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CESTODE PARASITES OF TELEOST FISHES OF THE WOODS HOLE REGION, MASSACHUSETTS

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ONLY those cestodes that pass their adult stage in teleosts are considered in this report. For records of encysted and larval stages of cestodes whose final host is a selachian, see a previous paper of mine.¹ While the encysted stage of selachian cestodes is found in both teleosts and selachians, the encysted stage of teleost cestodes has not been found in selachians. In a few instances teleost cestodes have been found in the stomachs of selachians, but the evidence in such cases pointed to their recent introduction with the food, and the usually more or less macerated condition of the strobilae showed that the selachian could not be regarded as the true final host.

The cestodes of selachian habitats belong to widely different family groups from those passing the adult stage in teleosts. Further, so far at least as their mature cestode parasites may be considered to figure, the groups of selachians and teleosts are as distinct from each other as either of them is distinct from the other classes of vertebrates.

This account is based on collections of the late Vinal N. Edwards, of the United States Bureau of Fisheries, which were made in each month of the year for many years, and upon collections made by me in the summer months over a long series of years at the Woods Hole laboratory of the Bureau of Fisheries. The authority for the scientific names of fishes used is Jordan, Evermann, and Clark's check list.²

* Died June 3, 1939.

¹ Notes on cestode parasites of sharks and skates. *Proc. U. S. Nat. Mus.*, vol. 64, art. 21, pp. 1-114, pls. 1-13, 1924.

² Check list of the fishes and fishlike vertebrates of North and Middle America north of the northern boundary of Venezuela and Colombia. *Rep. U. S. Comm. Fish. for 1928*, pt. 2, 670 pp., 1930.

TABLE 1.—*Teleost cestodes and their hosts, Woods Hole region*

Cestode	Host
<i>Caryophyllaeus terebrans</i> (Linton)-----	<i>Notropis rubrifrons</i> (?).
<i>Glaridacris catostomi</i> Cooper-----	<i>Catostomus commersonii</i> .
<i>Ligula chilomycteri</i> Linton-----	<i>Chilomycterus schoepfi</i> .
<i>Ligula</i> sp-----	<i>Palinurichthys perciformis</i> .
<i>Spathebothrium simplex</i> Linton-----	<i>Liparis liparis</i> , <i>Microgadus tomcod</i> .
<i>Bothrimonus intermedius</i> Cooper-----	<i>Acanthocottus octodecimspinosus</i> , <i>Microgadus tomcod</i> , <i>Morone americana</i> , <i>Tautoga onitis</i> .
<i>Fistulicola plicatus</i> (Rudolphi)-----	<i>Xiphias gladius</i> .
<i>Bothriocephalus scorpii</i> (Müller)-----	<i>Anguilla rostrata</i> , <i>Clupea harengus</i> , <i>Hemirhamphus americanus</i> , <i>Hippoglossus platessoides</i> , <i>Lophius piscatorius</i> , <i>Lophopsetta maculata</i> , <i>Menticirrhus saxatilis</i> , <i>Merluccius bilinearis</i> , <i>Oligoplites saurus</i> , <i>Palinurichthys perciformis</i> , <i>Paralichthys dentatus</i> , <i>P. oblongus</i> , <i>Pollachius virens</i> , <i>Pomolobus pseudoharengus</i> , <i>Poronotus triacanthus</i> , <i>Seriola zonata</i> , <i>Trachurops crumenophthalmus</i> , <i>Urophycis chuss</i> , <i>Zygonectes diaphanus</i> .
<i>Bothriocephalus claviceps</i> (Goeze)-----	<i>Acanthocottus aeneus</i> , <i>A. octodecimspinosus</i> , <i>Apeltes quadracus</i> , <i>Cyclopterus lumpus</i> , <i>Gladiunculus bispinosus</i> , <i>Limanda ferruginea</i> , <i>Pseudopleuronectes americanus</i> .
<i>Bothriocephalus manubriiformis</i> (Linton)-----	<i>Istiophorus americanus</i> .
<i>Bothriocephalus restiformis</i> (Linton)-----	<i>Tylosurus caribbaeus</i> .
<i>Bothriocephalus</i> sp-----	<i>Exocoetus volitans</i> .
<i>Bothriocephalus</i> sp. Immature (plerocerci), usually encysted.	<i>Acanthocottus aeneus</i> , <i>Bairdiella chrysura</i> , <i>Centropristes striatus</i> , <i>Clupea harengus</i> , <i>Decapterus macarellus</i> , <i>D. punctatus</i> , <i>Hemirhamphus americanus</i> , <i>Lagocephalus laevis</i> , <i>Lophopsetta maculata</i> , <i>Menticirrhus saxatilis</i> , <i>Microgadus tomcod</i> , <i>Paralichthys dentatus</i> , <i>P. oblongus</i> , <i>Peprilus paru</i> , <i>Pneumatophorus grex</i> , <i>Pomatomus saltatrix</i> , <i>Pomolobus pseudoharengus</i> , <i>Poronotus triacanthus</i> , <i>Remora remora</i> , <i>Sarda sarda</i> , <i>Scomber scombrus</i> , <i>Seriola lalandi</i> , <i>Sphoeroides maculatus</i> , <i>Stenotomus chrysops</i> , <i>Syngnathus fuscus</i> , <i>Tautoglabrus adspersus</i> , <i>Urophycis chuss</i> .
<i>Cleistobothrium crassiceps</i> (Rudolphi)-----	<i>Fundulus majalis</i> , <i>Hippoglossus hippoglossus</i> , <i>Lophius piscatorius</i> , <i>Merluccius bilinearis</i> , <i>Pomatomus saltatrix</i> , <i>Sphoeroides maculatus</i> , <i>Squalus acanthias</i> , <i>Urophycis chuss</i> , <i>U. tenuis</i> .
<i>Abothrium rugosum</i> (Batsch)-----	<i>Gadus morhua</i> , <i>Melanogrammus aeglefinus</i> , <i>Microgadus tomcod</i> , <i>Pollachius virens</i> , <i>Urophycis tenuis</i> .
<i>Ancistrocephalus microcephalus</i> (Rudolphi)---	<i>Mola mola</i> .
<i>Ancistrocephalus aluterae</i> (Linton)-----	<i>Ceratacanthus schoepfi</i> .
<i>Proteocephalus macrocephalus</i> (Creplin)-----	<i>Anguilla rostrata</i> .
<i>Proteocephalus</i> sp-----	<i>Zygonectes diaphanus</i> .
<i>Corallobothrium fimbriatum</i> Essex-----	<i>Ameiurus nebulosus</i> .

Since this paper is based on material not heretofore reported upon, data that have already been published, relating to habitats, frequency of occurrence, degree of parasitism, and the like, have not been included in the summaries.

Family CARYOPHYLLAEIDAE Leuckart

Genus CARYOPHYLLAEUS Gmelin

CARYOPHYLLAEUS TEREBRANS (Linton)

PLATE 60, FIGURES 1-3

Monobothrium terebrans LINTON, Rep. U. S. Fish Comm. for 1889-91, pp. 548-552, figs. 1-21, 1893 (from *Catostomus ardens*).

Caryophyllaeus terebrans (Linton) HUNTER, Illinois Biol. Mon., vol. 11, pp. 399-408, figs. 1, 30, 31, 51, 72, 1930.

Specimen from *Notropis rubrifrons* (?).—Collected June 14, 1916, by Vinal N. Edwards at Waquoit Bay (U.S.N.M. No. 8852). Maximum length 6 mm., breadth 0.6 mm., thickness 0.3 mm.

Nearly linear, slightly narrowed at anterior end, which is thickish and rounded. The vitellaria, in a specimen 6 mm. long, begin about 0.7 mm. from the anterior end and extend to the posterior end, except where interrupted by the uterus and ovary. The testes, about 25, occupy a relatively broad area along the median region from a point about 0.8 mm. back of the anterior end nearly to the anterior folds of the uterus, a distance of about 4.7 mm. They are surrounded dorsally, ventrally, and laterally by the vitellaria. The many-lobed ovary, 1.25 mm. from the posterior end, appears to be symmetrical and extends from margin to margin. One division of the uterus lies behind the ovary, and another and larger division lies in front of the ovary. Ova 0.039 to 0.048 by 0.03 to 0.039 mm.

In a series of sagittal sections, the cirrus bulb, with the vagina at its posterior border, is seen to lie at the anterior edge of the uterus. The cirrus bulb is only moderately muscular, its length about one-third the thickness of the body. The uterus appears to enter the vagina near the base of the cirrus bulb (pl. 60, fig. 3).

Genus GLARIDACRIS Cooper

GLARIDACRIS CATOSTOMI Cooper

For a full account of this species, see Hunter, 1930.³

Specimens from *Catostomus commersonii*.—Collected on two dates by Vinal N. Edwards:

June 4, 1913—8 specimens, 6 to 17 mm. long in formalin; 25 fishes examined.

