

# NOTES ON CESTODE PARASITES OF SHARKS AND SKATES.

By EDWIN LINTON,

*Of the Medical Department of the University of Georgia, Augusta.*

## INTRODUCTION.

While this paper was prepared for publication at the medical department of the University of Georgia, the greater part of the laboratory work upon which it is based was done while I was enjoying the privileges of the laboratories of the United States Bureau of Fisheries, Woods Hole, Massachusetts, and the zoological department of the University of Missouri.

All collections made in the Woods Hole region in the months from September to June, inclusive, with the exception of a few dates in the early part of September and the latter part of June, were made by the late Vinal N. Edwards, whose collections were made during a long series of years, and in all the months of the year. Some of this material proves to be new; some of it makes it possible to revise and add to earlier descriptions, which were often regrettably meager; much of it supplies new records of habitats, and of seasonal distribution.

In all cases where the locality from which material was obtained is not given, the Woods Hole region is to be understood.

Of the many examples of the encysted stages of selachian cestodes on which I have notes I have included but few which have not been satisfactorily identified. The most frequently recurring forms in the Woods Hole region are: *Otobothrium crenacolle*, *Rynchobothrium bulbifer*, *R. imparispine*, and *Tetrarhynchus bisulcatus*. A list of the intermediate hosts in which the larval cestode, *Phyllobothrium loliginis*, has been found was recently published (1922b).

The valuable Index Catalog of Stiles and Hassall<sup>1</sup> makes it unnecessary to burden this paper with extensive references to the literature. I have thought it best, however, to include references to those of my own papers which deal with the tapeworms of sharks and skates.

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<sup>1</sup> Hygienic Laboratory, Bulletin 85, Washington, 1912.

It should be noted that the sharks recorded in the years prior to 1922 as *Carcharhinus obscurus* were probably either *C. commersonii* or *C. milberti*.

The scientific names of fishes mentioned in this paper are, for the most part, those used by Jordan and Evermann in their Fishes of North and Middle America. Departures from that nomenclature have been made at the suggestion of the Bureau of Fisheries.

LIST OF CESTODES NOTED IN THIS PAPER.

Those marked with an asterisk are either described in greater or less detail or have had additions or emendations made to former descriptions.

<i>Anthobothrium</i> * <i>laciniatum</i> .	* <i>Ichthyotaenia adherens</i> .
<i>pulvinatum</i> .	<i>Discocephalum peltatum</i> .
<i>Spongiobothrium variabile</i> .	<i>Otobothrium crenacolle</i> .
<i>Echeneibothrium variabile</i> .	<i>dipsacum</i> .
<i>Rhinebothrium flexile</i> .	* <i>penetrans</i> .
<i>longicolle</i> .	<i>Rhynchobothrium attenuatum</i> .
* <i>macallumi</i> .	<i>bulbifer</i> .
<i>minimum</i> .	* <i>exile</i> .
<i>Crossobothrium angustum</i> .	<i>heterospine</i> .
<i>laciniatum</i> .	<i>hispidum</i> .
* <i>Monorygma perfectum</i> .	* <i>insigne</i> .
<i>species</i> .	<i>imparispine</i> .
* <i>Orygmatobothrium forte</i> .	<i>lomenteaceum</i> .
<i>paulum</i> .	<i>longicorne</i> .
<i>Anthocephalum gracile</i> .	<i>longispine</i> .
<i>Phyllobothrium foliatum</i> .	<i>speciosum</i> .
<i>Calyptribothrium minus</i> .	<i>tenuispine</i> .
<i>occidentale</i> .	<i>tumidulum</i> .
* <i>Trilocularia gracilis</i> .	* <i>uncinatum</i> .
<i>Lecanicephalum peltatum</i> .	<i>vagneri</i> .
<i>Calliobothrium eschrichtii</i> .	<i>species</i> .
<i>verticillatum</i> .	Larval stages, spe-
<i>Acanthobothrium paulum</i> .	cies not deter-
<i>coronatum</i> .	mined.
<i>Onchobothrium uncinatum</i> .	<i>Synbothrium filicolle</i> .
* <i>Phoreciobothrium exceptum</i> .	* <i>malleum</i> .
* <i>lasium</i> .	<i>Tetrarhynchus bicolor</i> .
* <i>pectinatum</i> .	<i>bisulcatus</i> .
* <i>triloculatum</i> .	<i>elongatus</i> .
* <i>Platybothrium cervinum</i> .	* <i>palliatum</i> .
* <i>parvum</i> .	<i>robustus</i> .
<i>Thysanocephalum thysanocephalum</i> .	<i>Scolex polymorphus</i> .
<i>Parataenia medusia</i> .	

NEW SPECIES.

CESTODE.	HOST.
<i>Ichthyotaenia adherens</i> -----	<i>Cestracion zygaena</i> .
<i>Orygmatobothrium forte</i> -----	<i>Cestracion zygaena</i> .
<i>Phoreciobothrium exceptum</i> -----	<i>Cestracion zygaena</i> .
<i>pectinatum</i> -----	<i>Cestracion zygaena</i> .

CESTODE.	HOST.
<i>Rhinebothrium maccallumi</i> -----	<i>Dasybatis centrura</i> .
<i>Rhynchobothrium insigne</i> -----	<i>Carcharhinus milberti</i> .
<i>uncinatum</i> -----	<i>Vulpecula marina</i> .
<i>Synbothrium malleum</i> -----	<i>Dasybatis centrura</i> .
<i>Tetrarhynchus palliatus</i> -----	<i>Cestracion zygaena</i> .

LIST OF PAPERS BY THE AUTHOR ON SELACHIAN CESTODES, OR IN WHICH  
THE SUBJECT OF SELACHIAN CESTODES IS CONSIDERED.

1887. Notes on two forms of cestode embryos. *American Naturalist* (Feb.), pp. 195-200, pl. 10.
- 1889a. Notes on Entozoa of Marine Fishes of New England. *American Journal of Science*, vol. 37, pp. 239-240.
- 1889b. Notes on Entozoa of Marine Fishes of New England. Report U. S. Fish Commission for 1886, pp. 453-511, pls. 1-6.
1890. Notes on Entozoa of Marine Fishes of New England. Part 2. Cestodes. Report U. S. Fish Commission for 1887, pp. 718-899, pls. 1-15.
- 1891a. Notes on Entozoa of Marine Fishes of New England. Part 3. Acanthocephala. Report U. S. Fish Commission for 1888, pp. 523-542, pls. 53-60.
- 1891b. The Anatomy of *Thysanocephalum crispum*. Report U. S. Fish Commission for 1888, pp. 543-566, pls. 63-67.
- 1897a. Notes on Cestode Parasites of Fishes. *Proceedings U. S. National Museum*, vol. 20, pp. 423-456, pls. 27-34.
- 1897b. Notes on Larval Cestode Parasites of Fishes. *Proceedings U. S. National Museum*, vol. 20, pp. 787-824, pls. 61-68.
1900. Fish Parasites collected at Woods Hole in 1898. *Bulletin U. S. Fish Commission for 1899*, pp. 267-304, pls. 33-43.
1901. Parasites of Fishes of the Woods Hole Region. Report U. S. Fish Commission for 1899, pp. 405-492, pls. 1-34.
1905. Parasites of Fishes of Beaufort, N. C. *Bulletin U. S. Fish Commission for 1904*, vol. 24, pp. 321-428, pls. 1-34.
- 1907a. An Abnormal Cestode Proglottid. *Biological Bulletin*, vol. 12, pp. 155-157, figs. 1, 2.
- 1907b. A Cestode Parasite in the Flesh of the Butterfish. *Bulletin U. S. Bureau of Fisheries*, vol. 26, pp. 111-132, pls. 1, 2.
- 1907c. Notes on *Calyptrobothrium*, a Cestode Genus in the Torpedo. *Proceedings U. S. National Museum*, vol. 32, pp. 275-284, figs. 1-8.
- 1907d. Notes on Parasites of Bermuda Fishes. *Proceedings U. S. National Museum*, vol. 33, pp. 85-126, pls. 1-15.
- 1907e. Preliminary Report on Animal Parasites of Tortugas. *Fifth Year-book of the Carnegie Institution of Washington*, pp. 112-117.
- 1908a. Second Report on Animal Parasites of Tortugas. *Sixth Year-book of the Carnegie Institution of Washington*, pp. 114-116.
- 1908b. Helminth Fauna of the Dry Tortugas. I. Cestodes. Publication 102, Carnegie Institution of Washington; Papers from the Tortugas Laboratory, 1, pp. 157-190, pls. 1-11.
- 1908c. Preliminary Report on Helminths collected at the Dry Tortugas in 1908. *Seventh Year-book of the Carnegie Institution of Washington*, pp. 124-127.

- 1910a. Notes on the Distribution of Entozoa of North American Marine Fishes. Proceedings 7th International Zoological Congress (Boston, 1907), pp. 686-696.
- 1910b. Notes on the Flesh Parasites of Marine Food Fishes. Bulletin U. S. Bureau of Fisheries, vol. 28, pp. 1195-1209.
1911. In "Biology of Woods Hole and Vicinity." Bulletin U. S. Bureau of Fisheries, vol. 31, pt. 2, pp. 585-589.
1912. Cestode Cysts in the Flesh of Marine Fish, and their Bearing on Food Values. Transactions American Fisheries Society for 1912, pp. 1-9.
1914. On the Seasonal Distribution of Fish Parasites. Transactions American Fisheries Society for 1914, pp. 48-56.
1915. Fish Parasites and the Public Health. Transactions American Fisheries Society for 1915, pp. 19-28.
1916. Notes on two Cestodes from the Spotted Sting Ray. Journal of Parasitology, vol. 3, pp. 34-38, pl. 1, text-figs. 1, 2.
1921. *Rhynchobothrium ingens* sp. nov., a Parasite of the Dusky Shark. Journal of Parasitology, vol. 8, pp. 22-32, pls. 4, 5.
- 1922a. A Contribution to the Anatomy of *Dinobothrium*. Proceedings U. S. National Museum, vol. 60, pp. 1-13 (author's reprint), pls. 1-4.
- 1922b. A New Cestode from the Maneater and Mackerel Sharks. Proceedings U. S. National Museum, vol. 61, pp. 1-16, pls. 1-3 (author's reprint).

**ANTHOBOTHRIUM PULVINATUM** Linton.

- 1890, pp. 754-759, pl. 3, figs. 10-13; pl. 4, figs. 1-3.
- 1897a, pp. 439-440, pl. 33, fig. 1.
- 1900, p. 275.
- 1901, p. 432.
- 1905, p. 346, fig. 125.
- 1910a, p. 695.
- 1911, p. 585.

Records of this cestode not before published:

*Dasybatis centrura*.

Collected in six of the years from 1903 to 1922, inclusive: On 1 date in June, 1, and a few free proglottides; length in sea water 150 mm., lengthening to 340 mm. after lying in fresh water for half an hour; on 3 dates in August, 1 on each date, maximum length 280 mm., a few free proglottides on one date; on 2 dates in September, 1 and a few free proglottides on one date, 3 on the other; on 1 date in October, 1 and a large number of free proglottides, length 175 mm. (U.S.N.M., Helm. Coll. 7731.)

*Squalus acanthias*.

1912, May 22: 1, length 115 mm. Other dimensions of formalin specimen: Diameter of scolex 2.75, of neck 1.5; breadth of strobile, middle, 4; thickness of strobile, middle, 2.57. There were nine ripe proglottides, length of longest 5, breadth 3; ova, average of four, 0.048 by 0.028 in the two principal diameters. The ova have thin, transparent shells, and are oval with more or less pointed ends.



## ANTHOBOTHRIMUM LACINIATUM Linton.

Plate 1, figs. 1-1c.

1890, pp. 754-759, pl. 3, figs. 10-13; pl. 4, figs. 1-3.

1897a, p. 439.

1900, p. 272.

1901, pp. 426, 427, 428, 429.

1905, pp. 339, 343, fig. 126.

1907c, p. 116.

1908b, p. 167.

1911, p. 585.

Cestodes referred to this species have been recorded from *Carcharhinus milberti*, *C. obscurus*, *C. platyodon*, *Isurus tigris*, and *Uestracion zygaena*. Following are records of finds of the species, with notes, not before published:

There is much variation in this species, especially in the character of the anterior portion of the strobile, which, for convenience, may be referred to as the neck. This fact was noted in the original description of the species when two varieties were distinguished and named *longicollis* and *brevicollis* respectively. In some instances the neck is longer relatively than is shown in the sketch of *longicollis*. Moreover, the first segments to appear are, in some cases, very short and devoid of laciniae, the laciniae appearing later. Thus, in three specimens from *C. obscurus*, the neck of one is 0.9 mm. in length, and is laciniate at the base; the neck of another is about 2.4 mm. in length, the first segments are very short and are not laciniate; the neck of the third is 0.32 in length and is laciniate. In a lot of these cestodes from *C. milberti*, all of which were long-necked, the neck of one was 1.75 mm. in length and laciniate, of another 2.9 mm. in length and non-laciniate, first segments also non-laciniate and very short. The neck and strobile are armed with short spines, a feature not noted in the original description, but mentioned in connection with record of specimens from the sharp-nosed shark collected at Beaufort, N. C.

The differences between strobiles which are weakly laciniate and those which are strongly laciniate would call for specific differentiation were it not for the existence of intermediate forms. The only differentiation that seems to be at all practicable would be the recognition of two groups, one having the neck of variable length but laciniate at base, and the proglottides beginning abruptly; the other having the neck more or less elongated, non-laciniate at base, the proglottides beginning as closely crowded, transverse striae.

Since strobiles of the first group are either smooth or with but faint indication of spines, and more or less flaccid, while strobiles of the second group are of firmer texture and densely spinose, I am

inclined to regard the strobiles of the first group as older than those of the second group.

*Anatomy of a proglottis.*—The genital apertures are irregularly alternate, and situated at about the anterior third of the length; in a segment 3.5 mm. in length the genital pore was 1.2 mm. from the anterior end. The cirrus is long and slender, bulbous at base and spinous. The vas deferens is voluminous, situated antero-medially to the base of the cirrus-pouch in a bend of the vagina. The testes fill the median region of the proglottis from the ovary to the anterior end. The vagina opens at the common pore anterior to the cirrus. In some cases it makes a loop-like bend around and in front of the dense mass of coils of the vas deferens, then follows the median line to near the posterior end, where it narrows to a slender sperm duct near the shell gland. The ovary forms two wing-like lobes, symmetrically placed with reference to the median line at the extreme posterior end of the proglottis. The shell gland is enclosed between the posterior halves of the lobes of the ovary. The vitelline glands are conspicuous, deeply staining bodies, as seen in whole mounts, lying along the lateral margins of the proglottis, from the ovaries to the anterior end. Outlines of the uterus are not clearly shown in my preparations; ova in ripe proglottides are distributed throughout the interior in front of the ovary, in some cases most abundant from the middle to the anterior third, where they may appear as a dense mass. The ova spherical, thin shelled, often collapsed in mounted segments, and 0.015 mm. in diameter, more or less.

*Carcharhinus milberti.*

Collected in three of the years from 1915 to 1922: On two dates in July, 4 and 13, with many free proglottides, 2 sharks, length 112 centimeters; on six dates in August (on one date, few in 1 of 6 sharks), 1 to 15, with many free proglottides, in each of 7 sharks, 112 to 210 centimeters in length, maximum length of strobile 18 mm.; on one date in September, 10, length about 20 mm., the anterior unsegmented portion slender and armed with short, bristly spines.

(U.S.N.M., Helm. Coll. 7659.)

*C. commersonii.*

1922, August 7: 2 from a 112 centimeter shark.

1923, August 6: 7, maximum length 60 mm., and a large number of free proglottides, from a 290-centimeter shark.

August 7: 19, maximum length 40 mm., from a 321-centimeter shark.

August 15: 115, maximum length 30 mm., from a 153-centimeter shark. One in each of 3 out of 7 sharks examined on three other dates in August.

*C. obscurus.*

Collected in nine of the years from 1905 to 1918: On four dates in July, few to many, maximum length 26 mm. (one date, few in 1 of 3 sharks), 6 sharks examined; on eight dates in August, 1 to numerous in each of 11 sharks; on three dates in September, 2 to 12, and numerous free proglottides, in 3 sharks.

It is to be remarked that the size of the host is no index of the number of parasites. For example, 3 of this cestode were found in a shark measuring 305 centimeters in length, many in a 110 centimeter shark, and 1 in a 165 centimeter shark.

It is likely that many of the sharks of the Woods Hole region, recorded as *C. obscurus*, were either *C. milberti* or *C. commersonii*. With the identification of species based on the character of the denticles, *C. milberti* was found to be abundant. *C. commersonii* was noted, *C. obscurus* was not seen. For many of the identifications of sharks in the summer of 1922 I am indebted to Dr. H. M. Smith. In the summer of 1923 the 17 sharks belonging to the genus *Carcharhinus* that were examined were all found to be *C. commersonii*.

*Cestracion zygaena.*

1908, August 3: Several small strobiles and fragments, scoleces macerated, one of them evidently *A. laciniatum*.

*Galeus glaucus.*

1905, August 5: 12, rather, small scoleces of most of them imperfect, apparently macerated: two were filiform at the anterior end.

1913, July 5: Several fragments, but no scoleces.

1923, July 23: 46, from a 245-centimeter shark; all small, maximum length 10 mm.

*Raja eglanteria.*

1905, August 12: 2 scoleces. Referred with some hesitation to this species. A memorandum sketch of the ova shows them to be circular in outline, with a thin shell which is separated from a segmenting cell mass by a clear space; diameter of shell 0.03, of cell mass 0.02. A memorandum sketch of an everted cirrus shows it to be slightly constricted near the base, then swollen and tapering gradually to the tip, and armed with short spines (fig. 1c).

*Scoliodon terrae-novae.*

1915, July 15: Few.

## SPONGIOBOTHRIUM VARIABILE Linton.

1889, pp. 462-464, pl. 2, figs. 13-19.

1890, pp. 778-780.

1897a, p. 442.

1900, p. 275.

1901, p. 433.

1905, p. 347.

1908b, p. 168.

1910a, p. 695.

1911, p. 589.

Records of this cestode not before published:

*Dasybatis centrura.*

Collected in six of the years from 1903 to 1922, inclusive: On two dates in June, few on one date, 4 and fragment on the other; on one date in July, 40, bothria mobile, in some cases with rather long and slender pedicels, and with a tendency to attach themselves to the bottom of the dish; on two dates in August, many on one date, collected by Dr. G. A. MacCallum, 1, length 40 mm., in alcohol, on the other; on two dates in September, few on one date, 10 on the other, bothria seen to be pedicellate; on one date in October, 4, maximum length 40 mm.

1923: On one date in July and one in August; 1 on each date; length 30 mm.

(U.S.N.M., Helm. Coll. 7660.)

## ECHENEIBOTHRIUM VARIABILE van Beneden.

1889b, pp. 460-462, pl. 1, figs. 9-13.

1890, pp. 766-767.

1897a, p. 440.

1900, p. 274.

1901, p. 431.

1911, p. 586.

Records of this cestode not before published:

*Raja diaphanes.*

Collected in 12 of the years from 1904 to 1916, inclusive: On 4 dates in April, 30 skates examined; 1 to 3 strobiles, maximum length 30 mm. On 10 dates in May, 51 skates examined, 1 to 3 strobiles, maximum length 90 mm.; numerous free, ripe proglottides on 3 dates; on one date 35 skates were examined, and but 1 strobile found, length 10 mm. On 1 date in June, 1 skate examined; 2 strobiles, length 45 mm., and a few free, ripe proglottides, largest 8 mm. in length. On 2 dates in August; 2 skates examined; 2 strobiles. On 2 dates in September; 1 to 3 strobiles, maximum 30 mm., and a few free proglottides. On 12 dates in October; 74 skates examined; 1 to 14 strobiles, maximum 30 mm. free proglottides on one date. On 2 dates in November; 1 to 3 strobiles, maximum 25 mm.



Not found in large numbers in this skate. For example: On May 15, 1914, 14 strobiles were found in 1 of 35 skates examined for parasites by Mr. Edwards.

A scolex, stained and mounted by Dr. G. A. MacCallum on August 17, 1914, showed that there are 8 loculi on each bothrium, one at each end, and separated by three paired loculi

*Raja eglanteria.*

1910, September 21: Free proglottides, about 15, largest about 6.5 by 2 mm.

*Raja erinacea.*

Collected in 6 of the years from 1905 to 1913, inclusive: On 1 date in April, 1, length 21 mm.; on 2 dates in July, 6, and free proglottides on 1 date, 4, each 100 mm., or more in length, slender, on the other; on 2 dates in August, 2, small, and a few free proglottides on 1 date, number not recorded on the other, large and small, maximum length 60 mm., in alcohol; on 1 date in October, 3 and a few fragments, from 2 skates; on 1 date in November, many free proglottides.

-(U.S.N.M., Helm. Coll. 7661.)

*R. stabuliformis.*

Collected in 4 of the years from 1907 to 1916, inclusive: On 2 dates in April, 1 length 45 mm., on 1 date, 4, with numerous fragments, and free proglottides on the other; on 1 date in May, a few short chains of immature proglottides, 2 with scoleces, and a large number of free proglottides, largest from 5 to 8 mm. in length, and from 2 to 3 mm. in breadth. One immature scolex, which appears to belong to this species, would probably have been recorded as *Scolex polymorphus* if it had not been associated with scoleces of *E. variabile*. On 1 date in June, 1, and free proglottides; on 2 dates in October, 1, length 10 mm. on 1 date, 1 and a few fragments on the other.

**RHINEBOTHRIUM FLEXILE** Linton.

1890, pp. 768-771; pl. 5, figs. 3-5.

1900, p. 275.

1901, p. 433.

1905, pp. 342, 347.

1908a, p. 167.

1910a, p. 695.

1911, p. 587.

Records of this cestode not before published:

*Dasybatis centrura.*

Collected in 6 of the years from 1903 to 1922, inclusive: On 1 date in July, 3; on 2 dates in August, 1 on 1 date, 12 on the other, collected by Dr. G. A. MacCallum; on 3 dates in September, 1 to 15.

(U.S.N.M., Helm. Coll. 7662.)

1923: 20 on one date in July, maximum length 16 mm.; 4 on one date in August, all small.

**Larval stage.**

*Scomber colias.*

1910, August 22: A cyst from the viscera of a chub mackerel contained a larval *Rhinebothrium* which appears to belong to this species. The cyst measured 1 by 0.17 mm., and was thin walled; blastocyst not satisfactorily made out; larva with strap-shaped bothria, provided with many loculi, and hinged in the middle, so that the scolex, when flattened under the cover glass, appeared to have eight bothria directed forward; length of bothrium 0.7 mm.

**RHINEBOTHRIUM LONGICOLLE Linton.**

1890, pp. 775-778, pl. 6, figs. 1-4.

1897a, p. 441, pl. 33, figs. 2-4.

1900, p. 275.

1901, pp. 433, 434.

1911, p. 585.

Records of this species not before published.

*Dasybatis centrura.*

1914, August 1: 6, collected by Dr. G. A. MacCallum.

*Myliobatis freminwillii.*

1903, July 11: 5 strobiles with scoleces, and about 8 with scoleces missing; length of longest about 28 to 30 mm.

(U.S.N.M., Helm. Coll. 7663.)

*Rhinoptera quadriloba.*

1917, July 12: 40, mostly adult and measuring as much as 100 mm. when straightened out in the killing fluid with camel's hair brushes; ripe segments 3 mm. in length: two small strobiles measured 15 and 24 mm. in length, respectively.

**RHINEBOTHRIUM MINIMUM (Beneden)**

1897a, pp. 441-442, pl. 33, fig. 5.

1901, p. 431.

1911, p. 587.

Records of this cestode not before published:

*Raja eglanteria.*

1906, May 14: 5 strobiles with scoleces, with fragments and free proglottides.

*Raja stabuliformis.*

Collected in 5 of the years from 1904 to 1914, inclusive; on 1 date in April, 2 scoleces with short strobiles, about 5 mm. in length, and numerous free proglottides; on 3 dates in May, 1 to 2 with numerous free proglottides; on 1 date in October, 1.

(U.S.N.M., Helm. Coll. 7664.)

## RHINEBOTHRIUM MACCALLUMI, new species.

Plate 1. figs. 2-4.

Scolex with four, short-pedicelled bothria, which, when flattened, are nearly elliptical, being slightly narrowed at the anterior end (fig. 3), each provided with about 16 pairs of loculi (fig. 4); neck practically none.

Strobile filiform, slightly swollen near the junction with the scolex; segments begin near the scolex, at first as fine transverse lines; first distinct segments much shorter than broad, increasing in length gradually, becoming longer than broad; adult proglottides not seen, last proglottides slender and rod-like with length three times the breadth.

Dimensions of specimen mounted in balsam (fig. 2): Length 28; bothrium, length 1.05, breadth 0.50; diameter, at junction of strobile and scolex 0.18, at enlargement back of junction 0.21, at point 1 mm., back of junction 0.16, at middle of length of strobile 0.18; distance to first distinct segments 2.8; length of first distinct segment 0.02, breadth 0.16; length of segments at middle of strobile 0.21, breadth 0.18; length of last segment 0.48, breadth 0.16; average length of last 10 segments 0.40.

There were approximately 150 segments in the last 24 mm. of the strobile.

The bothria in one of the mounted specimens were flattened so as to show the plan of loculi. In this specimen they were as shown in figure 4, that is, 16 pairs, with an odd, terminal loculus at the anterior end.

Adult proglottides were not seen, but from the positions of rudiments of cirrus-pouches, the genital apertures were seen to be irregularly alternate, near the middle of the length of the proglottis, and near the lateral margin.

*Type*.—U.S.N.M., Helm. Coll. 7665.

*Dasybatis centrura.*

1922, July 15: 3, from spiral valve of a large sting ray.

1923, August 20: 3.

## CROSSOBOTHRIMUM ANGUSTUM (Linton).

Plate 1, fig. 5.

1889b (*Orygmatobothrium angustum*), pp. 463-469, pl. 3, figs. 1-3.

1890, pp. 796-799, pl. 7, fig. 3.

1897a, p. 443.

1900, p. 272.

1901 (*C. angustum*), pp. 426, 427.

1905, pp. 339, 343.

1908a, p. 114.

1910a, p. 693.

1911, p. 585.

Records of this cestode not before published:

*Carcharhinus commersonii*.

1907, July 26: 3 strobiles, and a few fragments; collected by Dr. Davenport Hooker, at Tortugas, Florida.

1923. On 7 dates in August, and one in September: Many, 14, 57, 1, 1, 1, 1, 5, 3; maximum length noted 34 mm.

*Carcharhinus limbatus*.

1915, August 6: 175, and numerous free proglottides in spiral valve.

1923, August 23: 55, very slender, maximum length 80 mm., from a 199-centimeter shark.

*Carcharhinus milberti*.

See page 7 for remarks on the species *C. milberti* and *C. obscurus*.

This is a common parasite of this and of the dusky shark, where it is usually associated with other small cestodes in the spiral valve. For example, the record for July 3, 1922, shows 6 *C. angustum*, 69 *A. laciniatum*, and 185 *P. lasium*, with large numbers of free proglottides in the spiral valve of a shark.

Collected in the years 1915 and 1922. On 2 dates in July, 3 sharks examined, 31 in one, 6 in another, and few in another, the latter collected by Dr. G. A. MacCallum; on 8 dates in August, 17 sharks examined: (1) a few found in each of 3 out of 6 sharks; (2) very numerous; (3) 1 from each of 2 210-centimeter sharks; (4) 3, with free proglottides; (5) 5 from a 135-centimeter shark; (6) 113 from a 135-centimeter shark; (7) 9 from a 210-centimeter shark, 4, maximum length 22 mm., from a 210-centimeter shark, 71, maximum length 22 mm., from 165-centimeter shark, 24, maximum length 23 mm., from a 135-centimeter shark; (8) 36, with free proglottides.

*Carcharhinus obscurus*.

See page 7 for remarks on the species *C. milberti* and *C. obscurus*. See also under *C. milberti*.



Collected in 11 of the years from 1905 to 1918, inclusive: On 4 dates in July: (1) 200 or more, maximum length 20 mm.; (2) 30, young strobiles; (3) many; (4) few, in 1 of 3 sharks. On 7 dates in August: (1) to (4) numerous on each date, with large numbers of free proglottides; (5) 2, associated with 3 *A. laciniatum* and 8 *P. lasium*; (6) 33 in 1, and 3 in another of 3 sharks; (7) 14. On 9 dates in September: (1) few; (2) very numerous, with free proglottides, maximum length 20 mm.; (3) 50 or more, with many free proglottides, no other species found; (4) 8, with free proglottides, from 60-centimeter shark; (5) 20, maximum length 18.5 mm., with free proglottides; (6) 95, maximum length 23 mm., a few free proglottides; (7) 200 and over; (8) 8; (9) 1, length 20 mm. On 2 dates in October: (1) many with free proglottides; (2) 6, from 9 to 16 mm. in length.

(U. S. N. M., Helm. Coll. 7666.)

*Carcharias taurus.*

1905, August 8: 1 strobile with scolex, and easily separating, but mature, segments.

*Galeocerdo arcticus.*

1907, August 7: 5. The scoleces are in agreement with this species; the strobiles are rather longer, about 30 mm., in balsam, than is usual in this species; little change in the proportions made by the killing fluid.

1912, August 19: 2.

1915, July 31: Few.

*Galeus glaucus.*

1905, August 5: 20, very small; from spiral valve of young shark about 90 centimeters in length.

1923, July 23: 52, small, maximum 8 mm., from a 945-centimeter shark.

*Vulpecula marina.*

1914, July 23: 10, small, 7 to 10 mm. Dimensions of living specimen, in sea water: Length, 7.5; bothria, variable, length of one expanded and attached to slide, 0.52, breadth 0.45, diameter of acetabulum, 0.07; distance to first segment 3; first distinct segment, length, 0.19, breadth 0.18; last segment very variable, approximate length 0.70, breadth 0.45. The last segments separate from the strobile easily; length of free proglottis 2.65, breadth 0.78. The ova in this species are characteristically fusiform.

1922, August 23: 4. The bothria in this species, as I have usually seen them, are somewhat narrowed in the vicinity of the acetabula, especially while actively extending themselves. In this lot from the thrasher shark the bothria were rather oblong-elliptical, even

when they were actively contracting and extending. Length, 5.5, straightened in alcohol, in which they showed a tendency to contort: 4 free segments.

1923, August 28: 9, small, from a 173-centimeter shark.

**CROSSOBOTHRUM LACINIATUM** Linton.

1889*b*, pp. 469-474, pl. 3, figs. 4-18.

1890, pp. 799-802, pl. 7, fig. 4.

1897*a*, pp. 445-446.

1900, p. 273.

1901, p. 429.

1910*a*, p. 694.

1910*b*, p. 1200.

1911, p. 585.

Dr. W. C. Curtis, Biological Bulletin, vol. 5 (1903), pp. 125-142, figs. 1-8; vol. 11, (1906), pp. 202-228, pls. 4-7.

Following are records of this cestode not before published:

*Carcharias taurus*.

This cestode appears to be peculiar to the sand shark, from the spiral valve of which it is rarely absent.

Collected in 7 of the years from 1904 to 1922: On 4 dates in June: (1) 7 large, maximum 100 mm., a few small, and a few free proglottides; (2) very numerous, adult, young, and free proglottides; (3) 12, and numerous free proglottides, from a 150-centimeter shark; (4) few, no free proglottides, from a 105-centimeter shark. On 3 dates in July: (1) 108, large and small, from 2 sharks; (2) a few fragments of strobiles, and a few free proglottides; (3) 21, and a few free proglottides; among the strobiles were four with adult segments, beginning about 10 mm. back of the scolex. On 8 dates in August: (1) Numerous in each of 2 sharks; (2) 2 mature, 1 young; (3) few, large and small; (4) few, small; (5) 1 mature, free proglottis; (6) several, large and small; (7) numerous, some small, none with ripe proglottides; (8) 4, with many free proglottides, collected by Dr. G. A. MacCallum. On 8 dates in September: (1) very numerous, adult, young and free proglottides; (2) numerous in each of 2 sharks, adult, only 1 young noted, large numbers of free proglottides; (3) many, adult, young, and free proglottides; (4) numerous, a few young, many free proglottides; (5) numerous, a few young, many free proglottides; (6) 2 fragments; (7) 35 with scoleces, many without scoleces, and many fragments, great numbers of free proglottides, some of them unusually large, length 7 mm., breadth 3.5 mm.: young and adult, maximum length 120 mm., formalin material; (8) 1, from a 202-centimeter shark, and 91 from a 130-centimeter shark.

(U. S. N. M., Helm. Coll. 7667-7668.)

1923. On 4 dates in July and one in August; 3 to 40; few to great numbers of free proglottides; maximum length noted 100 mm.

NOTES ON CERTAIN GENERA BELONGING TO THE FAMILY PHYLLOBOTHRIIDAE.

In common with others who have attempted to classify Selachian Cestodes I have experienced much difficulty with those genera of the Phyllobothriidae which are characterized by having a scolex with four unarmed bothria, each provided with an auxiliary sucker at its anterior end, and without costae.

The generic names which I have used for members of this group are, *Anthocephalum* Linton, *Calyptrobothrium* Monticelli, *Crossobothrium* Linton, *Monorygma* Diesing, *Orygmatobothrium* Diesing, and *Phyllobothrium* Beneden.

As I have interpreted these genera they may be arranged according to the following scheme:

- |  |                           |
|--|---------------------------|
| 1. Auxiliary acetabula relatively small, borders of bothria usually thin and flexible, often folded or crumpled..... | 3.                        |
| 2. Auxiliary acetabula more or less cup-shaped.....  | 4.                        |
| 3. Bothria in pairs, leaf-like with crenulate borders.....   | <i>Phyllobothrium</i> .   |
| Bothria cruciform with crenulated borders.....   | <i>Anthocephalum</i> .    |
| Bothria cruciform, borders not crenulate.....  | <i>Crossobothrium</i> .   |
| 4. Bothria with sphincter muscle on border.....  | <i>Orygmatobothrium</i> . |
| Bothria plain, acetabula cup-shaped.....   | <i>Monorygma</i> .        |
| Acetabula large, horseshoe shape.....  | <i>Calyptrobothrium</i> . |

Consideration is not here given to two characters which are usually mentioned in descriptions of these genera, that is, the presence or absence of a myzorhynchus, and the pedicelled or sessile condition of the bothria.

As to these features it may be said that, whether the bothria are pedicelled or not, is often very difficult to determine in these strongly contractile forms, unless one has seen them when they were actively mobile. Furthermore, the presence or absence of a myzorhynchus, unless it is represented by a permanent sucker, as in *Echeneibothrium*, is of little importance, since it is an evanescent structure, found in a variety of larval forms, as for *Scolex polymorphus*, and may be retained more or less discernibly, in scoleces which have developed strobiles.

It is significant that Zschokke in his admirable monograph<sup>2</sup> gives evidence of the unsettled state of the systematic relations of such forms as are here being considered, as for example, *Orygmatobothrium* (*Phyllobothrium*) *dohrnii* Oerley, and *Anthobothrium* (*Orygmatobothrium*) *musteli* van Beneden; other examples could be cited.

<sup>2</sup> Recherch. sur Struct., etc., des Cestodes.

The material which I have does not warrant an attempt at the revision of these difficult forms. The foregoing observations are made in the hope that they may prove of assistance to future workers.

**MONORYGMA PERFECTUM (van Beneden).**

Plates 2 and 3, figs. 18-31.

*Anthobothrium perfectum* P. J. VAN BENEDEN, Mem. sur Les Vers Intestinaux, p. 125, pl. 17, figs. 11-14.

Diesing<sup>3</sup> made the new generic name *Monobothrium* for this species. See Zschokke.<sup>4</sup>

For more complete bibliography, see Stiles and Hassall.<sup>5</sup>

The material here reported was obtained from the stomach of a sleeper shark (*Somniosus brevipinna*), Moser Bay, Alaska, June 3, 1903, and was sent to me by Dr. C. W. Stiles.

(U.S.N.M., Helm. Coll. 7669.)

There are three strobiles in the lot, measuring 55, 70, and 85 mm. in length, respectively. No free proglottides were present, but there were a few short chains of ripe segments. Following are measurements of the largest specimen: Length 85; breadth of scolex 3.50; length of bothrium 2.50; breadth of strobile behind scolex 2.50; length of segments 10 mm. back of scolex 0.07, breadth 3; 25 mm. back of scolex, length 0.21, breadth 3.50; 40 mm. back of scolex, length 0.28, breadth 5; 60 mm. back of scolex, length 0.56, breadth 5; average length of last 15 segments 0.86; breadth 4.50.

Five ripe proglottides, each with the uterus swollen with ova, and bulging out on the ventral side, were 4.75 in breadth, and of about uniform length, 1.6. The thickness through the projecting uterus hump was 2. When pricked, one of these proglottides liberated large numbers of fusiform ova, 0.09 by 0.03 in the two principal diameters.

*Scolex*.—As seen in alcoholic specimens the scolex is pyramidal, truncate in front. The bothria are pyriform, the posterior loculus deeply cup-shape, with rather thin, sharply defined borders. The anterior loculus (auxiliary acetabulum) is shallower, almost saucer shape. Transverse sections of the scolex show a central dense mass of deeply staining cells, marking the anterior termination of the axis of the scolex. This appears in five sections of the series, and represents a structure which is a little more than one-third the length of the anterior loculus of a bothrium, and is doubtless to be interpreted as the rudiment of a myzorhynchus (fig. 21).

