

## NOTES ON PARASITES OF BERMUDA FISHES.

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### INTRODUCTION.

These notes are based on investigations made by the writer at the Bermuda Biological Station for Research, Flatts, Bermuda, from July 7 to August 7, 1903.

I am under obligations to many of my colaborers in the laboratory for their friendly assistance, and especially to Mr. Thomas Barbour, to whom I am indebted for the identification of many of the fish which were examined, and without whose energetic and disinterested help my list of fish would be shorter than it is.

It gives me pleasure also to record my grateful acknowledgments to the Bermuda Natural History Society and to Doctor Mark and Doctor Bristol for the privileges of the laboratory.

The opportunities for getting material were limited, and, moreover, much of the material was in poor condition. This was especially true of many of the small distomes. When it is remembered that the temperature of the laboratory was not often as low as 80° F., day or night, it will be easily understood that much care was necessary to prevent the rapid deterioration of material.

While an examination of a greater number of fish would, without doubt, add many parasitic forms to the list contained in this paper, enough has been ascertained to afford some data relative to the degree to which the Bermuda fishes are infested.

So far as my observation teaches, those fishes which are found on the inner reefs are freer from encysted parasites than are those which live on the outer reefs and in the deeper waters outside. On account of the exceeding transparency of the Bermuda waters, sharks, which are the great disseminators of cestode ova, do not frequent the shallower waters of the shoals. This fact probably accounts for the comparative scarcity of cestode larvæ in the fish which were taken on the shoals. On the other hand, the large groupers and rock fish, all of which were from about 14 fathoms of water on the outer reefs, were found to harbor numerous encysted cestodes on the viscera, and especially in the walls of the stomach. A recurring feature in the

larger groupers, hinds, and rock fish was the occurrence of cysts, inclosing waxy, degenerate tissue in the walls of the stomach. These cysts are of various shades of brown, from light amber to almost black, and are due, not to cestodes alone, but also to nematodes and acanthocephala.

*List of fish examined for parasites with summary of results.*

Scientific name of host.	Common or local name of host.	Number of fish examined.	Acanthocephala.	Nematoda.	Cestoda.	Trematoda.	Enchelopoda.	Isopoda.	Food notes.
<i>Carcharhinus platydon</i> (Poey).	Cub shark .....	6			4				Fragments of fish in stomachs.
<i>Lycodonis moringa</i> (Cuvier).	Spotted moray ...	2		2		81			
<i>Elops saurus</i> Linnaeus.	Bony-fish .....	1							Small fish in stomach.
<i>Synodus saurus</i> (Linnaeus).	Snake fish .....	2				12			
<i>Fundulus bermuda</i> Günther.	Mangrove minnow .....	1							
<i>Tylosurus acus</i> Lacépède.	Hound .....	2		++	++	3			Small fish (fry).
<i>Hyporhamphus unifasciatus</i> (Ranzani).	Half-beak .....	4							Green algae.
<i>Atherina harringtonensis</i> Goode.	Fry .....	27						++	Young gastropods and copepods.
<i>Sphyrna sphyrena</i> (Linnaeus).	Barracuda .....	5				3			Fish.
<i>Holocentrus ascensionis</i> Osbeck.	Squirrel .....	4		1		2			Small crustaceans.
<i>Upeneus maculatus</i> (Bloch).	Goat fish .....	1		1					Fragments of crustaceans and annelids.
<i>Seriola lamerlii</i> (Risso)	Amber Jack .....	6			few.	11			Fish.
<i>Seriola fasciata</i> (Bloch)	Bonito .....	1				2			Small fish.
<i>Seriola falcata</i> Cuvier and Valenciennes.	Bermuda salmon .....	1							Fish.
<i>Trachurus crumpeus</i> Bloch.	Big-eyed sea-dog .....							1	
<i>Bodianus fulvus punctatus</i> (Linnaeus).	Cony .....	4	2	few.	1	1			Crustaceans.
<i>Epinephelus striatus</i> Bloch.	Grouper, Hamlet .....	24	++	6	74	49	4		Fish and crabs.
<i>Epinephelus maculosus</i> Cuvier and Valenciennes.	Hind .....	11	1	+	+	6			Fish, crustaceans, annelids.
<i>Epinephelus morio</i> (Cuvier and Valenciennes).	Deer Hamlet .....	1	1						Fragments of crustacea and jaws of squid.
<i>Mycteroperca apua</i> (Bloch).	Rock fish .....	3	++	10	+	26			Fish; and fragments of mollusk shells, probably from intestines of fish.
<i>Paranthias furcifer</i> (Cuvier and Valenciennes).	Barber fish .....	3		++	++	1			Globigerina, spicules of sponge, setae of annelids and shells of a small pteropod.
<i>Priacanthus arcuatus</i> (Cuvier and Valenciennes).	.....							1	
<i>Neomaris griseus</i> (Linnaeus).	Gray snapper .....	9	2	5	6				Fish, crustaceans and annelids.
<i>Neomaris apodus</i> (Walbaum).	School master .....	3		2					Fish and crabs.
<i>Neomaris synagris</i> (Linnaeus).	Silk snapper .....	4		1	17				Fish, mussel, and bivalve and univalve shells.
<i>Neomaris hastingsi</i> Bean.	Black-finned snapper .....	2	1						Crustaceans and small lamellibranchs.
<i>Neomaris</i> , sp .....	White-water snapper .....	1		1					Crustaceans.
<i>Ocyurus chrysurus</i> (Bloch).	Yellowtail .....	13	6		few.	28			Fish.
<i>Hemulon macrostomum</i> Günther.	Streaked Grunt .....								Annelids and ophiurans.
<i>Hemulon carbonarium</i> Poey.	Black Grunt .....	1		2					Fragments of small fish and algae.

+ Frequent or many.

++ Numerous.

List of fish examined for parasites with summary of results—Continued.

Scientific name of host.	Common or local name of host.	Number of fish examined.	Acanthocephala.	Nematoda.	Cestoda.	Trematoda.	Eucelepodia.	Isopoda.	Food notes.
<i>Hæmulon flavolineatum</i> (Desmarest).	Yellow Grunt ...	16	1		1	12			Crustaceans, annelids, green algae, and broken shells.
<i>Bathystoma stratum</i> (Linnaeus).	White Grunt .....	1			1	2			Fragments of crabs.
<i>Calamus calamus</i> (Cuvier and Valenciennes).	Porgy .....	15	++			11			Crabs and mussels.
<i>Diplodus sargus</i> (Linnaeus).	Bream .....	11		2	2	1			Fish, crustaceans, broken mussel shells, tests and spines of s a urethins, stems of hydroids, green algae, small univalve mollusks and sand.
<i>Kyphosus scotarius</i> (Linnaeus).	Chub .....	1							Vegetable débris.
<i>Eupomacentrus fuscus</i> (Cuvier and Valenciennes).	Brown-cockeye Pilot .....	1			1				Small crustaceans, bryozoa, foraminifera, algae, sand.
<i>Abudefduf saxatilis</i> (Linnaeus).	Cow Pilot .....	10			1				Vegetable débris.
<i>Lachnolaimus maculatus</i> (Walbaum).	Hog fish .....	7	11			1		1	Mussel shells, seaweed and sand.
<i>Harpe rufa</i> (Linnaeus).	Spanish Hogfish .....	1		1		1			
<i>Iridio radiatus</i> (Linnaeus).	Bluefish .....	2		++		2			Large numbers of crushed shells of gastropods and bivalves, and tests and spines of sea-urethins.
<i>Iridio biellatus</i> (Bloch).	Slippery Dick .....	5				2			Shells and byssus of mussel, annelid, spine of sea-ureth.
<i>Scarus vetula</i> (Bloch and Schneider).	Parrot-fish .....	1							Stomach and intestine filled with crabs, univalve shells, sea-ureth spines, seaweed, and sand.
<i>Chætodon ocellatus</i> Bloch.	Four-eye .....	2							Algae.
<i>Chætodon</i> , sp. ....	Butter-fish .....	3				5			Fragments of fish.
<i>Anglichthys ciliaris</i> (Linnaeus).	Angel fish .....	11				1			Alimentary canal filled with a red sponge; a few annelids; bryozoa; a small mollusk shell and seaweed.
<i>Tenthis cirrulus</i> (Bloch and Schneider).	Blue Tang .....	1				1			Broken shells, mainly Serpula tubes and small gastropods, bryozoa, sponge, foraminifera, seaweed and sand.
<i>Tenthis hepatus</i> Linnaeus.	Doctor fish .....	5				2			Ascidian ( <i>Botrylloides</i> ), algae and sand.
<i>Balistes carolinensis</i> Gmelin.	Turbot .....	4			Few.	157			Alimentary canals crowded with broken mussel shells; setæ of large annelid.
<i>Balistes vetula</i> Linnaeus.	Bastard Turbo .....	1			1				Fragments of adductor muscle of a bivalve mollusk.
<i>Lactophrys trigonus</i> Linnaeus.	Cuckold .....	1		9					
<i>Lactophrys tricornis</i> Linnaeus.	Cowfish .....	6		3					Amphipods, mussels, bryozoa, seaweed, sand.
<i>Gobius soporator</i> Cuvier and Valenciennes.	Goby .....	3							
<i>Salariichthys testilis</i> Quoy and Gaimard.	Molly Miller .....	4				1			Foraminifera, vegetable débris.

++ Numerous.

## Order ACANTHOCEPHALA.

Representatives of this order were found in 11 of the 51 species of fish examined. They belonged to a single species and were immature and encysted on the viscera in all cases, except the rock fish, where they were also found mature in the alimentary canal. These worms have been referred to the new species *Echinorhynchus medius*.

**ECHINORHYNCHUS MEDIUS**, new species.

Plate IV, figs. 21-30.

*Type*.—Cat. No. 5796, U. S. N. M.

Body elongated, nearly linear, diameter greatest just behind base of sheath, whence it tapers gently to the neck; anterior end of body slightly deflected in same direction as the proboscis, which is inclined at an angle of  $45^{\circ}$ , more or less, to the axis of the body; anterior end of body also armed with sagittate spines, which, on the concave side, extend back a distance approximately one-third the length of the sheath, and about half as far on the convex side. The neck is smooth and conical, its length being somewhat less than its diameter at base. The proboscis varies from nearly linear to fusiform, with about 22 vertical rows of hooks, and about 20 hooks in one vertical row; hooks strongly recurved, stoutish, of nearly uniform size and shape, except at the base, where for about five rows the hooks are smaller than they are on the remainder of the proboscis. The hooks are deeply immersed in the cuticle and have strong but somewhat narrow basal supports; those near the base are about 0.045 mm. in length, others 0.06 mm., spines on body from 0.03 to 0.045 mm. in length. Sheath rather slender-fusiform, usually more than twice the length of the proboscis. Lemnisci long and slender.

In the male the testes are two, small, oblong-elliptical, situated about the anterior third of the length and separated from each other by a distance equal to five or more times the length of one. Remainder of male genitalia simple, consisting of the vas deferens and a long-oval cement gland near the posterior end; bursa large, oblong, its length not much exceeding its diameter in mounted specimens which are somewhat compressed.

The posterior end of the female is rather abruptly narrowed to a blunt point which is deflected, in some cases almost at right angles to the axis of the body.

Dimensions, in millimeters, of a male mounted in balsam: Length, 42; diameter, anterior 0.75, at posterior end of sheath 1.35, middle of body 1; bursa, length 1.5, diameter 1.2; neck, length 0.45, diameter at anterior end 0.37, at base 0.57; proboscis, length 1.4, diameter near base 0.45, near tip 0.30; sheath, length 3, anterior diameter 0.3, middle 0.67, posterior 0.3; distance from base of neck to first testis 12;

distance from first to second testis 6; lemnisci extend about 5.4 back of posterior end of sheath, diameter 0.15; testis, length 1, diameter 0.5.

Length of female, mounted in balsam, 54; ovarian masses, length 0.3, diameter 0.12; embryos 0.075 by 0.024.

This species is near *E. pristis*, in external appearance, but differs in the greater length of the lemnisci. The genitalia of the male are also much simpler; furthermore the species which I have found in a number of the Beaufort fishes and have recorded under the name *E. pristis*, is characterized by having a circle of hooks at the base of the proboscis which are longer than the other hooks.

*Adult stage*.—The adult worms were found in but one host:

*Mycteroperca apua*, intestine.

July 22, numerous. One of the largest specimens, after having been placed in fresh water, where it became turgid, measured 50 mm. in length. Among the preserved specimens a male measured 42 mm. and a female 54 mm.

*Immature stage*.—Immature forms, referred to this species, were found in the following hosts encysted in the viscera:

*Bodianus fulvus punctatus*.

July 22, three, on viscera, in thin connective tissue capsules incrustated with yellow pigment. One was removed from a cyst which was filled with dark-brown waxy secretion.

*Calamus calamus*.

July 16, ten, encapsuled on the viscera. When these worms were liberated from the thin cysts which enveloped them they were collapsed and the proboscides were retracted. Placed in fresh water they became plump and the proboscides were evaginated. July 18, two; August 3 and 7, numerous, on viscera and mesentery. Two of these immature forms were mounted in balsam and proved to be far enough developed to show the rudiments of various organs. The testes in this case were situated close together and back of the sheath a distance about equal to the length of that organ. In the female a small cluster of globular bodies at the posterior end of the sheath evidently represents the rudiments of the primitive egg masses.

The body is largest at the base of the sheath, whence it tapers each way. Proboscis slightly fusiform, one side straight or very slightly concave, the other convex, usually deflected in the direction of the convex side; about 20 hooks in a vertical row and 22 or 23 vertical rows, those near the base of the proboscis more slender than the others. Neck smooth and conical. Anterior end of body with about 20 rows of spines. These, on account of the manner in which they penetrate the cuticle, appear sagittate in front view. Sheath fusiform; longer than proboscis; lemnisci appear to be long and slender. Dimensions of female mounted in balsam, in millimeters: Length, 12;

proboscis, length 1.2, diameter, exclusive of hooks, at base 0.37, middle 0.55, apex 0.37, length of longer hooks 0.08; length of neck, approximate, 0.33; diameter of neck, anterior 0.35, posterior 0.50; sheath length 2.4, diameter, middle 0.63; diameter of body, at base of sheath, 0.9, near posterior end 0.45; testes about equal, length 0.24, breadth 0.16.

*Epinephelus maculosus.*

July 14, two, from cysts on serous coat of rectum, some dark pigment in cysts. August 3, one, on viscera.

*Epinephelus morio.*

July 22, one, on viscera. Dark brown degenerate tissue associated with cyst, also in the cyst along with the worm.

*Epinephelus striatus.*

July 16, one, an immature female; July 27, twelve, on pyloric cæca; August 3, numerous on viscera and mesentery.

*Hæmulon flavolineatum.*

July 27, one, encapsuled on viscera.

*Lachuolaimus maximus.*

August 3, eleven, encapsuled on viscera.

*Myeteroperca apua.*

July 21, two, encapsuled on viscera.

*Neomænis griseus.*

July 27, two, encapsuled on viscera.

*Neomænis hastingi.*

July 27, one, encapsuled on viscera.

*Ocyurus chrysurus.*

July 14, six, from serous coat of viscera.

## Order NEMATODA.

Nematodes were found in 15 of the 51 species of fish examined. Immature nematodes, while found in 8 species of fish, were not abundant in any. In many cases they were found to have given rise to cysts in the stomach wall. All but one of the finds of immature nematodes belong to the same species. Nematodes were found in the muscular tissue of but 1 species of fish, the gar.

### ASCARIS, species.

Plate I, figs. 1-1b.

Head truncate, lips squarish, no interlips; esophagus long, cylindrical, with bulbous base, from which springs a slender and usually short diverticulum; intestine relatively large with thick sacculated walls, its diverticulum short; nearly linear, tapering at each end, and crossed by exceedingly fine transverse striæ and by coarser furrows,

the latter making a crenulate outline. The anal papillæ are very small and numerous; the exact number was not determined. Seen in lateral view there appeared to be about 8 postanal and probably as many as 60 preanal papillæ.

The above description was based on a specimen mounted in balsam. The teeth and papillæ on the lips were not very distinct. The teeth appeared to be simple tubercular, and there appeared to be two papillæ on each of the lateral lips.

Postanal region slender pointed. Other details are given under the several hosts. This ascarid was found in three of the Bermuda fishes, as follows:

*Bodianus fulvus punctatus.*

July 22, one. Dimensions in millimeters of specimen mounted in balsam: Length, 7; diameter of head 0.12, at base of esophagus 0.3, middle 0.3, at anal aperture 0.10; distance from anal aperture to posterior end, 0.21; length of jaw 0.045, breadth 0.06; length of esophagus, 1.5, diameter of esophagus, anterior 0.12, middle 0.14, base 0.14; length of diverticulum of esophagus 0.33, of intestine 0.15.

*Epinephelus striatus.*

July 11, five, females, from intestine. These worms were yellowish, except at the extremities, where they were translucent white. The jaws were broader than long, with rather wide transparent borders and distinct branching pulp. Length, 12 to 14 mm.

*Mycteroperca apua.*

July 21, one, male; length in balsam, 8 mm. The postanal region was rather more slender than in others and the esophageal diverticulum was longer, but still shorter than the esophagus.

#### IMMATURE NEMATODES.

Plate I, fig. 2.

These all appear to belong to the same species and are probably young stages of the foregoing, *Ascaris*, species, from *Bodianus*, etc. They are characterized by having a very short diverticulum of the intestine and a longer and more slender diverticulum of the esophagus.

These immature forms were found in the following hosts:

*Bodianus fulvus punctatus.*

July 22, few, very small. Numerous small cysts containing amber-colored waxy secretion were found on the viscera of the fish taken on both the 22d and 23d. These were 0.7 mm. and less in diameter. A minute nematode was obtained from one of these cysts.

*Epinephelus maculosus.*

July 8 and 14, one on each date. Dimensions, in millimeters, life: Length, 5; length of esophagus 0.75, of bulb at base 0.04, of diverticulum 0.45; intestinal diverticulum very short, about equal to the

esophageal bulb; distance from anal aperture to posterior end 0.02. Cysts, usually numerous, were found in this host on July 8, 14, 22, 29, and August 3. They were found in the muscular coats of the stomach, and were of various sizes, from 0.6 mm. to 6 mm. in diameter. In all cases they contained waxy degenerate tissue which was dark brown or amber colored. One small cyst, less than 1 mm. in diameter was found to contain a minute nematode.

