

# NOTES ON CESTODE PARASITES OF FISHES.

By EDWIN LINTON, Ph. D.,

*Professor of Biology, Washington and Jefferson College.*

THESE notes are based on two collections. First, a collection made by the author at Woods Holl, Massachusetts, in July and August, 1889; and second, a collection belonging to the United States National Museum.

It is a matter of regret on the part of the author that fuller accounts of some of the species described are not given; particularly is this true of new species, and of those concerning whose identification there is some doubt. The excuse, in nearly every case, is, either the small amount or unsatisfactory condition of the material.

Following is a list of parasites and hosts mentioned in this paper:

No.	Parasite.	Host.	Plate.	Figure.
1	<i>Tænia salvelini</i> .....	<i>Cristivomer namaycush</i> .....	XXVII	1-5
2	<i>dilatata</i> Linton .....	<i>Anguilla chrysopa</i> .....		
3	<i>ocellata</i> Rudolphi .....	<i>Ambloplites rupestris</i> .....	XXVII	6-11
4	<i>Monobothrium hexacotyle</i> , new species ..	<i>Catostomus</i> , sp. ....	{ XXVII	12-19
5	<i>Schistocephalus dimorphus</i> Crepin ....	<i>Cottus bairdii</i> .....	{ XXVIII	1-3
6	<i>Cyathocephalus truncatus</i> Pallas .....	<i>Coregonus clupeiformis</i> .....	XXVIII	3-5
7	<i>Dibothrium manubriforme</i> Linton ....	<i>Tetrapturus imperator</i> .....		6-8
8	<i>Dibothrium punctatum</i> Rudolphi .....	<i>Bothus maculatus</i> .....		
9	<i>plicatum</i> Rudolphi .....	<i>Xiphias gladius</i> .....		
10	<i>rugosum</i> Rudolphi .....	<i>Gadus callarias</i> .....	{ XXVIII	9-10
			{ XXIX	1-4
11	<i>hastatum</i> , new species ....	<i>Polyodon spathula</i> .....	{ XXIX	5-11
12	sp. (fragment) .....	<i>Mustelus canis</i> .....	{ XXX	1, 2
13	<i>cordiceps</i> Leidy .....	<i>Salmo mykiss</i> .....		
14	<i>infundibuliforme</i> Rudolphi ..	{ <i>Lota maculosa</i> .....	{ XXX	3-6
		{ <i>Cristivomer namaycush</i> .....		
15	<i>laciniatum</i> , new species ..	<i>Tarpon atlanticus</i> .....	{ XXX	7-16
16	<i>occidentale</i> , new species ..	<i>Sebastodes</i> .....	{ XXXI	1-7
		{ <i>Catostomus latipinnis</i> or <i>C. insignis</i> ..	XXXII	1-11
17	<i>ligula</i> Donnadieu .....	<i>Osmerus mordax</i> .....		
		<i>Hybognathus nuchale</i> .....		
		<i>Notropis cornutus</i> .....		
18	sp. (larva) .....	<i>Cynoscion regalis</i> .....		
19	<i>Anthobothrium laciniatum</i> Linton ....	<i>Prionace glauca</i> .....		
20	<i>pulvinatum</i> Linton .....	<i>Dasyatis centrura</i> .....	XXXIII	1
21	<i>Echeneibothrium variabile</i> Beneden ..	<i>Raja erinacea</i> .....		
22	<i>Paratænia medusa</i> Linton .....	<i>Dasyatis centrura</i> .....		
23	<i>Rhinebothrium longicolle</i> Linton .....	<i>Myliobatis freminvillei</i> .....	XXXIII	2-4
24	<i>minimum</i> Beneden ..	<i>Raja lævis</i> .....	XXXIII	5



## List of parasites and hosts—Continued.

No.	Parasite.	Host.	Plate.	Figure.
25	<i>Spongiobothrium variabile</i> Linton....	<i>Dasyatis centrura</i> .....		
26	<i>Phyllobothrium foliatum</i> Linton....	<i>Dasyatis centrura</i> .....	XXXIII	6
27	<i>Orgymatobothrium angustum</i> Linton ..	<i>Prionace glauca</i> .....		
28	<i>paulum</i> , new species.	<i>Galeocerdo tigrinus</i> .....	XXXIII	7, 8
29	<i>crenulatum</i> , new species.	<i>Dasyatis centrura</i> .....	{XXXIII XXXIV	9-12 1
30	<i>Crossobothrium laciniatum</i> Linton....	<i>Carcharias littoralis</i> .....		
31	<i>Onchobothrium uncinatum</i> Diesing ..	<i>Dasyatis centrura</i> .....	XXXIV	2-5
32	<i>Calliobothrium eschrichtii</i> Beneden ..	<i>Mustelus canis</i> .....		
33	<i>verticillatum</i> Rudolphi	<i>Mustelus canis</i> .....	XXXIV	6, 7
34	<i>Phoreiobothrium lasium</i> Linton.....	<i>Prionace glauca</i> .....		
35	<i>Thysanocephalum crispum</i> Linton ..	<i>Galeocerdo tigrinus</i> .....		
36	<i>Rhynchobothrium bulbifer</i> Linton ..	<i>Mustelus canis</i> .....		
37	<i>tumidulum</i> Linton.....	<i>Mustelus canis</i> .....		
38	<i>tenuispine</i> Linton.....	<i>Prionace glauca</i> .....	XXXIV	8
39	<i>imparispine</i> Linton.....	<i>Raja erinacea</i> .....		
40	<i>longicorne</i> Linton ..	<i>Carcharias littoralis</i> .....		
41	<i>brevispine</i> , new species.	<i>Rhinoptera bonasus</i> (?).....	XXXIV	9-11
42	<i>agile</i> , new species..	<i>Rhinoptera bonasus</i> .....	XXXIV	12-15
43	<i>Tetrarhynchus robustum</i> Linton .....	<i>Rhinoptera bonasus</i> .....		
44	<i>bisulcatum</i> Linton .....	<i>Carcharinus obscurus</i> (?).....		
45	<i>tenue</i> Linton .....	<i>Dasyatis centrura</i> .....		

## 1. TÆNIA SALVELINI, new species.

(Plate XXVII, figs. 1-5.)

*Type*.—No. 4811, U.S.N.M. From intestine of Great Lake trout (*Cristivomer namaycush*); Outer Island, Lake Superior; J. W. Milner.

In this lot are several small *Tæniæ*; scolices with few roundish or oblong segments, in some of which the male genitalia were developed, otherwise immature; length from 3 to 5 mm.

These specimens bear some resemblance to the young of *T. torulosa*, Batch, as described by Zschokke.<sup>1</sup>

Head usually rounded in front, with suckers directed anteriorly. The diameter of the head varies according to state of contraction, usually 0.3 to 0.4 mm.; suckers relatively large, usually directed forward, prominent, rather deep, 0.15 to 0.18 mm. in diameter, aperture 0.1 mm. in diameter. Neck assuming various contraction shapes; in some continuous with head and merging imperceptibly in body; in others separated by a constriction behind the head; in others not separated from head by constriction but with segments beginning abruptly; numerous calcareous bodies in neck behind head. Usually first segments indistinct, broader than long. Oldest segments longer than broad; genital aperture near middle of lateral margin a little nearer anterior margin. Vitellaria making a narrow border along lateral margins; beginning of germ gland at posterior end; central region in front of rudimentary germ gland occupied by prominent testicular lobes; cirrus-bulb oblong, elliptical, convex on posterior, straight or slightly concave on anterior surface; cirrus enters from inner anterior edge of bulb, then traverses middle of bulb to orifice; length of bulb, 0.26 mm.; diameter, 0.14 mm.; largest segments, 1.5 mm. in length and 0.75 mm. in breadth.

<sup>1</sup> Rech. Vers Parasit. des Poissons d'eau douce, 1884, p. 20.



2. *TÆNIA DILATATA* Linton.

*Tænia dilatata* LINTON, U. S. Fish Com. Rept., 1886, pp. 488-489, pl. v, figs. 14-16.

No. 4812, U.S.N.M. From common eel (*Anguilla chrysopa*). Several strobiles but in bad state of preservation; no scolices; anterior ends have been exceedingly long and slender. The characteristic dilations of this species can not be proved from these specimens. The general appearance of the strobiles, as well as the character of the segments, however, agrees with this species.

It may be added that the segments of these specimens agree with Molin's description of his *T. hemispherica*. With the evidence at hand, however, I do not feel justified in uniting the two species of *T. dilatata* and *T. hemispherica*.

3. *TÆNIA OCELLATA* Rudolphi (?).

(Plate XXVII, figs. 6-11.)

*Tænia ocellata* DIESING, Syst. Helm., I, p. 513; Revis. d. Cephal., Cycl., pp. 376-377.—VON LINSTOW, Trosch. Archiv., 1875, I, p. 184.—ZSCHOKKE, Rech. Vers Parasit. des Poissons d'eau douce, pp. 13-14.

No. 4742, U.S.N.M. Two tapeworms from rock-bass (*Ambloplites rupestris*); J. W. Milner. Doctor Joseph Leidy describes a tapeworm from this fish<sup>1</sup> under the name of *Tænia ambloplitis*, which he states resembles *T. ocellata* Rudolphi of the European perch (*Perca fluviatilis*) and perhaps is the same.

My specimens agree with Doctor Leidy's pretty well except in the character of the neck. In *T. ambloplitis* the neck is described as "short or none." In my specimens the neck is long.

There is need of special systematic work to be done on species of the genus *Tænia* infesting the fresh-water fishes of North America. Of the specimens that have fallen under my observation, thus far only alcoholic, there are present so many characters that seem to unite them with some established European species, at the same time with so many contradictory characters, that satisfactory identifications can not be made.

The two specimens in this lot are 310 and 470 mm. in length, respectively. Other dimensions of the larger specimens are: Diameter of head, 0.75 mm.; breadth of neck, 0.55; thickness of neck, 0.5; diameter of sucker, 0.4.

Head squarish, depressed, bothria orbicular, prominent, with strong muscular structure. The head is slightly prominent at apex and is terminated by a small pore, which may and probably does function as a sucker. Neck narrower than head, subcylindrical, increasing in breadth uniformly for the first 15 mm., where, in the larger specimen its breadth is 1.35 mm.; it is unjointed, but is moderately wrinkled transversely, transparent, with somewhat delicate tissue. The first segments are about 30 mm. back of the head; 1.5 broad and 0.25 long; indistinct.

<sup>1</sup>Proc. Acad. Nat. Sci., Phila., 1887, pp. 22-23, figs. 7-8.



Toward the posterior end the segments become somewhat squarish. The strobile does not vary much in breadth, but is a little broader in median than in anterior region and narrows a little posteriorly. The segments are rather firmly united. The reproductive apertures are near the lateral margins of the segments near the anterior end; while they are irregularly alternate, there are frequently several in succession on the same side. The angles of the segments are bluntly rounded, and there is a slight tendency to convexity in the lateral margins, thus making the strobile weakly crenulate in places.

In postero-median segments the ovary is seen as an elongated transverse body lying near the posterior end of the segment; the vagina passes forward along the median line, passing in front of the cirrus bulb not far from the anterior border of the segment. The cirrus bulb is spacious, pyriform, equaling in length a little over the breadth of the segment. The vitellaria were seen mainly near the lateral margins and the testes in the antero-median region of the segment. In posterior segments ova were very numerous in racemose clusters along the middle portion of the segment, small, nearly globular, with thin, transparent shell and from 0.02 to 0.025 mm. in diameter.

The apex of the head in one of the specimens is somewhat elevated, and there appears to be a small terminal pore or depression, but it could not be called a sucker. In the other specimen the prominent suckers were directed forward so that the apex of the head was partly concealed. When the head was made transparent, no terminal sucker could be seen. If there be a fifth or terminal sucker, as in some of this series of *Tæniæ*, it must be exceedingly weak and ill-defined.

The head may assume diverse shapes with different degrees of contraction.

The length of the median segments in the larger specimens was 0.4 mm., breadth, 2.6; toward the posterior end, length 1, breadth 1.8. The last segment was 1 mm. in length, 1.3 broad at anterior end, tapering posteriorly to a blunt point. The cirrus was exerted in this segment and was 0.75 mm. in length, 0.07 in diameter at base, and 0.04 in diameter at apex.

This reference of these *Tæniæ* of *Ambloplites* to the species *T. ocellata* is provisional only. I think, however, that there can be little doubt but that my specimens are identical with *T. ambloplitis* Leidy. The apparent absence of neck in Leidy's species may be ascribed to the presence of strong transverse wrinkles, due probably to the action of the preserving fluid.

#### 4. MONOBOTHRIMUM HEXACOTYLE, new species.

(Plates XXVII, figs. 12-19; XXVIII, figs. 1-3.)

*Type*.—No. 4793, U.S.N.M. Label reads: "From sucker (*Catostomus* sp.) inhabiting the Gila River and Salt River, Arizona; E. Palmer."

Eight specimens; largest about 14 mm. in length and 1.5 in breadth and 0.3 thick; smallest about 8 long, 1 broad, and 0.25 thick.



Dimensions of one of the larger specimens: Length, 14.5 mm.; breadth of head, 0.72; breadth immediately back of head, 0.68; greatest breadth, 1; breadth near posterior end, 0.7; breadth at posterior end, 0.3; length of head, 0.7.

Genital aperture, 2.8 mm. from posterior end. Ova collected in folds of the uterus near the posterior end of the body, 0.038 to 0.040 mm. in larger diameter and about 0.2 in shorter diameter.

Bothrium terminal, somewhat two-lobed, lobes lateral, namely, corresponding to flat surfaces of body; each lobe divided by two longitudinal ribs into three loculi. The six loculi meet at the apex of the head and form a central papilla which may project forward as a sharp conical elevation or be contracted to a low eminence; doubtless other and diverse shapes may be assumed by this versatile organ; body flattened, not divided into segments. In specimen made transparent by oil of cloves the anatomy of the reproductive organs was seen to agree closely with that made out for *Monobothrium terebrans* Linton, found in a sucker (*Catostomus ardens*) from Heart Lake, Yellowstone National Park, Wyoming.<sup>1</sup> Testes arranged along central space; vitelline gland along lateral margins and at posterior end; both vitellaria and testes beginning near the head; ovary with lateral folds extending nearly to cirrus; uterus with ova lying in folds behind the genital aperture, also a few folds near the posterior end behind ovary; genital aperture about posterior fifth; cirrus about 0.1 mm. in diameter; cirrus-bulb about 0.27 in diameter. Cirrus extended in one specimen presented the following dimensions: Length, 1 mm.; diameter at apex, 0.043; diameter near middle, 0.055; diameter at tumid base, 0.086. Lateral vessels communicate with a posterior terminal pore.

The ovary lies nearest the face on which the genital aperture is situated, the median portion showing first in longitudinal sections. Calling this side ventral then at the posterior end the vitelline gland is dorsal to the posterior folds of the uterus, which in turn pass dorsally to the central portion of the ovary.

##### 5. SCHISTOCEPHALUS DIMORPHUS Crepin (?)

(Plate XXVIII, figs. 4-5.)

*Schistocephalus dimorphus* DIESING, Syst. Helm., I, pp. 484-485; Revis. d. Ceph. Par., pp. 232-233.—WILLEMOES-SUHM, Zeitschr. f. w. Zool., XIX, p. 469-472, pl. XXXV, figs. 1-3.—SHAUINSLAND, Embryonalentwicklung, pp. 36-39, pl. III, figs. 8-10.

No. 4727, U.S.N.M. From abdominal cavity of the blob (*Cottus bairdii*), Swan River, Montana, August 3, 1891; B. W. Everman, collector.

