located behind the buccal funnel. The intestine divides into two main intestinal trunks which extend along the sides of the body immediately behind the pharynx. Along their entire length are numerous interior and lateral outgrowths. The interior outgrowths of the

intestinal trunks behind the ovary form a thick net of merging branches which extends to the middle narrowed part /peduncle/ of the body. Among the majority of the specimens we examined the intestinal trunks do not branch in the peduncle, although rare anastomoses and outgrowths were observed in this location in scattered individuals. The intestinal trunks merge near the anterior edge of the disc and produce outgrowths branching toward all clamps.

The cephalic ganglion is located dorsal to the pharynx. The ventral pair of nerve trunks passes ventral to the intestinal trunks and produces a very complex interlacing network in the disc, innervating all four pairs of clamps.

The excretory system has not been adequately studied. The contractile bladders open dorsally along the sides of the anterior part of the body approximately at the level of the sex aperture. In sections, strongly curved and anastomosing little branches of excretory canaliculi can be observed throughout the entire body.

The common sex aperture /genital pore/ opens immediately behind the bifurcation of the intestine.

The male sex system is represented by a large number of rounded testes (Fig. 5, 1), lying between the intestinal trunks and their anastomosing interior branches. They begin behind the ovary and occupy almost the entire width of the body, terminating at the level of the transition of the anterior part of the body into the more narrowed middle part /peduncle/. The seminal duct (Fig. 4, A, 5 and Fig. 5, 6) curves anteriorly from the ovary ventrally and then, gradually rising toward the dorsal surface of the body, passes over the uterus. At the level of the sex aperture the seminal duct descends almost vertically toward the ventral surface, and forms a small widening--a seminal bladder (Fig. 4, A, 4), then, piercing the copulatory organ (Fig. 4, A, 3), it enters the sex cloaca /genital atrium/ (Fig. 4, A, 1). The male copulatory organ (Fig. 3 and Fig. 4, A, 3) is a rounded muscular formation measuring 0.09 mm in diameter armed with 12 chitinous hooks. All the hooks are of the same size and are located in a circle around the opening of the ejaculatory seminal canal. They are sickle-shaped with an expanded and sharpened plate shaped like an isosceles triangle. The base of the plate, which corresponds to the handle of the sickle, is larger and embedded in the tissue of the organ, whereas the free, sharpened part is oriented toward the center of the canal. This part of the hook has thickened edges merging and thinning into the point and a thinner middle part curved inward in the shape of a trough. In describing this parasite Linton presented an incorrect picture of the shape of the hooks of the copulatory organ. He stated that the sex aperture consisted of 15 two-branched hooks. The same error was later repeated by certain other authors describing different representatives of the family Diclidophoridae (Cerfontaine, 1895, p. 135, Llewellyn, 1942, p.403).

Goto (1894, p.93) was somewhat more accurate stating that, "the distal part consists of a thin thread and can be represented in the shape of a loop, the free ends of which merge." This error was based on the fact that above-mentioned authors did not notice the trough-shaped curved part of the hook, mistaking its thickened edges for separate parts not joined with each other.

The ovary (Fig. 5, 8) is located in front of the testes and nearer the anterior end of the body. It is strongly extended and folded in the shape of the letter "N". The blind end of the ovary, corresponding to oogonial chamber is located near the median line of the worm. The oviduct (Fig. 4, B, 5 and Fig. 5, 10) extends from the opposite side of the ovary bordering the right (if the subject is examined from the ventral surface) intestinal trunk, and then extends toward the center and then downward along the midline of the body. A large, segmented seminal receptacle opening into the oviduct by a short canal is located to the left of the ovary somewhat closer to the anterior end of the body. The genito-intestinal canal, which opens into the left intestinal trunk, extends almost horizontally from the oviduct and closer to the ventral side of the body beneath the seminal receptacle (Fig. 5, 3). Farther, the oviduct together with a vitelline duct enters the ootype (Fig. 4, B, 2). The latter has a slightly extended pear-shaped form. Numerous glands, represented by two types of cells, enter into it. The uterus (Fig. 4, A, 2 and Fig. 5, 5) curves slightly and extends anteriorly from the ootype. It passes along the ventral side of the body and opens also into the sex cloaca. The vitellaria (Fig. 5, 9) are strongly developed. They start at the level of the sex aperture and extend to the end of the widened portion of the body. The vitellaria join at the midline of the body in front of the ovary. The vitelline duct (Fig. 5, 7) extends in the shape of a wide canal from the place of junction of the vitellaria downward, narrowing gradually, and enters into the ootype next to the oviduct. Transverse vitelline ducts were not observed in the sections. p142

Heterobothrium affinis was described by Linton in 1898 under the name of Octoplectanum affinis. A few specimens discovered in the mouth of Paralichthys dentatus in Woods Hole (state of Mass., U.S.A.), and on preserved fishes of the same species in collections of the National Museum of the United States of America served for the description /of this parasite/. In the list of parasites collected at Woods Hole, Linton (1901) mentioned this same species under the name Diclidophora affinis (Linton).