May 13, 1914—9 specimens from 4 fishes, 10 to 18 mm. long in formalin; 9 fishes examined.

Ova, average of five, 0.071 by 0.041 mm.; maximum 0.075 by 0.024 mm., minimum 0.069 by 0.039 mm.

U.S.N.M. No. 8853.

³ Hunter, G. W., Illinois Biol. Mon., vol. 11, pp. 419-430, figs. 2, 25, 44, 45, 1930.

Family DIPHYLLOBOTHRIIDAE Lühe

Genus *LIGULA* Bloch

Cooper ⁴ refers all members of this genus to the one species: *Ligula intestinalis* (Linnaeus). Cestodes apparently belonging here have been found in two species of fishes of the Woods Hole region.

LIGULA CHILOMYCTERI Linton

Ligula chilomycteri LINTON, Proc. U. S. Nat. Mus., vol. 19, pp. 788-789, pl. 1, fig. 1, 1897.

From *Chilomycterus schoepfi*.

LIGULA species

PLATE 60, FIGURE 4

Specimen from *Palinurichthys perciformis*.—Collected August 17, 1904; three fragments of strobila, 27, 18, and 10.5 mm. long, respectively; maximum breadth 5.5 mm.; maximum thickness 4 mm.; minimum breadth 2 mm.; from intestine, somewhat macerated. This specimen (U.S.N.M. No. 8854) is represented in the collection by two slides of transverse sections, the median and larger of which measures 3.71 by 2.45 mm. There is a thin layer of delicate longitudinal muscles next to the cuticle, followed in turn by a conspicuous layer of longitudinal muscles surrounding the inner, parenchymatous area. Thickness of cuticle about 0.005 mm., of outer parenchymatous layer 0.63 mm., of longitudinal muscle layer 0.36 mm., of inner parenchymatous area 0.63 mm. The muscle bundles of the conspicuous longitudinal muscle layer are, for the most part, flat and thin; cross sections of larger bundles are about 0.18 by 0.012 mm.

What appears to be a unique feature of these sections is the occurrence of a band of longitudinal muscle fibers at each lateral margin of the inner parenchymatous area extending from the region of the nerve cord to a point corresponding to the marginal limit of the layer of longitudinal muscles. These bundles are more or less elliptical in cross section; dimensions of one of the larger cross sections, 0.06 by 0.021 mm. (pl. 60, fig. 4).

Family CYATHOCEPHALIDAE Nybelin

Genus *SPATHEBOTHRIUM* Linton*SPATHEBOTHRIUM SIMPLEX* Linton

PLATE 60, FIGURE 5

Spathebothrium simplex LINTON, Trans. Amer. Micr. Soc., vol. 41, p. 118-121, pl. 15, 1922 (from *Liparis liparis*).

Specimen from *Microgadus tomcod*.—Collected April 23, 1920, by Vinal N. Edwards (U.S.N.M. No. 8856). Measurements in formalin:

⁴ Illinois Biol. Mon., vol. 4, pp. 306-318, 1919.

Length 34 mm., breadth 2.5 mm., narrowing to 2 mm. at posterior end; without bothria and unsegmented. Measurements in balsam: Length 30 mm., maximum breadth about 2.2 mm., tapering anteriorly, posterior end bluntly rounded. The vitellaria begin 1 mm. from the anterior end and continue to a point about 0.4 mm. from the posterior end. The strobila is mature, the uterus occupying the greater part of the median region, the first ova appearing 1.3 mm. from the anterior end. The ovaries, which have the appearance of clusters of distinct lobes, are crowded by the gravid uterus to one side or other of the median line. The vitellaria lie in an unbroken line along each lateral margin of the strobila. The characteristic sphincter muscle at the orifice of the vagina could be distinguished, but details of cirrus and vagina were masked by the accumulation of ova in the uterus.

Measurements of ova in specimens from *Liparis liparis* and in specimen from *Microgadus tomcod*, about 0.033 by 0.018 mm.

Genus BOTHRIMONUS Duvernoy

BOTHRIMONUS INTERMEDIUS Cooper

PLATE 60, FIGURES 6, 7

Bothrimonus intermedius COOPER, Journ. Parasit., vol. 4, p. 35, 1917; Illinois Biol. Mon., vol. 4, pp. 351-357, figs. 6-8, 45, 81, 94, 1919.

Specimen from Acanthocottus octodecimspinosus.—Collected April 21, 1916, by Vinal N. Edwards; one strobila and fragments (U.S.N.M. No. 8857). Aggregate length in formalin 15 mm., maximum breadth in balsam 0.7 mm., breadth of scolex 0.53 mm.

Specimens from Microgadus tomcod.—Collected by Mr. Edwards on three dates in April in three different years, 1 on one date, 2 on another, and 17 on another. Lengths in formalin 4 to 50 mm., maximum breadth 1.4 mm. in balsam (U.S.N.M. No. 8858).

Specimens from Morone americana.—Collected by Mr. Edwards on two dates in April and one in May (U.S.N.M. No. 8859) in two different years, 1 strobila on date in May, 7 on one of the dates in April, and 51 from one fish on the other April date. Lengths 12 to 53 mm., breadths 0.5 to 2 mm. Measurements of longest strobila in formalin: Length 53 mm., maximum breadth 1.65 mm., at point about 0.5 mm. from posterior end 0.6 mm., scolex length 0.75 mm., breadth 1.35 mm. In formalin scolex opaque, strobila translucent bluish, genitalia ivory white.

Specimens from Tautoga onitis.—Collected by Mr. Edwards on two dates in April, 1 on one date and 2 on the other. Lengths 8, 18, and 20 mm. in formalin, maximum breadth 2 mm. Measurements in balsam: Length 18 mm., breadth (anterior) 0.36 mm., breadth (maximum) 1.31 mm., length of scolex 0.5 mm., breadth 0.67 mm. (U.S.N.M. No. 8860).

Family TRIAENOPHORIDAE Lönnberg

Genus FISTULICOLA Lühe

FISTULICOLA PLICATUS (Rudolphi)

Bothriocephalus plicatus RUDOLPHI, Entozoorum synopsis cui accedunt mantissa . . ., pp. 136, 470, 1819.

Dibothrium plicatum (Rudolphi) LINTON, Rep. U. S. Fish Comm. for 1887, pp. 746-750, pl. 3, figs. 1-6, 1890; Proc. U. S. Nat. Mus., vol. 20, pp. 430-431, 1897; Bull. U. S. Fish Comm., vol. 19, pp. 278, 448, 1901; vol. 31, pt. 2, p. 586, 1911.

Fistulicola plicatus (Rudolphi) COOPER, Illinois Biol. Mon., vol. 4, pp. 377-380, 1919.

Specimens from Xiphias gladius.—My record shows that 13 swordfishes were examined for Entozoa on seven dates in July in five different years, and this cestode was present in practically every one, 1 to 9 strobilae present in each, 44 in all. The smallest strobila noted measured 22 mm. in length and 1.5 mm. in breadth; the largest 240 mm. in length and 12 to 15 mm. in breadth throughout the greater part of the length. The greatest breadth noted in any strobila was 20 mm. (U.S.N.M. No. 8861).

The usual habitat of this cestode is the rectum of the host. The younger specimens are simply attached to the mucous membrane and are easily detached. The older strobilae are, as a rule, permanently affixed, the anterior ends penetrating the intestinal wall. Thus, in an example collected July 13, 1911, it was noted that the part that lay free in the rectum of the host measured 70 mm. in length and 11 mm. in maximum breadth. The anterior end of the strobila, after passing through the intestinal wall, continued in an elongated encysted portion in the body cavity. When dissected out, this portion, which had a diameter of 1 mm. in the intestinal wall and 1.5 to 3 mm. in the portion that lay in the body cavity, measured 90 mm. long. It was not complete, since a portion had been cut off and left in the fish when the viscera were removed.

Cooper (loc. cit., p. 380) records one specimen in the collection of the University of Illinois, taken by Vinal N. Edwards from *Mola mola* at Woods Hole.

Genus ANCISTROCEPHALUS Lühe

ANCISTROCEPHALUS MICROCEPHALUS (Rudolphi)

Dibothrium microcephalum Rudolphi, LINTON, Rep. U. S. Fish Comm. for 1887, pp. 736-745, pl. 2, figs. 5-18, 1890; Bull. U. S. Fish Comm., vol. 19, pp. 282, 465, 1901; Bull. U. S. Bur. Fish., vol. 31, p. 586, 1911.

Ancistrocephalus microcephalus (Rudolphi) LINTON, Fisheries and marine biological survey, Union of South Africa, Rep. No. 3, for 1922, pp. 12, 13, figs. 35-40, 1924.