Three specimens, 32, 30, and 5 mm. in length and 6, 5, and 1.5 in breadth, respectively. Dimensions of larger specimen: Length, 32 mm.; greatest breadth, middle, 6; breadth, 2.5, from anterior end, 3;

<sup>1</sup>U. S. Fish Com. Rept., 1889-1891, pp. 548-552, pls. LXIII-LXV, figs. 1-21.



breadth near posterior end, 2.50; length of median segments, 0.25; breadth of head, anterior end, 0.40; breadth of head, base, 1.30; length of head, 0.80. Body lanceolate, depressed, articulate. Head short-triangular, obtuse, with median, terminal pore, and two flat, leaflike flaps (bothria) on lateral margins, separated from each other on flat surface by a broad, shallow sulcus. First segment much broader than head, its posterior border much broader than its anterior border; subsequent segments increasing in breadth rapidly, their posterior borders greater than their anterior, until maximum breadth is attained; lateral margins of anterior segments with a distinct emargination, which character also appertains to the bothrial flaps of one of the specimens (Fig. 4).

*S. dimorphus* is described as having in the larval state a longitudinal median furrow on each face. These specimens do not exhibit this character; neither do they have anything that can properly be called a costa dividing the two bothria. I do not find any mention of emarginations on the segments in any of the descriptions of *S. dimorphus* to which I have access. On account of these differences I refer these specimens to *S. dimorphus* with some doubt. Diesing records *S. dimorphus* from the following hosts (genera only given here): Larval state from three genera of fish, *Gasterosteus*, *Cottus*, and *Salmo*; one bird, *Totanus*; one seal, *Phoca*. Adult state from the following genera of birds: *Corvus*, *Recurvirostra*, *Ardea*, *Ciconia*, *Sterna*, *Colymbus*, *Podiceps*, *Larus*, *Anas*, *Mergus*, *Uria*, *Alca*. The structure of the body resembles that of the genus *Dibothrium* (Fig. 5). Beginning with the outer layer the successive layers are (1) cuticle, (2) a fibro-granular layer with small bundles of longitudinal muscle fibers in the inner part, (3) a layer of circular fibers, (4) a glandular muscular layer, with radiating fibers. The outer part of this contains the incipient vitellaria, the central part contains large bundles of coarse longitudinal muscle-fibers; radiating fibers cross the layer separating the bundles of muscles from each other and passing between the glandular bodies; (5) a layer of circular fibers thicker than (2); (6) a central core surrounded by the layers of circular fibers and containing the incipient genitalia embedded in granulo-fibrous tissue. In the central core the testes could be made out; also a longitudinal vessel (nerve) (Fig. 5n). The only part examined in sections was the anterior, in which the genitalia were no further developed than is indicated in Fig. 5.

#### 6. CYATHOCEPHALUS TRUNCATUS Pallas.

(Plate XXVIII, figs. 6-8.)

*Tania truncata* PALLAS, 1781, Neue Nordische Beiträge, I, p. 105, pl. III, fig. 7.

*Cephalocotyleum* DIESING, Syst. Helm., I, p. 620.

*Cyathocephalus truncatus* KESSLER, 1868, Beiträge zur Fauna des Onega-Sees, p. 135, pl. VIII, fig. 3.—GRIMM, Zeitschrift f. w. Zool., XXI, pp. 502-504.—LÖNNBERG, K. Svenska Vet.-Akad. Handlingar, XIV, Afd. 4, No. 9 (1889).



*Cyathocephalus truncatus* PALLAS, Zschokke, Rech. sur les Vers Parasites des Pois. d'eau douce, pp. 37-40, pl. IX, fig. 9.

*Cyathocephalus truncatus* (PALLAS) KESSLER and KREMER, 1892, Zeitschrift f. w. Zoologie, LIII, 4, Heft (sep. abdr., pp. 6-35, XXVII, figs. 1-14).

No. 4782, U.S.N.M. From pyloric cœca of common white-fish (*Coregonus clupeiformis*) Outer Island, Lake Superior; J. W. Milner; several fragments, not in good state of preservation.

Body fusiform flattened, head funnel-shape. Dimensions of typical specimen: Length, 7 mm.; diameter of head at apex, 0.8; diameter of head at base, 0.45; length of head, 0.8; maximum diameter of body, 1.2. Genital apertures along middle of flat surface of body from 0.2 to 0.6 mm. apart.

The bodies of these specimens appear to be unsegmented, or, at best, with only very faint indication of division into segments. In this respect they differ from Zschokke's figure of the species, but agree well enough with his written account of it. "The segments are almost twice as broad as long. They are firmly attached to each other, their limits being seen with difficulty."<sup>1</sup>

Calcareous bodies numerous, many shapes, but usually irregularly oblong, from 0.01 to 0.02 mm. in length and showing concentric structure. Genital apertures about middle of segments. Ova were seen lying in clusters near middle of segments (specimen in oil of cloves and viewed on flat surface of body) behind and to one side of cirrus bulb, germ gland farther back at posterior edge of segment; testes median; vitelline glands lateral, voluminous in transverse lobules. The nucleated cells in the germ-gland are 0.01 mm. in diameter; cirrus-bulb pyriform with thick, muscular wall, transverse diameter, 0.135; longitudinal diameter, 0.12; uterus mainly dorsal. Musculature appears like that of the genus *Dibothrium*. Longitudinal muscle fibers stronger and more numerous in anterior part of body, somewhat scattered in posterior parts of body.

Ova in specimen in acetic acid, typical, 0.05 and 0.032 mm. in two principal diameters.

This, I believe, is the first notice of this rare parasite on this continent.

#### 7. DIBOTHRIUM MANUBRIFORME Linton.

*Dibothrium manubriforme* LINTON, U. S. Fish Com. Rept., 1886, pp. 456-458, pl. I, figs. 1-4; 1887, pp. 728-731.

No. 4711, U.S.N.M. Label reads: "From rectum of *Tetrapterus*, B. G. Wilder, August 5, Penikese."

Numerous specimens, fifty or more, tangled in a mass and in a poor state of preservation. Largest complete specimen noted measured 115 mm. in length and 3.5 in greatest breadth. Heads of diverse shapes. Dimensions of heads: Length of one, 2 mm.; breadth, 1; length of another, 2.5; breadth, 1; length of another, 1.5; breadth, 1.2.

<sup>1</sup> Rech. sur les Vers Parasites des Pois. d'eau douce, p. 38.



8. *DIBOTHRIUM PUNCTATUM* Rudolphi.

*Dibothrium punctatum* RUDOLPHI, U. S. Fish Com. Rept., 1887, pp. 731-736, pl. II, figs. 1-4.

From intestine of sand flounder (*Bothus maculatus* Mitchell), Woods Holl, Massachusetts, July 23, 1889.

Three specimens, longest, in alcohol, 223 mm.

Nos. 4703, 4702, 4705, 4701, 4730, 4704, 4784. There are nine lots of specimens belonging to this species in the National Museum collection.

1. Five specimens from stomach of sea raven (*Hemitripterus americanus*); largest about 300 mm. in length.

2. Three specimens, same host, Casco Bay, Maine, United States Fish Commission collection; slender, length, 400, 505, and 630 mm., respectively; breadth, 1.75, 3, and 3 mm., respectively.

3. Same host, Woods Holl, Massachusetts, November 9, 1886; V. N. Edwards, collector; several specimens; length of typical one, 290 mm., and breadth, 3.

4. Same host and locality; October 12, 1887; largest specimen, 280 mm. in length and 2 in breadth. These specimens were peculiar in having a pellucid cordate or peltate caudal segment, preceded by three or four narrowing segments. One of these terminal segments was 2 mm. in length and 1.5 in breadth.

5. Same host and locality; December 1, 1887; twelve specimens in lot. The dimensions of four typical specimens, in millimeters, from this lot follow: Length 740, greatest breadth 4; length 280, greatest breadth 5; length 530, greatest breadth 4.5; length 480, greatest breadth 6.

6. Same host and locality; one specimen; length, 575 mm.; breadth, 4.

7. Same host and locality; December 12, 1885; ten specimens; heads presenting variety of shapes; one specimen with anterior segments for first 30 or 40 mm. filiform.

8. Same host and locality; December 5, 1885; largest specimen in this lot measured 950 mm. in length and 4.5 in breadth; length of one head, 0.9; breadth, 0.3; length of another head, 1.2; breadth, 0.4.

Numbers 3 to 8 were collected by Mr. V. N. Edwards.

9. United States Fish Commission, off Block Island, 1880, from intestine of sand dab (*Limanda ferruginea*), three specimens.

9. *DIBOTHRIUM PLICATUM* Rudolphi.

*Dibothrium plicatum* RUDOLPHI, U. S. Fish Com. Rept., 1887, pp. 746-750, pl. III, figs. 1-6.

No. 4736, U.S.N.M. Label reads: "Trawl line near station 2091, United States Fish Commission steamer *Albatross*, 1883. Stomach or intestine of swordfish (*Xiphias gladius*)."

The specimen is a fragment 90 mm. long and 8 in greatest breadth. Since the usual position of this species is in the rectum of its host,



where the head and anterior portion of the body become imbedded in the intestinal walls, it is altogether probable that this specimen had a like position.

#### 10. *DIBOTHRIUM RUGOSUM* Rudolphi.

(Plates XXVIII, figs. 9-10; XXIX, figs. 1-4.)

*Dibothrium rugosum* RUDOLPHI, U. S. Fish Com. Rept., 1887, pp. 750-754, pl. III, figs. 7-10.

Nos. 4712, 4726, 4728, U.S.N.M. Ten lots of this species all from the intestine of the cod (*Gadus callarias*):

1. Intestine of cod, Woods Holl, Massachusetts; V. N. Edwards, collector; December 3, 1887. Several specimens, two with heads imbedded in pyloric cæca. Largest 188 mm. in length, 36 of which imbedded; tissue degenerate surrounded by waxy secretion. Body of nearly uniform size, 3 mm. broad and 1 thick; length of segment near posterior end 0.6.

2. Same as No. 1; December 10, 1887. Four fragments.

3. Same as No. 1; November 28, 1887. One specimen 36 mm. long, 1.5 broad; anterior end impacted in pyloric cæcum and surrounded with waxy secretion.

4. Same as No. 1; January 4, 1888. Fragments, largest 212 mm. long and 3.5 broad; some slender fragments, one 76 long and 1.5 broad, tapering anteriorly; no scolices.

5. Same as No. 1; November 28, 1887. Several specimens with heads impacted in pyloric cæca. Largest specimen 250 mm. long and 4.75 broad; some slender forms, one 165 long and 2 broad; heads of all degenerate.

6. Same as No. 1; November 25, 1887. One small fragment.

7. Same as No. 1; January 20, 1888. Two fragments. The posterior segment of one was exceptional in having the postero-lateral angles projecting in curved processes (Plate XXVIII, fig. 9).

8. Same as No. 1; November 14, 1887. Six fragments; largest 72 mm. long and 2 broad.

9. Same as No. 1; December 24, 1887. Three specimens; longest 215 mm., slender, head very little degenerated, as is usually the case on account of habit of worm to become impacted in pyloric cæca of host.

10. Same as No. 1; November 26, 1887. Four fragments.

All the above specimens collected at Woods Holl, Massachusetts, by Mr. V. N. Edwards.

Some portion of the anatomy of this species is shown in Plate XXVIII, fig. 10; Plate XXIX, figs. 1-4.

#### 11. *DIBOTHRIUM HASTATUM*, new species.

(Plates XXIX, figs. 5-11; XXX, figs. 1, 2.)

*Types*.—Nos. 4724, 4783, U.S.N.M. From intestine of paddlefish (*Polyodon spathula*). The fish from which these worms were taken was caught in the Ohio River, near Bellaire, Ohio, about March 13, 1889.



The worms were collected on March 15, when they were still active. There were one hundred and nine specimens in all; twenty-three were found on the viscera and in the stomach; twenty-six in pyloric cœca; ten in pylorus, and fifty in spiral intestine. Only the viscera had been brought to the laboratory. It is likely, therefore, that the specimens which were found on the viscera had escaped from the stomach after the viscera had been taken from the host. Two pits were found excavated in the mucous and submucous layers of the pylorus near the spiral valve, in which the heads of a number of *Dibothria* were inserted. The color was at first lemon-yellow; after lying in water for a few minutes the bodies became colorless or faintly bluish translucent, while the heads remained yellowish. Length of most of the specimens, when first removed, from 25 to 35 mm.; a few were a little longer than this. After lying in water for an hour four of the larger specimens measured 48, 60, 73 and 78 mm. in lengths, respectively. The specimens were at first very active, the lateral pits and the heads themselves changing their shape incessantly.

A specimen that had lain in water about an hour, the head being quiet, was measured and the following dimensions noted: Length, 60 mm.; length of head, 2.75; breadth of head at base, 2; breadth of head near apex, 1.8; length of pit, 1.6; diameter of pit, 0.8; breadth of neck near head, 11; length of last segments (average of fifteen), 1.13; breadth of last segments, 2.

Head sagittate (when at rest and contracted), terminated anteriorly with a button-shaped tip which is bluntly rounded in front and marked off from remainder of head by slight constriction, in life angled posteriorly; pits variable in life but usually elliptical, often with anterior margin acuminate and sometimes with posterior margin indistinct. The head is angled posteriorly both laterally and marginally, presenting a quite characteristic appearance in the living worm. Neck subcylindrical, narrower than head. The segments begin some distance (6 or 8 mm.) back of the head, as faint transverse lines. The first distinct segments are closely crowded, much broader than long, median segments squarish, posterior segments usually a little longer than broad, rectangular, apparently separating rather easily. The specimens were all young, so that the character of the ripe proglottides could not be made out. Posterior angles of the segments slightly projecting. Genital apertures on lateral margins, a little in front of the middle; a zigzag line of minute pores traverses the median region of one of the broad faces of the strobile, each pore being near the middle of its segment.

Outline of most of the strobiles nearly linear and about the same breadth as the head. All the segments were remarkably regular in outline, no irregularities being observed.

In the United States National Museum collection there is one lot of specimens belonging to this species, No. 4783, from *Polyodon spathula*; C. H. Gilbert, collector, 1885; eight specimens in lot. The strobiles are older than those in the lot collected by myself. Three of them bore



each a single ripe proglottis and one bore two ripe proglottides. (Figs. 9, 10.) The ripe proglottides were attached by a slender pedicel, so that if there were a number of them they would make a decidedly moniliform chain. When viewed on the flat surface they are irregularly circular in outline, in some cases longer than broad, in others broader than long. They are loosely attached. In each case they begin abruptly. These strobiles were from 40 to 56 mm. in length. Dimensions of one: Length, 45 mm.; length of head, 1.85; breadth of head at base, 1.7; thickness of head at base, 1.3; breadth of neck behind head, 1; thickness of neck, 0.4; length of median segments, 0.35; breadth of median segments, 2.5; length of segments near posterior end, 0.55; breadth of segments near posterior end, 2.7; length of ripe proglottis, 1.4; breadth of ripe proglottis, 1.7.

The genital apertures are about the middle of the lateral margins, irregularly alternate, usually two or three on same lateral margin of successive segments; an emargination at lateral margin indicates position of aperture. The genital aperture is cup-shaped, 0.07 mm. deep and 0.06 in diameter. The cirrus-pouch in the specimens examined measured 0.22 mm. in length and 0.14 in diameter. No sections were made. In a specimen cleared up in oil of cloves there appeared in some of the segments a slender, somewhat sinuous tube lying beside the cirrus, which I take to be the vagina. If this is correct, then the pores on the flat surface of the segments are for the escape of ova. The posterior segments are filled with ova, especially the round terminal, loosely attached segments. The ova are nearly spherical, with thin shells. They are about 0.04 mm. in the greatest diameter. The segments contain numerous calcareous bodies, which exhibit a concentric structure.