<sup>3</sup> Sitz. d. kais. Akad. d. Wissens., Wien, vol. 13, p. 583.

<sup>4</sup> Recherch. sur la Structure Anatomique et Histologique des Cestodes, pp. 281-294; pl. 7, figs. 114-120.

<sup>5</sup> Bulletin 85, Hygienic Laboratory, p. 276.



One conspicuous feature in scoleces of certain cestodes, as for example, *Calliobothrium*, mentioned by Zschokke<sup>6</sup> as characteristic of *Monorygma perfectum*, that is the four muscular bands placed transversely at the level of the boundary between the accessory suckers and the bothria, seems to be entirely wanting.

Diesing makes the presence of a myzorhynchus a generic character of *Monorygma*. Zschokke does not mention this structure, although his admirable account of this species does not include a detailed description of the histology of the scolex. As stated above I find what I interpret as the rudiment of a myzorhynchus in the scolex of the Alaska material.

*Strobile*.—For a short distance back of the scolex there is no indication of segments, further than is shown by faint, transverse lines. About 4 mm. back of the scolex the lateral margins are minutely but regularly crenulate, and at a distance of 10 mm., definite segments can be distinguished, with a length of 0.07 and a breadth of 3 mm. For other dimensions, see foregoing measurements. The general habit is rather broad, and, especially in the region of ripe segments, thickish. Sections of proglottides, with uterus moderately filled with ova, show the thickness to be about one-third the breadth. The lateral margins of the proglottides are slightly rounded, and the posterior margin projects but little. The genital pores are irregularly alternate, and are placed near the anterior end of the proglottis, almost exactly on the lateral margin, but shown in sagittal sections to be situated a little toward the ventral side.

The cuticle consists of a dense inner layer, and a thicker outer layer which abrades easily. The outer layer is difficult to interpret. I find no trace of the stiff, slightly recurved bristles on the neck, nor of the dense covering of papillae on other parts of the strobile, such as are mentioned by Zschokke.<sup>7</sup> The outer layer in longitudinal sections appears to be made up of short, blunt papillae, but these are but sections of the fine transverse corrugations on the surface of the strobile, which, it is true, simulate papillae.

The fibers of the longitudinal muscles are rather slender, and peculiar in that they are, for the most part, distinct, except at the lateral margins, and in the neck, where there is a slight indication of fascicles. The muscular layer is not sharply marked off from the vitellaria on the one hand, and its fibers interpenetrate the subcuticula on the other. Near the scolex the muscle fibers become larger and more numerous and they encroach on the surrounding tissue to

<sup>6</sup> Recherch. sur la Structure Anatomique et Histologique des Cestodes, p. 285.

<sup>7</sup> Idem, p. 284.

such a degree that the subcuticula is reduced, in transverse sections, to a narrow line. Next the cuticle the subcuticula is dense.

The longitudinal excretory vessels are rather remote from the lateral margins. In a transverse section, 4 mm. in the longer diameter, which represents the breadth of the strobile at that point, the longitudinal vessels were 0.86 from the lateral margins. In the same section the lateral nerve was 0.28 from the lateral margin. No trace of circular muscles was seen.

*Reproductive organs.*—The cirrus-pouch is long-pyriform, and lies near the anterior border of the proglottis. It opens by the common genital pore on the lateral margin near the anterior end of the proglottis. The cirrus is long and slender, and covered with very dense, hair-like spines. The vas deferens is voluminous, and lies between the median end of the cirrus-pouch and the uterus. The testes occupy the median portion of the parenchyma, extending laterally nearly to the nerve. They are continuous along the median axis of transverse sections of the anterior end of a proglottis, but are interrupted by the ovary, and, in ripe proglottides, by the uterus. In transverse sections they form a single slightly irregular row toward the margins, becoming irregularly two-ranked for a short distance near the middle of sections made in front of the uterus.

The vagina enters the common genital cloaca from the anterior side. In a series of sagittal sections the genital cloaca was estimated to be 0.2 mm. deep. The vagina is a thin walled tube at first lying along the anterior border of the cirrus-pouch, and the coils of the vas deferens. In its earlier portion it is lined with fine hair-like spines similar to those of the cirrus but shorter. It is compressed, at first dorso-ventrally, then antero-posteriorly (figs. 24-29). Toward the median axis of the proglottis it becomes tubular for a short distance, then, in most cases, it was compressed again in the vicinity of the uterus. At the median axis it turns toward the posterior and follows the uterus, being partly enclosed in the uterine walls, in a tortuous course on the dorsal side. Before joining the germ duct it enlarges to become the seminal receptacle, which lies, in about two close coils at right angles to the long axis of the proglottis. The complex formed by the ducts of the genitalia in the vicinity of the shell gland is compact, and difficult to reconstruct from the sections. A provisional interpretation is given in Figure 30. The ovary is at the posterior end of the proglottis and consists of two main divisions symmetrically placed, the one dorsal and the other ventral, each being distinctly lobulate.

The vitellaria make a distinct layer of the extra-parenchymatous region of the proglottis immediately within the layer of longitudinal

muscles. It is continuous at the lateral margins, thus surrounding the regions in which the longitudinal vessels and the lateral nerves lie.

The uterus is median in position, being nearly circular in its outline in sections of adult proglottides in both transverse and sagittal sections.

While there would seem to be no reason to doubt that these Alaska specimens belong to van Beneden's species, nevertheless, when one considers the details of the anatomy, given in Zschokke's excellent description of this cestode, differences appear which can not well be ignored.

1. Zschokke's figure of the scolex<sup>8</sup> shows elongated bothria which, it is hard to see could contract into the shape which all of my specimens uniformly have.

2. The figure of the uterus<sup>9</sup> shows a much more sacculated structure than I find in sections made at relatively the same stage of development.

3. In the plan of the reproductive system<sup>10</sup> while my material is far from being all that could be desired, I find a distinct ootype, that is, a muscular, funnel-like beginning of the germ duct; also the oviduct enters the uterus a little above the posterior third, instead of at the anterior end.

4. Both Beneden and Zschokke speak of ripe proglottides becoming longer than broad. In my specimens, even those which have the uterus bulging with eggs, the breadth of the proglottides is more than four times the length.

5. In my sections I find no trace of the "stiff, slightly recurved bristles" on the neck, nor the "dense covering of villi" of the remainder of the body, mentioned by Zschokke. As already stated, the outer layer of the cuticle in longitudinal sections of the Alaska material appears to be composed of short, blunt papillae, but these are sections of fine transverse corrugations on the surface of the strobile.

I venture the suggestion that Zschokke's material from *Catulus stellaris* is specifically different from Beneden's material from *Somniosus brevipinna* (*Seymnus glacialis*, and *Laemargus borealis* of Beneden's papers are synonyms; see Jordan and Evermann, Fishes of North America (p. 57) ).

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<sup>8</sup> Recherch. sur la Structure Anatomique et Histologique des Cestodes, fig. 114.

<sup>9</sup> Idem, fig. 120.

<sup>10</sup> Idem, fig. 119.

## MONORYGMA, species.

Plate 1, fig. 6.

1900, p. 271.

1901, pp. 426, 429.

1911, p. 586.

Small cestodes of this genus are recorded in my notes on a few occasions, but the preserved material does not admit of satisfactory specific determination. Following are records not before published.

*Squalus acanthias.*

1910, July 29: 1. Length of specimen in balsam 3 mm.; length of bothrium 0.28, breadth of anterior loculus 0.14, posterior loculus 0.28; bothria with thick, muscular walls.

*Raja stabuliforis.*

1904, October 10: 1. Dimensions of alcoholic specimen: Length 7.7; bothrium, length 0.42, breadth 0.21; breadth of neck 0.14; distance to first segment 0.42; length of first segment 0.04, breadth 0.14; last segment, length 0.45, breadth 0.30; last segment fusiform, tapering at each end.

(U.S.N.M., Helm. Coll. 7670.)

## ORYGMATOBOTHRIMUM FORTE, new species.

Plate 2, figs. 8-10.

*Scolex*.—Squarish in front view, bothria cup-shaped, with thick, muscular walls, directed forward. There is an anterior accessory sucker which, in contracted scoleces, is enclosed in the bothrial cup. This condition is brought about by the contraction of a sphincter muscle at the margins of the bothria. The sphincter is much weaker than in *O. paulum*. Back of the bothria the scolex contains a complex of vessels of the excretory system, together with many strong muscle fibers, which continue into the strobile. There is no trace of a myzorhynchus.

*Strobile*.—Unsegmented portion (neck) long, and crossed by fine transverse lines, which make a serrate outline on the lateral margins. In some cases of extreme flaccidity the strobiles become attenuated and lose the serrate character of the margins. The serrations may continue to the posterior end of the strobile. Adult and ripe proglottides do not appear in any of my material. The first indication of segments may be as much as 5 mm. from the scolex, where the breadth is many times the length. They gradually increase in length but remain about the same breadth. Toward the posterior end they become squarish, then longer than broad.

*Reproductive organs*.—Only the rudiments of genitalia had developed. The genital pores are irregularly alternate, and a little



in front of the middle of the length of the proglottis. The rudiment of the cirrus-pouch is at right angles to the margin. Rudiments of the vagina and uterus lie along the median region from the base of the cirrus-pouch is at right angles to the margin. Rudiments of transverse streak on the posterior border of the proglottis, thickening at the median line, the thickening probably representing the rudiment of the shell gland. A broad, granular marginal space represents the vitellaria which appear to form a continuous mass within the muscular layer. The rudiments of the testes are the most conspicuous feature of these immature proglottides. They lie on either side of the median space back of the level of the cirrus-pouch. In front of the cirrus-pouch they are continuous across the median line, and are continuous with lateral masses in the posterior portions of the proglottis, except where interrupted by the cirrus-pouch.

The average breadth of ten mounted scoleces is 0.65 mm.; the largest, which is considerably compressed, is 0.98, and the smallest 0.46 mm. broad.

Dimensions of a specimen mounted in balsam: Length 18; diameter of scolex 0.70; bothrium, length 0.35, breadth 0.31; breadth of neck 0.35; distance to first segment 4.9; first segment, length 0.07, breadth 0.32; last segment, length 0.28, breadth 0.43. In another: length about 25 mm., the maximum breadth is 0.72; penultimate segment, length 0.35, breadth 0.56. The last segment tapers to a bluntly rounded point. Diameter of auxiliary sucker, measured on a section, length, 0.075, breadth 0.090. In a strobile which has not been compressed the penultimate segment is 0.46 in length and 0.24 in breadth.

This species has been found in the hammerhead shark (*Cestracion zygaena*) on the following dates:

*Type*.—U.S.N.M., Helm. Coll. 7671.

1911, July 5: Number not ascertained; associated with large numbers of other small cestodes in the spiral valve.

1913, August 18: 9.

1915, July 19: A few specimens, collected by Dr. G. A. MacCallum.

Following are extracts from notes made on living material, collected July 5, 1911: This species was easily separated from the other small cestodes found in the spiral valve of a large hammerhead, on account of its stouter habit, and its tendency to throw the body into a close spiral. They also exhibited more vitality than the others. After lying over night in sea water they were still in good condition and active, rather more active than any of the other species. The bothria are cruciformly placed, and are characteristically thick and muscular. There is an acetabulum, and the border

of the remainder of the bothrium is thickened into a muscular sucker. While the shape of a bothrium at rest is circular, it assumes many shapes while actively contractile, becoming elongated, sometimes rather pointed in front, and, occasionally, there is a slight protuberance at the posterior edge. The scolex, with the exception of that part of the bothria which is enclosed by the larger sucker, is translucent, as is also the very short neck-like portion. The whole strobile is thickish, actively contractile, with a tendency to coil in a spiral. No ripe segments were observed.

Much confusion exists in the classification of the small cestodes belonging to the Phyllobothriidae largely on account of the great diversity of shapes which their soft and exceedingly contractile scoleces can assume. It is desirable that extensive collections be made from a large number of species of sharks and rays, and prepared, as far as possible, under the same conditions, and by the same technic.

ORYGMATOBOTHRIMUM PAULUM Linton.

Plate 2, figs. 11-13.

1897a, p. 444, pl. 33, figs. 7, 8.

1901, p. 426.

1911, p. 586.

*Monorygma galeocerdonis* MACCALLUM, Zoopath., N. Y. Zoolog. Soc., vol. 1, p. 237, fig. 122.

Records of this cestode not before published:

The maximum length of mounted specimens is 15 mm. The cirrus is long and slender with a bulbous base, which is armed with short spines. An interesting feature, observed in a number of these worms is that, while the genital pores are irregularly alternate, there is a tendency for many successive proglottides to have these pores on the same lateral margin. For example, in the specimen from which Figure 12 was made, the 10 posterior proglottides had the genital pores on the left side, then 1 on the right side, preceded by 12 on the left side. In another the last 14 pores were on the right side, preceded by 5 on the left side. In another, 9 on the right side were preceded by 10 on the left side, and these by 6 on the right side.

*Galeocерdo arcticus*.

Collected in 5 of the years from 1905 to 1915.

On 1 date in June, many, over 100, in spiral valve of a shark measuring 325 centimeters. On 4 dates in August: (1) 225, in spiral valve of a 150-centimeter shark, taken at Menemsha Bight. The small cestodes found in this shark were examined with care but no other species except young *Thysanocephalum thysanocephalum* was found; (2) about 100, maximum length 12 mm., bothria active; stro-

biles showed a tendency to coil in close, somewhat irregular spirals; (3), 3; (4), 23.

On 1 date in September, few.

(U.S.N.M., Helm. Coll. 7672.)

**ANTHOCEPHALUM GRACILE** Linton.

1890, pp. 794-796, pl. 7, figs. 1, 2.

1897a, p. 439.

1900, p. 275.

1901, p. 433.

1905, p. 347.

1907e, p. 113.

1908b, pp. 162, 169.

1910a, p. 10.

1911, p. 585.

Records of this cestode not before published:

*Dasybatis centrura.*

1906, September 20: 12 slender strobiles, only 1 with scolex; material not in good condition.

1913, August 29: 1, length 15 mm. in alcohol.

1920, September 1: 2.

1923, August 20: 2 in one of two rays.

(U.S.N.M., Helm. Coll. 7673.)

**PHYLLOBOTHRIUM FOLIATUM** Linton.

1890, pp. 787-794, pl. 6, figs. 5-10.

1897a, p. 443, pl. 33, fig. 6.

1900, p. 275.

1901, p. 433.

1905, pp. 340, 347.

1910a, p. 695.

1911, p. 587.

Records of this cestode not before published:

*Dasybatis centrura.*

Collected in eight of the years from 1903 to 1922, inclusive: On three dates in June: (1) 8, with ripe proglottides, from a large sting ray; (2) 3 and 2 fragments; (3) 2, maximum length 60 mm., from 1 sting ray, and 5, young and adult, from another. On one date in July: 3, and a few fragments. On three dates in August: (1) 7, maximum length 60 mm.; (2) 1, length 45 mm., in alcohol; (3) 22; while attached to the mucous membrane of the spiral valve the anterior portion of the strobile stretches out into a long thread-like part; when placed in alcohol they have a tendency to plump up in the middle region, so that the strobile becomes long-fusiform. On

four dates in September: (1) numerous; (2) 2, length 15 mm.; (3) 29; (4) few. On one date in October: 10, length 30 mm.

(U.S.N.M., Helm. Coll. 7674.)

1923. Five rays examined on 4 dates, 2 in July and 2 in August: 1, 7, 10 with scoleces and a few strobiles with scoleces missing, 3, 6. Each pair of bothria pedicelled; bothria bordered with small loculi; auxiliary acetabulum small and not easily seen; it appears to be one of the loculi with thickened, muscular border; maximum length, in sea water, 100 mm.

*Raja stabuliformis.*

Cestodes collected by Mr. Edwards on different dates from the barn-door skate which appear to belong to this species are here recorded. Auxiliary suckers could not be made out in the formalin material, but were recognized in a series of transverse sections.

1906, April 20: 7 strobiles with scoleces, and 4 without; also numerous free segments. The habit of the strobile resembles that of typical specimens from the sting ray. Ova 0.034 by 0.027 in the two principal diameters.

1913, April 17: 3, and free proglottides, lengths 20, 31, and 50 mm.; maximum breadth 2 mm. April 23: 6, maximum length 80 mm. April 29: 6, maximum length 80 mm. May 1: 23, and many free segments. May 29: 6.

1916, May 19: 4, maximum length 70 mm.

**CALYPTROBOTHRIUM MINUS** Linton.

1900 (*C. occidentale*, in part), pp. 275, 298-299, figs. 92, 93, 96.

1901, p. 432.

1907c (*C. minus*), pp. 279-283, figs. 3-7.

1910a p. 694.

1911, p. 585.

Records of this cestode not before published:

The scoleces of this species are usually rather firmly embedded in the mucous membrane of the spiral valve, and are thus liable to be left fixed in the intestinal wall unless especial care is taken to remove them.

*Narcacion nobilianus.*

Collected in five of the years from 1908 to 1920: On seven dates in July: (1) free, ripe proglottides; (2) 1 with scolex, 5 with scolex missing, maximum length 20 mm.; (3) 4 young strobiles, longest about 12 mm.; (4) free proglottides, eggs dark, slender, fusiform; (5) 1; (6) 1 strobile and a few scoleces, from 1 of 4 torpedoes; (7) 2. On one date in August, 3. On one date in October, 17 strobiles, 3 with scoleces.

(U.S.N.M., Helm. Coll. 7675.)



**CALYPTROBOTHRIUM OCCIDENTALE** Linton.

1900, pp. 275, 298-299, figs. 94, 95, 97.

1901, p. 432.

1907a, pp. 155-157, fig. 2.

1907c, pp. 276-279, figs. 1, 2.

1911, p. 585.

Records of this cestode not before published:

*Narcacion nobilianus.*

Collected in 5 of the years from 1908 to 1920: On 3 dates in July: (1) 2, lengths 125 and 200 mm.; (2) 1 scolex and 2 fragments of strobiles; (3) 1, in 1 of 4 torpedoes. On 2 dates in August: (1) 1; (2) few, at lower end of spiral valve, in 2 of 3 torpedoes. On 1 date in October, 3 fragments of strobiles, 25, 75, and 120 mm. in length. (U.S.N.M., Helm. Coll. 7676.)

**LECANICEPHALUM PELTATUM** Linton.

1890, pp. 802-805, pl. 9, figs. 2-4.

1900, p. 275.

1901, p. 433.

1905, p. 347.

1910a, p. 695.

1911, p. 586.

Following are records of finds of this cestode not hitherto published:

*Dasybatis centrura.*

Collected in 3 of the years from 1903 to 1922: On 1 date in June, 2, and a few fragments. On 2 dates in July (1) 2, and a fragment; (2) a few fragments. On 1 date in August, many, collected by Dr. G. A. MacCallum. On 4 dates in September: (1) few; (2) 22; (3) 1; (4) 3, small, the only parasites found in the alimentary canal. The ray had been kept in the pool for a few days, stomach empty.

(U.S.N.M., Helm. Coll. 7677.)

1923. On two dates in July and one in August: 2 to many; in one case the scoleces were adhering firmly to the mucous membrane of the spiral valve; when placed in sea water the scoleces were very active, the anterior portion forming a vase-like organ which is evidently capable of acting as a sucker; maximum length 25 mm.

**TRILOCULARIA GRACILIS** Olsson.

Plate 2, figs. 14-17.

1911, p. 589.

Small cestodes found in the spiny dogfish are easily referable to the genus *Trilocularia*, and presumably belong to Olsson's species *T. gracilis*.

So far as I am acquainted with the literature of this species, ripe, or even adult, proglottides have not been found attached to the strobile of *Trilocularia*. Luehe's species, *Urogonoporus armatus*,<sup>11</sup> was rightly regarded, I think, to be a free cestode proglottis.<sup>12</sup> As to its being the free proglottis of *T. gracilis*, as Olsson argues, that is a point which does not seem to me to be satisfactorily established. The presence of spines on *U. armatus* is hard to account for, if it is from the strobile of *T. gracilis*, the strobiles of which are not represented as being armed. In cestodes which are characterized by the possession of cuticular spines, the spines are most strongly developed on the anterior portions of the strobile, and are usually absent, or lingering but sparingly, on the mature proglottides.

None of the strobiles in my collection have the slender proglottides, shown in Olsson's figure 27, but the resemblance to his figure 26<sup>13</sup> is striking.

On one of my slides there are two ripe segments mounted along with scoleces of *T. gracilis*. One of these measures 2.8 mm. in length and 0.7 in breadth. It is fusiform and practically filled with ova, except for a small area at each end. The ova do not have sharp outlines, but appear to be from 0.015 to 0.018 mm. in diameter. The genital pore is near the middle, or a little in front of the middle of a lateral margin. These proglottides may or may not be the proglottides of *T. gracilis*.

This cestode is characterized by having the bothria divided by a transverse septum near the anterior end into two parts, the posterior, and larger of which, being divided by a median septum, so that the bothria become trilobulate.

#### *Squalus acanthias*.

Collected in 7 of the years from 1903 to 1914. On 4 dates in May: (1) Numerous young cestodes, resembling *Scolex polymorphus*, but with characteristic trilobulate bothria; strobiles taper to posterior end, which is frequently curved; length of longest 5 to 6 mm., diameter of scolex 0.9 mm.; (2) 6, maximum 16 mm., 9 dogfish examined; (3) 1 scolex found adhering to a free proglottis of *Anthobothrium pulvinatum*, in a lot of formalin material from the spiral valves of 40 spiny dogfish; breadth of bothrium 0.56 mm.; (4) 1, length 10 mm. On 1 date in June, 4, found adhering to specimens of *Phyllobothrium loliginis*; length 1.73; length of bothrium 0.31, breadth 0.30; diameter of neck 0.18; bothria in pairs on lateral margin, covered with minute, stout bristles. On 2 dates in September: (1) 10, from spiny dogfish taken by the steamer *Fish Hawk* on Crab Ledge, off Chatham, Mass., in 16 fathoms, 6 dogfish examined. The

<sup>11</sup> Archiv. de Parasit., vol. 5, 209-250.

<sup>12</sup> Lunds Univ. Arssk., vol. 3, pl. 2.

<sup>13</sup> Idem, vol. 8, 465-471.

cestodes were small, longest 3.5 mm.; length of bothrium 0.48, breadth 0.45 mm.; (2) 1. On 5 dates in October: (1) A few small, slender segments; (2) to (5) 1 on each of 4 dates, 6 to 9 mm. in length. On 1 date in November, 12, all small, less than 10 mm. in length.

(U.S.N.M., Helm. Coll. 7678-7679.)

### Family ONCHOBOTHRIIDAE.

Following are records of collections of cestodes belonging to this family made since the publication of my report on Parasites of Fishes of the Woods Hole Region (1901).

The genera represented are: *Acanthobothrium*, *Calliobothrium*, *Onchobothrium*, *Phoreiobothrium*, and *Platybothrium*, all of which bear structureless, chitinous hooks on the bothria. The genus *Thysanocephalum* does not belong in this group. The hooks in that genus, instead of being structureless, have a very dense striated structure, and appear to be a modification of the dense, muscular border of the bothria.

#### CALLIOBOTHRIUM ESCHRICHTII van Beneden.

1890, pp. 812-816, pl. 7, figs. 5-12.

1897a, pp. 447, 448.

1910a, p. 9.

1911, p. 585.

Records of this cestode not before published:

Host; *Galeorhinus laevis*. Smooth Dog-fish; spiral valve.

July 9, 1904: 2.

July 31, 1905: 1.

August 4, 1905: 1.

August 5, 1905: Few, maximum 10 mm.

August 18, 1905: Few.

(U.S.N.M., Helm. Coll. 7680.)

#### CALLIOBOTHRIUM VERTICILLATUM (Rudolphi).

1889b, pp. 476-479, pl. 4, figs. 1-8.

1890, pp. 810-812.

1897a, p. 447, pl. 34, figs. 6, 7.

1900, p. 270.

1901, p. 425.

1910a, p. 694.

1911, p. 585.

Records of this cestode not hitherto published.

*Galeorhinus laevis*.

Usually present in the spiral valve of the smooth dogfish. Collections made in 8 of the years from 1903 to 1922, inclusive. Free, ripe proglottides present in most instances. Thus, on August 18,

1903, 2 strobiles, with numerous free, ripe proglottides, were found in the spiral valve of a dogfish. The ova in the ripe segments soon became dark brown in sea water. The ova were in linear clusters, usually 5 or 6 in the same capsule, and contained six-hooked embryos.

On 2 dates in May, 9 dogfish examined; few, with ripe proglottides.

On 5 dates in June, 9 dogfish examined; 3 to 17, maximum length 135 mm.

On 6 dates in July, 9 dogfish examined; 4 to 40, ripe proglottides on one date.

On 11 dates in August, 12 dogfish examined; 2 to 50, ripe proglottides on 5 dates.

On 4 dates in September, 5 dogfish examined; 3 to 50, ripe proglottides on 2 dates.

1923, August 4: about 12 in each of 3 dogfish.

(U.S.N.M., Helm. Coll. 7681.)

*Squalus acanthias.*

Found in the spiral valve of the spiny dogfish, where it does not appear to be a frequent guest.

1904, June 6: 1, length 115 mm.

1910, July 29: 30, maximum length 76 mm., from one of nine dogfish examined.

1922, July 20: 31, collected by Dr. G. A. MacCallum.

**ACANTHOBOTHRIMUM CORONATUM** Rudolphi.

Plate 4, figs. 33-35.

1901, p. 431, fig. 293.

1911, p. 585.

Prof. T. Southwell, to whom I had sent specimens of this species, remarks on its resemblance to Yoshida's *A. ijimai*.<sup>14</sup>

It is a common parasite of the barndoor skate (*Raja stabuliformis*), only a few, or often only one, in the spiral valve.

Following are records of this cestode not before published:

*Raja stabuliformis.*

Collected in 10 of the years from 1903 to 1922, inclusive.

On 3 dates in April: 3 skates; 6 on each of two dates and 18, with many fragments, on the other; maximum length 66 mm.

On 5 dates in May: 5 skates; 1 strobile with scolex on each date, several fragments and scoleces with scolex missing; maximum length 48 mm.; length of last segment 1.20, breadth 1.12.

<sup>14</sup> Parasitology, vol. 9, pp. 573-5, pl. 23, figs. 12, 13, text-fig. 1.



On 2 dates in June: 2 skates; 1 on one date; on the other date 4 with scoleces, and about 6 with scoleces missing; maximum length 60 mm.

On 1 date in July: 3 skates; 19 strobiles slender and filiform; scoleces adhered firmly to bottom of dish; maximum length 54 mm.

On 1 date in August: 1 skate; 1, length 60 mm.

On 1 date in September: 1 skate; 3, length 16 mm.

On 5 dates in October: 5 skates; 1 to 8, 19 in all; maximum length 66 mm.

On 1 date in November: 1 skate; 6 and a few fragments.

(U.S.M.N., Helm. Coll. 7682.)

The scolex is often firmly attached to the mucous membrane of the spiral valve, and, unless care is taken, may not be secured in collecting the strobiles.

*Reja eglanteria*.—While examining preserved material from this host, which had been identified at the time of collecting as *A. paulum*, a few individuals were found which differed from that species in the character of the hooks in a marked degree (see figs. 32 and 33). The scoleces were much contracted, and difficult to interpret; one, however, was seen in which three accessory suckers could be made out in that part of the bothrium which is anterior to the hooks. Length of bothrium 0.70, breadth 0.56; maximum length of hook 0.11.

1905, August 8: Few. August 21: 1.

#### *Dasybatis centrura*.

Several found in a vial which contained a considerable number of *A. paulum*, collected from a large sting ray, September 1, 1903. I find in my notes made at the time of collecting, that, on account of the large amount of material obtained on that date, the small forms were not separated carefully. Length, mounted in balsam, 15 mm.; length of hooks 0.12 mm.

#### ACANTHOBOTHRIMUM PAULUM Linton.

Plate 4, fig. 32.

1890, pp. 816–819, pl. 8, figs. 1–7.

1900, p. 275.

1901, pp. 433, 434.

1905, pp. 346, 348, 349, fig. 126.

1910a, p. 10.

1911, p. 585.

The cestode recorded in preliminary reports: 1907e (p. 113), and 1908b (p. 163), as *A. paulum* proved to be a new species, and was described under the name *A. brevissimum*, 1908b (pp. 173–4; pl. 4, figs. 26–29).

Following are records of finds of this species not hitherto published:

*Raja eglanteria.*

1905, August 8: 26, maximum length 10 mm.; length of bothrium 0.67, breadth 0.25; length of hooks 0.14. August 12: 1. August 21: 3. There were also free proglottides which appeared to belong to this species. All of them had small ova, with thin, collapsed shells.

1910, July 21: 12, length about 10 mm.

1916, September 11: 1, length 18 mm.

*Dasybatis centrura.*

1903, September 1: Few.

1914, August 1: 20, collected by Dr. G. A. MacCallum.

1922, June 22: One sting ray examined; many small strobiles and free proglottides in spiral valve. *A. paulum* noted. The anterior ends of the bothria, in front of the hooks, were very mobile, extending themselves into nearly linear prolongations.

1923, July 20: 2, 14 mm. August 15: 1, small.

(U.S.N.M., Helm. Coll. 7683.)

**ONCHOBOTHRIMUM UNCINATUM** Diesing.

1897a, p. 446, pl. 34, figs. 2-5.

1901, p. 433.

1905, p. 347, fig. 127.

1911, p. 586.

This cestode has been found in the northern sting ray at Woods Hole, and in the southern sting ray at Beaufort, N. C.; following are records not before published:

*Dasybatis centrura.*

1914, August 1: 3, found in a large sting ray examined by Dr. G. A. MacCallum.

1922, July 31: 1; length in sea water, 68 mm.; scolex white, neck pale, becoming pinkish posteriorly; posterior half of strobile salmon color: rather active. There were four strongly developed fascicles of longitudinal muscles in the neck, connected with the bothria, and traceable throughout the length of the strobile. Dimensions in balsam: Length of bothrium, 0.77; length of hooks, 0.135; distance to first segments, approximately, 2.8; length of posterior proglottis, 0.7, breadth 1.61.

(U.S.N.M., Helm. Coll. 7684.)

**Genus PHOREIOBOTHRIMUM** Linton.

This generic name was proposed to accommodate a cestode from the dusky shark (*Carcharhinus obscurus*), 1889 (p. 474). Type species, *P. lasium*.

The finding of another species in the dusky shark, and of two additional species in the hammerhead shark (*Cestracion zygaena*) makes a restatement of the generic characters desirable.

*Characters of genus.*—Four cruciformly placed bothria, each with an auxiliary acetabular space in front of a pair of compound hooks, and loculate at the posterior end.

In some contraction states the bothria appear to be tubular, thus suggesting, as was stated in the original description of the genus, Diesing's *Cylindrophorus typicus*, a name which he proposed for Wagener's *Tetrabothrium carchariae-rondoletti*. Further, in some contraction states of the strobile, especially noticeable in the species from the hammerhead shark, the neck bears a strong resemblance to Wagener's figure.<sup>15</sup>

PHOREIOBOTHRIUM LASIUM Linton.

Plates 4 and 5, figs. 36-40 and 54.

1889b, pp. 474-476, pl. 4, figs. 24-29.

1890, pp. 819-820.

1897a, p. 447.

1900, pp. 272-273.

1901, pp. 426, 427, 428.

1905, pp. 340-343.

1907e, p. 116.

1908a, p. 114.

1908b, pp. 163, 165, 174.

1911, p. 587.

The cestodes recorded as *P. lasium*, from *Cestracion zygaena* (1900, p. 273; 1901, p. 428) should be referred to *P. pectinatum*.

*Scolex.*—This is somewhat rectangular in outline; the bothria, being provided with a thick muscular border, are rather rigid; at rest they are parallel with the neck, or slightly flaring at the posterior end, in which case the scolex becomes somewhat hour-glass shape. There is a short lappet-like projection at the back of each bothrium near the posterior end, and the space thus formed is divided into a considerable number, 20 or more, loculi (figs. 36, 38).

The muscular borders of the bothria are carried forward and form a single acetabular space in front of the hooks. In some cases this space appears to have a faint trilocular structure. Each bothrium carries a pair of three-pronged hooks. Each hook is like a short-handled three-toothed rake, in which the oblong, bluntly rounded embedded portion is the handle, a transverse bar is the head, and the three prongs, which are nearly at right angles to the transverse bar and are strongly reflected, are the teeth. The middle prong is about twice as long as the inner and a little longer than the outer prong.

<sup>15</sup> Entwicklung der Cestoden, fig. 270.

The inner end of the horizontal bar projects slightly beyond the inner prong and meets its fellow on the median line of the bothrium. Under favorable conditions a small papilla may be seen between the anterior ends of the bothria (fig. 37).

*Strobile.*—The neck, and sometimes the proglottides, are armed with spines. Seen in front view these spines are triangular. In some cases they are very abundant. They are, however, evanescent, and specimens may be encountered from which they have disappeared entirely. The neck is linear and usually rather straight, increasing in breadth gradually and uniformly. The first indication of proglottides appears from 2 to 3 mm. back of the scolex. The first proglottides are broader than long, or squarish, but soon become longer than broad, and adult proglottides are much longer than broad, and somewhat rectangular in outline.

*Reproductive organs.*—The genital apertures are irregularly alternate, and are situated at about the middle of the lateral margins. When an adult proglottis, in which ova have not yet made their appearance, is observed in dorso-ventral view the ovary is seen to occupy about the posterior fourth, the vitellaria forming a dense border along each lateral margin. The vagina lies close to the anterior border of the cirrus-pouch, runs at nearly right angles to the long axis of the proglottis to the median line, thence in a sinuous course to the ovary. The rudiment of the uterus lies along the median line and extends to near the anterior end of the proglottis. The cirrus-pouch is somewhat pyriform, and is nearly at right angles to the margin; its length is approximately equal to one-third the breadth of the proglottis. A little of the vas deferens is enclosed in the inner end of the cirrus-pouch, thence its rather voluminous coils extend forward along the median line. The most conspicuous organs are the testes, which fill the interior of the proglottis in front of the ovary within the layer of vitellaria. In horizontal sections the testes are circular in outline; in transverse sections they are elliptical, and lie in a single row.

Until the summer of 1922 the ova of this species were not certainly identified. Then I had the opportunity of examining a large number of sharks, and succeeded in demonstrating the presence of rod-shaped ova (fig. 54) in gravid proglottides of *P. lasium*. These were at first taken to be linear clusters of eggs, but they seem to be eggs which are undergoing segmentation. Of those observed the vast majority consisted of 4 cells, a few were seen with 3, many with 5, and one with 6 cells. In all cases the cells were in linear arrangement. When proglottides, plump with ova, are placed in sea water they soon burst and a chalky white mass of ova is discharged.

Three species of cestodes, of practically similar dimensions, and of superficially like appearance, were found often associated to-



gether; namely, *Anthobothrium laciniatum*, *Crossobothrium angustum*, and *Phoreiobothrium lasium*. These cestodes have a similar habit with respect to the ripening of the proglottides. In each species the proglottides separate from the strobile before maturity. They continue to grow after separation from the strobile. Often the chyle of the spiral valve was found to be swarming with free proglottides of these three species. The ova are very different, one species from the other. Thus, in *A. laciniatum* they are nearly circular in outline, in *C. angustum* they are fusiform, and in *P. lasium* they are as described above. Further details are given under *C. milberti* below.

Following are dimensions of four specimens mounted in balsam:

Length of strobile.....	40.00	15.00	25.00	18.00
Breadth of scolex, excluding projecting hooks..	0.39	0.34	0.38	0.25
Length of scolex.....	0.51	0.34	0.34	0.30
Length of longest hook.....	0.10	0.10	0.10	0.11
Length of spines on neck, maximum.....	0.015	0.015	0.018	0.018
Distance to first distinct segment.....	2.50	2.80	1.12	2.10
Length of posterior segment.....	2.20	1.20	0.77	0.50
Breadth of posterior segment.....	0.34	0.35	0.45	0.25

Following is a list of finds of this cestode not hitherto recorded. All are from the Woods Hole region, and all from the spiral valve of the host.

#### *Carcharhinus commersonii*.

1922, August 5: 6, associated with 1 *C. angustum*, in a 135-centimeter shark, brought to the laboratory by Otis Luce, and identified by Dr. H. M. Smith; menhaden in stomach, beak and lenses of squid in spiral valve, also a structure which appears to be decalcified and partly digested spines of a small sting ray. August 7: 17, associated with 2 *A. laciniatum* and 3 *C. angustum*; many free proglottides; in a 135-centimeter shark; menhaden in stomach.

1923. On 10 dates in August and 1 in September, in 16 sharks; many, few, 54, 10, 115, 134, 2, 7, 1, 30, 197, 9, 119, 164, 1, 3; maximum length 59 mm., usual length 25 to 30 mm.

#### *Carcharhinus limbatus*.

1915, August 6: 7, associated with 175 *C. angustum*.

1918, July 13: 4, associated with 14 *Discocephalum pileatum*; in 210-centimeter shark; lenses and otoliths of fish in spiral valve.

#### *Carcharhinus milberti*.

1915, August 12: Many in each of 5 sharks. August 18: Many.

1916, September 25: 2.

1922, July 3: 185, in one of two sharks; fragments of squid in spiral valve.