*Epinephelus striatus.*

Cysts like those found in *E. maculosus* were found in this host on July 11, 15, 16, 18, and August 3. In some cases they were most abundant in the submucous coat of the stomach; in others they were most numerous in the muscular coats. In the latter case they were as a rule in greatest numbers in the pyloric region, where the dark brown, sometimes almost black, cysts were in sharp contrast with the white tissue in which they were embedded. They are most abundant in the large groupers, and evidently represent entozoa which have had a long residence in their host and have either succumbed or migrated.

*Mycteroperca apua.*

July 21, two. Large numbers of cysts were also found on the mesentery and serous coat of the viscera generally. They contained dark-brown waxy degenerate tissue, and varied in size from 2 mm. or less to 20 mm. or more. They were irregular in shape, often nodular, sometimes flattened. No entozoa were found in them. The smaller ones are probably due to nematodes, the larger to cestodes.

*Hæmulon carbonarium.*

July 31, one, small.

*Iridio radiatus.*

July 29, numerous, also on July 31, many. These nematodes were first found in washings from the alimentary canal. It was observed that there were many small cysts in the intestinal wall, with the usual waxy contents. Some of these cysts were crushed under a cover glass and in one of them, a minute nematode, agreeing with the free specimens, was found.

*Neomænis apodus.*

July 17, two. These worms were active after lying about ten hours in water to which a little formalin had been added.

*Neomænis griseus.*

July 17, one, very small. Dimensions in millimeters, life: Length, 3.6; diameter, anterior, 0.04, middle, 0.07, at anal aperture 0.05; length of esophagus 0.3, of diverticulum of esophagus 0.3, of diverticulum of intestine 0.03.

*Paranthus farcifer.*

July 29, numerous, from intestine.



*Upeneus maculatus.*

July 11, one. This specimen was exceptional in that the diverticulum of the esophagus was longer than the esophagus. The diverticulum of the intestine was just as long as the basal bulb of the esophagus.

## IMMATURE NEMATODE.

Plate I, fig. 3.

A fragment of a small nematode from the intestine of *Harpe rufa* is different from the foregoing. The fragment is from the posterior end. The post-anal region tapers gradually and is slightly arcuate.

Dimensions, in millimeters, alcoholic: Length, 5.25; diameter 0.05, at anal aperture 0.03; distance from anal aperture to posterior end 0.06.

## HETERAKIS FOVEOLATA Rudolphi.

Plate I, figs. 5-7; Plate II, figs. 8-10.

A small nematode found sparingly in several Bermuda fishes is referred, with some hesitation, to this species. It agrees very closely with specimens found at Beaufort, North Carolina, and referred to this species.<sup>a</sup>

In the use of the generic name *Heterakis* in the Beaufort report I followed Schneider and Stossich. As a matter of fact these nematodes, while agreeing closely with Schneider's description of *H. foveolata*, are much nearer the type species of the genus *Dacnitis* than they are to the type species of *Heterakis*. The species *Dacnitis esariens* Dujardin is included by Schneider among the synonyms of *H. foveolata*.

It would be out of place in this paper to enter into a discussion of nomenclature, and until a more detailed study can be made I shall retain the name used in my Beaufort paper.

Head obtusely rounded in front; mouth bilabiate; lips dorsal and ventral, each with about two small papillae, and armed with numerous minute, simple teeth, of uniform size and shape, which make a crown-like border to the mouth. Neck narrowing behind the head, but enlarging again gradually, the body remaining nearly linear from the base of the esophagus to near the posterior end, where it tapers to an acute point. The anterior part of the body is, in many cases, curved backward. The esophagus narrows behind the conspicuous pharynx, then enlarges to the base.

The genital papillae, so far as made out, are as shown in fig. 7, namely, six post-anal papillae, two pairs of which are near the median line and near together; the other two are situated one on each side of the median pairs. Lateral to the anal aperture and near to it on each side

<sup>a</sup> Bulletin, Bureau of Fisheries, XXIV, p. 330, etc.

are three small papillæ near together, and lateral to each of these groups is a single papilla. Three pairs of pre-anal papillæ were made out, the bursa being, on all observed cases, between the two anterior pairs. The eight papillæ near the anal aperture were less distinct than either the pre- or post-anal papillæ, and were not always clearly made out. Between the anal aperture and the bursa there are strong diagonal muscles running from the lateral region medio-caudad. Spicules about equal.

The first sections of a series of transverse sections show the bilabiate mouth with an elongate aperture (fig. 8). The chitinous walls of the pharynx soon give evidence of a trifid division (fig. 9). The lumen of the esophagus becomes triradiate (fig. 10), each of the three divisions having two semicircular thickenings of the chitinous lining, which indicate the presence of six longitudinal chitinous ridges in the lining of the esophagus extending from the pharynx to the base. A series of sections made from one of the Beaufort specimens was compared with a series made from a specimen from *Mycteroperca apua*, and was found to agree.

I have found a nematode at the Tortugas which agrees with this species very closely.

NOTES ON HABITATS.

*Diplodus sargus*.

July 13, one, female. Dimensions in millimeters, life: Length 8; diameter, anterior 0.12, middle 0.3, at anal aperture 0.12; length of esophagus 0.8; distance from anal aperture to posterior end 0.27; distance of reproductive aperture from posterior end 3.

July 14, one, male. Dimensions in millimeters, life: Length 4, length of esophagus 0.6; diameter, anterior 0.10, middle 0.16, at anal aperture 0.09; distance of anal aperture from posterior end 0.15; length of spicules 0.42.

July 24, two, male and female; length in balsam, 3 and 8 mm.

*Holocentrus ascensionis*.

July 31, one, male. This specimen may belong to a different species. It was not in good condition, but appeared to agree with those from *Diplodus*, etc. Transverse sections show the lumen of the esophagus as a narrow slit with nearly parallel sides until near the base, where it has a tendency to become triradiate.

*Lycodontis moringa*.

August 3, one, male; length 5.27 mm.

*Mycteroperca apua*.

July 2, four; July 22, one.

*Neomænis griseus*.

July 14, four; July 27, two; August 3, one.

## HETERAKIS, species.

Plate II, figs. 11 to 14; Plate III, figs. 15 to 20.

This agrees very closely with a form from the flounder.<sup>a</sup>

The body is rather plump, truncate anteriorly, tapering posteriorly. Mouth bilabiate, but in some cases appearing to be obscurely trilobed in dorsal or ventral view. Lips armed with very numerous small teeth of nearly uniform size and shape, and each provided with about three papillæ. Diameter of neck but little less than that of the body, but narrowing slightly very near the anterior end. The esophagus is much narrower than the neck. It is largest at the anterior end, where it expands into the pharynx. Its smallest diameter is a little in front of its middle point, whence it enlarges posteriorly, the posterior third being nearly cylindrical. The reproductive aperture of the female is a little back of the middle. The uterus is voluminous, the eggs being retained in it until segmentation has begun. Behind the anal aperture of the female there are two papillæ. The postanal region is somewhat variable in length and is mucronate at the tip.

Transverse sections show that the cuticle is unusually thick, especially toward the anterior end. The character of the esophagus, as revealed in sections, is much like that of the preceding species.

These worms have been found thus far widely distributed, but only in very small numbers.

In *Fundulus heteroclitus* at Woods Hole, Massachusetts, males of this or a closely allied species were found.<sup>b</sup> The genital papillæ in these males are arranged as follows: In the postanal region, lateral view, there are three larger papillæ with three smaller papillæ lateral to them, the most anterior of the larger papillæ being very close to the anal aperture and lateral to it. In the preanal region, lateral view, there are two large papillæ near together a little anterior to the anal aperture and lateral, two others between these and the bursa, and two in front of the bursa, thus making in all twelve postanal and twelve preanal papillæ.

## NOTES ON HABITATS.

*Hæmulon carbonarium*.

July 31, one. Dimensions in millimeters, life, slightly compressed: Length 4; diameter, anterior 0.16, middle 0.40, at genital aperture (2.25 from posterior end) 0.36, at anal aperture 0.09; distance from anal aperture to posterior end 0.15; esophagus, length 0.53, diameter, anterior (pharynx) 0.12, middle 0.05, base 0.08.

<sup>a</sup>Bull. U. S. Fish Com. for 1899, p. 481, pl. vii, figs. 57-61. See also Bull. Bureau of Fisheries, XXIV, pp. 325, 390, 392, 412, 414, figs. 24, 25.

<sup>b</sup>Bull. U. S. Fish Com. for 1899, p. 441, pl. xvii, figs. 207, 208.

*Neomænis griseus.*

July 27, one. Dimension in millimeters, life: Length 6; diameter, anterior 0.45, at base of esophagus 0.96, middle 1, 1 millimeter from posterior end 0.90, at anal aperture 0.22; esophagus, length 1.20, diameter at anterior end 0.22, narrowing to 0.08 and expanding again to 0.18 at base.

## ICHTHYONEMA GLOBICEPS Rudolphi.

The flesh of two specimens of *Tylosurus acis*, which were examined on July 16, was found to be filled with parasitic worms.

These worms were very numerous in both gars, and were most abundant near the backbone, where they were distributed along the greater part of the length. The color of the worms was blood-red, and, since many of them were in tangled clusters, the appearance which they presented when the flesh was cut open was much like that of small blood vessels gorged with blood. With some difficulty some of the worms were extracted whole and found, after killing and straightening, to be about 80 mm. in length. All that were examined were females.

While the general color was blood-red, the intestine showed as a dark-brown stripe. In most cases the uterus was crowded with young, which were in a state of unceasing activity. The young worms were characterized by having a few black, granular spots in the middle of the body. In some of the adults ova, with what were taken to be spermatozoa, were seen mingled together in the uterus.

Dimensions of specimen mounted in balsam: Length 55; diameter of head 0.19; diameter of body nearly uniform, differences due mainly to contraction and pressure from 0.45 to 0.70.

## ICHTHYONEMA, species.

Plate 1, figs. 4 and 4a.

The following notes are made on finds of worms belonging to this genus, but on account of the fragmental nature of the material, satisfactory identifications could not be made:

*Epinephelus maculosus.*

July 22, fragments from testes; young and ova together in uterus.

*Epinephelus striatus.*

July 18, one from ovary of large, spent female.

*Lycodontis moringa.*

August 3, one, small, 10 mm., or less, in length; diameter, anterior 0.09; middle, and for almost the entire length 0.15; near posterior end 0.07.

*Myxeroperca apua.*

July 22, several fragments from testes; intestine dark-brown with elongated cells in its walls; ova, but no young, in the uterus; longest fragment 75 mm. in length.

*Neomænis, species.*

July 27, fragments from ovary; intestine narrow, very dark; young in uterus still active on the 28th.

## Order CESTODA.

Cestodes were found in 18 of the 51 species of fish examined.

There seemed to be a notable scarcity of encysted forms and especially of the small larvæ known as *Scolex polymorphus*, which are very common in the alimentary canals of our coast fishes. This may be explained perhaps by the fact that most of the fish which were examined came from the inner reef. All the larger fish from the deeper water on the outer reef, where sharks abound, had numerous cysts on and in the viscera. Cestode flesh parasites were found only in the gar.

## DISCOCEPHALUM PILEATUM Linton.

Plate V, fig. 31.

*Discocephalum pileatum* LINTON, Report U. S. Fish Com. for 1887, pp. 781-787, pl. x, figs. 1-7; Bull. U. S. Fish. Com. for 1899, p. 272.

On July 31 seven of these cestodes were found with their heads embedded in the mucous membrane at the anterior end of the spiral valve of a small cub shark (*Carcharhinus platyodon*). These worms varied in length from 10 to 340 mm. Five of the largest were attached within a space about 10 mm. square. Only two of the strobiles were immature. In the longer of the immature strobiles, which measured 100 mm. in length, reproductive organs were developing in the posterior segments. In addition to the attached strobiles there were several fragments of mature strobiles in the chyle.

The disk-like heads, shaped like a mushroom anchor, were firmly embedded in the submucosa with the mucous membrane closely embracing the necks. They can not be removed by simply pulling them away from their lodgment. This would merely break them and leave the heads securely embedded in the intestinal wall. Indeed, from the appearance of the pits after the worms have been removed, it seems doubtful whether they can detach themselves after they have once gained lodgment. It is probable, however, that they can do so, since the disk is a very muscular organ and doubtless is capable of assuming very diverse shapes; besides there is no evidence of degeneration either in the head or the surrounding tissue, which would be the case if the heads were permanently attached.

## RHYNCHOBOTHRIMUM SPECIOSUM Linton.

Plate V, figs. 32-35.

*Rhynchobothrium speciosum* LINTON, Proc. U. S. Nat. Mus., XIX, p. 801-805, pl. LXIV, figs. 13, 14; pl. LXV, figs. 1-7; Bull. U. S. Fish Com. for 1898, p. 784; same for 1899, p. 413, etc.; Bull. Bureau of Fisheries, XXIV, p. 332, etc.

This species was found in five of the Bermuda fishes. It is highly probable that the adult stage will be found in the cub shark.

## NOTES ON HABITATS.

*Epinephelus maculatus*.

July 8, one, from cyst on viscera; cyst thin, yellowish, on account of the presence of a waxy secretion, length 20 mm.; blastocyst translucent bluish-white, about same length as cyst; larva with triangular head, and neck enlarging posteriorly and slightly swollen at the bulbs. A specimen mounted in balsam and slightly compressed yielded the following measurements in millimeters: Length of bothria 0.75; breadth 0.52; length of head and neck 4.5; diameter of neck, anterior 0.36, middle 0.67, at bulbs 0.80; proboscis, length 2.2, diameter near base, excluding hooks 0.054, including hooks 0.078.

*Epinephelus striatus*.

July 11, several long-clavate cysts on viscera with yellowish-brown secretion. Two larvae measured 12 and 20 mm., respectively.

July 27, five, cysts on viscera and mesentery, mostly clavate. Length of one cyst 25 mm., of the larva 15 mm. August 3, two cysts.

*Mycteroperca apua*.

July 21 and 22, several clavate cysts from 20 to 25 mm. in length on viscera with dark-brown secretions.

*Neomænis griseus*.

July 27, six cysts on viscera.

*Neomænis synagris*.

July 18, one clavate cyst, length 20 mm., diameter 5 mm.

## RHYNCHOBOTHRIMUM SPIRACORNUTUM, new species.

Plate V, figs. 36-38.

*Type*.—Cat. No. 5797, U.S.N.M.

Head usually broader than long, orbicular or cordate; bothria lateral—that is, coinciding with the lateral margins of the body, with raised borders—neck long, slender, nearly linear, enlarging at base, sometimes appearing to begin abruptly by an articulation with the head and usually abruptly larger than the anterior end of the body; proboscides much shorter than neck, with a tendency to coil up into rather close spirals when everted; sheaths nearly straight, bulbs long-ovate, retractor muscle attached to posterior end. The hooks are of

many different shapes and sizes, but on account of the similarity of the hooks, which make up the several longitudinal rows, the general effect is that of uniformity and symmetry. There is some resemblance in the arrangement of the hooks to that of *R. speciosum*, particularly in the case of one of the longitudinal rows, where the small hooks of which it is composed are placed by twos on account of the lengthening of alternate intervals between the hooks of the row. A characteristic feature of this species is the distinctness of the longitudinal rows of hooks. There was no indication of segments. Dimensions given below.

## NOTES ON HABITATS.

*Epinephelus maculosus.*

July 29, one clavate cyst from viscera, length 28 mm. Bothria with raised borders and reticulated surface; neck linear but may present irregularities due to contraction. Dimensions of larva in millimeters, life: Length 20; bothria, length 0.75, breadth 0.60; diameter of neck, anterior 0.45, at base 0.60; bulbs, length 1.20, breadth 0.21. The following additional measurements are from the mounted specimen: Length 20; head, length 0.60, breadth (bothria spread apart) 0.90; length of head and neck 5.7; proboscis, length, approximate, 1.05, diameter near base, excluding hooks 0.036, including hooks 0.06. The hooks were denser and longer than in *R. speciosum*, and the proboscides coiled into close spirals when everted.

*Epinephelus striatus.*

July 18, four cysts from viscera. One larva measured 30 mm. in length. In a mounted specimen, the bothria being seen in marginal view, the length of the head is 0.60, the breadth 0.82 mm. The neck is linear except in front of the bulbs, where it is swollen, a condition evidently due to unequal contraction.

*Paranthias furcifer.*

July 29, four dark-brown cysts of various shapes. One of the larvæ differed from the others in that the outline of the head was somewhat triangular or cordate instead of orbicular in corresponding view.

## OTOBOTHRIUM CRENACOLLE Linton.

*Otobothrium crenacolle* LINTON, Report U. S. Fish Com. for 1887, pp. 850-853, pl. xiii, figs. 9-15; pl. xiv, figs. 1-4; Bull. U. S. Fish Com. for 1899, pp. 273, 428; Bull. Bureau of Fisheries, XXIV, p. 331, etc.; XXVI, pp. 111-132, pls. 1 and 11.

This widely distributed cestode was found in three of the Bermuda fishes.

*Balistes carolinensis.*

July 14 and 22, few on each date from cysts in walls of stomach and intestine. The cysts were small, oval, white; when compressed they revealed the larva in its blastocyst.

Dimensions in millimeters, life: Cyst, length 2.3, breadth 1.12; length of embryo 0.4.

*Diploodus sargus*.

July 14, two cysts inclosed in a mass of brown secretion on the serous coat of the viscera.

*Ocyurus chrysurus*.

July 22, few, small, from cysts on mesentery.

OTOBOTHRIUM PENETRANS, new species.

Plate VI, figs. 39-48.

*Otobothrium*, species, Bull. Bureau of Fisheries for 1904, XXIV, p. 357, figs. 102-109.

*Type*.—Cat. No. 5798, U. S. N. M.

Bothria marginal, widely divergent, with pits characteristic of the genus; neck somewhat elongated, at least longer than the head, stout, widely flaring and emarginate at posterior end; contractile bulbs curved, concave on lateral, convex on medial sides, approximate at their anterior ends but strongly divergent at the posterior ends; proboscides stout and of moderate length; hooks of many different sizes and shapes, the larger ones strongly recurved with rather narrow, unsymmetrical base. A few of the slender hooks near the base of the proboscides are somewhat spirally crooked.

Dimensions in millimeters of alcoholic specimen: Length of scolex to base of bulbs 4; breadth of head 1.75. Another, in balsam: Head compressed, length 1.12, breadth 1.95; approximate length of proboscides 1.8, diameter, including hooks 0.24, excluding hooks 0.15, length of longest hooks 0.09. In another, length of contractile bulbs 1.35, breadth 0.55; approximate length of proboscis 2.25.