#### 12. DIBOTHRIUM species.

Fragment No. 1473, U.S.N.M. From intestine of dogfish (*Mustelus canis*); Woods Holl, Massachusetts, July 21, 1887.

A chain of proglottides, 11 mm. in length and consisting of nine proglottides, breadth 5.5; ova escaping from median pores near anterior ends of segments; reproductive aperture on lateral margin about middle of length; all on same side of chain, the aperture a prominent cloaca; dimensions of ova, 0.053 and 0.035 mm. in two principal diameters.

Careful search was made for other fragments, so that if any had been present they certainly would have been found. These segments, without much doubt, had been introduced in their present state of development along with food.

#### 13. DIBOTHRIUM CORDICEPS Leidy.

*Dibothrium cordiceps* LEIDY, Hayden's Prelim. Rept. U. S. Geolog. Survey, 1871, pp. 381-382.—LINTON, Bull. U. S. Fish Com., IX, 1889, pp. 72-76, pls. xxv-xxvii; pp. 337-358, pls. cvii-cxix; 1889-1891, p. 547.

No. 4739, U.S.N.M. Neither host nor locality are given; numerous Proc. N. M. vol. xx—28



fragments. These specimens resemble the larva of *D. cordiceps* from the Rocky Mountain trout (*Salmo mykiss*). Upon comparison with specimens taken from the abdominal cavity of that fish they appear to be identical. The largest fragments were something over 30 mm. in length and 2.5 in greatest breadth.

#### 14. DIBOTHRIUM INFUNDIBULIFORME Rudolphi.

(Plate XXX, figs. 3-6.)

*Dibothrium infundibuliforme* DIESING, Syst. Helm., I, pp. 590-591.—WILLEMOES-SUHM, Zeitschr. f. w. Zoöl., XXIII, pl. xvii, fig. 10.

*Bothriocephalus infundibuliformis* RUDOLPHI, Entoz., II, Pt. 2, p. 46.

*B. proboscideus* RUDOLPHI, Zschokke, Recherches, pp. 21-25, pl. ix, fig. 3.

Nos. 4744, 4710, 4709, U.S.N.M. I have identified as *Dibothrium infundibuliforme* three lots of parasites, one from the ling (*Lota maculosa*) and the others from the Great Lake trout (*Cristivomer namaycush*).

1. Two specimens from *Lota maculosa*, Sebago Lake, Maine, January 7, 1887; collected by Professor L. A. Lee, of Bowdoin College, Brunswick, Maine. No. 4744, U.S.N.M. Dimensions of one of the specimens: Length, 109 mm.; length of head, 0.9; diameter of head, marginal view, in front, 0.35; middle, 0.28; base, 0.47; distance to first segment, 1.5; length of first segment, 0.37; diameter of first segment, middle, 0.28; breadth of posterior segment, 0.8; length of posterior segment about 0.38; no mature segments.

The two scolices, as well as the anterior portion of each strobile, present considerable differences, which, however, appear to be due to different states of contraction. In one the fossettes reach the extreme anterior border of the head, so that in front view the head is oblong, with very deep lateral emarginations. In the other the anterior border of each fossette is limited by an overhanging cushion. One is considerably larger than the other. The neck in the larger specimen is about two-thirds of the length of the head and conical; the first segments longer than broad, a few of them presenting the characteristic funnel-form of the species. The worm throughout is narrow, nowhere becoming more than 1 mm. broad. The segments are somewhat irregular and in places exhibit a grouping together noted especially in *D. punctatum*.

2. No. 4710, U.S.N.M. Label reads: "Intestinal worms *Salmo amethystus*; Shoal Island, Lake Superior, Wisconsin; J. W. Milner."

Specimens too much broken to get length, evidently long. Heads of different shapes due to contraction. Length of head about 1 mm. In most cases the head was squarish, truncate in front, neck short, first segments distinct, as long as broad and funnel-form; greatest breadth of strobile about 2 mm.; segments short and transversely rugose, with a shallow median, longitudinal sulcus. Ova 0.06 and 0.032 mm. in two principal diameters.

3. No. 4709, U.S.N.M. Label reads: "*Salmo sisco-net*. intestine; Outer Island, Lake Superior; J. W. Milner."



Numerous fragments, not in good state of preservation; some of the strobiles have evidently been long. Heads of diverse shapes. A few dimensions follow: Length of head and neck, 0.8 mm.; breadth of head, 0.45; breadth of neck, 0.38; first segments broader than long; length of head proper, 0.45; length of head and neck of another, 0.9; diameter, 0.35; diameter of neck, 0.3; length of head proper, 0.6; first segments as long or longer than broad.

A curiously tangled mass of strobiles about 8 mm. in length and 4 in breadth occurred in this lot. It appeared to be made up of the ends of probably a dozen or more strobiles. One strobile which protruded about 12 mm. from the mass was separated from it. The part that had partaken in the entanglement was found to be about 4 mm. in length, very slender and irregular in outline from pressure. The fore part was 2 mm. in diameter; the part that had been woven in the mass, 0.5 mm. in diameter. The end of the slender part was slightly enlarged. This was characteristic of the other pieces that made up the mass. The slender portion was at the posterior end of the larger fragment. All in this lot had distinct necks.

15. *DIBOTHRIUM LACINIATUM*, new species.

(Plates XXX, figs. 7-16; XXXI, figs. 1-7.)

*Type*.—No. 4741, U.S.N.M. From tarpum (*Tarpon atlanticus*).

Two specimens, 142 and 154 mm. in length, respectively. Largest specimen about 4 mm. broad at broadest place, near middle, from which point it tapers to about 2 at posterior end.

Head clavate, outline varying with state of contraction, truncate and somewhat four-lobed in front. Fossettes marginal as to head, corresponding to flat surface of body. Flat surfaces of head with profound median depression at apex and extending posteriorly about half length of head. These depressions, with the fossettes (bothria), give the front aspect of the head a four-lobed appearance. Head contracted near the base with salient posterior margin; fossettes extend posteriorly to constriction. Segments begin immediately behind the head. First funnel-shaped with salient posterior border. The salient posterior border of head and of the first segments have a distinct emargination on the middle of the border which lies on the flat surface of the body. This emarginate character is very distinct in the first segments, but becomes indistinct in the median segments. The median segments are much crowded, breadth as much as ten times the length; posterior segments with breadth one and a half times the length.

Body very rugose, due to the prominent thin posterior edges of the segments. The segments are not uniform; one segment with a salient posterior border followed by about two with less salient borders.

Further dimensions: Length of head, 2 mm.; breadth of head, anterior, 0.8; middle, 0.4; posterior, 0.6; at constriction, 0.25; thickness of head, anterior, 0.5; middle, 0.55; at constriction, 0.25; posterior, 0.35; length



of first segment, 0.7; breadth of first segment, anterior, 0.3; posterior, 0.65; length of median segments, 0.3; breadth, 3; length of posterior segments, 1; breadth, 1.5.

Ova numerous, in clusters along median line. 0.052 and 0.035 mm. in two principal diameters.

Thin sections made in the three principal directions reveal the following anatomical details: The reproductive cloacæ lie along the median line of one of the flat surfaces of the body. The external openings of the uterus lie along the median line of the opposite surface. The cirrus-bulb is very muscular, long pyriform, its inner end deflected to the right, where it communicates with the vas deferens, which lies in numerous folds in front and to the right of the cirrus-bulb. The length of one cirrus-bulb to the point of deflection was 0.4 mm., its greatest diameter 0.14. The vagina lies immediately behind the cirrus-bulb and follows a course parallel to it. Near the external aperture it expands into a napi-form muscular body; in the one measured, 0.05 mm. in length and 0.07 in transverse diameter. My sections were made from segments already mature, and the folds of the uterus containing ova occupied a considerable part of the interior, obliterating the communication between vagina and uterus. Calling that surface ventral which bears the reproductive apertures, then the apertures of the uterus are along the dorsal surface. The uterus near these apertures becomes capacious and is lined with cilia. The ovary lies near the dorsal surface and near the posterior part of the segment. The segments are not separable and not even sharply outlined. The structure of the body is as follows: Beginning with the external layer, (1) cuticle, (2) layer made up of radiating fibers with scattered delicate longitudinal fibers, (3) layer of glandular bodies, vitellaria, (4) thin layer of circular fibers from which fibers radiate into both contiguous layers, (5) layer of strong longitudinal muscle fibers, (6) circular layer, (7) central core consisting of transverse fibers, granular parenchyma, and containing the testes.

A body which lies about the middle of the posterior edge of each segment, behind the vaginal tube and near the ovary, I take to be either an enlargement of the vitelline duct or vitelline reservoir, or, in part at least, an internal vitelline gland. It has the same appearance in stained sections as the glands of the above-named third-body layer.

Numerous calcareous bodies with strongly marked concentric structure occur in different parts of the segments. They are mostly oval in shape. One of the smallest measured 0.017 mm. in length and 0.008 in breadth; one of the largest was 0.024 and 0.014 in the two principal diameters. Longitudinal vessels could not be made out in my sections. The laciniae are prolongations of the external cuticular layer and the underlying granulo-fibrous layer. In some cases a few of the glandular bodies of the third layer were observed in the substance of the laciniae, although, as a rule, they as well as the calcareous bodies were absent.



16. *DIBOTHRIUM OCCIDENTALE*, new species.

(Plate XXXII, figs. 1-11.)

This species appears to be near *Bothriocephalus angusticeps* Olsson.<sup>1</sup> The bothria in Olsson's species are said to be marginal, while the position of the genital apertures was not made out. It is therefore not possible to refer the specimens here described to that species.

*Type*.—No. 4740, U.S.N.M. Specimens sent to me by Doctor T. H. Bean for identification, received April 20, 1891. The specimens were taken from a so called rock cod (*Sebastes* sp.) at Whatcom, Washington.

The bottle contained two fragments and portion of pyloric cœca of fish. The fragments measured 190 and 310 mm. in length, respectively. Another fragment with scolex was found in one of the pyloric cœca; this was 115 mm. in length.

Head small, elongated truncate, and somewhat capitate, constricted near posterior end with prominent posterior margin; fossettes coincide with flat surface of body and extend posteriorly nearly to constriction; segments begin immediately behind head, somewhat funnel shaped, soon becoming densely crowded and much broader, ten to twenty or more times as broad as long, decreasing in breadth and increasing in length again toward posterior end. Posterior segments in groups of three or four, namely, divisions between segments of contiguous groups more distinctly marked than between other adjacent segments.

Dimensions of head and segments: Length of head, 1.30 mm.; breadth of head, apex, 0.46; middle, 0.46; base, 0.40; breadth of first segment, 0.42; length of first segment, 0.12; greatest breadth, 5.5; length of broadest segments, 0.25; breadth of posterior end, 2; length of posterior segments, 0.8.

Ova large, crowded along median line in oval or pyriform clusters. Two typical ova yielded the following measurements: Length, 0.076 mm.; breadth, 0.038; length, 0.072; breadth, 0.041.

The sides of the head which correspond with the lateral margins of the body are medianly depressed toward anterior end.

Only mature segments were sectioned, in which the uterus with its contained ova obliterated many details of structure. The cirrus and vagina open by a common aperture on the middle of one of the flat surfaces of the body. This surface may be regarded as the ventral aspect of the body. The vagina is behind the cirrus; in some cases directly behind it, in others a little to one side or the other of the median line. The cirrus is slender and the muscular pouch has rather weak walls. A central vitelline mass, as in *D. laciniatum*, and vitelline ducts were distinguished. The cells of the ovary are very large, with very conspicuous nuclei in carmine-stained sections. A subglobular

<sup>1</sup> Lund's Univ. Årsskr., IX, p. 12, pl. III, figs. 67-69.



sphincter was made out on the oviduct near the ovary (Fig. 6). The uterus opens externally on the middle of the dorsal surface.

The structure of the body is in brief as follows: Named from the outside the layers are: 1, cuticle; 2, a granular layer which contains radiating horizontal and longitudinal fibers and carries in its meshes numerous small nucleated cells. The longitudinal fibers of this layer lie mainly near the cuticle; 3, a glandular layer containing the vitellaria with radiating connective fibers; 4, a thin layer of circular fibers; 5, a thick layer of coarse longitudinal fibers, gathered into bundles, with transverse connective fibers between the muscle bundles; 6, a layer of circular fibers which surrounds 7, the inner core of the body containing the testes, which consists of lobular glands in a granular and fibrous stroma.

Calcareous bodies are present in the central core and sparsely scattered elsewhere, but nowhere abundant in the sections that were examined.

#### 17. DIBOTHRIUM LIGULA Donnadieu.

*Ligula digramma* CREPLIN (larva) DIESING, Syst. Helm., I, pp. 580-581; Revis. d. Cephal. Param., pp. 231-232.—SCHAUINSLAND, Embryonalentwickl. pp. 31-36, pl. III, figs. 1-7.

*Dibothrium ligula* ZSCHOKKE, Rech., pp. 26-27.

*Ligula catostomi* LINTON, Bulletin U. S. Fish Com., IX, pp. 66-72, pl. XXIII, figs. 1-5; pl. XXIV, figs. 1-6; pl. XXV, fig. 1.

1. No. 4706, U.S.N.M. Label reads: "Taken from the sucker (*Catostomus latipinnis* or *C. insignis*) inhabiting the Gila River and Salt River, Arizona. Several are found in one fish. E. Palmer, one specimen."

Dimensions: Length, 280 mm.; greatest breadth, 11.5; breadth, 10 mm. from anterior end, 9; breadth, 10 mm. from posterior end, 11.

Body smooth, with median furrow along middle of each side. With lens, body seen to be divided into segments by fine transverse lines which are about 0.4 mm. apart in the middle region of the body; also minute pores can be distinguished in median furrow toward posterior end of body.

2. No. 4708, U.S.N.M. Label reads: "From intestine of river smelt (*Osmerus mordax*) Potomac River; C. E. Ridenour, Hagerstown, Maryland."

One specimen, length, 230 mm.; breadth near anterior end, 6.5; greatest breadth back of head, 8.5; breadth near posterior end, 3.

3. No. 4707, U.S.N.M. From silvery minnow (*Hybognathus nuchale*). One specimen, length, 270 mm.; greatest breadth, 12; thickness, 3.5.

Minute transverse striæ cross the body and there is a deep median furrow on one side.

4. No. 4725, U.S.N.M. Label reads: "From male red-fin (*Notropis cornutus* Rafinesque); Fourth Lake, Fulton Chain, Adirondacks; fish 4 inches long, but milt not developed; F. Mather, July 2, 1882."

Several fragments in bad state of preservation. Largest fragment: Length, 45 mm.; greatest breadth, 5; thickness, 2.5. Median furrow distinct.



I follow Donnadien's suggestion and Zschokke's example in referring the genus *Ligula* (larva) to the genus *Dibothrium*. There have been numerous species of *Ligula* described, but the distinctive characters of the species rest, in many cases certainly, merely upon the difference of habitat and the dimensions of the body of the worm. I do not see anything in the above example to lead me to think that they would develop into more than one different species of worm. The fact established by the interesting experiments of Donnadien that *Ligula* is the larval stage of a worm living in the adult stage in the intestine of different aquatic birds accounts for the very wide distribution of this species.

18. *DIBOTHRIUM* species; larva.

No. 4792, U.S.N.M. From peritoneum of squeteague (*Cynoscion regalis*); Woods Holl, Massachusetts, July 26, 1889.

Length of living specimen about 15 mm. ; breadth, 2.4; of nearly uniform breadth and narrowed about equally at each end; posterior end with terminal pore; body crossed with fine wrinkles.

19. *ANTHOBOTHRIUM LACINIATUM* Linton.