July 10: 149, in a 135-centimeter shark; menhaden in stomach. Another shark, length 150 centimeters, was examined by Dr. G. A. MacCallum, many small cestodes in spiral valve, the majority of which were *P. lasium*.

August 5: 6, in a shark measuring 215 centimeters; menhaden in stomach.

August 11: 248, associated with 51 *C. angustum*, and 3 *A. laciniatum*. There were enormous numbers of ripe proglottides in the chyle. Most of those examined were *P. lasium*; 135-centimeter shark; fish vertebrae in spiral valve.

August 12: 9, associated with 9 *A. laciniatum*, and 113 *C. angustum*; 135-centimeter shark; menhaden in stomach. Measurements of three 4-celled eggs, living, gave the following results: Lengths, 0.08, 0.11, 0.13; breadth of each, 0.02. Dimensions of eggs mounted in balsam: Lengths of 5-celled eggs, 0.156, and 0.159; of 4-celled eggs, lengths, 0.12 and 0.135; breadths about the same in each, 0.02.

August 15: The sharks which were examined on this date were brought to the laboratory by Otis Luce, who had taken them in his trap at Blackwoods, near Tarpaulin Cove, Vineyard Sound. They were all males, and ranged in length from 144 to 202 centimeters. The stomachs contained menhaden. Seven sharks were examined. *P. lasium* found in each of them.

No. 1. Large: 30, maximum length 28 mm.; associated with 5 *A. laciniatum*, and 9 *C. angustum*. Many ripe proglottides; most of the eggs 4-celled; length of 3-celled egg, 0.066, breadth, 0.021, another measured 0.084 in length; a 4-celled egg measured 0.106 in length; breadth of eggs rather uniform, from 0.015 to 0.021.

No. 2. Large: 1, length 30; a few free proglottides.

No. 3. Large: 4, length 28; a few free proglottides.

No. 4. Large: 70, associated with 1 *A. laciniatum*, and 4 *C. angustum*; very many free proglottides.

No. 5. Medium: 4, maximum length 22; very few free proglottides.

No. 6. Medium: 23, associated with 71 *C. angustum*; a few free proglottides.

No. 7. Small: 11, maximum length 36, associated with 7 *A. laciniatum*, 24 *C. angustum*, and 5 *P. triloculatum*.

August 23: 42, associated with 15 *A. laciniatum*, and 36 *C. angustum*, in a 210-centimeter shark; menhaden in stomach.

(U.S.N.M., Helm. Coll. 7685.)

#### *Carcharhinus obscurus*.

See page 7 for remarks on the species *C. milberti* and *C. obscurus*.

Collected in 11 of the years from 1905 to 1918. On 4 dates in July: (1) Few, maximum 12 mm. in 135-centimeter shark: (2) 96, in a 120-centimeter shark, associated with 30 *A. laciniatum*, 10 *P. triloculatum*, and 1 *O. crenacolle*; a few free proglottides: (3)

many, with many *A. laciniatum*, and *C. angustum*, and 3 *P. triloculatum*; (4) few, in 1 of 3 sharks. On 10 dates in August: (1) many in 150-centimeter shark; (2) few, in 325-centimeter shark; (3) many, in a 302-centimeter shark; (4) 8, with 3 *A. laciniatum*, and 2 *C. angustum*, with very few free proglottides in a 225-centimeter shark; (5) 45, with 29 *A. laciniatum* and 5 *O. crenacolle*, in a 150-centimeter shark; (6) 3 in one shark, with 18 *A. laciniatum*, and 63 in another with 4 *A. laciniatum* and 4 *C. angustum*, many free proglottides; (7) 1, length 23 mm., and a few free proglottides in 1 of 2 240-centimeter sharks; (8) 30, in 165-centimeter shark, no other parasites found; (9) three 165-centimeter sharks from Obed Dagett's trap in Buzzards Bay. No. 1:65, with 6 *A. laciniatum*, 33 *C. angustum*, and 19 *D. pileatum*. No. 2:36, with 7 *A. laciniatum*, 19 *C. angustum*. No. 3:40, with 1 *A. laciniatum*, 2 *C. angustum*; (10) 9, no other parasites in spiral valve. On 5 dates in September: (1) 5, from 10 to 28 mm. in length, from a 150-centimeter shark; (2) 12, with 12 *A. laciniatum*, and over 200 *C. angustum*; (3) 14, with 95 *C. angustum*, from 3 small sharks; (4) 185, with 2 *A. laciniatum*, 8 *C. angustum*, 1 *P. cervinum*, and many free proglottides, in a 210-centimeter shark; (5), 93, with 9 *A. laciniatum*, 14 *C. angustum*, and 1 *T. bisulcatus*, in a 240-centimeter shark.

*Galeocerdo arcticus*.

1915, August 2: 2, with 2 *O. paulum*, and large numbers of *T. thysanocephalum*.

*Scoliodon tetrac-novae*.

1914, August 20: 1, length 20 mm., with 40 *C. angustum*, 2 *P. cervinum*, and 1 *D. pileatum*, in a 150-centimeter shark.

1915, July 15: Many, with a few *A. laciniatum* and many *C. angustum*.

*Vulpecula marina*.

1923, July 30: 1, and 2 fragments; lengths, 12, 15, 18 mm.

August 28: 270 counted; many adhering firmly to mucous membrane of spiral valve; maximum length 32 mm.

PHOREIOBOTHRIUM TRILOCULATUM Linton.

Plate 5, Figs. 45-46.

1901, p. 427, pl. 26, fig. 292.

1905, pp. 340, 343.

1911, p. 587.

This species is readily recognized by the three loculi at the posterior ends of the bothria.

*Scolex*.—Length and breadth about equal; more robust than *P. lasium*; hooks same general plan as in that species, but much larger,

middle and outer prongs about equal, inner prong much reduced, inner end of transverse bar blunt.

*Strobile*.—General characters as in *P. lasium* but rather stouter; spines on neck rather more slender; adult proglottides somewhat rounded, so that the posterior end of the strobile may become moniliform; anatomy of proglottis, so far as observed, differs little from that of *P. lasium*; free, ripe proglottides not yet certainly identified.

Measurements of four specimens mounted in balsam gave the following results:

Length of strobile.....	20.00	27.00	23.00	22.00
Breadth of scolex, excluding hooks.....	0.70	0.70	0.56	0.63
Length of scolex.....	0.70	0.70	0.56	0.63
Length of longest hook.....	0.18	0.14	0.15	0.165
Length of spines on neck, maximum.....	0.015	0.015	0.012	0.012
Distance to first distinct segment.....	2.50	3.00	1.68	1.48
Length of posterior segments.....	1.05	1.96	1.12	0.98
Breadth of posterior segments.....	0.63	0.43	0.56	0.42

This species has been recorded from *Carcharhinus obscurus*, at Woods Hole, Mass., and Beaufort, N. C., and from *Scoliodon terrae-novae*, at Beaufort.

The following additional finds of this species were all made at Woods Hole.

*Carcharhinus milberti*.

1922, July 3: 4, with 69 *A. laciniatum*, 6, *C. angustum*, and 185 *P. lasium*. August 15: 5, maximum length, 30 mm.

(U.S.N.M., Helm. Coll. 7686.)

*Carcharhinus obscurus*.

1905, July 28: Few, longest, 25 mm. August 11: 1.

1910, July 25: 10.

1914, July 11: 3.

**PHOREIOBOTHRIUM PECTINATUM, new species.**

Plate 5, figs. 47-50.

*Phoreiobothrium lasium*, 1900, p. 273; 1901, p. 428.

*Scolex*.—Smaller and relatively shorter than in either of the foregoing species; about seven loculi at posterior end of bothrium; the costa in front of the loculi is bordered with about seventeen short, flat, rounded, and scale-like papillae. The hooks are much like those of *P. lasium*, but smaller; moreover, the hooks of a pair are not symmetrical, the inner prong of one hook being much shorter than the other two, while the inner prong of the other hook is of nearly the same length as the two others (fig. 48). The horizontal bar of the hooks is relatively broader than in *P. lasium*, and the inner end projects very little.



*Strobile*.—The spines on the neck are longer and larger than in either of the foregoing species. The necks in most of my specimens are very slender. This species shows more irregularities due to different contraction conditions than is the case in either of the preceding species. Adult proglottides are from two to two and a half times as long as broad, with the ends more or less rounded or tapering. The general plan of the anatomy agrees with that of *P. lasium*.

Length of strobile.....	20.00	30.00	28.00	11.00
Breadth of scolex, excluding books.....	0.20	0.16	0.14	0.15
Length of scolex, approximate.....	0.12	0.16	0.14	0.15
Length of hooks, maximum.....	0.06	0.054	0.054	0.054
Length of spines on neck, maximum.....	0.03	0.03	0.03	0.03
Distance to first distinct segment.....	5.60	3.90	3.20	2.57
Length of posterior segments.....	1.82	1.92	1.68	0.77
Breadth of posterior segments.....	0.70	0.71	0.63	0.44

*Type*.—U.S.N.M., Helm. Coll. 7687.

From spiral valve of *Cestracion zygaena*.

1914, August 6: Few. August 7: 32.

The spiral valves from which these cestodes were obtained were given me by Dr. H. B. Goodrich. The sharks from which they came measured 135 and 150 centimeters, respectively. The worms were rather firmly attached to the mucous membrane near the anterior end of the spiral valve. The following measurements were made of living specimens:

Length of strobiles.....	24.00	29.00
Breadth of scolex, slightly compressed.....	0.27	0.27
Length of bothrium.....	0.15	0.15
Breadth of bothrium.....	0.18	0.18
Length of spines on neck, maximum.....	0.35	0.035

The scolex is so short that it usually presents nearly a front view when placed under the cover-glass. The neck is long and slender and the whole worm more or less spinose. Spines evanescent, many of them becoming detached when the cover-glass was placed on the worm in sea water.

PHOREIOBOTHRIUM EXCEPTUM, new species.

Plate 4, figs. 41-44.

*Scolex*.—Bothria enlarging toward the posterior end, which bears six loculi. The hooks appear to be two pronged. These prongs spring from a conical, roughened base which is inclined at an angle of about 45 degrees with the axis of the scolex. The inner tips of the bases of a pair of hooks meet on the median line of a bothrium in the same manner as do the horizontal bars of the three-pronged hooks of the three preceding species. The basal support of the hook

is short, bluntly rounded, as in the other species, and is situated opposite the base of the inner of the two large prongs. The two prongs of these hooks correspond to the middle and outer prongs of the three-tined hooks of the three foregoing species. The rudiment of a third, inner prong may be made out on close examination (fig. 43).

*Strobile*.—The neck, in all specimens seen, is slightly enlarged next the scolex, the enlarged portion being free from spines. Back of this point the neck narrows for a short distance, then enlarges, and has a tendency to enlarge and narrow irregularly. It is densely covered with relatively large, straight spines with strong basal supports which are elliptical in optical section. The neck is relatively long, and the first segments to appear are squarish, but are quickly followed by long and slender segments. Mature proglottides were not seen. The posterior segments show a tendency to become relatively broad, and are more or less rounded at the extremities. The genital pore appears to be a little back of the middle of a margin.

Measurements of four specimens mounted in balsam:

Length of strobile.....	20.00	16.00	14.00	25.00
Breadth of scolex, excluding hooks.....	0.46	0.35	0.42	0.42
Length of scolex.....	0.46	0.39	0.42	0.42
Length of hook, maximum.....	0.11	0.12	0.10	0.12
Distance to first distinct segment.....	0.036	0.036	0.036	0.036
Length of posterior segments.....	0.77	1.29	0.76	1.33
Breadth of posterior segments.....	0.68	0.49	0.43	0.28

From spiral valve of *Cestracion zygæna*.

*Type*.—U.S.N.M., Helm. Coll. 7688.

1911, July 5: 5, with many examples of *Platybothrium parvum*.

1913, August 1: 1.

#### PLATYBOTHRIUM CERVINUM Linton.

Plate 5. fig. 51.

1890, pp. 820–823, pl. 8, figs. 8–10; 9, fig. 1.

1901, p. 427.

1911, p. 587.

Hosts: *Carcharhinus obscurus*, *C. commersonii*, *C. milberti*, *Galeus glaucus*, and *Scoliodon terræ-novæ*; spiral valve.

This genus was based on a single specimen from the spiral valve of the dusky shark (*Carcharhinus obscurus*), collected at Woods Hole, August 12, 1887. It has been found on but three occasions since that date, all at Woods Hole.

On September 12, 1912, I found a single specimen of this species in a dusky shark. Dimensions, in balsam: Length 61; breadth of scolex in front, 0.2, middle, 0.52, posterior end, 0.12; length of scolex, 0.40; length of hooks, 0.15; breadth of pair of hooks, 0.21; distance

to first segments, 25; length of first distinct segments, 0.08; breadth, 0.28; length of posterior segments, 1.05, breadth 0.54; length of spines on neck, 0.012.

On August 20, 1914, two of these cestodes were found in the Sharp-nosed Shark (*Scoliodon tærrae-novae*). They measured 45 and 50 millimeters, respectively, lying in sea water. The neck was armed with short, triangular spines, about 0.015 mm. in length; strobiles spinose, sparsely so on posterior proglottides, which were immature. Length of hooks, 0.14; breadth of pair of hooks 0.25; breadth of scolex, 0.50; length of posterior proglottides, 0.70, breadth, 0.53.

On August 12, 1915, a few of these cestodes were found in each of two blue sharks (*Carcharhinus milberti*). Two of them in balsam measure 24 and 36 mm, respectively. The necks are densely, and the strobiles sparsely, spinose.

*C. commersonii*.

1923, August 4: 1, length 36 mm., in alcohol. 30:1.

*Galeus glaucus*.

1923, July 23: 77, young strobiles, maximum length about 16 mm.; densely spinose, length of spines about 0.02 mm.

(U.S.N.M., Helm. Coll. 7689).

This cestode has many features in common with *Phoriobothrium*. The neck is elongated, and both neck and proglottides are spinose, a feature that was not noted in the original description. There is an elliptical auxiliary sucker at the anterior end of each bothrium in front of the hooks. The posterior proglottides were sufficiently developed to show the following characters: The genital pores are at about the middle point of the lateral margin and are irregularly alternate. The vagina lies in front of the cirrus-pouch, passes antero-medial to the median line, thence, posteriorly, to the ovary at the posterior end of the proglottis. The vitellaria are best seen along the lateral margins but can be seen to form a continuous layer within the body wall. The cirrus-pouch was still rudimentary; its course from the margin is at first postero-medial, then antero-medial, with indications that coils of the vas deferens are enclosed in the median portion. The most conspicuous organs are the testes which fill the proglottis from the ovary to near the anterior end which for a short space is free from genitalia.

**PLATYBOTHRIUM PARVUM** Linton.

Plate 5, figs. 52 and 53.

1900, *Platybothrium*, species, pp. 273, 300, pl. 42, figs. 98, 99.

1901, pp. 426, 428, 430.

1911, p. 587.

Since the above records were made this species has been found at Woods Hole on the following occasions.

*Carcharhinus milberti*.

1922, August 5: 1, in spiral valve of a 210-centimeter shark.

*Cestracion zygaena*.

1911, July 5: Numerous, in spiral valve of a hammerhead shark, measuring 305 centimeter in length.

1913, July 21: Few, in spiral valve of a 225-centimeter shark, collected by Dr. G. A. MacCallum. August 1: 62 found in spiral valve of a 195-centimeter shark, and 12 in a 225-centimeter shark; maximum length about 12 mm. August 18: Many, from spiral valve of a 285-centimeter shark.

1914, August 7: 1; not noted at time of collecting, but found later on a slide with specimens of *Phoreiobothrium pectinatum* collected on this date.

(U.S.N.M., Helm. Coll. 7690.)

This species is readily distinguished from *P. cervinum* by its smaller size, the two costae, instead of one, on the bothria, and the larger size of the spines on the neck. Dimensions of specimen mounted in balsam: Length, 12 mm.; breadth of scolex, 0.30; length of hooks, 0.10; breadth of pair of hooks, 0.21; maximum length of spines on neck, 0.03; length of posterior proglottides, 1, breadth, 0.5; free proglottides, length, 2.24, breadth, 0.84; length, 2.10, breadth, 0.48.

In the lot collected July 5, 1911, mature free proglottides were observed which supply some details of the anatomy not given in the descriptions of this species which have been published.

The free proglottides, while presenting a considerable variety of shapes, are in general more or less oval in outline, the anterior end being free from genitalia. The cirrus is relatively large and covered with rather stout hooks. The distal portion of the vas deferens is enclosed in the inner end of the cirrus-pouch, the inner coils lying on the median line a little in advance of the vagina. Testes fill practically all of the inner portion of the proglottis. The vagina opens in front, and a little to one side of the cirrus at the genital pore, which is a little back of the middle of the margin; it passes directly to the median line, where it turns posteriorad and continues as a relatively large vessel, the seminal receptacle, to about the anterior edge of the ovary where it narrows and becomes the germ duct, which is more or less coiled and can be traced, in whole mounts, to the shell gland. The ovary is at the posterior end of the proglottis and occupies about half of the space behind the genital pore. The vitellaria form a layer surrounding the testes and are conspicuous in whole mounts along the lateral margins.



## THYSANOCEPHALUM THYSANOCEPHALUM (Linton).

*Phyllobothrium thysanocephalum*.

1889*b*, pp. 464-468, pl. 2, figs. 1-12.

*Thysanocephalum crispum*.

1890, pp. 823-824.

1891*b*.

1897*a*, p. 448.

1907*e*, pp. 113, 116.

1908*b*, pp. 162-163, 165, 174-175.

1910*a*, pp. 693-694.

1911, p. 589.

This cestode has been recorded hitherto only from the tiger shark (*Galeocerdo arcticus*), in which it has been found to be invariably present in the spiral valve, in large numbers, both young and mature strobiles, and large numbers of free, ripe proglottides.

Below will be found records of this cestode from a new host, the hammerhead shark (*Cestracion zygaena*).

Record of finds of this cestode not before published. Collections on the two 1908 dates were made in Tortugas, others at Woods Hole. *Galeocerdo arcticus*.

1905, August 26: Large numbers in spiral valve, adult to very small, with intermediate sizes, and many free proglottides; approximately 180, of which 30 were adult.

1907, August 7: 1 large specimen in stomach; 15 large, 13 medium, and 30 small specimens in spiral valve, with large numbers of free proglottides; largest 420 mm. in length.

1908, June 14: 200, approximately, small and medium. The spiral valve had been preserved in formalin at the Tortugas laboratory, and was examined by me on June 27. The shark had not been identified, but the character of the spiral valve, and the presence of large numbers of this cestode point to this host. June 24: Numerous, small and large, with free proglottides; from a shark 370 centimeters in length, Tortugas. The shark was taken before my arrival at the laboratory; the spiral valve had not been preserved, but some of the cestodes had been kept in formalin.

1910, September 3: 41, adult and young, longest about 220 mm.; one small specimen noted with forked posterior end. The gelatinous tissue plug, described in a former paper (1900, p. 271, fig. 102) as a tumor, is evidently normal, and is a structure whose function seems to be to prevent, or to render difficult, the passage of undigested pieces of food through the pylorus.

1912, August 19: 59 large, 494 medium and small, and large numbers of free, ripe proglottides, in spiral valve; maximum length about 600 mm.; from a 180 centimeter shark.

1913, August 13: Numerous, large and small, in spiral valve, largest 1 meter in length; shark examined by Dr. G. A. MacCallum. September 8: Numerous, large and small and free proglottides; from a 150 centimeter shark.

1914, August 12: Numerous, large, medium and small, and numerous free proglottides from spiral valve.

1915, July 31: Many different sizes, small to adult, numerous free proglottides, in spiral valve. August 5: Many, large and small, and great numbers of free proglottides in the chyle of the spiral valve.

1919, August 19: Large numbers, adult and young, and of free proglottides collected by George M. Gray.

(U.S.N.M., Helm. Coll. 7691.)

*Cestracion zygaena.*

1913, August 1: 1, in spiral valve. Dimensions, in balsam: Length 32; scolex, length 0.21, breadth 0.18; breadth of pseudoscolex 1.47; breadth of strobile behind pseudoscolex 1.05; posterior segment, length 1.40, breadth 1.90. Dimensions in alcohol before mounting: Length 40; diameter of scolex 0.22; diameter of pseudoscolex 1.82. The scolex agrees in details of structure with that of the form from the tiger shark, but is somewhat smaller. Thus, a scolex from the tiger shark, in balsam, measures 0.26 in diameter, and 0.30 in length. The chief difference between this example from the hammerhead and typical specimens from the tiger shark is that of size. While the posterior proglottides in the hammerhead specimen are not ripe, they are sufficiently developed to show all the genitalia except the uterus, the rudiment of which, however, can be distinguished in the posterior segment. Segments can be distinguished about 3 mm. back of the pseudoscolex, where their length is about 0.04, and their breadth 1.12. Ten mm. back of the pseudoscolex the proglottides are 0.32 in length and 1.54 in breadth. This is in sharp contrast with specimens from the tiger shark, which may be a meter or more in length, the first segments appearing at about one-third of the length of the strobile back of the pseudoscolex.

In spite of these differences, the details of structure are so similar in these cestodes that I do not feel justified in referring those from the hammerhead to a new species. It will be noted that while this cestode is very abundant in the tiger shark, it has been found on but three occasions in the hammerhead. It seems probable that the difference, which is mainly that of size, is due to the fact that the tiger shark furnishes a better physiological habitat for this particular species than does the hammerhead. Confirmation of this view is found in the condition of the material collected from a hammerhead in 1914, noted below.

The scolex was very active, projecting itself into an elongated, conical, proboscis-like tip, then retracting until it was hidden in the

folds of the pseudoscolex. It seemed to be more mobile than the forms from the tiger shark, while the borders of the bothria appeared to be less rigid.

1914, August 6: 1, measuring 115 mm., lying uncompressed in sea water. This specimen was badly macerated, as if affected by the digestive juices of the shark. The cestodes with which it was associated in the spiral valve, were living. Greatest breadth, near anterior end 5 mm.; breadth of posterior segments 3.5, length 2, compressed; breadth of pseudoscolex 6. When the specimen had been fixed in corrosive-alcohol-acetic, and straightened, it measured 147 mm.; in addition there were fragments aggregating 24 mm. Some of these were stained and mounted in balsam; although much macerated such of the anatomy as can be seen is in agreement with this species.

1915, July 19: 1, about 30 mm. in length, with medium sized pseudoscolex was collected from a hammerhead shark by Dr. G. A. MacCallam.

PARATAENIA MEDUSIA Linton.

1890, pp. 862-866. pl. 15, figs. 5-9.

1897a, p. 440.

1900, p. 275.

1901, p. 433; figs. 290, 291.

1905, p. 347.

1910a, p. 695.

1911, p. 587.

Records of this cestode not before published:—

*Dasybatis centrura.*

Collected in 6 of the years from 1903 to 1922 inclusive. On 1 date in July, 3 from small ray, 1 from large ray. On 3 dates in August: (1) Numerous; (2) 1, length 16 mm.; scolex, length 0.46, breadth 0.49; diameter behind scolex 0.17; distance to first distinct segments 0.14; first segments, length 0.14, breadth 0.19; median segments, length 0.58, breadth 0.22; last segment, length 1.12, breadth 0.29. Some free segments, much elongated, and crowded with minute thin-shelled eggs; (3) few. On 3 dates in September: (1) Few; (2) 2, length 4.5 mm.; (3) 2.

1923, July 7: many; August 15: 1; August 20: 4.

(U.S.N.M., Helm. Coll. 7692.)

ICHTHYOTAENIA ADHERENS, new species.

Plate 6, figs. 55-59.

*Taenia*, species 1901, p. 428; figs. 274-282.

1911, p. 589.

On July 31, 1899, a number of these cestodes were found attached to the mucous membrane of the spiral valve of a hammerhead shark at Woods Hole, Mass. About a dozen of them had their heads

deeply embedded within a space 10 mm. square. They were recorded as *Taenia*, species, with the comment that they suggested *Taenia gibbosa* Leidy, from a species of *Lamna* of the Pacific coast of North America. Since then I have examined hammerhead sharks at Woods Hole on nine different dates and have found these cestodes on two of those dates.

*Type*.—U.S.N.M., Helm. Coll. 7693.

*Cestracion zygaena*.

1903, August 3: 11, not in good condition, being in some cases partly macerated. The length of the longest specimen was 70 mm.; diameter of scolex 0.56, of bothrium 0.21; length of ripe proglottides 4.5, breadth 1.5; eggs large, smoky-brown, 0.21 by 0.14.

1914, August 7: On this date the spiral valve of a 180-centimeter hammerhead was examined; crystalline lenses and spermathecae of squid were found, and four species of cestodes, among them 10 specimens of this cestode. The maximum length was 75 mm. These worms were firmly attached to the mucous membrane. In many cases the scoleces were so deeply embedded that it was necessary to dissect them out in order to secure unbroken specimens. Around the point of attachment some infiltrated blood was noted. There seemed to be a faint patch of red pigment in the neck a short distance back of the scolex.

*Galeus glaucus*.

1923, July 23: 8, all firmly fixed to the mucous membrane of the spiral valve, which was slightly inflamed, and probably ulcerated at the points of attachment; length 41 mm., maximum breadth 1.4 mm.; densely beset with fine, short, evanescent spines, length about 0.024 mm.

Although several figures were published in the original report on this cestode, the written description was brief, and contained only data recorded at the time the collection was made. A more detailed description than that already published is therefore called for.

The Scolex is subglobular, with the bothria directed forward. The proglottides do not appear immediately behind the scolex. The general habit of the strobile is linear, but the breadth increases rather uniformly. Adult proglottides are longer than broad, and have the angles more or less rounded. Free, ripe proglottides may be three or more times as long as broad. The genital pores are irregularly alternate and situated at about the anterior third of the margin. A characteristic feature of ripe proglottides is the relatively large ova, which are nearly spherical and have thick shells. The dimensions which were given in the original description were of living material which had been washed in fresh water, and was consequently more or less turgid, hence the diameter of the scolex



there given is considerably larger than that given in measurements of material which has been obtained since.

The following dimensions are from measurements of material mounted in balsam, and belonging to the lot collected August 7, 1914.

Length 56; diameter of scolex 0.45, of bothrium 0.14; distance to first proglottis 0.70; length of first proglottis 0.14, breadth 0.42; length of proglottis 10 mm. from scolex 0.30, breadth 0.56; 20 mm. from scolex, length 0.70, breadth 0.84; 30 mm. from scolex, length 1.40, breadth 1.12; 40 mm. from scolex, length 1.40, breadth 1.20; length of last proglottides, average of three, 1.92, breadth 1.47. Another specimen of about the same length was in close agreement with this, the only difference being that the proglottides toward the posterior end were somewhat narrower. Thus, 40 mm. from the anterior end a proglottis measured 1.54 in length and 0.98 in breadth, while the average length of the last three was 1.86 and the breadth 1.12. The length of a free, ripe proglottis in the first lot, before placing in preservative, was 8.5, and the breadth 2.5.

*Anatomy of a proglottis.*—The cirrus is relatively long and is spinous, the spines measuring as much as 0.014 in length. In sagittal sections as many as seven sections of a retracted cirrus were noted in the same section of a cirrus-pouch. The coils of the vas deferens extend from the base of the cirrus-pouch anteriorly for a short distance near the median line and, in adolescent proglottides, lie beside the rudiment of the uterus. The testes are distributed throughout the interior of the proglottis inside the vitelline layer. In adult proglottides they are relatively large, and appear in sections as a single row of oval-elliptical bodies, from 0.14 to 0.16 mm. in the longer diameter. The vagina lies along the anterior border of the cirrus pouch and crosses the vas deferens near the median line. It then turns toward the posterior and follows the median line, along which its course is somewhat tortuous, to the shell gland which lies near the posterior end of the proglottis between the lobes of the ovary. The ovary lies near the posterior margin of the proglottis and is two-lobed, the lobes being united behind the shell gland. It occupies approximately two-thirds of the breadth and one-fourth of the length of an adolescent proglottis. The vitelline glands are widely distributed. In transverse sections they form a layer lying next within the muscular layer, its continuity being broken only in the vicinity of the genital pore. The uterus, before eggs have made their appearance, is tubular, and lies along the median line, extending from the vicinity of the shell gland near the base, nearly to the anterior end of the proglottis. In ripe proglottides it is much enlarged. In the proglottis sketched in Figure 56, the uterus communicated with the exterior through the ruptured wall of the

proglottis, on the median line, about on a level with the genital pore. The eggs are relatively large, for the most part nearly spherical, and are provided with very thick shells. In an egg measuring 0.18 mm. in diameter, the thickness of the shell was 0.012. All of the ova seen were segmenting. The largest number of nucleated cells noted in any section of an egg was 24.

DISCOCEPHALUM PILEATUM Linton.

Plate 1, fig. 7.

1890, pp. 781-787, pl. 10, figs. 1-7.

1900, p. 272.

1901, p. 427.

1907*d*, p. 97, pl. 5, fig. 31.

1907*e*, p. 116.

1908*b*, pp. 168-169, pl. 1, fig. 8.

1911, p. 586.

Hosts: *Carcharhinus commersonii*, Woods Hole, Mass.  
*limbatus*, Woods Hole, Mass.  
*milberti*, Woods Hole, Mass.  
*obscurus*, Woods Hole, Mass.  
*platyodon*, Bermuda and Tortugas.  
*Scoliodon terrae-novae*, Woods Hole, Mass.

Following are records of this cestode not before published:

*Carcharhinus commersonii*.

1923, August 4: 1, length 410 mm.; maximum breadth, 8 mm.

*Carcharhinus limbatus*.

1918, July 13: 14, attached to anterior third of wall of spiral valve of a 210 centimeter shark; length of smallest, 65 mm., one of the largest measured 450 mm. in length.

*Carcharhinus milberti*.

1915, August 12: 4, large specimens with ripe proglottides, attached at anterior end of spiral valve, from one of six sharks examined on this date. The scoleces of these cestodes, in shape something like a mushroom-anchor, have invariably been found firmly attached to the wall of the intestine, the muscular disk penetrating the mucous membrane, and removable only by dissection. Length variable, in sea water about 500 mm., and 10 mm. broad at widest part; segments toward posterior end have a tendency to become narrower; no free segments were seen. Enormous numbers of eggs were discharged. In a short time the bottom of the dish in which the worms were lying, was covered with ova, which, at first, were white, but shortly became dark colored. These ova were segment-

ing, and were somewhat irregular in outline; shell thin; 0.10 by 0.08 in the two principal diameters. These worms were much broader than those obtained from the black-finned shark on July 13. In other particulars, including the character of the ova, they were in agreement.

(U.S.N.M., Helm. Coll. 7694.)

*Carcharhinus obscurus*.

1914, September 1: 2, lengths 60 and 130 mm. Attached firmly to intestinal wall, the disk embedded in the mucosa. It was necessary to dissect it out before it could be removed.

1916, July 26: 2, scoleces missing, in one of three sharks. The sharks had been dead for some time. The scoleces were searched for with some care, but were not found. The strobiles were slightly macerated. After lying in sea water for a short time large numbers of segmenting eggs were discharged. Length of strobiles, 245 and 430 mm. respectively.

1918, August 5: 19, from one of three 165 centimeter sharks. These were all firmly attached to the wall of the spiral valve; 15 were attached in a row, 36 mm. in length; length of largest 360 mm., with a maximum breadth of 8 mm.; 4 small, immature specimens, in a cluster, length of each 25 mm.

*Scoliodon terrae-novae* (fig. 7).

1914, August 20: 2, lengths 140 and 240 mm. respectively. These agree with *D. pileatum*, except that the terminal disk is smaller than the cervical mass. The disk was ivory white, with a diameter of 0.80; when extended it was separated from the cervical mass by a constricted portion, 0.22 in length, and 0.60 in diameter; length of cervical mass 0.75, diameter 0.90. The general appearance of the scolex when fixed without compression bears some resemblance to the genus *Tylocephalum*.

The scolex was rather actively contractile, and showed a considerable variety of contraction phases.

There is a marked difference between the scoleces of these cestodes from the sharp-nosed shark and those from the dusky shark; the ratio of anterior disk to cervical mass being 0.82 to 140 in the former, and 1.82 to 1.40 in the latter, measurements made on specimens mounted in balsam. A comparison of the strobiles, however, does not reveal differences sufficient to justify referring them to different species. The posterior, ripe proglottides in each become longer than broad. The ova agree in size and appearance, having in each rather thin shells, irregularly collapsed, brownish, with a maximum size of about 0.11 by 0.07 mm.

## OTOBOTHRIUM CRENACOLLE Linton.

## Plate 13.

## IN FINAL HOST, ADULT.

- 1890, pp. 849-853, pl. 13, figs. 9-15; pl. 14, figs. 1-4.  
 1900, p. 273.  
 1901, p. 428.  
 1905, p. 344.  
 1907*b*, p. 122.  
 1907*e*, p. 116.  
 1908*b*, pp. 163, 185.

## ENCYSTED, LARVAL.

- 1897*b*, *Tetrarhynchus*, pt. pp. 807-809, pl. 16, figs. 6-9.  
 1901, *Rhynchobothrium*, pp. 453-454, pl. 23, figs. 255-256*a*; pl. 24, fig. 265.  
*Octobothrium crenacolle*.  
 1905, pp. 331, 340, 350, 363, 369, 372, 377, 381, 384, 386, 388, 395, 409, 413, figs. 110-115.  
 1907*b*, pp. 113-132, pls. 1, 2.  
 1907*d*, pp. 99, 100.  
 1910*a*, pp. 692, 694-5.  
 1910*b*, pp. 1201-1207.  
 1911, p. 586.  
 1912, pp. 5-9.  
 1914, pp. 53-56.  
 1915, pp. 19-28.

The adult stage of this cestode has been found in the spiral valve of *Carcharhinus obscurus*, at Beaufort, North Carolina, and Woods Hole, Massachusetts; *C. platyodon*, at Tortugas; *Scoliodon terrae-novae*, at Beaufort; *Cestracion zygaena*, at Woods Hole.

In the encysted stage it has been found, in Bermuda, in *Balistes carolinensis*, *Diplodus sargus*, *Ocyurus chrysurus*; at Beaufort, in *Bairdiella chrysurus*, *Carcharhinus obscurus*, *Coryphaena hippurus*, *Cynoscion nebulosus*, *Galeichthys milberti*, *Lagodon rhomboides*, *Micropogon undulatus*, *Opsanus tau*, *Orthopristes chrysopterus*, *Pomatomus saltatrix*, *Scoliodon terrae-novae*, *Scomberomorus regalis*; at Woods Hole, in *Carcharhinus limbatus*, *C. commersonii*, *C. obscurus*, *Caranx chrysos*, *Ceratocanthus schoepfii*, *Cynoscion regalis*, *Fundulus heteroclitus*, *Galeorhinus laevis*, *Lobotes suranensis*, *Paralichthys dentatus*, *Peprilus alepidotus*, *Pomatomus saltatrix*, *Poronotus triacanthus*, *Sarda sarda*, *Scomberomorus cavalla*, *Squalis acanthias*, *Trichiurus lepturus*, *Xiphias gladius*.

The encysted stage was found in the flesh of these species of fish: *Ceratocanthus schoepfii*, *Peprilus alepidotus*, and *Poronotus triacanthus*. In other hosts it was found in the submucosa of the stomach wall, in the mesentery, and on the viscera.

Following are records of finds of this cestode not hitherto published:

Adult stage. All at Woods Hole, Mass.

*Carcharhinus obscurus*.

1910, July 25: 1.

1913, August 6: 5.



*Cestracion zygaena.*

1908, August 27: 3, and numerous ripe proglottides free in the chyle of the spiral valve.

1912, August 9: Few, with free, ripe proglottides. The shark had been harpooned by Mr. Charles Grinnell on the 8th, and was not examined until the next day. The cestodes were somewhat macerated, but some of the ripe segments were still active.

1913, August 1: 2.

1914, August 7: Many, and large numbers of free, ripe proglottides, which were slender, wormlike, and active, even after lying for some time in sea water.

(U.S.N.M., Helm. Coll. 7695.)

**Larval stage.***Caranx chrysos.*

1910, September 22: 1, from small piece of stomach in vial.

*Carcharhinus limbatus.*

1915, August 6: Encysted in large numbers in submucosa of stomach.

1918, July 13: Very numerous in submucosa of stomach.

1923, July 28: Numerous, in submucosa of stomach.

*Carcharhinus obscurus.* (See p. 7.)

1907, August 3: Few, in amber colored cysts in stomach wall.

1911, August 3: Rather numerous, in submucous coat of stomach, most abundant near posterior end of cardiac portion. Some of the cysts were yellow. on account of the presence of degenerate tissue.

1912, September 12: Large numbers of cysts in submucosa of stomach; oval-elliptical, 1 to 1.5 mm. in diameter; submucosa of entire stomach thickly covered with these cysts, estimated to average 50 to the square inch.

1914, September 1: Cysts in stomach wall in enormous numbers. The stomach was examined in several places and these cysts were found in great numbers in all of them, most numerous at pyloric end. It was estimated that there were 12 cysts to every square centimeter of surface. The cysts were mostly yellowish, some were yellowish brown, and contained only degenerate tissue. Cysts which contain the characteristic scoleces of this cestode are from 1 to 2 mm. in the longer diameter. What was at first taken to be a cyst, 6 mm. in diameter, on the intestine of this shark, proved to be a small outfolding of the mucous membrane, filled with chyle. Its communication with the lumen of the intestine was nearly occluded.