Blastocyst (*plerocercus*): Elongated, white, very irregular in shape; one, somewhat contracted, measured 25 mm. in length.

NOTES ON HABITAT.

*Tylosurus acus*.

Blastocysts very numerous in the flesh of each of two gars, July 16. These were generally distributed in the muscles of the back and sides, but were most abundant along the dorsal region; a few were found in the peritoneum. They were all relatively large, white, and very active, even after they had been in sea water for several hours.

TETRARHYNCHUS BISULCATUS Linton.

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

*Tetrarhynchus bisulcatus* LINTON, Report U. S. Fish Com. for 1887, pp. 857-861, pl. XIV, figs. 10-12; pl. XV, fig. 1; Proc. U. S. Nat. Mus., XIX, pl. LXVI, figs. 11-15; XX, pp. 452; Bull. U. S. Fish Com. for 1899, pp. 272 and 414, etc.; Bull. Bureau of Fisheries, XXIV, p. 333, etc.



Found in two of the Bermuda fishes.

*Balistes vetula.*

July 27, one, from cyst in intestinal wall. The intestine of the fish was thickly beset throughout its length with chalky cysts. A number of these cysts were removed and left over night in sea water. When they were examined the following morning nothing was found in them but a pulpy, granular mass. The larval tetrarhynch was found free in the dish with the cysts. The scolex was still active, the bothria constantly changing their shape, and the proboscides at frequent intervals were protruded and withdrawn. This action was somewhat rythmical. The hooks were characteristic of the species; the collar was elongated and conical. Dimensions, in millimeters, life: Length 1.8, of bothria 0.75, of collar 1.05; breadth of head, maximum 0.60, of neck, behind bothria 0.52, at posterior end 0.22; diameter of proboscis 0.04.

*Paranthus furcifer.*

July 29, one, from a small degenerate cyst on viscera.

SCOLEX POLYMORPHUS Rudolphi.

*Scolex polymorphus* RUDOLPHI, Larval Tetrabothria, Rep. U. S. Fish Com. for 1886, pp. 3-4, pl. vi, figs. 8, 9; Larval Echeinebothria, Proc. U. S. Nat. Mus., XIX, pp. 789-792, pl. 1, figs. 4-15; Larval Cestodes, Bull. U. S. Fish Com. for 1899, pp. 270-284; p. 413, etc.; Bull. Bureau of Fisheries, XXIV, pp. 332, 333, etc.

Found in three of the Bermuda fishes:

*Abudefduf saratilis.*

July 31, few, in alimentary canal. They were small, the bothria without costæ. There were two red pigment spots in the neck and numerous calcareous bodies in the parenchyma. Length 0.60, breadth 0.27 mm.

*Epinephelus maculosus.*

July 8, two, in intestine, small; prominent terminal sucker; bothria without costæ and no pigment in neck. Length 0.9, breadth 0.2 mm.

*Epinephelus striatus.*

July 11, about 60 found after going over washings from the alimentary canal of three large groupers several times. These were small, with two red pigment patches just behind the head, and no costæ on the bothria. In contracting there was a tendency to lengthen the posterior end of the body into a slender, pointed tail, the head, at the same time becoming nearly globular. Most of them, when contracted, are transversely wrinkled. A contracted specimen was 0.6 mm. in length and 0.4 mm. in breadth. August 3, two cysts on viscera.

## LARVAL DIBOTHRIA.

Cestode larvæ, which appear to belong to the genus *Dibothrium*, were found in three of the Bermuda fishes.

*Bodianus fulvus punctatus.*

July 23, fragment. This specimen was finely and transversely wrinkled and the parenchyma contained numerous calcareous bodies. It resembles the posterior end of an immature *Dibothrium*.

*Eupomacentrus fuscus.*

July 11, one. This specimen was exceedingly variable in shape, and there were no definite organs. The anterior end was densely covered with short spines, and there was an aperture in front into which the anterior end of the body could be inverted. As the worm became quiescent under the cover glass the anterior end was permanently retracted and the worm assumed a vase shape.

*Paranthias furcifer.*

July 29, numerous cylindrical cysts, most of them dark brown, and some of them degenerate. One of the larger cysts measured 22 mm. in length and 2 mm. in diameter. The larva measured 14 mm. in length and 1.5 mm. in diameter. It was corrugated transversely, slightly inverted at the anterior end and had a small pore at the posterior end. There were numerous calcareous bodies in the parenchyma. The smaller cysts were from 3 to 5 mm. in length.

In one of the larger specimens numerous glandular bodies were seen. Similar structures have already been noted by me.<sup>a</sup> These structures have been made the subject of special inquiry by Pintner.<sup>b</sup>

The generic character of these larvæ is uncertain.

## CESTODE LARVÆ, CYSTS, ETC.

Larvæ too immature for identification and cysts with indefinite or indeterminable contents are here noted:

*Bathystoma striatum.*

July 17, one blastocyst from viscera; too immature for identification.

*Hæmulon flavolineatum.*

July 27, one cyst with blastocyst, but no larva recognizable.

*Neomænis synagris.*

July 18. Amber-colored cysts of uncertain origin, with waxy contents, were found in the stomach wall of the largest fish of the three examined. These cysts may be due to nematodes.

*Ocyurus chrysurus.*

July 7, one small blastocyst, white, variable, but for the most part pyriform; no larva in it. Length 1.5 mm., breadth 0.15, tapering to 0.05 mm.

<sup>a</sup> Proc. U. S. Nat. Mus., XIX, p. 797, pl. LXIII, figs. 14, 15; Bull. U. S. Fish Com. for 1899, p. 300, fig. 100.

<sup>b</sup> Sitz. d. k. Akad. d. Wissensch. in Wien, CXII, Abt. i, July, 1903.

## ORDER TREMATODA.

Trematodes were found in 29 of the 51 species of fish examined. In many cases only one, and often but very few, of a kind were found. In other cases the material was in poor condition, so that identification was not possible.

I have employed the old generic name *Distomum*, but in those cases where the form could be identified by the use of Pratt's Synopsis I have added the new generic name. Since many of the forms which can not be referred to any genus in Pratt's Synopsis were represented by a single example, or at best by few, and they in poor condition, it has seemed best not to burden the nomenclature of helminthology with any new generic names at present.

## ENCOTYLLABE, species.

Plate VII, figs. 49-53.

A single specimen from the gills of *Calamus calamus*, July 16, is referred to this genus.

Body elliptical, flattened; posterior sucking disk joined to the body by a stalk, provided with two hooks but without radial ridges; two anterior suckers, which were circular in the living but elliptical in the preserved specimen. The anterior end is provided with numerous small lobes, which probably represent two lobate antero-lateral prolongations of the body with lobulate borders. The genital aperture is on the left side of the median line a short distance behind the left sucker. The specimen was rolled up when first seen and was too fragile to allow of satisfactory manipulation.

Dimensions, in millimeters, balsam: Length 3; length of body 2.25; breadth, anterior 0.6, maximum 1; diameter of stalk 0.4; posterior sucking disk, length 0.45, breadth 0.42; transverse diameter of anterior sucker 0.13; length of hooks 0.3.

## MICROCOTYLE, species.

Plate VII, fig. 54.

Body lanceolate, tapering both anteriorly and posteriorly from about the middle. Vitellaria conspicuous along each margin, and leaving only a narrow median line, extending the entire length of the body proper from a point just behind the cirrus.

Dimensions, in millimeters, life: Length of body proper 4, of posterior suctorial part 3.2; breadth, anterior 0.16, maximum 0.6; each anterior sucker, length 0.09, breadth 0.04; about fifty pairs of posterior suckers, each, length 0.07, breadth, 0.03. An ovum in oviduct of specimen mounted in balsam measured 0.69 by 0.19.

The above notes were made on a specimen collected from the gill of *Calamus calamus*, July 14.

On the same date another specimen was obtained from the gill of *Diplodus sargus*. Only the body was seen, and it was in poor condition. Dimensions, in millimeters, life: Length 1.5; breadth, anterior 0.12, maximum 0.25; length of an anterior sucker 0.06, breadth 0.04. The cluster of copulatory spines resembles that of the specimen from *Calamus*.

#### ASPIDOGASTER RINGENS Linton.

Plate XV, figs. 98,99.

*Aspidogaster ringens* LINTON, Bull. Bureau of Fisheries, XXIV, pp. 367, 397, figs. 243-249.

It is possible that either the genus *Aspidogaster* should be revised in order to include this species, or, which is more in accord with present tendencies, a new genus will have to be provided for it.

This species was found in but one Bermuda fish, *Iridio radiatus*, from which two specimens were obtained on July 31.

These specimens agree closely with forms found in *Micropogon undulatus* and *Trachynotus carolinus* at Beaufort, and referred, with some hesitation, to this genus.

The large ventral disk is elliptical, with about forty-two loculi around the border, between which are marginal sense organs. There are about eighteen transversely elongated depressions, thus suggesting *Cotyloaspis*, but there is a low median ridge which divides the depressions into two longitudinal series of alveoli, which, with the marginal loculi, make four rows of depressions, a characteristic of the genus *Aspidogaster*. On account of the indistinctness of this median ridge, however, the genus *Aspidogaster* offers but an insecure resting place for this species. The upper lip is trilobed and the lower entire, or slightly undulate. In the Beaufort specimens the under lip is trilobed. The structure of the head suggests *Cotylogaster* but there is only one testis. In these specimens both the head and the conical tail protrude a short distance beyond the ventral disk. Color white, except in the dorsal region, where the mass of ova impart a yellow color.

Dimensions, in millimeters, of specimen mounted in balsam: Length 2; length of disk 1.77, breadth 0.9; diameter of head 0.42, of neck 0.33; pharynx, length 0.18, breadth 0.14; ova 0.06 by 0.03 and 0.08 by 0.04.

#### DISTOMUM MONTICELLII Linton.

Plate VIII, fig. 58.

*Distomum monticellii* LINTON, Proc. U. S. Nat. Mus., XX, p. 518-520, pl. XLIV, figs. 2-8; Bull. U. S. Fish Com. for 1899, pp. 451, 473, 482; Bull. Bureau of Fisheries, XXIV, p. 334, etc., pl. xxii, fig. 158.

This species was found in two Bermuda fishes.

*Mycteroperca apua.*

July 21, one. Dimensions, in millimeters, life, side view, compressed: Length 1.05; diameter of oral sucker 0.12, of ventral sucker 0.32; ova 0.02 by 0.01.

*Synodus saurus.*

July 20, twelve. These distomes were collected in the evening and placed in sea water to which a little formaldehyde had been added. They were still active on the following morning. These specimens are in agreement with this species in the general character and relative positions of testes, ovary, vitellaria, and seminal vesicle. The habit of the body suggests *D. laeve*; the testes, also, as in that species, are situated near the ventral sucker. They appear to be identical with forms found in *Synodus fátens* at Beaufort.

Dimensions, in millimeters, life: Length 2.55; diameter of oral sucker 0.15, of ventral sucker 0.33; ova 0.018 by 0.012.

This species belongs to the family Hemiurinae, and is near *Protopyge* Looss.

## DISTOMUM VITELLOSUM Linton.

Plate IX, figs. 63, 64.

*Distomum vitellosum* LINTON, Bull. U. S. Fish Com. for 1899, p. 290, pl. xxxvii, figs. 38-39; p. 416, etc., pl. xxx, figs. 333-340; Bull. Bureau of Fisheries, XXIV, p. 335, etc., pl. xxiv, figs. 176-178.

This variable distome, belonging according to Pratt to the subfamily *Psilostominae*, was found in five of the Bermuda fishes.

*Bathystoma striatum.*

July 17, one, small, imperfect.

*Bodianus fulvus punctatus.*

July 22, one, minute, about 1 mm. in length.

*Calamus calamus.*

July 14, one. This specimen agrees with this species in the general arrangement of the genital organs, size of ova, and proportions of the suckers. The ventral sucker is evidently pushed posteriorly by the extreme contraction of the body, since the uterus lies for half of its length directly dorsal to it. Dimensions, in millimeters, life: Length 1.72, breadth 0.67; ova 0.06 by 0.04. In balsam, length 1.40, greatest breadth 0.60; diameter of oral sucker 0.22, of pharynx 0.15, of ventral sucker 0.34.

*Hæmulon flavolineatum.*

July 9, four; 31, six. Length 1.35 to 2.78 mm. While agreeing closely with this species it was noted that on the dorsal surface at the anterior end there was a slight roughening due to low nodular projections.

*Holocentrus ascensionis.*

July 31, two, length 1.35 and 1.73 mm.

## DISTOMUM SUBTENUÉ, new species.

Plate IX, fig. 65.

*Type.*—Cat. No. 5799, U.S.N.M.

While none of the distomes referred to this species showed as much of the anatomy as could be desired, they were easily recognized in the several hosts by the large cirrus and the elongated ova.

An attempt was made to refer them to some genus in Pratt's Synopsis, but without success.

Body subcylindrical; ventral sucker larger than oral and prominent; testes two, globular, close together in a medio-dorsal position, and immediately preceded by the ovary; uterus extending back of the testes to the posterior end of the body; cirrus robust; genital pore a short distance in front of the ventral sucker and a little to the left of the median line; vitellaria confined to a few isolated patches in the median region of the body near the testes; uterus passing to the left of the cirrus; ova somewhat elongated; intestinal caeca not clearly made out, but apparently extending to the posterior end of the body. The ova are crowded at the posterior end of the body behind the testes, whence they extend ventrally to a point a little in front of the ovary. The longer diameter of the ova is more than twice the shorter. In a ventral view the apertures of the suckers are seen to be transverse. Dimensions, in millimeters, life: Length 3.60; diameter of body 0.63, of oral sucker 0.39, of ventral sucker 0.68; ova 0.05 by 0.02. Dimensions of specimen in balsam: Length 2.07; breadth 0.52; oral sucker, length 0.25, breadth 0.30; pharynx, short-fusiform, length 0.15, breadth 0.15; ventral sucker, length 0.30, breadth 0.48; ova, collapsed and crowded, not easily measured, 0.042 by 0.015.

This species was found in four Bermuda fishes.

*Calamus calamus.*

August 3, six; August 7, five.

*Harpe rufa.*

August 7, two. These distomes are smaller than those from *Calamus*, but they agree with them in essential particulars; length 1.02 mm., in balsam.

*Iridio bivittatus.*

July 9, two, immature. These were cylindrical, slightly arcuate with prominent ventral sucker. Dimensions, in millimeters, life: Length 0.6; diameter anterior 0.06, posterior 0.07, at ventral sucker 0.18.

*Lachnolaimus maximus.*

July 18, one, length 1.28 mm.

## DISTOMUM MACROCOTYLE Diesing.

Plate IX, fig. 66.

One specimen of this distome was found in *Teuthis hepatus*, August 3.

Dimensions, in millimeters, life: Length 4.8; diameter of oral sucker 0.3, of ventral sucker 0.5; ova 0.03 by 0.02.

Dimensions of same mounted in balsam: Length 4.35; diameter of neck 0.35, of middle of body 0.63, near posterior end 0.35; oral sucker, length 0.24, depth 0.30; diameter of pharynx 0.12; ventral sucker, length 0.72, depth 0.54; ova 0.027 by 0.015.

Anterior end white to ventral sucker, back of ventral sucker pink; yellowish in alcohol.

This distome is referred to the genus *Accacolum* in Pratt's Synopsis.

## DISTOMUM NITENS Linton.

Plate X, figs. 67, 68.

*Distomum nitens* LINTON, Proc. U. S. Nat. Mus., XX, p. 534, pl. LI, figs. 5, 6; pl. LII, fig. 1.

Two specimens of this distome were obtained, July 16, from *Tylosurus acus*. They were elongated, cylindrical, slightly irregular in outline, slender, suckers whitish, body orange, neck lighter in color than the body and concave below; ventral sucker somewhat prominent.

Dimensions of living worm in millimeters: Length 5; length of oral sucker 0.30, of ventral sucker 0.63; ova 0.028 by 0.014.

No spines were observed on these specimens. The ovary is transversely elongated instead of globular; a seminal receptacle was noted behind the ovary. Other details are given in the sketch.

These specimens belong to this species or are near it.

According to the later classification of distomes *D. nitens* belongs to the subfamily *Plagiorchinæ*, and probably is near the genus *Enodlia* Looss.

DISTOMUM GYRINUS,<sup>a</sup> new species.

Plate X, figs. 72-74.

*Type*.—Cat. No. 5800, U.S.N.M.

Body cercaria shape, the tail portion equaling, in some cases exceeding the length of the anterior portion, smooth; intestine not seen; pharynx absent.

Anterior sucker much larger than ventral; testes two, relatively large, lateral, transverse, beginning behind oral sucker and near it and extending posteriorly a short distance back of the ventral sucker; seminal vesicle in front and to right of ventral sucker, dorsal; ovary

<sup>a</sup> From the Latin word *Gyrinus*, signifying a tadpole.

behind ventral sucker; vitellaria filling the tail portion and extending forward on the left side as far as the testes.

Dimensions, in millimeters, life: Length 1.85; length of tail 0.98; diameter of anterior portion 0.45, of tail 0.18; diameter of oral sucker 0.25, of ventral sucker 0.09. Dimensions of specimen in balsam: Length 0.98; anterior portion, length 0.38, diameter 0.24; posterior portion, length 0.60, diameter at middle 0.08; diameter of oral sucker 0.12, of ventral sucker 0.04.

Average of three specimens, in life: Length 0.95; diameter of oral sucker 0.103, ventral sucker 0.04.

In Pratt's Synopsis this distome appears to be near the genus *Eumegacetes* Looss, but in reality is a very different form from that.

These distomes were found in two of the Bermuda fishes.

*Lactophrys trigonus*.

August 3, eight, maximum length 0.95 mm.

*Lactophrys tricornis*.

August 1, two, maximum length 1.85 mm.

DISTOMUM LAMELLIFORME, new species.

Plate X, fig. 75; plate XI, figs. 76-78.

*Type*.—Cat. No. 5801, U.S.N.M.

Body orbicular, flat and leaf-like, smooth, often broader than long. Ventral sucker larger than oral, sessile, with circular aperture, relative proportions of suckers somewhat variable, but in alcoholic specimens ventral sucker not twice the diameter of the oral. The average of four was: Oral sucker 0.075 mm., ventral sucker 0.10 mm.

Mouth subterminal, pharynx near oral sucker, globular; esophagus short; intestinal crura simple extending to near the posterior end of the body.