*Anthobothrium laciniatum* LINTON, U. S. Fish Com. Rept., 1887, pp. 754-759, pl. III, figs. 10-13; pl. IV, figs. 1-3.

No. 4776, U.S.N.M. From the intestine of the blue shark (*Prionace glauca*); Woods Holl, Massachusetts, August 5, 1889, few; numerous free, mature proglottides, measuring as much as 3.5 mm. in length and 1.5 in breadth; one proglottis somewhat distorted, was 4.5 mm. long and 1 broad.

Dimensions of scolices and strobiles generally not materially different than those given in original description of specimens from *C. obscurus*.

20 *ANTHOBOTHRIUM PULVINATUM* Linton.

(Plate XXXIII, fig. 1.)

*Anthobothrium pulvinatum* LINTON, U. S. Fish Com. Rept., 1887, pp. 759-765, pl. IV, figs. 4-9; pl. V, figs. 1, 2.

In the summer of 1889 I found this worm on two occasions in the sting ray (*Dasyatis centrura*); Woods Holl, Massachusetts, July 18, one specimen, length, 135 mm.; greatest breadth, 6. August 14, two specimens, length of longest 260 mm. The specimen collected on July 18 was slender for the first third of the entire length with nearly uniform diameter of 1.75 mm. It then thickened rapidly, reaching a maximum breadth of 6, whence it narrowed again gradually to the posterior end, where it was 2 broad. The thickness of the body throughout was about 2 mm. The thick part of the body was flesh color, the anterior slender part pale olive. Body crossed by fine transverse lines, i. e., segments in middle of body exceedingly short; segments near posterior end of body only about 0.2 mm. in length; length of last segment, 1.5.

The specimens collected on August 14 had heads and necks white and translucent, body thick, opaque, pale reddish-brown, or flesh color.



Fig. 1 is a sketch of the head of a living specimen introduced here to illustrate a common condition.<sup>1</sup>

In the National Museum collection there are five lots of these parasites, Nos. 4716, 4737, 4717, and 4725.

1. Bottle contains no label to indicate either locality or host. The specimens are not in good condition, but are easily identified. Five specimens, besides a number of fragments. Longest specimen, 230 mm.; greatest breadth, 6.5; breadth of head, bothria appressed, 3.5; breadth of head with divergent, cruciform bothria, 4.5.

2. Label reads: "Big ray, No. 182." No locality.

The vial contains four specimens in good condition. Dimensions of longest: Length, 160 mm.; breadth, 3; diameter of head, 3.5; diameter of bothrium, 2.

The specimens are plump, almost cylindrical, bothria contracted, corrugated, cushion-shaped, appressed so as to make quadrangular head when viewed in front.

3. Label: "From long-tailed ray." No locality. Three specimens. Largest specimen, 165 mm.

4. Label: "Big ray, No. 83." No locality. Two specimens with a number of fragments. Average length, 180 mm.; greatest breadth, 4.5; other dimensions as above.

5. No. 4409, U.S.N.M. Label: "*Trygon centrura*." One specimen.

## 21. ECHENEIBOTHRIUM VARIABLE Beneden.

*Echeneibothrium variable* BENEDEN, U. S. Fish Com. Rept., 1886, pp. 460-462, pl. I, figs. 9-13; 1887, pp. 766-767.

No. 4787, U.S.N.M. Twelve specimens of the common skate (*Raja erinacea*) were examined for parasites at Woods Holl, Massachusetts, July 23, 1889. Numerous examples of *E. variable* were found in the spiral intestines of most of the fish.

## 22. PARATÆNIA MEDUSIA Linton.

*Paratænia medusia* LINTON, U. S. Fish Com. Rept., 1897, pp. 862-866, pl. XV, figs. 5-9.

No. 4799, U.S.N.M. Two specimens which agree perfectly with my former observations on this species were found in the intestine of the sting ray (*Dasyatis centrura*); Woods Holl, Massachusetts, July 18, 1889.

The dimensions are not materially different from those given in the original description of the species.

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<sup>1</sup> U. S. Fish Com. Rept., 1887, p. 759.



## 23. RHINEBOTHRIUM LONGICOLLE Linton.

(Plate XXXIII, figs. 2-4.)

*Rhinebothrium longicolle* LINTON, U. S. Fish Com. Rept., 1887, pp. 775-778, pl. VI, figs. 1-4.

Nos. 4805, 4802, 4804. A few fragments of strobile, no scolex, overlooked in first description of the species; collected in August, 1884, from intestine of *Myliobatis freminvillei* belong to this species.

In the summer of 1889 I encountered this worm on three different occasions, each time in the cow-nosed ray (*Rhinoptera bonasus*), habitat added. August 1, ten specimens (from one ray); August 14, one specimen; August 16, two specimens.

This species was also found in the United States National Museum collection—no catalogue number; label reads: "Intestine of small *Raia*, Penikese, July 13, 1874." The vial contains a number of fragments, three of them with scolices; length of longest about 25 mm.

A specimen in the lot collected on August 16 was at first taken to be a distinct species, but subsequent examination of the alcoholic specimen proves it to belong to this species. For some reason, probably on account of age, the bothrial costæ are very indistinct, which gave the specimen a very different appearance, especially in the living specimen. Length, 37 mm.; length of ripe proglottis, 1.3. Figs. 3 and 4 represent the ova of this species as they were observed on different occasions. The thin pellicle which surrounds the ovum is extended into a long filament, which is five or six times the length of the ovum. In the proglottis these filaments are felted together. When they are extended in water they remain in a mass for a time, but ultimately lose the filaments. At least, in a lot of ova which had been lying for some time in sea water filaments were found on only a part of the ova, while those which were seen in place through the walls of the proglottis were all provided with filaments.

The dimensions of the largest ova in one lot were 0.028 and 0.038 mm. in the two principal diameters. The filaments were five or six times as long as the ova.

This species was first found in *Myliobatis freminvillei*.

## 24. RHINEBOTHRIUM MINIMUM Beneden.

(Plate XXXIII, fig. 5.)

*Echeneibothrium minimum* BENEDEN, Diesing, Revis. d. Cephal. Param., p. 268.

No. 4803, U.S.N.M.; United States Fish Commission, collector; off Marthas Vineyard, Massachusetts, 1881, station 919. From stomach of *Raja lævis*.

The vial contains several fragments, among which are two strobiles with scolices.

Dimensions of one of these: Length, 9 mm.; length of bothrium, 0.5; breadth of bothrium, 0.2; diameter of neck, 0.2; length of postero-median segments, 0.36; breadth of same, 0.4; length of posterior seg-



ment, 0.8; breadth of posterior segment, 0.38. The segments begin as fine transverse striæ, immediately behind the head. Bothria with ten loculi arranged in four pairs with a single one at each extremity. The bothria are attached by short pedicels near their posterior ends, their anterior ends projecting in front, giving the head the appearance of a four-petaled flower. Some of the free segments, probably belonging to this species, were much longer than broad; length, 2.7 mm.; breadth, 0.37.

These specimens agree with Beneden's description and figures of *E. minimum*.

## 25. SPONGIOBOTHRIUM VARIABLE Linton.

*Spongiobothrium variable* LINTON, U. S. Fish Com. Rept., 1886, pp. 462-464, pl. II, figs. 13-19; 1887, pp. 778-780.

Nos. 4807, 4806, U.S.N.M. Three finds of this species have been made since the report of 1887; each in the sting ray (*Dasyatis centrura*); all at Woods Holl, Massachusetts, in 1889.

1. July 18; one specimen; length, 94 mm.; bothria exceedingly variable, extending to 1 mm. or more. The appearance of the bothria was somewhat different from what I had previously observed in this species. The bothria are flat, thin, and very flexible, surrounded by a finely crenulate muscular border and mounted on pedicels, the latter being very flexible. The bothria become much crumpled and the pedicels greatly shortened as the worm contracts. When first removed and placed in sea water the bothria resemble those of *Anthocephalum gracile* Linton, but there is no auxiliary acetabulum. The mature segments measured 7 mm. in length and 0.9 in breadth.

2. July 24; one specimen. The edges of the bothria were very versatile in life, extending into flexible digitate projections when first placed in sea water.

3. August 5; one specimen, with numerous free proglottides; the latter plump and swollen. The neck was coiled in a close spiral in life, which imparted a very deceptive appearance to the specimen. One specimen, belonging to the lot collected July 18 and placed at the time of collecting with two specimens of *Paratania medusia*, proves to be an immature *Spongiobothrium variable*. It was at first taken to be a specimen of *Paratania*, although a little larger than the other specimens in the vial, and had a broad top-shaped head, which, when examined closely was seen to lack bothria, while the retracted part was a folded plicated organ looking, in this condition, not unlike the characteristic tentacles of *Paratania*. The segments resemble those of *Spongiobothrium*; the first very short, becoming as long as broad, then roundish, moniliform, and then longer than broad.

Dimensions: Length, about 4 mm.; breadth of head, 0.5; length of head, 0.33; breadth of neck, 0.1; length of last segment, 0.3; breadth of last segment, 0.14.



26. *PHYLLOBOTHRIUM FOLIATUM* Linton.

(Plate XXXIII, fig. 6.)

*Phyllobothrium foliatum* LINTON, U. S. Fish Com. Rept., 1887, pp. 787-794, pl. VI, figs. 5-10.

Nos. 4733, 4840, U.S.N.M. The following additional discoveries of this parasite are here recorded; all collected at Woods Holl, Massachusetts, from the spiral intestine of the sting ray (*Dasyatis centrura*), in the summer of 1889.

July 24, one specimen, one ray examined; August 9, several specimens, in each of two rays examined; August 14, three specimens, small, from one ray examined; August 16, two specimens, from one ray examined.

One of the rays examined on August 9 had begun to decompose slightly, there being a strong ammoniacal odor given off from the intestine. In this intestine the worms were exceedingly attenuate, as much as 260 mm. in length, and filiform; they were dead, and I infer that the attenuate, filiform condition represents a post mortem change. The worms from the other, slightly fresher intestine were normal in shape, and when placed in sea water were moderately active.

Fig. 6 represents a segment which was free when collected and which appears to belong to this species. It was observed after the free proglottides had lain in sea water for some twelve hours that a large mass of ova had been discharged from one or more of them and was lying spread out on the bottom of the dish. The mass adhered so tightly to the glass that it could not be removed by the suction of a pipette; when gently separated from the dish the ova were found to be held together by a mucilaginous substance. The adhesive material appears to be soluble in alcohol. The ova, at least many of them, were collapsed on one side, boat-shaped; 0.038 and 0.024 mm. in the two principal diameters.

27. *ORYGMATOBOTHRIUM ANGUSTUM* Linton.

*Orygmatobothrium angustum* LINTON, U. S. Fish Com. Rept., 1886, pp. 468-469, pl. III, figs. 1-3; 1887, pp. 796-799, pl. VII, fig. 3.

No. 4796, U.S.N.M. Numerous examples of this species were found in the intestine of the blue shark (*Prionace glauca*); Woods Holl, Massachusetts, August 5, 1889.

Although I am not satisfied with this disposition of the species, and am convinced that when the much-needed revision of the Tetrabothriidæ is made, *O. angustum* Linton must take the place of a synonym, I have retained the name which I have used in previous papers, in order to avoid confusion.



## 28. ORYGMATOBOTHRIUM PAULUM, new species.

(Plate XXXIII, figs. 7, 8 )

*Type*.—No. 4798, U.S.N.M. From spiral intestine of the tiger shark (*Galeocерdo tigrinus* Ranz); Woods Holl, Massachusetts, August 14, 1889; very numerous.

Bothria four, variable in shape from long to short-oval, each with two pits (acetabula), an anterior small and shallow, a posterior larger and profound, with a strong contractile border; anterior acetabulum confluent with posterior Fig. 8), which is from a sketch of a hardened specimen; the thick border of the bothria is not so evident in fresh specimens.

These specimens were referred at the time of collecting, upon a somewhat hasty examination of the living worms, to *O. angustum*, but on account of the smaller size, shorter neck, and different character of the bothria revealed in the preserved specimens, I have found it necessary to make a different disposition of them.

Dimensions of typical example: Length, 9 mm.; diameter of head, 0.43; length of bothrium, 0.22; diameter of neck, 0.15; distance to first segments, 0.47; breadth of first segment, 0.15; length of first segment, 0.03; length of fourth segment from last, 0.47; breadth of last segments, 0.28; length of last segment, 1.03.

Under a high magnifying power the neck and segments are seen to be crossed by fine transverse lines which give a finely serrate outline to the margins, the neck is shorter and the striæ and marginal serrations not so evident as in *O. angustum*.

The disposition of the reproductive organs agrees with that of *O. angustum*. The vitelline glands lie along the lateral margins; germ gland two-lobed near posterior end; vagina curves in a crook around and in front of cirrus-bulb; cirrus retracted in every case, but was seen to be beset with minute spines; cirrus-bulb pyriform; reproductive aperture on about anterior third of lateral margin; testes longitudinally placed, central to vitelline glands.

When scolices of preserved specimens of *O. angustum* and *O. paulum* are compared the differences are seen to be considerable, and can not be accounted for by different action of the preserving fluid.

## 29. ORYGMATOBOTHRIUM CRENULATUM, new species.

(Plates XXXIII, figs. 9-12; XXXIV, fig. 1.)

*Type*.—No. 5506, U.S.N.M. From spiral intestine of the sting ray (*Dasyatis centrura*); Woods Holl, Massachusetts, August 14, 1889; two examples.

Bothria four, cruciformly disposed, globular, each provided with an auxiliary acetabulum and an accessory disk of strong circular fibers; no myzorhynchus; neck crossed by fine transverse lines, which make a serrate or crenulate margin, which character persists throughout the



strobile, the posterior segments being crenulate on lateral margins; segments at first broader than long, becoming square, then longer than broad.

Dimensions of a specimen (alcoholic): Length, 8.5 mm.; diameter of head, 0.44; diameter of neck, 0.11; distance to first distinct segment, 1; length of first distinct segment, 0.08; breadth of same, 0.14; length of last segment, 0.56; breadth of last segment, 0.28.

The strobiles were young and the reproductive apparatus could not be made out satisfactorily. The vitellaria make a comparatively narrow border along the margins; ovary at posterior end, apparently single; testes centrally placed, mostly forward of the genital cloaca; the genital aperture is about the middle or a little in front of the middle of the length of the segment, not on a lateral margin, but near it. (Plate XXXIII, fig. 12.)

Plate XXXIV, fig. 1, is from a sketch of a longitudinal section through the head of one of the specimens, and represents the relation of the anterior acetabulum to the bothrium proper and of the auxiliary organ of circular fibers. The two former organs present the usual appearance made by the strong radiating fibers characteristic of such organs; the latter lies superficially to the larger acetabulum and consists almost entirely of strong circular fibers. In these two specimens these fibers were strongly contracted into a circular disk, with small aperture. The disk really represents the border of the bothria proper, and when relaxed no doubt gives to the bothrium a very different aspect from what it bears in these specimens.

Plate XXXIII, fig. 11, is a hypothetical sketch giving what I conceive to be the relation of the circular fibers to the acetabula when relaxed.

### 30. CROSSOBOTHRUM LACINIATUM Linton.

*Crossobothrium laciniatum* LINTON, U. S. Fish Com. Rept., 1886, pp. 469-474, pl. III, figs. 4-18; 1887, pp. 799-802, pl. VII, fig. 4.

Nos. 4718, 4723, 4734, 4738, 4780, 4781, U.S.N.M. Several lots of this parasite occur in the United States National Museum collection. All were collected at Woods Holl, Massachusetts, the host in each case being the sand shark (*Carcharias littoralis* Mitchell). The parasites were usually in considerable numbers and were found in the the spiral intestine.