1918, August 20: Cysts in submucosa of stomach. not numerous.

*C. commersonii.*

1923, August 25: Great numbers of cysts in mucous membrane of stomach of 184-centimeter shark, 100 cysts of *O. crenacolle* and one

*Synbothrium flicolle* in a piece of submucosa 12 by 8 mm., a large part of the stomach similarly infected; typical cyst 1.4 by 0.8 mm., largest 2 by 1.25 mm.

August 29: Very numerous in submucosa of stomach.

August 30: 1 cyst seen in submucosa, a few portions only of the stomach examined.

*Ceratacanthus schoepfi*.

1909, August 17: Numerous cysts in the flesh, most abundant near the back bone, associated with larvae of *Dibothrium*, species. Dimensions of one: Cyst 1.12 by 0.70; plerocercus 0.90 by 0.50; length of scolex 0.33.

*Cynoscion regalis*.

1903, August 20: Cysts in stomach wall; 1 fish examined.

1904, July 8: Cysts in stomach wall; 4 fish examined. August 6: 2 cysts, one of which contained 3 plerocerci.

1905, July 8 to 27: Cysts in stomach wall, few to many, in some cases associated with *T. bisulcatus*; on six dates; 29 fish examined.

*Fundulus heteroclitus*.

1904, August 26: 1 scolex, in dish in which viscera of 104 fish had been lying.

*Lobotes surinamensis*.

1908, August 15: Numerous, encysted in stomach wall.

*Paralichthys dentatus*.

1910, July 28: Encysted in stomach wall; 1 fish examined.

1920, August 25: Cysts in stomach wall, associated with *R. bulbifer*, 1 fish examined.

*Peprilus alepidotus*.

1908, July 24: Three fish, 11.5, 12.5, and 13.5 centimeters in length examined on this date. Each had numerous cysts in the flesh. Diameter of cyst, 0.7 by 0.5; plerocercus active, contracting between the lengths, 0.5 and 0.8; scolex, compressed, length, 0.8, diameter, 0.35, diameter of neck, 0.16, of scolex, 0.35, length of bothrium, 0.35; bulbs, length 0.07, breadth, 0.04.

July 29: Five fish, 13.5 centimeters in length, all had cysts in the flesh, 3 numerous, 2 many. Fish from Menemsha Bight trap. Cysts distributed as in the common butterfish, viz. above and below the vertebrae, most abundant ventral to the vertebrae above the posterior end of the body cavity, and between the body cavity and the caudal fin.

August 7: Two fish from Nantucket, J. H. Barrett, collector. These fish, 13 and 14 centimeters in length respectively, each had

numerous cysts in the flesh distributed both above and below the vertebrae, and through the muscles to the dorsal and ventral limits, mainly in the dorso-ventral median plane. Two fish on the same date, from Menemsha Bight, Daniel West, collector, and measuring 14 centimeters in length, each had numerous cysts in the flesh, also in the walls of the stomach.

October 10: Seven fish, examined by Vinal N. Edwards, all had cysts in the flesh.

1918, July 9: One fish from trap at Lamberts Cove. Cysts numerous in flesh.

*Pomatomus saltatrix.*

1910, July 1: Many on submucosa of 14-pound fish; most of the cysts amber color; a cyst, uncompressed, measured 1.82 by 0.70 mm.; a plerocercus, compressed, 2.38 by 1.05; length of scolex, 0.42.

1911, July 17: Small cysts in submucosa in each of 10 stomachs, very numerous. Some of these cysts contained typical scoleces of this species; others contained scoleces with somewhat longer necks, and of a yellowish color.

1912, August 16: Encysted in large numbers in submucosa of stomachs of 3 fish.

*Poronotus triacanthus.*

Occasionally found on viscera, but more often in the flesh; see special reports. Examinations of butterfish for flesh parasites have been made over a series of years. Following is a summary of the results of these examinations since 1908:

Year.	Length in centimeters.	Number of fish examined.	Number with many cysts in flesh.	Number with few cysts in flesh.	Number with no cysts in flesh.
1909	20 centimeters and over.....	282	175	83	24
	15 to 20 centimeters.....	131	82	31	18
	10 to 15 centimeters.....	43	15	16	12
	Less than 10 centimeters.....				
	Total for 1909.....	456	272	120	54
1910	20 centimeters and over.....	297	114	109	74
	15 to 20 centimeters.....	111	43	30	28
	10 to 15 centimeters.....	8	8		
	Less than 10 centimeters.....				
	Total for 1910.....	416	165	139	102
1911	20 centimeters and over.....	183	73	55	55
	15 to 20 centimeters.....	154	87	43	24
	10 to 15 centimeters.....	66	26	31	9
	Less than 10 centimeters.....	263	200	60	3
	Total for 1911.....	666	386	189	91
1912	20 centimeters and over.....	300	115	99	86
	15 to 20 centimeters.....	182	50	65	67
	10 to 15 centimeters.....	247	41	67	139
	Less than 10 centimeters.....	217		3	214
	Total for 1912.....	946	206	234	506

<sup>1</sup> On September 9, 1911, 36 butterfish, less than 10 centimeters in length, were all found to have cysts in the flesh, 12 with few, 24 with many. On September 15 of the same year, 220 butterfish, less than 10 centimeters in length, were also all found to have cysts in the flesh, 43 with few, 177 with many. These were exceptional cases. I have found butterfish which are less than 10 centimeters in length, as a rule, to be practically free from cysts in the flesh.

Year.	Length in centimeters.	Number of fish examined.	Number with many cysts in flesh.	Number with few cysts in flesh.	Number with no cysts in flesh.
1913	20 centimeters and over.....	412	135	147	130
	15 to 20 centimeters.....	264	29	136	99
	10 to 15 centimeters.....	396	24	262	110
	Less than 10 centimeters.....				
	Total for 1913.....	1,072	188	545	339
1914	20 centimeters and over.....	80	25	26	29
	15 to 20 centimeters.....	210	22	67	121
	10 to 15 centimeters.....	404	114	125	165
	Less than 10 centimeters.....	96		3	93
	Total for 1914.....	790	161	221	408
1915	20 centimeters and over.....	222	18	72	132
	15 to 20 centimeters.....	394	29	145	221
	10 to 15 centimeters.....	104	3	29	72
	Less than 10 centimeters.....	5			5
	Total for 1915.....	725	50	246	430
1916	20 centimeters and over.....	295	9	98	188
	15 to 20 centimeters.....	327	49	174	103
	10 to 15 centimeters.....	27	5	15	7
	Less than 10 centimeters.....	40			40
	Total for 1916.....	689	63	287	338
1917	20 centimeters and over.....	18	1	8	9
	15 to 20 centimeters.....	36	9	16	11
	10 to 15 centimeters.....	26	1	1	24
	Less than 10 centimeters.....	38			38
	Total for 1917.....	118	11	17	82
1918	20 centimeters and over.....	26	1	8	17
	15 to 20 centimeters.....	48	19	22	7
	10 to 15 centimeters.....	8		6	2
	Less than 10 centimeters.....	2			2
	Total for 1918.....	84	20	36	46
1919	20 centimeters and over.....	53	5	22	26
	15 to 20 centimeters.....	33	4	11	18
	10 to 15 centimeters.....	2	1		1
	Less than 10 centimeters.....				
	Total for 1919.....	88	10	33	45
1920	20 centimeters and over.....	11		5	6
	15 to 20 centimeters.....	6		4	2
	10 to 15 centimeters.....	21			21
	Less than 10 centimeters.....	80		1	79
	Total for 1920.....	117		9	108
1922	15 to 20 centimeters.....	6		2	4
	10 to 15 centimeters.....	5		3	2
	Less than 10 centimeters.....				
	Total for 1922.....	11		5	6

(U.S.N.M., Helm Coll. 7696.)

*Scomberomorus cavalla.*

1920, August 2: Numerous cysts in submucosa of stomach; 1 fish examined.

*Squalus acanthias.*

1907, August 15: Few, yellow, in wall of stomach. One was crushed, and proved to be a degenerated tetrarhynch with hooks agreeing with *O. crenacolle*.

*Trichiurus lepturus.*

1903, July 6: Several clusters of cysts on viscera, some with black pigment; 212 large, 28 small fish examined.

*Xiphias gladius.*

1904, July 15: A few cysts from peritoneal coat of pyloric caeca, associated with small waxy cysts; length of larva 0.67 mm.; 4 fish examined.



## OTOBOTHRIMUM DIPSACUM Linton.

1897*b*, pp. 806-7, pl. 66, figs. 1-5

1901, p. 451.

1905, p. 375.

1911, p. 586.

Only the encysted stage of this cestode has been found; in *Pomotomus saltatrix*, in the Woods Hole region, and in *Centropristes striatus*, at Beaufort, N. C. Following are records not before published:

*Ceratacanthus schoepfi*.

1915, August 21: 7 large cysts from body cavity, maximum 17 by 7, minimum 7.5 by 3.25. A cyst, 9 by 6 mm. when opened, released a plerocercus, length 5.25, diameter 3 mm. Under pressure a scolex with the characteristic proboscides of this species was seen; 1 fish examined.

1920, July 28. Large cysts, for the most part rather triangular in outline, from viscera; maximum 20 by 10 mm.

(U.S.N.M., Helm, Coll. 7697.)

*Mycteroperca falcata*.

1911, June 5; Cysts from serous coat of intestine. long-clavate, bluish black, for about half the length from the smaller end; one measured 24 mm. in length, and 6 mm. in diameter at larger end, tapering to 2 mm. at the smaller end; another 17 by 5; larva, length 2.5, breadth of head 1.5. Collected by Dr. F. A. Brink, State board of health of Florida, Pensacola, Florida.

*Pomotomus saltatrix*.

1904, July 22: 1, plerocercus about 12 mm. in length, and 6 mm. in diameter; length of larva 3.68, of head and neck, scolex, 3.45, of bothrium, at rest, 1.35; diameter of head, in front, 0.60, at base of flaring bothria, 1.65 to 3.15, very variable, contracting and expanding; diameter of neck, behind head, 0.75, at base of bulbs, 1.20; length of bulbs 1.50, diameter 0.22; diameter of proboscis, including hooks, 0.22.

*Xiphias gladius*.

1920, July 27: 1 cyst from viscera, oval, 12 by 6 mm.; 2 fish examined.

## OTOBOTHRIMUM PENETRANS Linton.

Plate 7, figs. 60-70.

1905, *Otobothrium*, species, pp. 357-358, figs. 102-109.

1907*d*, *O. penetrans*, p. 100, pl. 6, figs. 39-48.

1908*a*, p. 114.

1910*b*, p. 1202.

This specific name was first used to designate certain larval cestodes found encysted in the flesh of the gar, *Tylosurus acus* in Bermuda

in July, 1903. The same forms had been found in the flesh of the needle-fish, *T. raphidoma*, at Beaufort, N. C., in August, 1901, and recorded as *Otobothrium*, species.

I have found the adult stage of this tetrarhynch in the hammer-head shark, *Uestracion zygaena*, on two occasions, at Woods Hole, Massachusetts.

On the evening of August 2, 1908, a hammerhead shark, taken off Nomansland by Captain J. W. Fuller, of Provincetown, was brought to the laboratory of the United States Bureau of Fisheries. It was not opened until the following morning. The stomach contained fragments of fish and squid, large numbers of lenses, both of fish and squid, and a few "pens" of squid.

The cestodes, of which two species were found in the spiral valve, were somewhat macerated, especially at the anterior ends. Six of the larger cestodes, with free, ripe proglottides, were recognized as the adult stage of *O. penetrans*. The longest of the strobiles measured 160 mm. before, and 130 mm. after having been placed in alcohol. Length of scolex, 5 mm., breadth, in front, and at posterior end, near base of contractile bulbs, 3.25, breadth in middle, 2; free proglottides, length 8, breadth 4.5; eggs, 0.036 by 0.027.

The scoleces were not in good condition, the bothria were much crumpled, and the pits, characteristic of this genus, could not be made out, but all features present were in agreement with the genus *Otobothrium*, and the hooks on the proboscides, so far as seen, agreed with the species *O. penetrans*.

On August 18, 1913, a single specimen of this cestode was obtained from the spiral valve of a hammerhead shark. The shark measured 285 centimeters in length. The stomach contained numerous lenses of large fish, and a considerable quantity of oil.

The following measurements were made of material before it had been placed in preservative: Length of strobile, 103 mm.; scolex, length 4, breadth, anterior, 2.5, posterior, 3.5; last proglottis, length 5.5, breadth, 3.5; largest free proglottis, length, 8.5, breadth 3.5. There were also found twelve free proglottides, one short fragment of three segments, and a fragment of the posterior end of a strobile measuring 55 mm. in length. The strobile was flat and thin, the scolex subcylindrical. The bothrial pits were not made out at the time of collecting, but can be seen in the stained and mounted scolex.

A specimen of this species was collected by Dr. Davenport Hooker from *Carcharhinus commersonii*, at Tortugas, on July 26, 1907, and brought to me at Woods Hole by Dr. A. G. Mayor.

(U.S.N.M., Helm. Coll. 7698.)

In the original description of the species the statement that the bothria are marginal is misleading. It was probably written from the appearance of cross sections of the scolex made through the

bothria. The bothria are really placed on the sides of the scolex which coincide with the flat surfaces of the strobile.

Following are measurements of a specimen mounted in balsam: Length, 115 mm.; scolex, length, 4.5, breadth, near anterior end, 1.33, middle, 0.93, posterior, at base of widely flaring bulbs, 2.24; breadth of strobile at junction with scolex, 1.28, quickly increasing to 1.68; distance to first proglottides, 1.54; length of first proglottides, 0.07, breadth, 1.96; length of proglottis, 10 mm. from scolex, 0.52, breadth, 1.90; 20 mm. from scolex, length 1.12, breadth 1.88; 40 mm. from scolex, length 2.10, breadth 1.96; length of posterior proglottis 5.5, breadth, 1.96.

*Scolex.*—The bothria, in alcoholic specimens, are little, if any, wider than the axial portion of the scolex; in some of the mounted specimens they are contracted until they are not as broad as the portion of the axis which they enclose. There seems to be a tendency on the part of the bothria to contract strongly. The surface of the scoleces between the bothria and the contractile bulbs is roughly papillate. This is in agreement with the description of the scoleces from *Tylosurus raphidoma*. This character was not noted in the scoleces from *T. acus*, but, upon reexamining a mounted scolex from that host, I find the same character exhibited. The proboscides are rather stout, and are armed with hooks of a variety of shapes and sizes. The proboscis sheathes are slightly tortuous, and the retractile muscle is attached near the proximal ends of the bulbs, which, as is usually the case in this genus, are widely flaring. The scolex, as a whole, is somewhat hour-glass shape, and the posterior end slightly overlaps the beginning of the strobile. Transverse sections of the scolex of the adult and of larval forms show similar structure.

*Strobile.*—The strobile is flat and thin, and does not vary much in width throughout its length. The proglottides begin near the scolex, are at first very much broader than long, soon become squarish and ultimately become much longer than broad. The genital apertures are marginal, irregularly alternate, and are placed at about the posterior third of the length. Each is marked by a shallow notch with vertical walls.

*Reproductive organs.*—The sectioned material is not entirely satisfactory, but the following points were made out: The common genital pore opens into a shallow marginal notch. The vagina lies behind the cirrus-pouch, and enters the common duct near the marginal aperture. The cirrus-pouch is small, oval-elliptical, and horizontally placed. The vas deferens is voluminous. The testes occupy the entire median axial region, in sagittal sections being interrupted only by the cirrus-pouch and ovary. In a series of sagittal sections, 80 in all, the vagina joins the cirrus at the 6th section from the marginal genital notch. The cirrus-pouch continues

for about ten sections, that is to about the 16th section from the margin. Sagittal sections show that the proglottis thins a little in the vicinity of the cirrus-pouch. For example, in a sagittal section with maximum breadth, representing the thickness of the proglottis, of 0.25, the thickness at the level of the cirrus-pouch was 0.18, and the diameter of the pouch at this point was 0.14.

The vagina turns posteriorly near the median line, and enlarges into a relatively spacious seminal receptacle which occupies a median axial position. A slender sperm duct, which lies in a somewhat close and irregular spiral, leads from the seminal receptacle to the germ duct, which is joined later by a single yolk duct. The shell gland appears in the sections as a very compact structurē, granular in its central portion. The anterior border of the two-lobed ovary is about on a level with the posterior angle of the marginal genital notch. Its breadth is about half that of the proglottis, the length about equal to the breadth, and the distance between its posterior border and the posterior end of the proglottis equals approximately the breadth of the ovary. The vitellaria are distributed throughout the proglottis, showing in sections as a layer lying within the muscular layer of the body wall, and continuous, in adult proglottides, in which eggs have just begun to appear, except in the immediate vicinity of the cirrus-pouch. The uterus begins as a slender duct leading from the shell gland, quickly expands into a capacious pouch, is, in earlier proglottides, somewhat sacculate on its lateral margins, but in ripe proglottides comes to fill practically all the interior in front of the cirrus pouch.

In mounted material the ova are for the most part collapsed and boat shaped, with length up to 0.04 mm. Two, not collapsed, measured 0.039 by 0.028, and 0.042 by 0.028 in the two principal diameters.

**RHYNCHOBOTHRUM ATTENUATUM** Diesing.

1897*b*, pp. 805-806, pl. 5, figs. 8-11.

1900, p. 278.

1901, p. 448.

1911, p. 587.

Records of this species not heretofore published:

**Larval stage.**

*Carcharhinus milberti*.

1922, August 5: 1, from serous coat of viscera.

*Vulpecula marina*.

1912, August 7: 2, from serous coat of liver of a 510-centimeter shark, taken at Menemsha Bight, stomach and intestine brought to laboratory by Vinal N. Edwards. The stomach contained only a few vertebrae, lenses and otoliths of fish. These larvae were placed in



sea water, when each of them immediately turned and thrust its proboscides through its own body; length 35 mm., breadth 5.

*Xiphias gladius.*

1904, July 15: Many, in body cavity on viscera and peritoneum, in each of 3 swordfish. When placed in sea water they contracted to 30 mm., or less, and elongated to 100 mm., or more. These larvae are not encysted, but are wandering under the serous membrane of the viscera and body wall. One of the fish had many of the copepod parasite, *Penella plumosa*, burrowing into the flesh, some of them penetrating into the body cavity, where their heads were encysted. More internal parasites were found in this fish than in either of the others.

July 20: Many, in body cavity of each of 3 swordfish.

July 28: Many, on peritoneum of 1 swordfish.

1911, July 13: 40 from one swordfish, 8 from another; on viscera and peritoneum; probably not all collected; most of them white, one decidedly yellow; very contractile.

1912, July 20: 2, from viscera of 1 swordfish.

1913, July 7: Many, on viscera and peritoneum of 1 swordfish.

1920, July 27: About 10, from each of 2 swordfish; viscera and peritoneum. After lying in sea water for some hours they became much elongated, one of them measuring 150 mm.

(U.S.N.M., Helm. Coll. 7732.)

**RHYNCHOBOTHRIMUM BULBIFER** Linton.

1889b, *R. tenuicolle* RUDOLPHI, pp. 486-488, pl. 5, figs. 17, 18.

1890, *R. bulbifer* LINTON, S25-S29, pl. 10, figs. 8, 9, pl. 11, figs. 1, 2.

1897a, p. 448.

1900, p. 270.

1901, pp. 425, 436, 445, 447, 451, 460, 464, 482.

1910a, pp. 1201, 1202.

**Adult stage.**

The length of the hooks near the base of the proboscis greater than that given in the original description, being about 0.03 mm.

*Galeorhinus laevis.*

Collected in 7 of the years from 1903 to 1915, inclusive: On 5 dates in May, 5 to 75 strobiles, with from few to many free proglottides, 8 dogfish examined; 6 dates in June, 4 to 80 strobiles, free proglottides found on some of the dates, 24 dogfish examined; 7 dates in July, 4 to 100 strobiles, 9 dogfish examined; 9 dates in August, 2 to 6 strobiles, 9 dogfish examined; 2 dates in September, 1 and free proglottides from 1 dogfish on 1 date, 2 in 1 of 2 dogfish on the other.

(U.S.N.M., Helm. Coll. 7699.)

*Squalus acanthias.*

1904, June 6: 32, and free proglottides, from 4 dogfish.

1910, July 29: 3.

1914, October 13: 1, in spiral valve, still in cyst; sand eels in stomach. Cysts of this cestode are not uncommon in the flesh of the sand eel.

1922, August 29: 2, from 1 of 3 young spiny dogfish. Collected by Dr. G. A. MacCallum.

1923, July 23: 1.

August 4: about 12 in each of 3 dogfish.

*Vulpecula marina.*

1923, August 27: 5 in spiral valve.

**Larval stage.**

The cysts and plerocerci of this species are often club-shaped, or gourd-shaped, the larger end being subglobular, the remainder, which is of much smaller diameter and cylindrical, may be either straight or curved. Usually encysted on viscera, and in intestinal wall, but common in the flesh of sand eels, silverside, and young herring.

*Acanthocottus octodecimspinosus.*

1904, October 28: 1 cyst.

1910, October 14: A few cysts, some with degenerate tissue; 8 fish examined.

*Ammodytes americanus.*

Collected in 4 of the years from 1905 to 1914, inclusive: On 1 date in July, 2 cysts found by Dr. C. W. Hahn in the flesh near the tail fin. On the same date 25 fish were examined and 1 cyst found on the viscera; 4 dates in August—(1) 1 thin-walled cyst on viscera; (2) numerous characteristic plerocerci in thin-walled cysts on mesentery, 19 fish from stomach of squeteague; on same date in a lot of 16 sand-eels from the stomach of a bonito 2 cysts were found; (3) numerous, encysted in muscles of most of about 40 sand-eels from the stomach of a bonito; (4) many, in muscles, most abundant near caudal fin, 2 fish; 1 date in October, cysts, presumably from viscera, 12 fish; 1 date in November, a few cysts clustered in flesh under backbone; another record on same date, many cysts in flesh. Mr. Edwards reported that 7 out of 100 fish had cysts in the flesh.

*Anguilla rostrata.*

Collected in 7 of the years from 1904 to 1914, inclusive: On 1 date in April, 1 cyst; 1 date in May, 2 cysts, length 4 mm., 1 eel examined; 3 dates in July—(1) few small, pedicelled cysts on viscera, 7 eels; (2) characteristic gourd-shaped cysts and plerocerci on mesentery, 5 eels; (3) 20 cysts in walls of stomach and intestine of 2 eels; 4 dates in August—(1) few, characteristic cysts on viscera in 3 of 7 eels; (2) numerous cysts in intestinal wall, 1 eel; (3)

1 small, typical cyst, 3 eels; (4) many in intestinal wall of 2 out of 25 eels; 1 date in September, 16 cysts on intestine of 1 of 10 eels; 1 date in November, cysts of diverse shapes, elongated, cylindrical, claviform, reniform, etc., 6 eels.

*Caranx chrysos.*

1908, August 31: 1 cyst in intestine, introduced with food.

*Clupea harengus.*

Collected in 5 of the years from 1910 to 1920, inclusive: On 1 date in February, encysted in fragments of flesh of young herring from stomach of a gar; 6 dates in August, encysted in the flesh, on the viscera, and in the intestine (introduced with food), 15 fish, ranging in length from 52 to 74 mm.

*Cynoscion regalis.*

1904, August 6: A few small plerocerci, in intestine, probably recently introduced with food, 3 fish examined.

*Elops saurus.*

1905, October 17: 1 cyst, rather larger than usual, length 5.74 mm.; hooks typical.

*Gadus callarias.*

Collected in 3 of the years from 1904 to 1915: On 2 dates in January—(1) piece of intestine in bottle, with many cysts in its walls, 10 fish examined; (2) 1 cyst, 12 fish; 2 dates in November—(1) 1 small cyst, 20 fish; (2) 1 small cyst.

*Gasterosteus bispinosus.*

Collected on 1 date in July, few small, characteristic cysts in flesh, 10 fish examined; 2 dates in August—(1) 12 cysts in flesh of 1 fish, 6 in flesh of another, near backbone, 1 near caudal fin; (2) numerous cysts in flesh of sides from middle to near caudal fin, plerocerci globular with long slender appendage, 1 fish examined.

(U.S.N.M., Helm. Coll., 7700.)

*Gymnosarda alleterata.*

1905, August 12: Several characteristic cysts and plerocerci, from intestine, evidently recently introduced with sand eels, with which the stomach was filled.

*Lophopsetta maculata.*

1910, July 21: 1 cyst, typical plerocercus and scolex, collected by Dr. C. W. Hahn.

*Menidia notata.*

Collected in 4 of the years from 1906 to 1913: On 5 dates in August—(1) few characteristic cysts from viscera of a large number of silversides, brought to me by Dr. I. A. Field, who was experi-

menting with this species in the manufacture of sardines; (2) 1, from flesh, dorso-lateral region, 38 fish examined; (3) 1 cyst from viscera, 21 fish examined; (4) 1 cyst from viscera, 35 fish examined; (5) 4 cysts, typical. Dr. C. W. Hahn, to whom I am indebted for these specimens, said that about 1 out of 8 of the silversides which he had been examining for sporozoa, had these cysts in the flesh. The cysts were not numerous, 6 or 7 at most, usually near the tail, and easily seen when the fish is held up to the light.

*Menticirrhus saxatilis.*

Collected in 3 of the years from 1909 to 1912: On 2 dates in July—(1) 4 plerocerci in intestine, evidently introduced with the sand eels in the stomach, 1 fish examined; (2) cysts in intestine, evidently recently introduced with food, sand-eels in stomach, 9 fish examined; 1 date in October, 1 plerocercus in intestine, 10 fish examined.

*Merluccius bilinearis.*

Collected in 3 of the years from 1907 to 1916: On 3 dates in August—(1) 1 slender, but characteristic cyst, 16 fish examined; (2) 1 cyst on viscera, 5 fish examined; (3) cysts in intestine, probably introduced with young herring, 12 fish examined; 1 date in October, 1, typical, in intestine, round herring in stomach, 3 fish examined.

*Microgadus tomcod.*

Collected on 2 dates in July: Few cysts on viscera, 13 fish examined on each date.

*Myoxocephalus aeneus.*

1905, July 28: 2 small cysts, 1 fish examined.

*Narcacion nobilianus.*

Collected on 1 date in August, 1 cyst, with characteristic plerocercus, and larva in spiral valve, evidently recently introduced; 1 date in October, 1 cyst with larva; proboscides retracted, but characteristic hooks of the species seen; length of bothrium 0.45, breadth 0.37; length of contractile bulb 0.42.

*Palinurichthys perciformis.*

1910, August 20: 1 small cyst on viscera, 1 fish examined.

*Paralichthys dentatus.*

Collected on 2 dates in August—(1) numerous cysts in intestine, lately introduced with food, 2 fish examined; (2) small cysts in stomach wall, associated with *O. crenacolle*, 1 fish examined; 1 date in September, 3 plerocerceri, recently introduced with food.



*Pomatomus saltatrix.*

Collected on 3 dates in August—(1) 1 cyst from serous coat of intestine, 3 fish examined; (2) 1 plerocercus in intestine, introduced with food, 1 fish on each of 2 dates.

*Poronotus triacanthus.*

Collected in 5 of the years from 1904 to 1913: On 3 dates in July—(1) several small, gourd-shaped cysts, clear faint amber yellow, on viscera, 2 fish examined; (2) 1 cyst from viscera, collected by Dr. C. W. Hahn; (3) 1 cyst from viscera, 1 fish examined; 1 date in August, a few small cysts, mostly elongated, cylindrical, 2 fish examined.

*Prionotus carolinus.*

1913, August 3: A few pleurocerci in intestine, evidently introduced with sand eels, with which the stomach was filled. Dr. G. A. MacCallum.

*Pseudopleuronectes americanus.*

1908, August 20: 1, encysted in flesh, dorso-lateral region.

1913, December 29: Encysted on pyloric caeca.

*Raja erinacea.*

1905, August 23: Small, pyriform cyst, evidently recently introduced with food; scolex resembles this species; bothria emarginate, length 0.31, breadth about the same; length of contractile bulbs 0.22, breadth 0.14; diameter of proboscis, excluding hooks, 0.33; only base of proboscis everted, which bore a few slender hooks, longest 0.024.

1906, July 30: Small white cysts in wall of spiral valve near rectum; some had degenerated and contained carbonate of lime; one cyst was found with living larva, the hooks agreeing with this species.

*Raja diaphanes.*

1914, November 4: 1 cyst in spiral valve, evidently recently introduced with food; sand eels in stomach.

*Roccus lineatus.*

1912, September 11: Typical plerocerci in intestine, evidently introduced with sand eels, with which the stomach was filled, 1 fish examined.

*Sarda sarda.*

Collected on 2 dates in August—(1) 1 cyst from viscera, 1 fish examined; (2) cysts in intestine, evidently introduced with sand eels, of which there were 16 in the stomach.

*Scomber scombrus.*

Collected in 4 of the years from 1895 to 1914: On 2 dates in July—(1) few cysts on pyloric caeca, 12 fish examined; (2) a few

cysts on viscera, typical, some oval, 12 fish examined, 1 date in August, 12 cysts on mesentery and serous coat of viscera; 1 date in September, 1 cyst, 1 fish examined; 3 dates in October, a few small cysts on viscera on each date, number of fish examined 6, 14, and 12.

*Selar crumenophthalmus.*

1913, August 29: 3 typical cysts, plerocerci and larvae, 14 fish examined.

*Spheroides maculatus.*

Collected on 3 dates in August—(1) 15 characteristic cysts, 2 fish examined; (2) small cysts, serous coat of intestine, 2 fish examined, (3) 1 cyst, 1 fish examined.

*Tautoga onitis.*

Collected on 2 dates in August—(1) several cysts in walls of stomach and intestine, some degenerate; (2) 3 cysts on viscera, 2 small with some waxy, degenerate tissue, the other larger with calcified material in the cyst, 1 fish examined.

*Tautogolabrus adspersus.*

Collected on 1 date in July, 1 scolex attached to its plerocercus, introduced with food (pipefish), 6 fish examined; 3 dates in August—(1) few cysts, 2 fish examined; (2) 1 cyst, 1 fish examined; (3) 2 small, yellow cysts, 3 fish examined.

*Thunnus thynnus.*

1914, July 31: 1 small cyst from intestinal wall, typical hooks seen; diameter of cyst about 1.5 mm., associated with *Koellikeria*, species.

*Urophycis chuss.*

On 1 date in August, few cysts, 6 fish examined; 1 date in October, 1 cyst from intestine, introduced with food, alewife, and sand eels recorded in food, 12 fish examined; 2 dates in November, 1 cyst on one date, 2 on the other.

*Urophycis tenuis.*

1913, October 29: 1 cyst.

RHYNCHOBOTHRIMUM EXILE Linton.

Plate 9, figs. 85-90.

1908b, pp. 180-181, pl. 7, figs. 48-54.

Scolex as broad as long, slightly emarginate on posterior border; proboscides relatively long, with two stout and strongly recurved hooks at outer side of base, and about three stoutish, smaller hooks behind them; inner side of base slightly tumid, with numerous minute spines, remainder of proboscis armed with rather slender

spines, more or less recurved at the tip; sheathes spiral; bulbs elliptical-oblong, rather short.

Strobile very slender; segments beginning near the scolex, soon becoming as long as broad, and lengthening rapidly; last proglottis, immature, length, 2.60 mm., breadth, 0.26.

Only immature proglottides were seen. These are exceptional in that the cirrus and cirrus-pouch are so poorly developed as to be barely distinguishable, what were interpreted as their rudiments being made out only in the two last proglottides. In a proglottis measuring 2.6 mm. in length, the rudiment of the genital pore was situated at the posterior third, i. e. 0.84 from the posterior end, but a short distance in front of the ovaries. A similar rudiment, similarly placed was seen in another proglottis. In these proglottides the testes were well developed, and occupied practically all the interior, both in front of the ovary and behind it. The ovary could be distinguished in the two posterior proglottides. It is two lobed, the lobes lying opposite each other on either side of the median line. In a proglottis which measured 2.52 mm. in length, the posterior margin of the ovary was 0.5 mm. from the posterior end of the proglottis.

Dimensions of specimen in balsam: Length of strobile, 24.5; scolex, length 1.09, length of bothrium 0.34, breadth 0.36, diameter of neck at bulbs 0.32; contractile bulbs, length 0.24, diameter 0.06; length of posterior proglottis 2.60, breadth 0.40; diameter of proboscis, excluding hooks, 0.030, including hooks, 0.054; length of large stout basal hooks 0.024; length of longer hooks, middle of proboscis, 0.018.

#### *Galeocerdo arcticus.*

1914, August 12: 1, strobile active, length 26 mm., Woods Hole.

This cestode appears to belong to this species, which was founded in material from the tiger shark, collected at the Dry Tortugas, Florida.

(U.S.N.M., Helm. Coll. 7701.)

#### RHYNCHOBOTHRUM HETEROSPINE Linton.

1890, pp. 839-840, pl. 12, figs. 3-5.

1897b, p. 799; pl. 64, figs. 3-8.

1900, p. 283.

1901, pp. 425, 436, 443, 482.

#### *Squalus acanthias.*

1907, August 15: 2; scoleces attached to plerocerci.

## RHYNCHOBOTHRIMUM HISPIDUM Linton.

1890, pp. 833-835, pl. 11, figs. 12-17.

1900, p. 275.

1901, p. 433.

1905, pp. 345, 348; fig. 146.

1908*b*, p. 184.

1910*a*, p. 695.

1911, p. 587.

## Adult stage.

*Dasybatis centrura*.

1903, September 1: Noted, but number not recorded. September 20: 6, length 4 mm., with 4 free proglottides.

1904, August 20: Numerous.

1914, August 1: Few, collected by Dr. G. A. MacCallum.

1922, July 15: 1. July 31: 1, from each of two small sting rays. Also on same date, 1, from large sting ray, 270 centimeters in length, collected by Dr. G. A. MacCallum.

1923, July 20: 2; August 15: 2; August 20: 3 in each of 2 sting rays. (U.S.N.M., Helm. Coll. 7702.)

## Encysted stage.

*Tautoga onitis*.

1904, August 12: 1, from cyst.

1910, July 9: 1, scolex with red pigment blotch in neck, escaped from plerocercus. August 6: 1, similar to foregoing; sucker-like organ at base of plerocercus. August 30: 1, like specimen collected on preceding date.

## RHYNCHOBOTHRIMUM IMPARISPINE Linton.

ADULT STAGE.	LARVAL STAGE.
1890, pp. 840-843, pl. 12, figs. 6-9.	1897 <i>b</i> , pp. 788, 799-801, pl. 64, figs. 9-12.
1897 <i>a</i> , p. 450.	1890, p. 276.
1900, p. 275.	1891, pp. 436, 437, 445, 456, 458, 475, 476, 482, 484, 485, 488.
1901, pp. 431, 432, 434, figs. 251-254.	1910 <i>a</i> , p. 694.
1910 <i>a</i> , p. 694.	1910 <i>b</i> , p. 1201.
1911, p. 588.	1911, p. 588.
	1912, p. 2 (of reprint).
	1914, p. 53.

This cestode is a common parasite of skates belonging to the genus *Raja*. It has been found in the adult stage, with ripe proglottides, in *Narcacion nobilianus*, *Raja eglanteria*, *R. erinacea*, *R. stabuliformis*, and *Squalis acanthias*. In the encysted stage it has been found in a large number of species of teliosts.

Following are records of *R. imparispine* not before published.



Collections on dates other than those occurring between June 27 and September 3 were made by the late Vinal N. Edwards.

**Adult stage.**

*Carcharhinus obscurus.*

1916, July 26: 1 scolex; probably lately introduced with food.

*Dasybatis centrura.*

1903, October 5: 2 scoleces with strobile beginning on one of them; length of scolex, 6 mm.; length of young strobile, 13 mm.

1914, August 1: 1.

*Narcacion nobilianus.*

1905, August 7: 1; length 52 mm.; posterior segments, length 3.5, breadth, 1. August 12: 1, scolex only.

1914, July 13: 1. scolex only.

*Raja diaphanes.*

April: 1 to 17, in 38 skates, 13 dates, 3 different years; ripe joints on 7 dates.

May: Recorded on 27 dates, in 7 different years, 74 skates examined; largest number from one skate, 35; not found in all skates examined, but record does not indicate the number in which no cestodes were found; ripe joints noted on 10 dates.

June: 1 to 16, in 13 skates, on 9 dates, in 6 different years; ripe joints noted on 6 dates.

1905, August 9 to 25: 1 to 14, from 7 skates on 7 dates; ripe joints noted on 2 dates.

1907, August 30: 5 skates examined; many cestodes in 3, few in 2, 160 in all.

September: 4 dates, 3 different years, 54 skates examined; ripe joints noted on 2 dates; record does not always show the number of skates in which cestodes were found. Thus, the record for September 27, 1911, is 27, and numerous free segments from 43 skates.

October: 21 dates, 8 different years, 84 skates examined; ripe joints noted on 10 dates. The record usually gives the number of skates examined on a given date with, sometimes, the number of cestodes found in particular individuals. As a rule the label with the specimens bore only the name of the host, the number of fish examined, and the date. Mr. Edwards also kept a journal in which the character of the food of the fish examined for parasites was noted. The smallest number of cestodes noted for one skate in this month was 1, the largest, 108. On one date 40 skates were examined, and cestodes found in 10; on another date cestodes were found in 15 out of 20 skates examined.