For references to literature see Stiles and Hassall, Hyg. Lab. U. S. Public Health Serv. Bull. 85, pp. 101, 102, 198 (*Ancistrocephalus microcephalus*, *Ancistro-*

cephalus microcephalus, and *Dibothrium microcephalum*), 1912; for correct spelling of generic name see Lühe, Centralbl. Bakt. Parasit., vol. 27, p. 209, 1900.

Specimens from Mola mola.—Three sunfishes have been examined for Entozoa since the last report was made. The first and third of these came from a trap at Menemsha Bight, the second from a trap at Buzzards Bay, near Woods Hole. Each had been kept alive in the Bureau of Fisheries pool for about a week. Cestodes of this species found as follows:

September 23, 1923: 7 strobilae, young and adult, and a few fragments from intestine. Straightened in 70 percent alcohol the strobilae relaxed and became longer than they had been in sea water. The two largest measured: Lengths 725 and 650 mm., breadths 8 and 9 mm. (U.S.N.M. No. 8903).

July 19, 1926: 9 from anterior end of alimentary canal; maximum length 350 mm., minimum 30 mm.; all immature.

July 13, 1927: 28 slender, immature, most of them in a tangled mass.

ANCISTROCEPHALUS ALUTERAE (Linton)

PLATE 62, FIGURES 20-22

Dibothrium aluterae LINTON, Rep. U. S. Fish Comm. for 1886, pp. 458-459, pl. 1, figs. 5-8, 1889; Bull. U. S. Fish Comm., vol. 19, p. 464, 1901.—STILES and HASSALL, Hyg. Lab. U. S. Public Health Serv. Bull. 85, p. 196, 1912.

Specimens from Ceratacanthus schoepfi.—Five strobilae collected July 28, 1920, from intestine of one fish examined; maximum length 115 mm. These strobilae appeared to be immature, but transverse sections, 200 or more, contained sections of three ova, the largest of which measured 0.072 by 0.042 mm. The testes in these sections are conspicuous, 0.06 to 0.09 mm. in greatest diameter, with developed sperm. The aperture of the cirrus and vagina is marginal (U.S.N.M. No. 8904).

Larval stage (pl. 62, fig. 22): Plerocerci (U.S.N.M. No. 8905), presumably of this species, are of frequent occurrence in the filefish, encysted, sometimes free, usually in enormous numbers, especially in the walls of the stomach and intestine, but also often in the muscular tissue in all parts of the body, in the kidneys and on the viscera generally, in the pericardial cavity, and on the outside of the ventricle.

Thirteen filefishes were examined on four dates in July, eight in August, and one in September in 11 different years. To these may be added the intestine of a filefish containing numerous encysted plerocerci that was brought to my laboratory by Dr. E. B. Krumbhaar on August 17, 1929.

Following are a few extracts from notes made at the time of collecting Entozoa from the filefish:

Numerous in wall of stomach and intestine, contractile, 1 to 3 mm., numerous coarse granules in parenchyma, characteristic vase shape when at rest or under pressure.

Very numerous, some encysted, some free, serous coat of stomach and intestine, mostly slender, chalky white, very contractile.

Numerous in walls of stomach and intestine and muscles in vicinity of backbone.

July 28, 1920: Filefish, 30 cm. long, in very poor condition. A large number of transparent cysts on the viscera, approximating in bulk that of the viscera proper (see Proc. U. S. Nat. Mus., vol. 64, art. 21, p. 79, 1924). The muscular tissue in all parts of the body was peppered thickly with these plerocerci. Surrounding many of the larvae in the muscle tissue were thickish cysts that yielded bubbles with acid. Larvae very active wavelike enlargements beginning at anterior end and passing to posterior end. Length variable, extending to 4 mm. or more, in which case they became very thin, 0.03 to 0.05 mm. in breadth. These cysts were very abundant in the wall of the alimentary canal, especially on and in the wall of the esophagus.

Family PTYCHOBOTHRIIDAE Lühe

Genus BOTHRIOCEPHALUS Rudolphi

BOTHRIOCEPHALUS SCORPII (Müller)

PLATE 60, FIGURE 8; PLATE 61, FIGURES 9, 10

An extensive synonymy of *B. scorpii* is given in Cooper's account of the species: Illinois Biol. Mon., vol. 4, pp. 384-400, 1919.

Cestodes belonging to the genus *Bothriocephalus* and referable to *B. scorpii* or *B. claviceps* were found in many species of fishes of the Woods Hole region.

When, on account of the immaturity of the strobila or the unsatisfactory condition of the material, determination of the species depended upon the character of the scolex and of the anterior portion of the strobila, those with more or less elongate scolex, bothria shallow posteriorly, first segments slender, and usually as long as or longer than broad were referred to *scorpii*. Those with scolex variously contracted, usually short and broad, bothria extending to base of scolex, and first segments crowded together and much broader than long were referred to *claviceps*.

Specimens from Anguilla rostrata.—Collected on three dates in July and one in November, 1 to 9 strobilae on each date. Maximum length in alcohol 175 mm., maximum breadth 2 mm. (U.S.N.M. No. 8862).

Measurements in balsam

Scolex:			
Length.....	0. 65	1. 33	1. 05
Maximum breadth.....	. 19	. 30	. 35
First segment:			
Length.....	. 12	. 14	. 28
Breadth.....	. 12	. 25	. 11
Ova.....	. 05	. 054	. 062
	by . 03	by . 036	by . 032

Specimen from Clupea harengus.—One immature (U.S.N.M. No. 8863) collected May 11, 1916; segments not yet developed; scolex in balsam, length 1.05 mm., maximum breadth 0.21 mm.

Specimens from Hemitripterus americanus.—Cestodes (U.S.N.M. No. 8864) referred to this species were collected on two dates in January, one in February, two in April, eight in May, four in June, two in July, three in October, five in November, and three in December in 13 different years. Sixty-one fishes were examined on 32 dates, and this cestode was found in 46 of them on 30 of the 32 dates. All examinations, except those of July, were made by Vinal N. Edwards. In January he examined seven fishes and noted: "Worms in all, some of them 5 feet long." In one bottle that contains worms from one fish collected in January there were 14 strobilae with scoleces, maximum length 700 mm. On another date 3 strobilae were found in one fish, aggregate length 300 mm., maximum breadth 4.5 mm. On one date in February five fishes were examined, and Mr. Edwards noted: "Stomach contained tautog and cunners, very many tape-worms, some 6 feet when stretched." In a bottle containing worms from one fish collected on this date there were 43 strobilae, which, together with fragments, aggregated a total length of 1,223.5 cm., or 40 feet.

On one date in April three fishes yielded 6 strobilae, maximum length 540 mm., aggregate length 156.5 cm.; from one fish on another date fragments of strobilae were obtained aggregating 354 mm. in length. In May nine fishes were examined, each on a different date and in seven different years. One to three strobilae were found on each of eight dates, maximum length 1,045 mm., maximum breadth 5 mm. On one date 210 strobilae were collected from one fish, maximum length 175 mm., maximum breadth 2 mm., a very few with ripe segments.

In June, fishes were examined on three dates in different years, one fish on each date. Three strobilae were found on one date and one on each of the others, maximum length 500 mm., aggregate length 2,490 mm.

In July, two fishes were examined on different dates in different years. Several cestodes were obtained on one date and one on the other, maximum length 250 mm., maximum breadth 2 mm.

In October, six fishes were examined in separate years. Two strobilae from one fish, aggregate length 945 mm., maximum breadth 2 mm.; no ripe segments. Two strobilae and a fragment from one fish, maximum length 115 mm. Three strobilae from four fishes, maximum length 440 mm., maximum breadth 6.5 mm.

In November, 17 fishes were examined on five dates in three different years: (1) Two from one fish, length 155 and 215 mm., breadth 1.5 and 6.3 mm.; (2) eight fishes, one from one fish and four and fragments from others, maximum length 275 mm., maximum breadth 3.5 to 5 mm.; (3) one from one fish, length 290 mm., breadth 3.25 mm.; (4) three and fragments from three fishes, maximum length 630 mm., aggregate length 234.2 cm.; (5) one and fragments from four fishes, maximum length 272 mm., aggregate length 850 mm.

In December, seven fishes were examined on three dates: (1) Fragments aggregating 151 mm. from three fishes, breadth 2 mm.; (2) three from three fishes, lengths 182, 210, and 652 mm., maximum breadth 4.5 mm., and two small slender strobilae, lengths 35 and 58 mm., maximum breadth 0.5 mm.; (3) 11 strobilae with scoleces and fragments from one fish, aggregating 265 cm.; largest strobila, nearly linear, length 435 mm., maximum breadth 3 mm.

Cross sections of these cestodes from the sea raven show the longitudinal muscles to be fascicled. Ova 0.066 to 0.072 mm. by 0.033 to 0.039 mm., average of ten 0.067 by 0.037 mm.