Testes two, round, or, under pressure, with undulate outline, situated behind ventral sucker on opposite sides of the median line and separated from each other by a space approximately equal to the diameter of the testis. Seminal vesicle to the right of the ventral sucker preceded by the prostate gland and both inclosed in the cirrus pouch. Cirrus relatively large. Vitelline glands abundant, distributed throughout the posterior and lateral regions of the body as far forward as the pharynx. Ovary behind the ventral sucker and between the testes obscurely lobed. Uterus along median line between testes and passing to left of ventral sucker, in some cases a little in front, in others at same level, and in yet others a little behind that organ.

Ova relatively few and large.

Dimensions, in millimeters, life, specimen flattened under cover glass: Length 0.82, breadth 1.20; oral sucker, length 0.06, breadth 0.07; ventral sucker, length 0.15, breadth 0.21; ova 0.075 by 0.036. Another, length 0.72, breadth 0.65; another, length 1.10, breadth 1.20.



In Pratt's Synopsis this distome comes near the genus *Sperostomat*. The species was found in three of the Bermuda fishes.

*Balistes carolinensis*.

July 14, one hundred and fifty-one; July 22, two. The smaller specimens were longer than broad, the larger ones were broader than long. Many were folded by the approximation of the anterior and posterior ends.

*Lactophrys tricornis*.

August 1, one, circular, translucent-white, vitellaria yellowish. Dimensions, in millimeters, life: Length 1.73; breadth 1.77; diameter of oral sucker 0.14, of pharynx 0.09, of ventral sucker 0.15; ova 0.058 by 0.036.

*Lactophrys trigonus*.

August 3, one, small. Dimensions, in millimeters, life: Length 0.64, breadth 0.72; diameter of oral sucker 0.07, of ventral sucker 0.12; ova 0.07 by 0.04. The vitellaria were profuse. The stained specimen shows the ovary to be trilobed, the anterior lobe projecting dorsally.

**DISTOMUM TRULLA,**<sup>a</sup> new species.

Plate XI, fig. 79.

*Type*.—Cat. No. 5802, U.S.N.M.

In Pratt's Synopsis this species falls in the genus *Halicometra*.

Body pyriform, compressed, densely covered with small, low, round spines; oral and ventral suckers about equal; pharynx equal in length to the diameter of the ventral sucker, separated from the oral sucker by a short pre-esophagus, which may become indistinguishable in a contracted specimen; esophagus short; rami of intestines simple, apparently extending to near the posterior end of the body; testes two, near posterior end, diagonally placed and near together, unequal; cirrus pouch long-clavate, dorsal to ventral sucker and to the left; uterus between testes and ventral sucker, the thick-walled and glandular extremity lying beside the cirrus on the left; ovary three-lobed, in front of testes and contiguous with anterior testis and a little to the right of the median line of the body; ova rather numerous, their length equal to about one-fourth the diameter of the ventral sucker; vitellaria diffuse, filling the posterior and lateral regions of the body as far forward as the pharynx.

Dimensions, in millimeters, balsam: Length 1.14; breadth, anterior 0.27, middle 0.73, near posterior 0.47; oral sucker, length 0.15, breadth 0.14; pharynx, length 0.12, breadth 0.11; ventral sucker, length 0.14, breadth 0.15; ova 0.042 by 0.027.

From *Ocyurus chrysurus*.

July 22, three.

<sup>a</sup>From the Latin word *trulla*, signifying a trowel.

## DISTOMUM LEVENSENI, new species.

Plate XII, figs. 80-83.

*Type*.—Cat. No. 5803, U.S.N.M.

Body depressed, linear but with tendency to be inflated in the cervical region, wholly covered with minute, low, rounded spines, most conspicuous anteriorly, but discernible along the lateral margins to the posterior end. The oral and ventral suckers are about equal, the latter situated at about the anterior third or fourth of the length; mouth subterminal, circular, sometimes with the opening distorted; very short pre-esophagus; pharynx moderately elongated; esophagus rather longer than pharynx; intestinal crura extending to posterior end of the body. The testes are nearly equal, slightly lobed in specimens which have been killed under pressure, unequal, the posterior being usually the more elongated and larger. In all cases the testes were end to end and behind the middle of the body; in compressed specimens they are separated from each other by a short space. The seminal vesicle is behind the ventral sucker and inclosed in the cirrus pouch, which is inconspicuous. The cirrus passes to the left of the median line and opens in front of the ventral sucker a little to the left. The cirrus was not seen distinctly, but the whole pouch is elongated. Ovary smaller than testes, irregular oval, or oblong elliptical, or subglobular, in front of and close to anterior testis, in uncompressed specimens; in specimens killed under pressure it may be separated from the anterior testis by a space equal to once or even twice the diameter of the ovary. A seminal receptacle lies close to the ovary and dorsal to it. Vitelline glands diffuse but presenting some striking variations (figs. 81 and 82); in most cases they fill the greater part of the body behind the ventral sucker along the marginal region, covering and concealing the intestinal rami. These glands appear to lie behind the ventral sucker for the most part, although a diffuse and deeply staining layer, which may also be a part of this gland, continues anteriorly to the pharynx. The uterus is in front of the ovary, the ova being, for the most part, between the ovary and the base of the cirrus pouch. The uterus continues anteriorly beside and to the left of the cirrus to open at the genital aperture in front of the ventral sucker and to the left. Ova rather few and large.

This distome, according to Pratt's Synopsis, belongs to the genus *Allocreadium*. It is near the species *D. oculatum* Levinsen.

The species was found in two of the Bermuda fishes.

*Epinephelus maculosus*.

July 8, two; July 29, four. The living worms of the first lot were yellowish white with an amber-colored spot between the ventral sucker and the ovary where the ova lay; length 2.5 mm., breadth 0.5 mm. One of these, which had been fixed over the flame and afterwards

mounted in balsam, had the following dimensions, in millimeters: Length 1.8, breadth 0.33; diameter of oral sucker 0.08, of ventral sucker 0.08; pharynx, length 0.05, breadth 0.03; ova 0.048 by 0.024.

The specimens in the second lot present considerable variation in size and proportions. Three of them agree fairly well, the fourth is larger. It was somewhat macerated and consequently was flattened more than the others when placed under the cover glass.

*Dimensions of living specimens.*

Length.	Breadth.	Oral sucker.	Pharynx.	Ventral sucker.	Ova.
<i>mm.</i>	<i>mm.</i>	<i>mm.</i>	<i>mm.</i>	<i>mm.</i>	<i>mm.</i>
1.20	0.52	0.09	0.05	0.09	0.06 by 0.04
1.38	0.40	0.13	0.10	0.16	0.06 by 0.01
3.45	0.60	0.12	0.08	0.12	0.07 by 0.01

The principal difference between this lot and the former is in the size of the ova.

*Epinephelus striatus.*

July 11, twenty; July 14, four; July 18, twenty-three.

Most of the distomes in the first lot were broken. They were faint flesh color by reflected, yellowish-white by transmitted light.

Dimensions of a perfect specimen, in millimeters, life: Length 2.78; breadth, anterior 0.36, at ventral sucker 0.68; oral and ventral suckers each 0.24 in diameter, with circular aperture; ova 0.045 by 0.022. In the other lots there was great variety in size and proportions but they are all apparently the same species.

**DISTOMUM FENESTRATUM**, new species.

Plate XII, figs. 86-91.

*Distomum*, species, Bull. Bureau of Fisheries for 1904, XXIV, p. 373, 374, figs. 213, 214.

*Type*.—Cat. No. 5804, U.S.N.M.

This species will eventually have to be referred to a new genus, but, in view of the fact that the individuals thus far found are immature, it seems to me to be best not to give a generic name at present. On account of the ease with which they may be recognized, however, a specific designation appears desirable.

The reproductive organs not being in evidence, it is not possible to identify it with Pratt's Synopsis. The absence of a pharynx suggests the subfamily *Gorgoderine*.

So far as the anatomy of these distomes was worked out, their characterization is as follows: Body subcylindrical, tapering at each end; ventral sucker much larger than oral and situated at about the anterior fifth; pharynx none; esophagus slender, communicating with the capacious intestine a short distance in front of the ventral sucker.

The intestinal rami originate at the ventral sucker and dorsal to it. At their origin they constitute a somewhat convoluted or lobed mass, from which they continue to the posterior end of the body as greatly inflated, somewhat spiral tubes with very thin walls and filled with a clear, structureless, or colloid material. The intestinal rami occupy the greater part of the body behind the ventral sucker and are very conspicuous. Both in the living and the preserved material the intestinal rami appear as a series of semitransparent spaces. No genital organs, even as rudiments, were distinguished.

Transverse sections reveal the following structure: The epidermis is underlaid by a thin layer of longitudinal fibers. Next within this is a somewhat broken layer which, from its position, suggests the rudiments of vitellaria. The remainder of the body is filled with parenchyma, as shown in the figures.

Lengths of five living specimens, in millimeters: 2.15; 1.98; 1.68; 1.28; 1.05. Corresponding breadths: 0.35; 0.48; 0.38; 0.32; 0.27. Detailed measurements of one: Length 2.15, breadth 0.35; diameter of oral sucker 0.06, of ventral sucker 0.21. One specimen, which may be abnormal, had the following dimensions: Length 2.40, breadth 0.18; oral sucker, length 0.07, breadth 0.06; ventral sucker not quite definite but appeared to be 0.18 in diameter.

Forms resembling these were found in *Coryphæna equisetis* and *C. hippurus* at Beaufort, North Carolina, and in *Brevoortia tyrannus* at Woods Hole, Massachusetts.

They were found in one of the Bermuda fishes.

*Lycodontis moringa.*

August 3, eighty-four, in alimentary canal. Most of these specimens were found in washings from the intestines. A few cysts under the serous coat of the intestine were opened, and from two of them distomes of this species were obtained. Nothing distinguishable was found in the other cysts. These cysts were white, rather soft, and filled with a whitish, granular material.

DISTOMUM TOMEX,<sup>a</sup> new species.

Plate XIV, figs. 94-96.

*Type*.—Cat. No. 5805, U.S.N.M.

Body long and slender, unarmed; ventral sucker near the anterior end, smaller than oral sucker, with transverse aperture; oral sucker pyriform, the larger end in front, aperture circular and terminal; no pharynx; esophagus distinct; intestinal rami extending to the posterior end of the body; genital papilla prominent, at base of oral sucker on ventral side, with 2 external apertures; uterus with greater part of ova at posterior end of body, but opening at the genital papilla; vas

<sup>a</sup> From the Latin word *tomex*, signifying a cord.

deferens distinct along the median line anteriorly, not so distinctly seen near the testes as shown in the sketch. Other genitalia not quite satisfactorily made out. What were taken to be the testes are two elongated, lobed bodies, one following the other, but diagonally placed, and situated near the posterior end, but in front of that portion of the uterus which contains the greater part of the ova. Another organ, probably the ovary, lies beside the anterior testis. Clusters of deeply staining bodies, which extend from about the anterior sixth to a point a little in front of the middle, may possibly be the vitellaria, although some of them appeared to be folds of the intestinal rami.

Dimensions of specimen mounted in balsam, in millimeters: Length 12; diameter of anterior projection containing oral sucker 0.14; diameter of body, anterior 0.33, at ventral sucker 0.48; anterior sucker, length 0.14, breadth, anterior 0.08, posterior 0.06; genital papilla, length 0.04, breadth 0.05; ventral sucker, length 0.07, breadth 0.11; length of esophagus 0.3; distance of ventral sucker from genital papilla 0.46, from anterior end 0.63; ova 0.018 by 0.012. Length of living worm 14; breadth 0.2 to 0.5.

From *Epinephelus striatus*.

July 14, one.

I do not find any distome at all resembling this in Pratt's Synopsis.

#### UNDETERMINED DISTOMES.

The following distomes are not given specific names on account of either the small amount of material in each case or its unsatisfactory condition.

It is hoped that the notes which it was possible to make, together with the naming of the host in each instance, will prove to be of use to future investigators.

*Distomum*, species from *Seriola fasciata*. (Plate VII, figs. 55, 56.)

July 31, two. These worms being immature and partly macerated, but little of their anatomy could be made out. Testes, two, globular, near together, one following the other and near the posterior end; ovary small, globular, in front of anterior testis and separated from it by a distance about equal to the diameter of the testis. The anterior end of one was retracted, and there was a small mass of black pigment in each between the oral and ventral suckers. The vitellaria were not distinct. The character of the intestines could not be made out. Each of the specimens was linear and smooth.

Dimensions in millimeters, life: Length 3.30; breadth at ventral sucker 0.40, behind ventral sucker 0.30; diameter of oral sucker 0.19, of ventral sucker 0.30.

Dimensions of specimen in balsam: Length 2.55, breadth 0.25; diameter of oral sucker 0.18, of ventral sucker 0.24; distance of ventral sucker from anterior end 0.37, distance of posterior testis from

posterior end 0.22. The pharynx was not visible in this specimen, but in the other its length was 0.06. In the latter specimen the length of the oral sucker was 0.16, of the ventral sucker 0.21, whole length 2.

*Distomum*, species from *Angelichthys ciliaris*. (Plate VII, fig. 57.)

July 14, two; July 17, two. None of the specimens were in good condition. The body is subcylindrical and curved ventrally. Numerous dark brown blotches were noted in one. These are conspicuous in the mounted specimen, and appear to represent the intestines. Some deeply staining granular masses lay near each lateral margin at about the posterior third. They have the general structure of vitellaria. The ova, to the number of about two hundred, lay between these bodies.

Dimensions in millimeters, life: Length 2.16, breadth 0.7; suckers near together and about equal, the anterior 0.18 in diameter; ova 0.030 by 0.014. Length of another 1.65; breadth 0.42.

*Distomum* (*Lecithocladium*), species from *Seriola dumerili*. (Plate VIII, figs. 59, 60.)

July 16, nine; July 24, one. Body cylindrical, finely ringed, a character which may disappear when the specimen has been for some time under slight pressure; posterior end of body retractile; neck cylindrical, very contractile, with a tendency to arch; testes close together behind the ventral sucker, the left a little in advance of the right; cirrus and cirrus pouch in neck, genital pore just behind the oral sucker and a little to the left of the median line; seminal vesicle in front of testes; ovary close behind testes; folds of uterus behind testes and ovary, passing forward to right of cirrus to the genital pore; vitellaria tubular, convoluted, on either side of ovary; ventral sucker much larger than oral, pharynx oval, diameter about equal to length; rami of intestine extending nearly to the posterior end.

Dimensions, in millimeters, balsam: Length, exclusive of retractile portion, 1.14, diameter 0.30; diameter of oral sucker 0.15, of pharynx 0.06, of ventral sucker 0.27; ova 0.016 by 0.007.

*Distomum*, species from *Teuthis hepatus*. (Plate VIII, fig. 61.)

July 21, one and fragment, neither in good condition.

The stained and mounted fragment shows only the following meager details: Beginning at the posterior end the body is seen to be filled with ova. A small structure, 0.7 mm. from the posterior end, about 0.2 mm. in diameter, transversely striated, is apparently a seminal receptacle. At the anterior border of this organ is a cluster of oval bodies, four or more in number, which may represent a deeply lobed ovary with lobes 0.1 mm. in length. At a distance 0.6 mm. in front of these bodies a testis was made out, and beside it the faint indications of another. About 0.6 mm. in front of the testis a large seminal vesicle was seen.

Dimensions, in millimeters, balsam: Length 1.57, diameter 0.52; oral sucker, length 0.11, breadth 0.12; diameter of pharynx 0.09; ventral sucker, length 0.35, breadth 0.33; ova 0.018 by 0.009, mainly at the posterior end of the body. Vitellaria diffuse in median part of the body; oral sucker retracted, ventral sucker also slightly withdrawn.

The length of the fragment is 3.75 mm. It represents only the post-acetabular region.

*Distomum*, species from *Tylosurus acus*. (Plate VIII, fig. 62.)

July 16, one. Color of body orange, neck light orange, suckers whitish. The body is fusiform, tapering more to the posterior end than to the anterior. Ventral sucker larger than oral; pharynx separated from oral sucker by a pre-esophagus. Ovary subglobular, behind ventral sucker; uterus between ovary and ventral sucker and passing to the left of the ventral sucker to the genital aperture, which is in front of the ventral sucker and on the left of the median line. Vitellaria diffuse lateral and posterior, abundant, extending to ventral sucker. Testes not clearly made out, but appear to be represented by a mass of cells behind the ovary. Cirrus and its pouch in front of the ventral sucker and to the left. Ova few and large.

Dimensions of mounted specimen, in millimeters: Length 1.77; diameter, anterior 0.25, at ventral sucker 0.63, near posterior end 0.15; diameter of oral sucker 0.22, of pharynx 0.13, of ventral sucker 0.36; ova 0.97 by 0.04.

According to the later classification of the distomes this species probably belongs to the genus *Allocreadium*.

*Distomum*, species from *Chaetodon*, species. (Plate X, fig. 69.)

July 30, two; August 3, four; all the specimens in poor condition, as if macerated.

So far as could be made out from these imperfect specimens they have the following characters: Ventral sucker a little larger than oral; ovary with three or four lobes and situated half way between the ventral sucker and the posterior end; vitellaria abundant, diffuse, at posterior end and along margins to ventral sucker, overlying other organs in places. To the rear of the ovary and at its right side are about nine bodies which appear to be testes. The cirrus and its pouch were indistinctly seen, but they appear to pass dorsal to the ventral sucker to open in front of it on the left of the median line. There is a distinct prostate, with a seminal vesicle at its posterior edge, just behind the ventral sucker. In a larger specimen than the one sketched the seminal vesicle is farther back; the ova are rather few, mostly in front of the ovary, but a few are behind it, or at least very close to it. The uterus passes to the left of the cirrus to open immediately in front of the ventral sucker, and close to the median

line. The prostate is at the posterior border of the ventral sucker, a little to the left.

Dimensions, in millimeters, life: Length 2.25, breadth 0.54; diameter of oral sucker 0.10, of pharynx 0.06, of ventral sucker 0.13; ova 0.054 by 0.036. Length of smaller specimens 1 and 1.5.

*Distomum*, species from *Bodianus fulvus punctatus*. (Plate X, fig. 70.)

July 22, one, immature. Dimensions, in millimeters, life: Length 0.9, breadth 0.42; breadth of oral sucker, retracted, approximately 0.12; ventral sucker, length 0.10, breadth 0.12. Measurements of the specimen in balsam show that the diameter of the two suckers and the pharynx is about the same, namely 0.07; each a little wider than long.