November: 3 to 45, from 13 skates, on 8 dates, in 2 different years; ripe joints noted on 7 dates.

*Raja eglanteria.*

Collected in six of the years from 1905 to 1916, inclusive: On one date in May, 3 and a few free proglottides; on one date in June, 2 strobiles, length 36 mm., 1 ripe proglottis; on one date in July, 8; on two dates in August, 1 to 2, and a few free proglottides in each of 4 skates; on one date in September, 2, with free proglottides.

*Raja erinacea.*

April: 1 from each of two skates, two dates in different years; ripe proglottides.

May: 1 on one date and 2 on another, in different years; ripe proglottides.

July: 1 to 5, in 5 skates, on four dates in three different years; ripe proglottides in some.

1903, August 21: 4.

1904, August 29: 1 with scolex, and fragments of 2 others.

October: 1 to 26 in 11 skates, on 11 dates in 6 different years; free, ripe proglottides on most of the dates; maximum length noted 60 mm.

November: 5 to 21 in 8 skates, on 8 dates in 4 different years; many ripe segments.

(U.S.N.M., Helm. Coll. 7703.)

*Raja stabuliforis.*

April: 1 to 21, 10 skates on 5 dates, 2 different years; ripe proglottides on 1 date.

May: 1 to 8, in 15 skates, 15 dates, 8 different years.

June: 1 and 2, in 2 skates, in different years; ripe proglottides in each.

1912, July 30: 24, with many ripe proglottides, ivory white, very active. Some of the larger proglottides collapsed soon after they were placed in sea water, leaving a white mass of ova on the bottom of the dish.

August: 4 and 20, in 2 skates, different years: maximum length in sea water, 100 mm.

September: 3 and 4, in 2 skates, different years, maximum, 52 mm., ripe proglottides in one.

October: 1 to 15, in 18 skates, on 15 dates, 7 different years; ripe segments on 8 dates.

November: 3, with ripe proglottides, from 1 skate on each of two dates, same year; 3 skates examined on each date.

*Squalus acanthias.*

Collected in 7 of the years from 1903 to 1914: Strobiles with mature segments, and free proglottides found only on the dates in May. On 2 dates in May, 4 to 7, adult strobiles and free proglottides;

on 1 date in July, 5, scoleces only; on 3 dates in August, 1 to 3. Record for August 15, 1907: Scoleces with plerocerci attached. Inasmuch as cysts containing larvae of this species were found in large numbers on the viscera of whiting taken on the same date along with the dogfish in the fish-trap at Menemsha Bight, it is likely that whiting had been the intermediate host of these cestodes found in the stomachs of the dogfish. On 1 date in September, 4, from spiral valve, but only scoleces present, length about 7 mm.; on 5 dates in October, 1 to 20, maximum length 12 mm.; on 4 dates in November, 2 to 6, maximum length 12 mm. Record for November 9, 1914: 2 scoleces, maximum length 8 mm.. 50 dogfish examined.

#### Larval stage.

Usually encysted on viscera, and in wall of intestine, but found in flesh of sand-eel, scup, and pipefish.

#### *Acanthocottus octodecimspinosus.*

Collections made in 8 of the years from 1905 to 1914, inclusive; Cysts usually pyriform, 3 by 2 mm. to 7 by 3.5 mm.; on viscera, and embedded in intestinal wall; 1 date in April, 1 cyst, 2 fish examined; 3 dates in May, 3 to 6 cysts on each date, 40 fish examined; 1 date in August, 6 cysts, 1 fish examined; 7 dates in October, 1 to 6 cysts on each date, 152 fish examined; 8 dates in November, 6 or more cysts on each date, 247 fish examined; 1 date in December, 5 cysts.

#### *Ammodytes americanus.*

Collections made in 8 of the years from 1903 to 1914, inclusive: Cysts usually pyriform, on viscera, and embedded in wall of intestine, in flesh on one date; recorded sizes, from 5 to 9 mm. in length and 3 to 4.5 mm. in diameter; 2 dates in May, 20 cysts on 1 date, 50 fish examined, 1 on the other date, number of fish not given; 2 dates in July, 2 cysts on each date, 25 fish examined on each date; 3 dates in August, 1 cyst on each of 2 dates, 5 in flesh on 1 date, 75 fish examined; 3 dates in October, 6 to 10 cysts on each date; one record is a few cysts in 2 of the 30 fish examined; number of fish examined 280; 5 dates in November, 1 to 7 cysts on each date, 531 fish examined.

#### *Anguilla rostrata.*

1904, July 30: Few encysted in intestinal wall, 7 fish examined.

1910, July 27: 3 cysts from surface of stomach, Dr. C. W. Hahn, 1 fish examined.

#### *Centropristes striatus.*

1903, October 8: 1 cyst, scolex immature.

1910, July 8: 1 cyst, hooks of larva rudimentary, 9 fish examined, July 16: 1 cyst, 3 fish examined.

*Clupea harengus.*

1904, November 12: 1 cyst, 3 fish examined.

*Gadus callarius.*

Collections made in 10 of the years from 1903 to 1915, inclusive: Cysts many, with brown, waxy degenerate tissue, from serous coat of viscera and mesentery, mostly pyriform, some oval-elliptical, sometimes pedicelled, occasionally in clusters, about 5 mm. in greatest diameter. On 9 dates in January, 1 to 20 cysts on each date, 126 fish examined; 2 dates in May, 1 to 24 cysts on each date, 3 fish examined; 6 dates in November, 1 to 24 cysts on each date, 29 fish examined; 19 dates in December, 1 to 50 cysts on each date, 297 fish examined.

*Hemitripteris americanus.*

1904, December 9: 1 pyriform cyst, with some dark pigment, 1 fish examined.

1907, November 5: 18, encysted in piece of intestine 8.5 centimeters in length; much black pigment.

1911, November 27: Pyriform cysts of various sizes and shapes, about 5 by 2 mm., 4 fish examined.

1913, February 18: 2 cysts, 5 fish examined.

1914, January 10: 50 or more cysts, oval with dark brown pigment, and degenerate tissue, 2 to 3 mm. in diameter and of variable length, 6 fish examined.

*Leiostomus xanthurus.*

1913, September 29: 1, 3 fish examined.

*Leptocephalus conger.*

1903, August 24: Small oval cysts free in the intestine; evidently recently introduced with food (scup in stomach), number of fish examined 1.

1904, July 22: 1 scolex; evidently recently introduced with food, number of fish examined 1.

*Lophius piscatorius.*

Collections made in 13 of the years from 1899 to 1920, inclusive: In general the encysted stage of this species in the goosefish is represented by globular and pyriform cysts, few to many on the viscera. These cysts are often tense, translucent, often pedicelled, 3 to 13 mm. in diameter, some with degenerate tissue, larger. On 1 date in May, 2 large, pyriform, pedicelled cysts, 11 by 6.5, and 13 by 7; larger end of the cysts translucent, and filled with fluid, larva at smaller end with some degenerate tissue, 10 fish examined. On 1 date in June, cysts on viscera. On 5 dates in July. Record for July 29, 1910: Numerous pyriform cysts on stomach, intestine and mesentery, and embedded in walls of intestine of each of 4



goosefish; much degenerate tissue with the larger cysts; scoleces from the larger cysts were no larger than those from the smaller; larvae from some of the larger cysts had degenerated. On 6 dates in August. Record for August 3, 1910: Many cysts in wall of intestine and on mesentery of 1 goosefish. One unusually large cyst was irregularly oval and pedicelled, with blotches of dark pigment, and ivory-white material showing through the walls of the cyst; dimensions, 22 by 15 by 8 mm. When this cyst was opened it was found to be filled, with the exception of the small space occupied by the plerocercus, with white, cheesy material, in which there were calcified masses and some dark-brown, waxy degenerate tissue. The plerocercus was subglobular, 7 by 5 mm., with thin wall and clear fluid contents, except at one end where there was a small ivory-white spot, the scolex. This plerocercus did not differ either in appearance or size from many which were enclosed in the wall of the intestine. Many cysts were found in the intestinal wall which were completely calcified; when opened they liberated a solid calcified mass, resembling a grain of rice, about 4 by 2 mm. The scolex from the large cyst had the following dimensions: Length 4.2; breadth of head 0.70, of neck just behind head 0.35, at bulbs 0.72. On 1 date in September, cysts on viscera. On 6 dates in October, cysts on viscera as usual. On 4 dates in November. Record for November 12, 1909: 10 pyriform and subglobular cysts from 3 goosefish; smallest cyst about 9 by 6 mm., largest 22 by 11 by 8 mm., with a large amount of dark-brown degenerate tissue; smallest cyst translucent, larger cysts with increasing amount of degenerate tissue; scoleces typical. It is to be understood that the number of cysts collected by Mr. Edwards does not necessarily represent all the cysts seen. On 1 date in December, 1 cyst in vial; record shows that 3 fish were examined.

1923, August 17: Many encysted on viscera.

*Lophopsetta maculata.*

Collections made in 7 of the years from 1903 to 1910, inclusive: Cysts, usually pyriform, on viscera, or embedded in the intestinal wall, in many cases in clusters in wall of rectum. For example, on August 20, 1910, 27 sand dabs were examined; cysts were found in the interstitial wall of nearly all of them; five or six of the fish had each a cluster of from 10 to 20 cysts in a space of from 20 to 30 mm. in length; the cysts were most common in the wall of the rectum. On 3 dates in July, 1 to 18 cysts on each date, 3 fish examined; 7 dates in August, 9 to many cysts on each date, 36 fish examined; 1 date in September, 14 cysts, 1 fish examined; 2 dates in October, 5 to many cysts, 2 fish examined; 1 date in November, few cysts on each date, 3 fish examined.

*Melanogrammus aeglefinus.*

1895, October 31: 1 cyst.

1903, September 3: 1 cyst on viscera, 5 fish examined.

1906, May 7: 1 cyst, 1 fish examined.

1909, August 12: 36 collected, more could have been got, encysted on intestine, 16 fish examined.

1913, April 29: Encysted on, and in intestinal wall; 139 cysts were counted on a piece of intestine 35 mm. in length.

*Menidia notata.*

1906, August 25: 2 from large number of fish, brought to me by Dr. I. A. Field, who was experimenting with these fish in the manufacture of sardines.

1910, August 30: 1 cyst, 24 fish examined.

*Menticirrhus saxatilis.*

1909, September 8: 1 scolex, evidently recently introduced with the food.

*Merluccius bilinearis.*

Collected in 12 of the years from 1894 to 1914, inclusive: Cysts often in large numbers, on viscera, in mesentery, and in intestinal wall, usually pyriform, often with dark brown pigment, in many cases associated with immature nematodes; of varying sizes, but usually about 5 mm. in greatest diameter. A typical record is that of August 19, 1910: Numerous cysts on intestine and liver, and in intestinal wall, 6 fish examined. These cysts associated with immature nematodes, have usually been present on the viscera of whiting which I have examined. It was noted that these cysts and the contained scoleces agree with those recorded as *Rhynchobothrium*, species (1901, p. 474, figs. 251-254). On 3 dates in May, 1 to 9 cysts on each date, 17 fish examined; 1 date in June, few cysts, 1 fish examined; 8 dates in August, 1 on one date, many on others, 57 fish examined; 9 dates in October, 1 to numerous on each date, 103 fish examined; 17 dates in November, few to numerous, 144 fish examined.

*Microgadus tomcod.*

Collected in 5 of the years from 1904 to 1914, inclusive: Cysts on viscera. On 1 date in July, 1 cyst, 13 fish examined; 1 date in August, 1 cyst, 9 fish examined; 2 dates in October, 1 scolex, 12 fish examined.

1923, July 22: A few black-pigmented cysts on stomach walls of 2 fish.

*Morone americana.*

1906, August 8: 2 irregularly oval cysts, brownish yellow, 6 fish examined.

*Myoxocephalus aeneus.*

1906, January 3: 1 pyriform cyst, 50 fish examined.

*Osmerus mordax.*

Collected in 3 of the years from 1903 to 1909, inclusive: Cysts on viscera; on 5 dates in August, 2 to 6 cysts on each date, 81 fish examined; 2 dates in October, 2 cysts on each date, 41 fish examined; 2 dates in November, 1 cyst on each date, 41 fish examined.

*Palinurichthys perciformis.*

1912, September 19: 2 plerocerci, 35 fish examined.

*Paralichthys dentatus.*

1903, October 19: 1 cyst from stomach wall, 1 fish examined.

1906, August 16: 1 cyst, 1 fish examined. November 9: 1 cyst, 1 fish examined.

*Paralichthys oblongus.*

1912, June 7: 7 pyriform cysts, 6 by 3 mm., some of them with long pedicels.

*Pollachias virens.*

Collected in 6 of the years from 1903 to 1914, inclusive: Cysts of various shapes, but usually pyriform, 2.5 to 6 mm. in length; on viscera, most numerous on pyloric caeca. On 1 date in May, 1 cyst, 8 fish examined; 3 dates in June, 1 to many cysts, 21 fish examined; 2 dates in July, many on each date, 21 fish examined; 2 dates in October, 1 to 30, 2 fish examined. Typical record: June 30. Cysts in practically all of the 14 fish examined, mostly under the serous coat of the pyloric caeca; a small number under the caeca next the stomach wall; a few in the stomach wall; elliptical and pyriform.

*Pomolobus pseudoharengus.*

Collected in 6 of the years from 1907 to 1915, inclusive: On 1 date in April, 1 cyst, 2 fish examined; 2 dates in May; on one date, 1 cyst, 40 fish examined, on the other, few cysts, one 8 by 4 mm., 6 fish examined; 3 dates in June, 1 to 7 cysts, some pyriform, about 5 mm. in length, 19 fish examined; 2 dates in July, 1 cyst from testis of one fish, few from 2 fish; 1 date in August, 20 or more encysted on viscera of 3 fish, not noted in others, but about 10 found in dish in which viscera of 10 other fish had been lying; most of cysts pyriform, and about 4 mm. in length.

*Poronotus triacanthus.*

Collected in the years 1903, 1910, and 1911: On 1 date in June, 2 cysts from 1 fish; 3 dates in July, few cysts on viscera, on one of the dates found mostly on the pyloric caeca, 33 fish examined; cysts found in but few of the fish. On one of the dates a scolex was noted which came from a cyst resembling a form common in *R. bulbifer*.

This scolex was abnormal, in that it had only two perfect proboscides. The other proboscides were represented by the rudiment of a sheath, and a bulb near the bothria.

*Prionotus carolinus.*

1910, July 8: 1 cyst on viscera, 12 fish examined.  
(U.S.N.M., Helm. Coll. 7704.)

*Prionotus strigatus.*

1905, August 23: Few cysts between submucous and muscular layers of stomach wall, 1 on mesentery, 1 fish examined.

*Pseudopleuronectes americanus.*

Collected in 5 of the years from 1905 to 1913, inclusive: One date in May, 11 cysts, 4 to 8 mm. in diameter, 10 fish examined; 1 date in August, few cysts in wall of intestine, 4 fish examined; 1 date in September, 5 cysts, 9 mm. or more in length, scoleces usual size, from 1 fish; 1 date in October, 9 large cysts, the largest 12.5 by 5 by 3.5 mm., 20 fish examined; 1 date in November, 1 cyst, 1 fish examined.

*Sarda sarda.*

1904, August 18: 1 cyst from intestine of small bonito, evidently recently introduced with food; 28 small, and 1 large fish examined.

1906, August 14: Cysts in intestine, evidently lately introduced with food, 2 fish examined, 20 sand eels in stomachs of each.

*Scomber scombrus.*

Collected in 5 of the years from 1903 to 1922 inclusive; cysts usually small, yellowish-brown, and seed-like in appearance, many degenerate; in most cases 2 mm., or less, in diameter; occasionally larger maximum 5 mm., seen on only 1 date; characteristic hooks of this species found in some of the degenerate cysts. On 1 date in May, few degenerate cysts on viscera, 6 fish examined; 3 dates in June, few on one of the dates, numerous on the others, on viscera, in mesentery, and embedded in submucosa of stomach and intestine, 23 fish examined; 2 dates in July, few on serous coat of stomach, and many on pyloric caeca, all small, 13 fish examined; 3 dates in October, small, degenerate cysts, on viscera, 32 fish examined. Record for June 22, 1922: Viscera of a mackerel, 40 centimeters in length, thickly covered with cysts, from 1 mm. and less, to 5 mm. in diameter, many of them yellowish-brown. Submucosa of stomach and intestine crowded with cysts. A scolex, in fresh water, somewhat compressed, measured 7 mm. in length.<sup>16</sup>

*Siphostoma fuscum.*

1921, July 14: 10 cysts in muscle tissue of abdominal wall, 3 to 5 mm. in length; collected by Dr. P. Okkelberg.

<sup>16</sup> For more detailed report, see *Journal of Parasitology*, vol. 9, pp. 176-177, figs. 1, 2 (March, 1923). Note on Degenerating Cystode Cysts in Mackerel.



*Stenotomus chrysops.*

1904, August 11: 1 cyst on viscera, 6 fish examined.

1909, July 26: 4 cysts from muscles back of head, near back-bone; plerocerci, in sea water, 8 to 12 mm. in length, and 3 to 4 mm. in diameter, ivory-white, enclosed in very thin cysts; general outline pyriform with scolex protruding from larger end; scolex moderately active, plerocercus slightly contractile; contractile bulbs 0.9 by 0.4 mm. compressed, retractile muscle attached to base of bulb. Collected by Dr. C. W. Hahn.

*Tautoga onitis.*

1911, August 15: 1 cyst on viscera, 1 fish examined.

*Tautogolabrus adspersus.*

Collected in 5 of the years from 1902 to 1910: 1 to 4 cysts on each date, on viscera. On 1 date in July, 1 cyst, collected by Dr. C. W. Hahn; 3 dates in August, 1 on each of two dates, 4 on the other, on viscera, 35 fish examined; 1 date in September, 2 cysts, on viscera, 4 fish examined; 1 date in October, 2 cysts on viscera, 5 fish examined.

*Urophycis chuss.*

Collected in 10 of the years from 1901 to 1915: Cysts usually pyriform, most of them small, 2 mm., more or less, in greatest diameter, occasionally one as much as 5 mm. in diameter; on viscera and in intestinal wall; in some cases degenerated. For example the record of November 3, 1911, is: A few cysts, among them clusters of very small cysts, 0.5 mm., or less, in diameter, with yellowish, waxy degenerate tissue; in some the contents were in part calcified. In one of these degenerate cysts, the hooks of *R. imparispine* were identified.

On 4 dates in May, 1 to few cysts on each date, 22 fish examined; 1 date in June, 3 scoleces and 1 small cyst, 10 fish examined; 3 dates in August, numerous cysts, 10 fish examined; 5 dates in October, 1 to 5 cysts on each date, 50 fish examined; 18 dates in November, 1 to few cysts on each date, 288 fish examined.

*Urophycis regius.*

1911, November 6: 1 pyriform cyst, 3.5 by 2 mm., 1 fish examined. November 8: 2 small cysts, 3 by 1.5 mm., 1 fish examined.

*Urophycis tenuis.*

Collected in 8 of the years from 1907 to 1916, inclusive: Cysts, usually pyriform, on viscera, and in intestinal wall, often numerous, in some cases degenerate; usually about 5 mm. in greatest diameter, but occasionally larger, and not rarely smaller. On 1 date in April, 8 cysts, 1 fish examined; 2 dates in May, 3 on one date, few on the other, 4 fish examined; 2 dates in June, 3 on one date, few on the other, 3 fish examined; 1 date in August, few cysts, 3 fish examined; 13 dates in October, 1 to numerous cysts on each date, 34 fish ex-

amed; 13 dates in November, 1 to 27 cysts on each date, 65 fish examined.

Following are typical records, the first, of a piece of intestine, the second, of a portion of the pyloric caeca:

1913, October 29: Numerous pyriform cysts on serous coat of intestine, some embedded in wall of intestine, the latter, in many cases with cheesy degenerate tissue; cysts of various sizes, largest about 5 mm. in length. The bottle contained a piece of intestine, 7 centimeters in length, which was thickly beset with cysts.

1914, October 28: Numerous cysts on pyloric caeca; a small piece of pyloric caeca in the vial contained 50 cysts, surface count, in a space 20 mm. square; 114 cysts were removed from the piece.

*Xiphias gladius.*

1904, July 15: Few, from peritoneum, cysts, with plerocerci and scoleces, 4 fish examined. July 21: Cysts on viscera, also in intestine, probably recently introduced with food.

**RHYNCHOBOTHRUM INSIGNE, new species.**

Plate 11, fig. 99-107.

Bothria emarginate, as broad, or a little broader than long, lateral, rather thick in contracted condition, and widely divergent. Neck of scolex very long, subcylindrical, and linear to near the base, where it increases in breadth rather abruptly, but is still narrower than the anterior end of the strobile. Hooks on the proboscides of a great variety of shapes and sizes. There is a cluster of very small, scale-like hooks on one side of the base. This side of the proboscis carries small, slender spines of varying length, and rather sparsely set toward the middle of the area. In the middle of this area is the most characteristic feature of the armature, in the shape of a linear row of very closely crowded hooks with broad bases (figs. 105-7). These hooks become so much crowded, about one millimeter above the base of the proboscis, as to have the appearance of being made up of two rows of hooks (fig. 106). The nature of the overlapping which gives rise to this appearance is shown in the figure. At  $1\frac{1}{2}$  mm. from the base, which was as much as the proboscis was everted, the hooks in this linear row are still closely crowded together, but the appearance of being made up of two rows is almost wholly lost (fig. 107). On either side of the area, of which this linear row of closely crowded hooks is the center, there are larger hooks, which are long and slender, with a tendency to have rather abruptly recurved tips. The hooks on the two sides of the small-hook area are not quite symmetrical. They are separated on the opposite side of the proboscis by two longitudinal rows of relatively large, strongly recurved hooks, with elongated basal supports, and with the tips of one row inclined

towards the tips of the other (figs. 103, 104). These rows of stout hooks are flanked on either side with the slender hooks already mentioned. Those of one side have broad bases, when seen in outline (fig. 103). The contractile bulbs are slender, and about one-third the length of the neck of the scolex.

The strobile, in general, is somewhat linear, and rather thin in its dorso-ventral diameter. Its breadth at the junction with the scolex is about 3.5 mm. At a distance of less than 10 mm. from the scolex the breadth has increased to 5 mm. This breadth is maintained to the middle of the length of the strobile. With the formation of adult proglottides the breadth diminishes slightly, the posterior proglottides having a maximum breadth of about 3.5 mm. The last five proglottides have a uniform length of 6 mm., and maximum breadth of 3.5 mm.

First indications of proglottides, in the shape of closely crowded transverse lines, are seen near the scolex, and, at a distance of 8 mm., the segments are distinct with a length of 0.25 mm. The first adult proglottides appear about 70 mm. back of the scolex, where they are a little broader than long. They increase in length gradually, the posterior proglottides being longer than broad, somewhat constricted at their anterior end, and increasing in breadth to near the posterior end.

The genital apertures are irregularly alternate, and are situated at about the posterior third of the lateral margin. None of the cirri were everted. In each case the genital pore was at the center of a depression in the form of a notch with vertical walls. The cirrus-pouch is small, oval, nearly transversely placed. The vas deferens lies at the anterior border of the inner end of the cirrus-pouch and extends a little anteriorly to the median line. In many of the proglottides a globular body lay near the inner end of the cirrus-pouch which appears to be a seminal vesicle. Testes could be seen in the earlier adult proglottides, although somewhat masked by the vitellaria. They fill the interior of the proglottis, are most abundant in front and in the median region bounded by the lateral excretory vessels, although a few could be seen lying lateral to the excretory vessels, and lateral to the ovary at the posterior end of the proglottis.

The vagina lies on the posterior border of the cirrus-pouch, and passes toward the median line, thence back to the ovary, which is many lobed, and situated near the posterior end of the proglottis on the median line.

Sections were not made, and details of structure of shell gland and the complex of vitelline, germ and sperm ducts could not be made out from the mounted segments. The uterus opens on the median line near the anterior end of the proglottis. In earlier adult



segments the aperture is circular, in later, ripe proglottides it is more or less elongated.

The longitudinal excretory vessels are conspicuous, as are also transverse vessels, of which one lay near the base of each proglottis. The specimen had been placed in fresh water for a short time, which fact may account for the enlargement of these vessels.

A curious abnormality in the development of the proglottides was noted about 50 mm. back of the scolex. A sketch of this region is shown in Figure 102.

One specimen of this cestode was found, on August 5, 1922, in the spiral valve of a 210-centimeter shark, *Carcharhinus milberti*. The stomach of the shark contained fragments of menhaden and a considerable quantity of oil.

Dimensions of the cestode in life: Length 250 mm.; length of scolex 25, breadth 3.5; length of posterior segments, average of last five, 6.6, breadth 3.8. Length, in balsam, 210; length of scolex 21; breadth of scolex, through divergent bases of bothria, 3, immediately behind bothria, 2, which breadth is maintained to near the base, where it increases to about 3.25. Bothria emarginate, length 2 mm., breadth about the same, or a little more. The ova measure about 0.045 by 0.036 in the two principal diameters.

*Type*.—U.S.N.M., Helm. Coll. 7705.

Four large cestodes belonging to this species were found August 6, 1923, in the spiral valve of a shark, *Carcharhinus commersonii*: Maximum length 420 mm., maximum breadth 6 mm.; pinkish in median region when strongly contracted, scolex and anterior portion yellowish white, posterior yellowish.

Associated with these strobiles was a slender strobile, length 210 mm., linear, breadth 2 mm.; scolex ivory white, strobile translucent white. The books agree with *R. insigne*.

#### RHYNCHOBOTHRIMUM LOMENTACIUM Diesing.

1890, pp. 845-847, pl. 13, figs. 1-3.

1911, p. 588.

#### Adult stage.

*Galeorhinus laevis*.

1905, July 31: Fragments of strobile, referred to this species.

#### RHYNCHOBOTHRIMUM LONGICORNE Linton.

1890, pp. 847-849, pl. 13, figs. 4-8.

1897a, p. 450.

1901, p. 429.

1911, p. 588.

#### Adult stage.

*Garcharias taurus*.

1904, July 19: 2 scoleces, and a few free proglottides.

(U.S.N.M., Helm. Coll. 7706.)



## RHYNCHOBOTHRUM LONGISPINE Linton.

Plate 12, figs. 110-114.

1890, pp. 835-837, pl. 11, figs. 18-20.

1901, p. 433.

1911, p. 588.

**Adult stage.***Dasybatis centrura.*

1903, September 1: Many small Rhynchobothria were present in the chyle of the spiral valve; a few of them separated from the lot after they had been lying over night in formalin, were referred to this species.

**Larval stage.**

The encysted stage referred provisionally to this species, and found in various intermediate hosts is the same as that from *Stenotomus chrysops* (1897b, pl. 63, figs. 10-13). At the base of the proboscis the hooks, for a short distance, are rather straighter than they are elsewhere on the proboscis, and are somewhat appressed. They then become longer and more divergent (figs. 110, 111, 113), diminishing towards the tip. In the basal and middle regions there is not a great diversity in shape, the longer hooks being rather slender, tapering and arcuate. Towards the tip the hooks on one side of the proboscis are short, broad, and abruptly recurved, on the other side of the proboscis they are slender and arcuate (figs. 112, 114). This is in agreement with forms found in *Centropristes striatus* (1897b, p. 793; pl. 62, fig. 12).

*Leptocephalus conger.*

1903, August 24: Small oval cysts in intestine: doubtless recently introduced with food; stomach contained partly digested scup.

*Microgadus tomcod.*

1910, July 13: 2 small cysts. Figures 110-112 shows views of different regions of the proboscis of a larva from one of these cysts.

(U.S.N.M., Hehn. Coll. 7707.)

*Paralichthys dentatus* (figs. 113, 114).

Collected in 4 of the years from 1903 to 1910, inclusive: Small oval cysts, on viscera, in mesentery, and in wall of stomach and intestine. On 1 date in July, several small, oval cysts on mesentery, 1 fish examined; 4 dates in August, several cysts, on each date, on viscera and in wall of stomach and rectum. 11 fish examined; 1 date in October, several cysts in stomach wall.

(U.S.N.M., Helm. Coll. 7718.)

*Prionotus carolinus.*

1905, July 17: 1 cyst on viscera, 17 fish examined.

*Prionotus carolinus.*

1907, August 10: Amber colored cysts on viscera, 2 fish examined.

*Prionotus strigatus.*

1905, August 23: Several cysts between submucous and muscular coats of stomach; associated with cysts of *R. imparispine* and *T. bisulcatus*, 3 fish examined.

*Scomber scombrus.*

1905, August 18: Cysts in stomach wall, 3 fish examined.

1906, August 10: 1 cyst, with immature larva, 8 fish examined.

*Scomberomorus maculatus.*

1904, August 20: 3 cysts on viscera, 3 fish examined.

*Stenotomus chrysops.*

Collected in 8 of the years from 1904 to 1920, inclusive: Small, usually oval cysts on viscera. Dimensions of specimen, life, collected August 17, 1904: Plerocercus, compressed, length 2.25, breadth 1.47; larva, length 1.57, breadth 0.45; length of bulb 0.75; diameter of proboscis, including hooks, 0.07; length of longest hooks 0.03; 16 fish examined. On 5 dates in July, 2 to 20 cysts, on viscera, and in intestine, where probably introduced with food; 10 dates in August, 1 to numerous, on viscera, 93 fish examined; 1 date in September, 1 oval cyst, 2 fish examined.

*Urophycis chuss.*

Collected in 3 of the years from 1903 to 1910, inclusive: Small cysts of various shapes on viscera. On 1 date in May, small cysts on the intestine; on 1 date in September, a few small cysts on viscera, 3 fish examined; 4 dates in October, cysts of different shapes, in one case associated with immature nematodes, on viscera and mesentery, 26 fish examined; 3 dates in November, numerous on one date, 1 fish examined, few on one date, 3 fish examined, 1 on one date, 12 fish examined.

*Urophycis tenuis.*

1911, August 4: Few small cysts in submucosa of stomach, 3 fish examined.

## RHYNCHOBOTHRIMUM SPECIOSUM Linton.

1887, *Rhynchobothrium*, species, p. 195, pl. 10, figs. 1-6.

1897b, pp. 801-805, pl. 64, figs. 13-14; pl. 65, figs. 1-7.

1900, p. 278.

1901, pp. 413, 443, 447, 451, 455, 458, 460, 463, 473, 482, 488.

1905, pp. 332, 369, 373, 384.

1907d, p. 98, pl. 5, figs. 32-35.

1908b, pp. 176-177, pl. 2, figs. 78, 79.

1921, pp. 30, 31.

The adult of this species has not yet been noted. The larval cestodes which I have recorded under this species are southern forms,

and probably represent different species. A revision of the species is deferred until more material from southern fishes is available. Those here recorded appear to belong to the species represented by the forms originally described from the blue fish.

*Carana chrysos.*

1910, September 13: 1 cyst from viscera. Dimensions of larva in glycerin: Length 7.42; length of scolex 4.62; bothrium, length 0.56, breadth 0.56; diameter behind bothria 0.49, at bulbs 0.77; bulbs, length 0.90, diameter 0.21, 1 fish examined.

*Ceratacanthus schoepfi.*

1920, July 28: Large, and for the most part, elongated cysts from viscera; maximum length 65, diameter 2 to 6 mm., and length 40, diameter 5 mm., 1 fish examined.

*Cynoscion regalis.*

1904, August 9: 1 larva in thin cyst, no plerocercus, on viscera, 6 fish examined. August 13: 1 cyst on viscera, 1 fish examined.

1905, July 17: 1 cyst from serous coat of viscera, 6 fish examined. July 18: 1 cyst on viscera, 12 fish examined.

1908, July 28: 1 scolex from intestine, probably recently introduced with food, 2 fish examined.

*Pomatomus saltatrix.*

1904, July 22: 1 cyst on viscera, 6 fish examined.

1910, July 1: A large cyst, 24 by 8 mm., embedded in the pyloric caeca, with plerocercus, but no scolex yet developed; resembled cysts of this species, 1 fish examined. July 5: 1 cyst on intestine, 1 fish examined. August 22: 2 long pyriform cysts on intestine, 2 fish examined.

1911, July 17: Cysts with immature plerocerci, 10 fish examined.

(U.S.N.M., Helm. Coll. 7708.)

*Remora remora.*

1912, November 7: 1 cyst from viscera, length 30 mm., diameter in middle 5 mm., thickening a little toward one end, where there was an accumulation of waxy, degenerate tissue; length of plerocercus 30, of larva 20.5, 1 fish examined.

*Thunnus thynnus.*

1914, July 29: 1 cyst from serous coat of intestine; 5 by 3 mm.; hooks agree with this species, but scolex smaller than in typical specimens, 1 fish examined.

*Trichiurus lepturus.*

1903, July 6: 1 cyst, body cavity associated with *O. crenacolle*, and immature nematodes; scolex agrees in detail with this species, 1 fish examined.

## RHYNCHOBOTHRUM TUMIDULUM Linton.

1890, pp. 829-832, pl. 11, figs. 3-11.

1897a, p. 448.

1900, p. 270.

1901, pp. 425, 431, 468.

1905, pp. 348, 409.

1911, p. 588.

**Adult stage.***Carcharhinus obscurus.*

1907, July 31: 2, in spiral valve.

*Galeorhinus laevis.*

Collected in 4 of the years from 1903 to 1907: On 2 dates in July, 1 on one date, 30 on the other; on 6 dates in August, 6 to numerous, with ripe segments which were brown almost black; ova conical, with bristles; on 2 dates in September, 3, with ripe segments, in 1 of 15 dogfish, on one date, and 28 in one dogfish, and 26 in another on the other date.

(U.S.N.M., Helm. Coll. 7709.)

**Larval stage.***Lophius piscatorius.*

1903, October 29: 1, scolex attached to plerocercus. Dimensions, life: Length of larva, 5; maximum diameter, 1; diameter at bulbs, 0.63; length of bulbs, 0.27; hooks not satisfactorily shown, but largest about 0.03 in length. In balsam the length of the scolex to base of bulbs is 0.67; breadth at base, 0.56; behind bothria, 0.35; bothria, length, 0.33; breadth, 0.40; length of bulbs, 0.21; proboscides retracted and hooks not clearly shown; length, about 0.021.

*Opsanus tau.*

1910, October 5: 1 cyst, 4 by 1.5 mm.; proboscides of scolex retracted; referred provisionally to this species. Dimensions of a scolex mounted in balsam of date already reported (1901, p. 468): Length, much contracted, 0.98, breadth at base of bulbs 0.77, at anterior end behind bothria 0.35; length of bothrium 0.22, breadth 0.26; length of bulbs 0.35, breadth 0.08; diameter of proboscis, excluding hooks, 0.024; hooks slender, and, so far as seen, arcuate, maximum length about 0.009.

*Spheroides maculatus.*

1907, August 10: 2 scoleces attached to plerocerci, in intestine, red pigment in neck. Dimensions in balsam: Length of scolex, 0.70, breadth at base, 0.53, at anterior end 0.25; length of bothrium 0.22, breadth 0.21; length of bulbs 0.28; plerocercus, length 1.26, a little broader than scolex at anterior end, tapering to 0.21 at posterior end; hooks very small.



## RHYNCHOBOTHRUM UNCINATUM, new species.

Plates 7-8, figs. 74-78.

*Scolex* with slender, cylindrical neck, and bothria rather widely separated and deeply notched on the posterior border; proboscides long, when fully extended there is a basal, naked portion, succeeded by a few large hooks, 0.075 to 0.12 mm. in length, which are at the base of the hook-bearing portion of the proboscis; next is an interval of about 0.11 mm., densely covered with minute hooks, 0.016 mm., more or less, in length, some of them slender and bristle-like, others short and broad; then hooks, similar in shape to the large basal hooks, but not quite so long, appear and continue to the apex of the proboscis. These hooks are, for the most part, nearly uniform in size and shape. They are rather slender and graceful, with a tendency to be rather abruptly recurved at the tip, length about 0.05 mm. Sheathes spiral, bulbs long-elliptical with thickish walls, retractor muscle attached at base. In a mounted scolex, measuring 3.22 mm. in length, a contractile bulb measured 0.56 mm. in length, and 0.14 in breadth.

*Strobile* slender, segments beginning very close to the scolex, at first very short, but soon as long as broad, later becoming much longer than broad. In mature segments the length may be as much as five times the breadth.

*Reproductive organs.*—Genital pores irregularly alternate at about the anterior fourth, or a little back of that point. Cirrus long and slender; cirrus-pouch short, fusiform, with a relatively large seminal vesicle on its anteromedian border; vas deferens unusually voluminous, apparently occupying the median axial region from near the anterior border of the ovary to the seminal vesicle; testes distributed throughout the proglottis inside the vitelline layer.

The vagina was not satisfactorily made out in the whole mounts, and no sections were made. From what is shown in a ripe proglottis, in which the uterus occupies the greater part of the interior between the ovary and cirrus-pouch, it would appear that a part of the complex which comprises the folds of the vas deferens may be the vagina filled with sperm, and functioning as a seminal receptacle. What was interpreted to be the distal portion of the vagina was seen lying close to the posterior margin of the cirrus-pouch, but it could be traced for only a short distance. The ovary is bilobed, the lobes being symmetrically placed with respect to the median line. In adult, but unripe segments the lobes of the ovary are longer than broad, in one case, length 0.39, breadth 0.14; in a ripe proglottis, length 0.30, breadth 0.18; uterus in ripe proglottides spacious, occupying practically all the interior of the segment between the ovary and cirrus-pouch and seminal vesicle. The vitellaria have the usual

distribution, seen in whole mounts as a dense glandular mass along the lateral margins, but also constituting a layer surrounding the inner core of the segment which contains the testes.