Specimens from Hippoglossus platessoides.—The only record I have of these cestodes from the sand-dab is that of two strobilae, lengths 100 and 64 mm., maximum breadth 3 mm., collected by Mr. Edwards on November 12, 1898 (U.S.N.M. No. 8865). There are, however, in the collection three scoleces mounted in balsam and a series of sections. The scoleces agree with *B. scorpii*; the first segments are a little broader than long. Measurements in balsam: Scolex, length 1.29 mm., breadth 0.28 mm.; first segment length 0.15 mm., anterior breadth 0.24 mm., posterior 0.29 mm. Ova 0.054 to 0.066 mm. by 0.03 to 0.036 mm. (pl. 61, fig. 9).

Specimens from Lophius piscatorius.—Collected May 6, 1913, by Vinal N. Edwards from seven fishes examined, two strobilae. Lengths 90 and 130 mm., maximum breadth 3 mm.

Specimens from Lophopsetta maculata.—I have recorded this species under the name *Dibothrium punctatum* (Rudolphi) from this fish previously.⁵

My unpublished records show that 140 windowpanes have been examined for Entozoa on 54 dates in 14 different years. This cestode was found on one date each in June, July, September, October, and

⁵ Rep. U. S. Fish Comm. for 1887, pp. 731-736, pl. 2, figs. 1-4, 1890; Proc. U. S. Nat. Mus., vol. 20, p. 430, 1897; Bull. U. S. Bur. Fish., vol. 31, pt. 2, p. 586, 1911.

November in 8 different years. Examinations were made in every month of the year except March and December. The collection consisted of 12 strobilae and fragments. Maximum length 360 mm., maximum breadth 2.5 mm. Measurements in balsam: Scolex length 2.52 mm., breadth 0.36 mm.; first segment length 0.28 mm., anterior breadth 0.14 mm., posterior 0.21 mm. Ova 0.054 to 0.06 mm. by 0.03 to 0.033 mm. (U.S.N.M. No. 8866).

Specimens from Menticirrhus saxatilis.—Immature strobilae (U.S. N.M. No. 8867) collected on four occasions are here recorded. June 29, 1910, many from one fish; June 19, 1910, three; July 21, 1910, ten; July 21, 1926, one, length 8 mm. Maximum length in balsam 35 mm., maximum breadth 0.56 mm. (pl. 60, fig. 8).

Measurements in balsam

Scolex:				
Length.....	1. 96	1. 68	1. 19	1. 54
Breadth.....	. 28	. 25	. 22	. 22
First segment:				
Length.....	. 49	. 24	. 32	. 18
Breadth.....	. 14	. 24	. 25	. 14

Specimens from Merluccius bilinearis.—I have recorded this species under the name *Dibothrium angustatum* (Rudolphi) previously from this fish⁶ (U.S.N.M. No. 8868).

Specimens from Oligoplites saurus.—Four small immature strobilae were taken from one fish July 14, 1924. Measurements in balsam: Length 7 mm.; breadth 0.31 mm.; scolex length 1.4 mm., breadth of terminal disk 0.14 mm., near anterior end 0.2 mm., near posterior end 0.13 mm., at posterior end 0.14 mm.; first segment length 0.14 mm., anterior breadth 0.14 mm., posterior 0.15 mm. (U.S.N.M. No. 8869).

Specimens from Palinurichthys perciformis.—Recorded from this fish by me under the name *Dibothrium punctatum* (Rudolphi).⁷ It has also been recorded from Woods Hole by Cooper.⁸ Two slender immature specimens were taken from this fish on August 17, 1904; maximum length 115 mm., maximum breadth 1.6 mm.; most of the segments longer than broad (U.S.N.M. No. 8870). Also two, each about 12 mm. long, segments irregular, on August 20, 1910.

Specimens from Paralichthys dentatus.—This species under the name *Dibothrium punctatum* (Rudolphi) has been recorded by me⁷ and by Cooper.⁸ It was collected on three dates in August in two different years. On one date the record is one and fragments; on another, one, length 40 mm.; and on the other, one, length not given. Fragments, apparently of the same strobila, have an aggregate length of 150 mm.; maximum breadth 3 mm.; first segments slender, longer than wide; ova 0.06 by 0.03 mm. (pl. 61, fig. 10) (U.S.N.M. No. 8871).

⁶ Bull. U. S. Fish Comm., vol. 19, p. 474, fig. 269, 1901; Bull. U. S. Bur. Fish., vol. 31, pt. 2, p. 585, 1911.

⁷ Bull. U. S. Bur. Fish., vol. 31, p. 586, 1911.

⁸ Illinois Biol. Mon., vol. 4, p. 387, 1919.

Specimens from Paralichthys oblongus.—Specimens from this fish have been recorded by me⁹ under the name *Dibothrium punctatum* (Rudolphi).

Collected on one date in May, four in June, three in August, in six different years; 17 strobilae obtained, maximum length noted 70 mm. One of the two slides in the collection contains two scoleces and fragments of immature strobilae aggregating a length of 85 mm., maximum breadth 0.77 mm.; scoleces, lengths 1.33 and 1.61 mm., breadths 0.22 and 0.26 mm.; first segments, lengths 0.3 and 0.24 mm., breadths 0.16 and 0.17 mm. The other slide contains one scolex and fragments evidently belonging to the same strobila, total length 65 mm., maximum breadth 3 mm.; scolex length 2.31 mm., breadth 0.34 mm.; first segment length 0.21 mm., anterior breadth 0.33 mm., posterior 0.42 mm.; ova 0.064 to 0.06 by 0.03 to 0.033 mm. (U.S.N.M. No. 8872).

Specimens from Pollachius virens.—Collected August 19, 1908, one scolex and fragments of strobila, 10 and 25 mm. long, breadth 0.4 mm.; scolex length 0.7, breadth 0.28 mm.

Specimen from Pomolobus pseudoharengus.—One immature collected November 3, 1913. Length in formalin 14 mm.; scolex length 2.15 mm., breadth anterior 0.19 mm., maximum 0.52 mm., at base 0.21 mm.; first segment length 0.6 mm., breadth 0.25 mm.; length of scolex in balsam 2 mm. The segments show a tendency to divide at middle of length (U.S.N.M. No. 8873).

Specimens from Poronotus triacanthus.—Previously recorded from this fish by me under the name *Dibothrium angustatum* (Rudolphi).¹⁰

Specimens from Seriola zonata.—Immature strobilae collected September 16, 1913, lengths 2, 16, and 22 mm. in formalin (U.S.N.M. No. 8874).

Measurements

Scolex:		
Length	1. 19	1. 50
Breadth	. 21	. 28
First segment:		
Length	. 28	. 18
Breadth	. 08	. 14
Average length of first 5 segments	. 11	. 21

Specimens from Trachurops crumenophthalmus.—Recorded from this fish as *Dibothrium punctatum* (Rudolphi) by me¹¹ and by Cooper.¹²

Collected on two dates in August, four in September (U.S.N.M. No. 8875), and one in October, 1 to 12 on each date; immature strobilae with elongate scolex, segments usually longer than wide, associated with vase-shaped plerocerci. Measurements in balsam:

⁹ Bull. U. S. Fish Comm., vol. 19, p. 484, 1901; Bull. U. S. Bur. Fish., vol. 31, p. 586, 1911.

¹⁰ Bull. U. S. Fish. Comm., vol. 19, p. 454, 1901; Bull. U. S. Bur. Fish., vol. 31, p. 585, 1911.

¹¹ Bull. U. S. Fish Comm., vol. 31, p. 586, 1911.

¹² Illinois Biol. Mon., vol. 4, p. 388, 1919.

Scolex length 1.54 mm., breadth 0.25 mm.; first segments, average of five, length 0.41 mm., breadth of fifth segment 0.22 mm.; another scolex, length 1.65 mm., anterior breadth 0.19 mm., middle 0.3 mm., base 0.018 mm.

Specimens from Urophycis chuss.—Recorded from this fish under the name *Dibothrium punctatum* (Rudolphi) by me ¹³ and by Cooper.¹⁴ A large number of hakes were examined by Edwards through a long series of years. Cestodes here noted were collected on 26 dates in nine different years: 14 on seven dates in May, 81 fishes examined; 1 on one date in June, 10 fishes examined; 5 on three dates in August, 14 fishes examined; 23 on seven dates in October, 44 fishes examined; 11 on eight dates in November, 195 fishes examined. The largest number recorded from one fish is eight. Largest strobila, length 108 mm., breadth 2 mm. In most cases the strobilae were immature. In one specimen, collected October 3, 1915, mounted in balsam, length 32 mm., breadth 1.6 mm., there are segments with ova, 0.06 by 0.03 mm. Measurements in balsam: Scolex length 1.33 mm., breadth, marginal view, 0.28 mm.; first segment length 0.28 mm., anterior breadth 0.15 mm., posterior 0.19 mm. (U.S.N.M. No. 8876).