In the mounted specimen several granular bodies are disclosed which are the rudiments of the reproductive organs. The anterior end is beset with exceedingly minute spines.

*Distomum*, species from *Sphyræna sphyræna*. (Plate X, fig. 71.)

July 17, three, in poor condition, as if macerated by the digestive juices of their host. The barracuda indeed may not be the proper final host of these distomes.

Body elongated, the posterior half nearly linear, tapering to anterior end; oral sucker lost in all the specimens; pharynx preceded by a pre-esophagus and about two-thirds the size of the ventral sucker. The ventral sucker and its aperture longer than broad. Testes two, oval, on median line, separated from each other by a distance slightly less than the length of one, the posterior testis situated at about its own length from the posterior end of the body. Ovary globular and placed in front of the anterior testis, from which it is separated by a short interval. Vitellaria diffuse, posterior and lateral, extending forwards to a point about 0.7 mm. behind the ventral sucker. Faint indications of a seminal vesicle were seen behind the ventral sucker, and of a seminal receptacle in front of the ovary. The ova are rather large and numerous, the body being crowded with them for a distance of 3.75 mm. in front of the ovary.

Dimensions in millimeters of specimen mounted in balsam: Length 15; maximum diameter, at posterior testis, 0.96, at pharynx, 0.33; pharynx, length 0.33, breadth 0.25; ventral sucker, length 0.45, breadth 0.37; distance of pharynx from ventral sucker 1.8; distance of posterior testis from posterior end 0.9; posterior testis, length 1.05, breadth 0.60; anterior testis, length 0.90, breadth 0.54; distance between testes 0.67; diameter of ovary 0.30; distance of ovary from first testis 0.94; ova 0.06 by 0.03. The anterior end was macerated and drawn out into a slender thread, the oral sucker being lost and the pharynx about 0.75 mm. from the anterior end. On account of the macerated condition of these distomes the absence of spines is without significance.



*Distomum*, species from *Balistes carolinensis*. (Plate XII. fig. 84.)

July 14, three. Body thickish, depressed, covered with spines which are low and rounded in front, dense on head and anterior part of body, less dense posteriorly. Ventral sucker larger than oral; mouth subterminal; esophagus none; intestinal rami broad and extending to posterior end of body; testes two, close together, one in front of the other, about halfway between the ventral sucker and the posterior end, not lobed; ovary subglobular, in front of testis, near and a little to the right; uterus in front of testes passing to the left of the ventral sucker to open in front of it and a little to the left. Cirrus and its pouch very indistinct. Seminal vesicle in front of ovary and behind ventral sucker but not clearly shown. Cirrus dorsal to ventral sucker and on left side. Vitelline glands diffuse, posterior and marginal, covering and hiding other organs and extending in front of ventral sucker. Ova relatively few and large.

Dimensions, in millimeters, life, Length 3.45; breadth 0.56; diameter of oral sucker 0.22, of pharynx 0.15, of ventral sucker 0.3; ova 0.06 by 0.03.

In Pratt's Synopsis this species appears to belong in the genus *Halicometra*.

*Distomum*, species from *Paranthias furcifer*. (Plate XIII. fig. 85.)

July 29, one. Body nearly linear, covered with low, rounded spines; oral sucker slightly exceeding the ventral; ventral sucker nearly equally distant from the two extremities, aperture transverse; pharynx large, esophagus distinct, intestinal rami extending to posterior end; testes two, one following the other, near posterior end; ovary at front edge of anterior testis; uterus between ovary and ventral sucker; vitellaria diffuse, posterior and lateral, extending in front of ventral sucker.

Dimensions, in millimeters, life: Length 1.38; breadth, anterior 0.18, at ventral sucker 0.40; oral sucker, length 0.18, breadth 0.15; pharynx, length 0.15, breadth 0.12; diameter of ventral sucker 0.15; ova 0.05 by 0.036. Same, in balsam: Length 1.28; oral sucker, length and breadth, each 0.13; ventral sucker, length 0.10, breadth 0.12. The outline of the testes differs from that shown in the sketch, which was made from life; each testis is broader than long and the margins are uneven.

Although the specimen seems to be in fairly good condition and the testes, ovary, and vitellaria are well differentiated by the stain, there is no indication of cirrus, pouch, or genital aperture.

This distome appears to belong to the genus *Halicometra* of the later classification.

*Distomum*, species from *Salariichthys textilis*.

July 16, one. This distome was exceedingly minute. It was inclosed in an amber-colored, globular cyst. It was seen while examining some foodstuff with the microscope.

Diameter of the cyst about 0.2 mm. The distome was curved in a horseshoe shape inside the cyst.

Numerous minute spherical bodies, probably concretions in the excretory vessels, were noted. These concretions measured 0.004 mm. in diameter.

*Distomum*, species from *Tenthis ceruleus*.

July 22, one, partly macerated. This distome was stained and mounted, but is not in a condition to admit of identification or satisfactory description.

The mount yields a lateral view of the compressed specimen. The vitellaria are diffuse, not close to the margin, but filling the interior of the body from the posterior end to the ventral sucker. The ventral sucker is very indistinct; uterus in front of ovary; ova relatively few.

Dimensions, in millimeters, life: Length 1.35, breadth 0.83; oral sucker 0.21, pharynx 0.10, ventral sucker 0.21; ova 0.036 by 0.021.

So far as can be made out, the anatomy bears a general resemblance to that of *D. vitellosum*.

#### MONOSTOMUM VINAL-EDWARDSII Linton.

Plate XV, fig. 97.

*Monostomum vinal-edwardsii* LINTON, Bull. U. S. Fish. Com. for 1899, p. 470, pl. xxiv, figs. 373-376; Bull. Bureau of Fisheries, XXIV, pp. 379, 410, figs. 220-222.

This species was found in two of the Bermuda fishes.

*Neomænis synagris*.

July 18, fifteen large and two small. Dimensions, in millimeters, formalin: Larger, length 2.98, maximum breadth 0.98. Smaller, length 0.57, breadth 0.30.

*Ocyurus chrysurus*.

July 7, three; July 14, twenty-four; July 22, twenty. Large and small specimens were found together, as in the snapper.

#### MONOSTOMUM, species.

Plate XIV, figs. 92, 93.

Three small monostomes, from two Bermuda fishes appear to belong to the same species. In each case they were in poor condition, being somewhat macerated.

*Bathystoma striatum.*

July 17, one. Dimensions, in millimeters, life: Length 1; breadth, anterior 0.22, middle 0.42, posterior 0.15; ova, somewhat variable, largest 0.018 by 0.011.

*Ixemulon flavolineatum.*

July 31, two. Dimensions of larger, in millimeters, life: Length 1.05; breadth, anterior 0.12, middle 0.31, posterior 0.12; diameter of oral sucker 0.09, of pharynx 0.03, of genital sucker 0.08; ova 0.018 by 0.011.

## GASTEROSTOMUM, species.

Trematodes belonging to this genus were found on two occasions in the rock fish (*Mycteroperca apua*), in each case in poor condition.

The relative position of the vitellaria, ovary, testes, uterus, and cirrus much as in *G. arcuatum*; the vitellaria, however, are more crowded, in some of the specimens at least, than in that species, although agreeing closely in number, 28 having been counted in one and 29 in another. The anterior end is bluntly rounded, and the anterior sucker is relatively large, as in *G. baenlatum*.

July 21, twenty; length 2 mm., breadth 0.3 mm.; ova 0.024 by 0.015 and 0.03 by 0.02 mm. July 22, five; no two alike in shape, but generally slender; length 0.66 mm., breadth 0.3 mm.

## UNDETERMINED TREMATODE.

Plate XV, figs. 100-102.

This is possibly a new genus, related, but not closely, to *Phyllodistomum*.

Body nearly circular, rather thin, with edges folded under. The neck is subcylindrical and sharply marked off from the body. Ventral sucker larger than oral, with a nearly circular aperture. Mouth circular, probably nearly terminal, pharynx not clearly seen and very small, if any. The intestinal rami are simple and elongated, beginning near the oral sucker and extending to the posterior end, where, although they were not clearly seen, they appear to meet. The reproductive organs, if correctly interpreted, have the following arrangement: Testes two, transversely placed, not granular, but appearing as crumpled or folded structures; ovary in front of right testis, near it and ventral; vitellaria two, lobed, immediately behind ventral sucker; uterus between and behind testes; genital aperture behind oral sucker at bifurcation of intestine; cirrus and pouch in neck. Ventral disk nearly circular, marked with transverse lines, and minute longitudinal striae between the lines.

Dimensions, in millimeters, life: Length of disk 0.75, breadth 0.93; neck, arched and bent ventrally, diameter 0.42, length, estimated, 0.87. Specimen mounted in balsam: Body, length 0.75, breadth 0.90; neck, length 0.75, breadth 0.36; oral sucker, length

0.24, breadth 0.27; ventral sucker, length 0.34, breadth 0.30; diameter of ventral disk 0.58; ova of different sizes, largest 0.042 by 0.015.

This specimen was found in *Balistes carolinensis*, July 14.

#### PARASITIC COPEPODS.

I am indebted to my friend Prof. C. B. Wilson for the identification of the only species of parasitic copepod found.

*Lepeophtheirus dissimulatus* Wilson.

Proc. U. S. Nat. Mus., XXVIII, pp. 631-635, pl. XXII. This species was found on two of the Bermuda fishes.

*Epinephelus striatus*.

July 11, two; July 18, two. Found only on the large groupers.

*Mycteroperca apua*.

Five specimens collected by Mr. Louis Mowbray, St. Georges, Bermuda.

#### PARASITIC ISOPODS.

The parasitic isopods obtained by me in Bermuda were sent to Dr. Harriet Richardson, who has kindly furnished the following identifications:

*Cymothoa astrum* (Linnaeus).

Mr. Louis Mowbray of St. Georges, Bermuda, brought to the laboratory two isopods, one large the other small. The small one was from the mouth of a fish which was identified by Mr. Mowbray as *Trachurops crumenophthalmus*. It was collected on March 6, 1903. The large specimen was from the mouth of a fish which he identified as *Priacanthus arenatus*.

*Irona nana* Schoedte and Meinert.

From *Atherina harringtonensis*, July 15, numerous. These isopods were easily removed from the fish, and they could detach themselves at will. They were abundant; all that were seen were females with ova.

*Nerocila acuminata* Schoedte and Meinert.

From *Lachnolaimus maximus*, August 3, one, from fin. The specimen was a female, length 32 mm., breadth 17 mm.

*Corullena*, species.

This specimen was brought in with other material collected on a dredging expedition to the Challenger Banks conducted by Capt. W. E. Meyer, August 1 and 2. The host was not noted.

## EXPLANATION OF PLATES.

## REFERENCE LETTERS USED IN FIGURES OF TREMATODES.

<i>a.</i> ventral sucker.	<i>ph.</i> pharynx.
<i>c.</i> cirrus.	<i>sp.</i> seminal receptacle.
<i>cp.</i> cirrus pouch.	<i>sv.</i> seminal vesicle.
<i>ex.</i> excretory vessel.	<i>t.</i> testes.
<i>g.</i> genital aperture.	<i>u.</i> uterus.
<i>gs.</i> genital sucker.	<i>vd.</i> vas deferens.
<i>i.</i> intestine.	<i>vg.</i> vitelline gland.
<i>o.</i> ovary.	<i>vr.</i> vitelline reservoir.
<i>oe.</i> esophagus.	<i>vd.</i> vitelline duct.
<i>p.</i> prostate gland.	

## PLATE I.

*Ascaris*, species from *Mycteroperca apua*.

FIG. 1. Optical section of anterior end showing characteristic diverticulum of intestine (*id*), and of esophagus (*oe*); in balsam; length of esophagus 1.5 mm.

1*a.* Head enlarged; diameter 0.12 mm.

1*b.* Ventral view of posterior end, balsam; diameter at anal aperture 0.09 mm.

*Immature Nematode* from *Epinephelus maculosus*.

2. Diagrammatic sketch of anterior end, life.

*Immature Nematode* from *Harpe rufa*.

3. Posterior end; diameter at anal aperture 0.03 mm.

*Ichthyonema*, species from *Lycodontis moringa*.

4. Anterior end, optical section, life; diameter, anterior, 0.09 mm.

4*a.* Posterior end of same; diameter 0.07 mm.

*Heterakis foveolata* Rudolphi.

5. Female from *Diplodus sargus*; length 8 mm.

5*a.* Male; length 4 mm.

5*b.* Posterior end of male, lateral view, life; distance of anal aperture from tip 0.015 mm.; *an*, anal aperture; *b*, bursa; *sp*, spicule.

5*c.* Posterior end of female, life; diameter at anal aperture 0.12 mm.

6. Optical section, balsam, specimen from *Lycodontis moringa*; length of esophagus 0.8 mm.

7. Diagram of anal papille. The specimen from which this sketch was made was from *Neomænis griseus*.

## PLATE II.

*Heterakis foveolata* Rudolphi, continued.

FIG. 8. Transverse section of specimen from *Mycteroperca apua*. Anterior end of pharynx showing beginnings (*a a*) of longitudinal divisions of esophagus. The position of the third division will be at the lower end of the figure where, in this section, a few of the teeth are shown; maximum diameter, 0.13 mm.

- FIG. 9. Transverse section back of pharynx showing structure of esophagus; diameter, 0.13 mm.
10. Transverse section of esophagus of specimen from *Micropogon undulatus*, Beaufort, North Carolina, introduced here for comparison; diameter, 0.08 mm.

*Heterakis*, species.

11. Lateral view of female from *Neomanis griseus*, balsam; length, 6 mm.
- 11a. Lateral view of same, enlarged.
- 11b. Posterior end, ventral view of female from *Hæmulon carbonarium*.
12. Nearly transverse section of lips showing four of the mouth papillæ and the teeth; length of section, 0.12 mm. Figs. 12 to 15 are made from a specimen collected at Beaufort, from the southern flounder (*Paralichthys albiguttus*).
13. Sketch, somewhat diagrammatic, of anterior end of pharynx; breadth of gap of mouth, 0.11 mm. See fig. 15.
14. Section behind pharynx showing structure of esophagus; diameter, 0.25 mm; *a*, lateral area; *m*, muscle cell.

PLATE III.

*Heterakis*, species, continued.

- FIG. 15. Section of posterior end of pharynx, showing the division of the cuticle into three parts which become the three symmetrical longitudinal divisions shown in fig. 14; breadth of gap, 0.10 mm.
16. Dorsal view of specimen shown in fig. 11, enlarged.
17. Cross section of anterior end of specimen from *Neomanis griseus*, partly diagrammatic; breadth of section, 0.17 mm.
18. Cross section of pharynx, showing beginning of divisions of cuticle into three parts; maximum diameter, 0.26 mm.
19. Section a little behind that sketched in fig. 18. Note the very thick cuticle; *pa*, pulp of papilla; maximum diameter of section, 0.30 mm.
20. Cross section of esophagus, near base; maximum diameter, 0.14 mm.

PLATE IV.

*Echinorhynchus medius*, new species.

- FIG. 21. Adult male with bursa everted, from *Myeteroperca apua*; in balsam; length, 40 mm. *b*, bursa; *cg*, cement gland; *l*, lemnisci; *ps*, proboscis sheath.
22. Anterior end of female, proboscis and neck everted; length of proboscis, 1.35 mm.
23. Another, anterior end of body partly inverted; length of proboscis, 1.28 mm.; *a*, spine from body enlarged; actual length, 0.04 mm.
24. Transverse section of proboscis, middle; diameter, exclusive of hooks, 0.4 mm.
25. Same, near base; *rm*, retractor muscle.
26. Immature male from *Calamus calamus*; balsam; length, 12 mm.
27. Immature female; balsam; length, 14 mm.
- 28-30. Hooks from proboscis, enlarged; length, 0.08 mm.

## PLATE V.

*Discocephalum pileatum* Linton, from *Carcharhinus platyodon*.

FIG. 31. Worms attached to mucous membrane, heads embedded, life; about natural size.

*Rhynchobothrium speciosum* Linton.

32. Head and neck of scolex from cyst in *Epinephelus striatus*; balsam; length to base of contractile bulbs 5 mm.; *cb*, contractile bulbs; *ps*, proboscis sheath.

33. Posterior end of same.

34, 35. Two views of proboscis; diameter, including hooks, 0.06 mm.

*Rhynchobothrium spiracornutum*, new species.

36. Head and neck of scolex from cyst in *Epinephelus maculosus*; balsam; length to base of bulbs 5 mm.; *a*, Posterior end of larva; *cb*, bulbs; *ps*, sheath.

37, 38. Two views of proboscis; diameter, including hooks, 0.06 mm.

## PLATE VI.

*Otobothrium penetrans*, new species, from *Tylosurus acus*.

FIG. 39. Blastocyst (plerocercus), alcoholic; length, 10 mm.

40. Scolex, alcoholic; length, 3.5 mm.

41. Front view of bothria.

42. Scolex, alcoholic; length, 4 mm.

43. Front view of head.

44. Another, with proboscides everted; breadth, 2 mm.

45. Scolex with anterior end retracted; breadth at base of bulbs, 2.1 mm.; in balsam; *cb*, bulb; *ps*, sheath.

46-48. Different views of proboscides, all near base; diameter, including hooks, 0.22 mm.

## PLATE VII.

*Encotyllabe*, species, from *Calanus calanus*.

FIG. 49. Ventral view, life; length, 3.5 mm.

50. Lateral view of posterior end.

51. Anterior end, ventral view; in balsam.

52. Dorsal view of same.

53. Posterior end; in balsam.

*Microcotyle*, species, from *Calanus calanus*.

54. Hooks on retracted cirrus highly magnified; in balsam.

*Distomum*, species, from *Seriola fasciata*.

55. Lateral view; in balsam; length, 2 mm.

56. Ventral view of another specimen; in balsam; length, 2.5 mm.

*Distomum*, species, from *Angelichthys ciliaris*.

57. Lateral view, life; length, 1.26 mm.

## PLATE VIII.

*Distomum monticellii* Linton, from *Synodus saurus*.

FIG. 58. View of specimen, in balsam; length, 2.55 mm.

*Distomum (Lecithocladium)*, species, from *Seriola dumerili*.

59. Specimen with tail everted; length, 1.65 mm.

60. Another, tail inverted; length, 1.14 mm.

*Distomum*, species, from *Teuthis hepatus*.

61. Lateral view, life, specimen partly macerated; length, 2.55 mm.

*Distomum*, species, from *Tylosurus acus*.

62. Ventro-lateral view, balsam; length, 1.77 mm.

## PLATE IX.

*Distomum ritellosum* Linton, from *Haemulon flarolineatum*.