These specimens were collected in the months of August, November, and December. Collectors, Vinal N. Edwards and Ralph S. Tarr.

Both young and adult specimens were found together in the November collections, appearing much as I have seen them in July.

One specimen was found which had an elongated first joint, or neck, like that noticed and figured in my report on Cestodes of Marine Fishes.<sup>1</sup> This is the second individual of the kind that I have noticed among many hundreds of individuals from many different hosts.

<sup>1</sup> U. S. Fish Com. Rept., 1887, p. 800, pl. VII, fig. 4.



In this lot were some with attenuated anterior ends and distorted heads which would be very puzzling to one who has not seen the living worm.

Since reporting on this worm I have encountered it at Woods Holl, Massachusetts, July 8, 1889, where in about one hundred and seventy-five specimens, young and adult, it was found in spiral intestine of sand shark. The young worms were found in the anterior part of the intestine near the pyloric division of the stomach. Again on July 12, 1889, numerous specimens found in spiral intestine of each of two sand sharks, and on July 13, 1889, a few specimens were found in a mutilated intestine of sand shark which had been brought into the laboratory.

In July, 1889, I received from Doctor E. A. Andrews a vial containing a single example of *C. laciniatum*, which was found by him, in a pail containing specimens of *Molgulae*. August 16, 1889, one specimen of *C. laciniatum* in intestine of sand shark.

### 31. ONCHOBOTHRIUM UNCINATUM Diesing.

(Plate XXXIV, figs. 2-5.)

*Onchobothrium uncinatum* DIESING, Revis. d. Cephal., Param., pp. 269-270.—OLSSON, Lund's Univers. Årsskrift, III, p. 45, pl. II, figs. 30-34.

No. 4795, U.S.N.M., is from intestine of sting ray (*Dasyatis centrura*); two specimens, in poor state of preservation. Heads much distorted and details of structure difficult to make out; bothria, four, in marginal pairs, apparently trilocular; the largest loculus near apex, and surrounded by a pair of dark-brown, nearly black hooks; neck long; broadest segment some distance from posterior end, toward which they become narrower; genital apertures marginal, irregularly alternate.

Dimensions: Length of largest, 61 mm.; breadth of broadest segments, 2; length of same, 0.3; length of posterior segments, 0.8; breadth of posterior segments, 1; thickness of head, 0.6; breadth of head, 0.8; breadth of neck, 0.6; length of bothrium, 0.4; breadth of bothrium, 0.35.

One of the specimens was quite attenuate, and 34 mm. in length without any indication of segments. The details of structure of hooks were not made out with entire satisfaction. One hook of each pair bears a small tubercular hook at its base. The hooks are in pairs, whether united at base not certain; in one case the hooks of a pair were united by a slender chitinous bar, a blending of their broad bases. In another case the bases, while contiguous, were not united. The hooks were more or less broken, so that lengths could not be obtained exactly.

Dimensions of hooks: Length, measured from top to opposite of base, about 0.17 mm.; breadth of base, 0.1; length of hook proper, 0.08.

While the hooks do not agree in detail with descriptions of this species, none of them maintaining the tubercular hook which is born by one hook in each pair, I do not feel justified in making a new specific name, particularly when the small amount of material and its poor state of preservation are taken into consideration.



32. *CALLIOBOTHRIUM ESCHRICHTII* Beneden.

*Calliobothrium eschrichtii* BENEDEN, LINTON, U. S. Fish Com. Rept., 1887, pp. 812-816, pl. VII, figs. 5-12.

Nos. 4777, 4779, U.S.N.M. Three lots of this worm have been collected since the report for 1887 was made, all in the summer of 1889; Woods Holl, Massachusetts, from the dogfish (*Mustelus canis*). July 12, a small number of specimens from each of two dogfish; July 18, few specimens from each of four dogfish; August 1, few specimens from three of four dogfish.

In nearly every case they were associated with *C. verticellatum*, *Rhynchobothrium bulbosum*, and *R. tumidulum*.

33. *CALLIOBOTHRIUM VERTICILLATUM* Rudolphi.

(Plate XXXIV, figs. 6, 7.)

*Calliobothrium verticillatum* RUDOLPHI, LINTON, U. S. Fish Com. Rept., 1886, pp. 476-479, pl. IV, figs. 1-8; 1887, pp. 810-812.

No. 4778, U.S.N.M. The following discoveries of this species were made in the summer of 1889 at Woods Holl, Massachusetts; all from intestine of the dogfish (*Mustelus canis*). July 12, a small number of specimens in each of two dogfish; July 18, a few specimens in each of four dogfish; July 22, a few specimens in each of two dogfish; July 25, a good many, large, in one dogfish; August 1, many specimens in three of four dogfish.

Usually associated with *C. eschrichtii*, *Rhynchobothrium bulbosum*, and *R. tumidulum*, but, as a rule, I have found it more abundant than its associates, and more likely to occur in this, its apparently peculiar host.

Some proglottides belonging to those collected August 1 were left in sea water over night. On the following morning masses of ova were found in the water, inclosed in what appeared to be portions of the uterus (Fig. 6). Many of these ova had begun to undergo segmentation. In some the embryonic spines had made their appearance, although the exact number could not be made out with certainty in any case.

34. *PHOREIOBOTHRIUM LASIUM* Linton.

*Phoreiobothrium lasium* LINTON, U. S. Fish Com. Rept., 1886, pp. 474-476, pl. IV, figs. 24-29; 1887, pp. 819-820.

No. 4800, U.S.N.M. One specimen was found associated with numerous examples of the species *Orygmabothrium angustum*, from the intestine of the blue shark (*Prionace glauca*); Woods Holl, Massachusetts, August 5, 1889.

This species was originally described from specimens found in *Carcharinus obscurus*.



## 35. THYSANOCEPHALUM CRISPUM Linton.

*Phyllobothrium thysanocephalum* LINTON, U. S. Fish Com. Rept., 1886, pp. 464-468, pl. II, figs. 1-12.

*Thysanocephalum crispum* LINTON, U. S. Fish Com. Rept., 1887, pp. 823-824; 1888, pp. 543-556, pls. LXI-LXVII, figs. 1-43.

No. 4732, U.S.N.M. This species has been reported upon in a special paper, cited above. It was found on two occasions in the summer of 1889, at Woods Holl, Massachusetts, in the intestine of the tiger shark (*Galeocерdo tigrinus*). I have examined only three specimens of this shark, but in each have found enormous numbers of this curious cestod.

## 36. RHYNCHOBOTHRIMUM BULBIFER Linton.

*Rhynchobothrium tenuicolle* RUDOLPHI, LINTON, U. S. Fish Com. Rept., 1886, pp. 486-488, pl. V, figs. 17, 18.

*R. bulbifer* LINTON, U. S. Fish Com. Rept., 1887, pp. 825-829, pl. X, figs. 8, 9; pl. XI, figs. 1, 2.

Nos. 4752, 4746, U.S.N.M. I found this species on three occasions in the summer of 1889, Woods Holl, Massachusetts, in the intestine of dogfish (*Mustelus canis*). July 12, a few specimens in each of two dogfish; July 18, few in each of three dogfish; July 25, few in one dogfish.

This species is usually associated with the smaller *R. tumidulum* and the two species of *Calliobothrium*, *C. verticillatum* and *C. eschrichtii*.

## 37. RHYNCHOBOTHRIMUM TUMIDULUM Linton.

*Rhynchobothrium tumidulum* LINTON, U. S. Fish Com. Rept., 1887, pp. 829-832, pl. XI, figs. 3-11.

No. 4748, U.S.N.M. This species was discovered on three occasions in the summer of 1889 in intestine of the dogfish (*Mustelus canis*); Woods Holl, Massachusetts; July 12, a few from each of two dogfish; July 18, few in each of four dogfish; August 1, a few in three of four dogfish.

This species is usually associated in the dogfish with the larger *R. bulbosum* and two species of *Calliobothrium*, *C. verticillatum* and *C. eschrichtii*.

A *Rhynchobothrium* which I found in the intestine of the sting ray (*Dasyatis centrura*) at Woods Holl, Massachusetts, August 16, 1889, agrees with this species.

## 38. RHYNCHOBOTHRIMUM TENUISPINE Linton.

(Plate XXXIV, fig. 8.)

*Rhynchobothrium tenuispine* LINTON, U. S. Fish Com. Rept., 1887, pp. 837-838, pl. XII, figs. 1, 2.

Nos. 4749, 4751, U.S.N.M. I discovered this species on one occasion in the sting ray (*Dasyatis centrura*), intestine, since 1887, in the summer of 1889; July 18, one specimen.

I have also found a *Rhynchobothrium* in the spiral valve of the blue



shark (*Prionace glauca*) which appears to be identical with this species, at least in the character and disposition of the hooks on the proboscides, which I find to be one of the safest criteria in determining identities in the Tetrarhynchidæ. Two specimens were found in the blue shark August 5, 1889, at Woods Holl, Massachusetts. They were associated with *Orygmatobothrium angustum* and *Anthobothrium laciniatum*.

Dimensions of alcoholic specimens: Length of head and neck, 0.85 mm. in one, 1 in the other; length of bothrium, 0.24; breadth of head, 0.36; diameter of neck, 0.27; length of last (eighth) segment, 0.54; whole length of each specimen, 2.5. Color faint reddish brown or flesh color. The posterior segments are loosely attached and evidently became detached before maturity. A number of free proglottides which had been placed in a vial with specimens of *O. angustum* are evidently *Rhynchobothrium* segments and presumably belong to this species. One of them is represented in Fig. 8. If they are in truth specimens of this species they have increased in length enormously as compared with those which are still attached to the strobile.

Dimensions of one of these free proglottides (alcoholic): Length, 2.8 mm.; breadth near anterior end, 0.56; breadth at reproductive aperture, 0.56; breadth near posterior end, 0.3.

Proglottis slipper-shaped, round at anterior end, slightly constricted in front of reproductive aperture about middle, bluntly rounded and slightly narrowed posteriorly; reproductive aperture on lateral margin near posterior third, in broad shallow cloaca; vitellaria narrow along each lateral margin through nearly whole length; testicular masses in anterior half; ovaries two, united by narrow part about halfway between reproductive aperture and posterior end; vagina short, curved, opening beside and behind cirrus; cirrus bulb oval, inclined inward and forward.

The crenulate margins agree with what was observed on segments attached to strobile. Analogy with *R. bulbifer*, whose proglottides grow after separation from strobile, favor the theory that these segments belong to *R. tenuispine*. Length of longest fragment, 22 mm. (the length of a strobile must be very considerably greater than this); length of bothrium, 0.55; breadth of bothrium, 0.4; length of head and neck, 1.4; diameter of neck, 0.4; length of contractile bulbs, 0.35; length of last segments, 2.4; breadth of last segments, 0.6.

Dimensions of another specimen, alcoholic: Length of bothrium, 0.45 mm.; length of proboscis, 0.9; diameter of proboscis at base, including hooks, 0.045; diameter of proboscis at apex, including hooks, 0.035; length of largest hooks, 0.012.

In one specimen two of the proboscides had been extended along with 0.3 mm. of the sheath.

The scolex and strobile bear some resemblance to those of *R. agile*, but the character of the hooks on the proboscides is quite different in the two species.



## 39. RHYNCHOBOTHRIUM IMPARISPINE Linton.

*Rhynchobothrium imparispine* LINTON, U. S. Fish Com. Rept., 1887, pp. 840-843, pl. XII, figs. 6-9.<sup>1</sup>

No. 4745, U.S.N.M. From the intestine of the skate; October 17, 1887, Woods Holl, Massachusetts; V. N. Edwards, collector, seven specimens.

Dimensions of alcoholic specimen: Length, 26 mm.; length of bothrium, 0.9; length of head and neck, 6; length of posterior segments, 2.2; breadth of posterior segments, 1.

The hooks of this species bear a close resemblance to those of *R. erinaceus* Beneden.

The species of skate is probably *Raja erinacea*.

## 40. RHYNCHOBOTHRIUM LONGICORNE Linton.

*Rhynchobothrium longicorne* LINTON, U. S. Fish Com. Rept., 1887, pp. 847-849, pl. XIII, figs. 4-8.

No. 4839, U.S.N.M. was collected at Woods Holl, Massachusetts, date not given; from intestine of sand shark (*Carcharias littoralis*).

Dimensions of alcoholic specimen: Length, 35 mm.; length of head and neck, 5; length of proboscis, approximately, 4; length of last segment, 3.5; breadth of last segment, 1.75.

Genital aperture near anterior end with prominent lips showing crenulate outline. The bothria project in front of the head, are distinctly emarginate posteriorly, and bilobulate, with a prominent median ridge between the loculi. Hooks of very diverse shapes.

## 41. RHYNCHOBOTHRIUM BREVISPIKE, new species.

(Plate XXXIV, figs. 9-11.)

*Type*.—No. 4750, U.S.N.M. Label reads: "Intestine of small ray; Penikese, July 13, 1874."

It is highly probable that the ray was *Rhinoptera bonasus*, since a parasite recognized as *Rhinebothrium longicolle* was along with this parasite in the same vial.

Bothria elliptical, divergent at base; neck subcylindrical; first segments very short and crowded, becoming squarish, then much longer than broad, last segments four or more times as long as broad; reproductive aperture near middle of lateral margin, or a trifle nearer the posterior than the anterior edge of the segments; proboscides long and slender, twice as long as the bothria, very slightly tumid at base, tapering a little toward the apex; hooks small, about four longitudinal rows of stout hooks with broad bases and recurved points, these flanked by two longitudinal rows on each side of smaller hooks not quite so

<sup>1</sup>Errata, p. 839, line 2, read figs. 3-5 instead of figs. 3-6; p. 840, line 13, read figs. 6-9 instead of figs. 7-9; p. 880, for *Anthobothrium*, read *Anthocephalum*; p. 890, fig. 6, with explanation, should follow *Rhynchobothrium imparispine*.



broad. The remaining rows are composed of hooks which are more slender and not so sharply recurved. There is not a very great diversity of shape and size in the hooks in this species.

Dimensions obtained by measurement of alcoholic specimens.

42. *RHYNCHOBOTHRIUM AGILE*, new species.

(Plate XXXIV, figs. 12-15.)

*Type*.—No. 4747, U.S.N.M. Bothria elliptical, divergent at base, with longitudinal median raised septum; neck cylindrical, short when compared with strobile, which is very long and slender; proboscides armed with exceedingly small hooks, those on one side being stouter and more recurved and blunter than those on the other side, more slender, shorter, straightish, and sharper pointed; segments begin near base of contractile bulbs as fine, transverse lines; first segments consequently very short, soon becoming squarish, then oblong, ultimately twice as long as broad and subcylindrical, posterior margins slightly flaring; reproductive aperture near middle of lateral margin.

From intestine of cow-nosed ray (*Rhinoptera bonasus*); Woods Holl, Massachusetts, 1889, August 14, two specimens; August 16, one specimen.

Dimensions of living specimen: Length, 63 mm.; breadth of head, 0.7; length of bothrium, 0.46; breadth of bothrium, 0.44; diameter of neck, 0.4; length of free proglottides with ova, 4; breadth of free proglottides, 1.5.

The free segments were almost cylindrical. When placed in sea water one of them was seen to discharge ova from one end in a dense white stream. After a short time they formed a mass at the bottom of the watch glass. The color of the mass of ova changed rapidly from white to very bark-brown, almost black. Some of the ova appear nearly globular, others measured 0.028 and 0.022 mm. in the two principal diameters.