*Type*.—U.S.N.M., Helm. Coll. 7710.

**Adult stage.**

*Vulpecula marina*.

1912, August 7: 4 strobiles with scoleces, and 5 free proglottides; longest 33 mm.; length of scolex, 6, breadth through bothria 2; posterior proglottis, length 2.5, breadth 1; posterior segments rectangular, contracting when placed in killing fluid; ova subglobular, with very thin shells, diameter about 0.048. Diameter of proboscis, in balsam, basal hookless portion 0.072, portion near base bearing minute hooks, including hooks, 0.066, a short distance in front of portion bearing minute hooks, excluding hooks, 0.051, including hooks, 0.12.

**Larval stage.**

*Xiphias gladius*.

1911, July 10: Collected by Vinal N. Edwards, who, noticing the presence of parasites in flesh attached to a piece of backbone of a swordfish at the fish market, brought them to the laboratory. There was one scolex with an elongated plerocercus still attached, 40 mm. in length, increasing to 50 mm. when transferred to a slide. Beside this there were two fragments 27 and 12 mm. in length respectively. They were all embedded in muscular tissue near the vertebrae. Upon pressure the scolex with its short neck separated from the plerocercus. It was fixed under pressure with the proboscides in greater part extruded.

Upon comparing the scolex with that of the adult form from the thrasher shark, the agreement in detail in the peculiar character of the hooks was found to be so close that there seemed to be no room for doubt concerning their specific identity.

*Dimensions of scolex, adult from Vulpecula marina, larva from Xiphias gladius; specimens mounted in balsam, and more or less flattened.*

	Adult.	Larva.
Length of bothrium.....	0.63	0.77
Breadth, bothrium.....	0.72	0.84
Diameter of neck.....	0.49	0.67
Length of contractile bulb.....	0.56	0.56
Diameter, contractile bulb.....	0.14	0.21
Length of proboscis, approx.....	2.80	2.00
Diameter of unarmed basal portion.....	0.075	0.066
Diameter, median, including hooks.....	0.12	0.12
Diameter, median, excluding hooks.....	0.054	0.054
Length of large basal hooks.....	0.12	0.105
Length of smallest hooks, in front of large basal hooks.....	0.006	0.006
Maximum length of most abundant slender hooks.....	0.075	0.075

## RHYNCHOBOTHRIMUM TENUISPINE Linton.

1890, pp. 837-838, pl. 12, figs. 1, 2.

1897a, pp. 448-449, pl. 34, fig. 8.

1905, p. 348 (adult), p. 395 (larva), fig. 101.

1910a, p. 695.

1911, p. 588.

## Adult stage.

*Dasybatis centrura*.

Collected in 6 of the years from 1903 to 1920: On 2 dates in August, many on one date, 1, length 4 mm. on the other; on 4 dates in September, 1 to very numerous. There was a conspicuous red blotch in the neck, in specimens collected on one of these dates, which, in some cases involved the bulbs, and was easily visible to the unaided eye, ova with bristles. On one date in October, 1, length 15 mm., length of posterior segment 4 mm., number of segments 7.

1923, July 7, many; August 15, 20; August 20, 5.

This species is characterized by the relatively long proboscides, which are thickly beset with minute, spinose hooks.

(U.S.N.M., Helm. Coll. 7711.)

*Raja erinacea*.

1906, August 27: 1, scolex with plerocercus attached.

## RHYNCHOBOTHRIMUM, species.

A *Rhynchobothrium* (figs. 91-94) which is near *R. tenuispine*, but differing from typical representatives of that species in the relatively coarser and more sparsely set spines is recorded here for the present.

This form was found on two occasions, September 22, 1906, and September 1, 1920, one specimen on each date, and associated with typical representatives of *R. tenuispine*.

The bothria are rather widely separated; proboscides long and slender; hooks small, of about uniform size, somewhat sparsely set, except at the base of the proboscis, where they are close set on a slight enlargement, as in *R. tenuispine*. Strobile slender, immature; proglottides begin near the scolex, and increase in length rapidly. There were about nine segments in all, the last one making up nearly half the length of the strobile back of the scolex. Dimensions of specimen in balsam: Length 5; length of scolex, 1.06, of bothrium 0.29; breadth of bothrium 0.35; diameter of scolex at contractile bulbs 0.22; length of bulbs 0.43, diameter 0.07; diameter of proboscis, excluding hooks, 0.015, including hooks 0.021; length of hooks 0.006; length of last segment 1.91, breadth 0.21.

Again on July 7, 1923, 1 similar form was found among many typical *R. tenuispine*. In some particulars these forms suggest *R. hispidum*.

*Carcharhinus commersonii*.

1923, August 4: Record is here made of three small cestodes with red pigment spots in the neck, and in other recognizable features agreeing with *R. tenuispine*, but with slightly coarser hooks.

(U.S.N.M., Helm. Coll. 7712.)

## Larval stage.

*Scomber scombrus*.

1905, August 18: Cysts in stomach wall, associated with cysts of *R. longispine*, scoleces with minute, and moderately regular hooks, 3 fish examined.

## RHYNCHOBOTHRIMUM WAGENERI Linton.

1890, pp. 843-845, pl. 12, figs. 10-12.

1901, p. 433.

1911, p. 588.

*Dasybatis centrura*.

1911, September 14: 75. This is the only record I have of this species since it was first described. Measurements of specimens from this lot were in agreement with those given in the original description. The most characteristic feature of this species is the single, relatively large hook at the base of each proboscis; all the other hooks being very small, and not differing greatly, either in size or shape. The following measurements are from a specimen mounted in balsam: Diameter of proboscis, exclusive of hooks, 0.066, including hooks 0.075; length of a small hook 0.015, breadth at base 0.004; length of the solitary large hook at the base of a proboscis 0.045; breadth at base 0.024.

(U.S.N.M., Helm. Coll. 7713.)

## RHYNCHOBOTHRIMUM, species.

Plate 7, figs. 71-73.

Record is here made of scoleces from the torpedo, 1 from cyst on spiral valve, 4 scoleces, probably liberated from cysts which had been recently introduced with food.

*Narcacion nobilianus*.

1911, July 21: 4 scoleces, all small. The mounted specimens are from 1.64 to 2.24 mm. in length, from anterior end to base of contractile bulbs; length behind the bulbs varies from 0.28 to 0.56 mm.

Dimensions of specimen showing front view of bothrium; length to base of bulbs, 2.22, behind bulbs, 0.56; bothrium, length 0.42, breadth 0.56; diameter at bulbs 0.49; bulbs, length from 0.45 to 0.52, diameter 0.08.

Dimensions of specimen showing lateral view of bothria: Length to base of bulbs, 1.75, length behind bulbs 0.56; length of bothrium 0.38; diameter of scolex through bothria 0.56, at bulbs 0.34; bulbs,



length 0.42 to 0.45, diameter 0.07; diameter of proboscis, excluding hooks 0.03, including hooks 0.07; length of longest hooks 0.036.

(U.S.N.M., Helm. Coll. 7714.)

1914, July 7: 1, from small cyst on spiral valve. The mounted specimen is not in satisfactory condition for study. It was noted at the time of collecting that the hooks resembled those figured in my notes on larval cestode parasites of fishes (pl. 63, fig. 6, 1897b). The proboscides in this specimen are retracted. The hooks are smaller than in the former lot, one of the largest, resembling the stout, recurved hooks of lot 1, was 0.021 in length.

The hooks differ considerably both in size and shape, especially in lot 1 (figs. 71-72). The hooks of the specimen collected on the later date indicate a form that is specifically different from those of the first date.

LARVAL CESTODES BELONGING TO THE GENUS RHYNCIOBOTHRIUM.

*Carana chrysos.*

1911, September 22: 1 oval-elliptical cyst, 1.96 by 0.77, larva coiled at one end; hooks on the retracted proboscides appear to agree with those figured for species from *Carana chrysos* (1897b, pl. 62, figs. 13-15).

*Ceratacanthus schoepfi.*

1908, August 19: 1 elongated cyst, plerocercus with globular enlargement at one end which contained the larva; scolex slender; bothria deeply emarginate. Dimensions in balsam: Length of scolex 3, diameter, middle of neck, 0.28, at bulbs 0.37; length of bothrium 0.60, breadth 0.50; length of bulbs 0.60; length of longest hooks 0.04 (figs. 108, 109).

1909, October 6: 1 plerocercus, length 25 mm., no scolex.

1920, July 28: 2 cysts from wall of intestine. Dimensions in balsam: Length of pyriform cyst 0.98, greatest breadth 0.77; larva elongate, length of scolex 1.08, diameter at bulbs 0.12; length of bulbs 0.15; diameter of proboscis, excluding hooks, 0.018; length of longest hooks 0.015; hooks smaller and more densely placed than in species figured above.

(U.S.N.M., Helm. Coll. 7715-7716.)

*Cynoscion regalis.*

1907, August 24: 1, in flesh, collected by Charles R. Knight (figs. 115, 116). This cestode was found embedded in the flesh near the back-bone, and at about the middle of the length of the fish. The plerocercus was enveloped in a very thin, hyaline cyst, enlarged at one end, where the larva was enclosed, posterior two-thirds slender, cylindrical. Length 18 mm.; anterior, enlarged portion, length 5, diameter 3.5; diameter of slender portion 1.25. Length of larva

about 18 mm.; length of scolex 3.5; bothrium, length 1.43, breadth 1.14; contractile bulbs, length 1.08; proboscides, only base everted, diameter, excluding hooks, 0.18; length of longer hooks 0.06 to 0.08, of slender hooks on opposite side of proboscis 0.018 to 0.03.

1908, July 27: 2 cestodes found in the flesh of one out of 6 fish examined for parasites in the flesh. The fish measured about 500 mm. in length. One cestode, 75 mm. in length, and 1 mm. in diameter, lay in the muscles of the right side, near the anal aperture, color yellowish white; another, length 25 mm., diameter 2 mm., was found on the left side near the dorsal fin. The bothria were broader than long; hooks not yet developed.

1919, August —: In a lot of cestodes from a "salt water trout," presumably *C. regalis*, sent by S. S. Fay, State board of health, Miami, Fla., to the Bureau of Fisheries, and received by me August 12, plerocerci of a *Rhynchobothrium* were found, which probably came from the flesh. One proboscis of one of the scoleces is partly everted. The following dimensions are from a specimen mounted in balsam: Length of scolex 3.20, of bothrium 0.98; diameter at bulbs 0.91; length of bulb 1.12; diameter of proboscis, excluding hooks, 0.21; length of longer hooks 0.09, of slender hooks on opposite side of proboscis 0.018 to 0.03.

(U.S.N.M., Helm. Coll. 7717.)

These cestodes from the flesh of *C. regalis* appear to be the larval stage of *Rhynchobothrium*, species from *Scoliodon terrae-novae* (1905, p. 343, figs. 129–130c).

#### SYNBOTHRIUM FILICOLLE (Linton).

- 1887, *Tetrarhynchobothrium*, larva, p. 195, pl. 10, figs. 7–11.  
 1890, *Syndesmobothrium filicolle*, pp. 861–862, pl. 15, figs. 2–4.  
 1897b, *Synbothrium filicolle*, pp. 815–820, pl. 68, figs. 7–12.  
 1900, pp. 277, 278.  
 1901, pp. 425, 440, 451, 457, 460, 482.  
 1905, pp. 341, 344, 349, 362, 363, 369, 396, 413, 415.  
 1907e, p. 113.  
 1908b, pp. 185–186.  
 1910a, p. 693.  
 1911, p. 589.

Used as a type, without specific name, in an article entitled: "Notes on two forms of cestode embryos."<sup>17</sup>

#### Larval stage.

##### *Brevoortia tyrannis*.

1905, July 27: 1, encysted, on viscera.

1906, August 1: 1, length of plerocercus 10 mm., 3 fish examined.  
 August 7: 1, 2 fish examined.

1908, August 1: 1 plerocercus in thin hyalin cyst.

<sup>17</sup> American Naturalist, February, 1887, pp. 1–6 (author's reprint), pl. 10, figs. 7–11.

*Carcharhinus commersonii.*

1923, August 25: About 50 cysts collected from the submucosa of the stomach of a 202-centimeter shark, associated with large numbers of cysts of *O. crenacolle*, all rather small, 10 by 5 mm.

1923, August 29: 150 cysts from submucosa of stomach of a 230-centimeter shark, associated with very numerous cysts of *O. crenacolle*.

*Carcharhinus limbatus.*

1915, August 6: Several, associated with *Otobothrium crenacolle*, encysted in submucosa of stomach; one cyst measured 8 by 3.5 mm. in the two principal diameters.

1918, July 13: Many cysts in submucosa of stomach; 8 by 3 mm., and smaller; one plerocercus when liberated from its cyst assumed the shape characteristic of the species, in which the end in which the scolex is lodged, became globular, 2 mm. in diameter, while the remainder of the plerocercus was very variable, sometimes forming a linear extension as much as 28 mm. in length.

*Carcharhinus milberti.*

1922, July 3: 1 cyst on serous coat of stomach; scolex, when placed in fresh water everted the proboscides.

(U.S.N.M., Helm. Coll. 7719.)

*Carcharhinus obscurus.*

1905, August 11: 2, between submucous and muscular coats of stomach; characteristic cysts and plerocerci.

1911, August 3: 4, encysted in submucosa at posterior end of cardiac portion of stomach; dimensions of largest plerocercus, diameter of globular portion, 3 mm., length of remaining portion, when fully extended, 38, diameter, 0.5.

1912, September 12: Several transparent, oval-elliptical cysts in serous coat of stomach, and on spleen; one cyst measured 6 by 4.5 mm; plerocerci of usual character, scolex contained in dense, ivory-white, globular portion. remaining portion variable, usually more or less linear.

*Cynoscion regalis.*

1905, July 14: 1 elongated cyst, on mesentery, 5 fish examined. July 15. 1; length of plerocercus 94 mm.; globular portion active, lengthening to 5 or 6 mm., and contracting to sphere, 2.5 mm. in diameter.

*Galeocerdo arcticus.*

1907, August 7: 1, encysted in stomach wall near esophagus.

*Paralichthys dentatus.*

1904, August 8: 2 plerocerci, no scoleces.

*Pomatomus saltatrix.*

1904, July 22: 1 plerocercus on viscera; proboscides partly everted, showing the smallish, recurved hooks at the base, followed by longer recurved hooks on one side, and straightish hooks with notch at the extremity, on the other.

1906, August 27: 1, cyst, with plerocercus and scolex.

1912, August 16: 1 cyst from pyloric caeca.

*Poronotus triacanthus.*

1913, July 3: 1 cyst, 4.5 by 2.5 mm., in flesh, about 50 mm. in front of the caudal fin, of a fish 22.2 centimeters in length. The wall of the cyst was thin, and loosely surrounded an ivory-white plerocercus, which was moderately active when liberated in sea water, and measuring, at rest, 3.5 by 2 mm. The plerocercus was oblong, and did not show the differentiation into globular and elongated portions usual in this species. A typical scolex was obtained.

*Scomberomorus cavalla.*

1920, August 2: 3 cysts with characteristic plerocerci and scoleces. These were found in a dish containing material which had been scraped from the gills of the fish. The cysts were not seen in place.

*Seriola dumerili.*

1905, October 30: 1 plerocercus of usual type in vial, location in host not stated.

## SYNBOTHRIUM MALLEUM, new species.

Plate 10, figs. 95-98.

*Tetrarhynchus crinaceus* BENEDEN, 1897b, pp. 811-812, pl. 57, figs. 1-8.

1900, p. 281.

1901, pp. 451, 454, 460.

*Synbothrium* species 1905, pp. 350, 369, 377, 385, figs. 116-118.

Cestodes found on two occasions at Woods Hole agree in essential characters with the species recorded in my report on the parasites of fishes of Beaufort, N. C., as *Synbothrium*, species.

*Scolex*.—Elongate, bothria nearly at right angles to axis, giving a hammer-like effect to the scolex; bulbs slender, one-third the length of the entire scolex or more; sheathes sinuous or spiral, depending on the state of contraction; proboscides armed with hooks of a great variety of shapes and sizes, many of them large and strongly recurved; in a mounted scolex they are seen to vary in length from 0.012 to 0.126 mm.

Dimensions of a scolex, in balsam, somewhat contracted: Length, 4.48; length of bothrial portion, 0.84, breadth, 1.54; length of neck, 3.64, diameter, 0.77; length of contractile bulb, 1.54, diameter, 0.21. Dimensions of another scolex, in balsam, not contracted: Length,



5.18; length of bothrial portion, 0.84, breadth, 1.82; length of neck, 4.34, diameter, 0.77; length of contractile bulb, 2.30, diameter, 0.21.

In the specimens collected in 1914 the hooks were not quite so large as in the first lot, the maximum being about 0.10; moreover, one side of the proboscis is densely covered with small hooks, 0.012 to 0.024 in length. It should be remarked that the proboscides were almost entirely everted. The proboscides in the first lot were only partly everted; hooks as small as those in the first lot were found, but they were not seen to cover any part of the proboscis as densely as in the second lot.

*Strobile*.—Length of longest specimen, in balsam, 26 mm. The first distinct segments are broader than long, soon squarish, then longer than broad; last segment, with ova, length 2.34, breadth 1.54; distance of middle of notch at genital pore from posterior end of proglottis, 0.91. The outline of the proglottides is, in general, rectangular; the last proglottis in the longest strobile is bluntly rounded at the posterior end (fig. 97).

*Reproductive organs*.—The genital pores are irregularly alternate, situated but little in advance of the posterior third, and are characterized, in adult segments, by having thick, rounded, and slightly projecting lips. The cirrus was not seen everted, but is evidently short and smooth. The cirrus-pouch is oval-elliptical, at right angles to the margin, its length approximately one-third the breadth of the proglottis; vas deferens rather voluminous, at base of pouch, along median region of proglottis from the anterior border of the ovary to about the middle of the length of the proglottis; testes occupy the median area of the proglottis within the layer of longitudinal muscles. The vagina was not seen very satisfactorily. It appears to enter the cirrus-pouch on the ventral side and is, therefore, difficult to see in whole mounts. In sections it was seen lying on the ventral side of the pouch, and taking a diagonal course in the direction of the ovary. The ovary is two-lobed, somewhat dumb-bell shaped, and is situated near the posterior end of the proglottis about midway between the posterior border of the pouch and the posterior end of the proglottis. The uterus, as seen in horizontal sections, lies along the median line, and is more or less sacculated. It was seen to open by a definite pore on the median line near the anterior end of the ventral face of the proglottis; ova, 0.030 by 0.015, in specimen mounted in balsam.

*Type*.—U.S.N.M., Helm. Coll. 7720.

*Dasybatis centrura*.

1911, September 14: A single strobile, attached to the mucous membrane near the anterior end of the spiral valve, and a few free proglottides, which discharged white masses of ova soon after they had

been placed in sea water. In an hour or two these eggs had become a dark brown color. There appeared to be some variation in the size of the ova, one of the larger measured 0.040 by 0.027.

1914, August 1: 6, collected by Dr. G. A. MacCallum.

**TETRARHYNCHUS BICOLOR** Bartels.

Plate 8, figs. 79-80.

1897*b*, pp. 813-815, pl. 68, figs. 1-6.

1900, pp. 271, 277.

1901, pp. 426, 427, 446, 448, 452, 482.

1905, p. 373.

1911, p. 589.

Following are records of this species not heretofore published :

*Carcharhinus milberti*.

1922, July 10: 1; attached to wall of spiral valve, near anterior end; inflamed patch of mucous membrane at point of attachment about 15 mm. in diameter. The color of the scolex was deep purplish red; length of strobile, 50 mm., diameter of scolex, 3 mm.; greatest breadth of strobile, 2 mm.; collected by Dr. G. A. MacCallum.

*Carcharhinus obscurus*.

1905, August 14: 2; head and neck, including collar, of one, deep, purplish red; head and neck of the other the same, collar a lighter shade; strobiles, 30 and 45 mm. respectively, a fragment of strobile measured 110 mm. in length; largest proglottides, length 1.2, breadth 3; length of head and neck, 6.5 and 9.

1907, July 31: 2, in shark measuring 183 centimeters; one of the worms was firmly attached to the mucous membrane. Length of longer, in sea water, 200 mm. Head not much differentiated from neck; head and neck cylindrical, longitudinally ribbed, except collar, which is smooth, red (shade 1, Milton-Bradley Co.); deepest color about the vicinity of the bulbs. The pigment in the head and neck was not dissolved, either by the fixing fluid (chr.-acet.-form.), or the alcohol in which it was preserved. The color still persisted when this note was written, November 4, 1921, but disappeared as the specimen was dehydrated before mounting in balsam.

Length of scolex at rest, 11 mm., stretching to 20 mm., or more; diameter 1.75. The larger specimen was active, and contracted strongly, becoming sinuously crumpled posteriorly, and spiral anteriorly. The scolex was also very active, contraction waves beginning at the anterior end and passing posteriorly to about the middle of the length, thus showing admirable fitness for the penetration of mucous membranes. Color of strobile, cream, with a blotch of white in the center of the face of ripe segments, where ova are clustered.

The face of the strobile on which ova lie is convex, the opposite side is concave; ova somewhat variable, but the larger ones measured about 0.031 by 0.024; shells of ova very thin. After the larger specimen was straightened by wrapping it around the handle of a needle-holder and immersing it in the killing fluid, it measured 212 mm.

*Galeocерdo arcticus.*

1905, August 26: 3 scoleces, adhering to mucous membrane of stomach; ivory white.

1913, August 13: 1, attached to mucous membrane of stomach; length of scolex 5 mm., of strobile, 6 mm., segments beginning, short and much narrower than the scolex; collected by Dr. G. A. MacCallum.

1914, August 12: 6 scoleces from the mucous membrane of the stomach; at one point where some of these were attached there was considerable suppuration; color white, yellowish behind the bulbs. All short, but one showed the beginnings of a strobile. This one measured 18 mm. in length; no segments.

1915, August 6: Associated with *T. bisulcatus*, a number of them being attached together near the anterior end of the stomach in a pit of the mucous membrane which was abraded and inflamed.

(U.S.N.M., Helm. Coll. 7721.)

**Larval stage.**

*Echeneis naucrates.*

1920, August 31: 5, white globular cysts, 3 mm. in diameter, from serous coat of stomach and intestine; ivory white.

*Lophius piscatorius.*

1910, July 29: 1, length 7 mm., white; from viscera.

*Sarda sarda.*

1910, June 27: 2, under peritoneum; one white, the other yellow.

*Xiphias gladius.*

1904, July 15: Many, on viscera, in each of four swordfish; mostly yellowish white, some ivory white; active; 6 to 12 mm.

1911, July 13: 10, in globular cysts on viscera.

1912, July 20: 1, from viscera, yellowish.

**TETRARHYNCHUS BISULCATUS (Linton).**

**Adult stage.**

1899, *Rhynchobothrium bisulcatum*, pp. 479-484, pl. 4, figs. 9-23.

1890, *Tetrarhynchus bisulcatus*, pp. 857-862, pl. 14, figs. 10-12; pl. 15, fig. 1.

1897a, p. 452.

1900, p. 272.

1901, p. 427.

1905, pp. 340, 341, 344.

1910b, p. 1201.

1911, p. 589.

**Encysted stage.**

1897b, pp. 810-811, pl. 66, figs. 11-15.

1900, pp. 280-283.

1901, pp. 432, 448, 449, 451, 458, 460, 471, 472, 482, 484, 486, figs. 243, 261-264.

1905, pp. 359, 362, 363, 365, 366, 369, 371, 377, 381, 385, 386, 388, 393, 395, 399, 402, 404, 405, 409, 413, 415, 416.

1911, p. 589.

Records of this species not heretofore published:

**Adult stage.***Carcharhinus milberti.*

1915, August 18: In large numbers, the scoleces embedded in the mucous membrane of the pyloric division of the stomach throughout its entire length of 585 mm. They were not found in the stomach proper, and only chains of proglottides without scoleces occurred in the spiral valve. Enormous numbers of eggs were discharged when the strobiles were placed in sea water.

*Carcharhinus obscurus.*

1907, August 3: 1, at the beginning of the spiral valve, an unusual position; length, fixed, 112 mm.

1918, September 6: 1 strobile, scolex missing; pyloric division of stomach.

(U.S.N.M., Helm. Coll. 7722.)

*Galococerdo arcticus.*

1915, August 5: 5, stomach near esophagus; 1 attached alone, the others in a deep and highly inflamed pit of the mucous membrane. August 6: Several attached to the wall of the stomach, near its anterior end; a number of them together in an inflamed and abraded pit of the mucous membrane. Measurements of specimen in balsam: Diameter of proboscis, excluding hooks, 0.045, including hooks, 0.072; length of longest hooks, 0.021; bulbs, length 0.59 to 0.63, diameter, 0.15 to 0.18.

(U.S.N.M., Helm. Coll. 7723.)

*Squalus acanthias.*

1910, August 3: 1 scolex found in stomach, not attached.

1911, May 25: Fragments of strobiles, 6, 9, and 14 mm. in length; largest proglottides 3 mm. long, and 2 mm. broad; appear to belong to this species.

**Larval stage.**

Found encysted in many species of fish, on the viscera, but especially in the wall of the stomach and intestine, where its favorite lodgment is the submucosa; in flesh of the sea robin (*Prionotus carolinus*) on two occasions.



*Anguilla rostrata.*

1912, July 31: Cysts in stomach wall, 9 fish examined.

*Cynoscion regalis.*

Collected in five of the years from 1903 to 1910, inclusive. In all cases encysted on or in the submucous coat of the stomach, often in the submucosa of the intestine. Found in 54 of the 59 fish examined. On 8 dates in July, few to numerous cysts, 37 fish examined; 5 dates in August, few to numerous cysts, 22 fish examined.

*Lophius piscatorius.*

1905, August 23: Whitish, thick-walled cysts found in the stomach wall on this date resemble this species, but are much larger. Scolex, length 4, breadth 3; diameter of proboscis, with hooks 0.21, excluding hooks 0.14; length of longest hooks 0.056.

1910, July 29: Few cysts in stomach wall. Scolex, length 2, breadth 1.30; diameter of proboscis, including hooks, 0.08, excluding hooks, 0.05; length of longest hooks, 0.02.

*Lophopsetta maculata.*

1910, July 25: 1, encysted in mesentery; collected by Dr. C. W. Hahn.

*Merluccius bilinearis.*

1910, July 2: Several cysts in wall of intestine, 12 fish examined. August 16: Several cysts in wall of stomach, 12 fish examined.

*Microgadus tomcod.*

1910, July 13: 1, encysted on viscera; collected by Dr. C. W. Hahn.

*Paralichthys dentatus.*

Collected in 8 of the years from 1903 to 1920, inclusive: Usually encysted in submucosa of stomach and intestine, found also under serous coat of stomach, on gills, in post-branchial cavity and throat. Found in 54 of the 60 fish examined. On 1 date in June, many cysts; 9 dates in July, few to many cysts, 12 fish examined; 13 dates in August, few to many cysts, 44 fish examined; 1 date in September, several cysts, 1 fish examined; 2 dates in October, several to many cysts, 2 fish examined.

(U.S.N.M., Helm. Coll. 7724.)

*Pollachias virens.*

1913, June 30: Few cysts in stomach wall, 14 fish examined.

*Pomatomus saltatrix.*

1904, July 15: Numerous, encysted in submucosa of stomach.

*Poronotus triacanthus.*

1904, August 11: 1 cyst, from viscera.

*Prionotus carolinus.*

Collected in 4 of the years from 1905 to 1911: On 2 dates in July, 1 cyst in wall of esophagus on each date, 3 fish examined; 2 dates in August—(1) few cysts in stomach wall, more or less degenerated; (2) 3 cysts in flesh, beside anal fin, and 1 cyst on serous coat of intestine; 1 date in September, 3 cysts in flesh, above, and lateral to backbone, about middle of body.

*Prionotus strigatus.*

1905, August 23: Few cysts between muscular and submucous coats of stomach.

*Raja erinacea.*

1911, July 21: 1 cyst from wall of intestine; scolex large with faint pinkish tinge.

*Remora remora.*

1910, July 28: About 12 cysts at beginning of stomach.

*Scomber scombrus.*

1905, August 18: Associated with *Rhynchobothrium* cysts between coats of stomach.

1912, July 5: 2 cysts which appeared to be a young stage of this species, on pyloric caeca.

*Spheroides maculatus.*

Collected in 4 of the years from 1905 to 1910: On 2 dates in July—(1) few cysts on intestinal wall; (2) 1 cyst in stomach wall; 5 dates in August, few cysts on each date, from serous coat of intestine on 1 date, from wall of stomach and intestine on the others.

*Urophycis chuss.*

1910, August 12: 1 cyst in wall of esophagus; scolex resembles this species, but hooks appear to be smaller than usual, 3 fish examined.

*Xiphias gladius.*

1904, July 15: Several cysts on viscera. July 20. Few scoleces in alimentary canal; introduced with food.

**TETRARHYNCHUS ELONGATUS** Wagener.

1890, pp. 812-813, pl. 67, figs. 9-12.

1900, p. 282.

1901, p. 466, pl. 23, figs. 257-260.

1911, p. 589.

*Mola mola.*

1914, July 20: About 25 in liver, under serous coat, but with slender elongated portions penetrating the substance of the liver; still very active in sea water on July 21.

(U.S.M.N., Helm. Coll. 7725.)

There is a singularly close agreement between the plan of hooks on the proboscides of this species and that found in *Rhynchobothrium uncinatum* from *Vulpecula marina*. In each there is a basal portion which is devoid of hooks. This is followed by a collar-like cluster of relatively long hooks. This cluster does not completely surround the proboscis, but is on the side which corresponds with the periphery of the scolex. This is the position in which the hooks would be most serviceable as hold-fast organs. These large hooks are followed by very small, closely set hooks, which, in turn, are soon followed by longer, for the most part, slender hooks. Two vertical rows of stouter hooks lie on the peripheral side of the proboscis (1901, figs. 257-260). One proboscis was seen which was more than two-thirds of its length everted. It maintained a practically uniform diameter throughout.

Dimensions in balsam: Length of bothria, 2.80, breadth 2.03; diameter of neck, 2.03; length of proboscis, 5.32; diameter of unarmed, basal portion, 0.17; diameter of median region, including hooks, 0.28, excluding hooks, 0.17; length of large basal hooks, 0.14, of small hooks, in front of basal hooks, 0.03, of slender hooks, most abundant kind, 0.10; length of contractile bulb 2.10, diameter 0.56.

**TETRARHYNCHUS PALLIATUS, new species.**

Plate 8, Figs. 81-84.

*Tetrarhynchus bisulcatus* LINTON, MacCallum, Studies in Helminthology, vol. 1, No. 6 (1921), p. 206, fig. 105.

*Scolex*.—Concave in front; bothria long oval, bluntly pointed; neck portion short, subcylindrical; collar ample, flaring at posterior border; bulbs reaching almost to beginning of strobile; proboscis sheathes with about one spiral at junction with bulb, then nearly straight; retracted proboscides reach nearly to bulb; proboscides cylindrical, hooks of nearly uniform size and shape, increasing in size slightly toward tip, relatively stout, strongly recurved, about six showing in single spiral on one side, apparently about twelve vertical rows; collar of scolex more than one-third length of entire scolex, considerably wider than anterior portion of strobile, especially in specimens which have been more or less compressed.

The concavity at the anterior end, and the ample, flaring collar are distinct specific characters.

*Strobile*.—In uncompressed specimens, the strobile is nearly linear, under pressure, increasing in breadth slightly but uniformly toward the posterior end; free, ripe proglottides not seen. The first proglottides are enclosed in the collar of the scolex and are very short. They increase in length very slowly; posterior margins slightly projecting, thus giving to the lateral margins of the strobile a more or

less serrate outline; last proglottides thus far seen still broader than long. Thus, in a strobile, 30 mm. in length, the proglottides near the posterior end measured 0.56 in length, and 0.91 in breadth; in a strobile 20 mm. in length, the length of the posterior proglottides was 0.56; breadth, 0.70; in another which had been considerably flattened in mounting, length 30 mm., length of last proglottides, 0.63; breadth, 2.27.

*Reproductive organs.*—The genital pores are irregularly alternate, nearly symmetrical with respect to the dorso-ventral faces, and near the middle of the length; the cirrus is smooth, slender, with a bulbous base; the cirrus-pouch is cylindrical and extends from the genital pore, first forward to near the anterior margin of the proglottis, then transversely toward the median line; in an immature proglottis, 0.27 mm. in length and 1.33 in breadth, the inner end of the pouch is 0.49 from the margin; it is 0.56 in diameter, and has coils of the vas deferens, here quite slender, enclosed in the inner end. Voluminous folds of the vas deferens lie between the inner end of the bulb and the median line, on the dorsal side as far back as the level of the ovary. The testes appear in sections as two layers, and fill all the interior of the proglottis within the layer of vitellaria not occupied by other genitalia. The vagina lies close to the cirrus-pouch, on or near the posterior border; from the level of the inner end of the pouch to the middle line it is somewhat convoluted and lies beside the folds of the vas deferens; at the median line it turns posteriorad and, still more or less convoluted or sinuous, proceeds to its junction with the germ duct. The ovary is about one-third the breadth and one-half the length of a proglottis; in median sagittal sections it shows as two divisions, one ventral and the other dorsal, both lobulated. The shell gland, and the complex of germ duct, sperm duct, vitelline ducts, and beginning of the uterus lie between the dorsal and ventral lobes of the ovary. The vitellaria form an almost continuous layer immediately adjacent to the body wall, being interrupted only in the vicinity of the genital pores and the ovary. The uterus passes from the shell gland as a comparatively slender tube along the median line to near the anterior end of the proglottis, where it enlarges, becomes subglobular, and opens to the exterior by rupture of the walls of the ventral side of the proglottis at about the anterior third of the length. In sections studied, the uterus was filled with a rather heterogeneous mass of ova, germ, and yolk cells, from the vicinity of the shell gland to the point of discharge of contents (fig. 84).

*Type.*—U.S.N.M., Helm. Coll. 7726.

*Cestracion zygaena.*

On July 19, 1915, I examined the stomach of a hammerhead shark; the spiral valve of the same shark was examined by Dr. G. A. MacCallum.



A few specimens of an *Orygmatobothrium* and one *Thysanocephalum thysanocephalum* were found in the spiral valve.

In the stomach I found 41 examples of a *Tetrarhynchus* which, upon superficial examination, suggested both *T. bisulcatus*, and *T. robustus*.

Most of them were adhering to the stomach wall. When removed they still showed a tendency to fasten themselves again to the stomach wall and to each other.

Following are a few measurements of examples of four species of *Tetrarhynchus*. While there is much variation in the dimensions of these soft bodied worms, especially in preserved material, a record of dimensions is not devoid of value for purposes of comparison. Measurements made from material mounted in balsam.

Dimensions.	<i>T. robustus.</i>	<i>T. robustus.</i>	<i>T. bisulcatus.</i>	<i>T. bisulcatus, compressed.</i>	<i>T. palliatus.</i>	<i>T. palliatus.</i>	<i>T. tenuis.</i>	<i>T. tenuis.</i>
Length of strobile.....	15.00	15.00	76.00	100.00	30.00	20.00	10.00	22.00
Length of scolex.....	1.00	0.91	1.28	1.68	1.82	1.93	0.67	0.49
Length of bothrium.....	0.56	0.49	0.70	0.84	0.76	0.77	0.38	0.32
Diameter of scolex through bothria.....	0.63	0.51	0.81	1.29	0.93	0.70	0.26	0.22
Diameter of neck behind bothria.....	0.45	0.35	0.52	1.05	0.84	0.53	0.15	0.15
Diameter of neck (collar), posterior end.....	0.40	0.39	0.39	0.80	1.28	1.19	0.15	0.14
Length of collar.....	0.19	0.30	0.18	0.42	0.70	0.70	0.07	0.08
Length of contractile bulb.....	0.30	0.27	0.31	0.46	0.39	0.35	0.12	0.09
Diameter of contractile bulb.....	0.10	0.10	0.10	0.22	0.14	0.14	0.03	0.04
Length of proboscis.....	0.64	0.50	0.70	.....	0.50	0.53	0.32	.....
Diameter of proboscis, base, including hooks.....	0.03	0.045	0.06	0.06	0.06	0.06	0.02	.....
Length of hooks, maximum.....	0.006	0.015	0.02	0.018	0.021	0.019	.....	.....
Length of posterior proglottis.....	.....	0.70	0.46	0.98	0.60	0.49	0.50	0.77
Breadth of posterior proglottis.....	.....	1.12	1.42	2.10	2.36	1.33	0.28	0.53

The proboscis of *T. robustus* tapers from the base to the tip. For example in a proboscis measuring 0.37 mm. in length, the diameter at base, exclusive of hooks, was 0.027, at the tip 0.015; maximum length of hooks 0.009.