In 1894 Goto described a species from Tetrodon sp. which was similar to this parasite and which he called Diclidophora tetrodonis. In describing this species Goto indicated that its peculiarity consists in the reverse orientation of the skeleton of the first pair of clamps in the relation to all the others. According to the drawing appended to this description (Goto, 1894, Plate X, Fig. 1), it is apparent that the central plate A in the first pair of clamps is oriented with its wing-shaped end posterior, whereas in the three other pairs the wing-shaped end is oriented anterior (in the relation to the longitudinal axis of the body).

Cerfontaine (1895), attaching great importance to this characteristic, considered it necessary to isolate this species into a special genus, Heterobothrium Cerfontaine, with H. tetrodonis as the type species. Price (1936) transferred D. affinis into genus Heterobothrium without giving any explanations. In 1940 Linton mentioned the second finding of D. affinis in Woods Hole on the same host. Llewellyn (1941b) in his attempt at revision of the family Diclidophoridae Furm. re-established the genus Choricotyle Ben. and Hesse, making Diclidophora Diesing a synonym, and replaced Diclidophoridae Furm. by the family Choricotyliidae Llew. At the same time he named D. affinis, Ch. affinis (Linton). p143

Brinkmann (1942) also revised the family and considered the genus Diclidophora Dies. synonymous with the genus Dactylocotyle Parona and Perugia, changing the name of the family to Dactylocotyliidae Brinkmann. Without having his own material, Brinkmann expressed doubt concerning the systematic position of the described species; at the same time he referred to Pratt (1916), who indicated that the clamps of the worm act as pincers. As the result of this Brinkmann tentatively ascribed this species to the genus Dactylocotyle.

Price (1943) established the new genus Neoheterobothrium, type species N. affinis, and gave a diagnosis which differed from the diagnosis of Heterobothrium only in the characteristic of normal orientation of the first pair of the attaching clamps.

Sproston (1946) liquidated Neoheterobothrium and transferred N. affinis back to Heterobothrium. At the same time Sproston indicated that the characteristic of different orientation of clamps, which is the basis of the diagnosis of the genus established by Cerfontaine, is not significant and because of this she gave a new short description of the basic characteristics of the genus Heterobothrium.

We agree with the conclusions of Sproston and consider that different orientation of clamps cannot be considered as a basic criterion for a genus. There are a number of more important characteristics which really distinguish this genus from other representatives of the family of Diclidophoridae and which were not indicated by Cerfontaine but were correctly noted by Sproston (see below).

Thus, we consider the genus Neoheterobothrium Price non existant because the only characteristic by which it differs from Heterobothrium Cerf. (that is, the reverse orientation of the first pair of clamps) cannot be considered critical.

The species described by Linton in 1898 from Paralichthys dentatus and discovered by us on the gills of Atheresthes evermanni and A. stomias must be attributed to genus Heterobothrium as emended.

In our opinion the diagnosis of the genus must be as follows:

Genus Heterobothrium Cerf.Syn. Neoheterobothrium Price.

Diclidophoridae, in which the body is divided into three parts sharply delineated from each other: a widened anterior part in which the entire sex complex is situated, a narrow middle part /peduncle/ capable of contracting strongly and the attaching disc. The testes are located behind the ovary. The vitellaria are strongly developed in the anterior part of the body but do not extend into its narrowed part. The vagina is absent.

Type species--Heterobothrium tetrodonis (Goto, 1894).

LITERATURE

- Brinkmann, A. I. 1942. On some new and little-known Dactylocotyle species, with a discussion on the relations between, the genus Dactylocotyle and the "family" Diclidophoridae. Got. Mus. Zool., Avd. 92, Got. vit. samh. Handl. Sjatte Foljden., ser. B, 1: 1-32.
- Cerfontaine, P. 1895. Note sur les Diclidophorinae (Cerf.) et description d'une nouvelle espece Diclidophora labracis (Cerf.). Bull. Acad. Belg., Cl. Sci., 30: 125-150.
- Goto, S. 1894. Studies on the ectoparasitic trematodes of Japan. Journ. Coll. Sci. Imp. Univ. Tokio, VIII: 1-273.
- Linton, E. 1898. Notes on trematode parasites of fishes. Proc. U. S. Nat. Mus. 20: 507-548.
- Linton, E. 1940. Trematodes from fishes mainly from the Woods Hole region, Massachusetts. Proc. U. S. Nat. Mus., LXXXVIII: 1-172.
- Llewellyn, J. 1941a. A description of the anatomy of the monogenetic trematode Choricotyle chrisophryi v. Ben. and Hesse. Parasitology, XXXIII: 397-405.
- Llewellyn, J. 1941b. A revision of the monogenean family Diclidophoridae Fuhrmann. Parasitology, XXXIII: 416-430.
- Melugin, J. 1940. Studies on marine fish trematodes of Louisiana. Univ. Bull. Louisiana State Univ., 32: 89.
- Pratt, H. S. 1916. A manual of the common invertebrate animals. Chicago, 1-176p.