FIG. 63. Sketch from life, specimen partly macerated; length 2.78 mm.

64. Ventral view of specimen from *Calanus calanus*, balsam; length 1.4 mm.

*Distomum subtenue*, new species, from *Calanus calanus*.

65. Lateral view, balsam; length 1.5 mm.

*Distomum (Accacalium) macrocotyle* Diesing, from *Teuthis hepatus*.

66. Lateral view, balsam; length 4.35 mm.

## PLATE X.

*Distomum nitens* Linton, from *Tylosurus acus*.

FIG. 67. Sketch of specimen mounted in balsam; length 4.5 mm.

68. Ventral view of anterior end.

*Distomum*, species, from *Chatodon*, species.

69. Ventral view, life; breadth 0.3 mm.

*Distomum*, species, from *Bodianus fulvus punctatus*.

70. Sketch from life, anterior end inverted; length 0.9 mm.

*Distomum*, species, from *Sphyrana sphyraena*.

71. Ovum, alcoholic; longer diameter 0.07 mm.

*Distomum gyrinus*, new species, from *Lactophrys trigonus*.

72. Dorsal view, balsam; length 0.95 mm.

73. Ventral view of another, balsam, diameter, anterior 0.24 mm.

74. Ventral view, life, specimen from *Lactophrys tricornis*; length 1.58 mm.

*Distomum lunelliforme*, new species, from *Lactophrys trigonus*.

75. Ventral view, balsam; diameter 0.57 mm.



## PLATE XI.

*Distomum lomelliforme*, new species, continued.

- FIG. 76. Ventral view of specimen from *Balistes carolinensis*, balsam; breadth 0.9 mm.  
 77. Dorsal view, life; length 0.82 mm., breadth 1.20 mm.  
 78. Ventral view of specimen from *Lactophrys tricornis*, life; length 1.78 mm.

*Distomum trulla*, new species, from *Ocyurus chrysurus*.

79. Ventral view, balsam; length 1.14 mm.

## PLATE XII.

*Distomum leucensei*, new species.

- FIG. 80. Dorsal view of specimen from *Epinephelus striatus*, balsam; length 1.3 mm.  
 81. Dorsal view of specimen from *Epinephelus maculosus*, balsam; length 1.8 mm.  
 82. Posterior end of same, showing excretory vessel with muscular bulb; diameter of bulb 0.03 mm.  
 83. Ventral view of another; length 0.96 mm.

*Distomum*, species, from *Balistes carolinensis*.

84. Dorsal view, life; length 1.77 mm.

## PLATE XIII.

*Distomum*, species from *Paranthias furcifer*.

- FIG. 85. Dorsal view, life; length 1.38 mm.

*Distomum fenestratum*, new species, from *Lycodontis moringa*.

86. Ventral view, balsam; length 1.65 mm.  
 87. Anterior end of same, enlarged.  
 88. Sketch of a less usual form than that shown in figure 86, life; length 2.4 mm.  
 89. Transverse section of neck; diameter 0.16 mm. *cu*, cuticle; *gl*, glandular layer; *lm*, longitudinal muscles; *oe*, esophagus.  
 90. Transverse section through anterior part of ventral sucker; diameter 0.18 mm. *i*, convoluted beginning of intestine; *cs*, ventral sucker; other letters as in fig. 89.  
 91. Transverse section, middle of body; transverse diameter 0.27 mm. *ii*, intestine; other letters as in fig. 89.

## PLATE XIV.

*Monostomum*, species, from *Bathystoma striatum*.

- FIG. 92. Dorsal view, life; length 1 mm.

*Monostomum*, species, from *Hamulon flavolineatum*,

93. Ventral view, life; length 1.05 mm.

*Distomum tonex*, new species, from *Epinephelus striatus*.

94. Ventral view, balsam; length 12 mm. *a'*, ova; length 0.018 mm.  
 95. Anterior end of same; diameter at ventral sucker 0.48 mm.  
 96. Genital papilla; transverse diameter 0.05 mm. *c*, aperture of cirrus; *u*, aperture of uterus.

## PLATE XV.

*Monostomum vinal-edwardsii* Linton, from *Ocyurus chrysurus*.

FIG. 97. Dorsal view, balsam; length 2 mm.

*Aspidogaster ringens* Linton, from *Iridio radiatus*.

98. Dorsal view, balsam; length 2 mm.

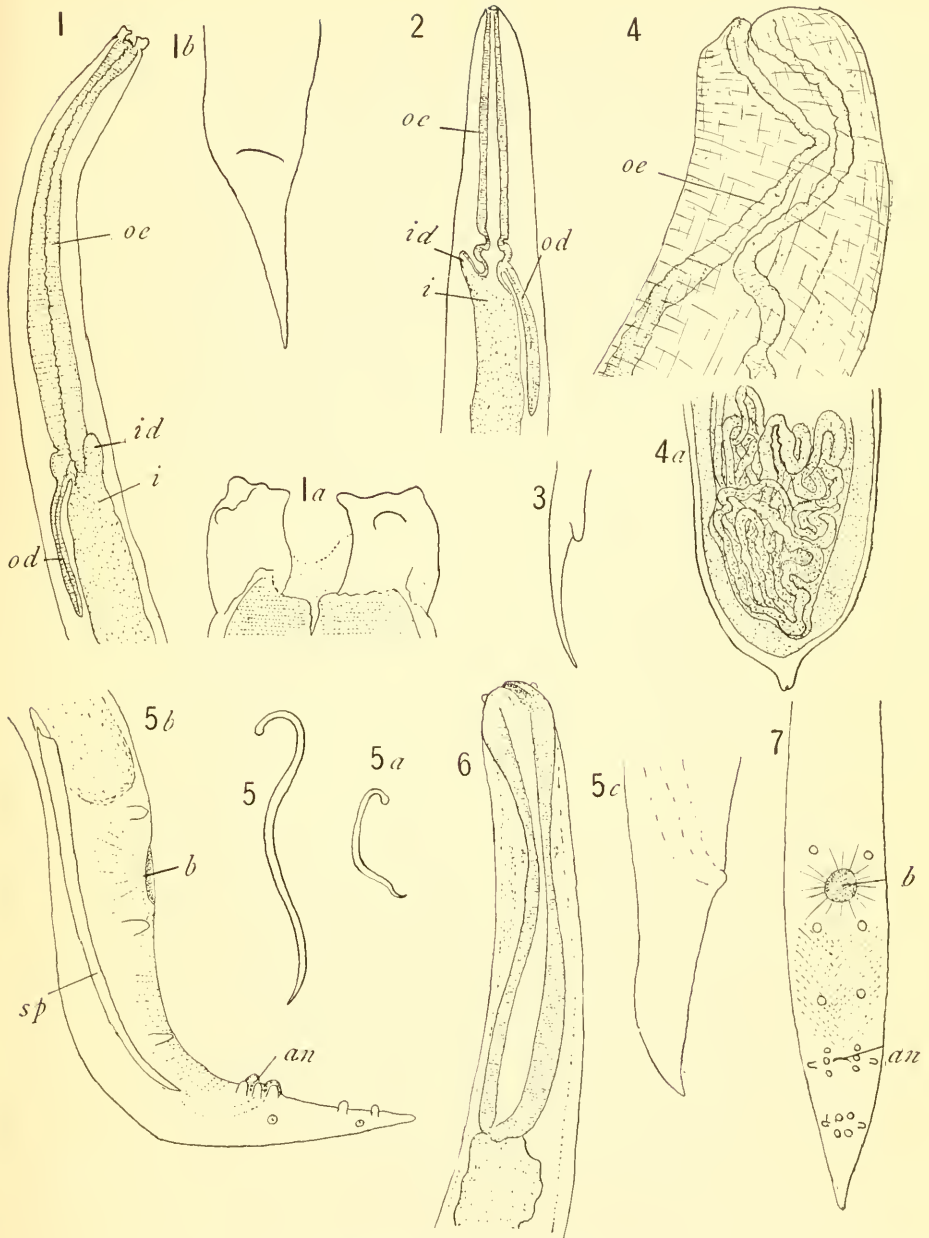
99. Ventral view of head and anterior portion of sucking disk, balsam; diameter of head 0.42 mm.

Undetermined *Trematode*, allied to *Phyllodistomum*, from *Balistes carolinensis*.

100. Ventral view, life; diameter of body 0.93 mm.; *d*, disk.

101. Same, stained and mounted in balsam.

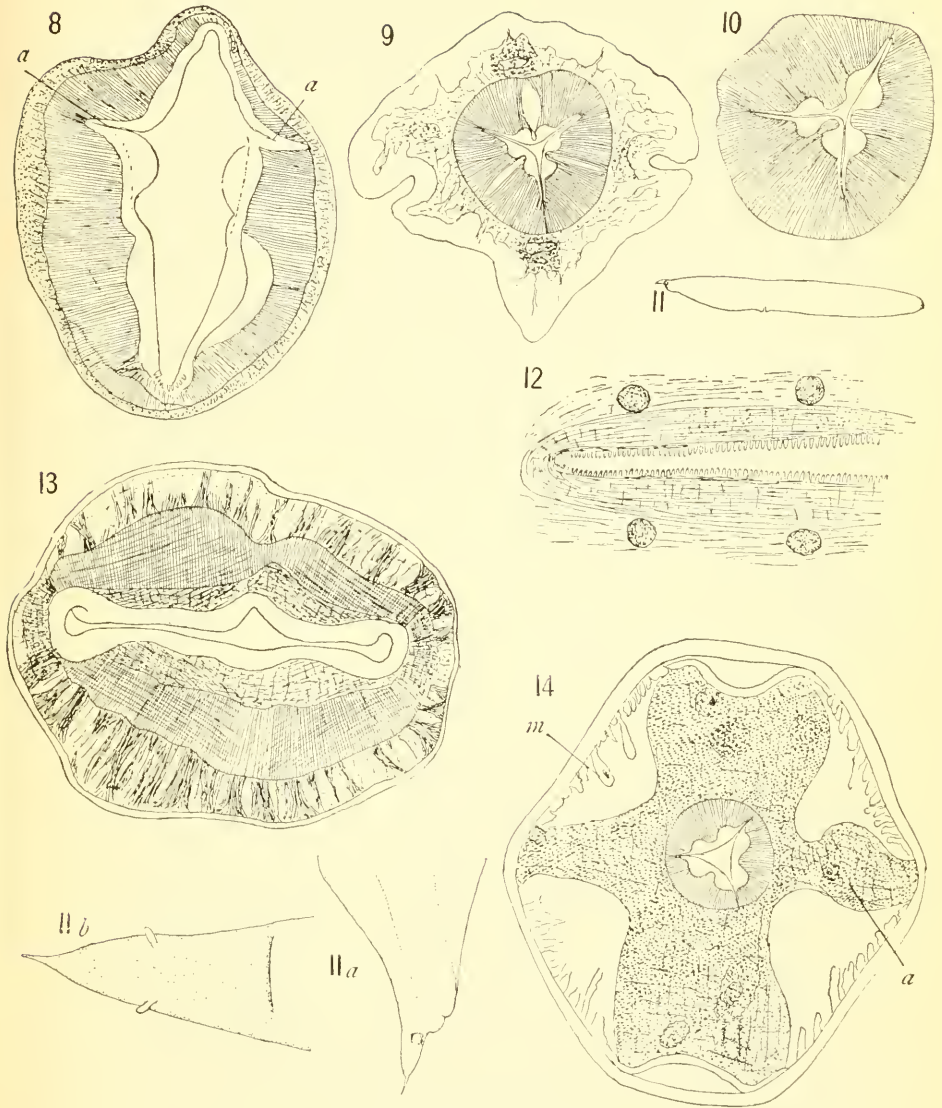
102. Portion of ventral disk highly magnified; distance between striæ 0.015 mm.



PARASITES OF BERMUDA FISHES.

FOR EXPLANATION OF PLATE SEE PAGE 121.

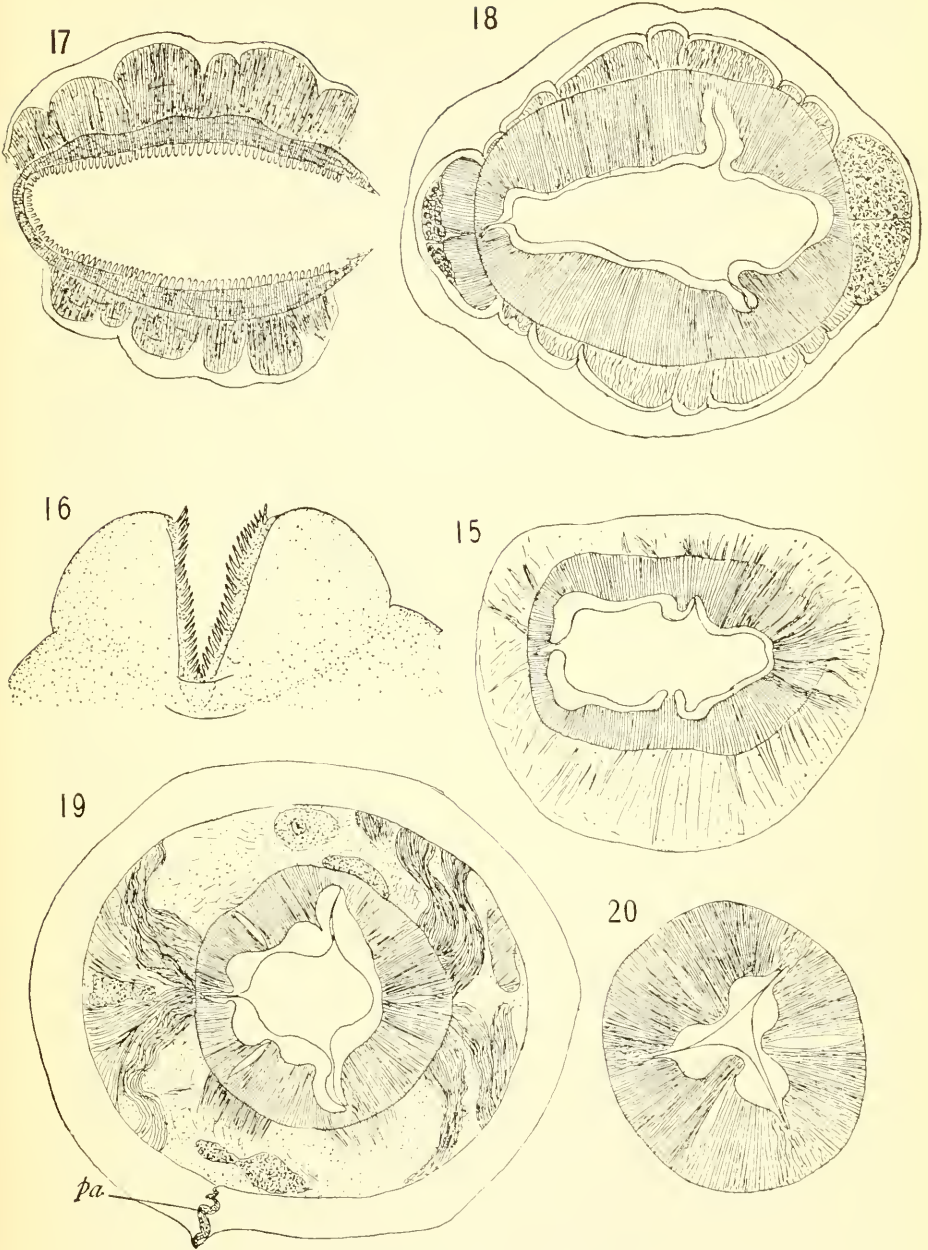




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FOR EXPLANATION OF PLATE SEE PAGES 121, 122.



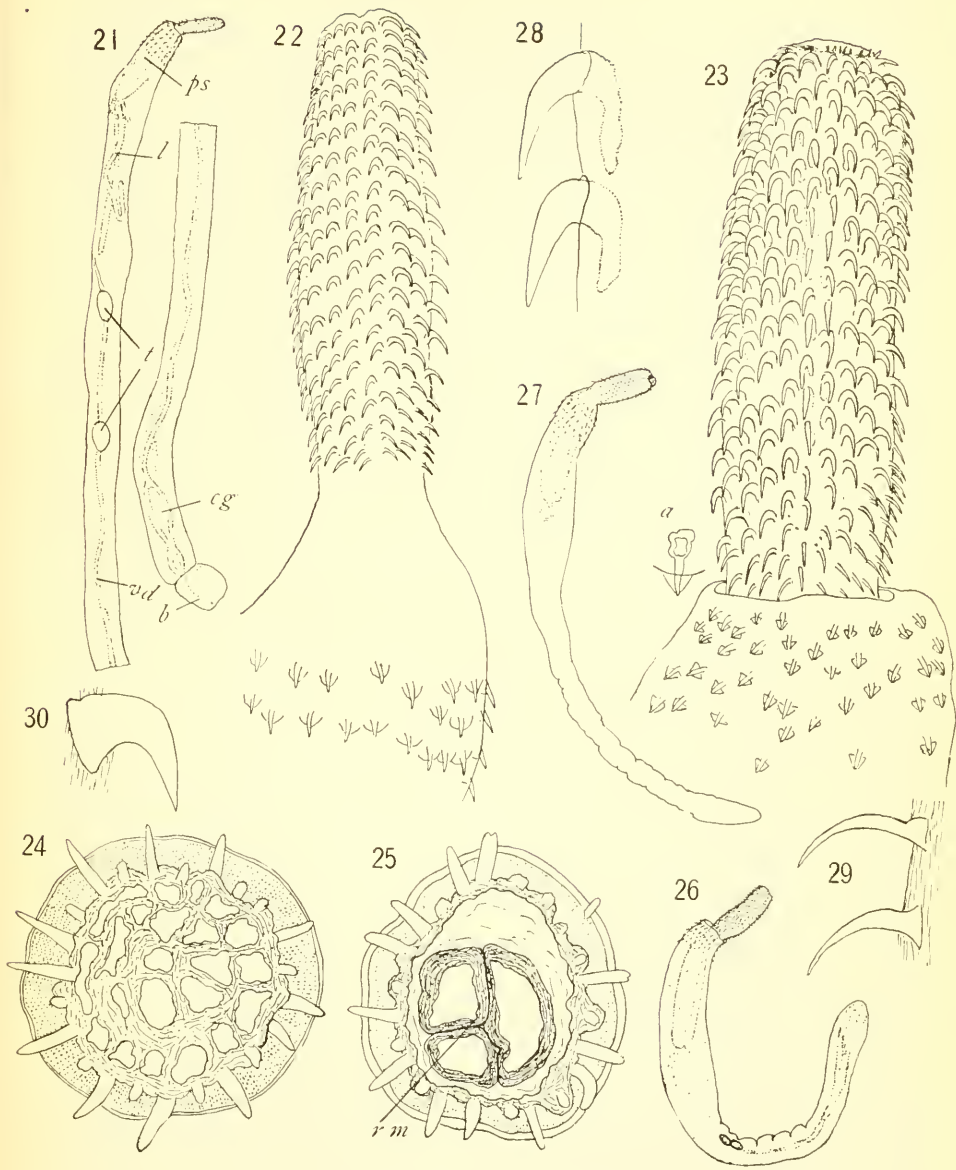


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FOR EXPLANATION OF PLATE SEE PAGE 122.