The specimen obtained on August 16 was long and slender, white, very active, even after lying twelve hours in sea water, contracting irregularly and throwing itself into knots and coils so that it was impossible to get satisfactory measurements. In contracting, tumid places are succeeded by filiform places, which in their turn may quickly become tumid again. This worm was still active nearly twenty-four hours after its capture, when it was placed in picrosulphuric acid. It was broken in several pieces while it was still alive in endeavoring to dislodge the proboscides from a segment into which the worm had thrust them. It held on very tenaciously and was dislodged with the greatest difficulty.

Some dimensions of alcoholic specimen: Breadth of head, 0.65 mm.; length of bothrium, 0.45; breadth of bothrium, 0.36; diameter of neck, 0.36; length of contractile bulbs, 0.34; length of head and neck, 1.23; diameter of proboscis exclusive of hooks, 0.03; length of largest hooks, 0.006; length of last segment, 1.5; diameter of last segment, 0.65.



## 43. TETRARHYNCHUS ROBUSTUM Linton.

*Tetrarhynchus robustum* LINTON, U. S. Fish Com. Rept., 1887, pp. 855-857, pl. XIV, figs. 7-9.

No. 4821, U.S.N.M.; Woods Holl, Massachusetts, August 14, 1889, intestine of cow-nosed ray (*Rhinoptera bonasus*), two specimens.

The dimensions of the bothria and all the soft parts somewhat less than those given of *T. robustum* in original description and more than those given of *T. tenue*; the shape, arrangement, and dimensions of the hooks agree with those of *T. robustum*. Reproductive apertures are near the anterior margin of the proglottis.

This species was originally described from specimens found in the sting ray (*Dasyatis centrura*).

## 44. TETRARHYNCHUS BISULCATUM Linton.

*Rhynchobothrium bisulcatum* LINTON, U. S. Fish Com. Rept., 1886, pp. 479-486, pl. IV, figs. 9-23.

*Tetrarhynchus bisulcatum* LINTON, U. S. Fish Com. Rept., 1887, pp. 857-861, pls. XIV, figs. 10-12; XV, fig. 1.

No. 4713, U.S.N.M. Label reads: "Spotted shark, No. 69."

Numerous specimens of this species are felted together into a mass from which it is difficult to get a complete specimen. One fragment was measured and found to be over 150 mm. in length.

I have found this species in the adult condition, thus far, only in the dusky shark (*Carcharinus obscurus*). The name "spotted shark" is not distinctive. The host in this case was without much doubt *Carcharinus obscurus*.

## 45. TETRARHYNCHUS TENUE Linton.

*Tetrarhynchus tenue* LINTON, U. S. Fish Com. Rept., 1887, pp. 853-855, pl. XIV, figs. 5-6.

No. 4827, U.S.N.M. The following additional find of this species is here noticed: August 16, 1889, Woods Holl, Massachusetts, one specimen from the sting ray (*Dasyatis centrura*) stomach.

## EXPLANATION OF PLATES.

The following letters have the same significance in all figures:

<i>a.</i> auxiliary bothrium.	<i>lm.</i> longitudinal muscles.
<i>b.</i> bothrium.	<i>o.</i> ovary.
<i>c.</i> cirrus.	<i>t.</i> testes.
<i>cb.</i> calcareous bodies.	<i>u.</i> uterus.
<i>cm.</i> circular muscles.	<i>v.</i> vagina.
<i>cp.</i> cirrus pouch.	<i>vd.</i> vas deferens.
<i>cu.</i> cuticle.	<i>v g.</i> vitelline gland.
	<i>vsp.</i> vaginal sphincter.

Where the degree of enlargement is not noted on the figure, the symbols used in these explanations refer to the eyepieces and objectives of Zeiss. stand No. VII.

The degree of enlargement with the eyepieces and objectives which were used in



the construction of these sketches, draw-tube open, is approximately that given in the following table:

Objective.	Eyepiece.	
	2	4
A.....	50	90
B.....	240	420

It should be remembered, in using this table, that the figures have been reduced one-fourth linear in the process of printing.

Most of the sketches were made with the aid of a camera lucida. Those in which the Zeiss eyepieces and objectives were used were made with an Abbe camera lucida. It is to be understood that the sketches are made from alcoholic specimens unless otherwise stated.

#### PLATE XXVII.

*Tania salvelini*, from *Cristivomer namaycush*.

- Fig. 1. Head and neck. Enlarged fourteen times.  
 2. Head, neck, and first segments of another specimen. Enlarged fourteen times.  
 3. Small strobile, entire. Enlarged fourteen times.  
 4. Head and neck. Enlarged thirty times.  
 5. Single proglottis of one of longer strobiles. Enlarged fourteen times.

*Tania ocellata* Rudolphi (?), from *Ambloplites rupestris*.

6. Front view of head. Enlarged fifteen times.  
 7. Same enlarged. Enlarged thirty times.  
 8. Posterior segments. Enlarged fourteen times.  
 9. Postero-median segment, in oil of cloves. Enlarged fifteen times.  
 10. Longitudinal vertical section through cirrus and vagina. Zeiss 2/A, draw-tube open.  
 11. Longitudinal horizontal section through cirrus-pouch and vagina. Zeiss 2/A, draw-tube closed.

*Monobothrium hexacotyle*, new species, from *Catostomus* sp.

12. Ventral view of specimen. Enlarged three times.  
 13. Head of same, side view. Enlarged fifteen times.  
 14. Head of another specimen, side view. Enlarged fifteen times.  
 15. Marginal view of head. Enlarged fifteen times.  
 16. Transverse section near anterior end of head. Zeiss 2/A, draw-tube open.  
 17. Transverse section of head farther back than fig. 16. Zeiss 2/A, draw-tube open.  
 18. Cell from parenchyma (see Plate XXVIII, Fig. 2). Zeiss 4/D, draw-tube open.  
 19. Another cell from same. Zeiss 2/D, draw-tube open.

#### PLATE XXVIII.

(*Monobothrium hexacotyle*, new species (continued)).

- Fig. 1. Transverse section toward base of head. Zeiss 2/A, draw-tube open.  
 2. Transverse section through middle of body, *gc.* cell in parenchynea, see Plate XXVII, Figs. 18 and 19. Zeiss 2/A, draw-tube open.  
 3. Diagrammatic sketch, ventral view.



*Schistocephalus dimorphus* Creplin (?), from *Cottus bairdii*.

Fig. 4. Head and interior segments. Enlarged fifteen times.

5. Part of transverse section of body, *n.* nerve, *lm.* small longitudinal muscle bundles, *lm.* large longitudinal. Zeiss 2/A, draw-tube open.

*Cyathocephalus truncatus* Pallas, from *Coregonus clupeiformis*.

6. Ventral view of specimen. Enlarged six times.

7. Head of same. Enlarged thirty times.

8. Head of another specimen. Enlarged thirty times.

*Dibothrium rugosum* Rudolphi, from *Gadus callarias*.

9. Posterior segment, abnormal. Enlarged about fourteen times.

10. Longitudinal horizontal section, *lv.* excretory vessel. Zeiss 2/A, draw-tube closed.

#### PLATE XXIX.

*Dibothrium rugosum* Rudolphi (continued).

Fig. 1. Longitudinal vertical section. Zeiss 2/A, draw-tube closed.

2. Same, more highly magnified, showing cross section of cirrus-pouch and vagina. Zeiss 2/D, draw-tube open.

3. Part of transverse section of body through the laterally placed cirrus-pouch. Zeiss 2/A, draw-tube closed.

4. Part of longitudinal vertical section of body through the external orifices of uteri. Zeiss 2/A, draw-tube closed.

*Dibothrium hastatum*, new species, from *Polyodon spathula*.

5. Lateral view of head, sketch from life. Enlarged fifteen times.

6. Marginal view of same, from life. Enlarged fifteen times.

7. Antero-median segments, from life, enlarged about three times.

8. Median segments, from life. Enlarged about three times.

9. Posterior segments. Enlarged four times.

10. Same of another strobile. Enlarged four times.

11. Optical section of lateral genital aperture, in oil of cloves. Enlarged one hundred and eighty times.

#### PLATE XXX.

*Dibothrium hastatum*, new species (continued).

Fig. 1. Lateral view of head of living specimen. Enlarged thirty times.

2. Marginal view of head of living specimen. Enlarged twenty-five times.

*Dibothrium infundibuliforme* Rudolphi, from *Lota maculosa* and *Salvelinus namaycush*.

3. Head of specimen from *L. maculosa*. Zeiss 2/A, draw-tube closed.

4. Head of another specimen from same host. Zeiss 2/A, draw-tube closed.

5. Head of specimen of *S. namaycush*. Enlarged fifteen times.

6. Another type of head from same host. Enlarged fifteen times.

*Dibothrium laciniatum*, new species, from *Tarpon atlanticus*.

7. Head and anterior segments. Enlarged twelve times.

8. Same specimen, lateral view. Enlarged twelve times.

9. Another specimen, marginal view, corresponding to lateral margin of body. Enlarged twelve times.

10. Lateral view of same specimen. Enlarged twelve times.

11. Front view of head. Enlarged twelve times.

12. Antero-median segments. Enlarged twelve times.



- Fig. 13. Postero-median segments. Enlarged twelve times.  
 14. Posterior segments. Enlarged twelve times.  
 15. Longitudinal vertical section. Zeiss 2/A, draw-tube open, *vg'*., inner vitelline gland.  
 16. Ovum. Zeiss 4/D, draw-tube open.

## PLATE XXXI.

*Dibothrium laciniatum*, new species (continued).

- Fig. 1. Genital cloaca with external end of cirrus-pouch and vaginal sphincter, from longitudinal, vertical section. Zeiss 2/D, draw-tube closed.  
 2. Part of transverse section of body through cirrus-pouch and external, dorsal, opening of uterus. Zeiss 2/A, draw-tube closed.  
 3. Section of cirrus and cirrus-pouch and vaginal sphincter, near ventral surface, from longitudinal, horizontal section of body. Zeiss 2/D, draw-tube open.  
 4. Same, section made a little deeper in body than *lm*. longitudinal muscles of cirrus-bulb, Fig. 3. Zeiss 2/D, draw-tube open.  
 5. Section of cirrus and cirrus-pouch and vagina, from longitudinal horizontal section of body, not so much magnified as 3 and 4. Zeiss 2/D, draw-tube closed.  
 6. Portion of transverse section. Zeiss 2/D, draw-tube closed.  
 7. Longitudinal muscles and calcareous bodies. Zeiss 4/D, draw-tube open.

## PLATE XXXII.

*Dibrothrium occidentale*, new species, from *Sebastodes* sp.

- Fig. 1. View of head, bothrial side. Enlarged twenty-seven times.  
 2. Marginal view of head. Enlarged forty times.  
 3. Part of transverse section of body. Zeiss 2/A, draw-tube closed.  
 4. Longitudinal section of cirrus-pouch, from transverse section of body. Zeiss 2/D, draw-tube open.  
 5. Longitudinal section of external end of vaginal tube, vagina surrounded by nucleated cells, from transverse section of body. Zeiss 2/D, draw-tube open.  
 6. Portion of ovary showing large, nucleated germ cells (*gc.*) and sphincter of oviduct (*spo*), from transverse section of body. Zeiss 2/D, draw-tube open.  
 7. Transverse section of genital aperture, near surface, from longitudinal, horizontal section of body. Zeiss 2/D, draw-tube open.  
 8. Same, a little deeper in body than Fig. 7, showing end of cirrus and opening of vagina, from longitudinal, horizontal section of body. Zeiss 2/D, draw-tube open.  
 9. Transverse section of cirrus-pouch and vagina, deeper in body than fig. 8, from longitudinal, horizontal section of body. Zeiss 2/D, draw-tube open.  
 10. Ovum. Zeiss 4/D, draw-tube open.  
 11. End of ovum with apercle. Zeiss 4/D, draw-tube open.

## PLATE XXXIII.

*Anthobothrium pulvinatum* Linton, from *Dasyatis centrura*.

- Fig. 1. Free-hand sketch of head from life. Enlarged about twice.

*Rhinebothrium longicolle* Linton, from *Rhinoptera bonasus*.

2. Cirrus, sketch from life. Enlarged about two hundred times.  
 3. Ova as seen through transparent walls of proglottis, compressed, from life. Enlarged about two hundred times.  
 4. Single ovum, from life, in sea water, filament not shown. Enlarged about four hundred times.



*Rhinebothrium minimum* Beneden, from *Raja laevis*.

Fig. 5. Head, bothria somewhat distorted. Enlarged about fourteen times.

*Phyllobothrium foliatum* Linton, from *Dasyatis centrura*.

6. Free proglottis. Enlarged about forty times.

*Orygmatobothrium paulum*, new species, from *Galeocерdo tigrinus*.

7. Front view of head. Zeiss 2/A, draw-tube open.

8. Single bothrium, front view. Zeiss 2/D, draw-tube closed.

*Orygmatobothrium crenulatum*, new species, from *Dasyatis centrura*.

9. Front view of head. Zeiss 2/A, draw-tube open.

10. Single lobe of same; *as*, anterior sucker; *ps*, posterior sucker; *cm*, circular muscles. Zeiss 2/A, draw-tube open.

11. Single lobe, diagrammatic, letters same as in fig. 10.

12. Posterior segments. Zeiss 2/A, draw-tube closed.

#### PLATE XXXIV.

*Orygmatobothrium crenulatum*, new species (continued).

Fig. 1. Part of longitudinal section of head; letters same as in Plate XXXIII, fig. 10, highly magnified.

*Onchobothrium uncinatum* Diesing, from *Dasyatis centrura*.

2. Side view of head. Enlarged twenty-four times.

3. Hooks as seen in front view of head; *tb*, tubercle. Enlarged about one hundred and eighty times.

4. Broken hooks; *h*, base of hooks; *th*, base of tubercle. Enlarged about one hundred and eighty times.

5. Side view of hook; *th*, tubercle. Enlarged about one hundred and eighty times.

*Calliobothrium verticillatum* Rudolphi, from *Mustelus canis*.

6. Masses of ova in oviduct, from life. Enlarged about sixty times.

7. Single mass of ova, from life. Enlarged about two hundred and twenty-five times.

*Rhynchobothrium tenuispine* Linton, from *Dasyatis centrura*.

8. Free, mature segment; *cl*, genital cloaca; *sr*, seminal receptacle. Enlarged about twenty times.

*Rhynchobothrium brevispine*, new species, from small ray (*Rhinoptera bonasus*)?

9. Head and neck, proboscides extended. Enlarged about twenty-two times.

10. Proboscis near base. Enlarged about four hundred and seventy-five times.

11. Another view of proboscis, near base. Enlarged about four hundred and seventy-five times.

*Rhynchobothrium ague*, new species, from *Rhinoptera bonasus*.