The proboscis of *T. bisulcatus* remains practically the same diameter from base to tip. Thus, in a proboscis 0.70 mm. in length, the diameter at base, exclusive of hooks, was 0.048, at tip 0.045; length of hooks near base of proboscis, 0.015, near tip 0.024.

In *T. palliatus* the proboscides are of the same type as those of *T. bisulcatus*. In a proboscis 0.53 in length, the diameter at base, exclusive of hooks, was 0.030, at tip, 0.027; length of hooks near base 0.015, at tip 0.021. No proboscis in this species was seen fully extended.

## TETRARHYNCHUS ROBUSTUS Linton.

1890, pp. 855-857, pl. 14, figs. 7-9.

1900, p. 276.

1901, pp. 430, 431, 433, 434, fig. 242.

1905, p. 341.

1911, p. 589.

Record of this species not heretofore published:

**Adult stage.***Dasybatis centrura.*

1905, August 20: 1, with several fragments.

(U.S.N.M., Helm. Coll. 7727.)

**Larval stage.***Echeneis naucrates.*

1920, August 21: 2 globular cysts, 1 mm. in diameter, from serous coat of stomach; 1 fish examined.

## SCOLEX POLYMORPHUS Rudolphi.

Larval Tetrabothria, 1889*b*, pp. 453, 454, pl. 6, figs. 6-9.

Larval Echeneibothria, 1897*b*., pp. 789-792, pl. 61, figs. 4-15.

Larval cestodes, 1900, pp. 276, 277, 279-284.

*Scolex polymorphus* RUDOLPHI, 1901, p. 413 (page references to 28 hosts).

1905, pp. 326, 332-333 (page references to 34 hosts).

1907*d*, p. 101.

1908*b*, pp. 162, 175.

1911, p. 588 (39 hosts named).

This name is retained for convenience, although it is to be interpreted, not as an ordinary specific designation, but rather as the name of a group of larval cestodes, in which many species, and even genera, are represented.

The complete life history of these forms has not been made out. They appear to be scoleces which have passed the encysted stage in some other, probably Arthropod, host, and are free in the alimentary canals of their hosts, as sojourners, for a short time in teliosts, as potential adults in such selachian as may be adapted to be a final host.

See the admirable paper by Dr. W. C. Curtis.<sup>18</sup>

Following are records of finds of these cestodes, details of which have not hitherto been published. Collections in the months, September to June, inclusive, for the most part made by Vinal N. Edwards.

<sup>18</sup> Journal of Morphology, vol. 22, pp. 819-853, pls. 1 and 2 (September, 1911).

*Acanthocottus octodecimspinosus.*

1912, November 9: 30, 6 fish examined. December 27: 1, 2 fish examined.

1913, February 15: 1, 6 fish examined.

*Alosa sapidissima.*

1910, July 13: 2, two red pigment spots in neck, 1 fish examined.

1911, July 7: Few, two red pigment spots in neck, length of bothrium 0.2 mm., rudimentary costae, 1 fish examined.

1923, July 5: 40, length 1.26, breadth 0.56 mm.

(U.S.N.M., Helm. Coll. 7728.)

*Ammodytes americanus.*

1914, October 20: 16, 100 fish examined.

*Anchovia argyrophana.*

Collected in 1905, 1906 and 1911: On 4 dates in October, numerous on 1 date, very numerous on others, several hundred in the vials, length about 1.23 mm., breadth 0.5, outline long-oval, 2 fish examined on 1 date, 10 on 1 date, and 50 on each of 2 dates; 1 date in November, 5, length 2 mm., 3 fish examined.

*Anchovia brownii.*

1906, August 15: Many, 2 red pigment spots, rudiments of costae, 12 fish examined.

*Anguilla rostrata.*

1911, January 28: 10, length in formalin 3 mm., 61 fish examined.

1914, July 10: 3, one with distinct loculi on bothria, 9 fish examined.

*Brevoortia tyrannis.*

Collected in 6 of the years from 1903 to 1913, inclusive: red pigment spots noted on 7 of the 12 dates; lengths recorded on one date 0.09 to 0.12 mm. On 1 date in June, 1, six fish examined; 7 dates in July, 1 to numerous, 26 fish examined; 4 dates in August, 1 to few, 10 fish examined.

*Caranx chrysos.*

1911, October 13: 20, length 1.5 mm., myzorhynchus with trumpet-shaped border, 15 fish examined.

*Ceratacanthus schoepfi.*

1908, August 19: Many, 1 fish examined.

*Clupea harengus.*

Collected in 3 of the years from 1905 to 1919, inclusive: On 4 dates in July, 1 to numerous, from each of 6 fish measuring from 5.5 to 8 centimeters in length. On 6 dates in August, on 1 date, several, minute, 40 fish examined, size not noted; on other dates,

1 to many in each of 22 fish measuring from 7 to 10 centimeters in length.

*Cyclopterus lumpus.*

1915, May 6: 18, 2 to 5 mm. in length in formalin, 1 fish examined. (U.S.N.M., Helm. Coll. 7729.)

*Cynoscion regalis.*

Collected in 6 of the years from 1903 to 1910, inclusive: Usually present in the cystic ducts of squeteague, where they occur in considerable numbers in clusters with heads buried in the mucous membrane; much smaller examples occasionally met with in the intestine. Some with red pigment spots, some without; some with plain bothria, some with rudiments of acetabula and costae. On about 12 dates in July, in cystic ducts of 47 out of 59 fish examined, and on about 15 dates in August, in 42 out of 44 fish examined. The following measurements were made on living specimens collected July 19, 1905: From the cystic duct a typical specimen varied in length from 2.5 to 6 mm., breadth 1 mm. when contracted. A specimen from the intestine varied from 0.11 to 0.28 mm. in length, and from 0.03 to 0.07 mm. in breadth.

*Decapterus macarellus.*

1918, August 7: Few, in each of three 95-mm. fish.

1920, August 17: 5 small, 1 fish examined. A distinctly progressive movement was observed in one which was creeping on the bottom of the dish, by alternately extending each of the two pairs of bothria, which acted as suckers to pull the body along.

*Decapterus punctatus.*

1906, August 17: 18, small, no pigment; head more transparent than body; bothria rather flat and leaf-like, nearly circular when contracted, with transverse wrinkles which suggested rudimentary costae as in the genus *Rhinebothrium*; varying in length from 0.32 to 1.40 mm.

*Etrumeus sadina.*

Collected in 4 of the years from 1905 to 1918, inclusive: On 1 date in July, few, 25 fish examined; on 2 dates in August, 1 to few from each of 3 fish, length, noted on 1 date, 14 centimeters; on 3 dates in September, 1 to few, 27 fish examined, length, noted on 1 date, 14.5 centimeters. Record of September 2, 1905: Few, length 1.7 mm., diameter of head 0.5 mm.; a memorandum sketch made at the time of collecting shows the bothria grouped into a disk-like head, with no myzorhynchus, 25 fish examined.

*Gasterosteus bispinosus.*

1919, July 5: 3; lengths 0.37, 0.70, 0.80 mm., from one 20 mm. fish.



*Hippoglossus hippoglossus.*

1906, June 14: Few, 7 fish examined.

*Lagodon rhomboides.*

1914, June 4: 31 in 1 fish, 19 in 1 fish; length 2 mm., 2 fish examined.

*Leiostomus xanthurus.*

1912, October 18: 1, length 1.9; diameter of head 0.33, 6 fish examined.

*Leptocephalus conger.*

1903, August 24: Small, number not noted, 1 fish examined.

*Lophius piscatorius.*

Collected in 15 of the years from 1899 to 1920: Usually present in enormous numbers among the villi of the intestine, in most cases from 1 mm., or less to 5 mm. in length; in a few instances the length was as much as 11 mm.; red pigment noted on but one date, but most of the material had been in formalin before it was examined. On 1 date in May, numerous, 2 fish examined; 1 date in June, very numerous, 0.9 to 2.25 mm. in length, 1 fish examined; 5 dates in July, few to very numerous, 9 fish examined. On July 9, 1912, my attention was called by Dr. G. A. MacCallum to small cestodes which appeared to have developed proglottides. This appearance was due to somewhat regular constrictions of the body wall, but there was no indication of the beginning of proglottides. The bothria were rather thick margined with strong acetabula. Structures which appeared to be rudiments of hooks were noted; terminal sucker very small. On 6 dates in August, few on 1 date, very numerous on others, 9 fish examined; 3 dates in September, many, 3 fish examined; 6 dates in October, many to very numerous, 7 fish examined. Record for October 10, 1904: Very numerous, shorter ones about 1 mm. in length, longer, without intermediate forms, 5 mm., or more, in length; bothria with well-defined, Monorygma-like auxiliary sucker. October 13, 1905: Very numerous, maximum length 6.5 mm.; pseudo-segments present; bothria suggest *Echeneiobothrium* or *Acanthobothrium*. On 5 dates in November, many to very numerous, 6 fish examined; 2 dates in December, few on one date, numerous on the other, 4 fish examined.

(U.S.N.M., Helm. Coll. 7730.)

*Melanogrammus aeglefinus.*

1906, May 7: Few.

*Menticirrhus saxatilis.*

Collections made in 1903 and 1910: On 1 date in July, 2 from gall-bladder, 2 red pigment patches, collected by Dr. C. W. Hahn; 2 dates in August—(1) very small, number not recorded, 4 fish ex-

aminated; (2) 1, very small, 1 fish examined; 2 dates in September, 1, on each date, large, no pigment, 3 fish examined on 1 date, 14 on the other; 1 date in October, few, lodged in cyst-like structure which was destroyed before its real nature was determined, probably a part of the cystic duct.

*Merluccius bilinearis.*

Collected in 6 of the years from 1903 to 1913: On 1 date in July, few, very small, red pigment in neck; 5 dates in August—(1) few, red pigment, 1 fish examined; (2) many, small, simple bothria, distinct myzorhynchus, 10 fish examined; (3) many, small, rudimentary costae, red pigment spots, 16 fish examined; (4) few, from gall-bladder, collected by Dr. C. W. Hahn; (5) 1, rather large, with costae, but no pigment, 1 fish examined.

*Microgadus tomcod.*

1910, July 13: 1; 2 red pigment spots in neck; Dr. C. W. Hahn.

1913, September 23: 1, 6 fish examined.

1915, February 16: 1, 50 fish examined.

*Morone americana.*

1912, October 28: Few, 5 fish examined.

1913, April 21: 50, 1 to 2 mm. in length, 2 fish examined.

*Mugil cephalus.*

1913, September 16: 2; length in formalin 1.40, breadth 0.36, 30 fish examined.

*Opsanus tau.*

1898, October 28: Numerous, small, from intestine.

1910, August 5: Numerous, large, in cystic duct, where they are clustered as in the squeteague and flounder; no pigment, 7 fish examined.

1913, September 29: 1, 13 fish examined.

*Osmerus mordax.*

1911, October 23: 1; length 0.75, breadth 0.36, length of bothria 0.21, 8 fish examined.

*Palinurichthys perciformis.*

1910, August 22: Numerous; 2 red pigment spots.

1920, August 6: 1.

*Paralichthys dentatus.*

Collected in 5 of the years from 1903 to 1920, inclusive: As in the squeteague, so in the summer flounder, these larvae are common in the cystic duct, where they are often in large numbers, clustered together with their heads in the mucous membrane. Much smaller examples occur in the intestine. Red pigment and rudiments of

acetabula and costae noted; one noted on August 16, 1906 that suggested *Phyllobothrium loliginis*.

A case of jaundice was encountered in a flounder on August 6, 1908. Numerous larvae (*S. polymorphus*) formed a subspherical enlargement of the cystic duct. The flounder was about 40 centimeters in length, and was of a bright yellow color, the muscles also were decidedly yellow. The cestodes appeared to completely occlude the duct, which, doubtless accounted for the jaundiced condition of the fish. Larvae active, varying from 2 to 5 mm. in length; myzorhynchus distinct, bothria with faint costae near anterior end; some with red pigment spots in neck.

On 4 dates in July, few on each of three dates, numerous on one date, 7 fish examined; on 10 dates in August, few to numerous, 37 fish examined; on 1 date in October, very numerous, relatively large, adhering in clusters in cystic duct near intestine, numerous in intestine, 3 fish examined.

*Paralichthys oblongus.*

1905, August 4: Few, small; 2 red pigment spots; bothria with distinct acetabulum, and faint indication of costa near posterior third, 4 fish examined.

1907, June 10: Few, 1 fish examined.

1913, June 6: 1 noted with well defined costae on bothria, 2 fish examined.

*Pollachias virens.*

1908, August 19: Few, 2 fish examined.

1912, July 1: 1, 18 fish examined.

*Pomatomus saltatrix.*

1904, August 11: Few, minute, length 0.06 mm., 1 fish examined.

1906, August 27: Few, less than 1 mm. in length, no red pigment, 1 fish examined.

1911, July 17: Few, no red pigment or costae, 10 fish examined.

1919, August 21: 1, in intestine of 125 mm. fish.

*Pomolobus aestivalis.*

1908, August 11: 6, 2 bright red pigment patches in neck; rudiment of anterior costa, 1 fish examined.

1910, July 20: Many, 6 fish examined.

*Pomolobus mediocris.*

1906, August 15: 2, small, simple bothria, no pigment, 1 fish examined.

*Pomolobus pseudoharengus.*

Collected in 5 of the years from 1906 to 1914, inclusive: On 1 date in April, 34 in vial, no pigment in formalin material, but label stated that there were red spots in the living worms; on 2 dates in May,

few on one date from 10 fish, 1 on the other date, from 8 fish; on 3 dates in July, 1 to numerous, red pigment noted, 6 fish examined; on 2 dates in August, few, red pigment present, 15 fish examined; on 1 date in September, few, 6 fish examined.

*Poronotus triacanthus.*

1905, July 18: 1, length 1.4, breadth 0.7 (compressed), 17 fish examined.

1917, July 24: 14, in a 75 mm. fish. August 11: Few, in a 88 mm. fish. August 14: 1, in a 29 mm. fish. August 21: 1, in a 128 mm. fish. August 30: 1, in a 72 mm. fish.

1918, September 3: 1, in a 48 mm. fish. September 10: 2, in a 50 mm. fish, 1 in each of 3 fish, 48, 57, and 64 mm. in length.

*Prionotus carolinus.*

1915, April 16: 1, in vial attached to a distome, 1 fish examined.

*Pseudopleuronectes americanus.*

1914, February 13: 2, length 9 mm., in formalin, 22 fish examined. February 24: 1, length 4 mm., in formalin. It is worthy of note that these larval forms were not found in any of the 398 winter flounders, which were examined for their food. Also, in this connection, it is interesting to recall that Vinal Edward's record shows that 628 adult winter flounders were examined by him on 82 dates.<sup>19</sup>

*Pterophryne histrio.*

1919, September 5: Several, in intestine; largest, length 0.52, breadth 0.31 mm., 1 fish examined.

*Remora remora.*

1918, July 26: Few, small, in one fish, length 0.27, breadth 0.15 mm., 2 fish examined.

*Sarda sarda.*

1918, August 27: Few, in one 145 mm. fish.

*Scomber scombrus.*

Collected in 4 of the years from 1906 to 1914, inclusive: On 2 dates in July, 1 on one date, few on the other, 2 fish examined; on 7 dates in August, 1 on one date, many on one date, few on others, 32 fish, from 7.5 to 17.5 centimeters in length, examined; on 1 date in September, few, from 17-centimeter fish; on 1 date in October, 1, length 1.5 mm., 14 fish examined.

*Selar crumenophthalmus.*

1913, August 17: Few, small, no pigment, 13 fish examined. September 17: 4, more or less enlarged behind bothria; terminal os, in some cases, everted and vase shaped; length 1.65; breadth of head 0.30, breadth behind bothria 0.45, 1 fish examined.

<sup>19</sup> See Appendix 4 to Report of U. S. Commissioner of Fisheries for 1921, pp. 1-14.



*Seriola zonata.*

1910, August 16: 1, length 1.12 mm., 2 red pigment patches, head and neck transparent, yellowish, body opaque, 3 fish examined.

1913, September 22: 1, length 1.43 mm., 7 fish examined.

*Siphostoma fuscum.*

1919, July 15: 1, in one 45 mm. fish.

*Spheroides maculatus.*

1907, August 1: Number not noted, small, no pigment, 2 fish examined.

*Stenotomus chrysops.*

Collected in 8 of the years from 1904 to 1920, inclusive: On 7 dates in July, few on 2 of the dates, 12 fish, size not noted, examined: on the remaining 5 dates, from 2 to 27 larvae found in each of 7 fish, measuring from 2.5 to 14 centimeters in length. On 14 dates in August, on 1 date 1 larva, 7 fish examined, on another few, 6 fish examined; on remaining dates from 1 to numerous in each of 88 fish, measuring from 2.7 to 14 centimeters in length. On 1 date in September, many from a 7-centimeter fish.

Larvae all small with two red pigment spots; rudiments of costae noted on one date.

*Trichiurus lepturus.*

1903, July 6: Very numerous, among villi of pieces of intestine in bottle, estimated to be 3,900 to the square inch, 212 large and 28 small fish examined. August 6: Same conditions as in foregoing, 283 large fish examined. September 16: Enormous numbers from pieces of intestine; much contracted by the formalin, oval-elliptical to globular, 0.6 to 0.8 mm. in length.

1904, August 2: Very numerous, among intestinal villi, 2 fish examined.

1913, June 18: Very numerous, length in formalin about 2 mm., 1 fish examined. These larval cestodes were found in the pyloric caeca, but most abundant in the intestine where, in many cases they were embedded in the mucous membrane so close together as to make the number in a given area equal to that area divided by the area of a cross section of a worm. The number to the square inch, given above, was estimated from several counts made at different places on different pieces of intestine.

*Tylosurus marinus.*

1904, August 25: Few, 2 pigment patches, no costae, 3 fish examined.

1907, September 9: Few, small, 2 red pigment patches, 5 fish examined.

1912, September 9: 2, small, no pigment, 1 fish examined.

*Urophycis chuss.*

1903, October 17: 1, from intestine, bothria with costae, 1 fish examined.

1910, August 12: Many, some in gall bladder; red pigment, Dr. C. W. Hahn, 3 fish examined.

1914, October 28: 1, 10 fish examined.

1915, August 20: Numerous, small; Dr. G. A. MacCallum, 10 fish examined.

*Urophycis regius.*

1908, September 26: Very numerous, 1000; approximately, in vial; length 0.40 to 1.60 mm.; myzorhynchus, in many cases protruded; characteristic shape long oval, or wedge shape, a few clavate; diameter through bothria about 0.30, 1 fish examined. October 21: Few, 1 fish examined.

1912, November 14: 3, 1 fish examined.

*Urophycis tenuis.*

1911, August 4: Few, small, red pigment, 3 fish examined.

1916, June 15: Few, small; in vial attached to a specimen of *P. loliginis*, 2 fish examined.

1918, September 10: Few, 1 fish examined.

*Xiphias gladius.*

1904, July 15: Many, and great variety of forms; among them were many small larvae with 2 red pigment spots in the neck, and the rudiment of an auxiliary acetabulum on the bothrium, 1 mm. and less in length; others, much larger, with distinct acetabula, but with pigment spots and as much as 3 mm. in length, are apparently simply larger examples of the cestode which is represented by the smaller forms; some of these larger forms have the neck differentiated from the body, and appear to be young of *Phyllobothrium loliginis*, examples of which were present, but with no intermediate forms. The largest *S. polymorphus* was 3 mm. in length, while the smallest *P. loliginis* was 10 mm. in length, contracted; 4 fish examined. (See 1922b, pp. 10, 11.) July 28: Many, as in foregoing, 1 fish examined.

## EXPLANATION OF PLATES.

<i>c.</i> cirrus.	<i>sg.</i> shell gland.
<i>cp.</i> cirrus pouch.	<i>sr.</i> seminal receptacle.
<i>ex.</i> excretory vessel.	<i>sv.</i> seminal vesicle.
<i>gd.</i> germ duct.	<i>t.</i> testes.
<i>lm.</i> longitudinal muscles.	<i>u.</i> uterus.
<i>n.</i> nerve.	<i>up.</i> uterine pore.
<i>nc.</i> nerve cell.	<i>v.</i> vagina.
<i>o.</i> ovary (germarium).	<i>vd.</i> vas deferens.
<i>ot.</i> ootype.	<i>vg.</i> vitelline gland.
<i>ov.</i> oviduct.	<i>yd.</i> vitelline duct.
<i>sd.</i> sperm duct.	

### PLATE 1.

#### *Anthobothrium laciniatum* Linton.

FIG. 1. Scolex and anterior portion of strobile; balsam; length of portion sketched 3.5 mm. From *Carcharhinus milberti*.

1a. Last proglottis of strobile, the anterior end of which is shown in fig. 1; length 1.12.

1b. Scolex; balsam; breadth 0.6.

1c. Everted cirrus of adult proglottis, from *Raja eglanteria*; life; length approximately 0.4.

#### *Rhinebothrium maccallumi*, new species, from *Dasybatis centrura*.

FIG. 2. Free-hand sketch of specimen mounted in balsam; length about 28 mm.

3. Free-hand sketch of another scolex, compressed; diameter of scolex 1.47.

4. Camera lucida sketch of bothrium, showing arrangement of loculi; length 0.45 mm.

#### *Crossobothrium angustum* Linton, from *Carcharhinus obscurus*.

FIG. 5. Egg; life; length 0.15.

#### *Monorygma*, species, from *Raja stabuliforis*.

FIG. 6. Scolex and anterior part of strobile; alcohol; diameter of scolex 0.56.

#### *Discocephalum pilcatum* Linton, from *Scoliodon terrae-novae*.

FIG. 7. Scolex in different states of contraction; free hand from life; diameter of scolex 0.80. This form from the sharp-nosed shark has relatively smaller scolex, and larger pseudoscolex than the type from the tiger shark.

### PLATE 2.

#### *Orymatobothrium forte*, new species, from *Cestracion zygaena*.

FIG. 8. Scolex, nearly front view; balsam; breadth 0.72.

9. Section of scolex; diameter 0.58.

10. Portion of section of bothrium, showing two nerve cells in the midst of the muscle fibers, thickness of bothrium 0.06.

*Orymatobothrium paulum* Linton, from *Galeocerdo arcticus*.

- FIG. 11. Front view of bothrium, contracted, the suckers seen in optical section; balsam; length 0.35.
12. Four proglottides, showing tendency of genital apertures to lie many in succession on the same margin; balsam; breadth 0.5.
13. Adult proglottis; balsam; length 1.68.

*Trilocularia gracilis* Ollson, from *Squalus acanthias*.

- FIG. 14. Scolex; balsam; breadth 0.5.
15. Front view of bothrium; glycerine; breadth 0.25.
16. Portion of strobile, posterior end to right; balsam; breadth 0.17.
17. Posterior end of same; balsam; breadth 0.14.

*Monorygma perfectum* (van Beneden), from *Somniosus brevipinna*.

- FIG. 18. Transverse section of proglottis; two sections of the series used; longer diameter of section 4.

## PLATE 3.

*Monorygma perfectum* (continued).

- FIG. 19. Scolex and strobile; balsam; length 85.
20. Scolex of same; balsam; diameter 3.5.
21. Transverse section near anterior end of scolex (fifth section of series), showing rudiment of myzorhynchus, *mz*; maximum diameter 0.88.
22. Tenth section of same series of sections of scolex; longer diameter 1.57.
23. Thirtieth section of series (65 sections in series); longer diameter 2.29.
24. Vagina and cirrus pouch in fourth section from margin, in series of sagittal sections; greater diameter of cirrus pouch 0.17.
25. Same, as seen in tenth section.
26. Same, as seen in twentieth section.
27. Vagina and cirrus pouch, the latter with three sections of the cirrus, as seen in the fortieth sections.
28. Same in fiftieth section.
29. Vagina and vas deferens, sixty-third section. Figures 24-29 drawn to same scale.
30. Diagram of female genitalia reconstructed from sagittal sections.
31. Egg, 0.09 by 0.03 in the two principal diameters.

## PLATE 4.

*Acanthobothrium paulum* Linton, from *Raja eglanteria*.

- FIG. 32. Pair of hooks; length 0.14.

*Acanthobothrium coronatum* Rudolphi, from *Raja stabuliformis*.

- FIG. 33. Pair of hooks; length 0.11.
34. Bothrium; length 1.
35. Pair of hooks; length 0.15.

*Phoreiobothrium lasium* Linton, from *Carcharhinus obscurus*.

- FIG. 36. Bothrium; balsam; length 0.30.
37. Front view of scolex; balsam; maximum length of hooks 0.10.
38. Marginal view of bothrium; balsam; length of bothrium 0.35; from *C. limbatus*.
39. Pair of hooks; length 0.10.
40. Spines from neck; maximum length 0.015.



*Phoreiobothrium exceptum*, new species, from *Cestracion zygaena*.

- FIG. 41. Scolex and anterior part of strobile; balsam; diameter of scolex 0.56.  
 42. Bothrium; balsam; length 0.47.  
 43. Pair of hooks; maximum length 0.13.  
 44. Spines from neck; maximum length 0.036.

PLATE 5.

*Phoreiobothrium trilocolatum* Linton, from *Carcharhinus obscurus*.

- FIG. 45. Bothrium; balsam; length 0.60.  
 46. Pair of hooks; maximum length 0.15. (a) Spines from neck; maximum length 0.012.

*Phoreiobothrium pectinatum*, new species, from *Cestracion zygaena*.

- FIG. 47. Bothrium; balsam; length 0.18.  
 48. Pair of hooks; maximum length 0.06.  
 49. Spines from neck; maximum length 0.03.  
 50. Proglottis; balsam; length 1.22.

*Platybothrium cervinum* Linton, from *Carcharhinus obscurus*.

- FIG. 51. Scolex; balsam; breadth 0.52. (a) Spines from neck; maximum length 0.015.

*Platybothrium parvum* Linton, from *Cestracion zygaena*.

- FIG. 52. Scolex; flattened under cover glass, and fixed over flame; breadth 0.35.  
 53. Proglottis; balsam; length 2.10.

*Phoreiobothrium lasium* Linton, from *Carcharhinus obscurus* (see fig. 36-40).

- FIG. 54. Segmenting ova; length of smallest, 0.06.

PLATE 6.

*Ichthiotaenia adherens*, new species, from *Cestracion zygaena*.

- FIG. 55. Scolex; balsam; diameter 0.45.  
 56. Anterior end of ripe proglottis with wall ruptured exposing the uterus filled with, large, segmenting ova; breadth, in front of genital pore, 1.68.  
 57. Part of transverse section of immature proglottis near genital pore; two sections used; diameter of section at median line 0.5.  
 58. Spine from cirrus; length about 0.008.  
 59. Part of transverse section near posterior end of immature proglottis; diameter at median line 0.5.

PLATE 7.

*Otobothrium penetrans* Linton, from *Cestracion zygaena*.

- FIG. 60. Strobile; alcohol; length 122.  
 61. Scolex and anterior part of strobile; balsam; length of scolex 4.5.  
 62. Proboscis, near base; diameter 0.21.  
 63. Proboscis, middle; diameter 0.18.  
 64. Hooks from near base of proboscis, drawn to same scale; maximum length 0.11.  
 65. Immature proglottides; length of single proglottis 1.26.  
 66. Ripe proglottides; balsam; length of longest 8.  
 67. Ripe proglottis; balsam; length 5.

FIG. 68. Sagittal section of ripe proglottis; length 1.82.

69. Median region of transverse section of adult proglottis; diameter of section 0.26.

70. Diagrammatic plan of genital ducts in vicinity of shell gland. o. d. oviduct.

*Rhynchobothrium*, species, from *Narcacion nobilianus*.

FIGS. 71, 72. Views of proboscis; diameter, excluding hooks, 0.03.

73. Hooks; maximum length 0.036 mm.

*Rhynchobothrium uncinatum*, new species, from *Vulpecula marina*.

FIG. 74. View of mid-region of proboscis; length of hooks 0.05 (see figs. 75-78).

#### PLATE 8.

*Rhynchobothrium uncinatum*, new species, from *Vulpecula marina* (see fig. 74).

FIG. 75. Scolex; balsam; breadth through bothria 1.12.

76, 77. Views of opposite sides of the base of a proboscis, small hooks somewhat diagrammatic; diameter in region of small hooks 0.075.

78. Posterior proglottis; length 3.91.

*Tetrarhynchus bicolor* Bartels, from *Carcharhinus obscurus*.

FIG. 79. Scolex; life; length 10.5.

80. Scolex with proboscides everted; life; length 8.5.

*Tetrarhynchus palliatus*, new species, from *Cestracion zygaena*.

81. Scolex; balsam; length 1.82.

82. View of proboscis; diameter, including hooks, 0.05.

83, 84. Sagittal sections of a proglottis; length 0.56.

#### PLATE 9.

*Rhynchobothrium exile* Linton, from *Galeocерdo arcticus*.

FIG. 85. Scolex; balsam; length 2.52.

86, 87. Views of opposite sides of base of a proboscis.

88. Proboscis, above base; diameter, excluding hooks, 0.03.

89. Hooks of same.

90. Posterior, but still immature proglottis; balsam; length 2.60.

*Rhynchobothrium*, species, near *R. temispine* from *Dasybatis centura*.

FIG. 91. Scolex and small portion of strobile; balsam; length of scolex 1.06.

92. Base of proboscis.

93, 94. Views of other regions of proboscis; diameter, including hooks, 0.015.

#### PLATE 10.

*Synbothrium malleum*, new species, from *Dasybatis centura*.

FIG. 95. Hooks from proboscis; length of smallest 0.015; length of longest 0.03.

96. Hooks from proboscis of another specimen, drawn to same scale as fig. 95.

97. Posterior proglottis; balsam; length 2.34.

98. Transverse section near anterior end of proglottis, passing through the point where the uterus opens to the exterior; longest diameter of section 1.23.

## PLATE 11.

*Rhynchobothrium insigne*, new species, from *Carcharinus milberti*.

Sketches made from specimen mounted in balsam.

- FIG. 99. Scolex and interior part of strobile; length of scolex 20 mm.  
 100. Proglottis, about 100 mm. from anterior end; length 3.5.  
 101. Proglottis, posterior end of strobile; length 6 mm.  
 102. Abnormal proglottides, about 80 mm. from anterior end; breadth 5 mm.  
 103. View of proboscis near base; diameter, excluding hooks, 0.21.  
 104. Tip of proboscis, same side as that shown in fig. 103; two hooks of the linear row appear on the inverted border; diameter, excluding hooks 0.16.  
 105. Linear row of closely placed hooks, at its beginning near the base of the proboscis; camera lucida sketch with Spencer No. 6 ocular and 4 mm. objective.  
 106. Linear row of hooks, about 0.9 mm. from base of proboscis, same magnification.  
 107. Same, about 1.4 mm. from base of proboscis.

## PLATE 12.

*Rhynchobothrium*, species, from cyst on viscera of *Ceratacanthus schoepfli*.

- FIG. 108. View of proboscis, near base; diameter, excluding hooks, 0.075; balsam.  
 109. Anterior end of proboscis, so far as it was everted; diameter, excluding hooks, 0.054.

*Rhynchobothrium longispine* Linton.

- FIG. 110. View of proboscis near base; diameter, including hooks, 0.054; from *Microgadus tomcod*.  
 111. Same, near middle; diameter, including hooks, 0.062.  
 112. Same, near tip; diameter, including hooks, 0.036.  
 113. View of proboscis near base; diameter, including hooks, 0.048; from *Paralichthys dentatus*.  
 114. Same, near tip; diameter, including hooks, 0.030.

*Rhynchobothrium*, species, from flesh of *Cynoscion regalis*.

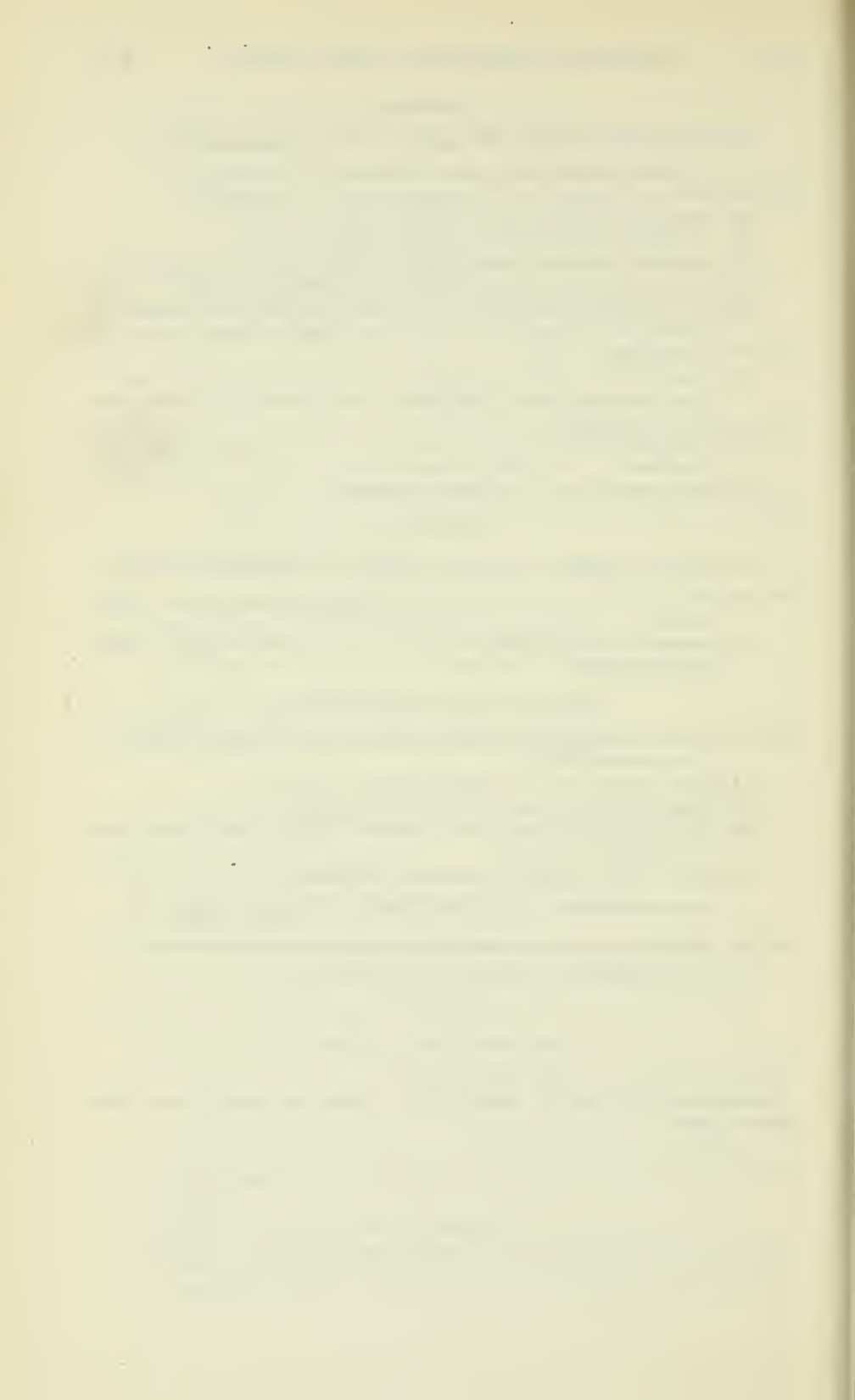
- FIG. 115. Proboscis, so much as was everted; diameter, excluding hooks, 0.18.  
 116. View of opposite side from that shown in fig. 115.

## PLATE 13.

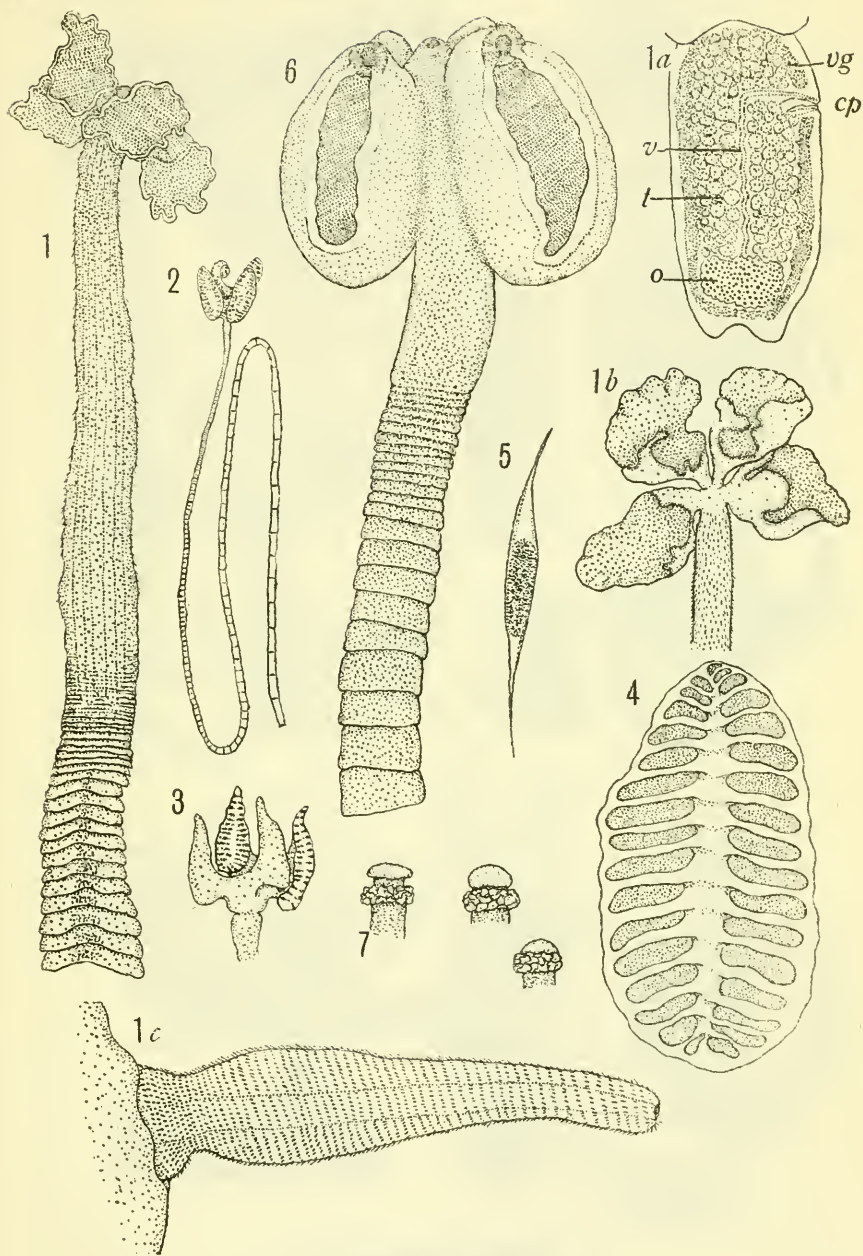
*Otobothrium crenacolle* Linton.