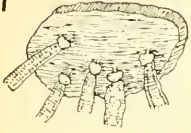


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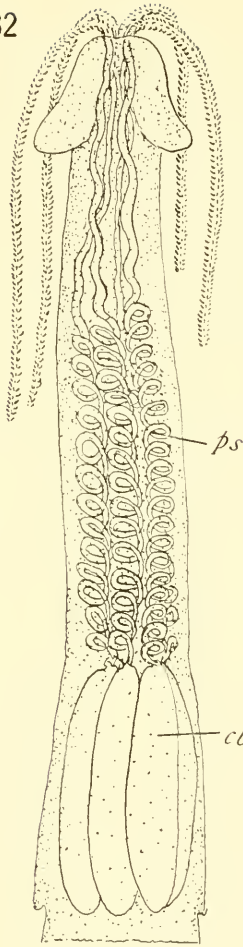
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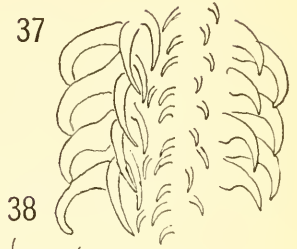
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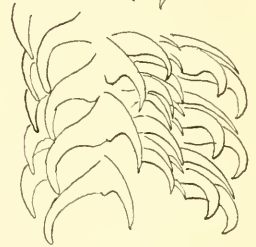
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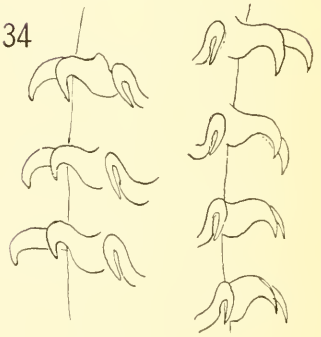
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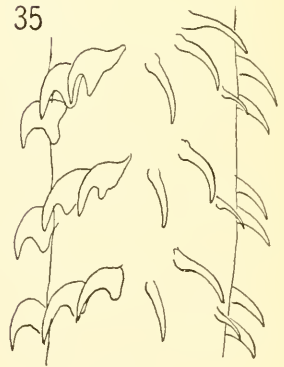
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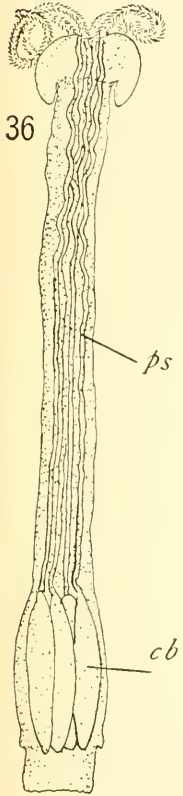
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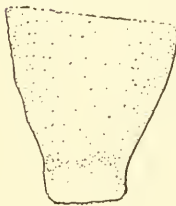
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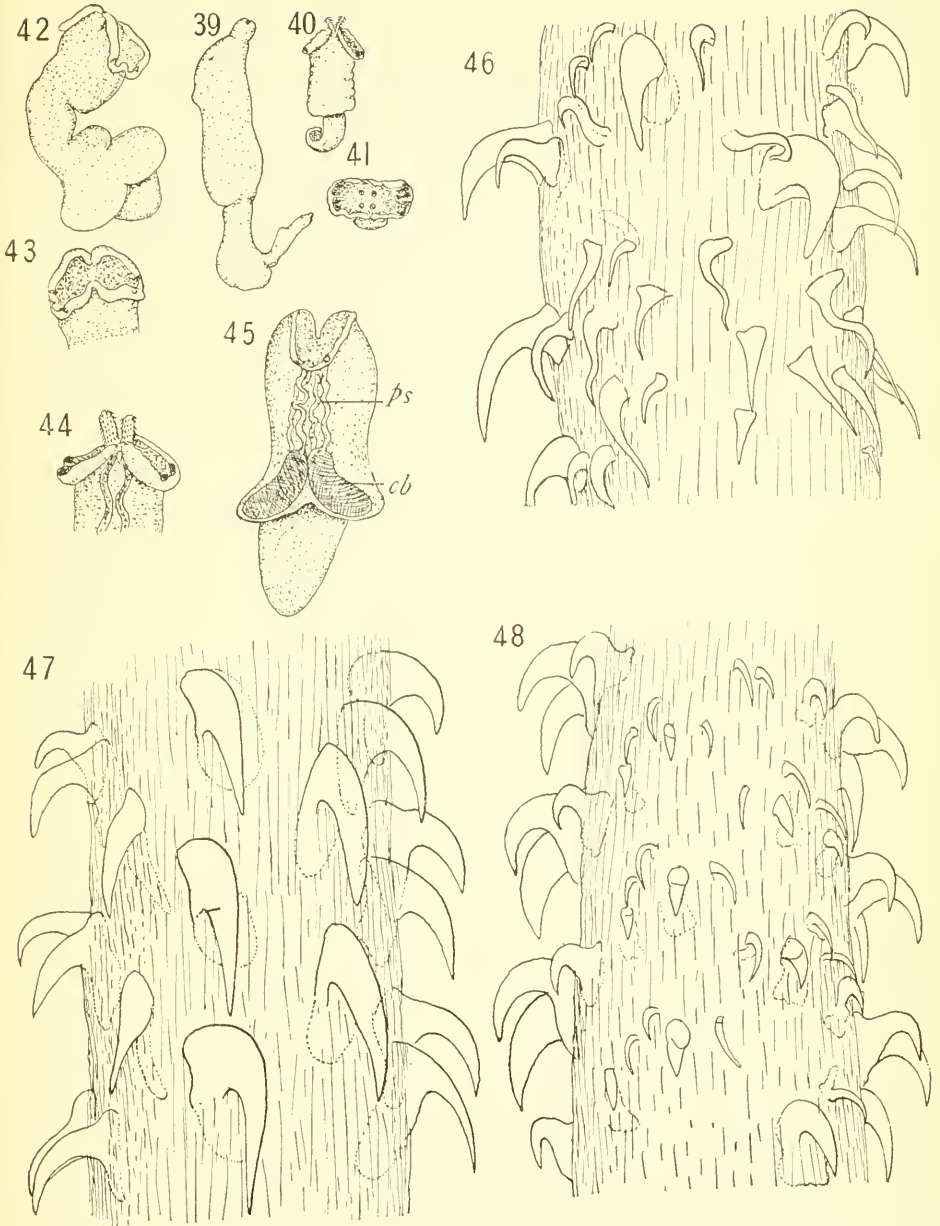
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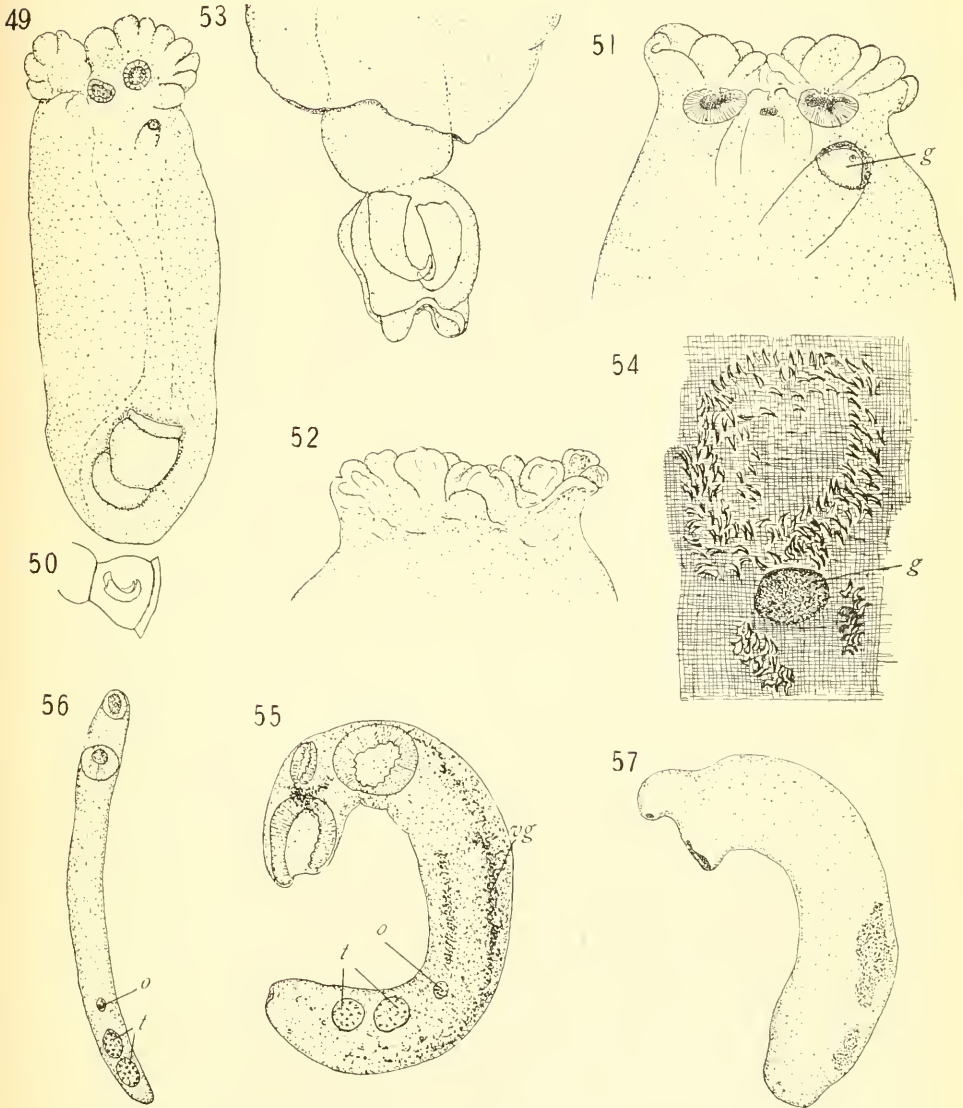




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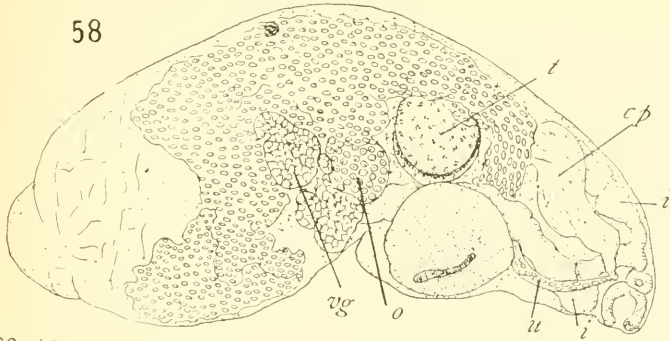
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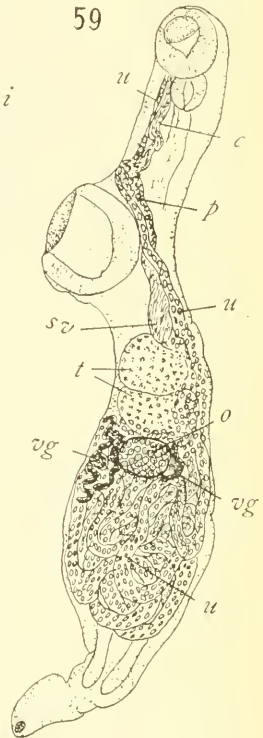




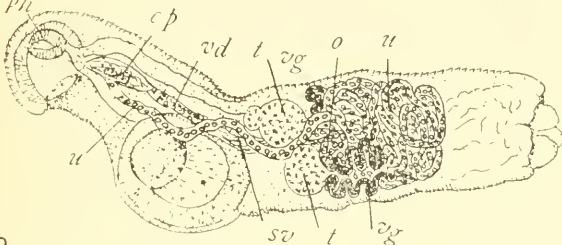
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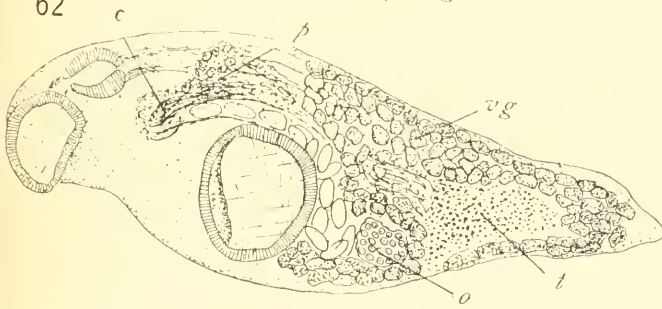
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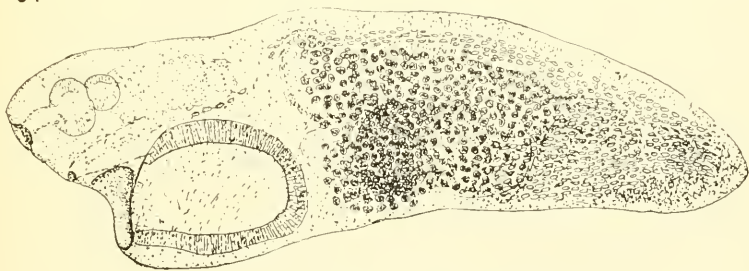
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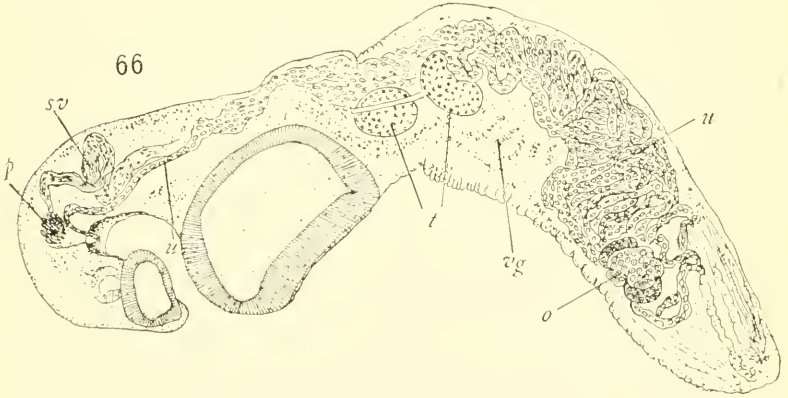
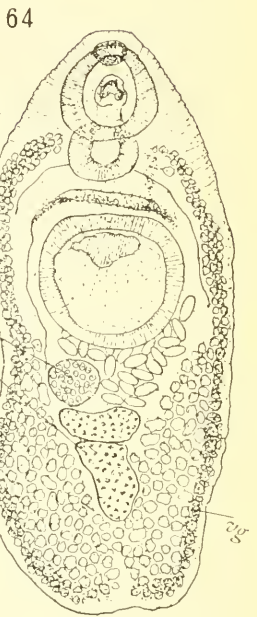
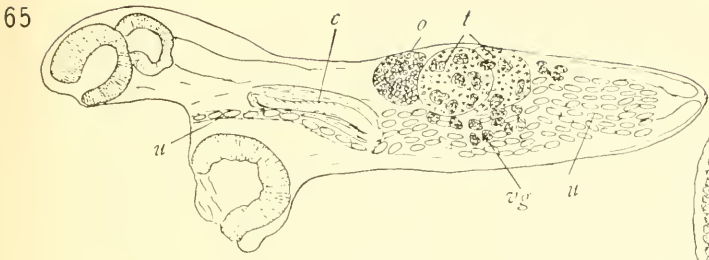
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PARASITES OF BERMUDA FISHES.