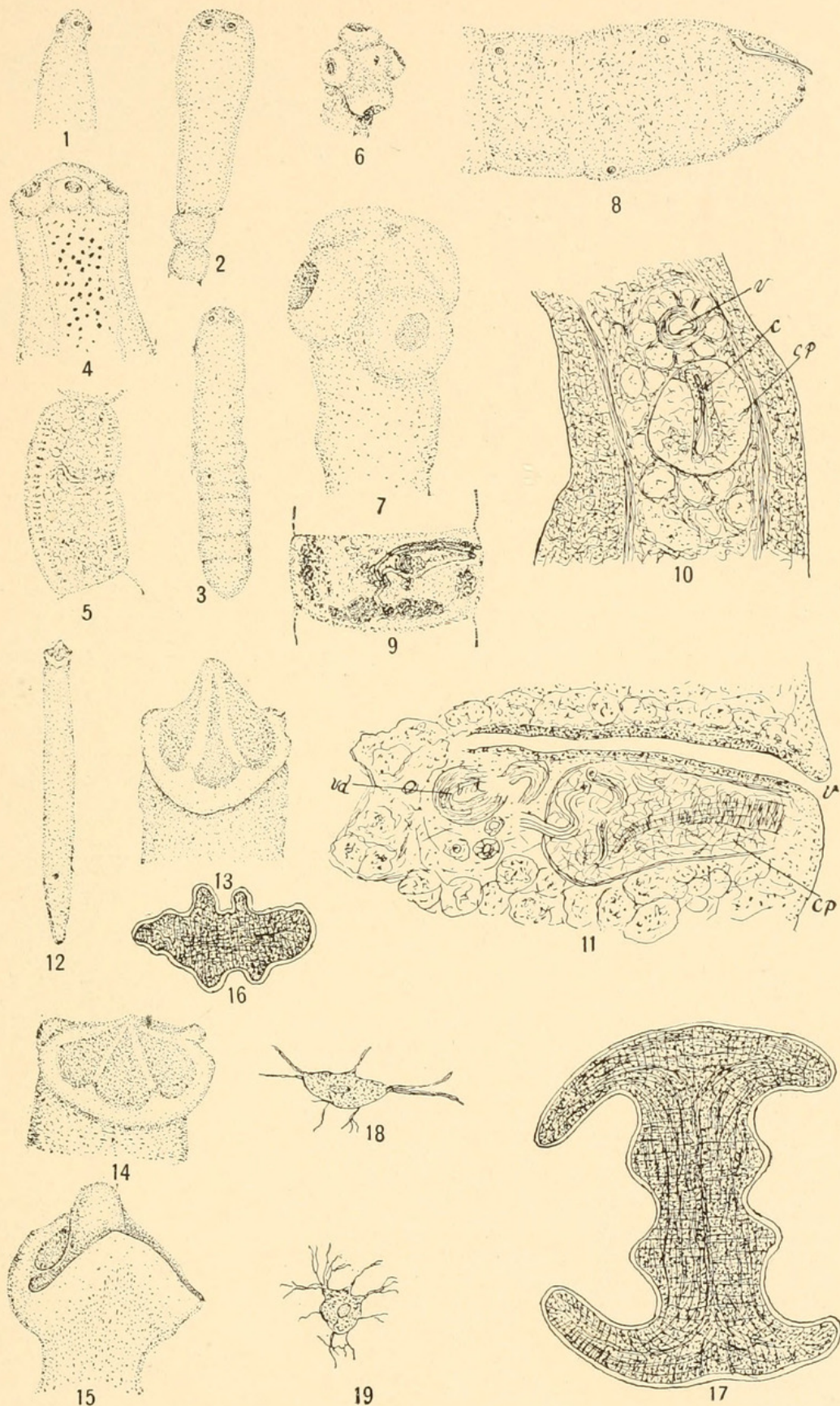
12. Head and neck, showing proboscides, sheaths, and bulbs. Zeiss 2/A, draw-tube closed.

13. Portion of strobile. Enlarged about fifteen times.

14. Proboscis, near apex. Zeiss 2/D, draw-tube open. The hooks are larger on the opposite side of the proboscis.

15. Proboscis, near base. Zeiss 2/D, draw-tube open. The hooks are smaller on the opposite side of the proboscis.

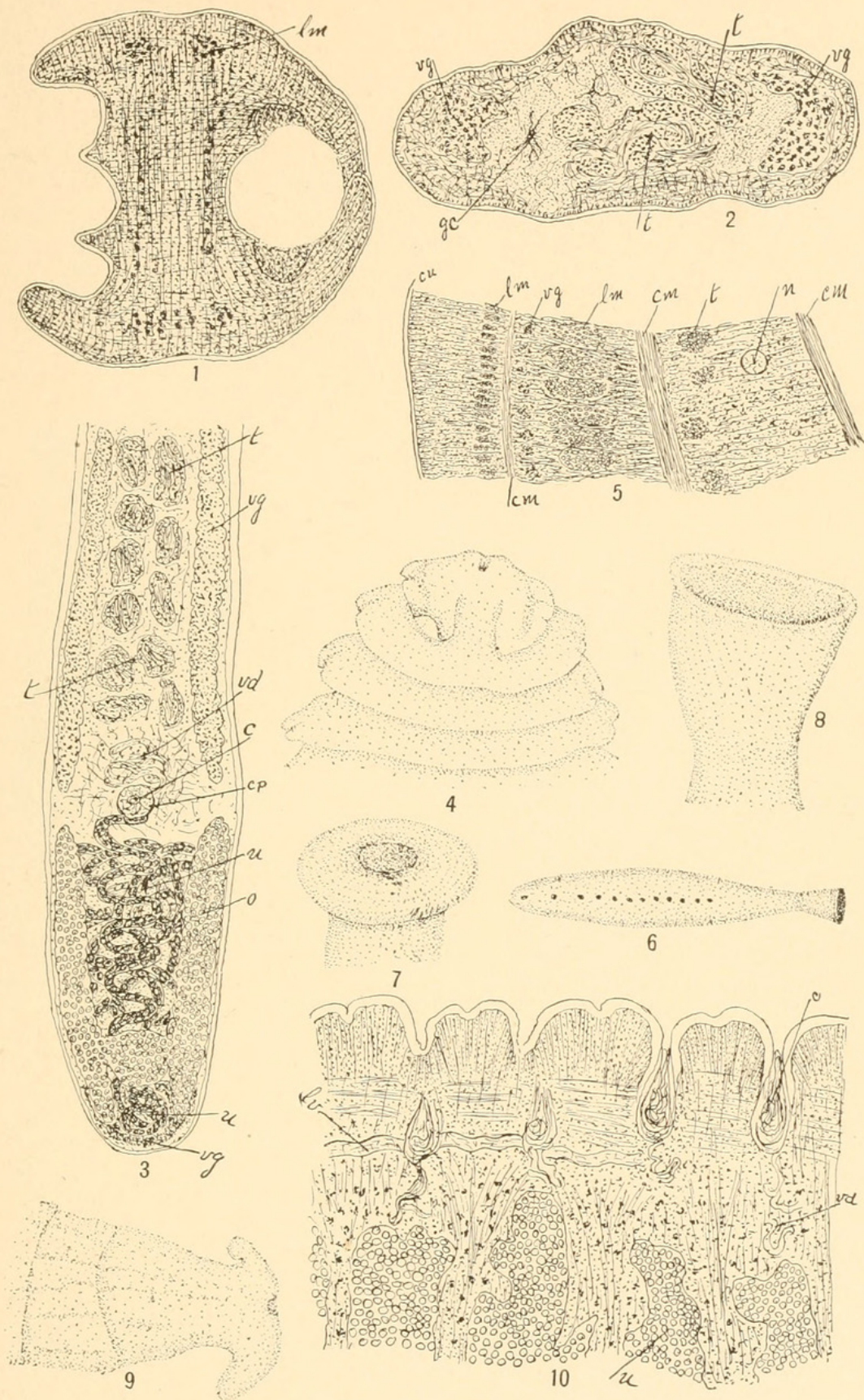




PARASITIC WORMS (*Taenia*) FROM GREAT LAKE TROUT AND ROCK BASS, AND (*Monobothrium*) FROM SUCKER.

FOR EXPLANATION OF PLATE SEE PAGE 453.

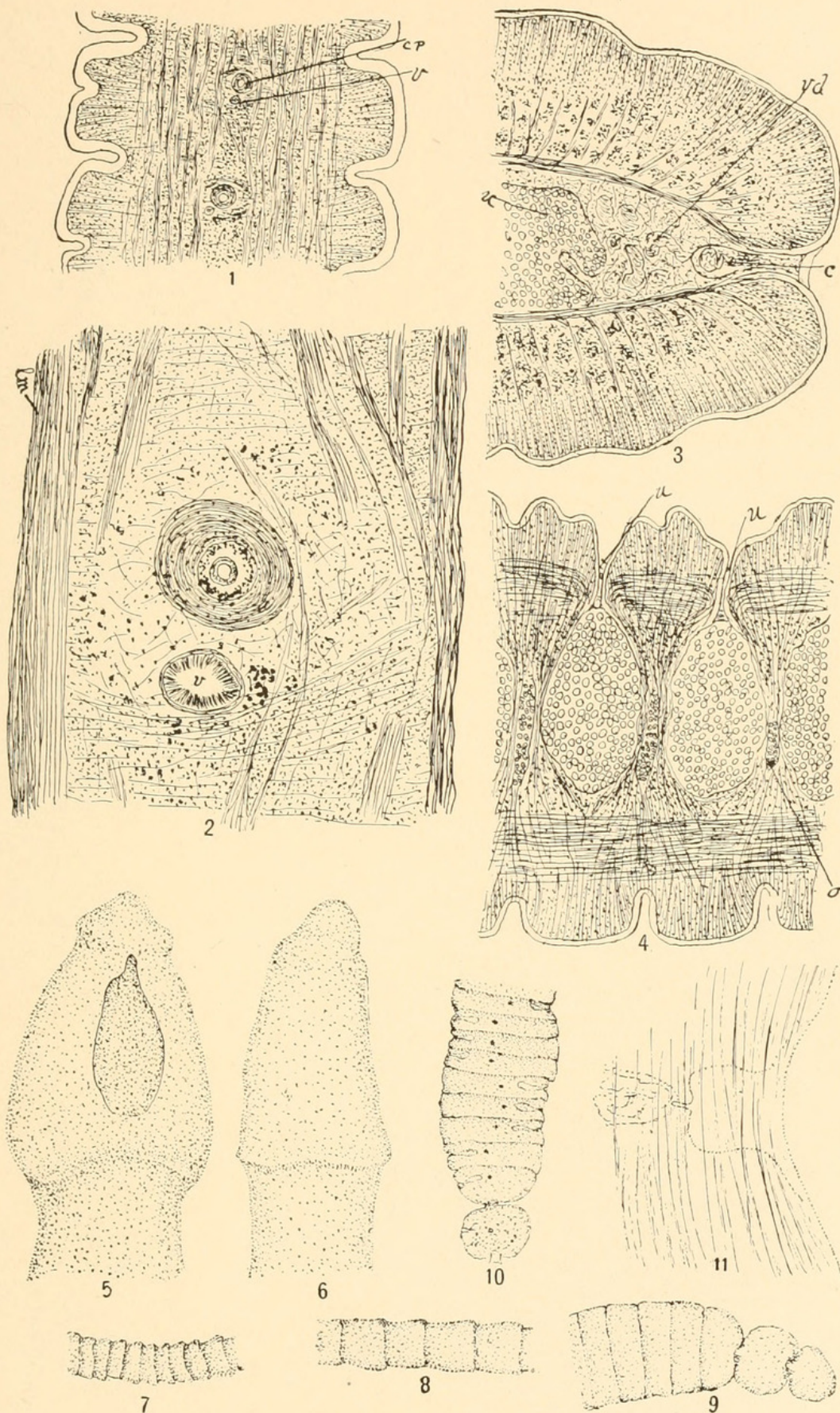




PARASITIC WORMS (*Monobothrium*) FROM SUCKER, (*Schistocephalus*) FROM BLOB, (*Cyathocephalus*) FROM WHITEFISH, AND (*Dibothrium*) FROM COD.

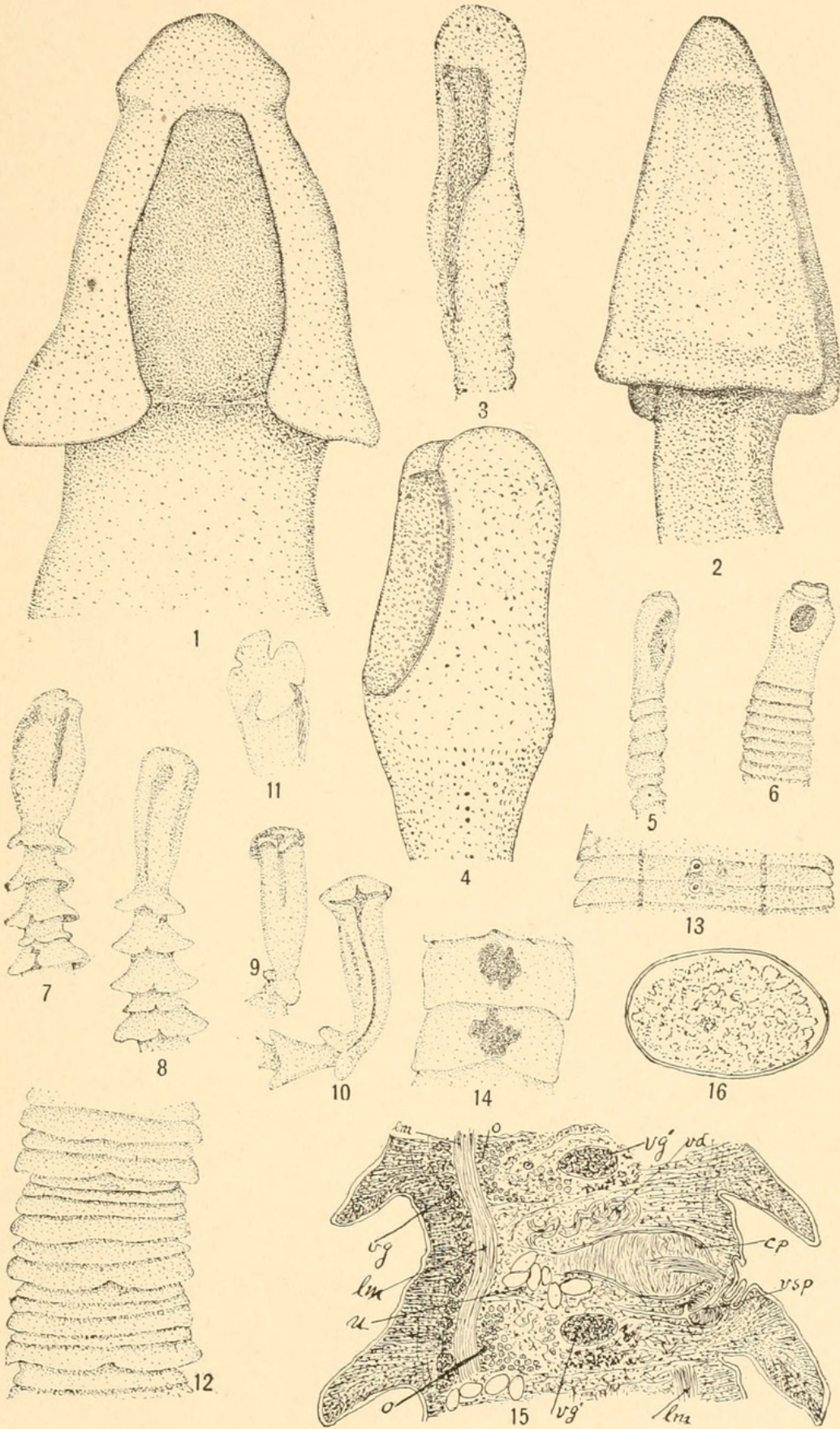
FOR EXPLANATION OF PLATE SEE PAGES 453 454.



PARASITIC WORMS (*Dibothrium*) FROM COD AND PADDLEFISH.

FOR EXPLANATION OF PLATE SEE PAGE 454.