- Price, E. W. 1936. North American monogenetic trematodes. Geo. Wash. Univ. Bull. (Summaries of Doctoral Theses, 1934-1936): 10-13.
- Price, E. W. 1943. North American monogenetic trematodes. Journ. Wash. Acad. Sci., XXXIII, 2: 44-54.
- Sproston, N. G. 1946. A synopsis of the monogenetic trematodes. Trans. Zool. Soc. London, XXV, 4: 185-600.

FIGURES

- FIG. 1. Heterobothrium affinis. General view. Vitelline follicles lying behind the intestines on the right side of the body are not shown.
- FIG. 2. Attaching apparatus of Heterobothrium affinis. A--General view of the clamp of the left half of the attaching disc of H. affinis; B--Diagram of the skeletal formations of the clamp of the right half of the attaching disc; 1-5 separate parts of the skeleton; 6-sucker.
- FIG. 3. Copulatory organ of Heterobothrium affinis.
- FIG. 4. Sagittal sections through the sex system of Heterobothrium affinis.
A--terminal portions of male and female sex systems:
1--sex cloaca
2--uterus
3--copulatory organ
4--seminal vesicle
5--seminal duct
B--in the region of the ootype:
1--ovary
2--ootype
3--"shell glands" of two types
4--vitelline follicles
5--oviduct.
- FIG. 5. Sex system of Heterobothrium affinis.
1--testes
2--ootype
3--intestinal-sex canal
4--seminal receptacle
5--uterus
6--seminal duct
7--yolk duct
8--ovary
9--vitelline follicles
10--oviduct.

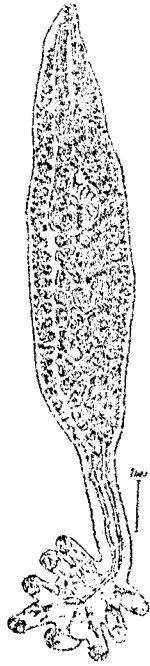


FIG. 1.

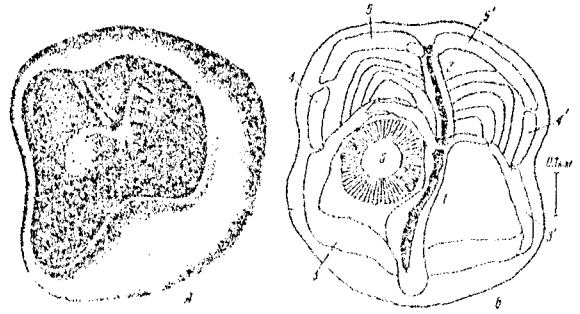


FIG. 2.

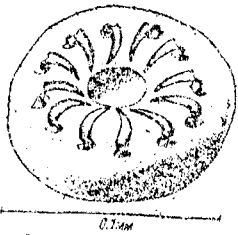


FIG. 3.

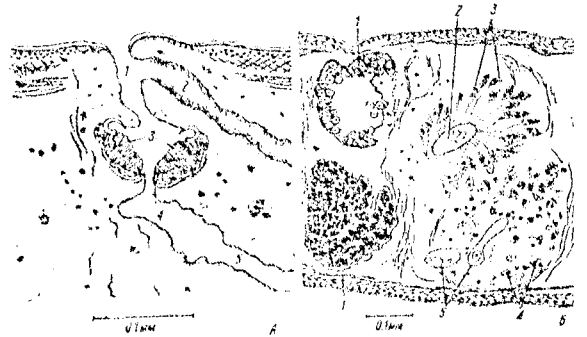


FIG. 4.

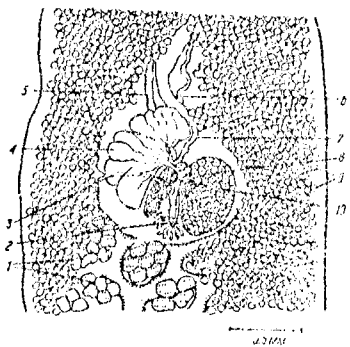


FIG. 5.