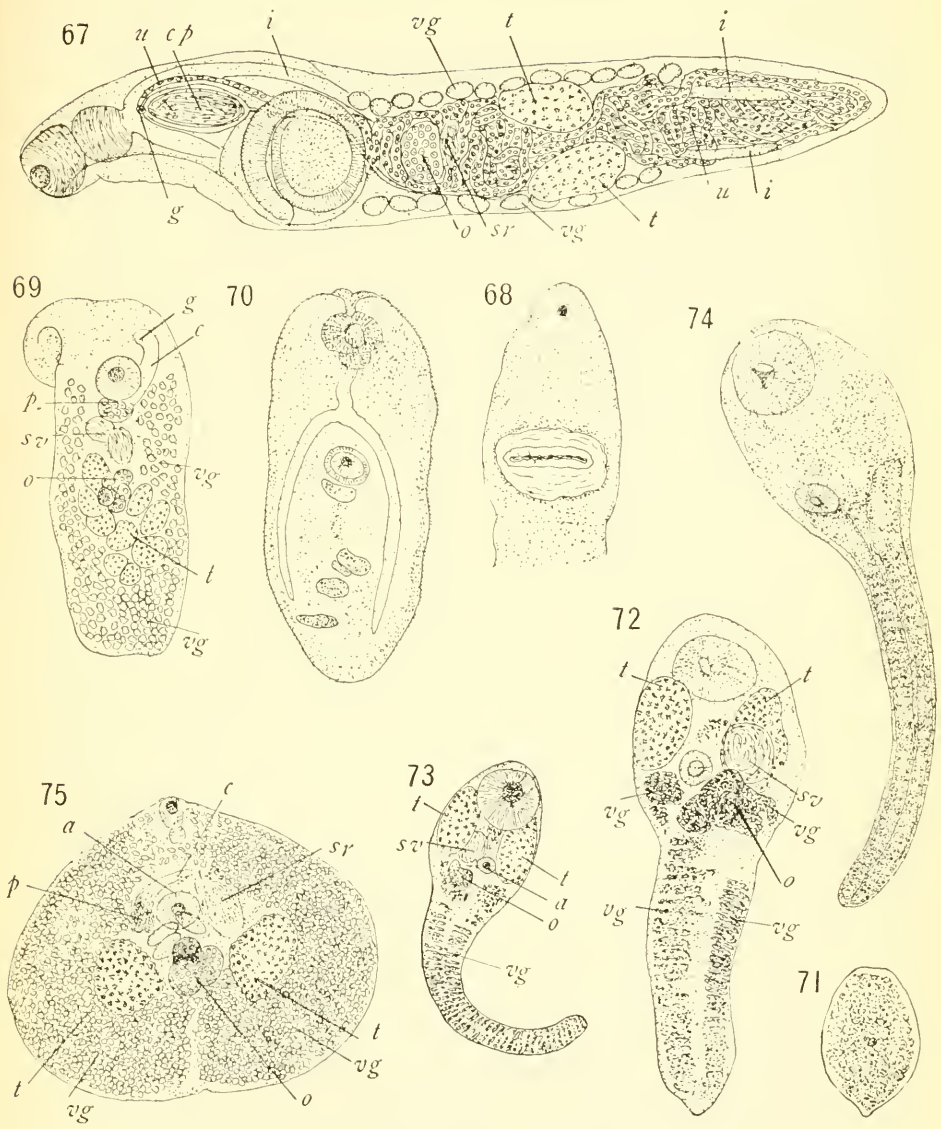
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PARASITES OF BERMUDA FISHES.  
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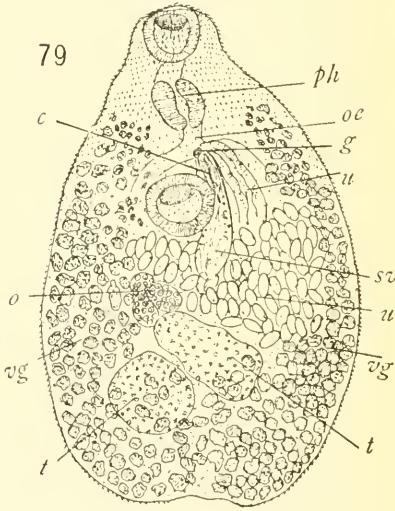
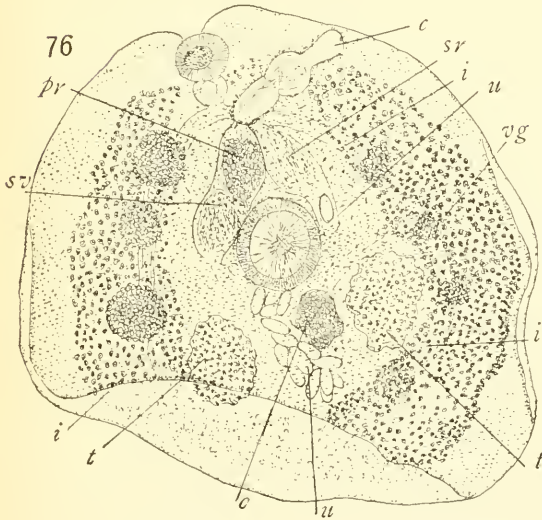
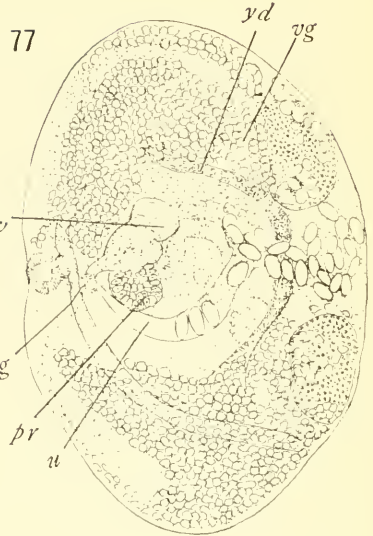
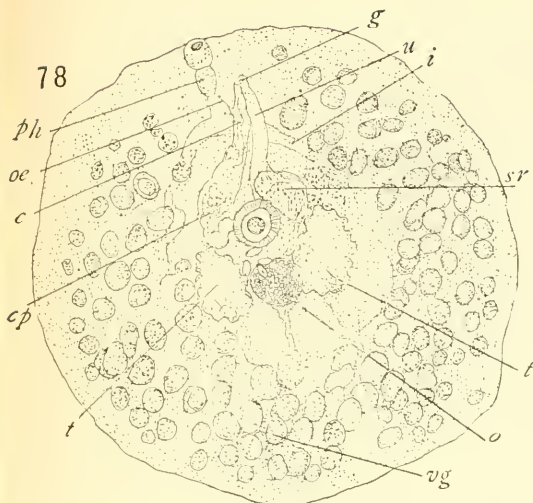




PARASITES OF BERMUDA FISHES.

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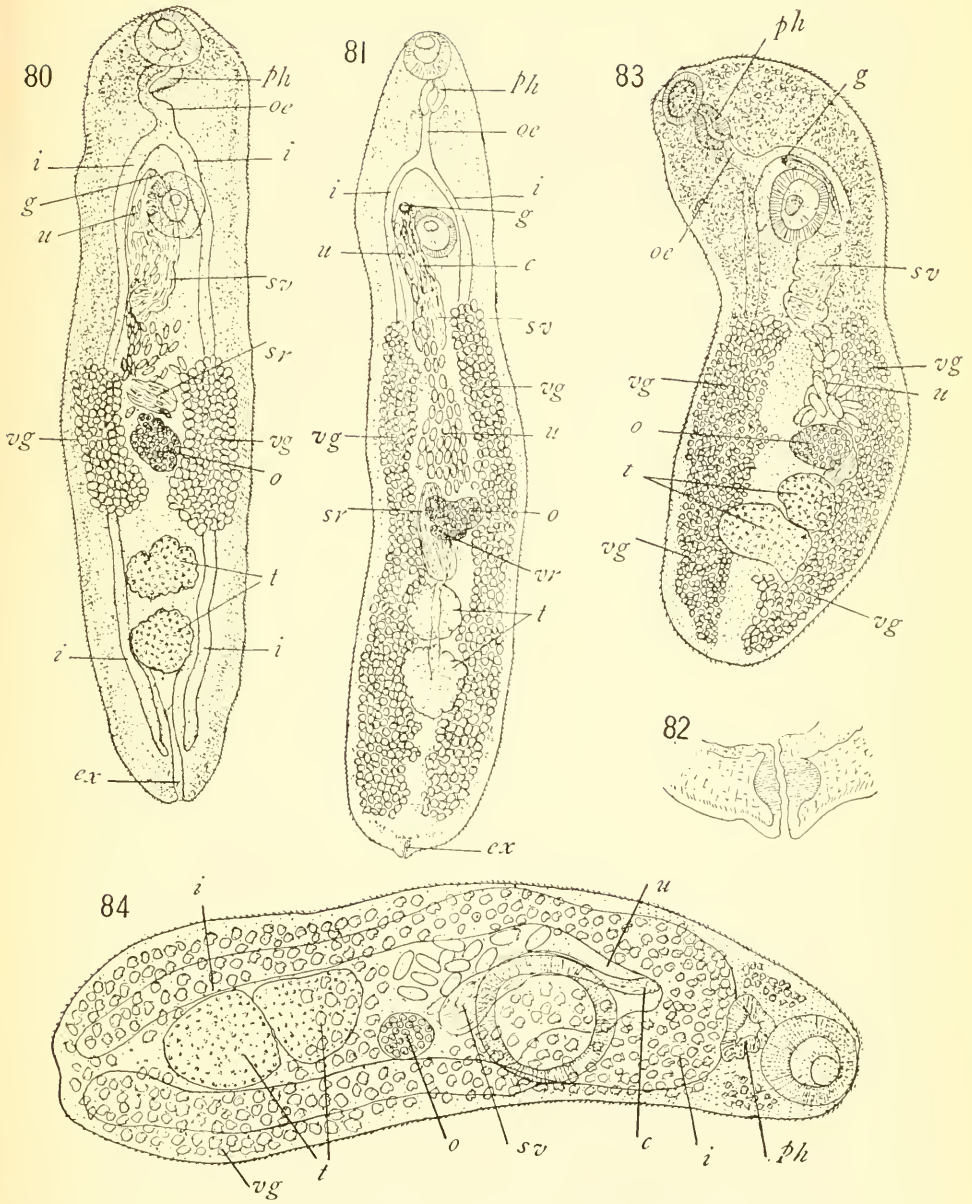


PARASITES OF BERMUDA FISHES.

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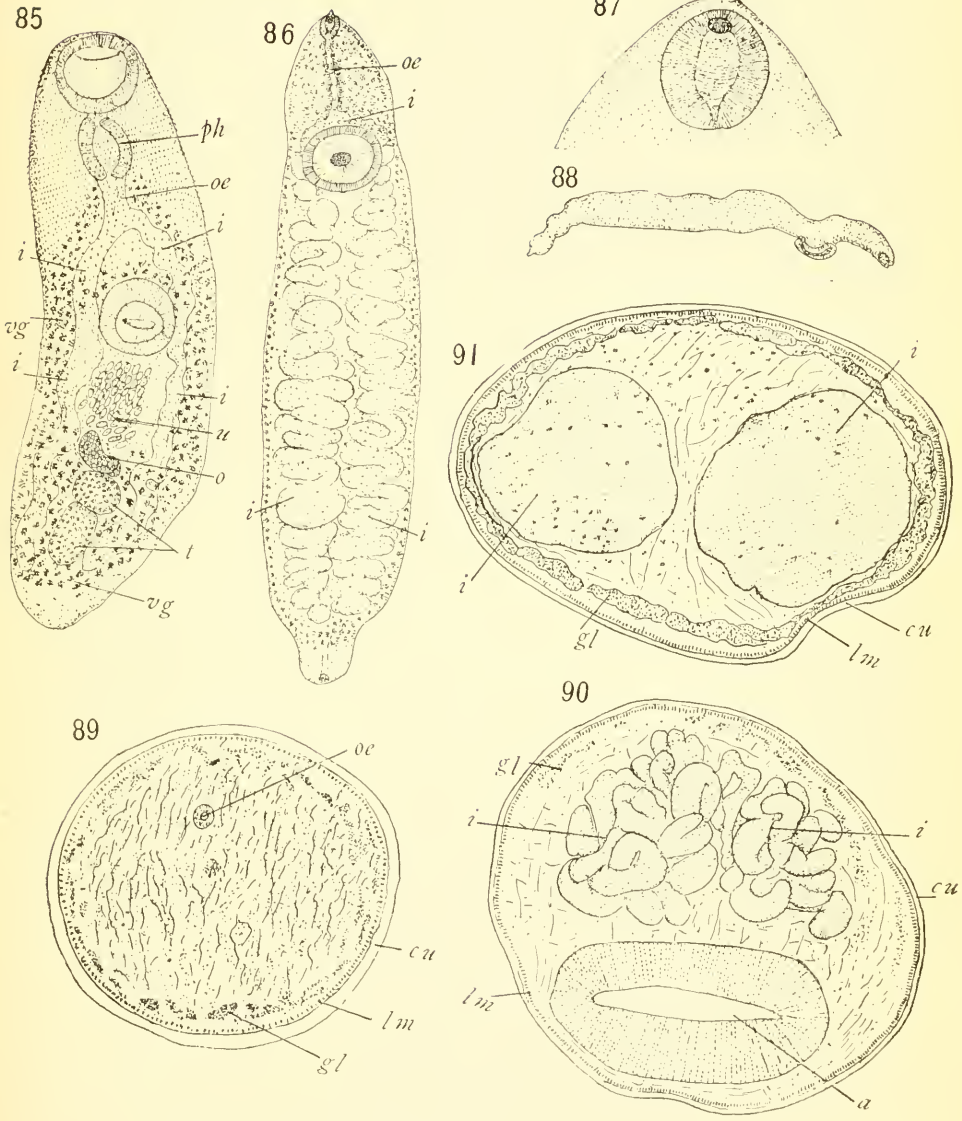




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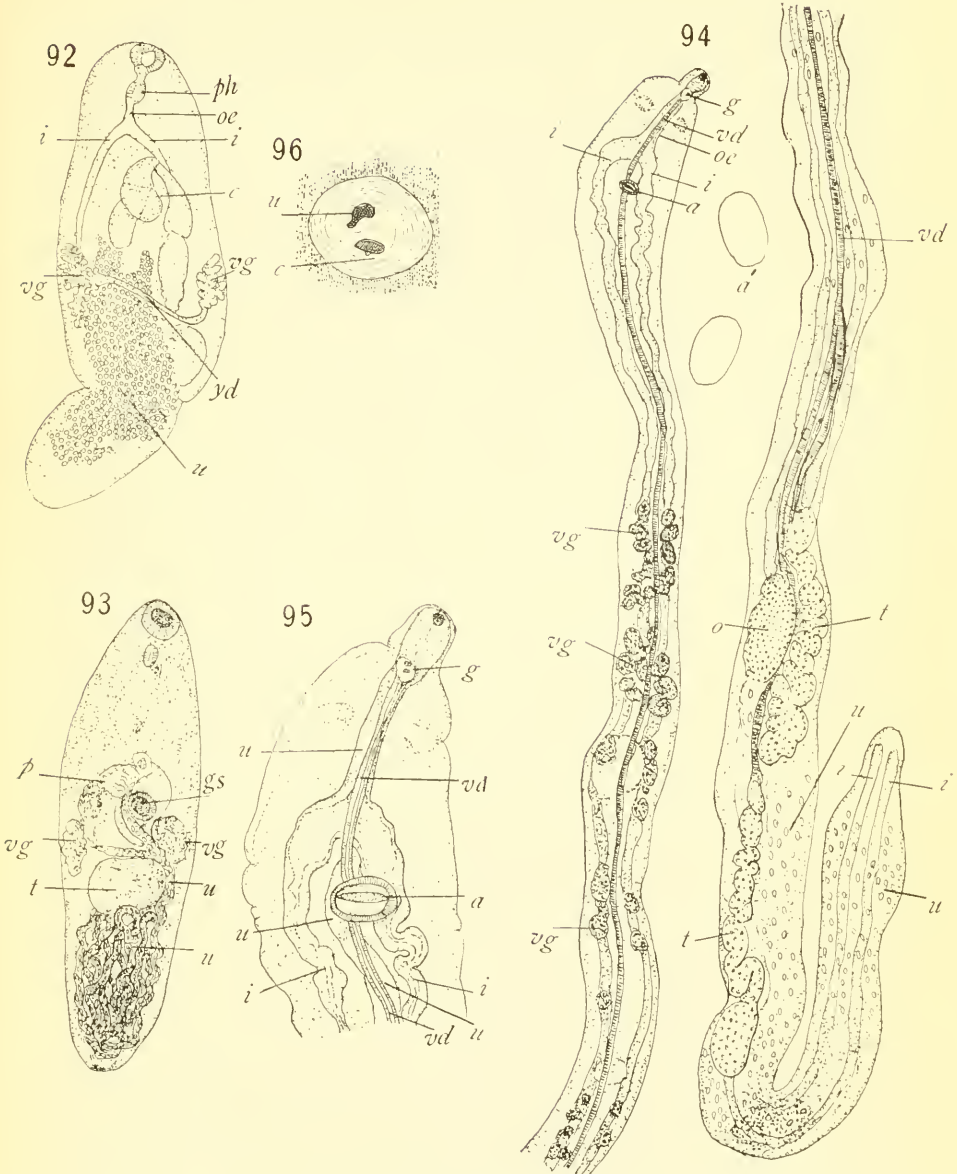




PARASITES OF BERMUDA FISHES.

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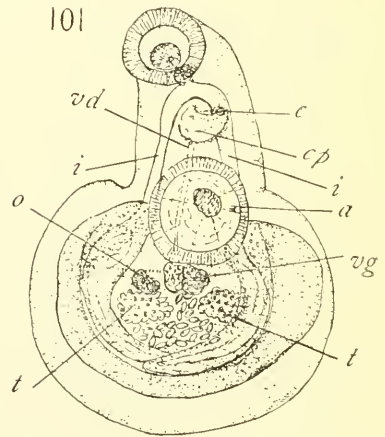
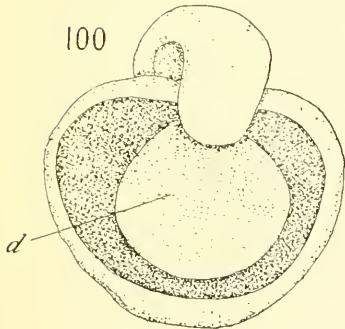
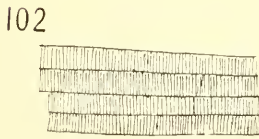
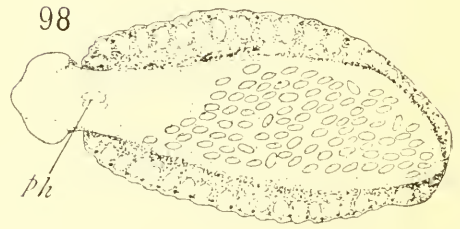
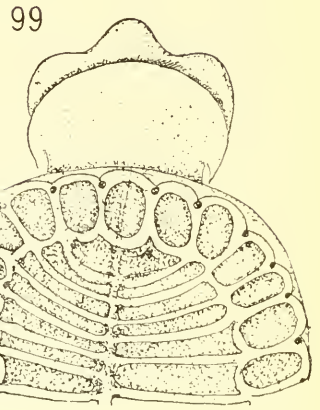
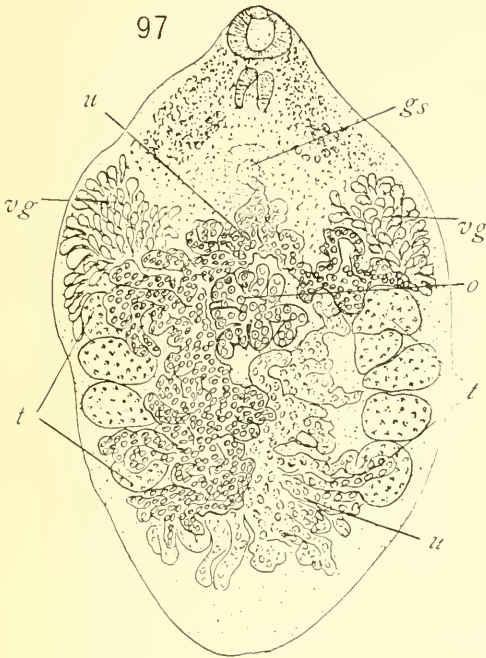




PARASITES OF BERMDA FISHES.

FOR EXPLANATION OF PLATE SEE PAGE 125.





PARASITES OF BERMUDA FISHES.  
 FOR EXPLANATION OF PLATE SEE PAGE 126.