Specimens from Zygonectes diaphanus.—Two collected August 22, 1916, lengths 6 and 12 mm. Measurements in balsam: Scolex length 0.7 mm., breadth 0.22 mm., anterior disk 0.21 mm.; first segment length 0.15 mm., anterior breadth 0.14 mm., posterior 0.18 mm.; posterior segments, average length of eight, 0.42 mm., breadth 1 mm.; ova 0.048 to 0.057 by 0.03 to 0.036 mm. (U.S.N.M. No. 8877).

BOTHRIOCEPHALUS CLAVICEPS (Goeze)

PLATE 61, FIGURES 11-13

For full account of this species, including synonymy, see Cooper, Illinois Biol. Mon., vol. 4, pp. 402-410, 1919.

To this species are referred cestodes of the genus that are characterized by having the first segments usually crowded and much broader than long, with the scolex assuming a variety of shapes from elongate to nearly spherical, the bothrial pits extending to the base of the scolex. The ova are thin-shelled and often collapsed and show but faintly through the body wall, in contrast with *B. scorpii*, in which the shells of the ova are thicker, the masses of ova showing as dark-brown blotches in strobilae with ripe segments.

Specimens from Acanthocottus aeneus.—Recorded by me ¹⁵ from this fish under the name *Dibothrium punctatum* (Rudolphi).

A large number of sculpins were examined for Entozoa over a long series of years. Cestodes of this species were found on 20 dates in

¹³ Bull. U. S. Bur. Fish., vol. 31, p. 586, 1911.

¹⁴ Illinois Biol. Mon., vol. 4, p. 388, 1919.

¹⁵ Bull. U. S. Bur. Fish., vol. 31, p. 586, 1911.

January, when 335 fishes were examined and 64 strobilae found; on five dates in February, 40 fishes examined, 10 strobilae; four dates in March, 110 fishes, 10 strobilae; four dates in April, 110 fishes, 16 strobilae; four dates in May, 45 fishes, 11 strobilae; one date in June, one fish, 6 strobilae; one date in July, 1 fish, 3 strobilae; one date in October, 20 fishes, 3 strobilae; two dates in November, 9 fishes, 5 strobilae; 11 dates in December, 649 fishes, 54 strobilae. On a few dates the number of fishes was not recorded, in which cases one fish was counted.

Maximum length noted 300 mm., maximum breadth 5 mm. Measurements of four scoleces in formalin:

Length	Breadth
0. 70	0. 38
. 52	. 48
. 38	. 34
. 35	. 35

Ova thin-shelled, many collapsed, 0.072 by 0.042 mm. (U.S.N.M. No. 8878).

Specimen from Acanthocottus octodecimspinosus.—Recorded by me ¹⁵ from this fish under the name *Dibothrium punctatum* (Rudolphi).

The common sculpin was examined for Entozoa by Edwards on many dates over a long series of years. On a few dates the number of fishes examined was not recorded. In such cases one fish was counted in preparing the following summary. The record then shows that 7 fishes were examined in January on three dates; 6 in February on one date; 10 in March on two dates; 182 in April on 32 dates; 70 in May on 17 dates; 5 in June on one date; one in July on one date; 767 in October on 39 dates; 846 in November on 45 dates; 32 in December on five dates.

Following is a summary of collections of cestodes (U.S.N.M. No. 8879) made by Edwards from this fish: 2 on one date in February, 6 fishes examined; 6 on two dates in March, 10 fishes; 50 on 20 dates in April, 123 fishes; 15 on eight dates in May, 52 fishes; 12 on 10 dates in October, 436 fishes; 20 on 12 dates in November, 251 fishes; 3 on two dates in December, 23 fishes.

Strobilae with ripe segments were found in all the months in which these cestodes were collected except January. Following are the maximum measurements of strobilae noted:

	Length	Breadth
February.....	160	4
March.....	235	4. 5
April.....	375	6. 55
May.....	86	(Not recorded.)
October.....	170	4. 25
November.....	115	4
December.....	275	4

¹⁵ Bull. U. S. Bur. Fish., vol. 31, p. 586, 1911.

There is considerable variation in the proportions of the scolex. Thus, the length, breadth, and thickness of two in formalin were 0.75, 0.72, 0.55 and 0.9, 0.97, 0.73 mm.; another in glycerin: Length 1.65, breadth 0.43 mm. Following are lengths and breadths of scoleces in balsam: 0.3 by 0.19, 0.31 by 0.25, 0.42 by 0.28, 0.5 by 0.32, 0.5 by 0.36, 0.7 by 0.38, 0.98 by 0.28, 1.4 by 0.28, 1.7 by 0.25 mm. Measurements of the first segment in a typical strobila: Length 0.07 mm., breadth 0.56 mm. In an immature strobila with maximum breadth about 1 mm., the length of the first segment was 0.15 mm., anterior breadth 0.22 mm., posterior 0.35 mm. Ova thin-shelled and in most cases collapsed in sections and balsam mounts; average of 10: 0.068 by 0.039 mm.; largest 0.075 by 0.045 mm.; smallest 0.06 by 0.036 mm.

Specimen from Apeltes quadracus.—One collected April 21, 1911; 12 fishes examined. Length in formalin 31 mm., breadth 2.8 mm. Measurements in balsam: Length 16 mm., breadth 2.4 mm.; scolex length 0.84 mm., anterior breadth 0.24 mm., posterior 0.35 mm.; first segment length 0.24 mm., anterior 0.48 mm., posterior 0.58 mm.; ova thin-shelled, average of 19: 0.063 by 0.036 mm. (U.S.N.M. No. 8880).

Specimen from Cyclopterus lumpus.—One collected May 6, 1913; 7 fishes examined. Length in formalin 90 mm. Measurements in balsam: Scolex length 0.6 mm., thickness 0.3 mm.; first segment length 0.06 mm., breadth 0.24 mm.; posterior segments, length 0.56 mm., breadth 1.4 mm.; median segments, length 0.21 mm., breadth 1.96 mm.; ova 0.054 by 0.03 (pl. 61, fig. 13) (U.S.N.M. No. 8881).

Specimens from Gladiunculus bispinosus.—Recorded from this fish by Cooper.¹⁶

Cestodes (U.S.N.M. No. 8882) referred to this species were collected by Edwards from the stickleback as follows: April: 12 on four dates, 450 fishes examined; 23 on two dates, number of fishes examined not recorded. May: 7 on two dates, 120 fishes examined; 25 on three dates, number of fishes examined not recorded. June: 4 on two dates, 80 fishes examined; 1 on one date, number of fishes examined not recorded. Collections made in five different years. Maximum length 75 mm., maximum breadth 2.7 mm. Scoleces elongate to very short; bothrial pits extend to base of scolex; first segments, except in immature strobilae, short, crowded, much broader than long. Ova thin-shelled, about 0.51 to 0.63 by 0.3 to 0.42 mm.

Measurements in balsam: Length 18 mm.; maximum breadth 2.1 mm.; scolex length 0.21 mm., breadth 0.28 mm.; first segment length 0.08 mm., breadth 0.35 mm.; last segment length 0.28 mm., breadth 0.91 mm.; ova 0.051 by 0.033 mm. Ova appear about 4.27 mm. from anterior end.

¹⁶ Illinois Biol. Mon., vol. 4, p. 404, 1919.

Specimens from *Limanda ferruginea*.—Recorded previously by me ¹⁷ from this fish under the name *Dibothrium punctatum* (Rudolphi).

Four strobilae and fragments collected December 10, 1904, from three of five fishes examined; length of longest 72 mm., maximum breadth 5 mm. Three collected April 19, 1910, by Vinal N. Edwards from two fishes examined (worms in each); maximum length 133 mm., breadth 4.5 mm.

Measurements in balsam: Scolex length 1.68 mm., maximum breadth 0.55 mm.; first segment length 0.07 mm., breadth 0.6 mm.; ova 0.06 to 0.072 by 0.033 to 0.039 mm.; average of 10: 0.065 by 0.036 mm. (pl. 61, fig. 11) (U.S.N.M. No. 8883).

Specimens from *Pseudopleuronectes americanus*.—Recorded by me ¹⁸ from this fish under the name *Dibothrium punctatum* (Rudolphi).

Collected from the winter flounder on one date in January, two fishes examined, one strobila, immature, length 7 mm.; 8 on six dates in February, 92 fishes examined, maximum length 80 mm.; 2 on one date in April, 2 fishes examined, maximum length 60 mm.; 1 on one date in August, 7 fishes examined, length 84 mm.; 1 on two dates in December, 14 fishes examined, length 267 mm. Collections, except in August, by Vinal N. Edwards.