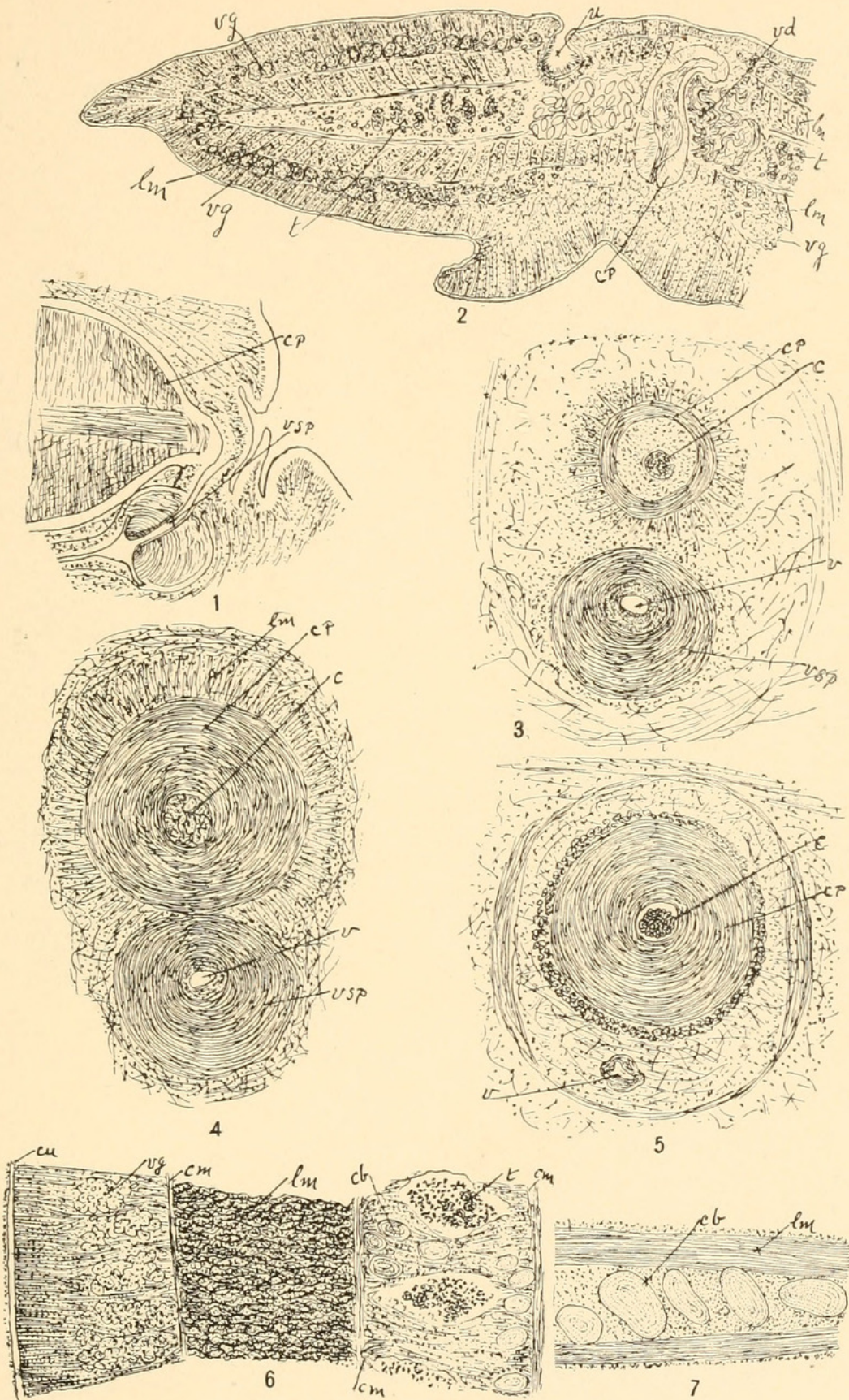




PARASITIC WORMS (*Dibothrium*) FROM PADDLEFISH, COD, LING, GREAT LAKE TROUT, AND TARPUM.

FOR EXPLANATION OF PLATE SEE PAGE 454.

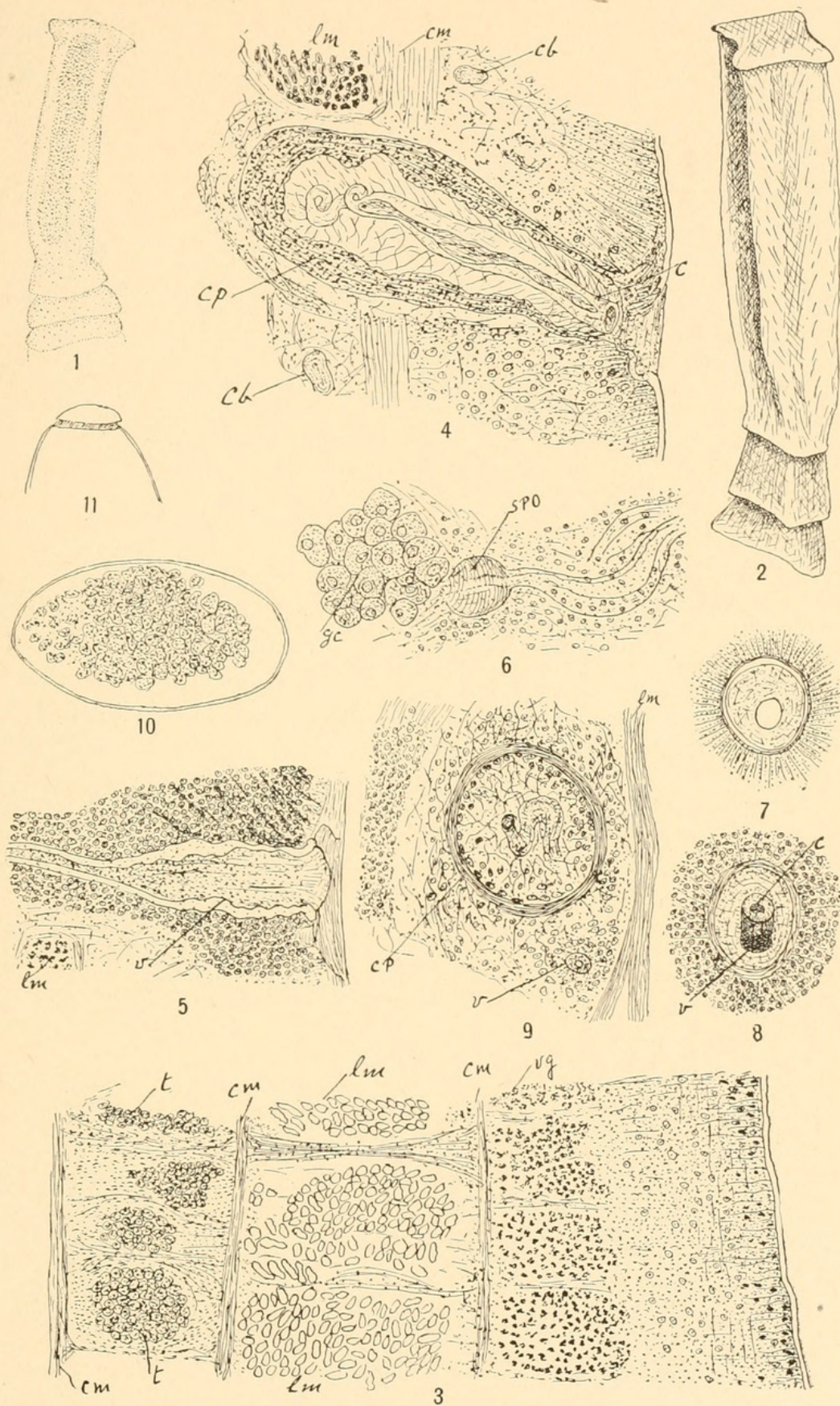




PARASITIC WORM (*Dibothrium*) FROM TARPUM.

FOR EXPLANATION OF PLATE SEE PAGE 455.

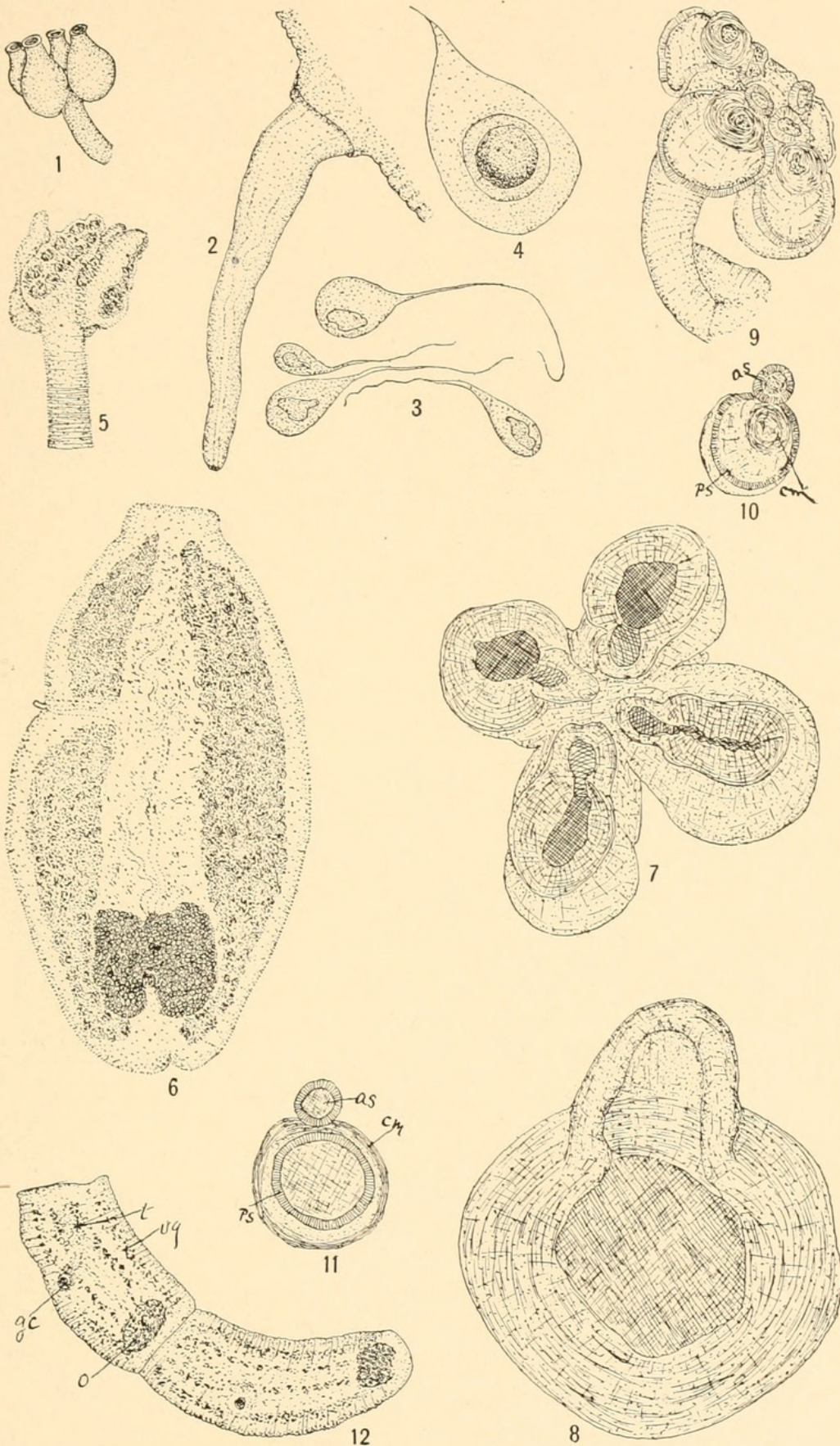




PARASITIC WORM (*Dibothrium*) FROM ROCK COD.

FOR EXPLANATION OF PLATE SEE PAGE 455.

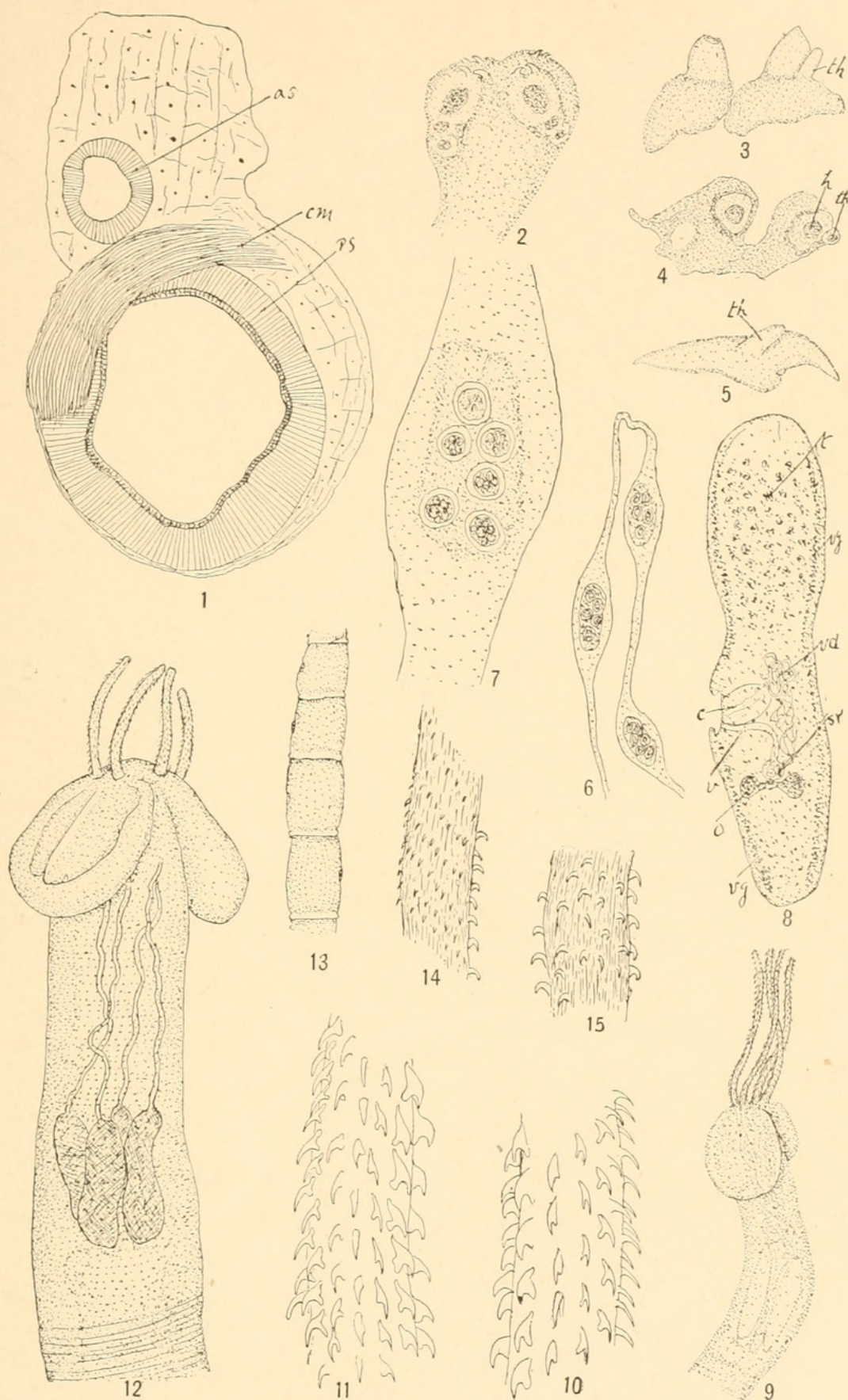




PARASITIC WORMS (*Anthobothrium* and *Phyllobothrium*) FROM STING RAY, (*Rhinebothrium*) FROM COW-NOSED RAY AND SMOOTH RAY, AND (*Orygmatobothrium*) FROM TIGER SHARK AND STING RAY.

FOR EXPLANATION OF PLATE SEE PAGES 455, 456.





PARASITIC WORMS (*Orygmatobothrium* and *Onchobothrium*) FROM STING RAY, (*Calliobothrium*) FROM DOGFISH, AND (*Rhynchobothrium*) FROM STING RAY AND COW-NOSED RAY.





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