Cysts in flesh of *Poronotus triacanthus*.

Photographed by Roy W. Minor, in the summer of 1909, Woods Hole, Massachusetts.

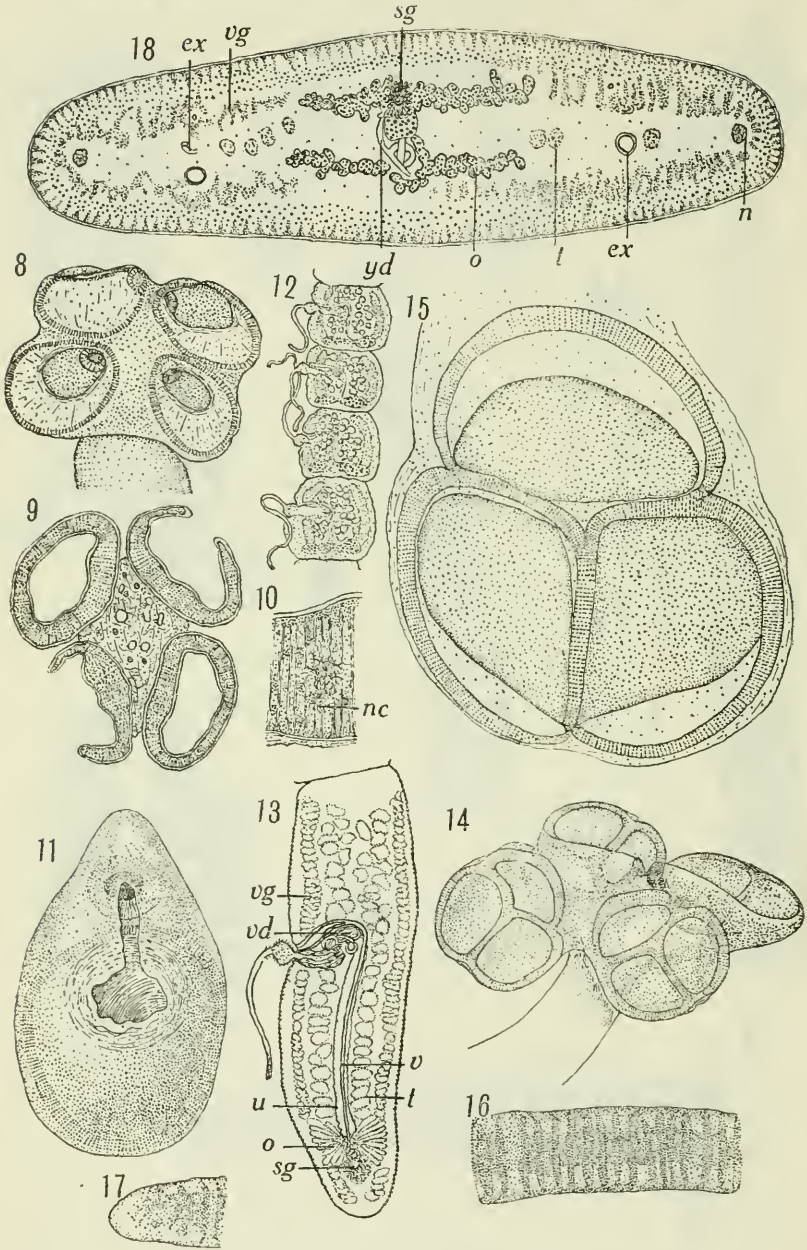






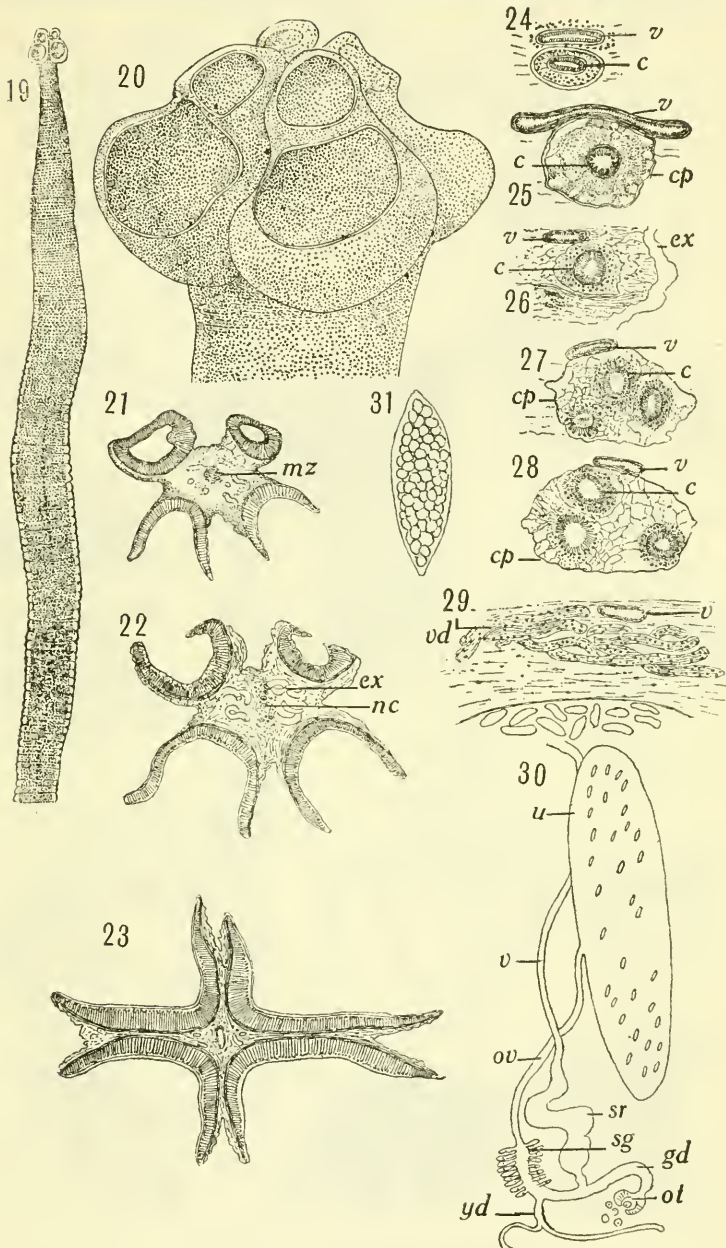
CESTODES OF SHARKS AND SKATES

FOR EXPLANATION OF PLATE SEE PAGE 107.



CESTODES OF SHARKS

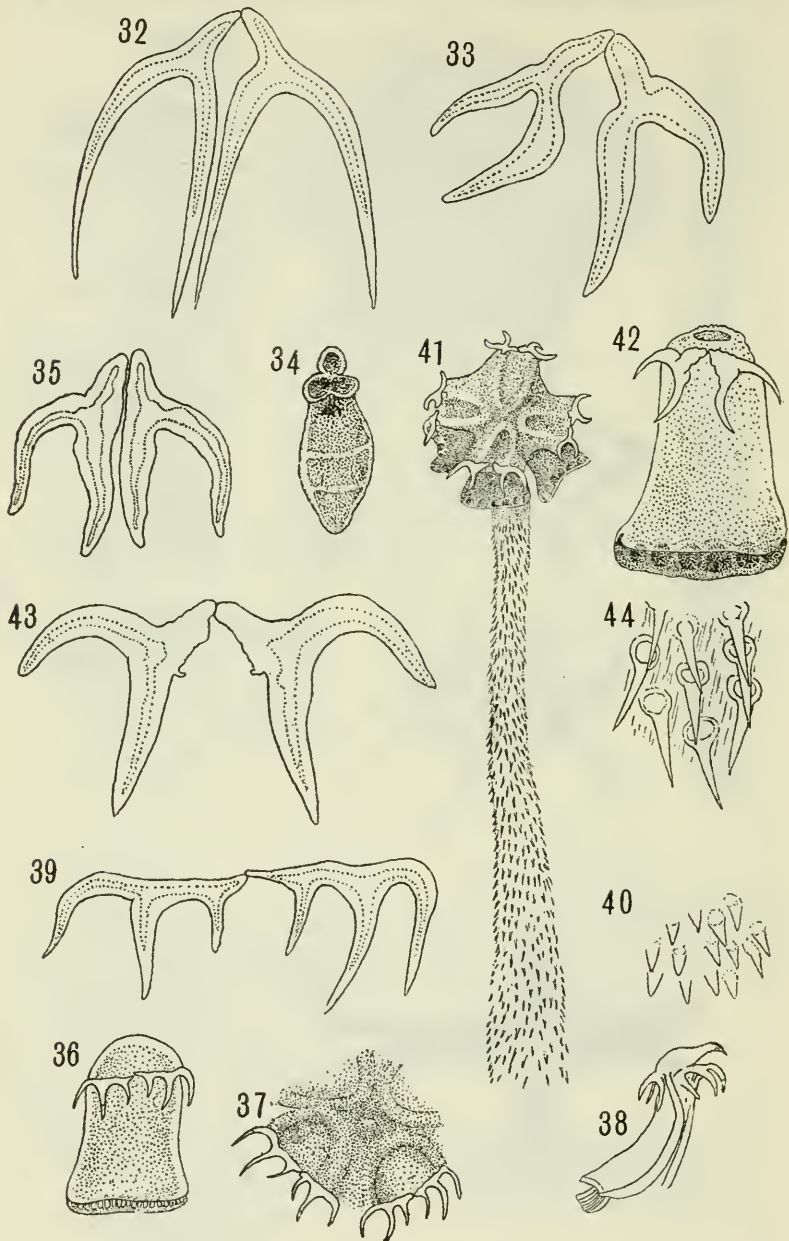
FOR EXPLANATION OF PLATE SEE PAGES 107 AND 108.



CESTODE FROM SLEEPER SHARK

FOR EXPLANATION OF PLATE SEE PAGE 108

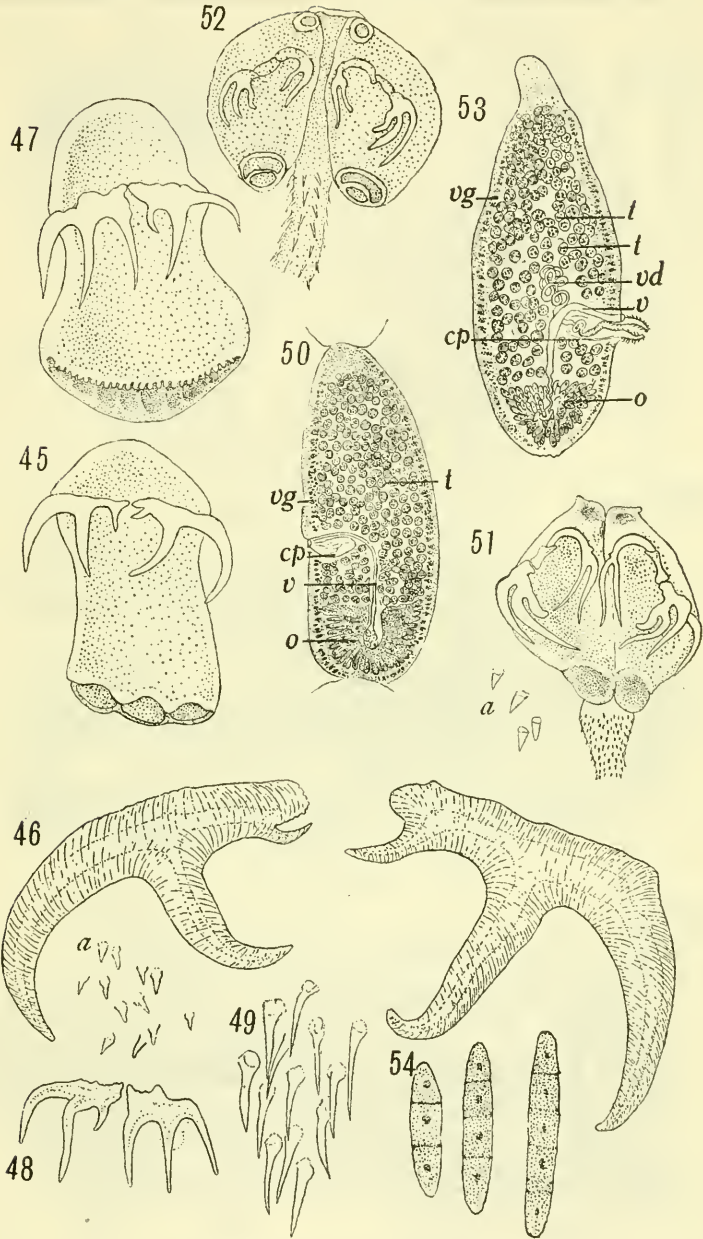




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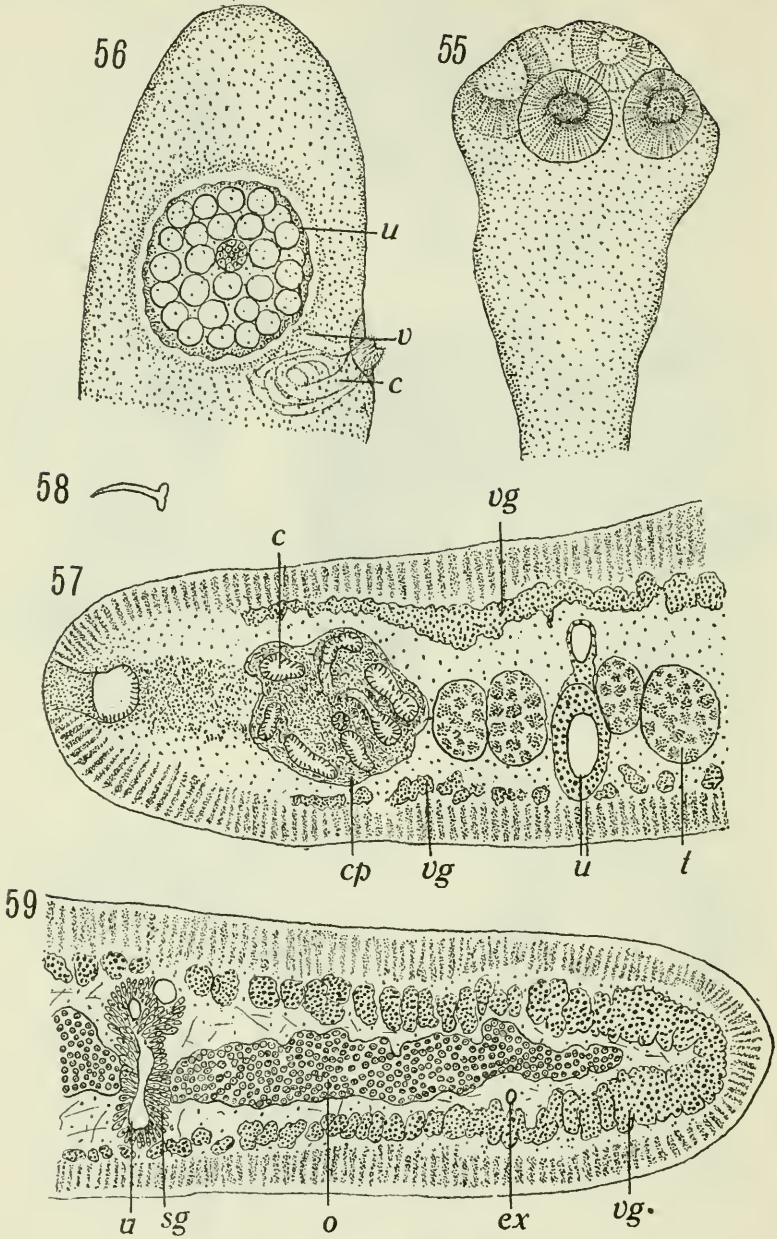
FOR EXPLANATION OF PLATE SEE PAGES 108 AND 109.





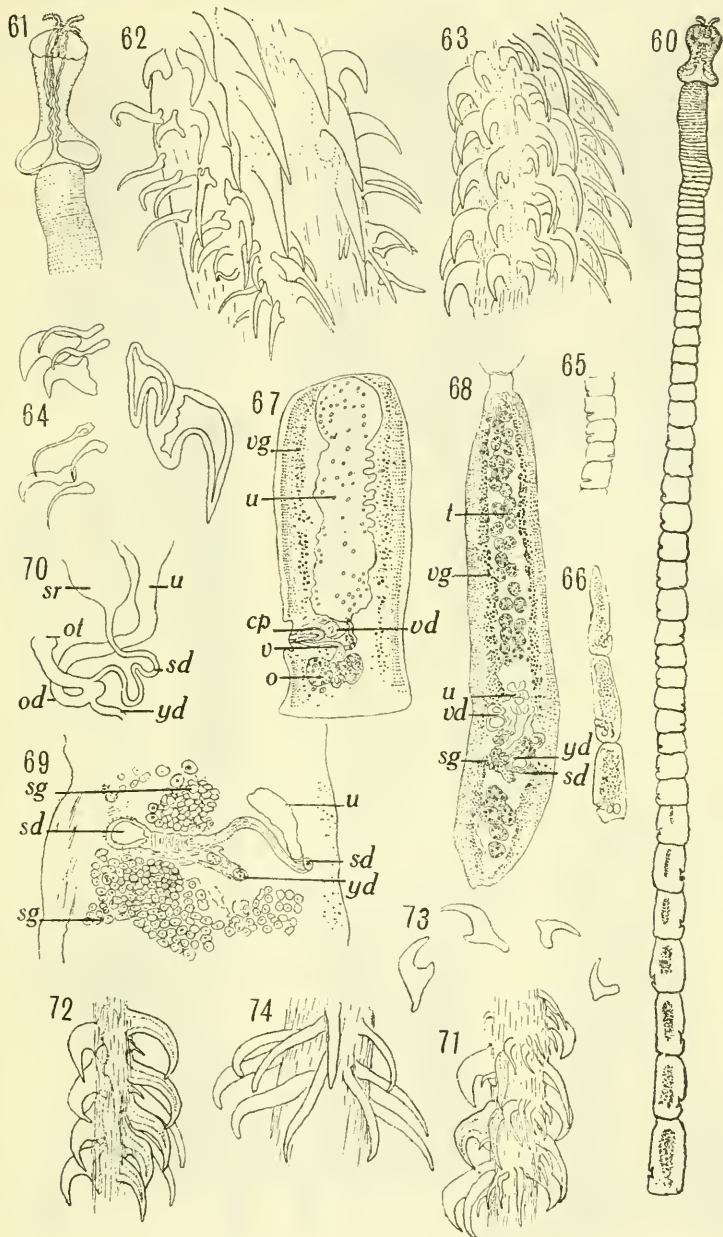
CESTODES OF SHARKS

FOR EXPLANATION OF PLATE SEE PAGE 109.



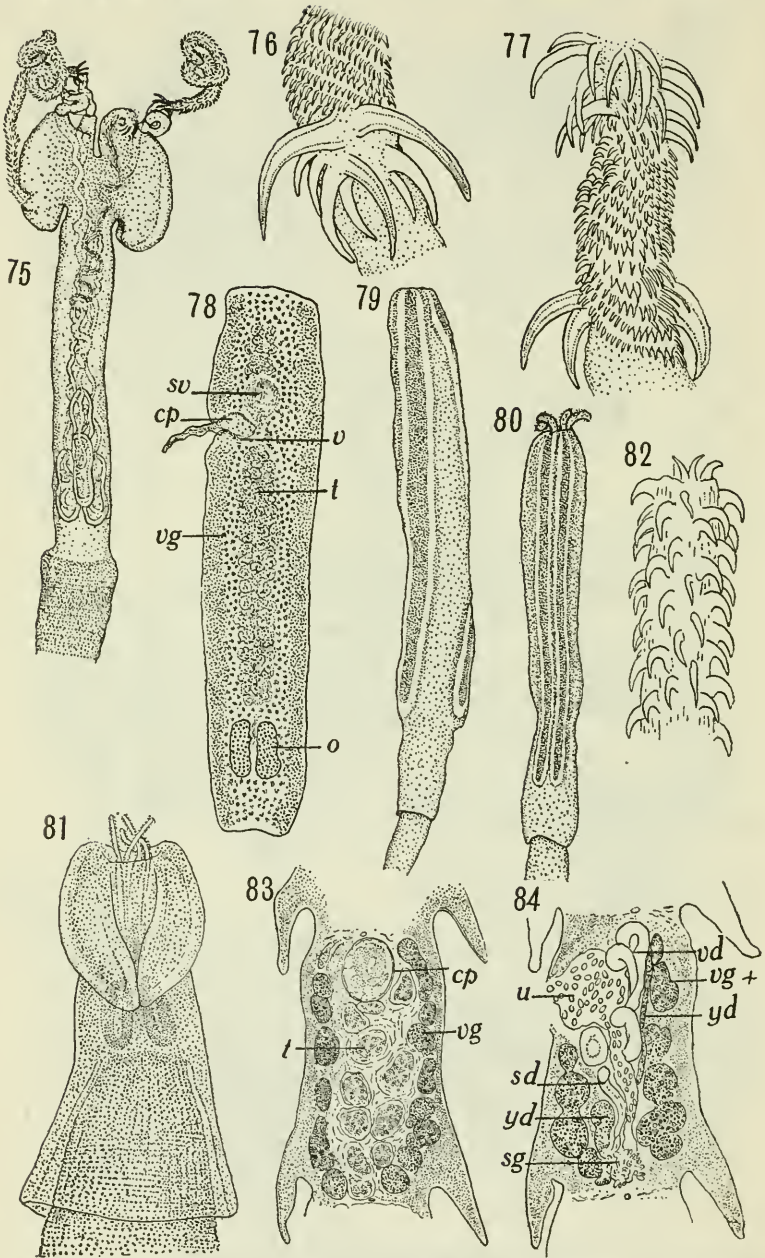
CESTODE FROM HAMMER-HEADED SHARK

FOR EXPLANATION OF PLATE SEE PAGE 109.



CESTODES OF HAMMER-HEADED SHARK, THRASHER SHARK, AND TORPEDO

FOR EXPLANATION OF PLATE SEE PAGES 109 AND 110.

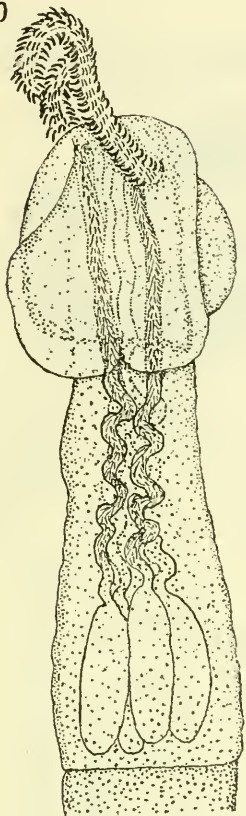


CESTODES OF SHARKS

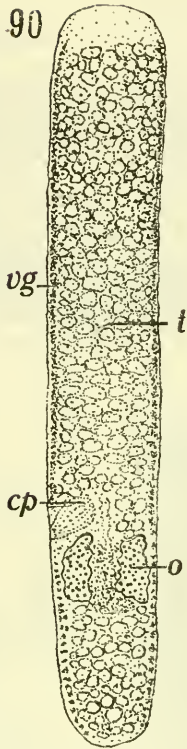
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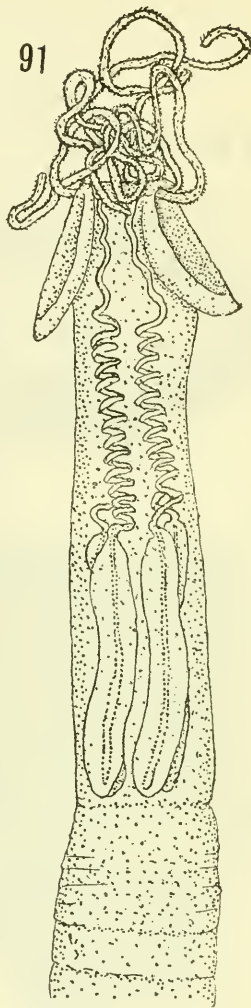
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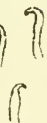
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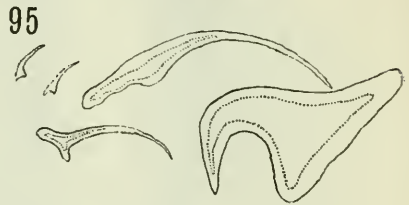
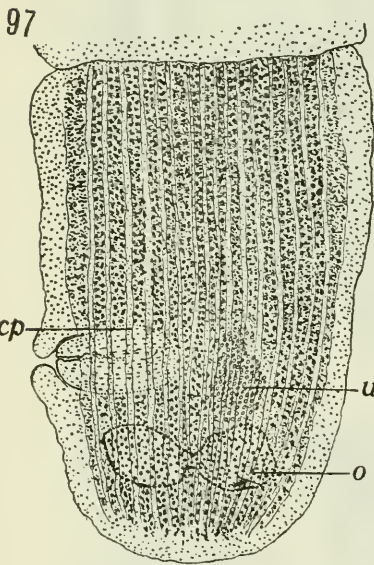
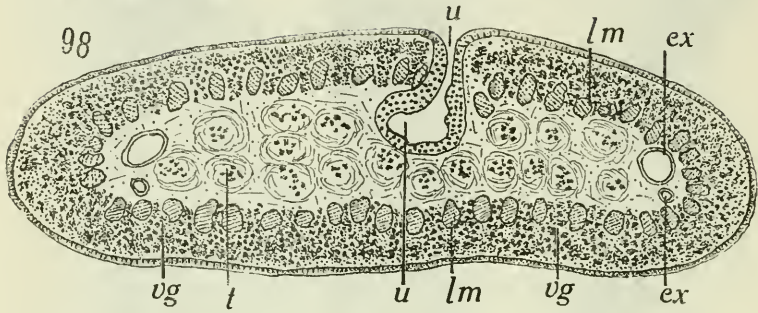


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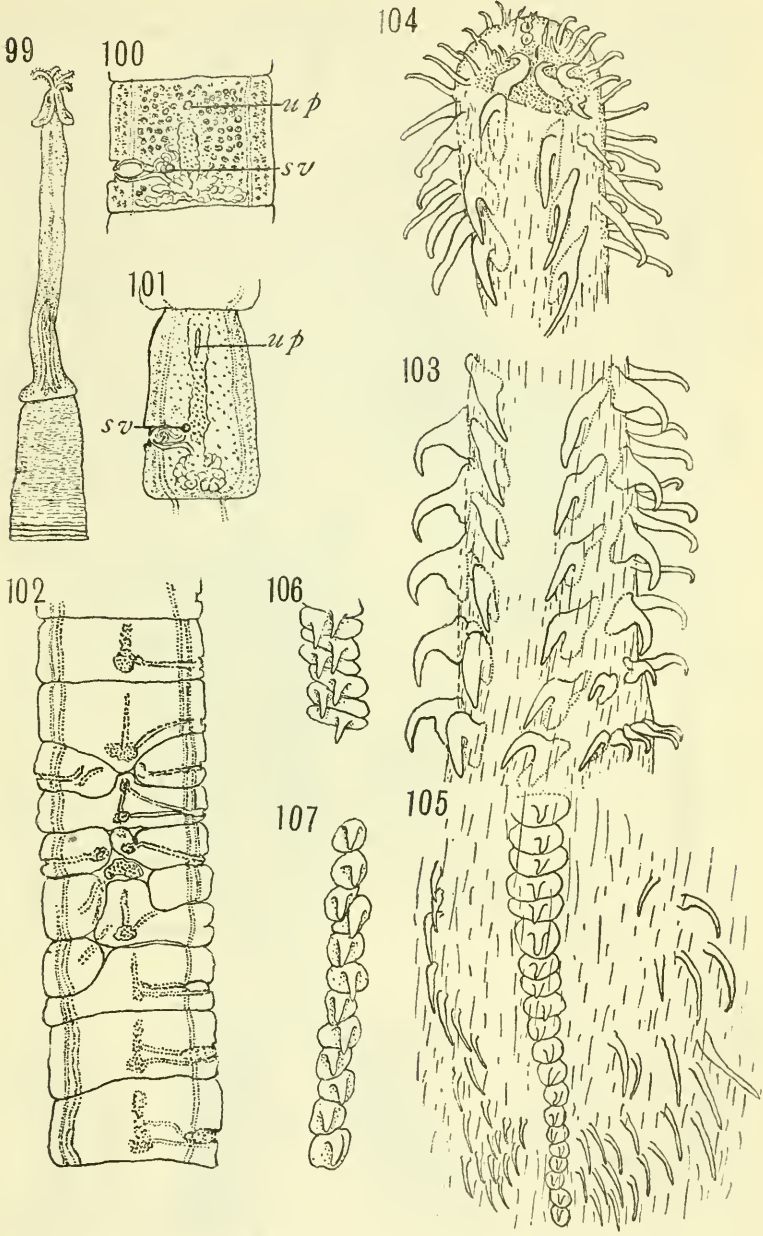
CESTODES OF TIGER SHARK AND STING RAY

FOR EXPLANATION OF PLATE SEE PAGE 110.



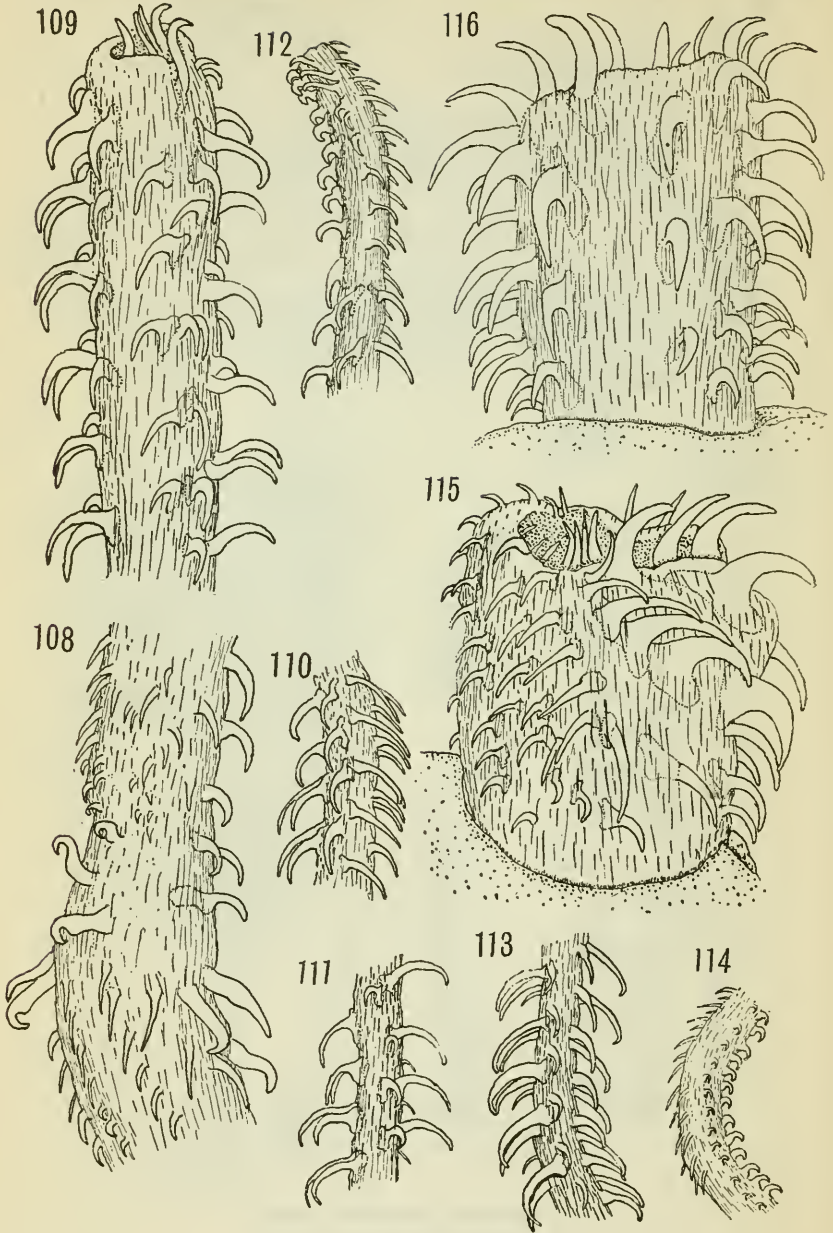
CESTODE FROM STING RAY

FOR EXPLANATION OF PLATE SEE PAGE 110.



CESTODE FROM BLUE SHARK

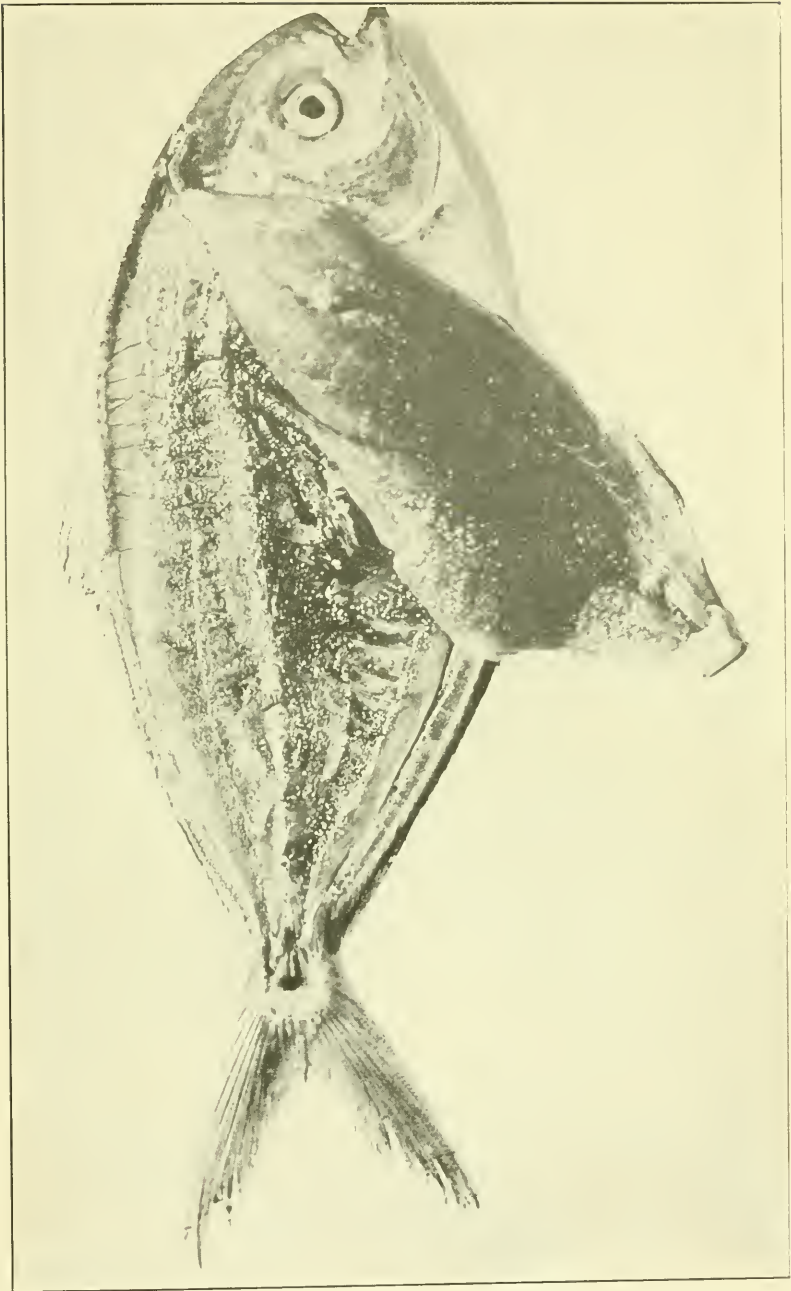
FOR EXPLANATION OF PLATE SEE PAGE 111.



CESTODES OF SHARKS AND SKATES

FOR EXPLANATION OF PLATE SEE PAGE 111.





LARVAL STAGE OF SHARK CESTODE ENCYSTED IN FLESH OF A TELIOST

FOR EXPLANATION OF PLATE SEE PAGE 111.



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