Measurements in balsam: Scolex length 0.6 mm., anterior breadth 0.22 mm., middle 0.3 mm.; first segment length 0.14 mm., breadth 0.66 mm.; posterior segment length 0.21 mm., breadth 2.24 mm.; ova, average of 10 sections, 0.069 by 0.034 mm. (pl. 61, fig. 12) U.S.N.M. No. 8884).

BOTHRIOCEPHALUS MANUBRIFORMIS (Linton)

Dibothrium manubriforme LINTON, Rep. U. S. Fish Comm. for 1886, pp. 456–458, pl. 1, figs. 1–4, 1889 (from *Tetrapterus albidus*); Rep. U. S. Fish Comm. for 1887, pp. 728–731, 1890 (from *T. albidus* and *Histiophorus gladius*); Proc. U. S. Nat. Mus., vol. 20, p. 429, 1897 (from *Tetrapterus*); Bull. U. S. Fish Comm., vol. 19, pp. 447–448, 1901; Bull. U. S. Bur. Fish., vol. 31, p. 586, 1911 (from *Istiophorus nigricans* and *T. imperator*).

Bothriocephalus manubriiformis (Linton) ARIOLA, Arch. Parasit., vol. 3, p. 410, 1900.—COOPER, Illinois Biol. Mon., vol. 4, pp. 421–433, 1919.

Specimens from *Istiophorus americanus* ¹⁹.—Fifty strobilae, young and adult, collected August 17, 1913, by Dr. G. A. MacCallum; 77 strobilae collected August 8, 1927, from intestine near pyloric caeca, length 10 to 135 mm., maximum breadth 4 mm.

BOTHRIOCEPHALUS RESTIFORMIS (Linton)

Dibothrium restiforme LINTON, Rep. U. S. Fish Comm. for 1887, pp. 722–728, pl. 1, figs. 1–16, 1890 (from *Tylosurus caribbaeus*: U.S.N.M. No. 8885).

¹⁷ Rep. U. S. Fish Comm. for 1887, p. 732, 1890; Proc. U. S. Nat. Mus., vol. 20, p. 430, 1897; U. S. Bur. Fish., vol. 31, p. 586, 1911.

¹⁸ Bull. U. S. Bur. Fish., vol. 31, p. 586, 1911.

¹⁹ According to Jordan, Evermann, and Clark's Check List, the Istiophoridae recorded as hosts of this species of cestode represent but one species: *Istiophorus americanus*.

Bothriocephalus restiformis (Linton) ARIOLA, Boll. Mus. Zool. Anat. Comp. Univ. Genova, 1896, p. 20; Arch. Parasit., vol. 3, pp. 422-423, 1900.

One slide (U.S.N.M. No. 8885).

BOTHRIOCEPHALUS species

PLATE 62, FIGURE 23

Record is here made of an immature strobila (U.S.N.M. No. 8886), collected August 9, 1928, from a flyingfish (*Exocoetus volitans*).

Measurements in balsam: Length, including two fragments, 6.9 mm.; anterior breadth 0.42 mm., posterior 0.5 mm.; scolex length 1.18 mm., breadth 9.87 mm. The scolex, in dorsoventral view, is bluntly sagittate, the bothrial pits marginal, with thickened and irregularly sinuous border. The strobila appears to be unsegmented. Rudiments of the genitalia begin about 1.5 mm. back of the scolex. They lie along the median line as rather conspicuous granular clusters, staining strongly with haematoxylin; about 12 of them in the posterior 2 mm. of the strobila.

A note on this pseudophyllidean cestode from a flyingfish was published in 1934.²⁰

BOTHRIOCEPHALUS species

Larval (plerocercoid) stage, usually encysted, probably for the most part belonging to the genus *Bothriocephalus*, is here recorded.

Specimens from Acanthocottus aeneus.—Previously recorded by me.²¹

Specimens from Bairdiella chrysura.—Vase-shaped larvae with abundant calcareous bodies, collected September 29, 1903.

Specimen from Centropristes striatus.—One plerocercus from a 9-mm. fish, June 30, 1919.

Specimen from Clupea harengus.—Cyst, about 1 mm. long, containing a plerocercus, collected by Dr. Hahn, July 11, 1914.

Specimens from Decapterus macarellus.—Previously recorded by me.²²

Specimen from Decapterus punctatus.—One, actively contractile, collected August 17, 1906. Length 1.2 to 1.6 mm.; anterior half, more contractile than posterior, length 0.4 to 0.8 mm., breadth 0.14 mm., diameter of posterior half, 0.07 mm.

Specimens from Hemitripterus americanus.—Two, collected by Vinal N. Edwards April 12, 1913. Length in formalin 3.5 mm., breadth 1 mm.; plump, vase-shaped, yellowish.

²⁰ Trans. Amer. Micr. Soc., vol. 53, p. 66, 1 fig., 1934.

²¹ Bull. U. S. Fish Comm., vol. 19, p. 467, 1901; Bull. U. S. Bur. Fish., vol. 31, p. 586, 1911.

²² Bull. U. S. Fish Comm., vol. 19, p. 449, fig. 228, 1901.

Specimens from Lagocephalus laevigatus.—A few small cysts, habitat not recorded but probably from intestinal wall, collected July 17, 1906; plerocercus removed from cyst, length 1.54 mm., breadth 0.38 mm.

Specimen from Lophopsetta maculata.—One collected by Vinal N. Edwards September 22, 1905. Length 5 mm., breadth 2 mm., in formalin.

Specimens from Menticirrhus saxatilis.—Two small flask-shaped plerocerci collected July 19, 1910; length 2.1 mm., breadth 0.7 mm.

Specimens from Microgadus tomcod.—Two slender larvae collected by Vinal N. Edwards April 8, 1910 (U.S.N.M. No. 8887); length 8 mm., breadth 0.6 mm., in formalin.

Specimens from Paralichthys dentatus.—Collected on two dates in July and two in August 1905. Of the 15 fishes examined, numerous cysts containing plerocerci were found in the intestine wall of one and on the ovary of another; one cyst was noted in each of two fishes.

Specimens from Paralichthys oblongus.—Cysts on intestine and mesentery, 1 to 4 mm. in diameter, were collected on one date in May, two in June (U.S.N.M. No. 8888), and two in August; few on each date. These cysts contained plerocercoidlike larvae of a maximum length of 4.5 mm., some of which, however, are larval tetrarhynchs.

Specimens from Peprilus paru.—Collected on three dates in July (U.S.N.M. No. 8889), two in August, and one in September, few to numerous, on viscera in three different years. The plerocerci are small, white, slender, actively contracting, from 8 mm. or less to 5 mm. when fully extended, often assuming a vase shape; calcareous bodies rather large. Measurements in formalin: Length 1.05 mm., breadth 0.29 mm.; scolex length 0.1 mm., breadth 0.21 mm. Measurements in balsam: Length 0.88 mm., breadth 0.27 mm.; scolex length 0.08 mm., breadth 0.17 mm.; length of bothrial pit 0.08 mm. Scolex covered with minute spines.

Specimens from Pneumatophorus grex.—Small plerocerci collected from intestine on three dates in July and one in August; three fishes examined on each date; 5 to 12 plerocerci found on each date, most of them macerated, evidently lately introduced with food.

Specimen from Pomatomus saltatrix.—One small, slender, linear specimen collected August 27, 1906.

Specimen from Pomolobus pseudoharengus.—One collected October 9, 1914. Length 5 mm., breadth 0.6 mm., in formalin. Filled with relatively large glandular bodies, 0.03 by 0.07 mm., similar to those noted in a larval cestode from *Sarda sarda*.

Specimens from Poronotus triacanthus.—Small, vase-shaped plerocerci are recorded from this host on two dates in July and two in August in four different years; under serous coat of stomach, extending

and contracting at anterior end, which is occasionally invaginated; many calcareous bodies in parenchyma. Measurements under slight pressure: Length 1.4 mm., breadth 0.18 mm., nearly linear.

Specimen from Remora remora.—One larval cestode collected July 22, 1919, resembling cestode larvae from *H. americanus*, *M. tomcod*, and *C. schoepfi*. Length 13 mm., breadth 2 mm., in balsam.

Specimens from Sarda sarda.—Previously recorded by me.²³

Specimens from Scomber scombrus.—Previously recorded by me.²⁴

Numerous cysts, 1 to 3 mm. long, each containing a plerocercus, were found in washings from viscera August 3, 1906.

Collected on 24 dates in August 1918 from 192 small mackerel, 108 to 185 mm. long, examined for stomach contents. On five dates cysts containing plerocerci were found in eight fishes, one to few in each fish. In one fish the cysts were on the viscera; in the other cases they appeared to have been introduced with the food (U.S.N.M. No. 8890).

Specimen from Seriola lalandi.—One vase-shaped plerocercus from stomach wall, actively contracting and extending from 5 to 6 mm., collected August 14, 1906. Diameter, anterior, 0.5 mm.; maximum, near anterior end, 0.84 mm.; posterior end 0.21 mm. For a distance of 3.5 mm. from the anterior end of the body filled with coarse granules, for the most part oval-elliptical but assuming various shapes where closely crowded together, about 0.084 to 0.105 by 0.039 to 0.06 mm. (U.S.N.M. No. 8891).

Specimens from Sphoeroides maculatus.—Six puffers, two on each of three dates in August, and nine on one July date, out of a large number of puffers examined, had from a few to rather numerous larval cestodes encysted on the wall of the intestine. Length of one cyst 2.5 mm., diameter 0.35 to 0.56 mm.

Specimens from Stenotomus chrysops.—One plerocercus from young scup collected August 9, 1916, by Dr. G. A. MacCallum.

A small scup, 10 mm. long, with white cysts showing through the body wall was brought to my attention by Miss Cable, July 27, 1933. The cysts contained plerocerci with calcareous bodies. Three, compressed slightly, measured: 1.33 by 0.46, 1.4 by 0.42, and 1.89 by 0.7 mm.

Specimen from Syriotes fuscus.—One from a 45-mm. fish collected July 15, 1919. Length 0.37 mm., breadth 0.15 mm., thickness of cuticle 0.006 mm., diameter of calcareous bodies 0.012 mm. (U.S.N.M. No. 8892).

Specimen from Tautogolabrus adspersus.—One vase-shaped plerocercus, active, the anterior end, with short spines, capable of consider-

²³ Proc. U. S. Nat. Mus., vol. 19, p. 789, pl. 9, figs. 2, 3, 1897; Bull. U. S. Fish Comm., vol. 19, pp. 278, 300, fig. 100, 1901.

²⁴ Bull. U. S. Fish Comm., vol. 19, p. 445, 1901; Bull. U. S. Bur. Fish., vol. 31, p. 586, 1911.

able alterations, frequently invaginated, full of rather large calcareous bodies, collected July 21, 1904. Length 2 mm., breadth 0.6 mm. (pl. 61, fig. 14) (U.S.N.M. No. 8893).

One plerocercus, encysted, collected August 11, 1906.

Specimens from Urophycis chuss.—Plerocerci in cysts under serous coat of intestine collected November 1, 1904.

Genus CLESTOBOTHRIUM Lühe

CLESTOBOTHRIUM CRASSICEPS (Rudolphi)

PLATE 61, FIGURES 15-18

An extensive account of this species, including synonymy, is given by Cooper.²⁵

The species is readily recognized by the more or less globose scolex, with conspicuous dorsoventral bothria, the segmentation of the strobila beginning immediately behind the scolex; the mature proglottides often partly divided by false articulations; genital cloaca median, dorsal. It will be noted that strobilae have been collected from the whiting (*Merluccius bilinearis*) that are nearly double the maximum length of 92 mm. recorded by Cooper.

Although this cestode is recorded from nine specific hosts in the Woods Hole region, its occasional or rare occurrence in most of them, and the evidence of recent introduction of mature strobilae along with food in at least one host (*Lophius piscatorius*), reduce the species that may be regarded as true host to one—*Merluccius bilinearis*.

Specimens from Fundulus majalis.—One strobila and fragments (U.S.N.M. No. 8894), aggregating 32 mm. in length, collected September 6, 1913; bluish-transparent; fragments slightly macerated. The killifish, along with specimens of whiting that were found to harbor *C. crassiceps*, came from a fishtrap at Menemsha Bight. The condition of the cestode fragments suggests that they had been discharged from the whiting while confined in the trap and eaten by the killifish.

Measurements in balsam: Scolex length 0.73 mm., breadth 0.62 mm.; first segment length 0.16 mm., breadth 0.58 mm.; maximum breadth 0.92 mm.

Specimen from Hippoglossus hippoglossus.—One (U.S.N.M. No. 8895) collected June 14, 1906; length in formalin 15 mm. The scolex is typical of the species, but the strongly contracted strobila shows but little of the anatomy. Measurements in balsam: Length 13 mm.; scolex length 0.7 mm., breadth 0.84 mm.; first segment length 0.07 mm., breadth 0.81 mm.; middle segments, length 0.14 mm., breadth 1.4 mm.; posterior segment length 0.56 mm., breadth 0.47 mm.

²⁵ Illinois Biol. Mon., vol. 4, pp. 442-458, 11 figs., 1919.

Specimens from Lophius piscatorius.—Vinal Edwards' notes yield many dates, extending over a long series of years, on which whiting were recorded in the stomach contents of the goosfish. Since *C. crassiceps* is of frequent occurrence in the whiting, it would be surprising if this cestode were not found in the goosfish. Following is the record of finds of this cestode in the goosfish:

November 24, 1905: 1 fish examined, 4 with scoleces, longest 70 mm.

July 6, 1910: 5 fish examined, 3 cestodes, maximum length 45 mm.

May 15, 1913: 10 fish examined, 1 with scolex, length 18 mm. Stomach of fish full of shad, hake, whiting, dogfish, and squid. Vinal N. Edwards.

June 6, 1914: 1 fish examined, 2 scoleces and fragments, each about 8 mm. long, one with ripe segments.

June 15, 1914: 3 fish examined, 4 cestodes, maximum length 72 mm., breadth 2 mm.; scolex breadth 1.12 mm. Measurements in balsam: Length 42 mm.; maximum breadth 1.75 mm.; scolex length 0.98 mm., breadth 0.94; first segment length 0.07 mm., breadth 0.98 mm.; median segments, length 0.09 mm., breadth 1.75 mm.; posterior segment length 0.63 mm., breadth 0.77. Ova thin-shelled and collapsed, best examples about 0.072 by 0.033 (pl. 61, figs. 17, 18) (U.S.N.M. no. 8896).

Specimens from Merluccius bilinearis.—Recorded previously by me ²⁶ under the name *Dibothrium crassiceps* (Rudolphi) from this fish. This cestode was collected from whiting at Woods Hole in all the years except one from 1903 to 1928, inclusive, as follows:

Month	Number of dates	Number of fishes examined	Strobilae
May.....	6	25	260
June.....	1	2	25
July.....	10	34	60
August.....	12	64	114
September.....	1	1	2
October.....	16	132	141
November.....	29	272	391
Whiting were examined but no cestodes found, as follows:			
August.....	1	1	-----
September.....	1	3	-----
October.....	2	7	-----
November.....	5	31	-----

²⁶ Bull. U. S. Fish Comm., vol. 19, p. 473, figs. 266-268, 1901; Bull. U. S. Bur. Fish., vol. 31, p. 585, 1911.

Dimensions, in millimeters, balsam mounts:

Length.....	30. 00	16. 00	113. 00	138. 00
Scolex:				
Length.....	. 84	. 49	1. 20	1. 26
Breadth.....	. 84	. 49	1. 00	1. 26
First segment:				
Length.....	. 07	. 05	. 08	. 14
Breadth.....	. 68	. 42	. 63	1. 05
Median segment:				
Length.....	. 25	. 35	. 24	. 15
Breadth.....	1. 05	. 81	2. 24	2. 50
Posterior segment:				
Length.....	. 35	. 30	. 50	. 49
Breadth.....	. 70	. 63	1. 20	1. 56

Maximum length of strobila, in formalin, 180 mm.; ova 0.07 by 0.03 to 0.04 mm.

Specimens from Pomatomus saltatrix.—Recorded by me ²⁷ under the name *Dibothrium crassiceps* (Rudolphi).

Specimens from Sphoeroides maculatus.—Three strobilae, with scoleces (U. S. N.M. No. 8898), collected June 6, 1914, length of each about 15 mm.; one, scolex missing, length 30 mm.; 10 fishes examined by Vinal N. Edwards, who reported worms in 4. Measurements in balsam: Length of first segment 0.11 mm., breadth 0.23 mm.; posterior segments, length 0.28 mm., breadth 1.12 mm. False articulation of segments, giving the appearance of their arrangement in the strobila by twos, is a conspicuous feature.

Specimens from Squalus acanthias.—Two strobilae (U.S.N.M. No. 8899) collected September 22, 1913, from one of eight dogfishes examined by Edwards. Aggregate length of strobilae and fragments in formalin 72 mm. Length of longest strobila in balsam 35 mm. Ova 0.063 to 0.075 by 0.033 to 0.039 mm. These worms were doubtless introduced with food.

Specimens from Urophycis chuss.—Two strobilae with scoleces and fragment collected May 9, 1913, from 15 fishes examined by Edwards. Lengths in formalin 18, 24, and 14 mm. Breadth of scolex 0.42 mm., maximum breadth about 0.65 mm. (U.S.N.M. No. 8900).

Specimens from Urophycis tenuis.—Two strobilae collected May 9, 1913, from three fishes examined by Edwards; lengths 7 and 24 mm. A few fragments from one fish June 30, 1924, no scolex seen; whiting among the stomach contents.

²⁷ Bull. U. S. Fish Comm., vol. 19, p. 451, 1901; Bull. U. S. Bur. Fish., vol. 31, p. 585, 1911.

Family AMPHICOTYLIDAE Ariola

Genus ABOTHRIUM van Beneden

ABOTHRIUM RUGOSUM (Batsch)

PLATE 62, FIGURE 19

Taenia rugosa BATSCH, Naturgeschichte der Bandwurm-gattung überhaupt und ihrer Arten insbesondere . . ., p. 208, 1786.

Dibothrium rugosum (Batsch) DIESING, Systema helminthum, p. 591, 1850.—LINTON, Rep. U. S. Fish Comm. for 1887, pp. 750-754, pl. 3, figs. 7-10, 1890; Proc. U. S. Nat. Mus., vol. 20, p. 431, pl. 28, figs. 1-4, 1897; Bull. U. S. Fish Comm., vol. 19, p. 476, 1901; Bull. U. S. Bur. Fish., vol. 31, p. 586, 1911.

For extended synonymy and account of this species see Cooper, Illinois Biol. Mon., vol. 4, pp. 460-473, 9 figs., 1919.

The adult strobila of this cestode is usually found with the anterior end impacted in the pyloric caeca, where it is surrounded by waxy degenerate tissue.

Specimens from Gadus morrhua.—Concerning the distribution by months in the following summary it should be remarked that, with the exception of the two dates in June, all the fish had been kept for some time in a live-car. On one of the June dates the fish was taken off Nantucket, the other 20 miles east of Great Round Shoal. All collections, except those of July, were made by Vinal N. Edwards in the years from 1903 to 1916, and on four dates in earlier years reference to which was not included in previous publications.

Month	Number of dates when examined	Number of fishes examined	Number of dates on which found	Maximum aggregate in one fish	Maximum length of strobila
January-----	23	253	15	959	400
February-----	5	20	2	575	-----
April-----	2	2	-----	-----	-----
May-----	13	57	6	1,849	355
June-----	2	2	1	1,130	416
July-----	2	5	-----	-----	-----
October-----	6	13	2	-----	100
November-----	52	396	17	1,685	400
December-----	58	1,014	35	1,018	322

Specimens from Melanogrammus aeglefinus.—Thirty-eight haddock were examined on 14 dates in six different years. Examinations were made in every month except January, February, and March. *A. rugosum* was found as follows:

April: 1 fish examined; 1 strobila, length 250 mm, breadth 4 mm.

August: 16 fishes examined on one date; 2 strobilae, length 60 and 36 mm, breadth 2 and 3.5 mm.

October: (1) 1 fish examined; 8 strobilae, maximum length 122 mm. (2) 4 fishes examined on one date; 6 strobilae and fragments aggregating 1,358 mm, maximum length 210 mm.

The anterior ends of the strobilae are imperfect on account of their permanent fixation in the pyloric caeca (U.S.N.M. No. 8901).

Specimens from *Microgadus tomcod*.—Tomcod were examined for Entozoa by Edwards in nearly every month and over a long series of years. Cestodes that appear to belong to this species were found twice:

January 1, 1904: 30 fish examined; 1 strobila, length 50 mm.

April 26, 1910: 1 fish examined; fragments of strobilae.

Specimens from *Pollachius virens*.—Three fragments belonging to two strobilae were collected May 28, 1913; lengths 25, 145, and 242 mm., thickish; segment of maximum breadth, in balsam, length 0.84 mm., breadth 3.7 mm.; ova in sections, about 0.044 by 0.033 (U.S.N.M. No. 8902).

Specimens from *Urophycis tenuis*.—Collected as follows:

December 15, 1904: 1 strobila, length 140 mm, breadth 4 mm; scolex missing.

November 5, 1910: 1 strobila, length 23 mm.; no scolex.

August 4, 1911: 1 strobila, with scolex and numerous fragments.

May 7, 1913: 2 strobilae, lengths 10 and 14 mm.

Family PROTEOCEPHALIDAE LaRue

Genus PROTEOCEPHALUS Weinland

PROTEOCEPHALUS MACROCEPHALUS (Creplin)

PLATE 62, FIGURES 24-28

Taenia dilatata LINTON, Rep. U. S. Fish Comm. for 1886, p. 488, 1889; Proc. U. S. Nat. Mus., vol. 20, p. 429, 1897; Bull. U. S. Fish Comm., vol. 18, p. 435, 1901.

For full synonymy and description see La Rue, Illinois Biol. Mon., vol. 1, pp. 129-143, 1914.

Specimens from *Anguilla rostrata*.—My notes show that 106 eels were examined for parasites on one date in January, two in March, six in April, three in May, one in July, two in August, four in September, three in October, and nine in November in 12 different years from 1903 to 1924, inclusive. *Taenia* referred to this species were found on two dates in April, nine eels examined, one strobila and fragments, longest 4 mm.; on one date in June, six eels examined, one strobila, length 350 mm., breadth 2 mm.; on one date in July, 9 eels examined, 10 strobilae and fragments, longest 140 mm.; on one date in August, two eels examined, one strobila and fragments, longest 90 mm.; on four dates in November, 43 eels examined, six strobilae and fragments, longest 295 mm., maximum breadth 2 mm.

Diameter of scolex in balsam, average of 10, 0.24 mm., minimum 0.35 mm.; ripe proglottids in different strobilae, lengths 1.47 and 1.96 mm., breadths 1.33 and 1.12 mm. (U.S.N.M. No. 8906).

Specimens from Zygonectes diaphanus.—On July 22, 1905, 52 fresh-water killifishes were examined, and three scoleces with rudimentary strobilae were found. Measurements in balsam: Length 2.2 mm., breadth 0.24 mm., diameter of scolex 0.18 mm., diameter of sucker 0.11 mm.

Genus CORALLOBOTHRIUM Fritsch

CORALLOBOTHRIUM FIMBRIATUM Essex

PLATE 62, FIGURES 29, 30

Corallobothrium fimbriatum ESSEX, Illinois Biol. Mon., vol. 11, pp. 275-283, 33 figs., 1927.

The genus *Corallobothrium* as defined by Essex: With characteristics of family. Scolex bears four suckers situated on anterior surface surrounded by many irregular folds and lappets of tissue. Rostellum, hooks, and spines absent. Neck broad, short. Vagina inconstant in position, anterior or posterior to cirrus pouch. Habitat: In Siluridae. Type species, *C. solidum* Fritsch.

Essex described two new species of *Corallobothrium*: *C. giganteum* and *C. fimbriatum*, from anterior portion of intestine of *Ictalurus punctatus*, *Leptops olivaris*, and *Ameiurus melas*.

Specimens from Ameiurus nebulosus.—This cestode (U.S.N.M. No. 8907) was collected by Mr. Edwards, Dr. MacCallum, and the author on 10 dates from 1913 to 1918, inclusive, from horned pout taken in fresh-water ponds near Quisset and Waquoit.

May 9: 10 fishes examined, 70 cestodes found, maximum length 35 mm. May 11: 31 fishes examined, 60 cestodes, maximum length 50 mm. May 14: Number of fishes not recorded, 106 cestodes, maximum length 12 mm. May 24: 5 fishes examined, 27 cestodes, maximum length 20 mm. June 6, number of fishes not recorded, 12 cestodes, maximum length 5 mm. June 15: 1 fish examined, 3 cestodes, maximum length 3 mm. July 1: 15 fishes examined, many cestodes, maximum length 4 mm. July 7: 5 fishes examined, 8 cestodes, 2 to 18 mm. long. August 13: 38 fishes examined, many cestodes, 3 to 10 mm. long. September 29: Number of fishes not recorded, 5 cestodes, maximum length 4 mm.

Measurements in balsam: Length 32 mm.; breadth near scolex 1.05 mm.; segment 1 mm. back of scolex, length 0.16 mm., breadth 1.2 mm.; posterior segment, length 2.45 mm., breadth 1.4 mm.; scolex breadth 1.54 mm., length 0.91 mm.; diameter of sucker 0.35 mm. Ova thin-shelled, somewhat variable, circular outline, in life 0.028 to 0.035 mm.

ABBREVIATIONS USED ON PLATES

<i>c</i> , cirrus	<i>u</i> , uterus
<i>cp</i> , cirrus pouch	<i>v</i> , vagina
<i>o</i> , ovary	<i>vd</i> , vas deferens
<i>ov</i> , oviduct	<i>vg</i> , vitellaria
<i>t</i> , testes	



Linton, Edwin. 1941. "Cestode parasites of teleost fishes of the Woods Hole region, Massachusetts." *Proceedings of the United States National Museum* 90(3112), 417–442. <https://doi.org/10.5479/si.00963801.90-3112.417>.

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